

# Fieldbus Universal Bridge



Summary of changes in the FEBRUARY / 2020  
version  
- Section 24

**smar**  
NOVA SMAR S/A  
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## AVOIDING ELECTROSTATIC *DISCHARGES*



### ATTENTION

Electrostatic discharges may damage semiconductor electronic components in printed circuit boards. They usually occur when touching components or connector pins from modules and racks, without wearing the appropriate equipment to prevent discharges. It is recommended to take the following precautions:

- Before handling modules and racks, remove the electrostatic charge from your body by wearing a proper wristband or touching grounded devices;
- Avoid touching electronic components or connector pins from racks and modules.



# INTRODUCTION

The DFI302 is a powerful multifunction hardware component integral to the modular **SYSTEM302** that includes the most up-to-date hardware and software necessary to manage, monitor, control, maintain and operate your plant. The DFI302 throughout the plant are completely self-contained and perform most of the functions required by a system; therefore very few additional components are required.

Below, there are some DFI302 features:

- Integral part of **SYSTEM302**
- Single integrated unit with functions of interfacing, linking device, bridge, controller, gateway, fieldbus power supply and distributed I/O subsystem
- Tight integration with intelligent devices and software from multiple manufacturers due to the use of open standards, such as: FOUNDATION™ fieldbus and OPC
- Connectivity with equipment through conventional I/O modules and Modbus through RS-232 or Ethernet communications
- Full redundancy and fault isolation for high safety and uninterrupted operation
- Cleanest and most cost effective architecture
- High information throughput from plant floor to the corporate network

## **Structure of DFI302 manual**

For further information about the DFI302 automation platform more quickly, the user manual can be obtained separately by subjects, directly on the site [www.smar.com](http://www.smar.com) as parts A through L. They are:

### **A – Installation and basic configuration**

This part has all general and basic information about installation of controllers, racks, I/O modules, IP configuration, OPC servers, firmware update, project types, and general information about adding function blocks and flexible function blocks.

This part also has troubleshooting information, and the SRF (Service Request Form).

It has the following sections:

- Overview
- Installing
- Setting up
- Configuring the OPC servers
- Configuring strategies
- Adding function blocks
- Adding logic by using flexible function blocks
- Adding I/O modules
- Adding racks
- Troubleshooting
- Appendix (SRF)
- Appendix B - SNMP Diagnostics

### **B – Technical Specifications**

This part has all technical specification of the DFI302 hardware components. They are:  
Controllers – DF51, DF62, DF63, DF73, DF79, DF81, DF89, DF95, DF97, and DF100  
Ethernet cables, serial cables and cables for racks' interconnection  
Power supplies – DF50, DF49/53, DF52/60, DF56, and DF87  
Intrinsic safety barriers – DF47-12 and DF47-17  
Interfaces – DF58 and DF61

It has the following sections:

- Technical specification for controllers
- Cable specification
- Adding power supplies
- Adding interfaces

## **C – Modbus**

This part has information to integrate systems that use Modbus protocol to the DFI302 automation platform. It has the following section:

- Adding Modbus

## **D – DF51 Platform**

This part has information to create control strategies and redundant systems that use the DF51 controller.

This part also has information about redundant system architecture and its configuration, hot standby redundancy and LAS redundancy. It has the following sections:

- Creating a fieldbus strategy by using DF51
- Adding redundancy to DF51 controller

## **E – DF65 Platform**

This part has information about the DF65 logic coprocessor which is connected to DF51 (controller of DFI302 automation platform) to improve its capacity for discrete control. The ladder logic and the coprocessor function blocks help and improve the Fieldbus control system.

It has the following section:

- Adding logic configuration by using coprocessors modules

## **F – Configuring strategies with HSE/FF controllers**

This part has information to create control strategies that use the DF62 or DF63 controllers.

It has the following section:

- Creating a FOUNDATION fieldbus strategy by using the DF62/DF63

## **G - Configuring strategies with HSE/PROFIBUS controllers**

This part has information to create control strategies that use the DF73, DF95 or DF97 controllers.

The DF73 is the HSE/Profibus-DP controller with 2 Ethernet 100 Mbps ports, and 1 Profibus DP channel.

The DF95 is the HSE/Profibus controller with 2 Ethernet 100 Mbps ports, 1 serial port, 2 Profibus PA ports, and 1 Profibus DP channel.

The DF97 is the HSE/Profibus controller with 2 Ethernet 100 Mbps ports, 1 serial port, 4 Profibus PA ports, and 1 Profibus DP channel.

It has the following section:

- Creating a Profibus configuration by using DF73, DF95 or DF97

## **H - Configuring strategies with HSE/DeviceNet controllers**

This part has information to create control strategies that use the DF79 controller.

The DF79 is the HSE/DeviceNet controller with 2 Ethernet 100 Mbps ports and 1 DeviceNet channel.

It has the following section:

- Creating a DeviceNet configuration by using DF79

## I - Configuring strategies with HSE/AS-i controllers

This part has information to create control strategies that use the DF81 controller.

The DF81 is the HSE/AS-i controller with 2 Ethernet 100 Mbps ports, and 2 AS-i channels.

It has the following section:

- Creating an AS-i configuration by using DF81

## J - Configuring strategies with HSE/Modbus controllers

This part has information to create control strategies that use the DF89 controller.

The DF89 is the HSE/Modbus controller with 2 Ethernet 100 Mbps ports and 1 RS-485/RS-232 Modbus RTU port.

It has the following section:

- Creating a Modbus configuration by using the DF89

## K - Configuring strategies with HSE/WirelessHART controllers

This part has information to create control strategies that use the DF100 controller.

The DF100 is the HSE/WirelessHART™ controller with 2 Ethernet 100 Mbps ports, 1 RS-485 port and 1 WirelessHART channel.

It has the following section:

- Creating a FOUNDATION fieldbus strategy by using the DF100

## L – Redundancy

To meet the requirements for fault tolerance, system availability and safety of the industrial process, the DFI302 HSE controllers (DF62/DF63/DF73/DF75/DF89) work with a Hot Standby redundancy strategy.

This part has information about installation and configuration of redundant systems which use those controllers.

It has the following sections:

- Adding redundancy to DFI302 HSE controllers
- Adding redundancy with redundant I/O modules R-Series

## M – Conventional and redundant input/output modules

There are many types of input/output modules available for DFI302 automation platform, designed to fit a broad range of applications in the automation and process control industry.

The available types are:

- Discrete inputs and outputs
- Combined discrete inputs and outputs
- Pulse inputs
- Analog inputs and outputs
- HART inputs and outputs
- Redundant inputs and outputs

The Digital and Analog Input/Output Modules of DFI302 manual has all information about those modules. This part of manual can be obtained on the Smar's website ([www.smar.com](http://www.smar.com)), downloading the file MESDAME.pdf.

## **N - Interfaces for panels**

With the Smar’s panel interfaces is possible to eliminate the hard work of making cables, fixing washers and mounting terminal blocks. Just fit the interfaces in the DIN rail and connect the cable. It’s easy and fast!

The interfaces have many features which will fit your application. They were designed for the Smar’s I/O modules.

The Interfaces for Panels manual has all necessary information. This part of manual can be obtained on the Smar’s website ([www.smar.com](http://www.smar.com)), downloading the file ITFPANELME.pdf.



# TABLE OF CONTENTS

|  |            |
|--|------------|
| <b>SECTION 1 - OVERVIEW</b> .....  | <b>1.1</b> |
| AVAILABLE MODULES FOR THE DFI302 SYSTEM .....                                    | 1.2        |
| MAIN FEATURES.....   | 1.6        |
| DISTRIBUTED ARCHITECTURE.....  | 1.6        |
| HIGH RELIABILITY.....  | 1.6        |
| CONFIGURATION.....   | 1.7        |
| SUPERVISION.....   | 1.7        |
| SYSTEM INTEGRATION.....  | 1.7        |
| REDUNDANCY.....  | 1.8        |
| EXPANDABLE.....  | 1.8        |
| <b>SECTION 2 - INSTALLING</b> .....  | <b>2.1</b> |
| RACKS, CABLES AND ACCESSORIES OF DFI302 SYSTEM .....                             | 2.1        |
| INSTALLING THE SYSTEM'S BASE WITH DF92 AND DF93 RACKS .....                      | 2.2        |
| INSTALLING RACKS - DF92 AND DF93.....  | 2.3        |
| INSTALLING THE EXPANSION FLAT CABLES - DF101, DF102, DF103, DF104 AND DF105..... | 2.5        |
| FLAT CABLES PROTECTOR (CONNECTOR CAP).....                                       | 2.6        |
| INSTALLING THE IMB TERMINATOR - DF2 OR DF96.....                                 | 2.7        |
| EXPANDING THE SYSTEM'S POWER - DF90 AND DF91.....                                | 2.8        |
| DIAGNOSTIC RESOURCES.....  | 2.11       |
| INSTALLING THE SYSTEM'S BASE WITH DF1A AND DF78 .....                            | 2.13       |
| INSTALLING A RACK IN THE DIN RAIL .....  | 2.14       |
| ADDING RACKS .....   | 2.14       |
| TIPS FOR ASSEMBLING.....   | 2.15       |
| IMPROVING SIGNAL GROUND OF DFI302 (DF1A AND DF78 RACKS) .....                    | 2.15       |
| NON-ADJACENT RACKS .....   | 2.16       |
| ADJACENT RACKS .....   | 2.16       |
| INSTALLING MODULES IN THE RACK .....   | 2.17       |
| INSTALLING THE HARDWARE.....   | 2.18       |
| USING THE DF51 CONTROLLER.....   | 2.18       |
| USING THE DF62/DF63 CONTROLLER.....  | 2.20       |
| USING THE DF73 CONTROLLER.....   | 2.22       |
| USING THE DF75 CONTROLLER.....   | 2.25       |
| USING THE DF79 CONTROLLER.....   | 2.27       |
| USING THE DF81 CONTROLLER.....   | 2.29       |
| USING THE DF89 CONTROLLER.....   | 2.33       |
| USING THE DF95 CONTROLLER.....   | 2.35       |
| USING THE DF97 CONTROLLER.....   | 2.37       |
| USING THE DF100 CONTROLLER.....  | 2.39       |
| DIMENSIONAL DRAWINGS OF DF1A RACK AND MODULES.....                               | 2.57       |
| DIMENSIONAL DRAWINGS OF DF93 AND MODULES .....                                   | 2.58       |
| DIMENSIONAL DRAWING OF DF100.....  | 2.59       |
| INSTALLING THE STUDIO302 .....   | 2.60       |
| GETTING LICENSE FOR DFI302 SERVERS .....   | 2.60       |
| <b>SECTION 3 - SETTING UP</b> .....  | <b>3.1</b> |
| DFI OLE SERVER AND HSE OLE SERVER SETTINGS .....                                 | 3.1        |
| CONNECTING THE DFI302 IN THE SUBNET .....  | 3.1        |
| FOR NETWORK WITH DHCP .....  | 3.1        |
| FOR NETWORK WITHOUT DHCP .....   | 3.1        |
| UPDATING THE FIRMWARE.....   | 3.8        |
| DFI DOWNLOAD CLASSIC .....   | 3.8        |
| BATCH DOWNLOAD .....   | 3.11       |
| CHANGING IP ADDRESS.....   | 3.16       |
| CHANGING IP CONTROLLER .....   | 3.16       |
| CONFIGURING THE RTC.....   | 3.22       |
| <b>SECTION 4 - CONFIGURING THE OPC SERVERS</b> .....                             | <b>4.1</b> |
| INTRODUCTION .....   | 4.1        |
| CLIENT / SERVER ARCHITECTURE VIA OPC.....  | 4.1        |

|   |            |
|---|------------|
| WIN32-BASED PLATFORM .....  | 4.1        |
| OPC COMPLIANT .....   | 4.1        |
| OLE FOR FIELDBUS CONFIGURATION (OFC) .....  | 4.1        |
| OPC – OLE FOR PROCESS CONTROL .....   | 4.2        |
| OVERVIEW .....  | 4.2        |
| LOCAL SERVERS AND REMOTE SERVERS .....  | 4.3        |
| MINIMUM DCOM SETTINGS .....   | 4.3        |
| CLIENT AND SERVER RUNNING IN THE SAME MACHINE .....   | 4.3        |
| CLIENT AND SERVER RUNNING IN DIFFERENT MACHINES .....   | 4.3        |
| CREATING CLIENT/SERVER CONNECTION IN WINDOWS 2000 WITH USER SPECIFIC SECURITY .....   | 4.3        |
| CREATING CLIENT/SERVER CONNECTION IN WINDOWS 2000 WITHOUT USER SPECIFIC SECURITY .....  | 4.5        |
| CONFIGURATIONS FOR WINDOWS XP PROFESSIONAL AND WINDOWS SERVER 2003 .....  | 4.6        |
| CONFIGURATIONS FOR WINDOWS XP PROFESSIONAL SERVICE PACK 2 AND WINDOWS SERVER 2003 SERVICE PACK 1 WITH USER SPECIFIC SECURITY .....    | 4.6        |
| CONFIGURATIONS FOR WINDOWS XP PROFESSIONAL SERVICE PACK 2 AND WINDOWS SERVER 2003 SERVICE PACK 1 WITHOUT USER SPECIFIC SECURITY ..... | 4.8        |
| CONFIGURING WINDOWS FIREWALL .....  | 4.10       |
| DFI OLE SERVER DETAILS .....  | 4.10       |
| HSE OLE SERVER DETAILS .....  | 4.10       |
| A&E OPC SERVER DETAILS .....  | 4.10       |
| HDA OPC SERVER DETAILS .....  | 4.11       |
| HSE DEVICE DEFINITION .....   | 4.11       |
| INFORMATION FOR FIREWALL CONFIGURATION .....  | 4.11       |
| SMAROLESERVER.INI CONFIGURATION .....   | 4.12       |
| TOPOLOGY UPLOAD .....   | 4.13       |
| SMAR SERVER MANAGER APPLICATION .....   | 4.13       |
| OPTIMIZING DF51 ACCESS TO SUBNETS .....   | 4.14       |
| ENABLING THE SYNCHRONISM BY SNTP .....  | 4.15       |
| ENABLING THE SYNCHRONISM BY SNTP IN THE DF51 .....  | 4.15       |
| ENABLING THE SYNCHRONISM BY SNTP IN THE DF62, DF63, DF73, DF75, DF79, DF81, DF89, DF95, DF97 AND DF100 CONTROLLERS .....              | 4.18       |
| <b>SECTION 5 - CONFIGURING STRATEGIES.....</b>  | <b>5.1</b> |
| INTRODUCTION .....  | 5.1        |
| AREA TYPES .....  | 5.2        |
| AREA .....  | 5.2        |
| HSE AREA .....  | 5.3        |
| PREDEFINED AREA .....   | 5.4        |
| STRATEGY TEMPLATE .....   | 5.5        |
| DEVICE TEMPLATE .....   | 5.5        |
| BRIDGE TEMPLATE .....   | 5.5        |
| CONTROLLER TEMPLATE .....   | 5.6        |
| <b>SECTION 6 - ADDING FUNCTION BLOCKS.....</b>  | <b>6.1</b> |
| INTRODUCTION .....  | 6.1        |
| CREATING A NEW BLOCK .....  | 6.1        |
| ATTACHING NEW BLOCK.....  | 6.3        |
| <b>SECTION 7 - ADDING LOGIC BY USING FLEXIBLE FUNCTION BLOCKS (FFB 1131).....</b>   | <b>7.1</b> |
| INTRODUCTION .....  | 7.1        |
| AREA WITH FFB 1131 .....  | 7.2        |
| ARRANGING THE SYSCON WINDOWS.....   | 7.4        |
| DEFINING THE FFB PARAMETERS .....   | 7.4        |
| <b>SECTION 8 - ADDING I/O MODULES.....</b>  | <b>8.1</b> |
| INTRODUCTION .....  | 8.1        |
| STEPS TO CONFIGURE I/O MODULES .....  | 8.4        |
| RES – RESOURCE BLOCK.....   | 8.5        |
| HCT – HARDWARE CONFIGURATION TRANSDUCER .....   | 8.5        |
| TEMP – TEMPERATURE TRANSDUCER.....  | 8.6        |
| TBH – RIO HART TRANSDUCER BLOCK .....   | 8.8        |
| FUNCTION BLOCK CREATION.....  | 8.12       |
| CHANNEL CONFIGURATION .....   | 8.12       |

|   |             |
|---|-------------|
| MODULE SPECIFICATION STANDARD .....   | 8.14        |
| <b>SECTION 9 - ADDING RACKS.....</b>  | <b>9.1</b>  |
| DF1A – RACK WITH 4 SLOTS .....  | 9.1         |
| DESCRIPTION .....   | 9.1         |
| TECHNICAL SPECIFICATIONS .....  | 9.1         |
| DF78 - RACK WITH 4 SLOTS FOR REDUNDANT CPUS.....                            | 9.2         |
| DESCRIPTION .....   | 9.2         |
| TECHNICAL SPECIFICATIONS .....  | 9.2         |
| DF93 - RACK WITH 4 SLOTS (WITH DIAGNOSTIC) .....                            | 9.3         |
| DESCRIPTION .....   | 9.3         |
| TECHNICAL SPECIFICATIONS .....  | 9.3         |
| DF92 - RACK WITH 4 SLOTS FOR REDUNDANT CPUS (WITH DIAGNOSTIC SUPPORT) ..... | 9.5         |
| DESCRIPTION .....   | 9.5         |
| TECHNICAL SPECIFICATIONS .....  | 9.5         |
| <b>SECTION 10 - TROUBLESHOOTING .....</b>                                   | <b>10.1</b> |
| WHEN TO USE THE PROCEDURES OF FACTORY INIT/RESET .....                      | 10.3        |
| <b>SECTION 11 - TECHNICAL SPECIFICATIONS FOR THE CONTROLLERS.....</b>       | <b>11.1</b> |
| DFI302 SPECIFICATIONS .....   | 11.1        |
| DF51 SPECIFICATIONS .....   | 11.2        |
| PART NUMBER .....   | 11.2        |
| DESCRIPTION .....   | 11.2        |
| TECHNICAL SPECIFICATIONS .....  | 11.2        |
| USING THE FAULT INDICATION .....  | 11.3        |
| JUMPERS ON BOARD .....  | 11.4        |
| FIELDBUS LIMITS .....   | 11.4        |
| SUPERVISION LIMITS .....  | 11.5        |
| MODBUS LIMITS .....   | 11.5        |
| DF62 SPECIFICATIONS .....   | 11.6        |
| PART NUMBER .....   | 11.6        |
| DESCRIPTION .....   | 11.6        |
| CHARACTERISTICS AND CONTROLLER LIMITS .....                                 | 11.6        |
| CONTINUOUS CONTROL WITH FOUNDATION™ FIELDBUS .....                          | 11.7        |
| DISCRETE CONTROL .....  | 11.7        |
| FLEXIBLE FUNCTION BLOCK USAGE.....  | 11.7        |
| FIRMWARE VERSION AND DEVICE REVISION .....                                  | 11.7        |
| TECHNICAL SPECIFICATIONS .....  | 11.9        |
| ELECTRICAL CERTIFICATION .....  | 11.10       |
| INDICATION LEDS .....   | 11.12       |
| DF63 SPECIFICATIONS .....   | 11.13       |
| PART NUMBER .....   | 11.13       |
| DESCRIPTION .....   | 11.13       |
| CHARACTERISTICS AND CONTROLLER LIMITS .....                                 | 11.13       |
| CONTINUOUS CONTROL WITH FOUNDATION™ FIELDBUS .....                          | 11.14       |
| DISCRETE CONTROL .....  | 11.14       |
| FLEXIBLE FUNCTION BLOCK USAGE.....  | 11.14       |
| FIRMWARE VERSION AND DEVICE REVISION .....                                  | 11.14       |
| TECHNICAL SPECIFICATIONS .....  | 11.15       |
| ELECTRICAL CERTIFICATION .....  | 11.17       |
| INDICATION LEDS .....   | 11.18       |
| DF73 SPECIFICATIONS .....   | 11.19       |
| PART NUMBER .....   | 11.19       |
| DESCRIPTION .....   | 11.19       |
| CHARACTERISTICS AND MODULE LIMITS .....                                     | 11.19       |
| CONTINUOUS CONTROL WITH PROFIBUS.....                                       | 11.20       |
| DISCRETE CONTROL .....  | 11.20       |
| FIRMWARE VERSION AND DEVICE REVISION .....                                  | 11.20       |
| TECHNICAL SPECIFICATIONS .....  | 11.21       |
| ELECTRICAL CERTIFICATION .....  | 11.23       |
| INDICATION LEDS .....   | 11.24       |
| DF75 SPECIFICATIONS .....   | 11.26       |
| PART NUMBER .....   | 11.26       |
| DESCRIPTION .....   | 11.26       |

|  |       |
|--|-------|
| CHARACTERISTICS AND CONTROLLER LIMITS .....        | 11.26 |
| CONTINUOUS CONTROL WITH FOUNDATION™ FIELDBUS ..... | 11.27 |
| DISCRETE CONTROL .....                             | 11.27 |
| FLEXIBLE FUNCTION BLOCK USAGE .....                | 11.27 |
| FIRMWARE VERSION AND DEVICE REVISION .....         | 11.27 |
| TECHNICAL SPECIFICATIONS .....                     | 11.28 |
| ELECTRICAL CERTIFICATION .....                     | 11.29 |
| INDICATION LEADS .....                             | 11.31 |
| DF79 SPECIFICATIONS .....                          | 11.32 |
| PART NUMBER .....                                  | 11.32 |
| DESCRIPTION .....                                  | 11.32 |
| CHARACTERISTICS AND MODULE LIMITS .....            | 11.32 |
| CONTINUOUS CONTROL WITH DEVICENET .....            | 11.33 |
| DISCRETE CONTROL .....                             | 11.33 |
| FIRMWARE VERSION AND DEVICE REVISION .....         | 11.33 |
| TECHNICAL SPECIFICATIONS .....                     | 11.34 |
| ELECTRICAL CERTIFICATION .....                     | 11.36 |
| INDICATION LEADS .....                             | 11.37 |
| DF81 SPECIFICATIONS .....                          | 11.38 |
| PART NUMBER .....                                  | 11.38 |
| DESCRIPTION .....                                  | 11.38 |
| CHARACTERISTICS AND MODULE LIMITS .....            | 11.38 |
| CONTINUOUS CONTROL WITH AS-I .....                 | 11.39 |
| DISCRETE CONTROL .....                             | 11.39 |
| FLEXIBLE FUNCTION BLOCK USAGE .....                | 11.40 |
| FIRMWARE VERSION AND DEVICE REVISION .....         | 11.40 |
| TECHNICAL SPECIFICATIONS .....                     | 11.40 |
| ELECTRICAL CERTIFICATION .....                     | 11.42 |
| INDICATION LEADS .....                             | 11.44 |
| DF89 SPECIFICATIONS .....                          | 11.45 |
| PART NUMBER .....                                  | 11.45 |
| DESCRIPTION .....                                  | 11.45 |
| CHARACTERISTICS AND CONTROLLER LIMITS .....        | 11.45 |
| CONTINUOUS CONTROL WITH FOUNDATION™ FIELDBUS ..... | 11.46 |
| DISCRETE CONTROL .....                             | 11.46 |
| FLEXIBLE FUNCTION BLOCK USAGE .....                | 11.46 |
| FIRMWARE VERSION AND DEVICE REVISION .....         | 11.47 |
| TECHNICAL SPECIFICATIONS .....                     | 11.47 |
| ELECTRICAL CERTIFICATION .....                     | 11.49 |
| INDICATION LEADS .....                             | 11.50 |
| DF95 SPECIFICATIONS .....                          | 11.51 |
| PART NUMBER .....                                  | 11.51 |
| DESCRIPTION .....                                  | 11.51 |
| CHARACTERISTICS AND MODULE LIMITS .....            | 11.51 |
| CONTINUOUS CONTROL WITH PROFIBUS .....             | 11.52 |
| DISCRETE CONTROL .....                             | 11.52 |
| FIRMWARE VERSION AND DEVICE REVISION .....         | 11.52 |
| TECHNICAL SPECIFICATIONS .....                     | 11.53 |
| INDICATION LEADS .....                             | 11.56 |
| DF97 SPECIFICATIONS .....                          | 11.58 |
| PART NUMBER .....                                  | 11.58 |
| DESCRIPTION .....                                  | 11.58 |
| CHARACTERISTICS AND MODULE LIMITS .....            | 11.58 |
| CONTINUOUS CONTROL WITH PROFIBUS .....             | 11.59 |
| DISCRETE CONTROL .....                             | 11.59 |
| FIRMWARE VERSION AND DEVICE REVISION .....         | 11.59 |
| TECHNICAL SPECIFICATIONS .....                     | 11.60 |
| INDICATION LEADS .....                             | 11.63 |
| DF100 SPECIFICATIONS .....                         | 11.65 |
| DESCRIPTION .....                                  | 11.65 |
| GENERAL CHARACTERISTICS AND LIMITS .....           | 11.66 |
| CONTINUOUS CONTROL WITH FOUNDATION™ FIELDBUS ..... | 11.66 |
| HSE WIO FUNCTION BLOCKS AND TRANSDUCERS .....      | 11.66 |
| FIRMWARE VERSION AND DEVICE REVISION .....         | 11.67 |
| TECHNICAL SPECIFICATIONS .....                     | 11.67 |

|   |             |
|---|-------------|
| INDICATION LEDS .....   | 11.69       |
| LEDS RELATED TO <i>WIRELESSHART</i> MANAGER .....                         | 11.70       |
| HARDWARE CONFIGURATION.....   | 11.70       |
| <b>SECTION 12 - CABLE SPECIFICATIONS .....</b>                            | <b>12.1</b> |
| ETHERNET CABLE SPECIFICATIONS .....                                       | 12.1        |
| DF54/DF55.....  | 12.1        |
| SERIAL CABLE SPECIFICATIONS .....   | 12.2        |
| DF59.....   | 12.2        |
| DF68.....   | 12.3        |
| DF82.....   | 12.4        |
| DF83.....   | 12.4        |
| CABLES FOR RACKS INTERCONNECTION AND POWER DISTRIBUTION .....             | 12.5        |
| EXPANSION FLAT CABLES FOR SYSTEMS BASED ON DF92 AND DF93.....             | 12.5        |
| FLAT CABLES PROTECTOR (CONNECTOR CAP) .....                               | 12.5        |
| DF90 CABLE .....  | 12.6        |
| <b>SECTION 13 - ADDING POWER SUPPLIES.....</b>                            | <b>13.1</b> |
| INTRODUCTION .....  | 13.1        |
| DF50 – POWER SUPPLY MODULE FOR BACKPLANE (REDUNDANT) .....                | 13.2        |
| DESCRIPTION .....   | 13.2        |
| INSTALLATION AND CONFIGURATION .....                                      | 13.2        |
| TECHNICAL SPECIFICATIONS .....  | 13.3        |
| DF56 – POWER SUPPLY FOR BACKPLANE (REDUNDANT) .....                       | 13.5        |
| DESCRIPTION .....   | 13.5        |
| INSTALLATION AND CONFIGURATION .....                                      | 13.5        |
| TECHNICAL SPECIFICATIONS .....  | 13.6        |
| DF87 – POWER SUPPLY FOR BACKPLANE (5 A, REDUNDANT, WITH DIAGNOSTIC) ..... | 13.8        |
| DESCRIPTION .....   | 13.8        |
| INSTALLATION AND CONFIGURATION .....                                      | 13.8        |
| TECHNICAL SPECIFICATIONS .....  | 13.9        |
| DIAGNOSTICS LEDS .....  | 13.10       |
| CALCULATING THE POWER CONSUMPTION .....                                   | 13.12       |
| POWER SUPPLIES AND RACKS POSITIONING .....                                | 13.13       |
| FOR SYSTEMS BASED ON DF92 AND DF93 RACKS WITH DF90 AND DF91 .....         | 13.13       |
| FOR SYSTEMS BASED ON DF78 AND DF1A RACKS (LEGACY SYSTEMS).....            | 13.15       |
| FAULT DIAGNOSTIC IN IMB .....   | 13.16       |
| CONDITIONS THAT MAY CAUSE IMB FAULT STATE: .....                          | 13.16       |
| DF52 / DF60 – POWER SUPPLY FOR FIELDBUS .....                             | 13.17       |
| DESCRIPTION .....   | 13.17       |
| TECHNICAL SPECIFICATIONS .....  | 13.18       |
| DF53/DF98 – POWER SUPPLY IMPEDANCE FOR FIELDBUS .....                     | 13.20       |
| DESCRIPTION .....   | 13.20       |
| TECHNICAL SPECIFICATIONS .....  | 13.21       |
| INSTALLATION.....   | 13.22       |
| MAINTENANCE AND TROUBLESHOOTING .....                                     | 13.22       |
| DF47-12 AND DF47-17 – INTRINSIC SAFETY BARRIER FOR FIELDBUS .....         | 13.23       |
| DESCRIPTION .....   | 13.23       |
| INSTALLATION.....   | 13.23       |
| TECHNICAL SPECIFICATIONS .....  | 13.25       |
| CERTIFICATION INFORMATION .....   | 13.26       |
| HAZARDOUS LOCATIONS APPROVALS.....  | 13.29       |
| IDENTIFICATION LABELS AND CONTROL DRAWINGS.....                           | 13.32       |
| <b>SECTION 14 - ADDING INTERFACES.....</b>                                | <b>14.1</b> |
| INTRODUCTION .....  | 14.1        |
| DF58 – RS-232/RS-485 INTERFACE .....                                      | 14.2        |
| DESCRIPTION .....   | 14.2        |
| INTERFACE SETTINGS .....  | 14.2        |
| RS-232 MODE: HALF-DUPLEX/FULL-DUPLEX.....                                 | 14.2        |
| RS-485 BUS TERMINATOR: ON/OFF .....                                       | 14.2        |
| CONNECTORS.....   | 14.3        |
| TECHNICAL SPECIFICATIONS .....  | 14.3        |
| DF61 – ETHERNET SWITCH 10/100 MBPS .....                                  | 14.4        |

|   |             |
|---|-------------|
| <b>SECTION 15 - ADDING MODBUS.....</b>  | <b>15.1</b> |
| INTRODUCTION .....  | 15.1        |
| STEPS TO CONFIGURE MODBUS.....  | 15.3        |
| MBCF - PARAMETERS DESCRIPTION .....   | 15.4        |
| MBCS – MODBUS CONTROL SLAVE.....  | 15.7        |
| PARAMETERS DESCRIPTION .....  | 15.8        |
| MBSS – MODBUS SUPERVISION SLAVE.....  | 15.11       |
| PARAMETERS DESCRIPTION .....  | 15.12       |
| DATA TYPE AND SUPPORTED STRUCTURES BY MBSS.....                               | 15.14       |
| MBCM – MODBUS CONTROL MASTER.....   | 15.15       |
| PARAMETERS DESCRIPTION .....  | 15.16       |
| MBSM – MODBUS SUPERVISION MASTER.....   | 15.21       |
| PARAMETERS DESCRIPTION .....  | 15.22       |
| MODBUS SLAVE ADDRESSES .....  | 15.27       |
| MODBUS COMMANDS .....   | 15.29       |
| SCALING CONVERSION .....  | 15.30       |
| REDUNDANCY AND MODBUS .....   | 15.31       |
| USING MODBUS IN CONTROLLERS DF73, DF75, DF79, DF81, DF89, DF95 AND DF97 ..... | 15.33       |
| PARAMETERS DESCRIPTION .....  | 15.34       |
| TROUBLESHOOTING.....  | 15.35       |
| <br>  |             |
| <b>SECTION 16 - CREATING A FIELDBUS STRATEGY BY USING DF51.....</b>           | <b>16.1</b> |
| INTRODUCTION .....  | 16.1        |
| PROJ_DF51.....  | 16.1        |
| STARTING THE AREA .....   | 16.2        |
| PHYSICAL PLANT PROJECT.....   | 16.3        |
| ARRANGING FIELDBUS WINDOWS .....  | 16.4        |
| ADDING BRIDGES .....  | 16.5        |
| ADDING FIELDBUS DEVICES .....   | 16.6        |
| ADDING FUNCTION BLOCKS.....   | 16.7        |
| CREATING NEW PROCESS CELLS.....   | 16.9        |
| CREATING A CONTROL MODULE (FBAPPLICATION) .....                               | 16.10       |
| INSERTING BLOCKS IN THE CONTROL MODULE .....                                  | 16.11       |
| CONFIGURING THE CONTROL STRATEGY .....  | 16.12       |
| ADDING BLOCKS TO THE STRATEGY WINDOW .....                                    | 16.12       |
| LINKING THE BLOCKS .....  | 16.13       |
| FUNCTION BLOCK CHARACTERIZATION.....  | 16.14       |
| OPTIMIZING THE SUPERVISION .....  | 16.18       |
| BACKGROUND TIME .....   | 16.19       |
| MVC (MULTIPLE VARIABLE CONTAINERS).....                                       | 16.20       |
| SUPERVISION TIME .....  | 16.21       |
| UPDATE TIME .....   | 16.21       |
| OPC UPDATE RATE.....  | 16.22       |
| <br>  |             |
| <b>SECTION 17 - ADDING REDUNDANCY TO THE DF51 CONTROLLER.....</b>             | <b>17.1</b> |
| INTRODUCTION .....  | 17.1        |
| HOT STANDBY REDUNDANCY.....   | 17.1        |
| LINK ACTIVE SCHEDULER (LAS) REDUNDANCY .....                                  | 17.2        |
| REDUNDANT SYSTEM ARCHITECTURE .....   | 17.2        |
| SYSTEM PRE-REQUIREMENTS.....  | 17.3        |
| CONFIGURING HOT STANDBY REDUNDANCY .....                                      | 17.3        |
| FIRST TIME CONFIGURATION PROCEDURE.....                                       | 17.6        |
| CHANGING THE CONFIGURATION .....  | 17.6        |
| REPLACING A MODULE WITH FAILURE.....  | 17.6        |
| FIXING THE SYSTEM WHEN THE H1 CABLE BREAKS.....                               | 17.7        |
| FIRMWARE UPDATE WITHOUT PROCESS INTERRUPTION.....                             | 17.7        |
| ADDING REDUNDANCY TO A SYSTEM IN OPERATION.....                               | 17.7        |
| CONFIGURING LAS REDUNDANCY .....  | 17.8        |
| FIRST TIME CONFIGURATION PROCEDURE.....                                       | 17.8        |
| REPLACING AN ACTIVE MODULE WITH FAILURE .....                                 | 17.9        |
| REPLACING A BACKUP MODULE WITH FAILURE .....                                  | 17.9        |
| PLACING THE SYSTEM INTO OPERATION AFTER A GENERAL POWER FAILURE.....          | 17.10       |

|   |             |
|---|-------------|
| FIXING THE SYSTEM WHEN THE H1 CABLE BREAKS.....   | 17.10       |
| FIRMWARE UPDATE WITHOUT PROCESS INTERRUPTION.....                                       | 17.10       |
| <b>SECTION 18 - ADDING LOGIC CONFIGURATION USING CO-PROCESSORS MODULES .....</b>        | <b>18.1</b> |
| INTRODUCTION .....  | 18.1        |
| DF65 CONFIGURATION .....  | 18.1        |
| SERIAL COMMUNICATION SETTINGS .....   | 18.2        |
| PHYSICAL LAYER AND TIMEOUT .....  | 18.2        |
| CHANGING DF65 COMMUNICATION SETTINGS.....   | 18.3        |
| LOGIC CONFIGURATION DOWNLOAD .....  | 18.3        |
| CONFIGURING DF51 MODBUS BLOCKS .....  | 18.4        |
| SUPERVISING DF65 CO-PROCESSOR DATA USING MBSM BLOCK .....                               | 18.4        |
| DATA EXCHANGE BETWEEN DF65 CO-PROCESSOR AND DF51 USING MBCM BLOCK .....                 | 18.4        |
| EXAMPLE OF COMMUNICATION BETWEEN DF51 AND DF65 WITH LADDER LOGIC .....                  | 18.5        |
| HOW TO CONFIGURE THE COMMUNICATION AND DATA EXCHANGE BETWEEN THE DF65 AND THE DF51 .... | 18.6        |
| DF65 – CO-PROCESSOR MODULE .....  | 18.7        |
| DESCRIPTION .....   | 18.7        |
| TECHNICAL SPECIFICATIONS .....  | 18.8        |
| COMMUNICATION CHANNELS .....  | 18.9        |
| RESTRICTIONS:.....  | 18.9        |
| DEVICE COMMUNICATION BAUD RATE AND DEVICE ADDRESS .....                                 | 18.11       |
| OPERATION MODES.....  | 18.11       |
| DF65 WITH THREE MODBUS RTU CHANNELS .....   | 18.12       |
| DF65 MASTER IN A DF66 SYSTEM.....   | 18.12       |
| FACTORY INIT .....  | 18.12       |
| DF66 – REMOTE I/O COMMUNICATION INTERFACE .....   | 18.13       |
| DESCRIPTION .....   | 18.13       |
| ADDING A DF66 UNIT .....  | 18.13       |
| REMOTE I/O ARCHITECTURE .....   | 18.14       |
| BAUD RATE AND ADDRESS SETTING.....  | 18.14       |
| DF65R/DF65ER – REDUNDANT CO-PROCESSOR MODULE .....                                      | 18.15       |
| INTRODUCTION .....  | 18.15       |
| TERMINOLOGY AND INITIAL DESCRIPTIONS.....   | 18.15       |
| ARCHITECTURE .....  | 18.17       |
| POWER UP PROCEDURES.....  | 18.18       |
| COMMUNICATION WITH REMOTE INPUT AND OUTPUT (RIO) MODULES .....                          | 18.20       |
| LEDS FOR STATUS INDICATION.....   | 18.20       |
| <b>SECTION 19 - CREATING A FOUNDATION FIELDBUS STRATEGY BY USING DF62/DF63.....</b>     | <b>19.1</b> |
| INTRODUCTION .....  | 19.1        |
| PROJ_DF62 .....   | 19.1        |
| STARTING THE AREA .....   | 19.2        |
| PHYSICAL PLANT PROJECT.....   | 19.3        |
| ARRANGING THE FIELDBUS WINDOWS .....  | 19.4        |
| ADDING THE BRIDGE.....  | 19.4        |
| ADDING FIELDBUS DEVICES .....   | 19.6        |
| ADDING FUNCTION BLOCKS.....   | 19.8        |
| CREATING NEW PROCESS CELLS.....   | 19.10       |
| CREATING A CONTROL MODULE.....  | 19.11       |
| INSERTING BLOCKS IN THE CONTROL MODULE .....  | 19.13       |
| CONFIGURING THE CONTROL STRATEGY .....  | 19.14       |
| ADDING BLOCKS TO THE STRATEGY WINDOW .....  | 19.14       |
| LINKING THE BLOCKS .....  | 19.15       |
| FUNCTION BLOCK CHARACTERIZATION.....  | 19.16       |
| MACROCYCLE FOR THE H1 CHANNEL .....   | 19.21       |
| BACKGROUND TIME .....   | 19.21       |
| <b>SECTION 20 - CREATING A PROFIBUS CONFIGURATION BY USING DF73, DF95 OR DF97 .....</b> | <b>20.1</b> |
| INTRODUCTION .....  | 20.1        |
| PROJ_DF73 .....   | 20.1        |
| STARTING THE AREA .....   | 20.4        |
| PHYSICAL PLANT PROJECT.....   | 20.5        |
| ARRANGING THE FIELDBUS WINDOWS .....  | 20.6        |
| INSERTING THE CONTROLLER .....  | 20.6        |

|  |       |
|--|-------|
| ADDING PROFIBUS DEVICES.....   | 20.8  |
| INSERTING SLAVE DEVICES THAT ARE NO PRESENT IN THE “AVAILABLE SLAVES” LIST ..... | 20.10 |
| SETTING PROFIBUS DEVICES .....   | 20.10 |
| MAPPING PROFIBUS IO POINTS TO BE USED IN LADDER.....                             | 20.18 |
| MAPPING PROFIBUS IO POINTS TO BE USED IN FUNCTION BLOCKS .....                   | 20.23 |
| ADDING OTHER FUNCTION BLOCKS .....   | 20.26 |
| CREATING NEW PROCESS CELLS.....  | 20.27 |
| CREATING A CONTROL MODULE .....  | 20.29 |
| INSERTING BLOCKS TO THE CONTROL MODULE.....                                      | 20.30 |
| CONFIGURING THE CONTROL STRATEGY .....   | 20.30 |
| ADDING BLOCKS IN THE STRATEGY WINDOW .....                                       | 20.32 |
| LINKING THE BLOCKS .....   | 20.32 |
| BLOCK CHARACTERIZATION .....   | 20.33 |
| COMMISSIONING AND CONFIGURATION DOWNLOAD TO THE CONTROLLER.....                  | 20.37 |
| SYSTEM302 MAINTENANCE PROCEDURE .....  | 20.39 |
| PROFIBUS NETWORK TIME PARAMETERS.....  | 20.40 |
| DEFAULT VALUES OF THE PROFIBUS STANDARD .....                                    | 20.42 |
| RECOMMENDED VALUES.....  | 20.43 |
| REQUIRED VALUES WHEN USING THIRD PARTY DEVICES.....                              | 20.43 |
| NETWORK DIAGNOSTICS.....   | 20.44 |
| NETWORK DIAGNOSTIC USING THE NETWORK CONFIGURATOR .....                          | 20.44 |
| EXTENDED DIAGNOSTIC IN THE NETWORK CONFIGURATOR.....                             | 20.47 |

**SECTION 21 - CREATING A DEVICENET CONFIGURATION BY USING DF79..... 21.1**

|  |       |
|--|-------|
| INTRODUCTION .....   | 21.1  |
| PROJ_DF79 .....  | 21.1  |
| STARTING THE AREA .....  | 21.2  |
| PHYSICAL PLANT PROJECT.....  | 21.3  |
| ARRANGING THE FIELDBUS WINDOWS .....   | 21.4  |
| INSERTING THE CONTROLLER .....   | 21.5  |
| ADDING DEVICENET DEVICES .....   | 21.6  |
| INSERTING SLAVE DEVICES THAT ARE NO PRESENT IN THE “AVAILABLE SLAVES” LIST ..... | 21.8  |
| SETTING DEVICENET DEVICES.....   | 21.9  |
| MAPPING DEVICENET IO POINTS TO BE USED IN LADDER.....                            | 21.14 |
| MAPPING DEVICENET IO POINTS TO BE USED IN FUNCTION BLOCKS .....                  | 21.18 |
| ADDING OTHER FUNCTION BLOCKS .....   | 21.22 |
| CREATING NEW AREAS .....   | 21.23 |
| CREATING A CONTROL MODULE .....  | 21.24 |
| INSERTING BLOCKS TO THE CONTROL MODULE.....                                      | 21.25 |
| CONFIGURING THE CONTROL STRATEGY .....   | 21.26 |
| ADDING BLOCKS IN THE STRATEGY WINDOW .....                                       | 21.27 |
| LINKING THE BLOCKS .....   | 21.27 |
| BLOCK CHARACTERIZATION .....   | 21.29 |
| COMMISSIONING AND CONFIGURATION DOWNLOAD TO THE CONTROLLER.....                  | 21.31 |
| SYSTEM302 MAINTENANCE PROCEDURE .....  | 21.33 |
| DEVICENET ADVANCED TOPICS .....  | 21.34 |
| I/O MESSAGES CONFIGURATION IN THE NETWORK CONFIGURATOR.....                      | 21.34 |
| NETWORK CONFIGURATOR ONLINE COMMUNICATION WITH THE CONTROLLER .....              | 21.35 |
| EXPLICIT MESSAGE CONFIGURATION.....  | 21.37 |
| ONLINE READING/WRITING OF SLAVE’S PARAMETERS .....                               | 21.38 |
| CHANGING THE ADDRESS VIA SOFTWARE.....   | 21.39 |
| ENABLING AND DISABLING A DEVICE IN THE CONFIGURATION .....                       | 21.40 |
| NETWORK DIAGNOSTICS.....   | 21.42 |
| NETWORK DIAGNOSTIC USING THE NETWORK CONFIGURATOR .....                          | 21.42 |
| COMMON ERRORS OF COMMISSIONING.....  | 21.51 |
| THE AUTO DETECTED DEVICES .....  | 21.53 |
| DEVICES DIAGNOSTIC THROUGH THEIR LEDS .....                                      | 21.54 |
| DIAGNOSTIC THROUGH TRANSDUCER BLOCK .....  | 21.55 |
| DEVICENET CONTROLLER SPECIFIC BLOCKS.....  | 21.58 |
| DEVICENET COMMUNICATION TRANSDUCER .....   | 21.58 |

**SECTION 22 - CREATING AN AS-I CONFIGURATION BY USING DF81..... 22.1**

|                        |      |
|------------------------|------|
| INTRODUCTION .....     | 22.1 |
| PROJ_DF81 .....        | 22.1 |
| STARTING THE AREA..... | 22.2 |



PHYSICAL PLANT PROJECT ..... 22.3

ARRANGING THE FIELDBUS WINDOWS ..... 22.4

INSERTING THE CONTROLLER ..... 22.4

ADDING AS-I DEVICES ..... 22.6

INSERTING DEVICES IN THE TOPOLOGY ..... 22.8

PERFORMING THE UPLOAD OF DETECTED DEVICE ..... 22.10

INSERTING NEW AS-I DEVICES IN STANDARD LIST ..... 22.12

CONFIGURING THE AS-I DEVICES ..... 22.12

MAPPING AS-I I/O POINTS TO BE USED IN LADDER ..... 22.14

NETWORK DIAGNOSTICS ..... 22.18

    NETWORK DIAGNOSTIC USING THE NETWORK CONFIGURATOR ..... 22.18

    NETWORK DIAGNOSTIC USING THE COMMUNICATION TRANSDUCER BLOCK ..... 22.20

    NETWORK DIAGNOSTIC USING THE LEDS' CONTROLLER ..... 22.21

SPECIFIC BLOCKS OF AS-I CONTROLLER ..... 22.21

    AS-I COMMUNICATION TRANSDUCER ..... 22.21

**SECTION 23 - CREATING A MODBUS CONFIGURATION BY USING DF89 ..... 23.1**

    INTRODUCTION ..... 23.1

    CREATING A BASIC AREA ..... 23.2

    DF89 CONFIGURATION AS MODBUS SERIAL MASTER ..... 23.6

        MODBUS NETWORK CONFIGURATION ..... 23.7

        CONFIGURING MODBUS DEVICES ..... 23.8

        HOW TO EDIT THE DEVICES PROPERTIES ..... 23.9

        ADDING COMMANDS TO THE DEVICE ..... 23.9

        MAPPING THE MODBUS POINTS FOR THE SYSTEM302 LOGIC ..... 23.11

    DF89 CONFIGURATION AS MODBUS TCP MASTER ..... 23.15

        CONFIGURING THE MODBUS DEVICES ..... 23.15

        EDITING THE DEVICES PROPERTIES AND COMMANDS ..... 23.16

    MAKING LOGIC WITH THE MODBUS I/O POINTS ..... 23.17

        MAPPING THE MODBUS POINTS TO BE USED ON LADDER ..... 23.17

        MAPPING THE MODBUS POINTS TO BE USED IN FUNCTION BLOCKS ..... 23.19

    COMMISSIONING AND CONFIGURATION DOWNLOAD TO THE CONTROLLER ..... 23.20

    DF89 CONFIGURATION AS MODBUS SLAVE ..... 23.22

    DF89 CONFIGURATION AS BYPASS MODBUS ONLY ..... 23.23

        ADVANCED MODBUS TOPICS ..... 23.24

        TYPES OF DATA SUPPORTED ..... 23.25

        SUPERVISION AND CONTROL USING DF89 ..... 23.26

        SCAN TIME BETWEEN COMMANDS ..... 23.27

        OPTIMIZATION OF COMMANDS ..... 23.27

        ENABLING AND DISABLING A DEVICE IN THE CONFIGURATION ..... 23.27

        NETWORK CONFIGURATOR ONLINE COMMUNICATION WITH THE CONTROLLER ..... 23.28

        SYSTEM302 MAINTENANCE PROCEDURE ..... 23.29

    SMAR NETWORK CONFIGURATOR PARAMETERS ..... 23.30

        SERIAL CHANNEL PARAMETERS ..... 23.30

        TCP CHANNEL PARAMETERS ..... 23.30

        SERIAL DEVICE PARAMETERS ..... 23.31

        TCP EQUIPMENT PARAMETERS ..... 23.31

        PARAMETERS OF DEVICE COMMANDS (SERIAL OR TCP) ..... 23.32

    SPECIFIC BLOCKS OF DF89 CONTROLLER ..... 23.33

        MODBUS COMMUNICATION TRANSDUCER ..... 23.33

        MODBUS SLAVE CONFIGURATION ..... 23.35

    REDUNDANCY AND MODBUS ..... 23.36

**SECTION 24 - CREATING A FOUNDATION FIELDBUS STRATEGY BY USING THE DF100 ..... 24.1**

    INTRODUCTION ..... 24.1

        PROJ\_DF100 ..... 24.1

        STARTING AN AREA ..... 24.2

        PHYSICAL PLANT PROJECT ..... 24.3

        ARRANGING THE FIELDBUS WINDOWS ..... 24.4

        ADDING THE CONTROLLER ..... 24.4

        ADDING HSE WIO TRANSDUCER AND FUNCTION BLOCKS ..... 24.6

        ADDING CONVENTIONAL FUNCTION BLOCKS ..... 24.13

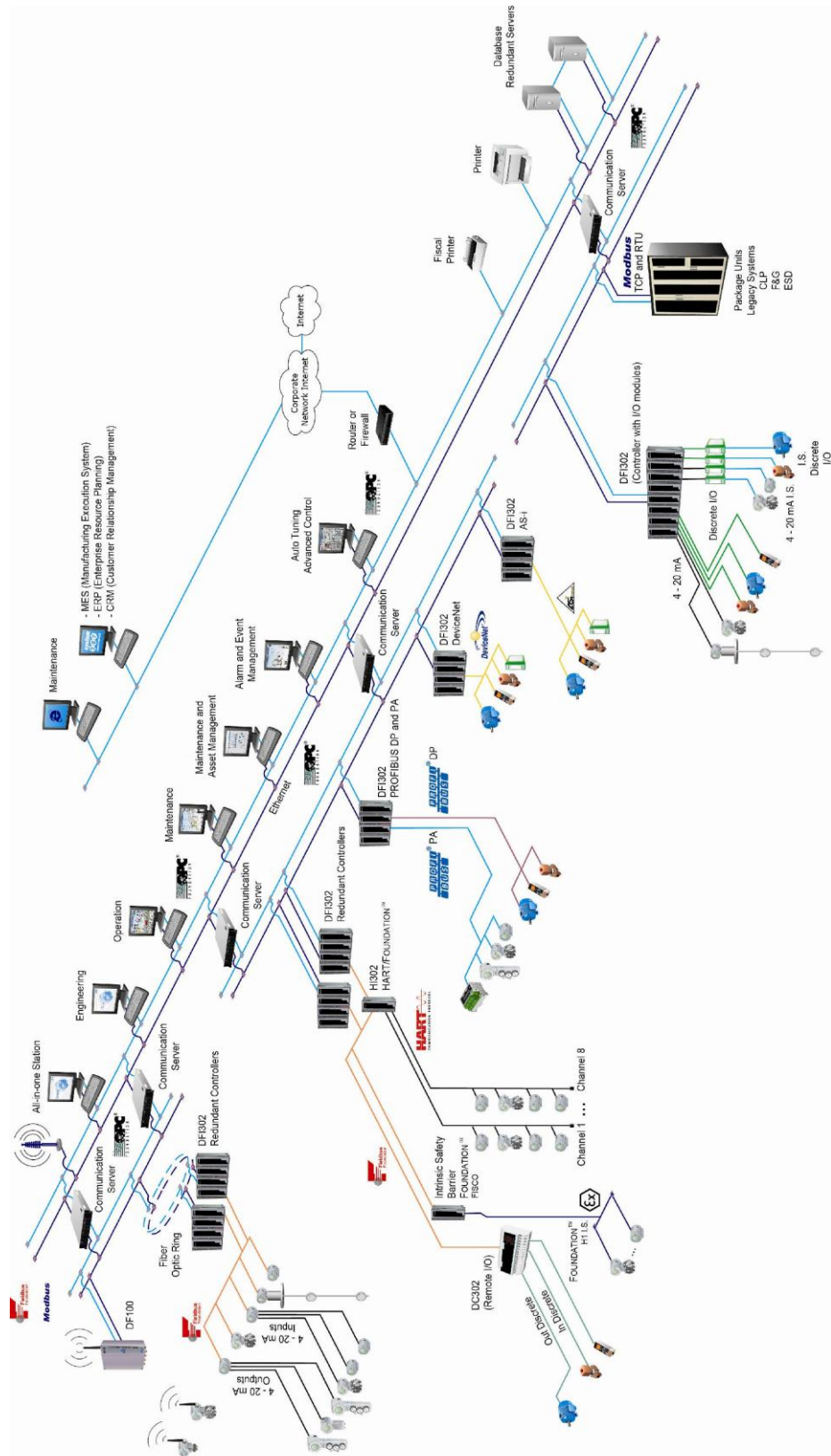
        CREATING NEW PROCESS CELLS ..... 24.14

        CREATING A CONTROL MODULE ..... 24.15

|   |             |
|---|-------------|
| INSERTING BLOCKS IN THE CONTROL MODULE .....  | 24.16       |
| CONFIGURING THE CONTROL STRATEGY .....  | 24.17       |
| ADDING BLOCKS TO THE STRATEGY WINDOW .....  | 24.18       |
| LINKING THE BLOCKS .....  | 24.18       |
| FUNCTION BLOCK CHARACTERIZATION.....  | 24.20       |
| DF100 CONVENTIONAL FUNCTION BLOCKS.....   | 24.22       |
| DF100 SPECIFIC BLOCKS .....   | 24.23       |
| MODBUS PROTOCOL SUPPORT.....  | 24.24       |
| SUPPORTED CHARACTERISTICS .....   | 24.24       |
| NATIVE MAPPING .....  | 24.24       |
| MODBUS COMBINED SCENARIO .....  | 24.28       |
| <b>SECTION 25 - ADDING REDUNDANCY TO THE DFI302 HSE CONTROLLERS.....</b>                          | <b>25.1</b> |
| INTRODUCTION .....  | 25.1        |
| HOT STANDBY REDUNDANCY.....   | 25.1        |
| PREPARING A REDUNDANT SYSTEM.....   | 25.2        |
| ETHERNET NETWORK ARCHITECTURES.....   | 25.2        |
| CONFIGURING THE SERVER MANAGER AND SYSCON.....  | 25.5        |
| SYNCHRONISM CHANNEL.....  | 25.6        |
| FOUNDATION FIELDBUS H1 CHANNELS .....   | 25.7        |
| ACCESSING THE I/O BUS .....   | 25.7        |
| HOT STANDBY REDUNDANCY WORKING .....  | 25.8        |
| STARTING UP THE REDUNDANCY .....  | 25.8        |
| OPERATIONAL TRANSPARENCY.....   | 25.8        |
| SWITCH OVER CONDITIONS.....   | 25.9        |
| STANDBY LED BEHAVIOR .....  | 25.11       |
| PROCEDURES FOR HOT STANDBY REDUNDANCY .....   | 25.12       |
| CONFIGURING FOR THE FIRST TIME A REDUNDANT SYSTEM .....   | 25.12       |
| CHANGING THE CONFIGURATION .....  | 25.13       |
| REPLACING A CONTROLLER WITH FAILURE.....  | 25.13       |
| ADDING REDUNDANT CONTROLLERS IN A NON-REDUNDANT SYSTEM.....                                       | 25.13       |
| FIRMWARE UPDATE WITHOUT PROCESS INTERRUPTION.....   | 25.13       |
| TROUBLESHOOTING.....  | 25.14       |
| <b>SECTION 26 - ADDING REDUNDANCY WITH REDUNDANT I/O MODULES.....</b>                             | <b>26.1</b> |
| INTRODUCTION .....  | 26.1        |
| R-SERIES ORDERING CODES.....  | 26.1        |
| R-SERIES IO REDUNDANT SYSTEM OVERVIEW .....   | 26.2        |
| SWITCHOVER SCENARIOS .....  | 26.3        |
| ADDING THE R-SERIES I/O MODULES TO A REDUNDANT SYSTEM .....                                       | 26.4        |
| STARTING THE AREA .....   | 26.4        |
| CREATING A LOGIC FROM THE FFB FUNCTION BLOCK.....   | 26.6        |
| CONFIGURING THE HARDWARE ON LOGICVIEW FOR FFB .....   | 26.7        |
| DIAGNOSTICS VIA SNMP.....   | 26.9        |
| <b>APPENDIX A - SRF – SERVICE REQUEST FORM .....</b>  | <b>A.1</b>  |
| <b>APPENDIX B - SNMP DIAGNOSTICS.....</b>   | <b>B.1</b>  |
| INTRODUCTION .....  | B.1         |
| WORKING PRINCIPLE .....   | B.1         |
| INTEGRATION AND NETWORK SECURITY .....  | B.2         |
| OVERVIEW OF DIAGNOSTIC FEATURES FOR DFI302 CONTROLLERS.....                                       | B.3         |
| DIAGNOSTIC GROUPS COMMON TO ALL CONTROLLERS.....  | B.3         |
| GENERAL INFORMATION OF THE CONTROLLERS .....  | B.3         |
| DIAGNOSTIC/STATUS OF ETHERNET PORTS.....  | B.3         |
| DIAGNOSTIC/STATUS OF SERIAL PORT.....   | B.4         |
| SPECIFIC DIAGNOSTIC GROUPS .....  | B.4         |
| DIAGNOSTIC/STATUS OF THE CONTROLLER REDUNDANCY (DF62, DF63, DF73, DF75, DF89, DF95 AND DF97) .... | B.4         |
| DIAGNOSTIC/STATUS OF THE FOUNDATION H1 PORTS (DF62 AND DF63) .....                                | B.5         |
| DIAGNOSTIC OF REDUNDANT I/O MODULES SYSTEM (DF62, DF63 AND DF75).....                             | B.5         |
| DETAILS OF STATUS BITS FOR I/O REDUNDANT MODULES.....   | B.6         |
| DIAGNOSTIC/STATUS OF THE DF87 POWER SUPPLY AND DF93 RACKS (DF62, DF63 AND DF75) .....             | B.8         |
| SNMP ITEMS - ADDITIONAL INFORMATION.....  | B.8         |
| BATTERY STATUS.....   | B.9         |

|                  |     |
|------------------|-----|
| REDUNDANCY ..... | B.9 |
| FIELDBUS .....   | B.9 |

## OVERVIEW



## Available Modules for the DFI302 System

| CONTROLLERS       |  |
|-------------------|--|
| Code              | Description  |
| DF51              | CPU DFI 1x10 Mbps, 4xH1  |
| DF62              | HSE/ FOUNDATION fieldbus Controller                                      |
| DF63              | HSE/ FOUNDATION fieldbus Controller                                      |
| DF65              | Logic Coprocessor  |
| DF65R             | Redundant logic Coprocessor  |
| DF65E             | Logic Coprocessor - 52 Kbytes  |
| DF65ER            | Redundant Logic Coprocessor - 52 Kbytes                                  |
| DF73              | HSE/Profibus-DP Controller   |
| DF75              | HSE Controller   |
| DF79              | HSE/ DeviceNet Controller  |
| DF81              | HSE/AS-i Controller  |
| DF89              | HSE/Modbus Controller  |
| DF95              | HSE/Profibus Controller with 2 Profibus PA ports e 1 Profibus DP channel |
| DF97              | HSE/Profibus Controller with 4 Profibus PA ports e 1 Profibus DP channel |
| DF99 <sup>1</sup> | HSE/WirelessHART Controller for rack                                     |
| DF100             | HSE/WirelessHART Controller  |

| I/O MÓDULES |  |
|-------------|--|
| Code        | Description  |
| DF11        | 2 Groups of 8 Digital Inputs 24 Vdc - Sink                                 |
| DF12        | 2 Groups of 8 Digital Inputs 48 Vdc - Sink                                 |
| DF13        | 2 Groups of 8 Digital Inputs 60 Vdc - Sink                                 |
| DF14        | 2 Groups of 8 Digital Inputs 125 Vdc - Sink                                |
| DF15        | 2 Groups of 8 Digital Inputs 24 Vdc - Source                               |
| DF16        | 2 Groups of 4 Digital Inputs 120 Vac                                       |
| DF17        | 2 Groups of 4 Digital Inputs 240 Vac                                       |
| DF18        | 2 Groups of 8 Digital Inputs 120 Vac                                       |
| DF19        | 2 Groups of 8 Digital Inputs 240 Vac                                       |
| DF20        | 1 Group of 8 Push-Button Switches  |
| DF21        | 1 Group of 16 Digital Outputs 24 Vdc - Sink                                |
| DF22        | 2 Groups of 8 Digital Outputs 24 Vdc - Source                              |
| DF23        | 2 Groups of 4 Digital Outputs 120/240 Vac - Triac                          |
| DF24        | 2 Groups of 8 Digital Outputs 120/240 Vac - Triac                          |
| DF25        | 2 Groups of 4 NO Relay Outputs   |
| DF26        | 2 Groups of 4 NC Relay Outputs   |
| DF27        | 1 Group of 4 NO and 4 NC Relay Outputs                                     |
| DF28        | 2 Groups of 8 NO Relay Outputs without RC Protection                       |
| DF29        | 2 Groups of 4 NO Relay Outputs without RC protection                       |
| DF30        | 2 Groups of 4 NC Relay Outputs without RC protection                       |
| DF31        | 1 Group of 4 NO and 4 NC Relay Outputs without RC protection               |
| DF32        | 1 Group of 8 24 Vdc Inputs and 1 Group of 4 NO Relay                       |
| DF33        | 1 Group of 8 48 Vdc Inputs and 1 Group of 4 NO Relay                       |
| DF34        | 1 Group of 8 60 Vdc Inputs and 1 Group of 4 NO Relay                       |
| DF35        | 1 Group of 8 24 Vdc Inputs and 1 Group of 4 NC Relay                       |
| DF36        | 1 Group of 8 48 Vdc Inputs and 1 Group of 4 NC Relay                       |
| DF37        | 1 Group of 8 60 Vdc Inputs and 1 Group of 4 NC Relay                       |
| DF38        | 1 Group of 8 24 Vdc Inputs and 1 Group of 2 NO and 2 NC Relay              |
| DF39        | 1 Group of 8 48 Vdc Inputs and 1 Group of 2 NO and 2 NC Relay              |
| DF40        | 1 Group of 8 60 Vdc Inputs and 1 Group of 2 NO and 2 NC Relay              |
| DF41        | 2 Groups of 8 Low Frequency (0 - 100 Hz) 24 Vdc Pulse Inputs               |
| DF42        | 2 Groups of 8 High Frequency (0 - 10 KHz) 24 Vdc Pulse Inputs              |
| DF44        | 1 Group of 8 Voltage/Current Analogue Inputs with Internal Shunt Resistors |
| DF45        | 1 Group of 8 Low Signal Analogue Inputs for TC, RTD, mV and Ohm            |

<sup>1</sup> The DF99 is a HSE / WirelessHART controller specially designed for rack mounting. Unlike the DF100, it can access digital I/O. For more information, please contact us.

|       |   |
|-------|---|
| DF46  | 1 Group of 4 Voltage/Current Analogue Outputs   |
| DF57  | 1 Group of 8 Voltage/Current Differential Analogue Inputs with Internal Shunt Resistors |
| DF67  | 2 Groups of 8 High Frequency (0 - 10 KHz) AC Pulse Inputs                               |
| DF69  | 2 Groups of 8 NO Relay Outputs  |
| DF71  | 2 Groups of 4 NO Relay Outputs without RC protection - Max 10 mA                        |
| DF72  | 2 Groups of 4 NC Relay Outputs without RC protection - Max 10 mA                        |
| DF116 | 8 analog inputs with HART master interface (4-20 mA)                                    |
| DF117 | 8 analog outputs with HART master interface (4-20 mA)                                   |

| CABLES |   |
|--------|---|
| Code   | Description   |
| DF3    | Flat cable to connect 2 racks – length 6.5 cm                       |
| DF4A   | Flat cable to connect 2 racks – length 65 cm                        |
| DF5A   | Flat cable to connect 2 racks – length 81,5 cm                      |
| DF6A   | Flat cable to connect 2 racks – length 98 cm                        |
| DF7A   | Flat cable to connect 2 racks – length 110 cm                       |
| DF54   | Twisted pair cable 100 Base-TX                                      |
| DF55   | Twisted pair cable 100 Base-TX – cross cable – length 2m            |
| DF59   | Cable RJ12 used to connect DF51 and DF58                            |
| DF68   | Cable to connect redundant CPUs                                     |
| DF76   | Cable to connect coprocessors                                       |
| DF82   | Synchronism cable to connect redundant controllers – length 500 mm  |
| DF83   | Synchronism cable to connect redundant controllers – length 1800 mm |
| DF90   | IMB power cable   |
| DF101  | Flat cable to connect racks by left side – length 70 cm             |
| DF102  | Flat cable to connect racks by right side – length 65 cm            |
| DF103  | Flat cable to connect racks by right side – length 81 cm            |
| DF104  | Flat cable to connect racks by right side – length 98 cm            |
| DF105  | Flat cable to connect racks by right side – length 115 cm           |

| POWER SUPPLIES |   |
|----------------|---|
| Code           | Description   |
| DF50           | Power Supply  |
| DF52           | Power Supply for Fieldbus – 90 to 264 Vac                             |
| DF56           | Power Supply for Backplane – 20 to 30 Vdc Input                       |
| DF60           | Power Supply for Fieldbus - 20-30 Vdc Input                           |
| DF87           | Power Supply for Backplane 20-30 Vdc, 5 A, redundant, with diagnostic |

| BARRIERS AND IMPEDANCES FOR POWER SUPPLY |   |
|--|---|
| Code                                     | Description   |
| DF47-12<br>DF47-17                       | Intrinsic Safety Barrier for FOUNDATION fieldbus        |
| DF53                                     | FOUNDATION fieldbus Power Supply Impedance with 4 ports |
| DF98                                     | High Current Power Supply Impedance for Fieldbus        |

| INTERFACES |  |
|------------|--|
| Code       | Description                                  |
| DF58       | EIA-232/ EIA-485 Interface                   |
| DF61       | Ethernet Switch 10/100 Mbps                  |
| DF66       | Remote I/O Communication Interface for DF65  |
| DF66E      | Remote I/O Communication Interface for DF65E |

| RACKS AND ACCESSORIES |   |
|-----------------------|---|
| Code                  | Description   |
| DF0                   | Blind module to fill empty slots  |
| DF1A                  | Rack with 4 slots – support to shielded flat cable                        |
| DF2                   | Terminator for last the rack – right side                                 |
| DF9                   | Support for a single module   |
| DF78                  | Rack with 4 slots – It supports Hot Swap of CPUs and redundant I/O access |

|      |   |
|------|---|
| DF84 | IMB Soft Starter  |
| DF91 | Lateral adapter   |
| DF92 | Rack with 4 slots for redundant CPUs, hot swap and diagnostic support |
| DF93 | Rack with 4 slots, with diagnostic                                    |
| DF96 | Terminator for the last rack – left side                              |

| INTERFACES FOR I/O MODULES AND THEIR ACCESSORIES* |   |
|---|---|
| Code  | Description   |
| <b>ITF - 005AC1</b>                               | Interface for 16 points of 120 Vac input compatible with DF15.  |
| <b>ITF - 005AC2</b>                               | Interface for 16 points of 240 Vac input compatible with DF15.  |
| <b>ITF - 001</b>                                  | Interface for 16 points of 24 Vdc input compatible with DF11.   |
| <b>ITF - 005DC</b>                                | Interface for 16 points of 24 Vdc input compatible with DF15.   |
| <b>ITF - 101</b>                                  | Interface for 16 points digital output for relay with NA and NC contact compatible DF21.                                    |
| <b>ITF - 101FAC</b>                               | Interface for 16 points digital output for relay with NA and NC contact with fuse for AC load compatible with DF21.         |
| <b>ITF - 101FDC</b>                               | Interface for 16 points digital output for relay with NA and NC contact with fuse for DC load compatible with DF21.         |
| <b>ITF - 102</b>                                  | Interface for 16 points digital output for relay with NA and NC contact compatible DF22.                                    |
| <b>ITF - 102FAC</b>                               | Interface for 16 points digital output for relay with NA and NC contact with fuse for AC load compatible with DF22.         |
| <b>ITF - 102FDC</b>                               | Interface for 16 points digital output relay for relay with NA and NC contact with fuse for DC load compatible with DF22.   |
| <b>ITF - 120AC</b>                                | Interface for 8 points digital output for AC load relay compatible with DF25.   |
| <b>ITF - 120DC</b>                                | Interface for 8 points digital output for DC load relay compatible with DF25.   |
| <b>ITF - 123-7</b>                                | Interface for 16 points digital output for relay with NA and NC contact compatible for AC load with DF69.                   |
| <b>ITF - 1237FAC</b>                              | Interface for 16 points digital output for relay with NA and NC contact with fuse for AC load compatible with DF28 or DF69. |
| <b>ITF - 1237FDC</b>                              | Interface for 16 points digital output for relay with NA and NC contact with fuse for DC load compatible with DF28 or DF69. |
| <b>ITF - 304</b>                                  | Interface for 16 point AC pulse input compatible with DF67.   |
| <b>ITF - 401</b>                                  | Interface for 8 point analog input compatible with DF44 and DF57.   |
| <b>ITF - 402</b>                                  | Interface for 8 point analog input compatible with DF45.  |
| <b>ITF - 501</b>                                  | Interface for 8 point analog output without fuse compatible with DF46.  |
| <b>ITF - QDA-AC</b>                               | Power distribution interface for 10 points 110/240 Vac @ 2A per point.  |
| <b>ITF - QDA-DC</b>                               | Power distribution interface for 10 points 24 Vdc @ 2A per point.   |
| <b>ITF - C-10</b>                                 | Connection cable between DFI302 modules and ITF interfaces - 1.0 m.   |
| <b>ITF - C-15</b>                                 | Connection cable between DFI302 modules and ITF interfaces - 1.5 m.   |
| <b>ITF - C-20</b>                                 | Connection cable between DFI302 modules and ITF interfaces - 2.0 m.   |
| <b>ITF - C-25</b>                                 | Connection cable between DFI302 modules and ITF interfaces - 2.5 m.   |
| <b>ITF - C-30</b>                                 | Connection cable between DFI302 modules and ITF interfaces - 3.0m.  |
| <b>ITF - C-35</b>                                 | Connection cable between DFI302 modules and ITF interfaces - 3.5 m.   |
| <b>ITF - C-40</b>                                 | Connection cable between DFI302 modules and ITF interfaces - 4.0 m.   |
| <b>ITF - C-45</b>                                 | Connection cable between DFI302 modules and ITF interfaces - 4.5 m.   |
| <b>ITF - C-50</b>                                 | Connection cable between DFI302 modules and ITF interfaces - 5.0 m.   |

| <b>R-SERIES</b>   |  |
|---|--|
| <b>RACKS AND ACCESSORIES</b>  |  |
| <b>Code</b>   | <b>Description</b>   |
| DF106   | Master Rack - 6 slots for I/O redundancy                               |
| DF110 -1  | Slave Rack - 10 slots for I/O redundancy - Terminal blocks             |
| DF110 -2  | Slave Rack - 10 slots for I/O redundancy – Interface cabling           |
| DF109   | Thin stub cable (0,40m)  |
| DF119   | Thick cable (1,0m) for DF106-DF109 or DF106-DF110                      |
| DF0-R   | Blind module to fill empty slots                                       |
| ITF-CR-10<br>ITF-CR-15<br>ITF-CR-20<br>ITF-CR-25<br>ITF-CR-30<br>ITF-CR-35<br>ITF-CR-40<br>ITF-CR-45<br>ITF-CR-50 | Interface cabling ( 1 m to 5 m)  |
| ITF-DIG   | Passive Interface Panel for 16 Digital Input and/or Output Module - DC |
| ITF-AN-IOR  | Interface Panel for 8 Analog Input and/or Output Module                |
| <b>SCANNERS</b>   |  |
| DF107   | Master Scanner for I/O Redundancy                                      |
| DF108   | Slave Scanner for I/O Redundancy                                       |
| <b>I/O MODULES</b>  |  |
| DF111   | 1 Group of 16 Redundant Digital Inputs 24 Vdc - Source                 |
| DF112   | 1 Group of 16 Redundant Digital Outputs 24 Vdc - Sink                  |
| DF113   | 1 Group of 8 Redundant Current Analog Inputs                           |
| DF114   | 1 Group of 8 Redundant Current Analog Outputs                          |



## Main Features

**DFI302** is the most flexible multiprotocol system of the market.

**DFI302** (Fieldbus Universal Bridge) is a key-interfacing element in the distributed architecture of Field Control Systems. It combines powerful communication features with direct I/O access and advanced control for discrete and continuous applications. Due to its modular structure, it can be placed inside panels in the control room or sealed boxes in hazardous areas. Highly expandable, it is targeted to applications ranging from small standalone systems to large and complex plants.

**DFI302** is a modular multifunctional device with a DIN-rail mounted backplane into which all components are installed, including main and fieldbus power supplies (DF50 and DF52, respectively), Controllers (DF51, DF62, DF63, DF73, etc), and line impedance (DF53) modules. They are plugged-in through industrial grade connectors and by using a robust metal screw. A conventional or redundant I/O subsystem with modules for analog and discrete inputs and outputs can be connected (optional). Modularity is the keyword for **DFI302** flexibility. Besides, since all modules including the fieldbus power supply subsystem are plugged into the same backplane, the **DFI302** comes up as a single integrated unit.

Electric wiring for power and H1 channels are done through plug-in connectors making removal and insertion easy and reliable.

**DFI302** power supply module is plugged straight to the Backplane board, extinguishing any additional bulk power supplies. Their LED indicators show normal and failure modes, making troubleshooting easier to be detected, especially in a wide plant system. An external fuse located on the incoming line side provides the user easy replacement without removal of the power supply module or disconnecting any wiring.

### Note that:

- One Backplane is required for each 4 modules.
- Flat Cable is required for interconnecting one to other backplanes.
- One terminator is required for each **DFI302**.
- Each **DFI302** requires at least a power supply for backplane and one CPU module.
- Additional power supply for fieldbus can be required.
- The license for the DFI OLE Server is available in different levels, depending on the number of supervision blocks.

## Distributed architecture

The modular concept of the **DFI302** makes it the perfect building block of the system topology. Any topology can be created with the **DFI302**. All system set up and maintenance can be easily done with high efficiency and interoperability.

The distribution of the control task among field devices and multiple **DFI302** systems increases the overall performance and reliability.

### The system supports

- Modbus Gateway
- Ethernet Gateway
- Profibus Gateway
- DeviceNet Gateway
- AS-i Gateway
- WirelessHART Gateway
- H1 Power Supply
- H1 Safety Barrier
- Conventional I/O
- Redundant I/O

## High Reliability

The distributed and embedded architecture of the **DFI302** warrants high reliability even if in adverse industrial environments: no HDDs, no fans, and no mechanical moving parts. At software execution

level, the internal processes (communication, function blocks, supervision, etc.) are controlled by a prioritized multitasking operating system guaranteeing determinism and real-time operation.

## Configuration

The **DFI302** is completely configurable through Foundation fieldbus function blocks. They allow that the whole system (DFI302 and field devices) to be set up by single software.

The function block language is ideal for process control, since it represents all the process functions well known by the automation professionals - process control, logic interlocking, alarms, recipes, calculations and equations. Everything can be configured in one single environment.

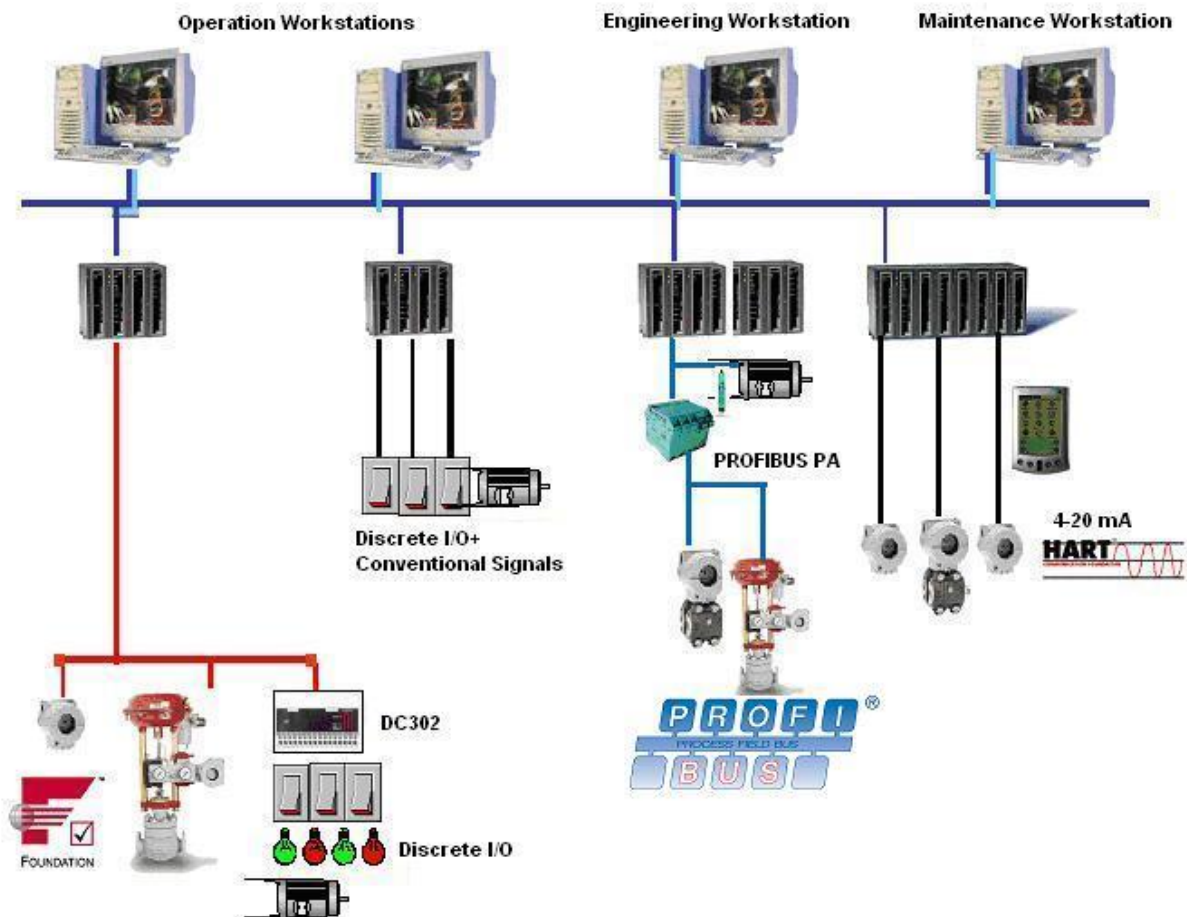
## Supervision

The **DFI302** is developed with the most updated technology. The use of leading technologies as OPC (OLE for Process Control) makes the **DFI302** the most flexible Fieldbus interface in the market.

The OPC server allows the **DFI302** to be connected to any HMI package. The only requirement is to have an HMI compatible with OPC. **DFI302** connects with most HMI in the market, customizing our System302 to your needs and knowledge.

## System Integration

Advanced communication features found in the **DFI302** grant high system integration:



## ***Redundancy***

**DFI302** supports hot-standby redundancy in several levels:

- OLE Server
- LAS (Link Active Scheduler)
- Ethernet
- Function Blocks
- H1 Links
- Modbus Gateway

## ***Expandable***

Each controller can directly access I/O points distributed among local I/O modules. Exploring fieldbus features such as interoperability, bridge, and Ethernet communication, **DFI302** system becomes a virtually unbounded solution for automation industry.

## Section 2

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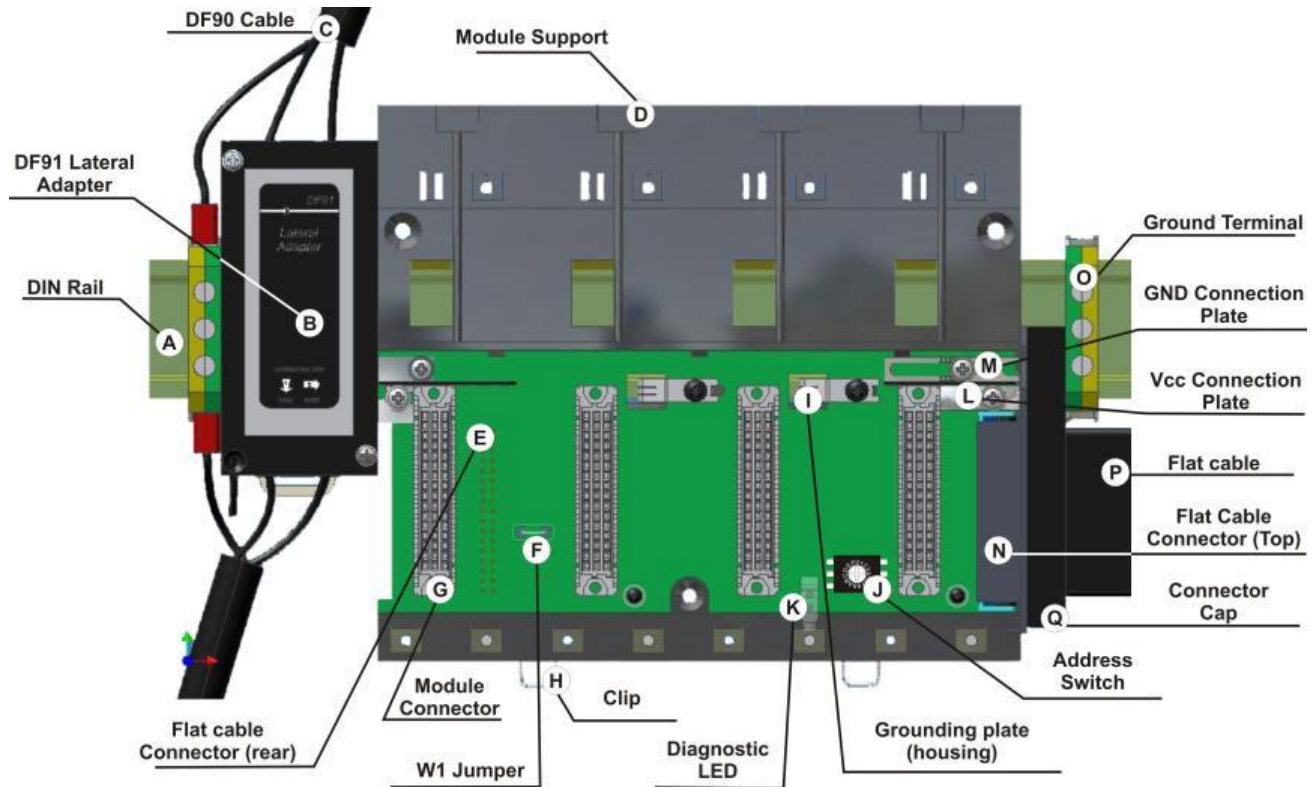
# INSTALLING

### *Racks, cables and accessories of DFI302 system*

| MODEL | DESCRIPTION   |
|-------|---|
| DF0   | Blind module to fill empty slots  |
| DF1A  | Rack with 4 slots – support to shielded flat cable                        |
| DF2   | Terminator for the last rack – right side                                 |
| DF3   | Flat cable to connect 2 racks – length 6.5 cm                             |
| DF4A  | Flat cable to connect 2 racks – length 65 cm                              |
| DF5A  | Flat cable to connect 2 racks – length 81,5 cm                            |
| DF6A  | Flat cable to connect 2 racks – length 98 cm                              |
| DF7A  | Flat cable to connect 2 racks – length 110 cm                             |
| DF9   | Support for a single module   |
| DF54  | Twisted pair cable 100 Base-TX  |
| DF55  | Twisted pair cable 100 Base-TX – cross cable – length 2m                  |
| DF59  | Cable RJ12 used to connect DF51 and DF58                                  |
| DF68  | Cable to connect redundant CPUs   |
| DF76  | Cable to connect coprocessors   |
| DF78  | Rack with 4 slots – It supports Hot Swap of CPUs and redundant I/O access |
| DF82  | Synchronism cable to connect redundant controllers – length 500 mm        |
| DF83  | Synchronism cable to connect redundant controllers – length 1800 mm       |
| DF84  | IMB Soft Starter  |
| DF90  | IMB power cable   |
| DF91  | Lateral adapter   |
| DF92  | Rack with 4 slots for redundant CPUs, hot swap and diagnostic support     |
| DF93  | Rack with 4 slots, with diagnostic  |
| DF96  | Terminator for the last rack – left side                                  |
| DF101 | Flat cable to connect racks by left side – length 70 cm                   |
| DF102 | Flat cable to connect racks by right side – length 65 cm                  |
| DF103 | Flat cable to connect racks by right side – length 81 cm                  |
| DF104 | Flat cable to connect racks by right side – length 98 cm                  |
| DF105 | Flat cable to connect racks by right side – length 115 cm                 |

## Installing the system’s base with DF92 and DF93 racks

In the following figure is shown the DF93 rack with its components.



**Figure 2. 1 - DF93 components**

**A – DIN rail-** Base for rack connection. It should be tightly fixed to the place where the rack is being mounted.

**B – Lateral adapter DF91 –** It allows the connection of DF90 cables to rack.

**C – DF90 cable–** Cable for IMB power transmission. In this cable is the Vcc and GND of IMB and it has to be connected in the rack’s left side.

**D – Module support -** Module holder located in the top of the rack.

**E – Flat Cable Connector (rear) –** It allows that two racks are interconnected by flat cable (P). When there is more than one rack in a same DIN rail, the user should proceed as described in the “Connection between adjacent racks” topic.

**F –W1 Jumper –** To disconnect the rack from the power of the previous rack, W1 must be cut, together with the Vcc connection plate (L) of the previous rack. This condition is necessary if a new power supply is inserted from this rack.

**G – Module connector –** Connector to attach the module’s bottom part to the rack.

**H – Clips –** The metal clips, located in the rack’s bottom part, allow attaching the rack to the DIN rail. They must be pulled before fitting the rack on DIN rail, and then, pushed for pieces fixation.

**I – Grounding plate (housing)**

**J – Address switch –** When there is more than one rack in same data bus, the addressing switch allows different addresses to each rack.

**K – LED for diagnostic** – It is used for diagnostic of the rack's voltage.

**L – Vcc connection plate** – Vcc terminal (for power transmission).

**M – GND connection plate** - GND terminal (for power transmission).

**N – Flat Cable Connector (top)**– It allows that two racks are interconnected by flat cable (P). When there is more than one rack in a same DIN rail, the user should proceed as described in the "Connection between adjacent racks" topic.

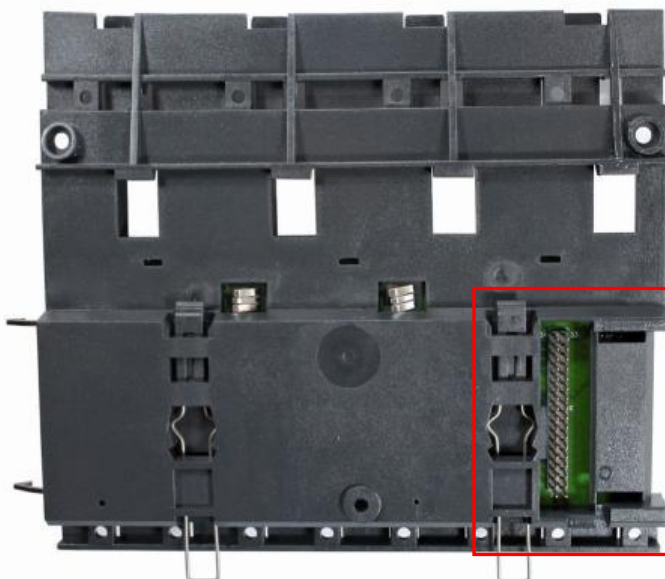
**O – Ground terminal** – It is used to ground the flat cables shield.

**P – Flat Cable** – Cable used to interconnect the data bus among racks.

**Q – Connector cap** – To meet the EMC requirements a protector against ESD must be installed in the flat cables connections, at right.

## Installing Racks - DF92 and DF93

The DF92 is used by redundant controllers, and it must be the first rack of IMB. The other racks must be DF93.



**Figure 2. 2 - Rear connector of DF93 rack**

### IMPORTANT

Remember to leave a space in the DIN rail to install the DF91 and the grounding terminal at rack's left side.

## Installing racks in the DIN rail

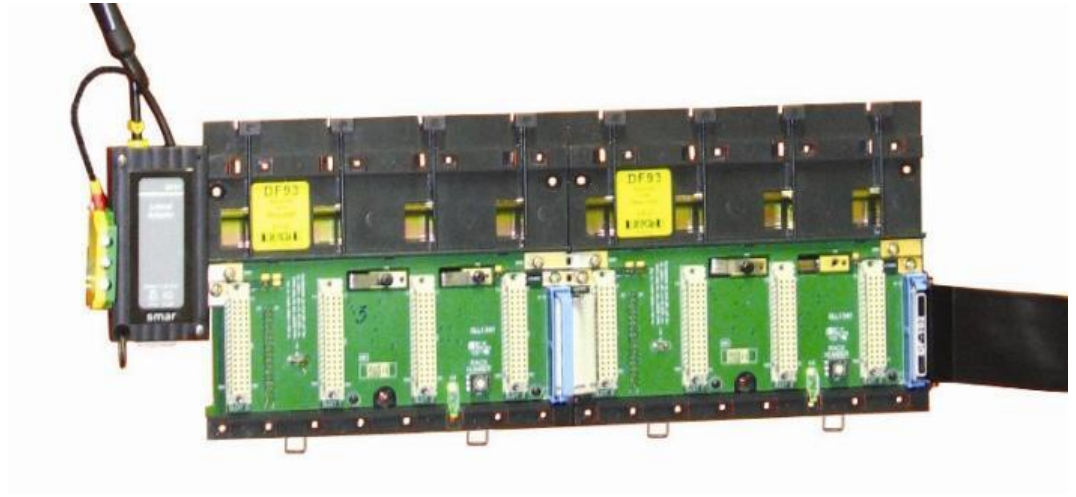
### IMPORTANT

Before installing the rack on DIN rail, connect the flat cable to rear's connector (E) if you will connect this rack to another at left. After connected to the DIN rail is not possible place the flat cable on the rear's rack without remove it.

1. Use a screwdriver (or your fingers) to pull the clips down.
2. Place the back of the rack on the top of the DIN rail edge.
3. Accommodate the rack on the DIN rail and push the clips up. You will hear a click sound when they lock properly.
4. Set the correct address for the DF93 rack using its rotating switch (J). The DF92 rack does not have address switch.

### Connection between adjacent racks

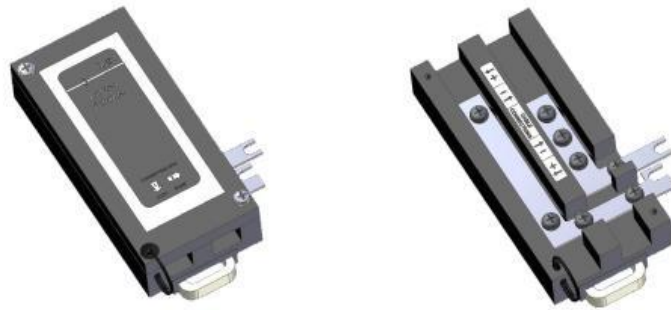
1. The adjacent cards to the joining part, between the racks, must be removed allowing access to this operation (racks’s third slot, at left and slot 0 of rack, at right).
2. Connect the two racks using DF3 flat cable. This flat cable should already be connected to the connector on the rear’s rack at right. And then, connect it to the top connector (N) of the rack at left.
3. Connect the two racks to the power connectors (L and M), moving them with a screwdriver and fixing with screws. Loose the screws only the sufficient avoiding them from falling when making the connection. See the next figure.



**Figure 2. 3 - Connection between adjacent racks**

### Using the DF91

For further details about DF91 installation, refer to “Expanding the system’s power supply –DF90 and DF91” topic.



**Figure 2. 4 - DF91 details**

### Left side ESD protection

If the power supply side connector on the left side of the rack (DF92 or DF93) is disconnected, it should be capped with the left side ESD protection for compatibility with the EMC standards. This situation can occur in the left-most rack in systems with a single row of racks or systems with individual racks.

The installation is done screwing the protection in the connection terminals on the left side of the rack. See the following figure.



**Figure 2.5 – Left side ESD protection installed on the rack**

This protection is provided along with the DF2 terminator.

#### Disconnecting racks

1. The adjacent cards to the joining part, between the racks, must be removed allowing access to this operation.
2. Remove the flat cable of top connector (N) of the adjacent rack, at left.
3. Remove the power connections (L and M) of both sides of the rack that will be disconnected. For that, with a screwdriver, release the screws (only the sufficient) and move the connection plates to left until they are completely withdrawn, thus the rack is free to be removed.
4. If the DF91 (B) is connected to rack that will be removed, remove it until the rack to be free.
5. Remove the rear connector (E) after removing the rack from DIN rail.

#### IMPORTANT

Although any application using DF93 as the first rack can use DF84 (IMB soft starter), it is only necessary when the controller (DF62, DF63, DF73, DF75, DF79, DF81, DF95 and DF97) executes local logic with discrete output cards. This rule applies only in the DF1A and DF93 racks where the controller is installed.

When using DF92 rack, DF84 is not necessary, the stabilization feature is already built into the rack's board.

### Installing the expansion flat cables - DF101, DF102, DF103, DF104 and DF105.

These flat cables are used when the DF1302 is expanded in more than one row of racks, i.e., in different DIN rail segments, one below the other.

#### DF101 - Flat cable to connect racks by left side

It is installed in the rack's rear connectors (E) of the left extremity of each row of racks, interconnecting the rows 2-3, 4-5 and 6-7 (if they exist).

To ground the flat cables shield, use the ground terminal (O) next to flat cables connection. The available terminal, next to each DF91 (B), can be used.

#### DF102, DF103, DF104 and DF105 - Flat cable to connect racks by right side

They are installed on the upper connectors (N) of the right extremity rack of each row of racks, interconnecting the rows 1-2, 3-4 and 5-6 (if they exist).



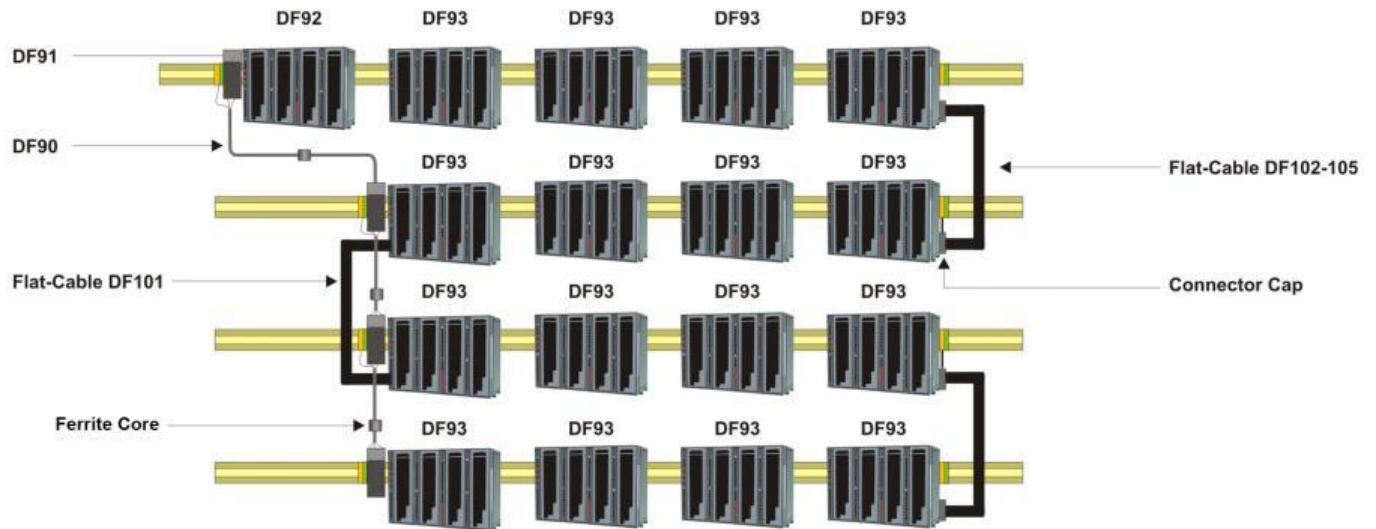


Figure 2. 6 - Illustration - DF101 and DF102-105 Flat cables

To ground the flat cables shield, use the ground terminals (O) next to flat cables connection.

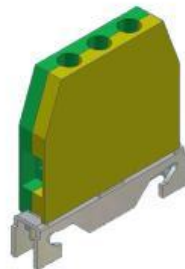


Figure 2. 7 - Ground terminal

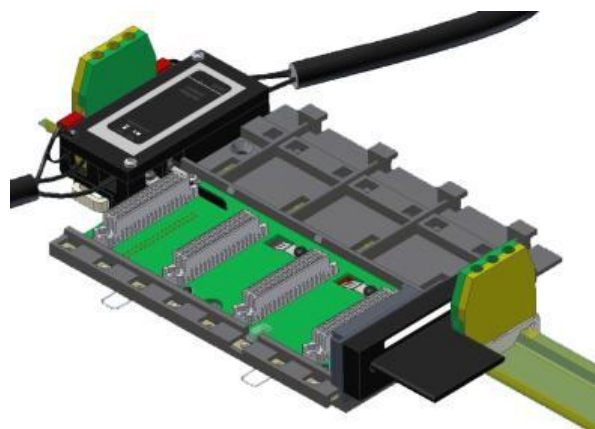
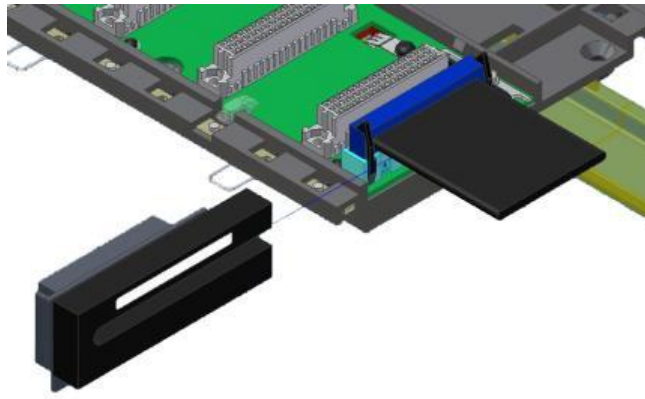


Figure 2. 8 - Ground terminal installed

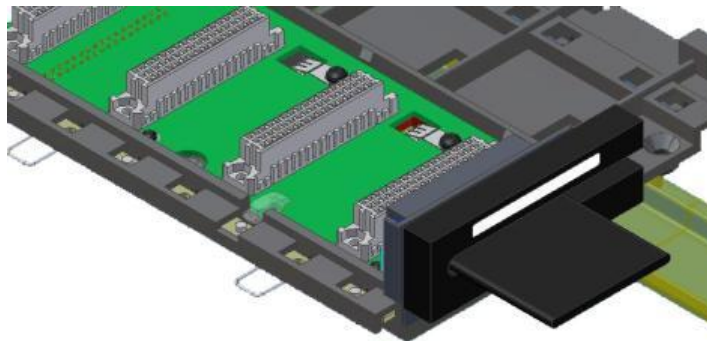
### Flat cables protector (connector cap)

To meet the EMC requirements a protector against ESD has to be installed on the flat cables connection, at right. In the following figure a flat cable protector is shown when it is being installed on the cable connector.



**Figure 2.9 - Installing the connector cap**

In the following figure is shown a connector cap installed.



**Figure 2.10 - Connector cap installed**

### Installing the IMB terminator - DF2 or DF96

Only one of these two terminators types (DF2 or DF96) must be installed at the end of IMB bus. It will depend on which side the last rack is connected to the system.

#### DF2 – IMB terminator for right side

It is connected to connector N of the last rack, when it is connected to the others by the left side. See the following figure.

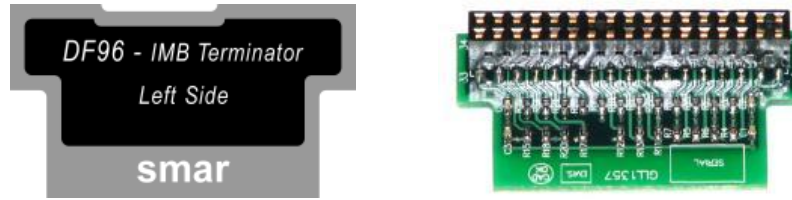


**Figure 2.11 - DF2 terminator installed**

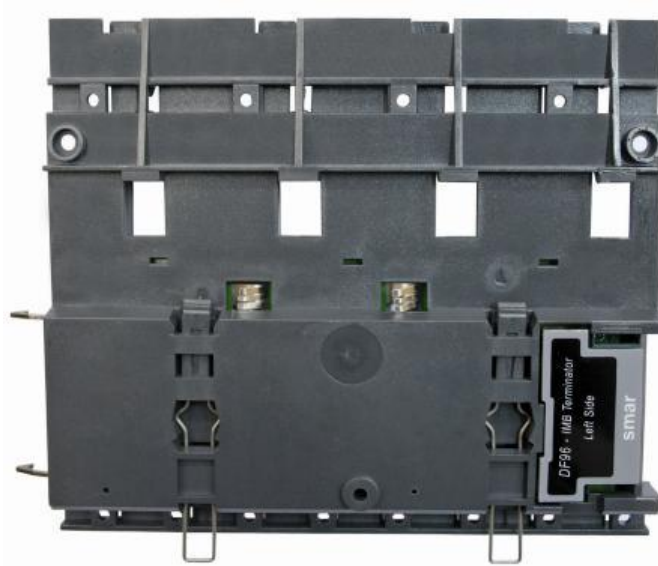
For further details about its installation refer to DF2 manual.

#### DF96 – IMB terminator for left side

It is connected to connector E of the last rack, when it is connected to the others by the right side. See the next figure.



*Figure 2. 12 - DF96 terminator*



*Figure 2. 13 - DF96 terminator installed in the DF93 rack*

Summarizing, if the last rack has a flat cable connected by left side, use the DF2 terminator. If the last rack has a flat cable connected by right, use DF96 rack.

Both cases depend on the number of row of racks, if it is even or odd.

### **Expanding the system’s power - DF90 and DF91.**

This expansion has to be used when the DFI302 is expanded in more than one row of racks, i.e., in different DIN rail segments, one below the other.

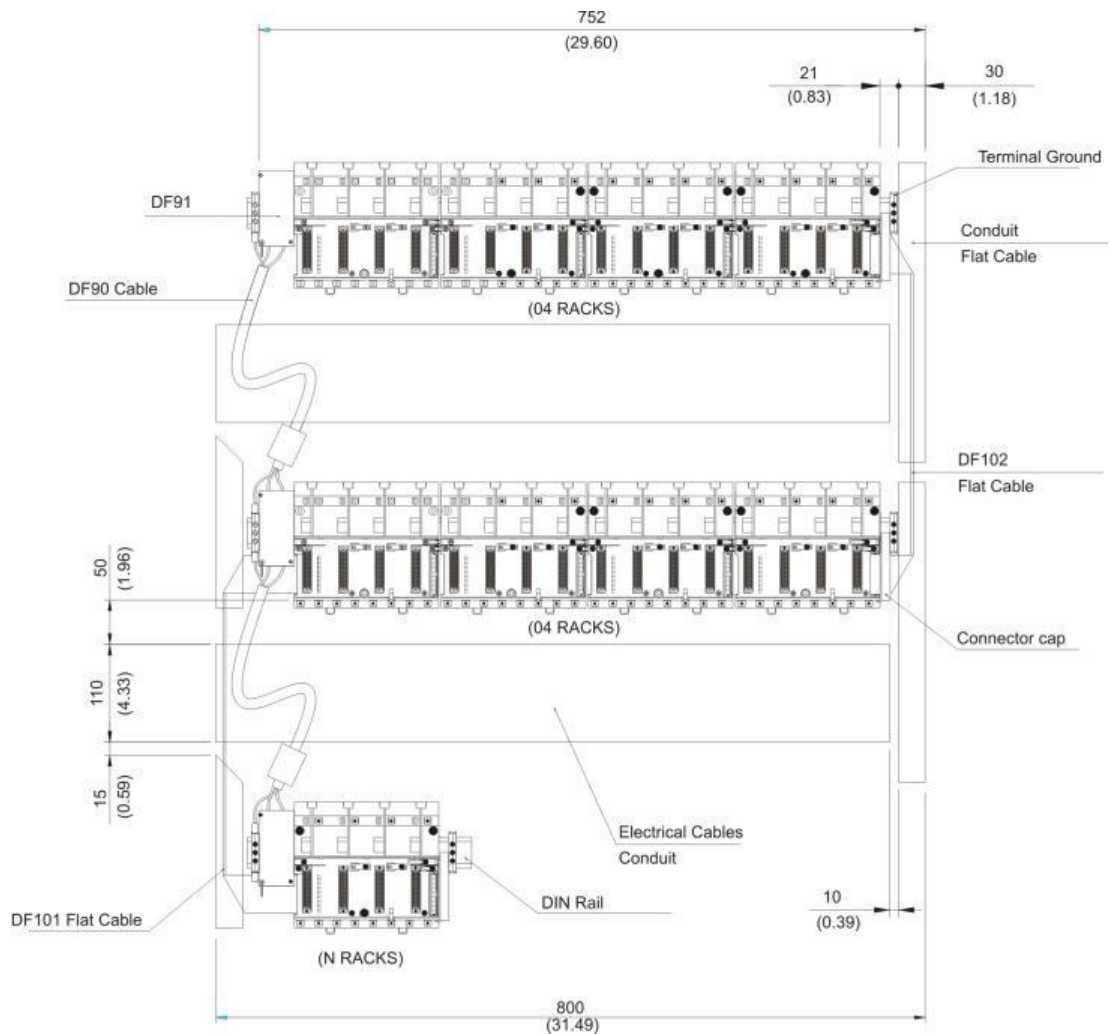


Figure 2. 14 - Example of expanded system

**Installing the DF91 in the DIN rail**

The DF91 is installed on the rack of the left extremity of each row of racks.

To connect the DF91 to the DIN rail, fix the DF91's rear part in the upper edge of the DIN rail, and then, accommodate the DF91 in the rail, pushing it until you hear a "click" sound.

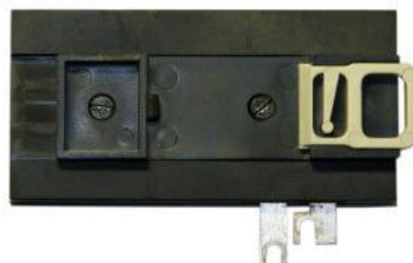
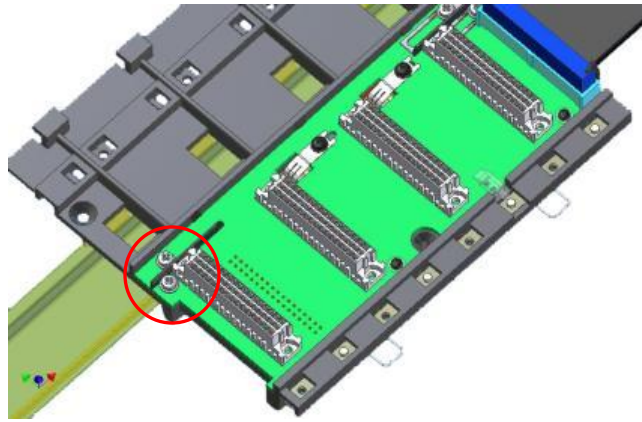


Figure 2. 15 - DF91 rear part

**Connecting the DF91 to rack**

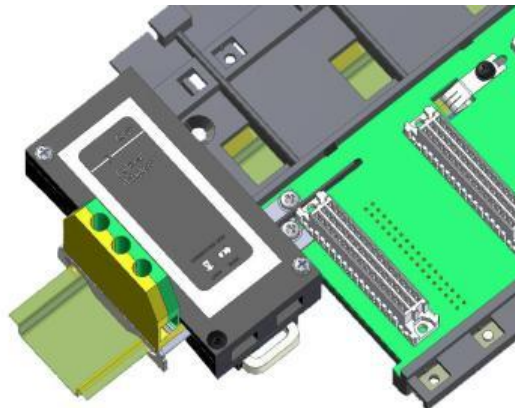
The first rack's slot needs to be empty allowing access to this operation.

1. Loose the screws (only the sufficient) of the rack's power connector. See the next figure.



**Figure 2. 16 - Details of screws of the rack’s power connector**

2. Move the DF91 to right up to fix in the screws.
3. Tighten the screws.
4. After connect the DF91 to the rack, install the terminal ground in the left side of DF91, keeping it firm to the rack. This terminal also will be used for grounding of DF90’s shield.



**Figure 2. 17 - DF91 connected to rack**

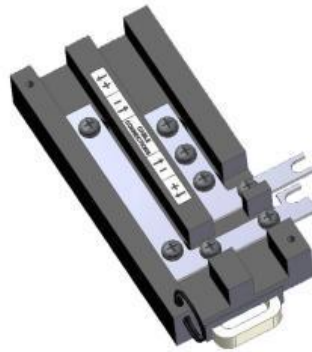
### Installing DF90



**Figure 2. 18 - IMB power cable (DF90)**

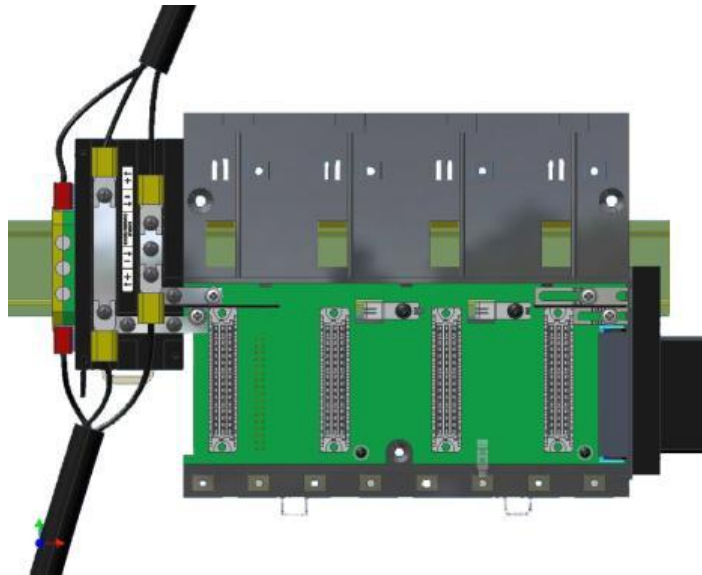
The cable DF90 must be connected only through DF91, interconnecting two of them. Follow the next steps to execute that procedure.

1. With DF91 already connected to rack, release the cover’s screws, and open it;
2. Release the DF91’s screws indicated by labels (+) and (-);



**Figure 2.19 - DF91 detail**

3. Attach the DF90's terminals with the DF91's screws, obeying the polarity indications;
4. Connect the DF90's shield terminal to the ground terminal next to DF91;



**Figure 2.20 - DF91 installed in the rack**

5. Close the DF91 cover and tighten the screws.

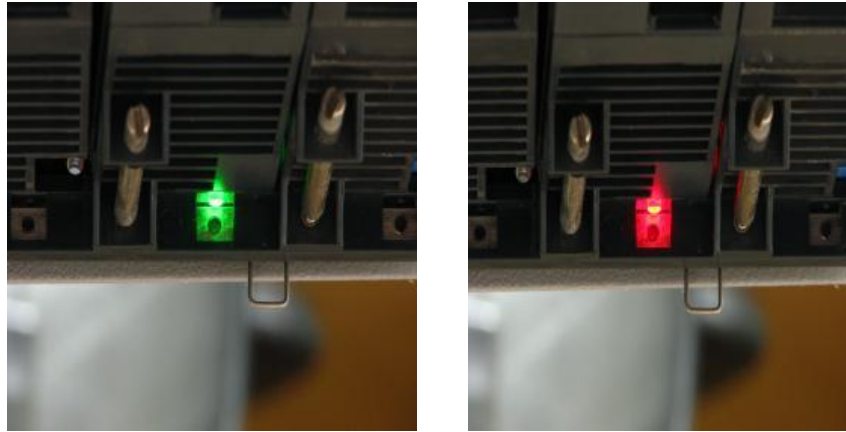
#### **Disconnecting DF91 from rack**

1. The first card of the rack that will be disconnected must be removed allowing access to this operation;
2. Release (only the sufficient) the connector's screws of rack power, where DF91 is connected;
3. Move the DF91 to left (without separate it from rail) until the DF91's connection plates are out of rack's edge;
4. Tighten again the rack's screws if you will not connect them;
5. To remove the DF91, with a screwdriver, unlock it from DIN rail by pulling down the lock at its bottom part and removing that part from the rail.

#### **Diagnostic resources**

The DF93 rack has simple resources, but valuable, for voltage diagnostic in the bus. See the following table.

| LED   | Status                              |
|-------|-------------------------------------|
| Off   | Without voltage or voltage very low |
| Red   | Insufficient voltage                |
| Green | Sufficient voltage                  |



**Figure 2. 21 - LEDs for diagnostic in the DF93 rack**

## Installing the system's base with DF1A and DF78

See below the figures and descriptions of module and rack:

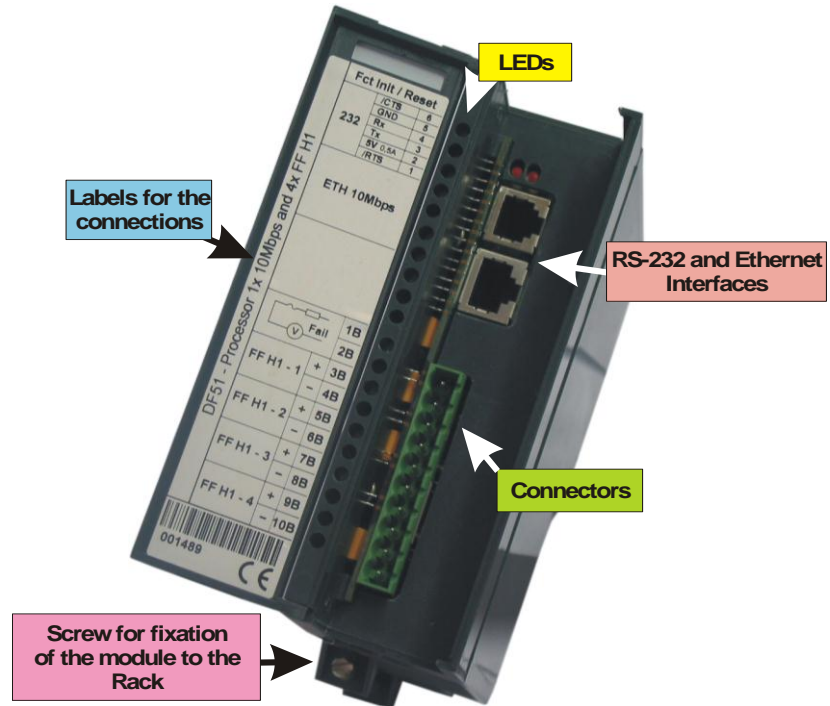


Figure 2.22 - DF51 Module

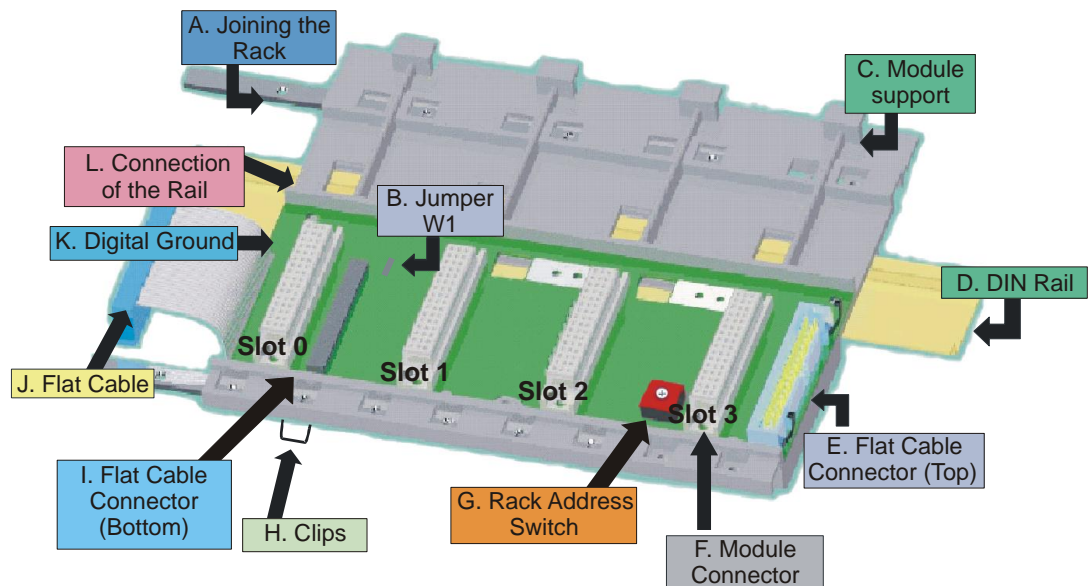


Figure 2.23 - Rack - DF1A

A. **Joining the Rack:** When assembling more than one rack in the same DIN rail, use this metallic piece to interconnect the racks. This connection generates stability to the assembly and makes possible the digital ground connection (K).

B. **Jumper W1:** When connected, it allows the rack to be powered by the previous rack.



- C. **Module support:** Module holder located in the top of the rack.
- D. **DIN Rail:** base rack connection. It should be tightly fixed to the place where the rack is being mounted.
- E. **Flat Cable Connector (Top):** When existing more than one rack in the same DIN rail, they must be hooked up by a flat cable (J) connected to the flat cable connectors (I) and (E).
- F. **Module Connector:** Bottom connection of the module to the rack.
- G. **Rack Address Switch:** When using more than one rack in the DIN rail, the rack address switch allows a distinct address to each rack.
- H. **Clips:** The clips, located above of the rack, allow it to be connected in the DIN rail. It should be pushed down before inserting the rack in the DIN rail and after that pushed up to fix the pieces.
- I. **Flat Cable Connector (Bottom):** When existing more than one rack in the same DIN rail, they must be hooked up by a flat cable (J) connected to the flat cable connectors (I) and (E).
- J. **Flat Cable:** Cable used to connect the data bus between the racks.
- K. **Digital Ground** – When using more than one rack in the same DIN rail, the connection between digital grounds (K) must be reinforced through appropriate metallic piece.
- L. **Connection of the Rail:** Support that brings the connection between the rack and the DIN rail (D).

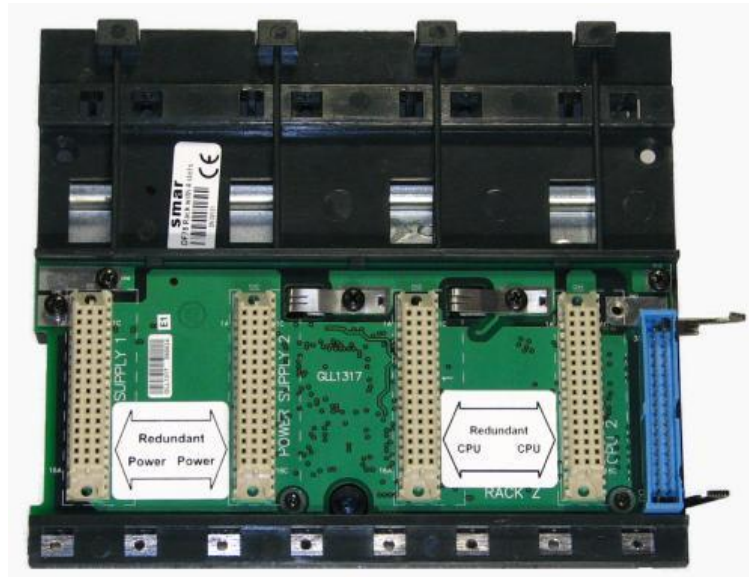


Figure 2. 24 - Rack – DF78

## Installing a Rack in the DIN rail

1. In case of only one rack, this fixation can be done as the first step, even before of fixing any module to the rack.
2. Use a screwdriver (or your fingers) to pull the clips (H) down.
3. Place the back of the rack on the top of the DIN rail edge.
4. Accommodate the rack on the DIN rail and push the clips up. You will hear a click sound when they lock properly.
5. Set the correct address for the rack using the rotating switch at the rack.

## Adding Racks

1. In case of using more than one rack in the same DIN rail, take a look in the flat cable connections (J) in the top connector of the first rack and in the bottom connector in the second rack,

- before plugging the new module in the slot 3 of the first rack;
2. Fix one rack to the other through the joining part of the rack (A). Pass the metal connector of one rack to the other and fix with screws;
  3. Connect the digital ground (K), using one metallic connection fixed by screws.
  4. Do not forget to place a terminator in the last rack. The terminator should be plugged in the flat cable connector (top) (E);
  5. Set the address for the new rack using the rotating switch.

## Tips for Assembling

If there is more than one rack in the same system:

- Do the grip in the DIN rail at the end of the assembly.
- Keep free the slot 3 of the rack to connect the other module through the flat cable connector.
- Check the addresses configuration (rack address switch), as well as the jumper W1 and the cable of the bus.
- Remember that to give continuity to the DC power supply to the previous rack, it is necessary to have the jumper W1 connected.
- Make the amendment of racks and strengthens the digital ground of the hardware.

### IMPORTANT

Although any application using DF1A as the first rack can use DF84 (IMB soft starter), it is only necessary when the controller (DF62, DF63, DF73, DF75, DF79, DF81, DF95 and DF97) executes local logic with discrete output cards. This rule applies only in the DF1A and DF93 racks where the controller is installed.

When using DF78 rack, DF84 is not necessary, the stabilization feature is already built into the rack's board.

## Improving Signal Ground of DFI302 (DF1A and DF78 Racks)

Besides the fact that the racks of the **DFI302** system are connected by flat cables for signal and power transportation, it is possible to occur some fading in the signal ground for applications that make use of many modules. A solution to keep the signal ground stable and the system more immune to electrical noises is to add an extra wire between racks.

These wires should follow the flat cable path to avoid ground loops. Wire must be strained and have a diameter of at least the AWG18.

For adjacent racks, use the “extending connector” placed on its left side. Obviously, it is possible to have a system with adjacent and non-adjacent racks.

### NOTE

The terminator board must be always used in the last rack.

### Non-Adjacent Racks

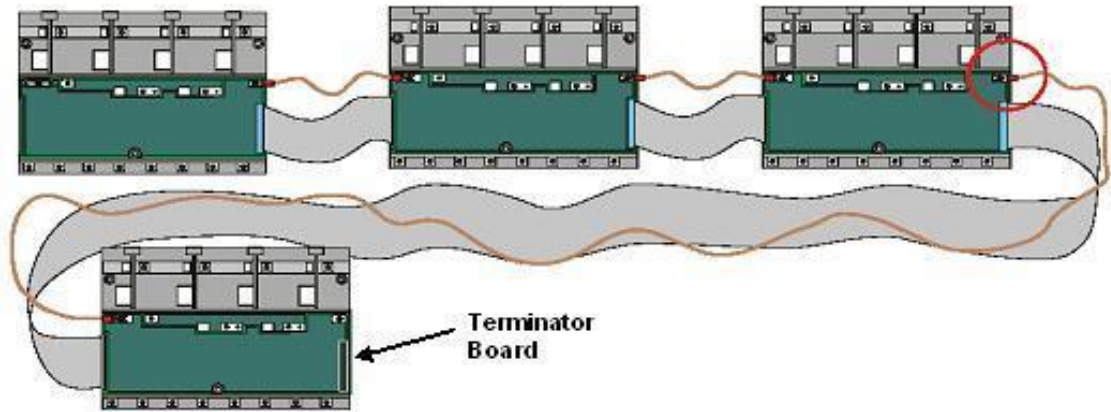


Figure 2. 25 – Improving signal ground

The figure above shows how the signal ground cable is connected between racks.

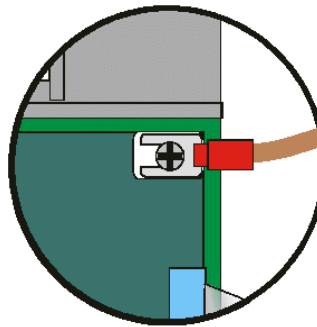


Figure 2. 26 - Detail of the signal ground connection wire

### Adjacent Racks

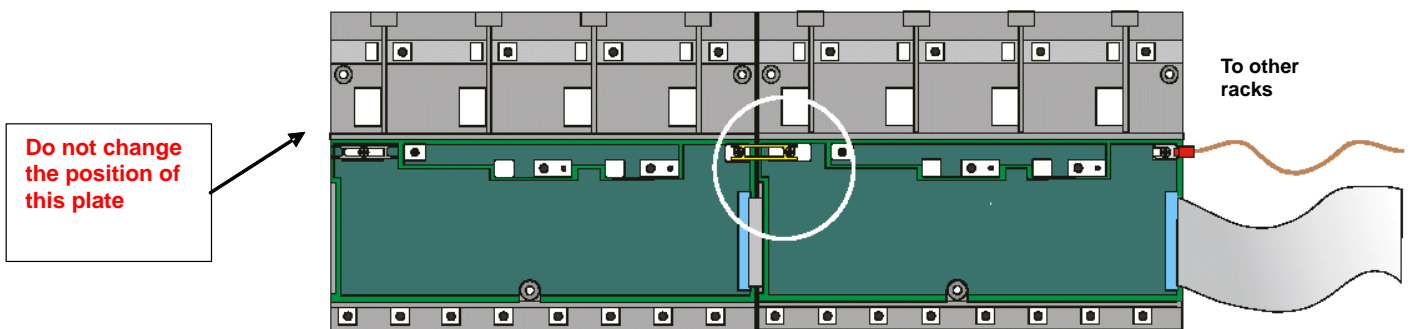


Figure 2. 27 - Connecting adjacent racks

## Installing Modules in the Rack

Follow the steps below to install a module in the rack.

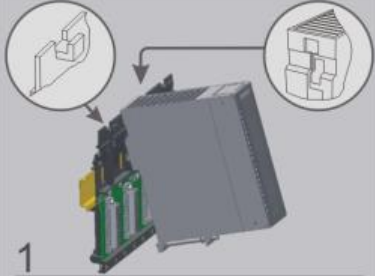

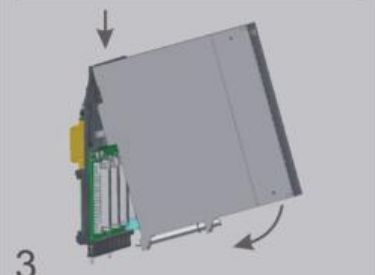
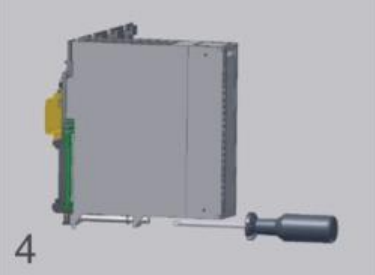
|   |   |
|---|---|
|  <p>1</p> <p>The diagram shows a grey module being tilted at a 45-degree angle to fit into a white rack support. Two circular callouts provide close-up views: the left one shows the module's top edge fitting into a slot, and the right one shows the module's base resting on a support ledge.</p> | <p>Attach the top of the module (with a 45° inclination) to the module support located on the upper part of the rack.</p> |
|  <p>2</p> <p>A close-up view of the module's top edge being pushed into the rack's support structure.</p>  | <p>Mounting detail.</p>   |
|  <p>3</p> <p>The diagram shows the module being pushed forward into the rack's connector. A downward arrow indicates the direction of movement, and a curved arrow shows the module's front panel being pushed into place.</p>  | <p>Push the module fixing it to the module connector.</p>   |
|  <p>4</p> <p>The diagram shows the module fully seated in the rack. A screwdriver is shown at the bottom, positioned to tighten a screw that secures the module to the rack's frame.</p>   | <p>Next, fix the module to the rack using a screwdriver, and fasten the fixation screw at the bottom of the module.</p>   |

Figure 2. 28 - Installing a module in the rack

## Installing the Hardware

DFI302 has LED indicators to show when the communication is active or failing. The modules can be connected and disconnected without turn them off. Using hub/switches the devices can be disconnected without interrupting the process or the control with other nodes.

### Using the DF51 Controller

See the details of the modules frontal view:

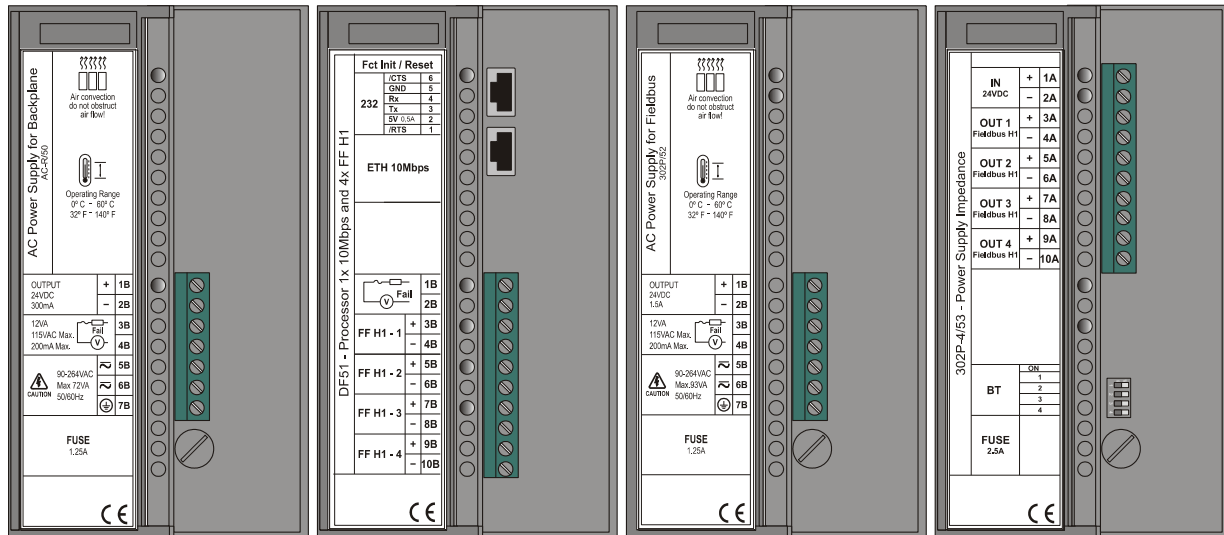


Figure 2.29 - Basic system of DFI302 with DF51 (frontal view - opened)

For the connection between the DF51 and hub, the DF54 cable (or compatible with CAT5 STP type) should be used. The direct connection between the DF51 and computer can be done using the DF55 cable (or compatible with CAT5 STP cross type). For further information about available cables, refer to the cable specifications section.

Hints to basic installation:

1. Connect the four modules (DF50, DF51, DF52, and DF53) plus the terminator (DF2) in the rack (DF1A or DF93).
2. Connect the AC voltage in the inputs of DF50 and DF52 power supply modules.
3. Connect the DF52 output to the DF53 input.
4. Plug the Ethernet twisted pair cable, connecting DF51 to an Ethernet Hub or Switch.
5. Connect the Fieldbus H1 bus in the DF51 and DF53 FOUNDATION fieldbus H1 ports.
6. If DHCP Server is available **DFI302** IP address is automatically set up, otherwise a fixed IP will be generated (192.168.164.100). This initial fixed address IP can be changed through FBTools (see the "Connecting **DFI302** in your Subnet " topic).

Observe in the following figure:

**Detail A** shows the electrical connections above mentioned, without the rack view (DF1A or DF93) and the terminator (DF2).

**Detail B** shows the switches that enable the internal terminator for each Fieldbus H1 channel. In this example, there is only one Fieldbus H1 channel powered on, so the corresponding switch 1 is ON.

**Note:**

A shielded twisted pair is used for connecting the DF51 to the hub. **DFI302** has simple RJ-45 connectors. It is no necessary any special tool to connect the modules. It is an easy and quick installation.

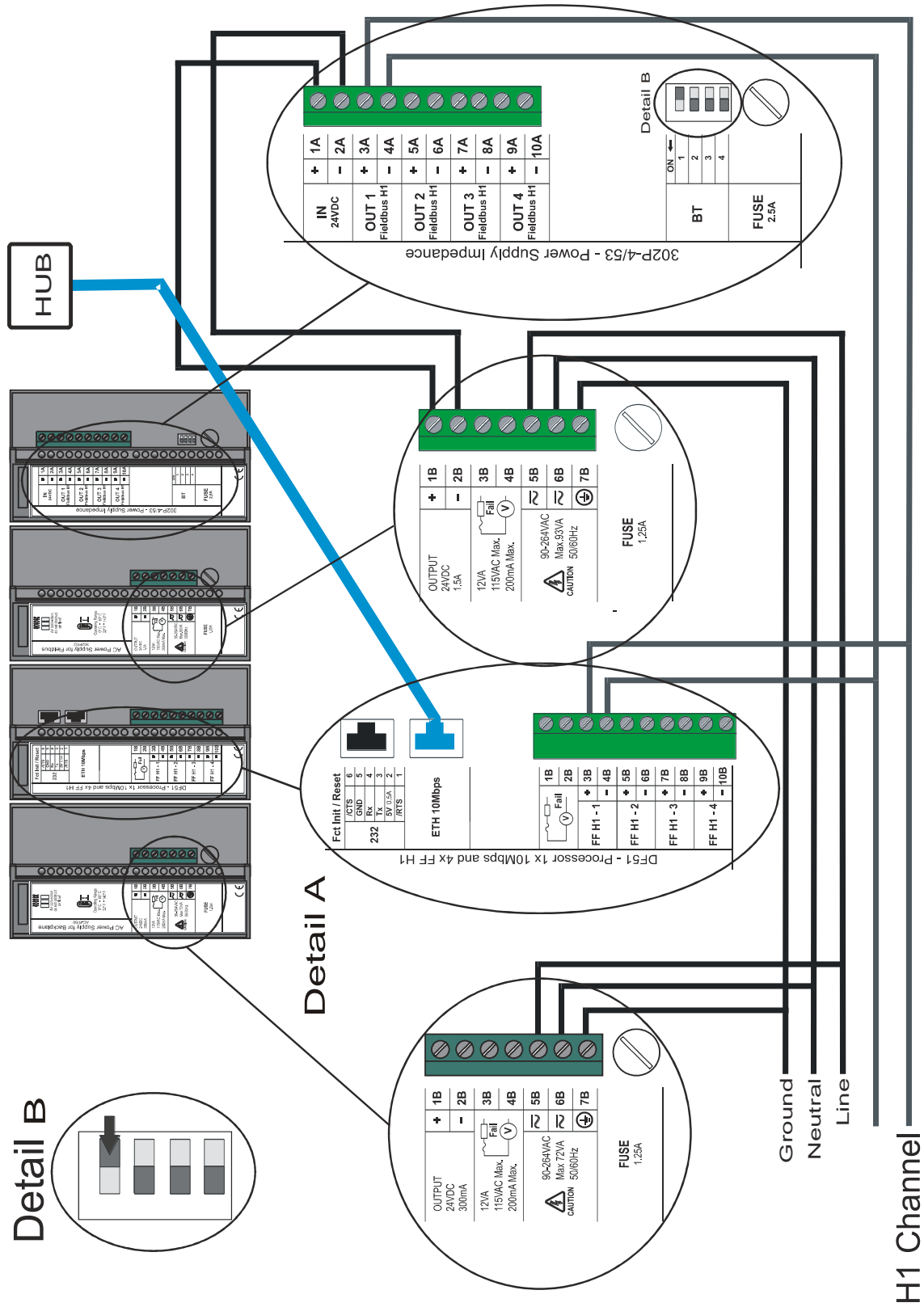


Figure 2. 30 – Connections' details

## Using the DF62/DF63 Controller

A typical configuration of the system with the DF62 controller is showed below:

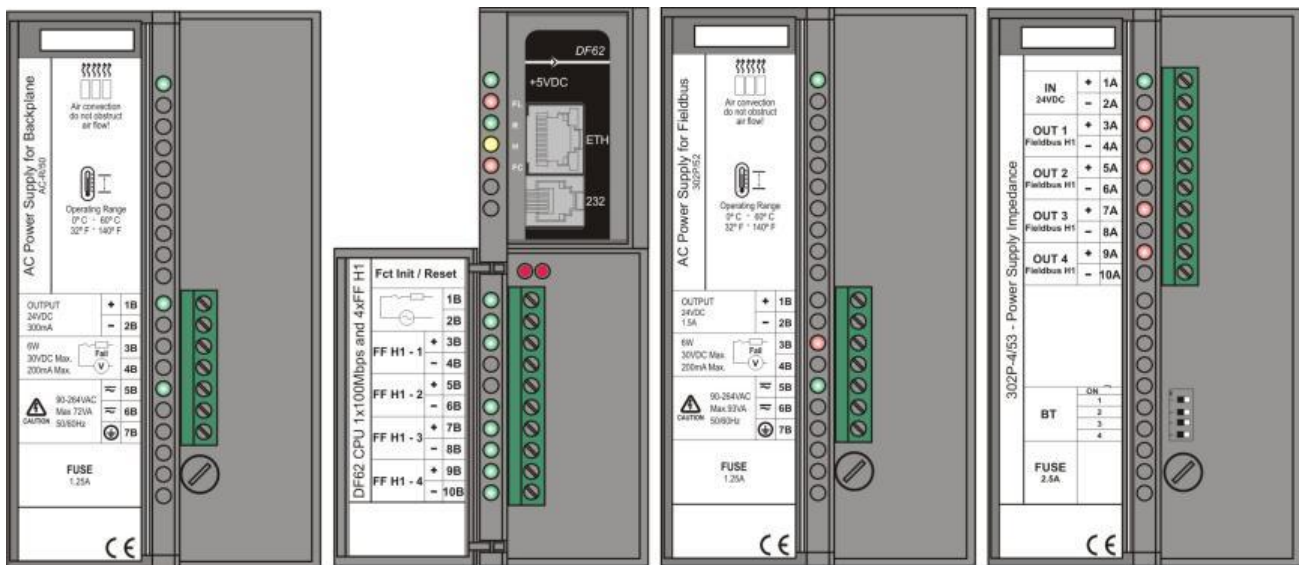
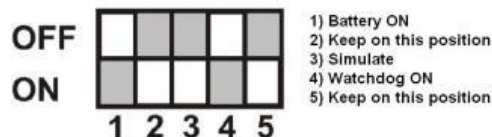


Figure 2. 31 - Basic system of DFI302 with DF62 and/or DF63 (frontal view - opened)

### Important:

The DF62 has an internal battery that keeps the Real Time Clock (RTC) and its non volatile RAM (NVRAM) when there is lack of external supply. This battery can be either enabled or disabled, depending on the position of the switch 1, in the back part of the DF62. To enable the battery, set the switch to 1 as shown in the following figure:



- In this configuration, when there is lack of energy, the RTC and the NVRAM will be supplied by the battery, allowing the retention of all configuration data. In case of equipment storage, it is recommended that the battery is turned off (switch 1 in position OFF). For further information about the battery, refer to the “Technical specification for controllers” section.

So, before fixing the DF62 module in the rack, be sure the switch 1, which refers to the battery, is in the enabled position.

The Watchdog is a mechanism to detect if an important or high priority task stops in the controller. So, be sure the switch 4, which refers to the Watchdog, is in the ON position.

### Steps for the basic installation

1. Connect the four modules (DF50, DF62, DF52, and DF53) plus the terminator (DF2) in the rack (DF1A or DF93).
2. Connect the AC voltage in the inputs of DF50 and DF52 power supply modules.
3. Connect the DF52 output to the DF53 input.
4. Plug the Ethernet twisted pair cable, connecting DF62 to an Ethernet Hub or Switch.
5. Connect the Fieldbus H1 bus in the DF62 and DF53 FOUNDATION fieldbus H1 ports.
6. If DHCP Server is available, **DFI302** IP address is automatically set up, otherwise a fixed IP will be generated (192.168.164.100). This initial fixed address IP can be changed through FBTools (see the "Connecting DFI302 in the Subnet" topic).

### Observe in the following figure:

In the next figure, the cable diagram is showed when using the DF62 module.

- Observe that only one H1 segment is being used.
- The DIP switches for the bus are showed in the Detail A.

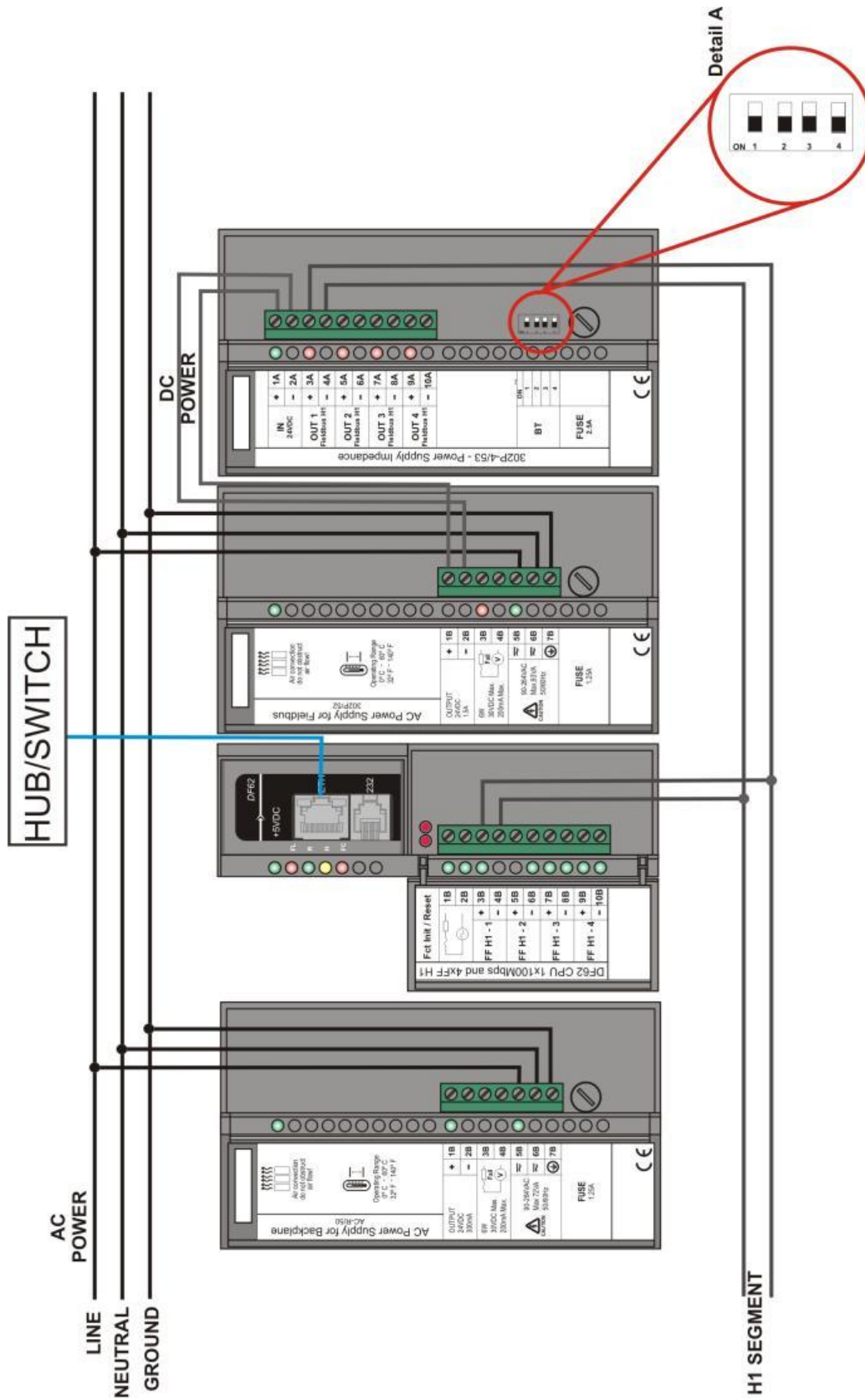


Figure 2. 32 – Cable diagram for DF62



## Using the DF73 Controller

A typical system using the DF73 can be composed by:

- DF1A or DF93 – Rack with 4 slots
- DF50 –AC Power Supply
- DF73 – HSE/Profibus DP Controller
- Up to 16 DF1A or DF93 with I/O modules

A redundant system by using the DF73 can be composed of:

- DF78 – Rack with 4 slots (Hot Swap of CPUs and redundant I/O access) or DF92 – Rack with 4 slots (for redundante CPUs, support to Hot Swap and diagnostic);
- DF50 –AC Power Supply;
- DF50 –AC Power Supply ;
- DF73 –HSE Controller;
- DF73 - HSE Controller;
- Plus up to 16 DF1A or DF93 with I/O modules

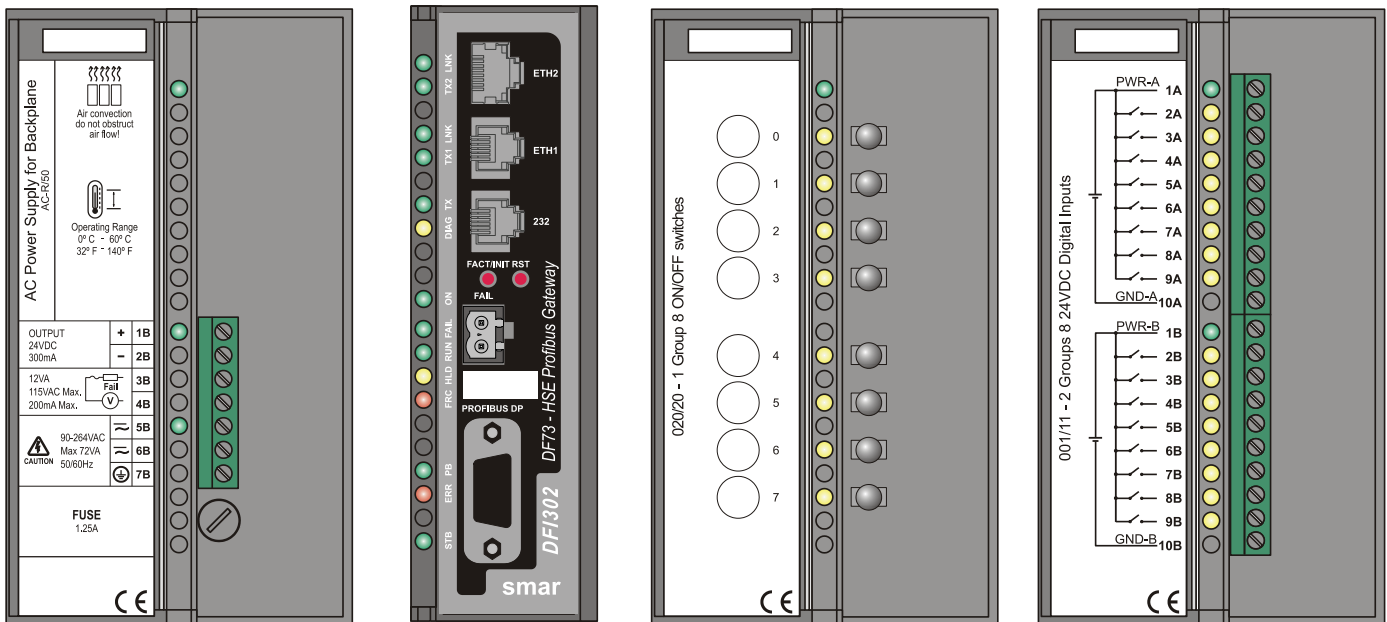
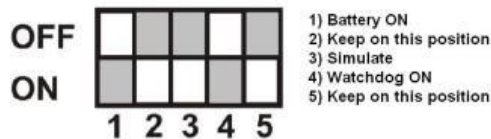


Figure 2.33 - Basic system of DFI302 with DF73

### Important:

The DF73 has an internal battery that keeps the Real Time Clock (RTC) and its non volatile RAM (NVRAM) when there is lack of external supply. This battery can be either enabled or disabled, depending on the position of the switch 1, in the back part of the DF73. To enable the battery, set the switch to 1 as shown in the following figure:



- In this configuration, when there is lack of energy, the RTC and the NVRAM will be supplied by the battery, allowing the retention of all configuration data. In case of equipment storage, it is recommended that the battery is turned off (switch 1 in position OFF). For further information about the battery, refer to “Technical specification for controllers” section.

So, before fixing the DF73 module in the rack, be sure the switch 1, which refers to the battery, is in the enabled position.

The Watchdog is a mechanism to detect if an important or high priority task stops in the controller. So, be sure the switch 4, which refers to the Watchdog, is in the ON position.

### NOTE:

The terminators used in the DP network must be enabled according to the network topology.

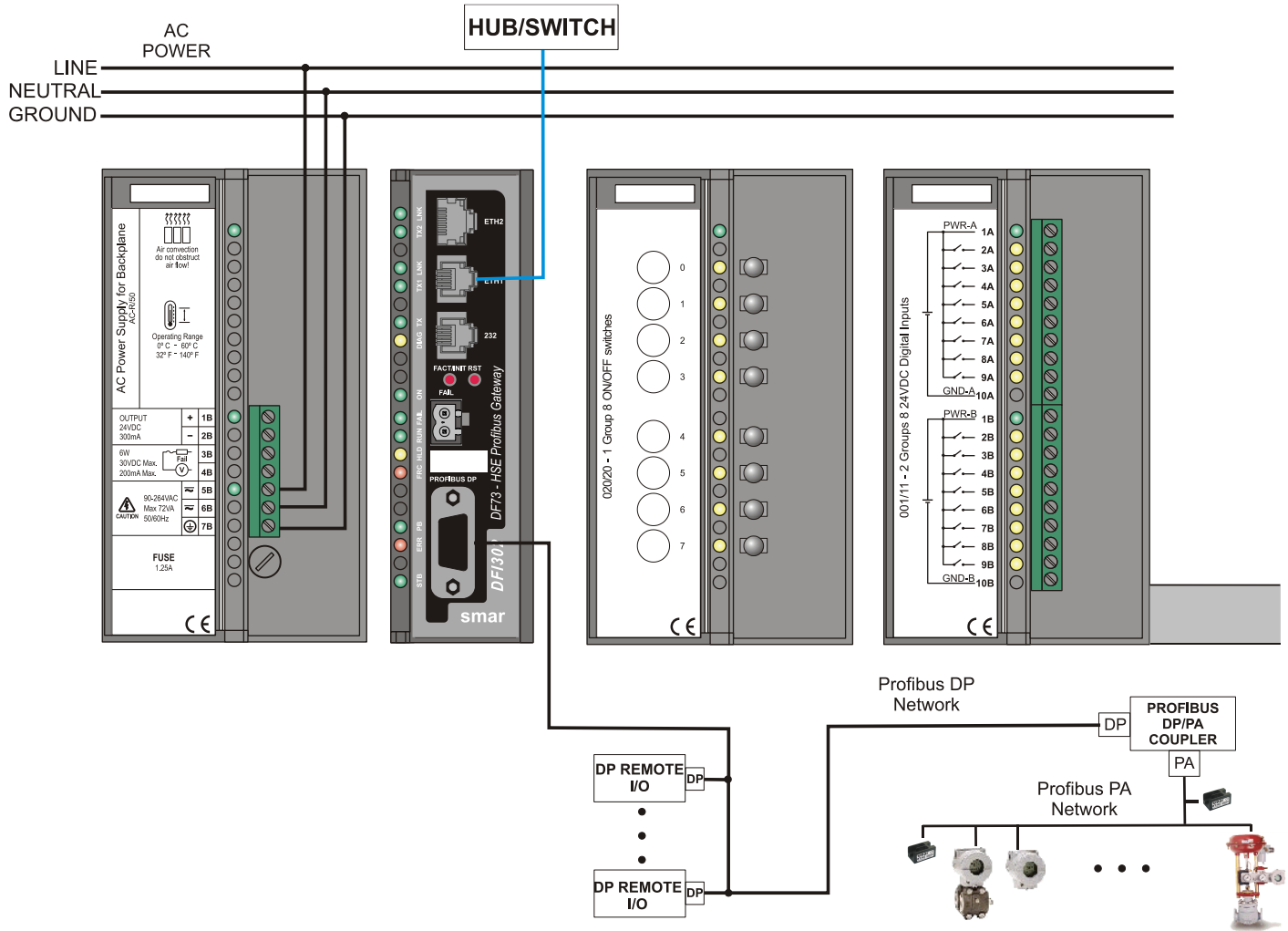


Figure 2. 34 – Cable diagram for DF73

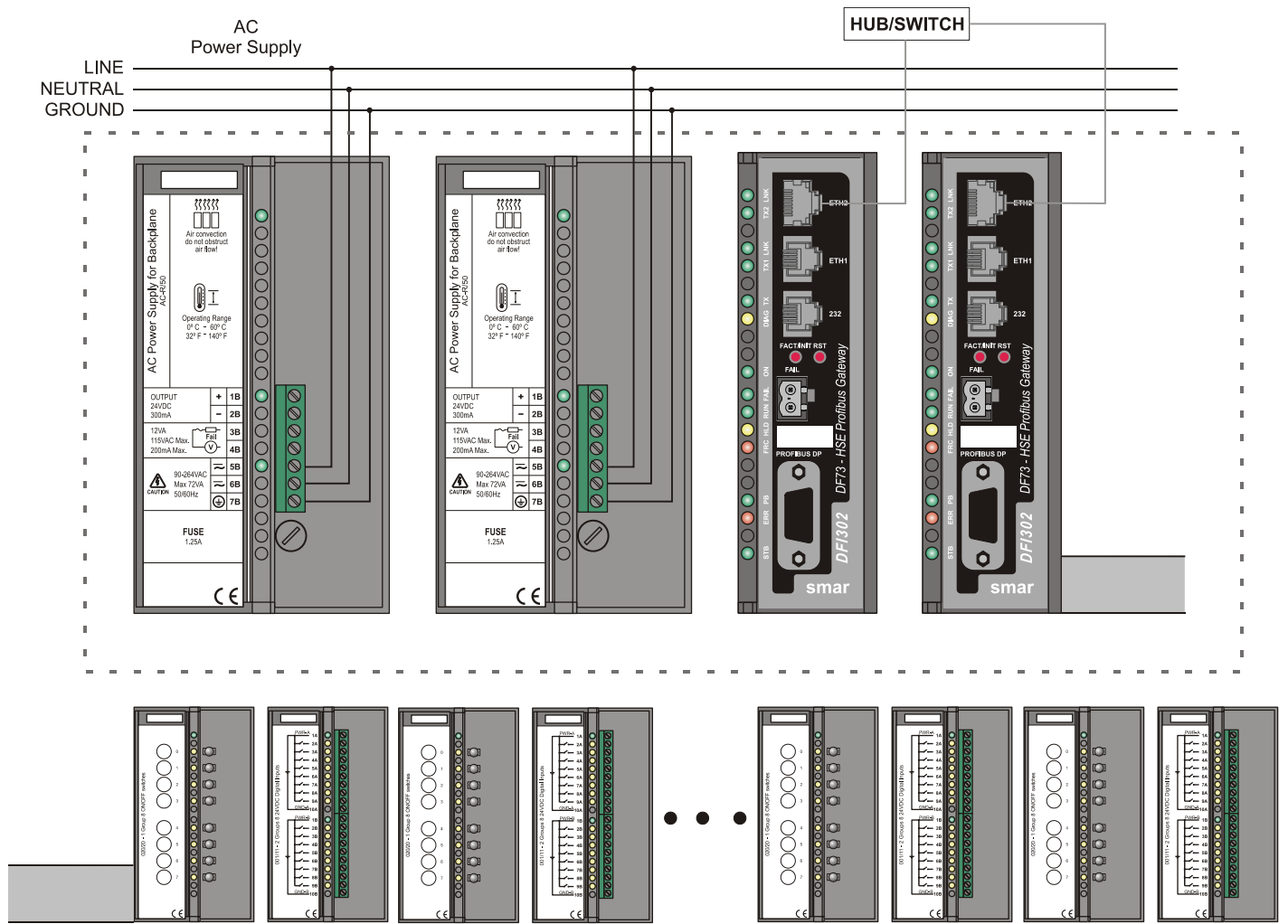


Figure 2. 35 – Redundant System using DF73 Controller

## Using the DF75 Controller

- A typical system is composed by:
- DF1A or DF93 – Rack with 4 slots;
  - DF50 –AC Power Supply;
  - DF75 –HSE Controller;
  - Up to 16 DF1A or DF93 with I/O modules

- A redundant system by using the DF75 can be composed by:
- DF78 – Rack with 4 slots (Hot Swap of CPUs and redundant I/O access) or DF92 – Rack with 4 slots (for redundante CPUs, support to Hot Swap and diagnostic);
  - DF50 –AC Power Supply;
  - DF50 –AC Power Supply ;
  - DF75 –HSE Controller;
  - DF75 - HSE Controller;
  - Plus up to 16 DF1A or DF93 with I/O modules.

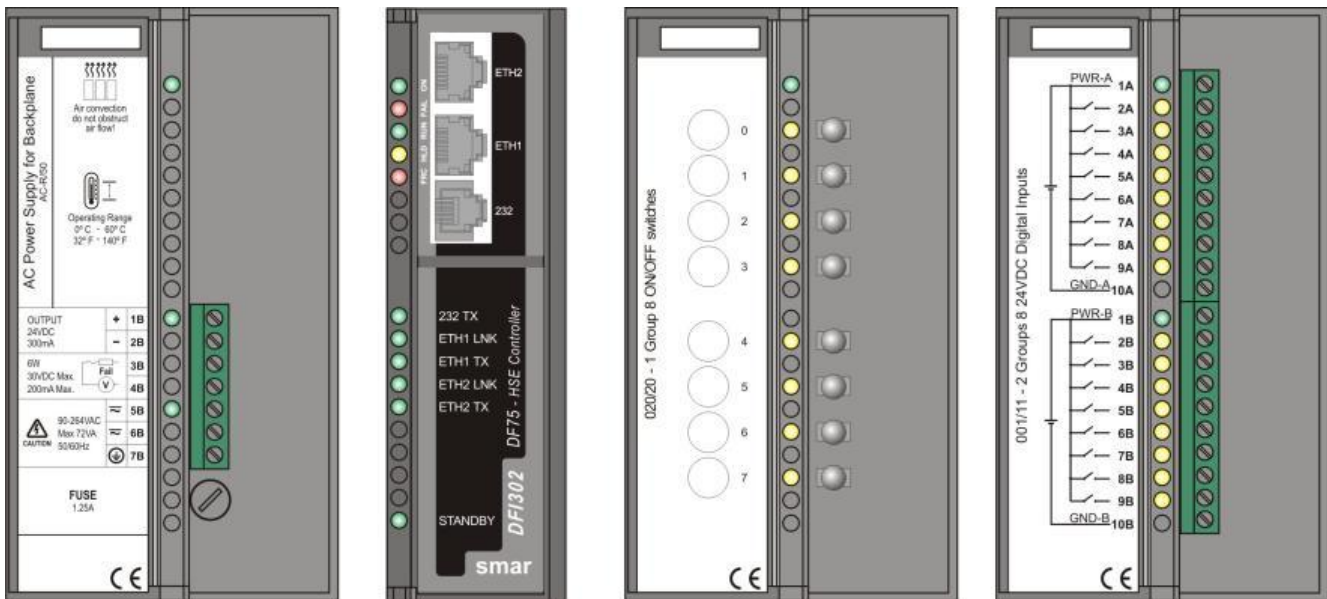
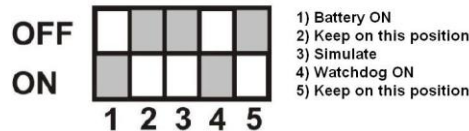


Figure 2.36 - Basic system of DFI302 with DF75

### Important:

The DF75 has an internal battery that keeps the Real Time Clock (RTC) and its non volatile RAM (NVRAM) when there is lack of external supply. This battery can be either enabled or disabled, depending on the position of the switch 1, in the back part of the DF75. To enable the battery, set the switch to 1 as shown in the following figure:



In this configuration, when there is lack of energy, the RTC and the NVRAM will be supplied by the battery, allowing the retention of all configuration data. In case of equipment storage, it is recommended that the battery is turned off (switch 1 in position OFF). For further information about the battery, refer to the “Technical specification for controllers” section.

So, before fixing the DF75 module in the rack, be sure the switch 1, which refers to the battery, is in the enabled position.

The Watchdog is a mechanism to detect if an important or high priority task stops in the controller. So, be sure the switch 4, which refers to the Watchdog, is in the ON position.

### Observe in the next figures:

- Basic system using the DF75 controller
- Redundant system using the DF75 controller

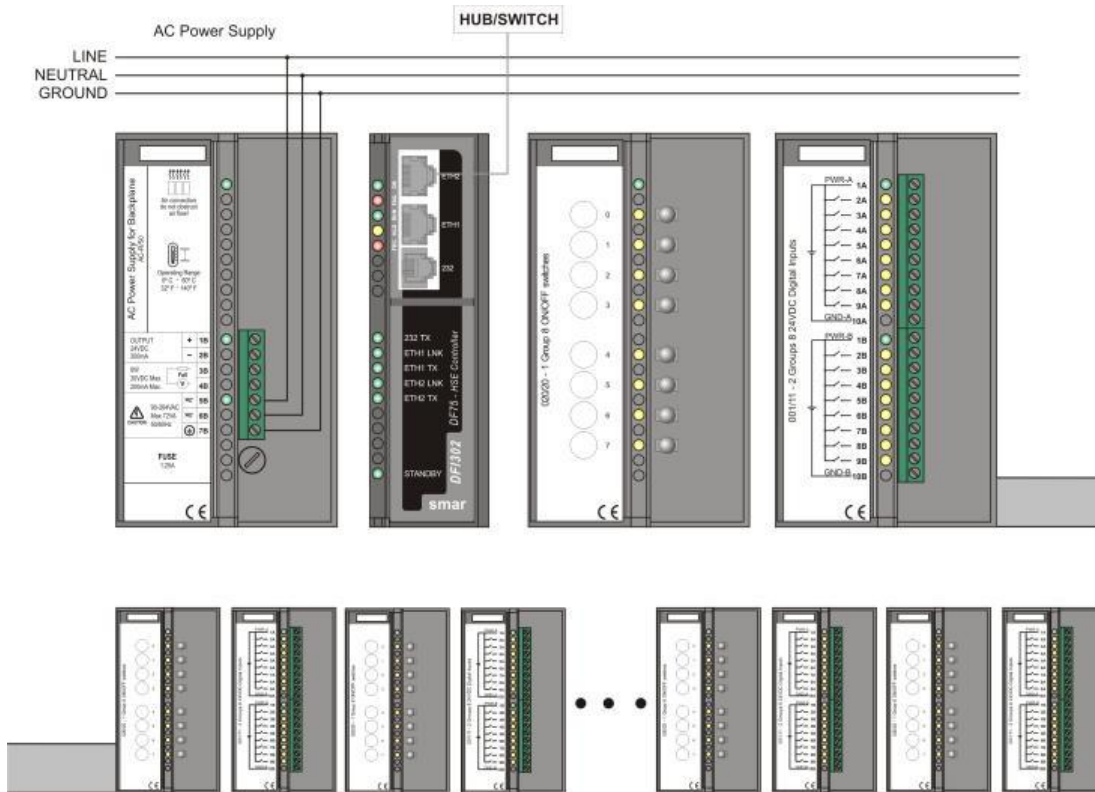


Figure 2.37 - Basic system using the DF75 controller

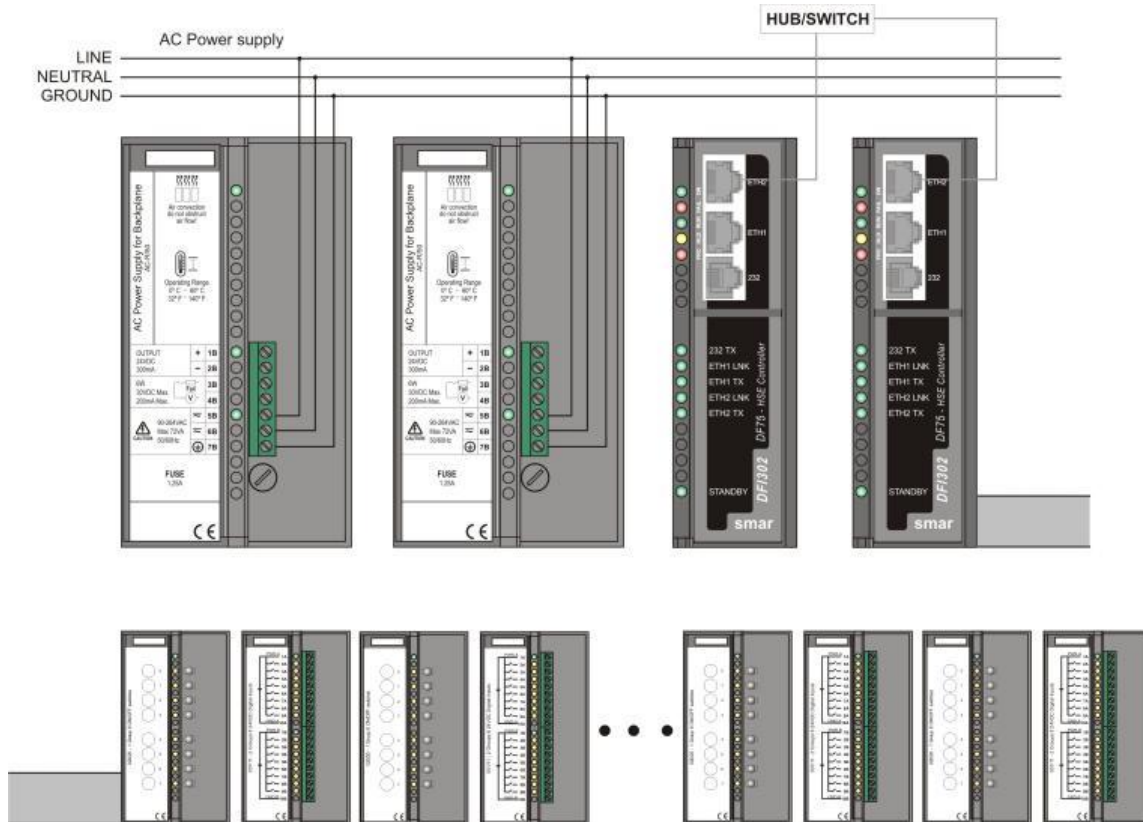


Figure 2.38 - Redundant system using the DF75 controller

## Using the DF79 Controller

- A typical system using the DF79 can be composed by:
- DF1A or DF93 – Rack with 4 slots
  - DF50 –AC Power Supply
  - DF79 – HSE/DeviceNet Controller
  - Power Supply 24 Vdc, 8A for DeviceNet devices

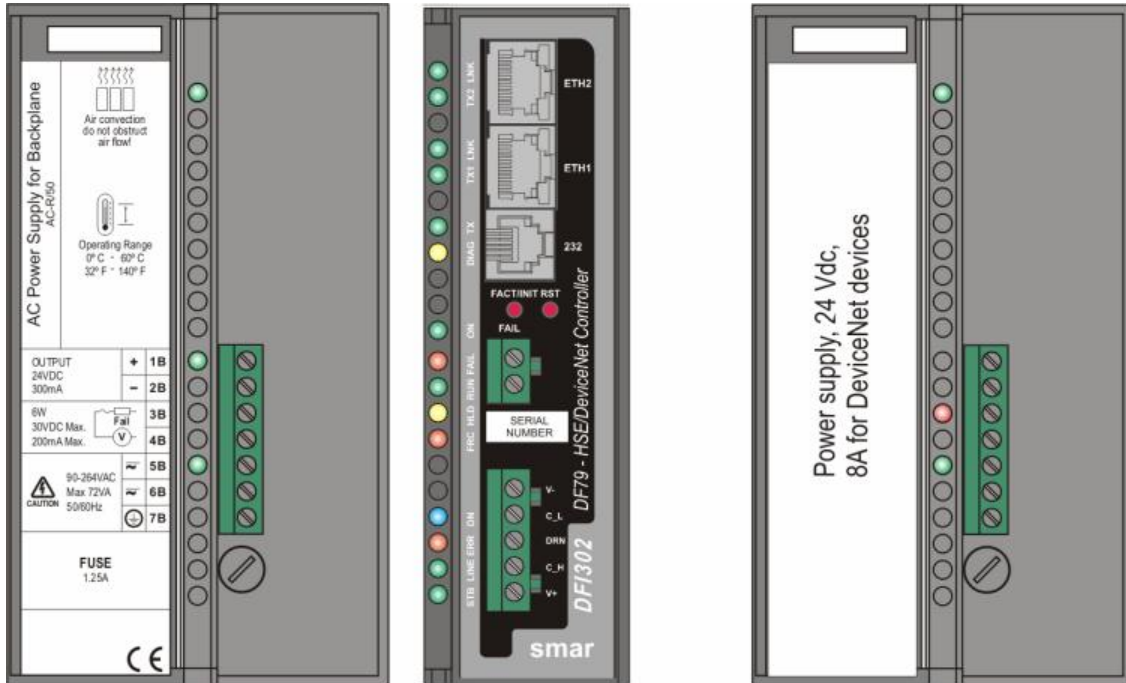
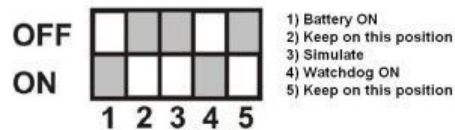


Figure 2. 39 - Basic system of DFI302 with DF79

### Important:

The DF79 has an internal battery that keeps the Real Time Clock (RTC) and its non volatile RAM (NVRAM) when there is lack of external supply. This battery can be either enabled or disabled, depending on the position of the switch 1, in the back part of the DF79. To enable the battery, set the switch to 1 as shown in the following figure:



In this configuration, when there is lack of energy, the RTC and the NVRAM will be supplied by the battery, allowing the retention of all configuration data. In case of equipment storage, it is recommended that the battery is turned off (switch 1 in position OFF). For further information about the battery, refer to the “Technical specification for controllers” section.

So, before fixing the DF79 module in the rack, be sure the switch 1, which refers to the battery, is in the enabled position.

The Watchdog is a mechanism to detect if an important or high priority task stops in the controller. So, be sure the switch 4, which refers to the Watchdog, is in the ON position.

### NOTE:

The terminators used in the DeviceNet network must be enabled according to the network topology.

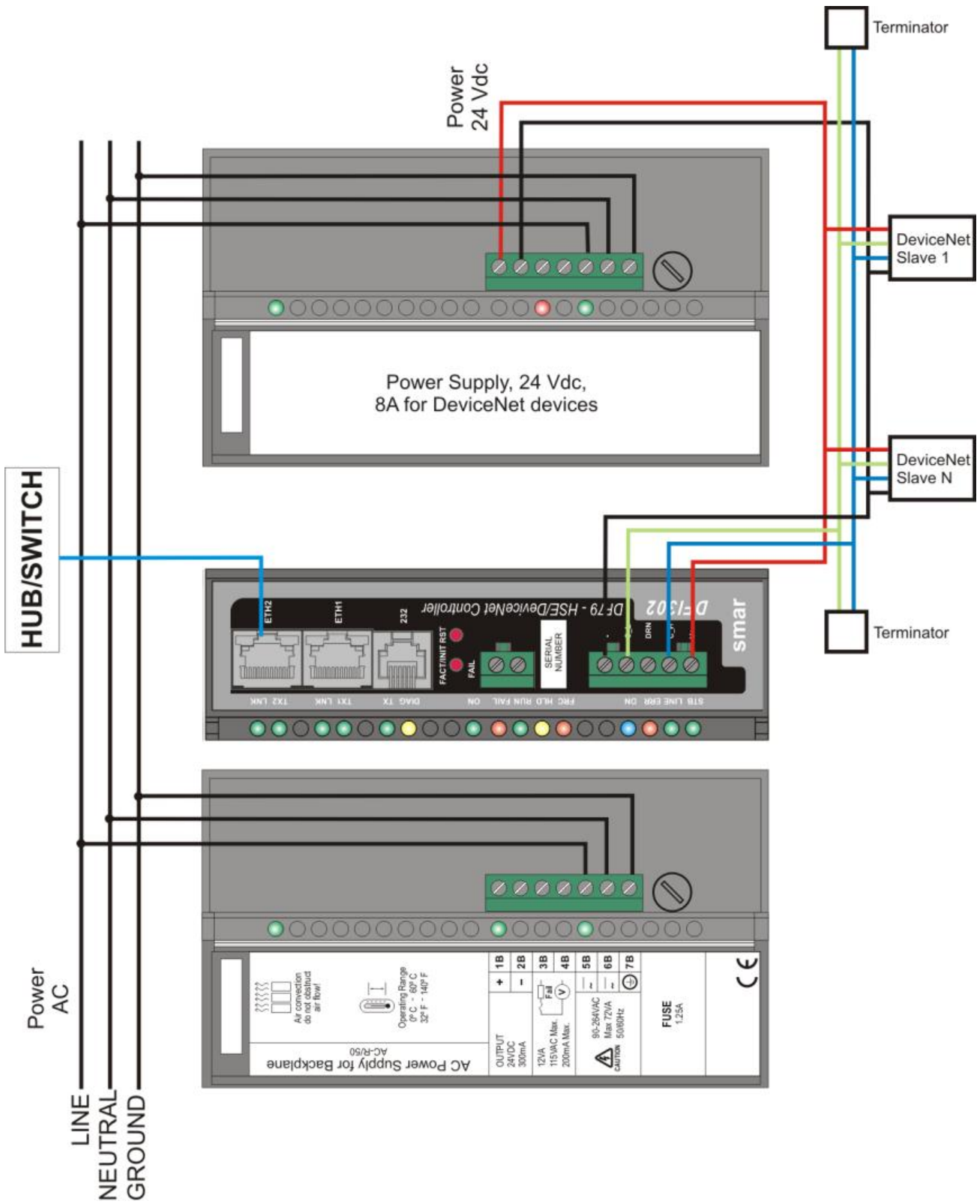


Figure 2. 40 – Cable diagram for DF79

## Using the DF81 Controller

A typical system using the DF81 can be composed by:

- DF1A or DF93 – Rack with 4 slots;
- DF50 – AC Power Supply
- DF81 – HSE/AS-i Controller
- DF00 – Empty Module
- AS-i Power Supply 29,5V up to 31,6V (aproximately  $30.55V \pm 3\%$ ) and maximum current 8A (one for each channel).

A typical configuration of a system with DF81 controller can be seen in the following figure:

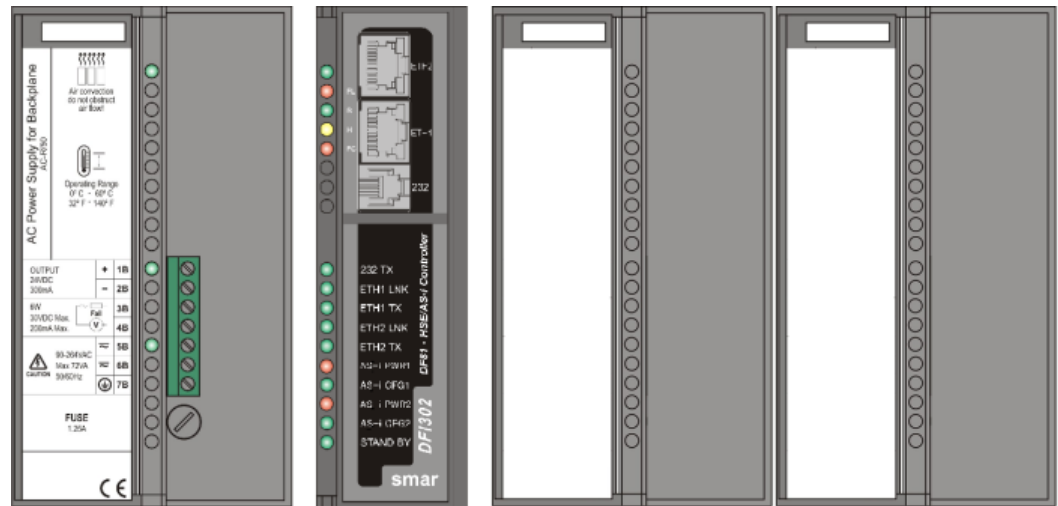
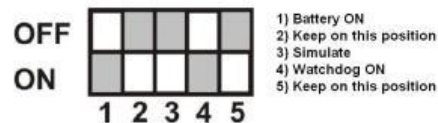


Figure 2. 41 - System of DFI302 with DF81

### Important:

The DF81 has an internal battery that keeps the Real Time Clock (RTC) and its non volatile RAM (NVRAM) when there is lack of external supply. This battery can be either enabled or disabled, depending on the position of the switch 1, in the back part of the DF81. To enable the battery, set the switch to 1 as shown in the following figure:



In this configuration, when there is lack of energy, the RTC and the NVRAM will be supplied by the battery, allowing the retention of all configuration data. In case of equipment storage, it is recommended that the battery is turned off (switch 1 in position OFF). For further information about the battery, refer to the “Technical specification for controllers” section.

So, before fixing the DF81 module in the rack, be sure the switch 1, which refers to the battery, is in the enabled position.

The Watchdog is a mechanism to detect if an important or high priority task stops in the controller. So, be sure the switch 4, which refers to the Watchdog, is in the ON position.

### Steps for a basic installation:

Execute the following procedures for a basic installation using DF81:

- Connect 4 modules (DF50, DF81, DF00, DF00) and the terminator (DF2) in the rack (DF1A or DF93);
- Connect the power supply in the DF50 input;
- Connect the auxiliary power supply in the channels AS-i CH1 and AS-i CH2, one for each channel;



- Connect the Ethernet cable (twisted pair cable) connecting DF81 to the hub or *switch*;
- Connect the AS-i bus cable to the channels AS-i CH1 and AS-i CH2 of DF81.

**WARNING**

NEVER grounded the negative AS-i channel.

- Note there are 2 inputs CH1 and 2 inputs CH2. It can, for example, to connect the cable of the power supply in one of the CH1 input and in the other the AS-i cable (yellow) in the other CH1 input/output for communication and supply of the AS-i slaves.
- DF81 will obtain automatically an IP address from DHCP Server, but if this server is not available, initially have a fixed IP (this initial fixed IP address it may be changed by FBTools (see the "Connecting the DFI302 in the subnet" topic).
- It is important that the IP addresses of the ETH1 and ETH2 ports are different.

**See in the figure follow:**

In the following figure, the wiring diagram is shown for the use of the DF81:

- Note that only one AS-i segment is being used;
- In the figure the present cable is standardized yellow, in that the brown wire should be connected to the terminator " + " and the blue in the terminator " -"

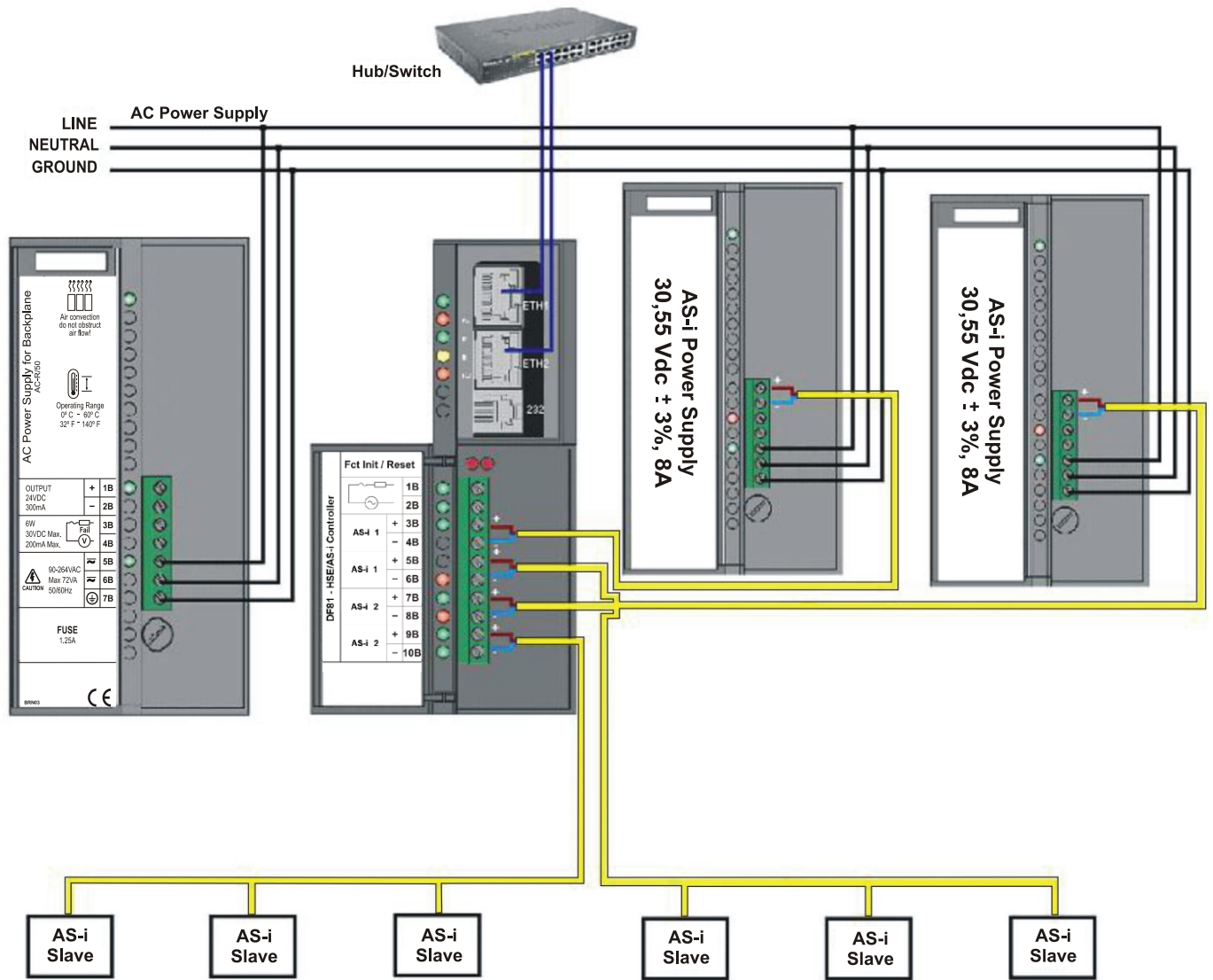
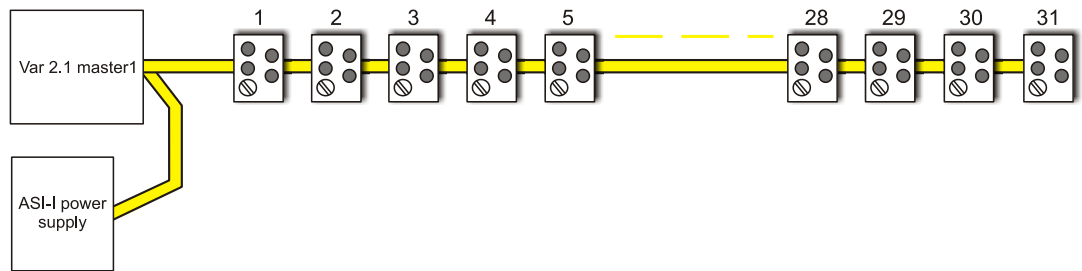


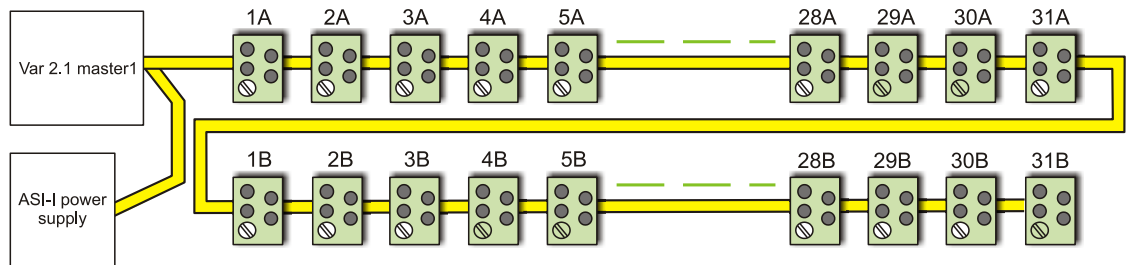
Figure 2. 42 – Cable diagram for DF81

**AS-i topology examples:**

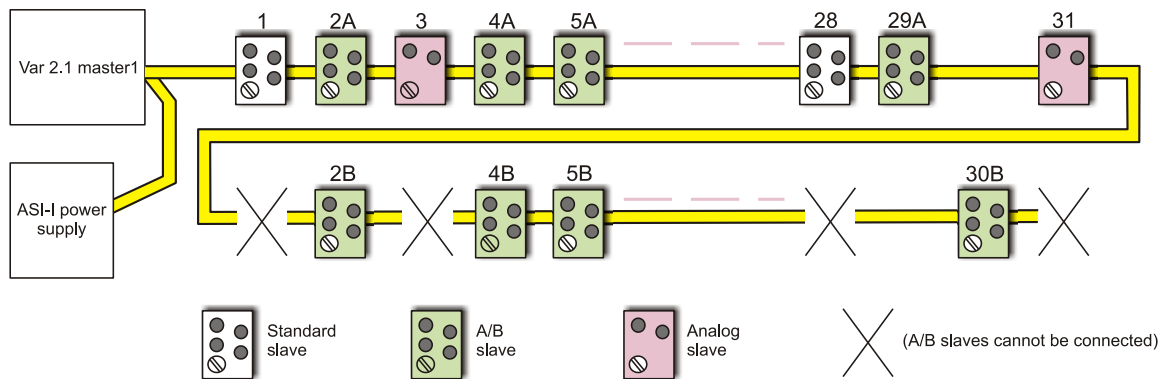
Example 1: 31 standard slaves



Example 2: 62 A/B slaves



Example 3: Standard slaves, A/B slaves and analog slaves used together



**Figure 2. 43 – Bus examples with slaves 2.0 and/or 2.1 versions (include analog). The analog slaves are not supported by DF81**

**NOTE**

The above illustration shows the allocation of slave for easy reference. Actual connections do not require allocation in address order.

## Using the DF89 Controller

- A typical system is composed by:
- DF1A or DF93 – Rack with 4 slots;
  - DF50 –AC Power Supply;
  - DF89 –HSE/Modbus Controller;
  - Up to 16 DF1A or DF93 with I/O modules

- A redundant system by using the DF89 can be composed by:
- DF78 – Rack with 4 slots (Hot Swap of CPUs and redundant I/O access) or DF92 – Rack with 4 slots (for redundante CPUs, support to Hot Swap and diagnostic);
  - DF50 –AC Power Supply;
  - DF50 –AC Power Supply ;
  - DF89 –HSE/Modbus Controller;
  - DF89 – HSE/Modbus Controller;
  - Plus up to 16 DF1A or DF93 with I/O modules.

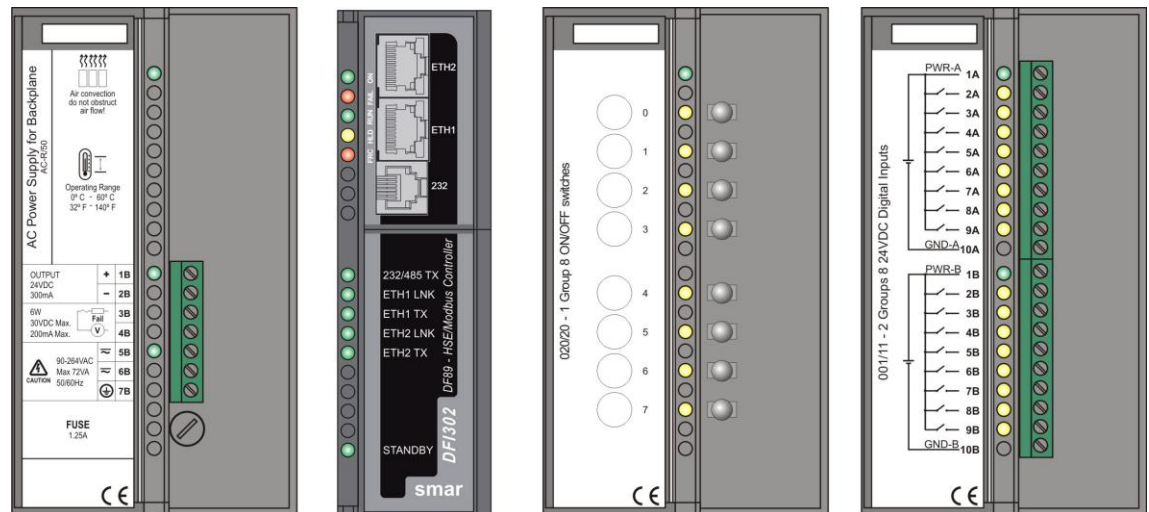
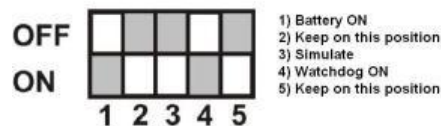


Figure 2.44 - Basic system of DF1302 with DF89

### Important:

The DF89 has an internal battery that keeps the Real Time Clock (RTC) and its non volatile RAM (NVRAM) when there is lack of external supply. This battery can be either enabled or disabled, depending on the position of the switch 1, in the back part of the DF89. To enable the battery, set the switch to 1 as shown in the following figure:



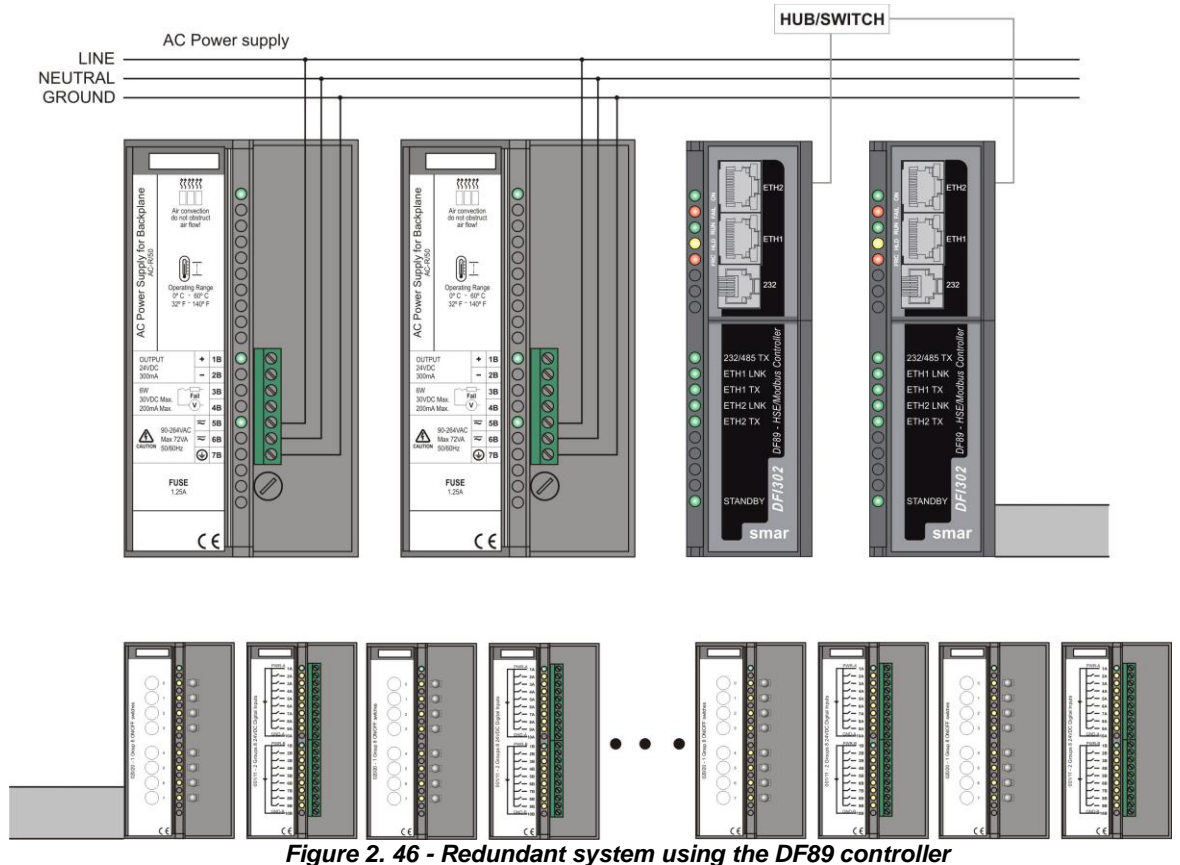
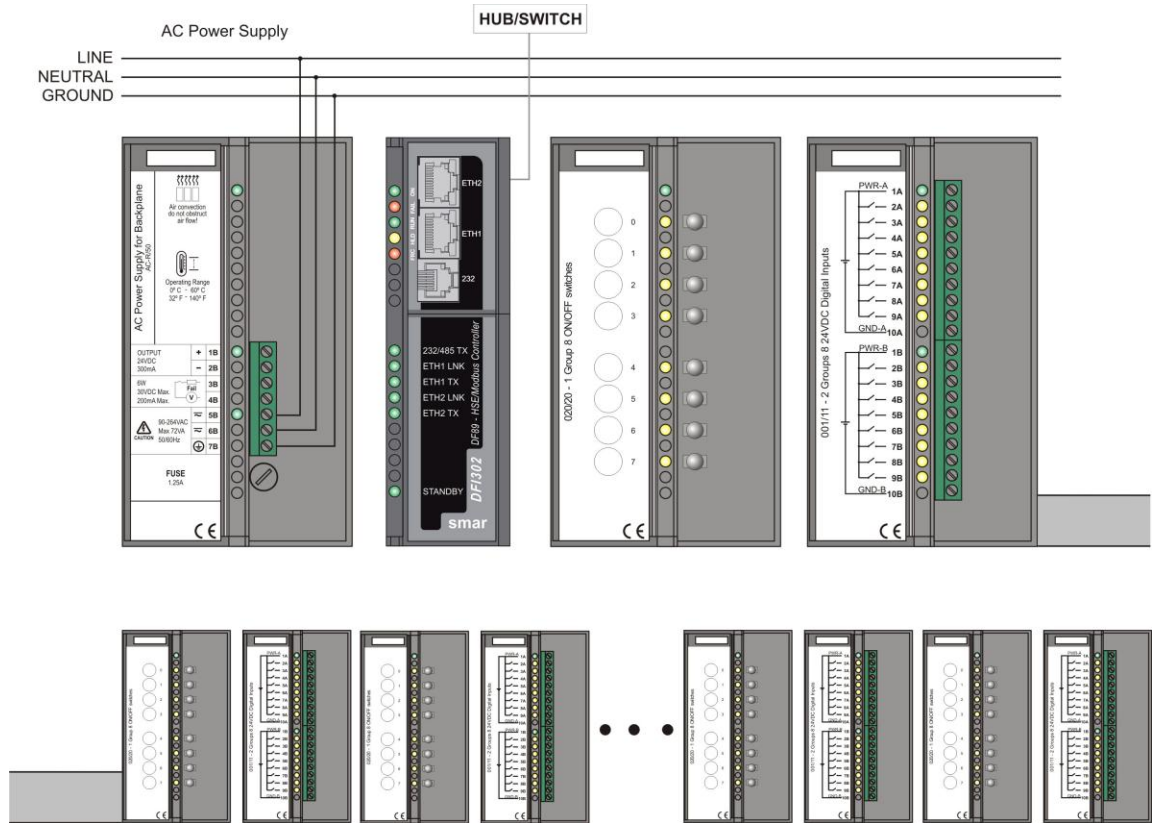
In this configuration, when there is lack of energy, the RTC and the NVRAM will be supplied by the battery, allowing the retention of all configuration data. In case of equipment storage, it is recommended that the battery is turned off (switch 1 in position OFF). For further information about the battery, refer to the “Technical specification for controllers” section.

So, before fixing the DF89 module in the rack, be sure the switch 1, which refers to the battery, is in the enabled position.

The Watchdog is a mechanism to detect if an important or high priority task stops in the controller. So, be sure the switch 4, which refers to the Watchdog, is in the ON position.

### Observe in the next figures:

- Basic system using the DF89 controller
- Redundant system using the DF89 controller



## Using the DF95 Controller

A typical system using the DF95 can be composed by:

- DF1A or DF93 – Rack with 4 slots
- DF50 –AC Power Supply
- DF95 – HSE/Profibus DP Controller
- DF52 – Power Supply for Profibus devices
- DF53 – Power Supply Impedance for Fieldbus
- Up to 16 DF1A or DF93 with I/O modules

**NOTE**

If the DF52 and DF53 modules were not used for powering Profibus devices, the DF0 or I/O modules must be inserted in the empty slots.

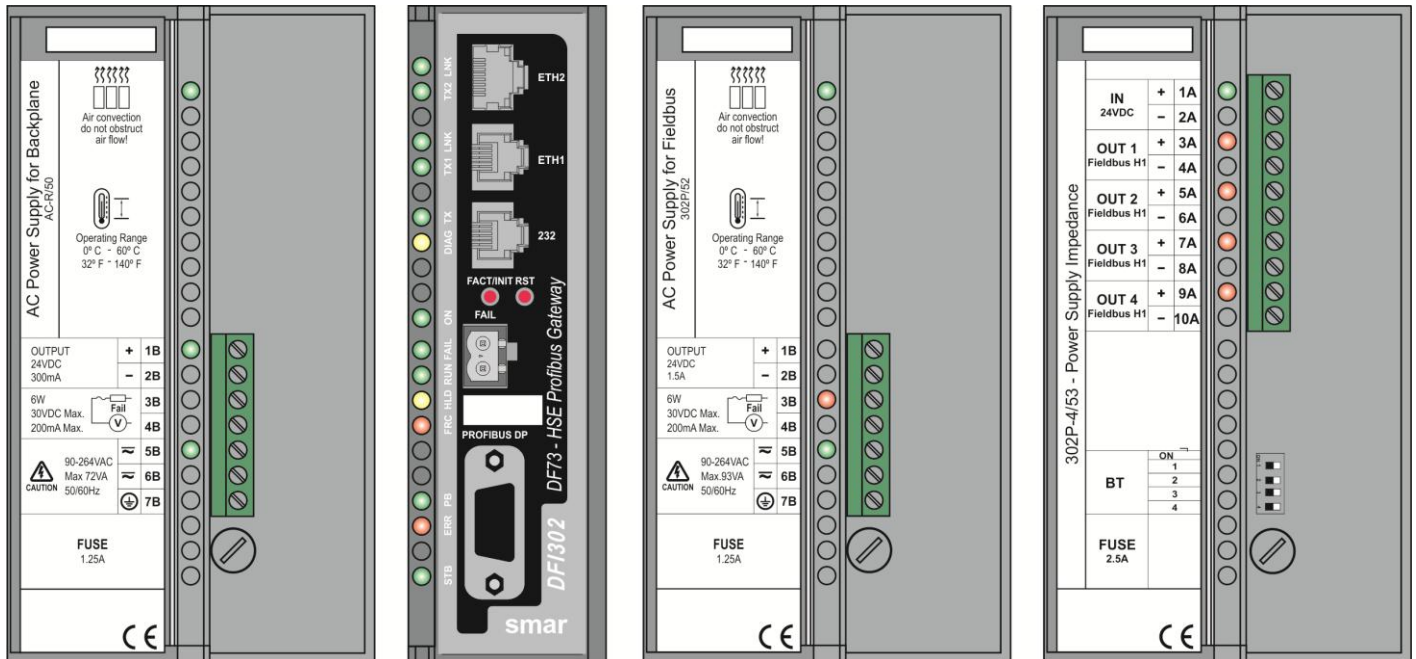
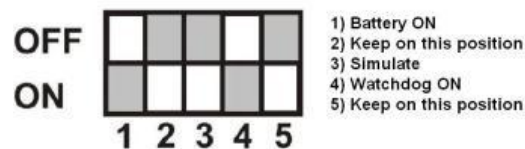


Figure 2. 47 – System of DFI302 with DF95

### Important:

The DF95 has an internal battery that keeps the Real Time Clock (RTC) and its non volatile RAM (NVRAM) when there is lack of external supply. This battery can be either enabled or disabled, depending on the position of the switch 1, in the back part of the DF95. To enable the battery, set the switch to 1 as shown in the following figure:



In this configuration, when there is lack of energy, the RTC and the NVRAM will be supplied by the battery, allowing the retention of all configuration data. In case of equipment storage, it is recommended that the battery is turned off (switch 1 in position OFF). For further information about the battery, refer to the “Technical specification for controllers” section.

So, before fixing the DF95 module in the rack, be sure the switch 1, which refers to the battery, is in the enabled position.

The Watchdog is a mechanism to detect if an important or high priority task stops in the controller. So, be sure the switch 4, which refers to the Watchdog, is in the ON position.

### NOTE:

If the terminators is positioned at the beginning or end of the Profibus DP network, the terminator

must be put on the ON position.

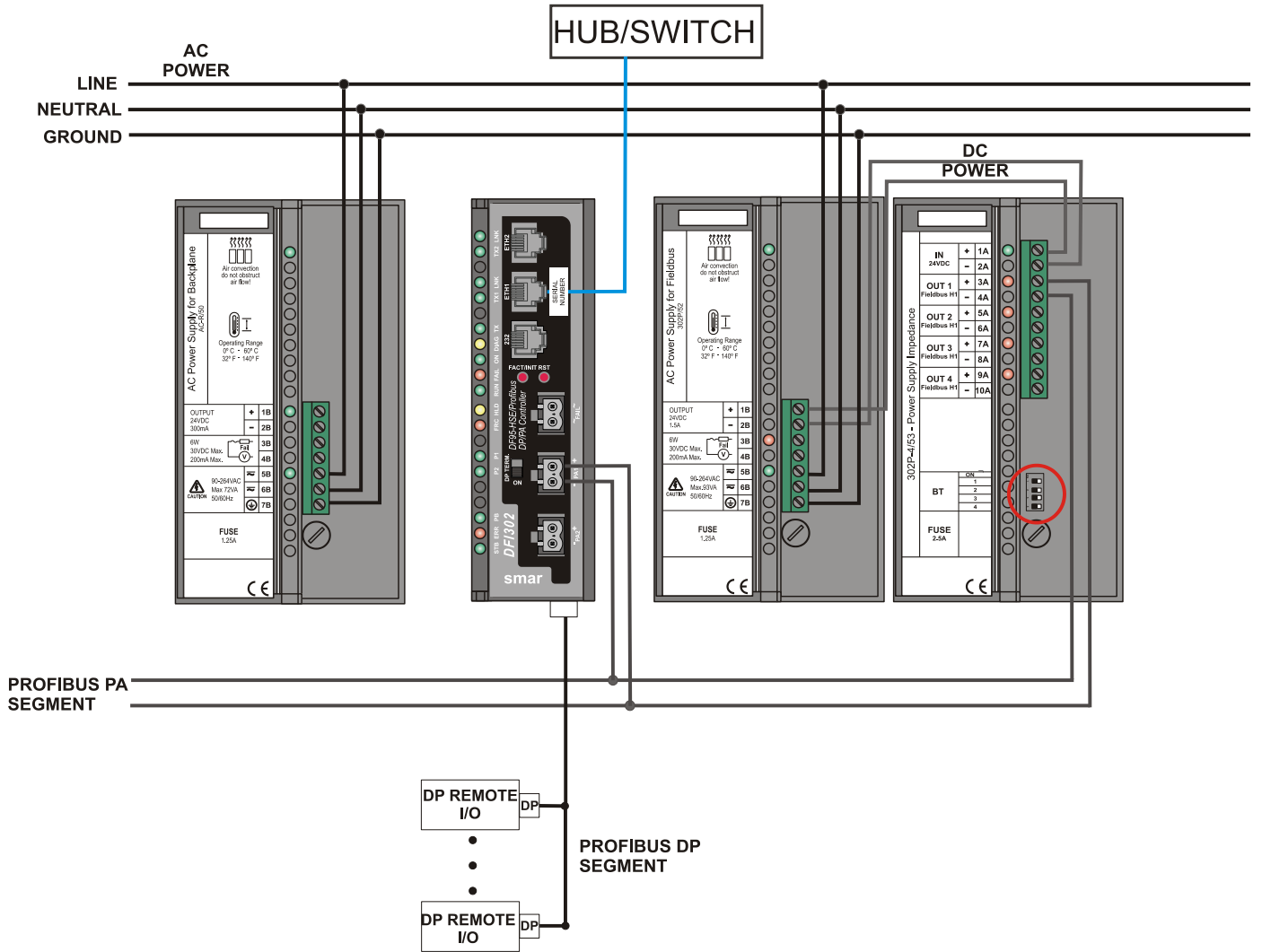


Figure 2. 48 – Cable diagram for DFI95

## Using the DF97 Controller

A typical system using the DF95 can be composed by:

- DF1A or DF93 – Rack with 4 slots
- DF50 –AC Power Supply
- DF97 – HSE/Profibus DP Controller
- DF52 – Power Supply for Profibus devices
- DF53 – Power Supply Impedance for Fieldbus
- Up to 16 DF1A or DF93 with I/O modules

**NOTE**

If the DF52 and DF53 modules were not used for powering Profibus devices, the DF0 or I/O modules must be inserted in the empty slots.

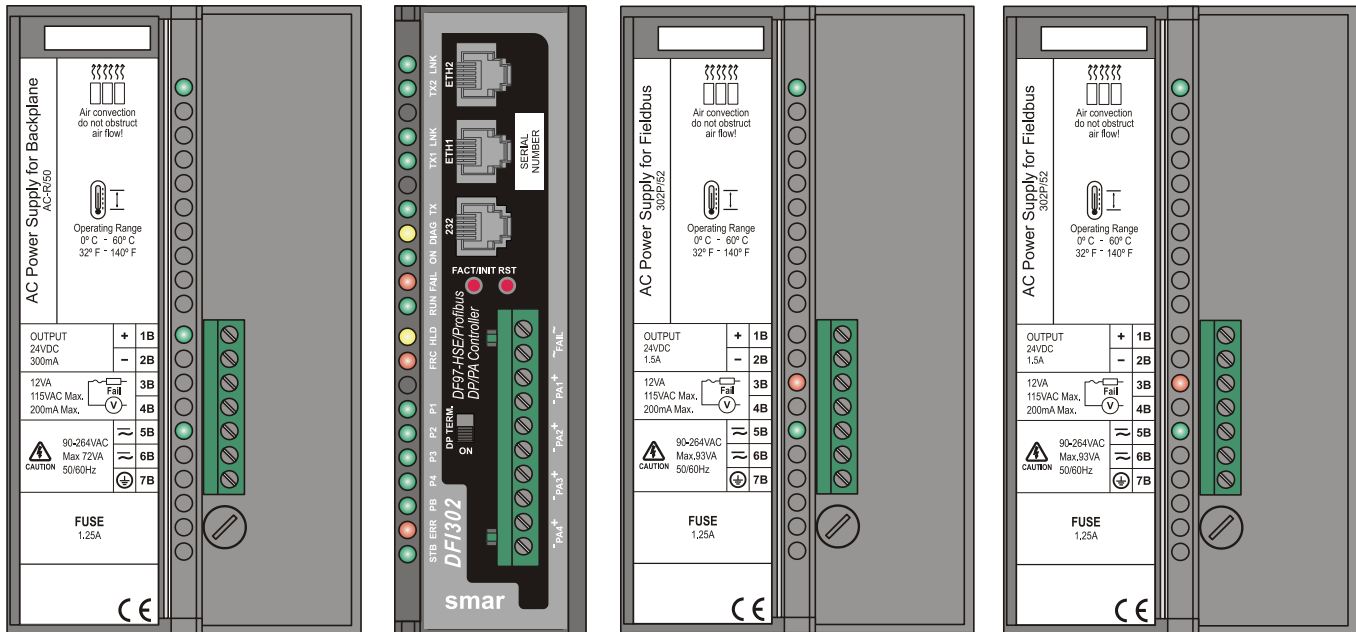
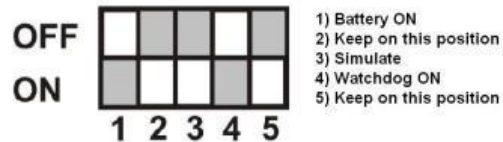


Figure 2.49 – Basic system of DFI302 with DF97

**Important:**

The DF97 has an internal battery that keeps the Real Time Clock (RTC) and its non volatile RAM (NVRAM) when there is lack of external supply. This battery can be either enabled or disabled, depending on the position of the switch 1, in the back part of the DF97. To enable the battery, set the switch to 1 as shown in the following figure:



In this configuration, when there is lack of energy, the RTC and the NVRAM will be supplied by the battery, allowing the retention of all configuration data. In case of equipment storage, it is recommended that the battery is turned off (switch 1 in position OFF). For further information about the battery, refer to the “Technical specification for controllers” section.

So, before fixing the DF97 module in the rack, be sure the switch 1, which refers to the battery, is in the enabled position.

The Watchdog is a mechanism to detect if an important or high priority task stops in the controller. So, be sure the switch 4, which refers to the Watchdog, is in the ON position.

**NOTE:**

If the terminators is positioned at the beginning or end of the Profibus DP network, the terminator must be put on the ON position.



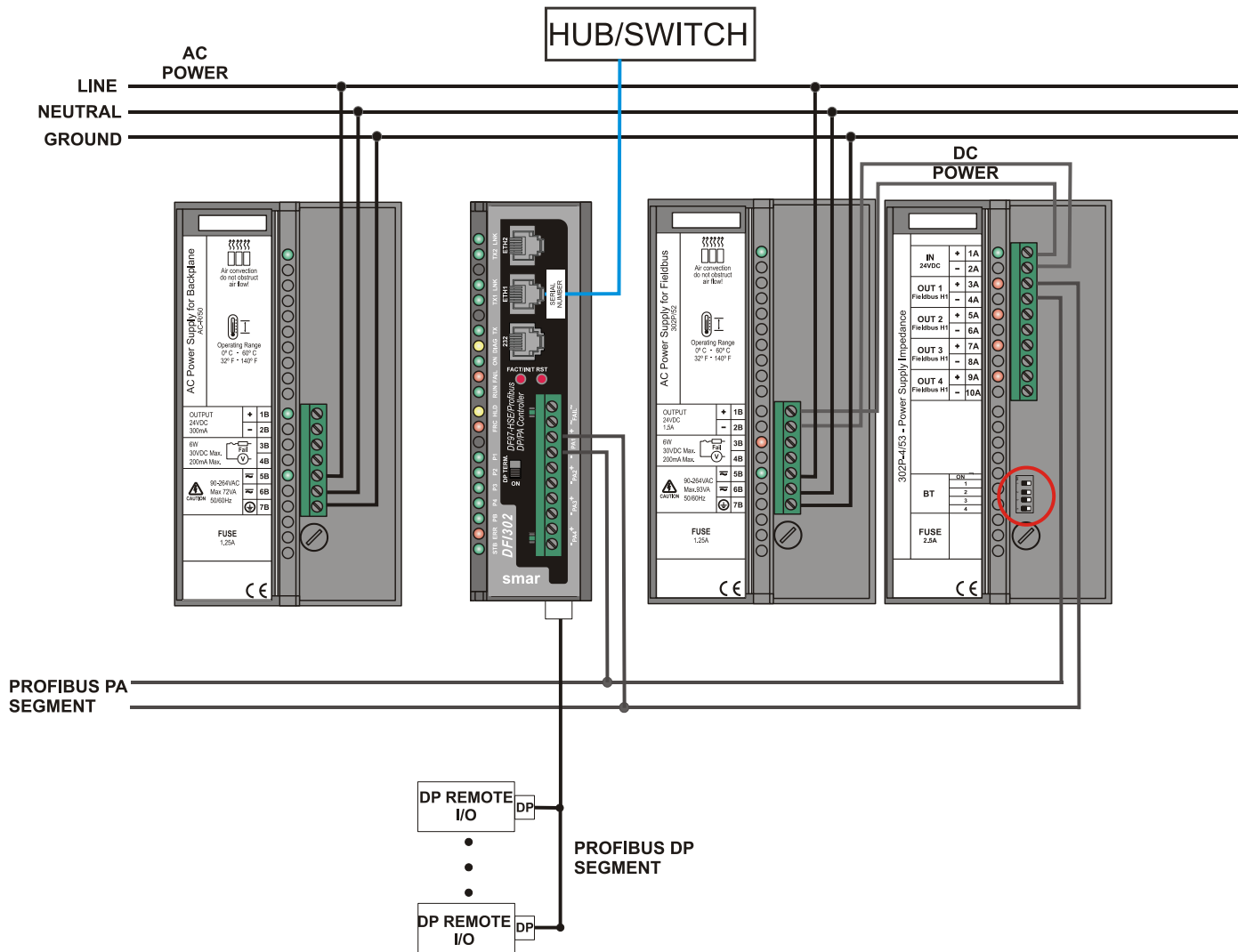


Figure 2. 50 – Cable diagram for DF97

## Using the DF100 Controller

### WirelessHART technology overview

The *WirelessHART* technology is based on a wireless mesh network communication protocol used in process automation applications. It adds wireless capabilities to the HART protocol, while maintaining compatibility with existing HART devices, commands and already known and used tools.

#### WirelessHART network

Basically, a *WirelessHART* network, defined in the HART specifications, consists of a host, a *WirelessHART* Gateway and one or more field devices and/or *WirelessHART* adapters. Together they compose a mesh network where the host and devices can communicate.

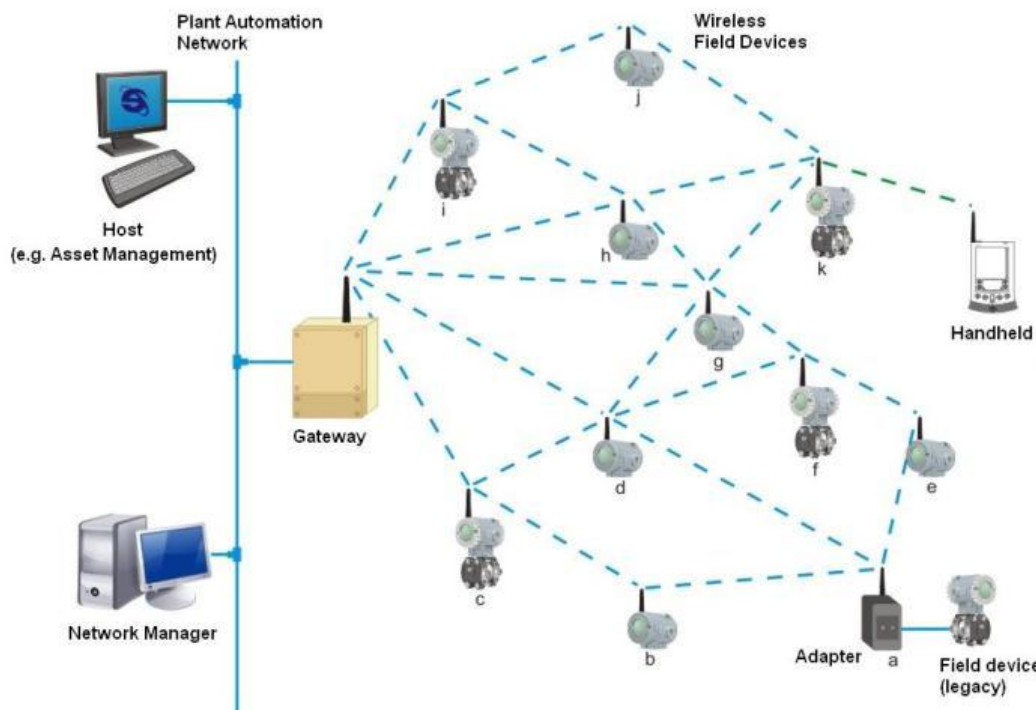


Figure 2. 51 – WirelessHART network

#### Host

The host, usually connected to the control network, is a workstation in which, e.g., can be installed an Human Machine Interface application, which allows an operator to interact with the process. Through the *WirelessHART* Gateway, the host can gather data from devices connected to the *WirelessHART* network. The host communicates with the *WirelessHART* Gateway using a communication protocol, for example, HSE, H1, Profibus or Modbus.

#### WirelessHART Gateway

It is a "translator" equipment. Thus it converts data from the host to the *WirelessHART* protocol, used by the devices connected to the *WirelessHART* network, and converts data from the devices to the host. In general, the *WirelessHART* Gateway incorporates the features of Network Manager and Access Point. Roughly, the access point can be understood as the *WirelessHART* radio installed at the gateway to communicate with devices connected to the wireless network.

#### Network Manager

The Network Manager is an application that can be embedded in the *WirelessHART* Gateway. On a *WirelessHART* network is only allowed to have one Network Manager. Among its responsibilities, the Network Manager distributes network identity (advertisement) publishing its existence, manages and authenticates the addition (joining) of devices to the network. It also distributes individual security keys (static or rotating) to the devices to ensure secure communication between it and the devices. The Network Manager assigns communication band to the devices already connected to

the network that requested services to it, as well as manages the routes between the devices on the mesh network.

Specifically about the joining process of a *WirelessHART* device to the network, the Network Manager validates the Network ID and the Join Key attributes which are configured in the *WirelessHART* Gateway and *WirelessHART* devices.

The Network ID identifies a *WirelessHART* network in unique way. It is an **unsigned integer** attribute and must be configured on the *WirelessHART* Gateway and all *WirelessHART* devices. Considering a *WirelessHART* network installed in a plant, the permitted values for the Network ID ranges from 0 (hex 0x0000) to 32767 (0x7FFF hexadecimal).

The Join Key is a security key used to encrypt joining requests from *WirelessHART* devices that receive the advertisement with the Network Id identical to theirs. It may be single or each *WirelessHART* device may be configured with an individual Join Key. In the first case, the *WirelessHART* Gateway and all *WirelessHART* devices must be configured with the same Join Key. In the second case, which provides higher communication security level, (a) must be configured in the *WirelessHART* Gateway a list with individual Join Keys, i.e., a key for each *WirelessHART* device, and (b) you must configure each *WirelessHART* device with its individual Join Key. The Join Key is a hexadecimal string of 16 bytes. There is no restriction to the hexadecimal value of each byte. The table below shows examples of some join keys.

| JOIN KEYS                         | 16-BYTES HEXADECIMAL STRING  |
|-----------------------------------|--|
| 00000000000000000000000000000000  | 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00 |
| 000000000000000000000000000000302 | 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x03, 0x02             |
| 00000000FFFFFFFF0000000000000000  | 0x00, 0x00, 0x00, 0x00, 0xFF, 0xFF, 0xFF, 0xFF, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00 |
| 550000000000000000000000000000AA  | 0x55, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0xAA |

**Examples of Join Keys**

**WirelessHART device**

The *WirelessHART* field device is the device that connects to the process, being able to receive and/or transmit data on the *WirelessHART* network. It is a *WirelessHART* router (repeater) by nature, i.e., it is able to retransmit messages to/from other devices on the *WirelessHART* network.

**WirelessHART Adapter**

It is a bridge-type device, because it is able to provide data of HART + 4 to 20mA field device, legacy, to the host via *WirelessHART*. The adapter uses HART FSK standard communication, wired, to access data from HART field devices. And the adapter also uses the *WirelessHART* communication to provide data of the field device to the host. The adapter thus enables a HART field device to work on *WirelessHART* network.

We recommend a visit to the HART Communication Foundation website for additional information about the *WirelessHART* protocol such as *WirelessHART* project planning, positioning of devices, commissioning and verification tools, and practices.

**Planning an *WirelessHART* network**

The planning of a *WirelessHART* network is a task that is very similar to the activities that currently we perform with conventional wired devices. Furthermore, due to the simplicity of a mesh *WirelessHART* network, is exempt, in general, detailed field surveys, which are usually needed when we plan networks based on other wireless technologies.

Basically, a *WirelessHART* network involves planning, design, installation and commissioning phases.

**Planning**

This phase requires the execution of the steps below:

### Scope definition

Clearly define the scope of the network. Answer the question: why do we need the wireless network? To monitor process variables or to implement a non-critical control? The answer to this question will facilitate the understanding between the team members responsible for the network and determine one or more process units in the plant. For each process unit, allocate a gateway with unique and specific Network ID. Outline the main field devices.

### Identify potential sources of interference

Are there radio communications or other wireless networks in the plant? What protocols and frequencies do they use? Use high power? Although unlikely, given the robustness of the radios used by the *WirelessHART* technology, prior knowledge of the answers to these questions may identify potential sources of interference and to indicate the taking of preventive and/or limiting actions even before installation. For example, you can select a frequency channel as unavailable, adding it to the black list of frequencies that is under the *WirelessHART* Network Manager control.

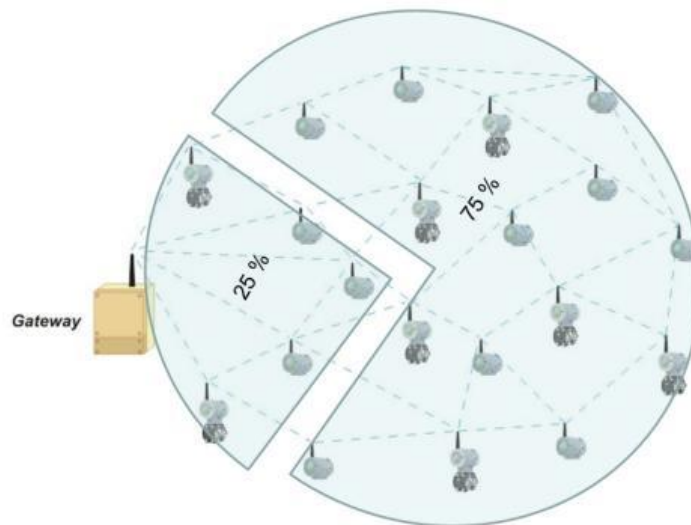
### Integration with the host

The gateway connects the *WirelessHART* field devices to the host system. Plan what devices and what data are needed. Also, the stations or applications which will process the data have to be clearly defined. From this set, among the protocols in the system, define which one will be used for integration with the host and with the existing tools for configuring the devices. After defining the protocol for integration, the user has to choose the gateway on the market that best meets your requirements.

### Project

In the project phase, it is recommended the adoption of the practices below. Although conservative, these practices ensure robustness and scalability to the network.

- Define the Network ID that will be used for all devices in the process unit;
- Define if the Join Key will be common to all devices or individual and dedicated ;
- Define the policy to be used for the definition of devices (Long) Tags;
- Use a scale drawing of the process unit;
- Place the gateway in a strategic position in the process unit ;
- Plan networks with at least five devices;
- Install at least five devices within the gateway coverage area;
- Ensure that 25 % of the devices are within the gateway coverage area;



**Figure 2. 52 –Gateway coverage area**

- Reposition the gateway as needed ;
- Check the coverage area of each device;
- Ensure that each device has three neighbors within its coverage area;

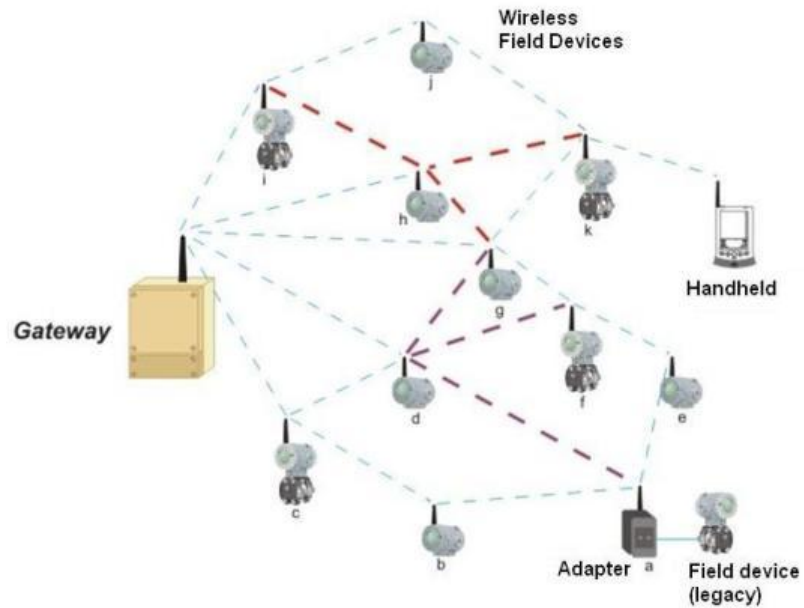


Figure 2.53 – WirelessHART devices vicinity

- o Place the repeaters as needed.

**Installation**

As mentioned before, *WirelessHART* devices should be connected to the process and configured the same way as conventional wired HART devices.

Handheld terminals can be used normally. Just be sure of having it properly uploaded with the latest DD files of the devices. However, it is known that the *WirelessHART* devices have characteristics inherent to the technology. Because of this, it is recommended the adoption of practices mentioned below for positioning the gateway and devices.

- o Install the gateway and the devices so that their antennas are vertical;
- o Ensure that the antennas are at 0.5 m minimum distance of large obstacles or surfaces ;
- o Ensure that the antennas of gateway and repeaters are 2 m above most obstacles within their coverage areas;

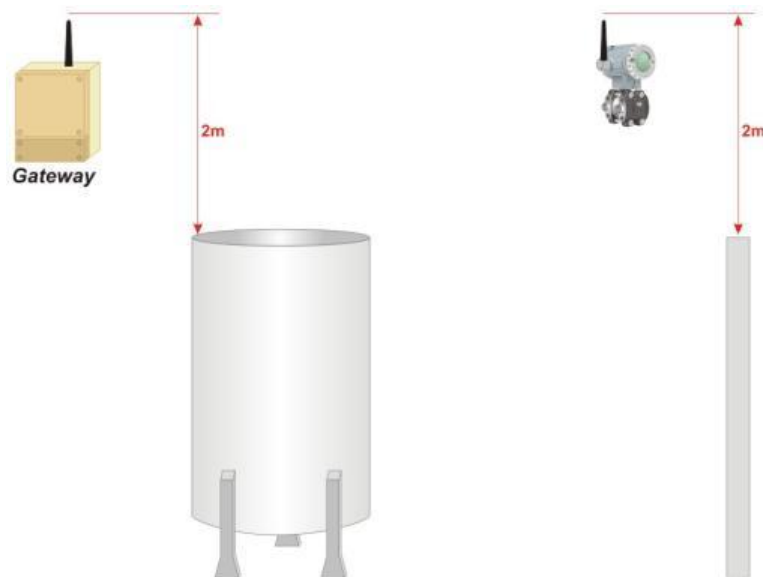
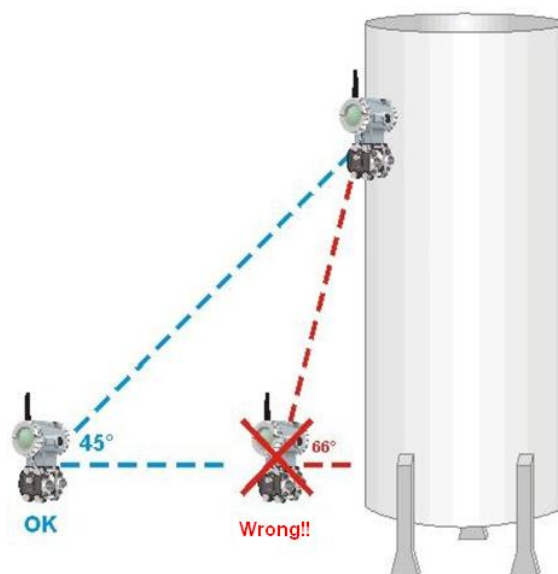


Figure 2.54 – Gateway and repeater 2m above the obstacles

- o If there are high devices, does not exceed 45° viewing angles between them;



**Figure 2. 55 – Device’s viewing angle**

- Make sure that the gateway is integrated to the host system as planned.

### Commissioning

The commissioning of devices and gateway must be considered<sup>1</sup>.

#### WirelessHART devices commissioning

- Ensure that the gateway is installed and powered;
- Install each device individually. Start with those closest to the gateway, i.e., those that will be within the coverage area of the gateway;
- If the device is powered by batteries, check that they have the same characteristics documented in the device’s operation manual;
- Power the device up;
- Use a handheld terminal and configure the device according to the application requirements;
- Configure the Long Tag of the device;
- Configure the Network ID;
- Configure the Join Key;
- Define and configure the update rate;
- Command, if necessary, the device connection to the network;
- Follow the device connection to the network, waiting until it reaches the operational state. The monitoring can be done from the device<sup>2</sup> or gateway;
- Make sure the device is operating to ensure its commissioning. For example, check the value of PV measured and its update rate.

#### Gateway commissioning

- Make sure that the gateway is available to the host system;
- Check the gateway and make sure it has at least five devices directly connected to it;
- Check if 25 % of the devices are connected directly to the gateway. If necessary, add repeaters;
- The gateway connects the devices to the host system. Thus, check if the data of the devices are coming to the applications that subscribe them.

### Basic Characteristics of DF100

The DF100 is an HSE/*WirelessHART* controller. Integrates up to 100 *WirelessHART*<sup>3</sup> devices to the SYSTEM302 through recently standardized FF HSE WIO technology and *WirelessHART*. Thus, the DF100 is a controller that provides a *WirelessHART* device data to workstations and controllers connected to corporate and control networks. It is a more powerful Smart controller, which, besides

<sup>1</sup> The steps below assumes that the Network ID and the Join Key(s) are already configured.

<sup>2</sup> Refer to the device’s manual to learn procedures for such verification.

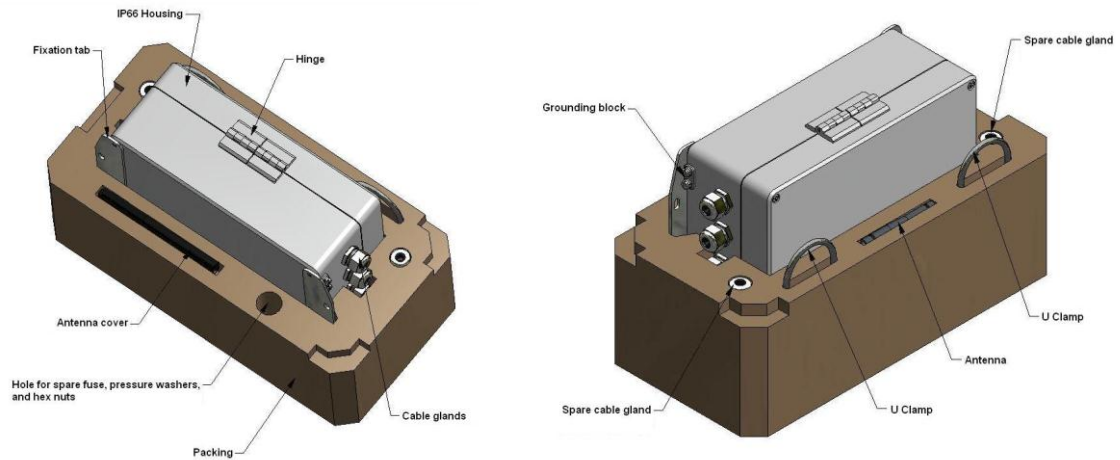
<sup>3</sup> The maximum number of *WirelessHART* devices may be less depending on the update rate desired.

the HSE protocol, can be integrated with existing host systems via Modbus TCP and RTU (via RS-485 port). Unlike other controllers of the DFI302 family, the DF100 does not use the rack, nor supports I/O modules. In addition, the DF100 has IP66 rating which allows their installation outdoors, open, whose temperature range varies from -40 °C to +60 °C.

## Package Contents

The package of DF100 controller contains the following items:

- 01 DF100 Controller (installed in the IP66 metal housing, with grounding block);
- 02 Cable glands installed in the IP66 metal housing;
- 02 Plugs (installed in the IP66 metal housing, next to the cable glands above mentioned);
- 01 Antenna protective cover;
- 01 Omnidirectional antenna;
- 02 1/4" U clamps (for housing fixation in pipes);
- 04 1/4" pressure washers (for housing fixation in pipes);
- 04 1/4" hex nuts (for housing fixation in pipes);
- 02 Cable glands (spare parts – for Ethernet and RS-485 communication);
- 01 Fuse (spare part);

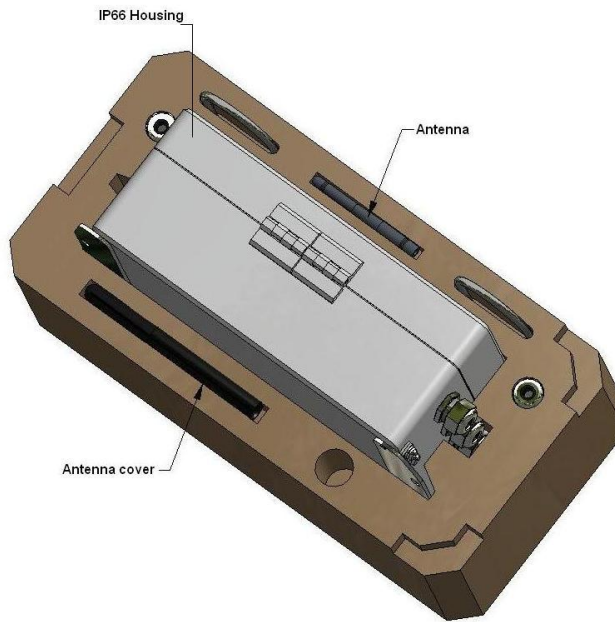


**Figure 2.56 – Package detailing**

## Mounting the Antenna

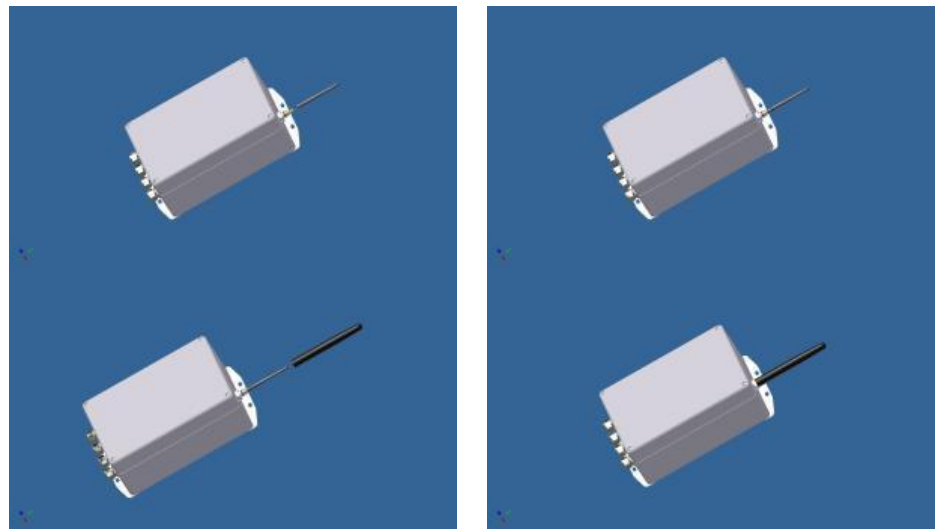
The DF100 controller received must be mounted before being powered for the first time. Its mounting is very simple and resumes to the mounting of the antenna. Although simple, requires that primary care be taken against static discharges during installation (see Preventing Electrostatic Discharge section at the beginning of this manual).

Once opened the package, remove the IP66 metal housing of the controller, the omnidirectional antenna, and its protective cover. The antenna and the protective cover are embedded into polyurethane packaging that protects the DF100. The following figure shows and identifies each of the above mentioned parties.



**Figure 2. 57 – Parts needed to mount the antenna**

Initially, firmly screw the omnidirectional antenna in the SMA (gold) connector existing on the antenna adapter. The antenna adapter is available on the outer IP66 metal housing, in its upper part, right. Once installed the omnidirectional antenna, finally screw the antenna protective cover until the base of the antenna adapter. The figure below shows the steps for mounting the antenna.



**Figure 2. 58 – Mounting the antenna**



## Connections and Power Supply

### DC Power Supply

The DF100 must be powered with a DC power supply. The following figure shows the electronic circuit board and the female<sup>4</sup> connector, to which the power supply must be connected.



**Figure 2.59 – Power supply connector**

The nominal output voltage of the power supply must be 20-30 Vdc, knowing that the DF100 consumes 11W, max. We recommend using a DC power supply with rated output voltage of 24 Vdc. In this case, the power supply must be able to provide at least about 459 mA at 24 Vdc.

Before connecting the power supply to the DF100 and power it, make sure that the polarities (+ and -) and reference ( $\text{---}$ ) indicated in the warning label, located on the mounting plate, and in the screen printing of electronic circuit board were respected.

#### NOTE

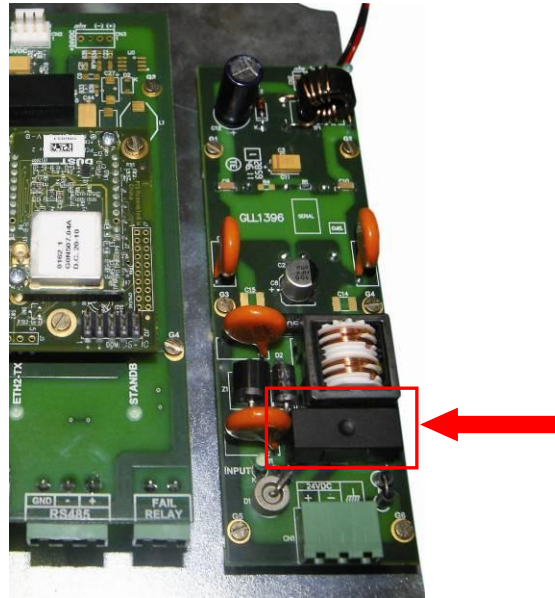
The procedures described below require opening the IP66 housing of DF100, which will expose parts of the product electronic circuitry. It is recommended therefore:

1. Disconnect the DF100 power connector before performing any of the procedures described below;
2. Disconnect any communication cables that are connected to the Ethernet and RS-485 connectors;
3. Respect labels and screen printings warnings of the product to avoid any electrical damage to electronic parts of DF100, such as those due to electrostatic discharges that can occur during handling the product;
4. Avoid performing the procedures described above in humid environments

### Fuse – Location and Replacement

The DF100 electronic circuit is protected by a fuse of 5 x 20mm, 2A, 250V. It is inside a plastic housing, located nearby the female connector that receives the supply voltage input. See the following figure.

<sup>4</sup> The male connector is supplied with the product.



**Figure 2.60 – Fuse location**

If necessary, follow the steps below to replace the fuse<sup>5</sup>:

1. Place a finger on the right side of the plastic housing cover and pull it slightly upwards. This will unlock the cover housing base;
2. Remove completely the housing cover <sup>6</sup> to access the fuse to be replaced;
3. With the aid of, for example, a plastic rod, gently push the fuse from left to right, while the pulling lightly upward. This will release the fuse left end from the terminal socket and will allow that the removal operation can be finalized with the fingers;
4. With the empty fuse socket, initially place the ends of the new fuse on terminal socket and then press it down to make sure its perfect fit;
5. Take the housing cover and place it on its base . Press it down lightly until you hear a click.

### **Ethernet connection**

The IP66 housing of DF100 has, on its bottom, cable glands specially designed to accommodate CAT5 Ethernet cables. However, it is not possible to pass an Ethernet cable (with RJ45 connectors) through cable glands. So follow these steps to prepare Ethernet cables, direct (straight through) or crossover for the DF100.

The following materials are required:

- CAT5 Ethernet Cable, shielded, with the required length;
- For each Ethernet cable, two RJ45 connectors, shielded;
- Crimping pliers for RJ45 connectors;
- Wrench;
- Phillips screwdriver.

Follow the steps below to prepare and connect the Ethernet cable to the DF100.

<sup>5</sup> The DF100 is supplied with a spare fuse.

<sup>6</sup> Do not dispose it because it will be used later on this same procedure to seal the plastic housing after installing new fuse.

Using the crimping plier, crimp a shielded RJ45 connector to one end of the Ethernet cable.



Using a Phillips screwdriver, unscrew the four screws located on the top, outside of the DF100 IP66 housing cover.



Open the DF100 IP66 housing.



Using a wrench, unscrew the cable gland protect cover, reserved for the Ethernet cable.



Remove the cable gland protect cover.



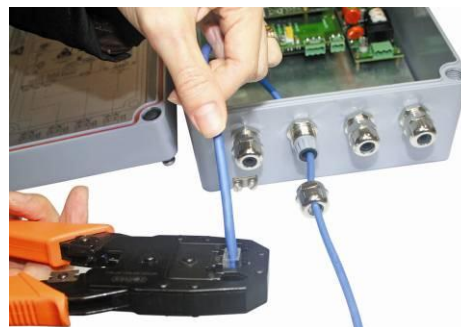
Pass the end of the Ethernet cable that was not crimped through the cable gland.



Put another RJ45 connector at the end of the Ethernet cable.



Again, using the crimping plier, crimp the connector at the end of the Ethernet cable that was passed through the cable gland.



Connect the cable to the ETH1 port of DF100.



Adjust the cable inside the DF100 housing and replace the protect cover on the cable gland.



Using a wrench, screw tightly the cable gland. Repeat this procedure if the ETH2 port is used for network redundancy (see notes).



**NOTES**

- It is recommended that the preparation of Ethernet cable be performed by a qualified electrician that follows the instructions contained in the Cable Specifications section in this manual.
- If the DF100 ETH2 port is not used, for HSE network redundancy, remove its respective cable gland (if installed) and replace it with a stainless steel plug (cap).

After connecting a CAT5 Ethernet cable, shielded, in the DF100 ETH1 port is necessary to connect it in the HSE control network hub/switch. If you prefer to connect to DF100 ETH1 port to the Ethernet network card of a personal computer or notebook, use a crossover Ethernet cable, shielded. Make sure that the length of used Ethernet cable does not exceed 100 m.

**NOTE**

For HSE network redundancy, consider the procedure described above and connect another Ethernet cable to the port ETH2 of DF100.

If the Modbus communication is not used, make sure to properly close the DF100 IP66 housing after the connection operation, described above.

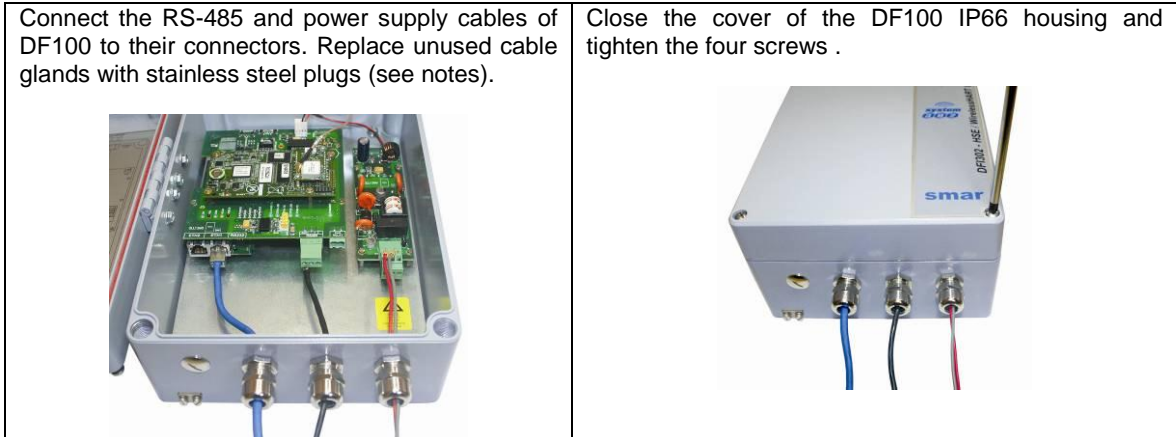
**RS-485 Connection**

The RS-485 connection requires 3 wires, for differential signals positive (+) and negative (-) and ground GND, respectively. It is recommended to use twisted pair cable, shielded, 2 x 1.5 mm<sup>2</sup> and terminating resistors at both ends of the bus<sup>7</sup>. Connect the shield to the GND ground pin. The DF100 operates at baud rate of 19200 bps, max. Thus, it is also recommended that the cable length does not exceed 1200 m.

<sup>7</sup> The DF100 has switches to enable the termination resistor.

The RS-485 connector, which exists on the interface board is physically identical to the connector used in the input power supply board of the DF100. However, for its connection, the RS-485 needs to be rotated 180° relative to the power supply. In addition to the guidelines contained in the DF100 informational tag<sup>8</sup> about the connector placement, this fact alerts the user when installing the connector to the RS-485 port and helps avoiding mistakes.

See below the finalizing of the connection procedure of RS-485 and power supply cables to the DF100.



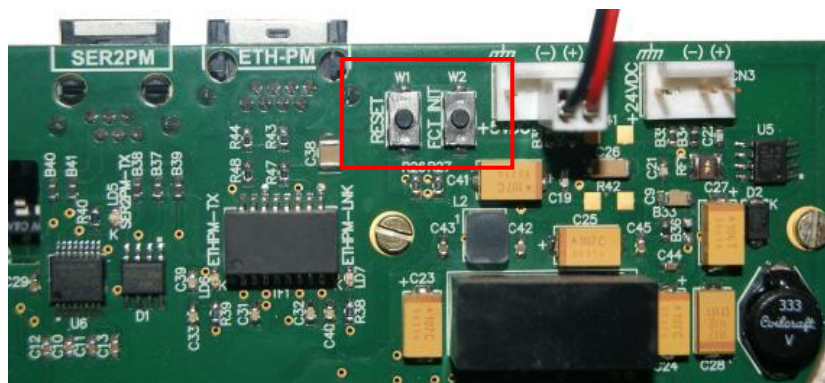
- NOTES**
- If the Modbus communication is not used, remove its respective cable gland (if installed) and replace it with a stainless steel plug (cap).
  - Make sure to properly close the DF100 IP66 housing after completing the connection operation, just described above

### Configuring the DF100 to operate on a WirelessHART network

The DF100 is a DFI302 controller, and therefore has all the common characteristics of DFI302 controllers (eg, Reset, Factory Init, default IP address) are configured similarly. Thus, we describe below only the specific characteristics of the DF100.

#### Factory Init/Reset

The same options for Reset and operation modes that exist in other DFI302 controllers are also available for DF100. The Factory Init/Reset push-buttons in the DF100 are identified as **W1** and **W2**, respectively, and are placed at the top front of the interface board. Refer to Troubleshooting Section in this manual for details on operation modes.



**Figure 2. 61 – Detail of Factory Init and Reset push-buttons**

<sup>8</sup> The informational tag is located on the internal side of the IP66 metal housing cover.

**NOTE**

The informational tag contains the W1 and W2 BUTTONS table, which outlines how the push-buttons W1 and W2 may be used to apply an operation mode to DF100.

**RS-485 Communication**

The DF100 has one EIA-485 port and RS-485 switches (SW1, SW2, SW3 and SW4) that are available in the interface board, near to the RS-485 connector, to configure the *pull-up and pull-down* resistors and a terminating resistor to suit the communication bus. Refer to Technical specifications for the controllers section for further information about the RS-485 switches.

**WirelessHART Network Identifier (Network Id)**

The DF100 Web Server is the tool to be used for configuring the *WirelessHART* Network Id. Power the DF100 and launch a browser. In the address field (URL) of the browser, type the IP address<sup>9</sup> of the current DF100 that will be configured. Then press the ENTER key. The DF100 home page will open.

From the home page, select the *WirelessHART* network configuration page, from **WirelessHART > Network.> Configuration**.

**Figure 2. 62 – WirelessHART configuration page**

Click the box associated to the *WirelessHART* Network Id, named **Access Point Network Id** and type a valid value, and then click **Apply Changes** button. Valid values for the Network Id are described in the Network Manager topic.

<sup>9</sup> All DF100 is configured with default IP address equal to 192 168 164 100. If DF100 does not respond when is requested this address, we suggest the application of Mode 3 - Assign Automatic IP. To do so, use the push-buttons of Factory Init/Reset (W1 and W2).

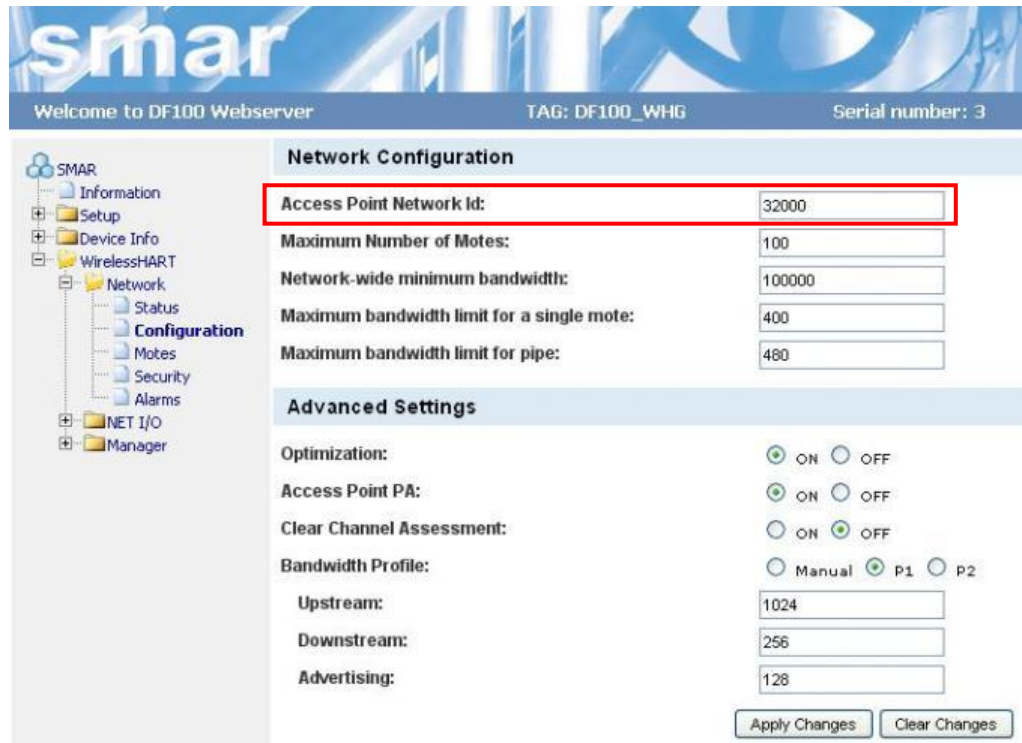


Figure 2. 63 – Configuring the Network Identifier

**NOTE**

The standard value of the Network Identifier for the DF100 is 302 (0x012E, hexadecimal). User is recommended to replace this value by another that suits your needs.

**ATTENTION**

The value assigned to the *WirelessHART* network identifier must be kept confidential.

**Join Key of the *WirelessHART* network**

The DF100 WEB Server is also used for configuring the Join Key. With the DF100 powered and using a browser, launch the home page of the DF100<sup>10</sup>.

From this home page, select the *WirelessHART* network security page, from **WirelessHART > Network > Security**.



Figure 2. 64 – *WirelessHART* security page

A dialog box will appear for user authentication. Log in using <smar, smar> for the fields <User name, password> of the dialog box, and then, click **OK**.

<sup>10</sup> To launch the DF100 home page, review the section on configuration of *WirelessHART* Network Identifier.

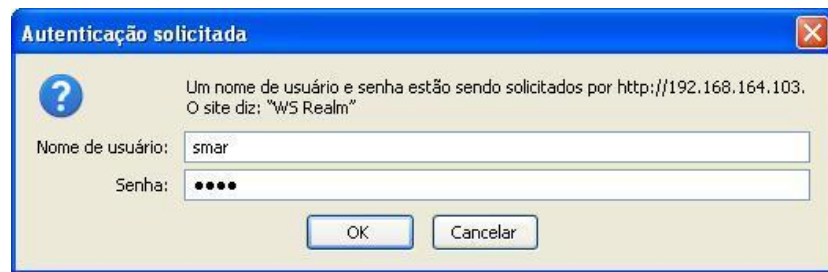


Figure 2. 65 – Dialog box for authentication

The page **Security Management** will open. Select the **Accept Common Join Key** and in the field **Common Join Key** type the desired key. And then, click **Apply Changes** button.



Figure 2. 66 – Configuring the Join Key

#### NOTE

The Standard value of the Join Key for the DF100 is 00000000000000000000000000000000302 (0x00000000000000000000000000000000302, hexadecimal). User is recommended to replace this value by another that suits your needs.

#### ATTENTION

The value assigned to the join key must be kept confidential.

## Installing the DF100 in the field

As we have seen, unlike the other DF1302 controllers, the DF100 was designed to operate outdoors. This controller is designed with mounting tabs that allow its installation in walls or pipes.

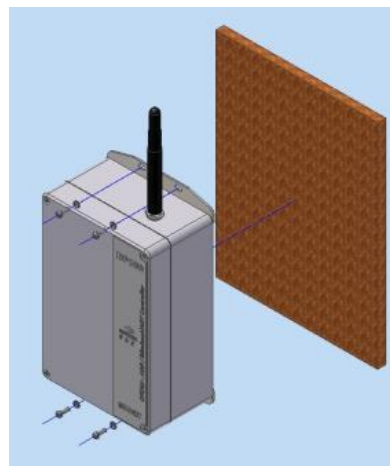
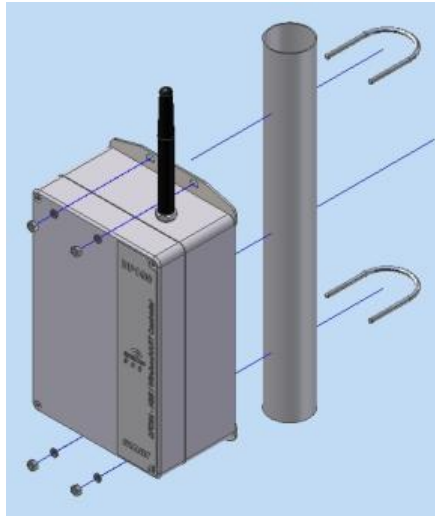


Figure 2. 67 – Wall mounting





**Figure 2.68 – Pipe mounting**

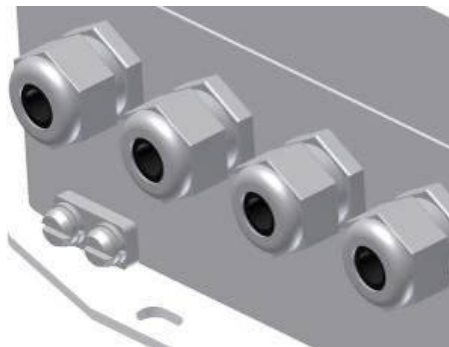
It is recommended to install the DF100 in a central and strategic plant place, from which it both has a good line of sight of a minimum set of *WirelessHART* devices, and proximity of the control room where the host is. Once configured, the DF100, understood here as the *WirelessHART* Gateway, should be the first device to be energized (powered) in a planned *WirelessHART* network. In other words, the DF100 must always be energized before any other *WirelessHART* device (field device or adapter).

**ATTENTION**

The DF100 installation can only be done by qualified electricians.

**Grounding**

Use the grounding plate at the bottom, left, of the DF100 IP66 housing (see next figure) to properly ground it. Additional information on grounding can be found in the SYSTEM302 - Electrical Installation Guide.



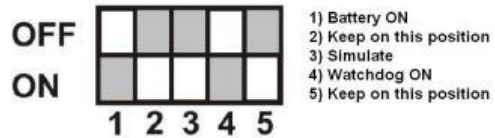
**Figure 2.69 – Grounding plate**

**ATTENTION**

The DF100 grounding can only be done by qualified electricians.

**Important:**

The DF100 has an internal battery that keeps the Real Time Clock (RTC) and its non volatile RAM (NVRAM) when there is lack of external supply. This battery can be either enabled or disabled, depending on the position of the switch 1, in the internal part of the DF100. To enable the battery, set the switch 1 to ON position as shown in the following figure:



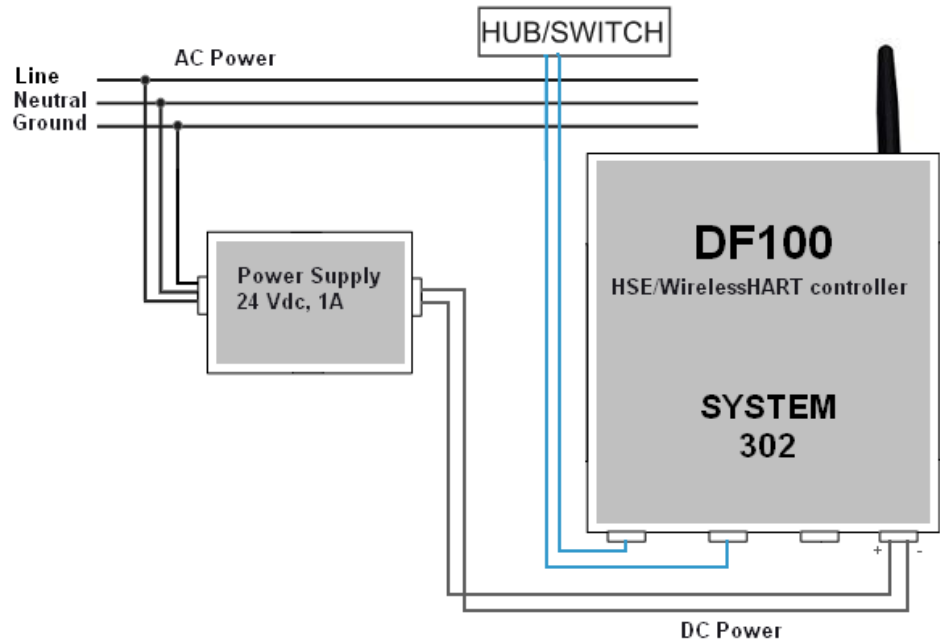
In this configuration, when there is lack of energy, the RTC and the NVRAM will be supplied by the battery, allowing the retention of all configuration data. In case of equipment storage, it is recommended that the battery is turned off (switch 1 in OFF position). For further information about the battery, refer to the "Technical specification for controllers" section.

So, before installing the DF100 module, be sure the switch 1, which refers to the battery, is in the enabled position. If the battery is not enabled during the start-up, the DF100 controller starts in HOLD mode.

The Watchdog is a mechanism to detect if an important or high priority task stops in the controller. So, be sure the switch 4, which refers to the Watchdog, is in the ON position.

Knowing the topics of the above sections, a basic system using the DF100 controller can be composed of:

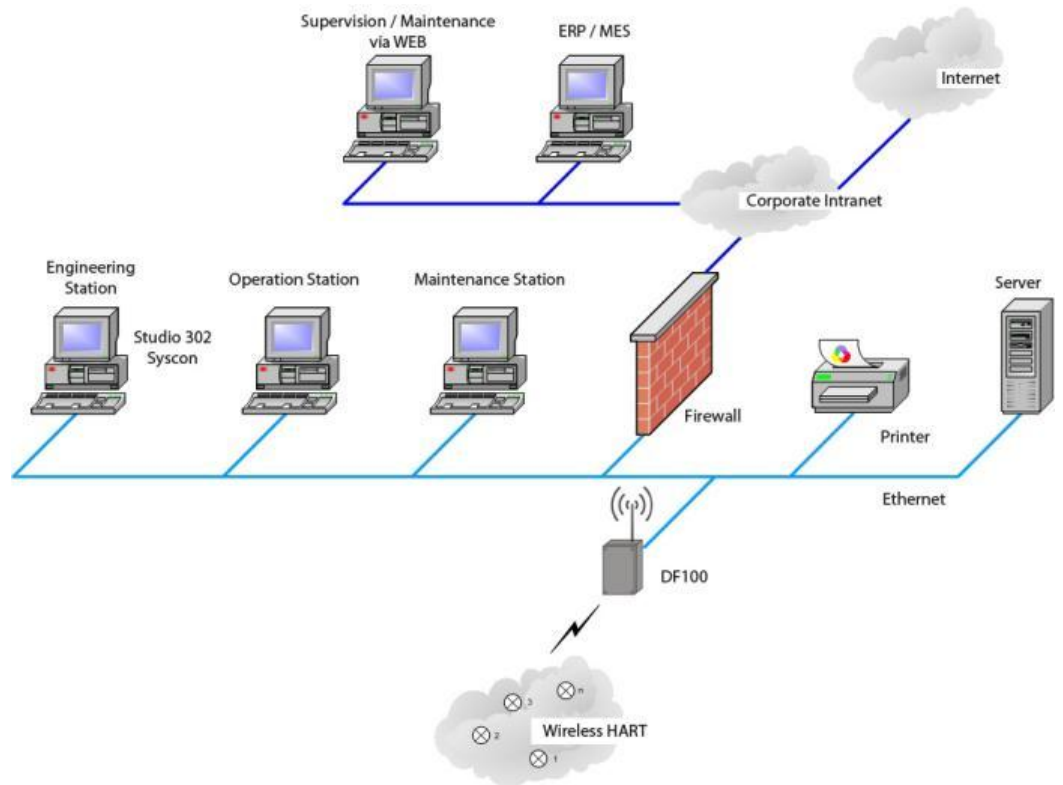
- Power Supply (24Vdc, 1A);
- DF100 – HSE/WirelessHART Controller;



**Figure 2. 70 – Basic system using the DF100 controller**

The DF100 can be used outdoors, because it has IP66 rating. The wireless technology significantly reduces costs related to cabling, trays, and technical/engineering hours spent on maintaining the network.

The basic project topology is shown in the following figure. It has two control network segments interconnected to corporate networks. On the control network is added the DF100 controller. Finally, supervision and control stations complete the interconnection system.



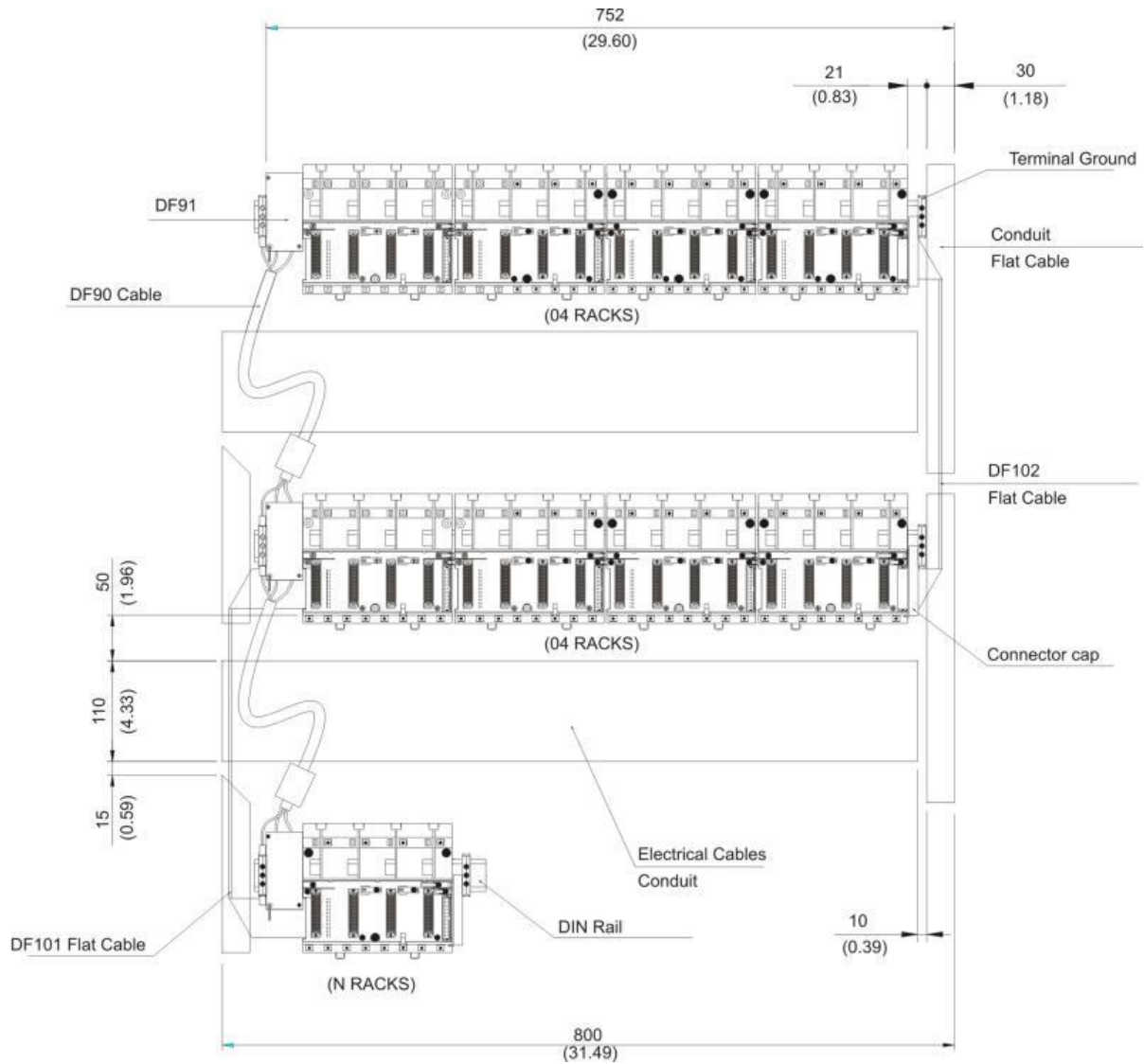
**Figure 2. 71 – Wireless architecture for control network**

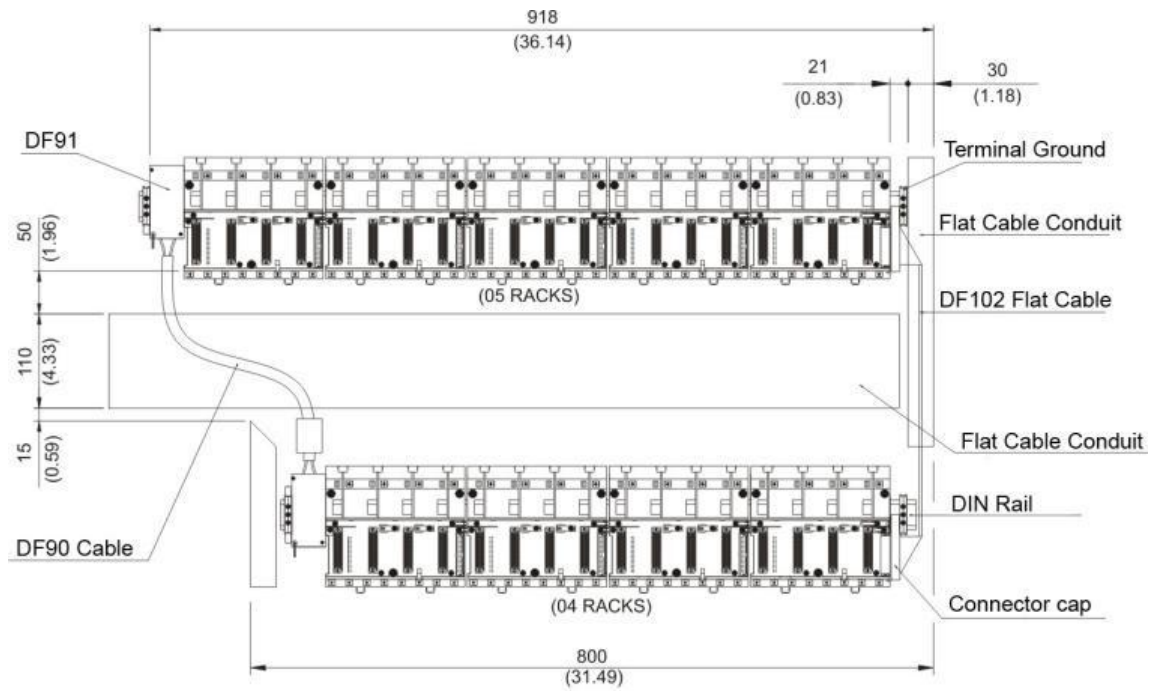
Tools such as **Syscon** and **Studio302** are related to the architecture to integrate the controller and the wireless network to others industrial automation protocols. For further details refer to the Creating a Foundation fieldbus strategy using the DF100.



## Dimensional Drawings of DF93 and Modules

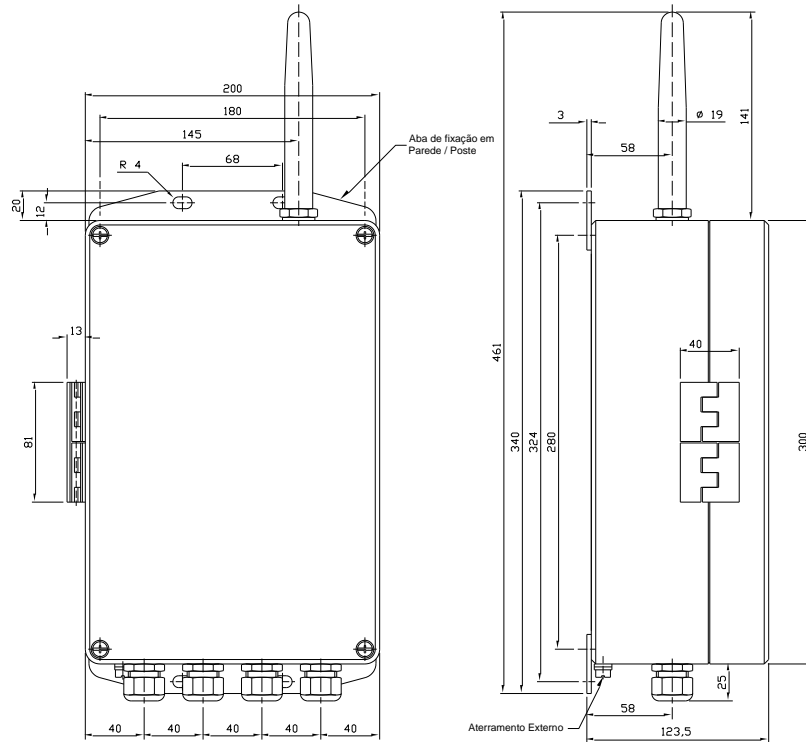
The following figures shows two possible combinations (dimensions in mm).





**Dimensional drawing of DF100**

Dimensions in mm



## Installing the Studio302

Install the programs that compose the **SYSTEM302** using the installation DVD. For further details about installing the programs, refer to the **SYSTEM302** Installation Guide. The **Studio302** is the user-friendly, easy-to-use software tool that integrates all applications included in Smar's Enterprise Automation package.



Figure 2. 73 – Installing Studio302

## Getting License for DFI302 Servers

There are two ways to get the **DFI OLEServer** and **HSE OLEServer** license. One version is through Hard Lock protection (Hard Keys) and other through Software (Soft Key).

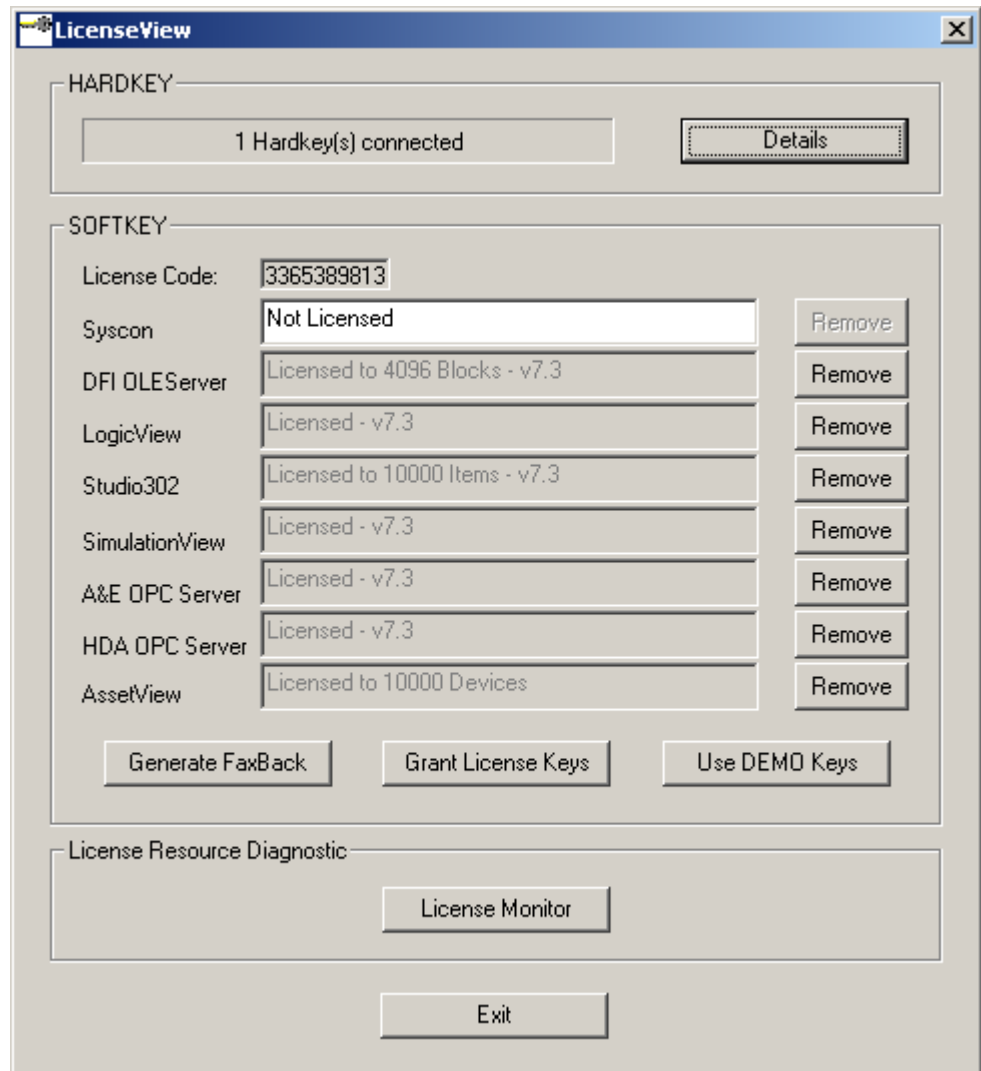
When using Hard Key, just connect it in the appropriated port in the computer (parallel or USB ports).

When using Soft Key, it is necessary to get a License Key through a SMAR contact. For this, use the application **LicenseView**, found in the shortcut in the **Studio302** interface.

From the information generated by this application, fill in the form FaxBack.txt and send it to SMAR appropriate fax number.

### NOTE

This license is valid for **DFI OLEServer** and **HSE OLEServer**.



**Figure 2. 74 – Getting Licenses**

Afterwards, SMAR will send the Licenses Keys. Type the codes in the blank fields (observe the previous figure) and click the **Grant License Keys** button.

If these codes were accepted, a message will be generated confirming the successful operation. At this moment, **Syscon**, **DFI OLEServer** and **HSE OLEServer** will be ready to be used.





# Section 3

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## SETTING UP

### *DFI OLE Server and HSE OLE Server Settings*

After success in Getting License procedures, user should set some parameters related to the DFI OLE Server and HSE OLEServer. For further details about SMAR OLE Servers, refer to the specific section.

### *Connecting the DFI302 in the Subnet*

**DFI302** working environment is composed by a network (subnet) where IP addresses will be necessary for each connected instrument.

The automatic solution for attribution of these addresses is called DHCP (Dynamic Host Configuration Protocol) Server.

Using DHCP Server these IP addresses are generated automatically preventing any IP conflict between two distinct devices.

#### ATTENTION

To connect more than one **DFI302**, the following steps must be fully executed for each **DFI302**.

- 1- Plug the Ethernet cable (DF54) of the controller module to its respective subnet switch (or hub).

#### NOTE

For point-to-point connection (the module **DFI302** connected directly to the computer), uses the DF55 cross cable.

- 2- Turn on the controller module. Ensure that ETH10 and RUN indication LEDs are on.
- 3- Keep tight pressed the left push-button (Factory Init / Reset) and press the right push-button for three times. The FORCE LED will blink three times consecutively.

#### NOTE

If the user loses the number of times that the right push-button was pressed, just see the number of times that the FORCE LED is blinking at each second. It will turn to blink once after the fourth touch (this function is cyclic).

- 4- Release the left push-button and the system will execute the RESET, and subsequently will start the firmware with standard values for IP address and the subnet mask.

### **For Network WITH DHCP**

- 5- If the network has a DHCP server (consult the network administrator), the controller is already connected to the subnet. Stop the steps here.

### **For Network WITHOUT DHCP**

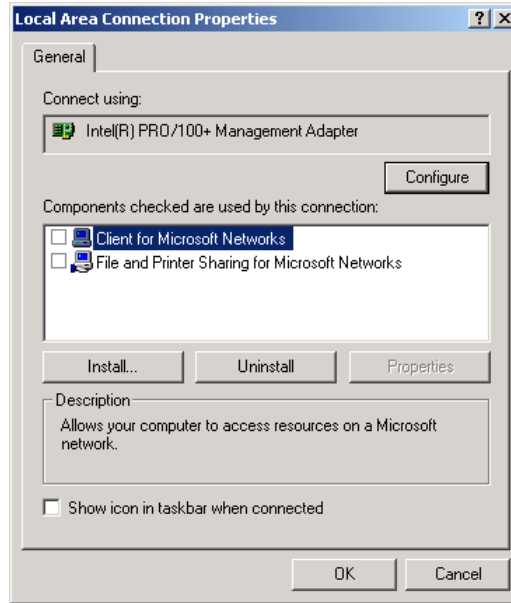
- 6- If the network does not have a DHCP server, the controller will have the default IP address 192.168.164.100 and it will need to follow the next steps.

The IP address of the user's computer needs to change for a while (network management knowledge is required). The following procedures are based on Windows 2000. Choose **Start → Settings → Control Panel**. Double-click **Network and Dial-Up Connections** option or similar.

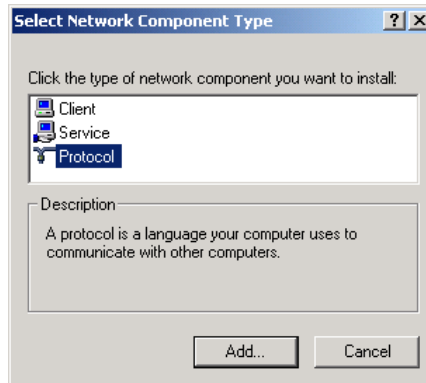
#### NOTE

Right-click **Local Area Connection**, choose **Properties** from the pop-up menu. Whether in the component list has TCP/IP protocol, the user should skip to step 9 or proceed the installation using the **Install** button.

7- Click **Install**.

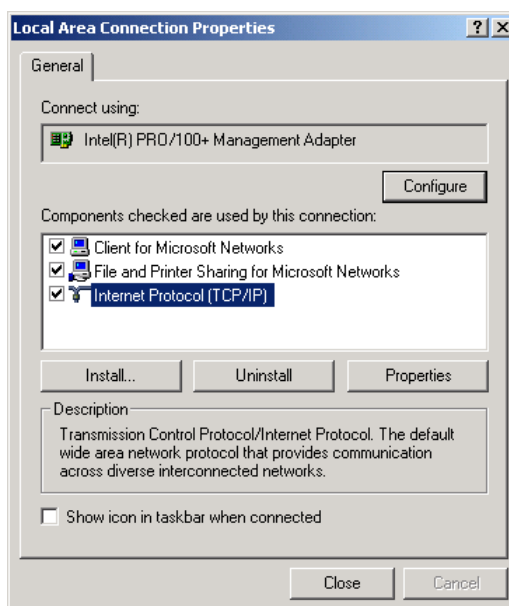


8- Select the network type **Protocol**, and click **Add**.



9- Select **Internet Protocol**, and click **Ok**.

10- Select **Internet Protocol (TCP/IP)**, and click **Properties**.



- 11- Take a note of the original values of IP address and Subnet Mask of the computer to restore them when the operation ends.

#### NOTE

If the IP address is already something like: 192.168.164.XXX, skip to Step 14.

- 12- Change IP address and the Subnet Mask of the computer. It must select the same Subnet of DFI302 (164) and an IP address different of the DFI302 (100). The Network Administrator must provide the IP address.

#### NOTE

The values will be something like: IP Address 192.168.164.XXX and network mask (Subnet Mask) 255.255.255.0. Keep the default gateway value.

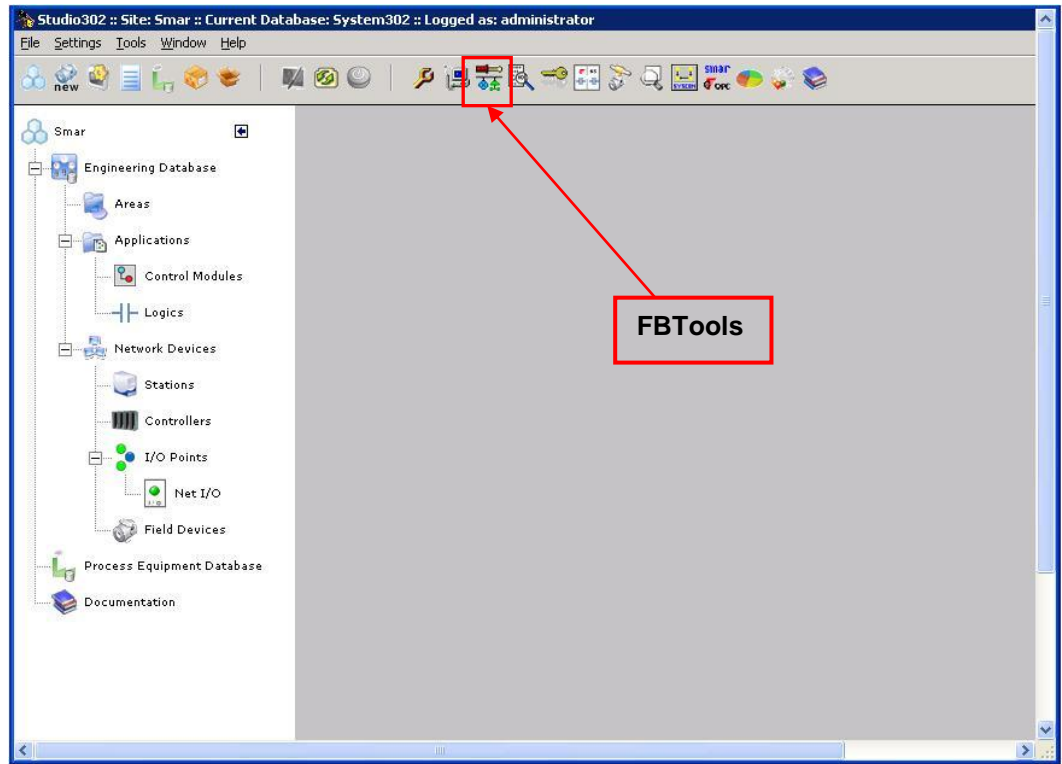
#### ATTENTION

Do not use the IP Address 192.168.164.100. This is already DFI302 default address.

- 13- Click **OK**.

- 14- Run the **FBTools** through **Studio302**. Click **Start menu** → **Programs** → **System302** →

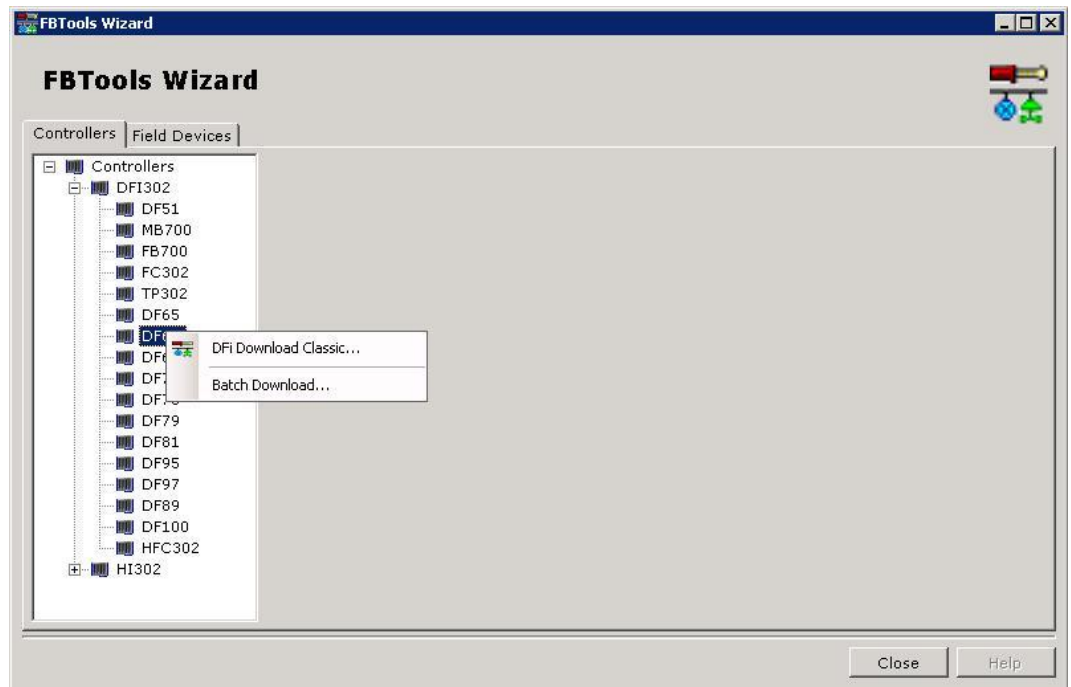
**Studio302**. Do a login in the system. In the **Studio302** interface click the  icon in the main toolbar. See the next figure.



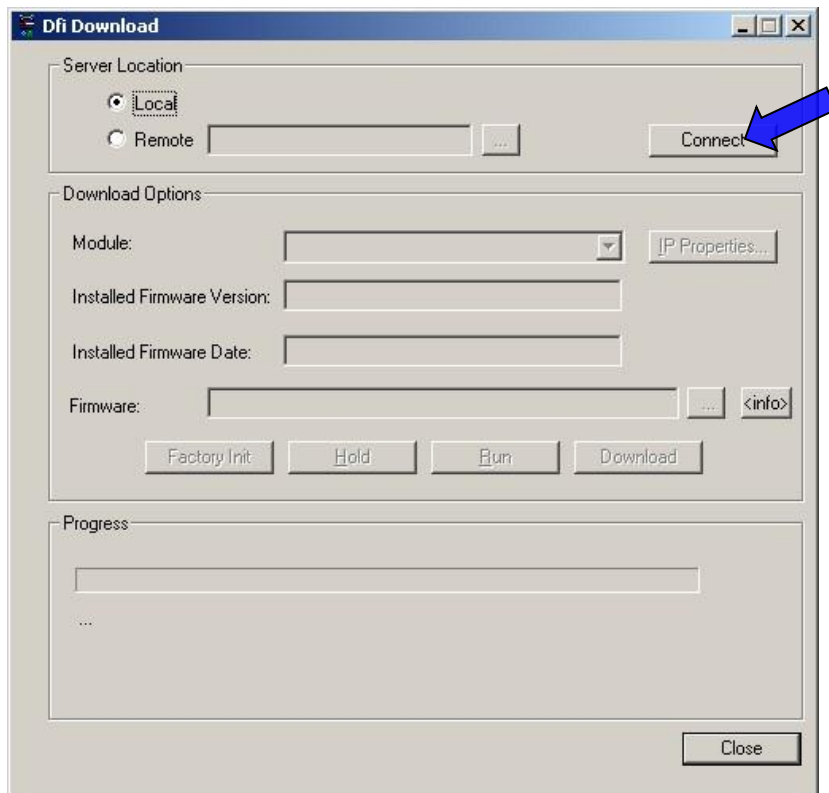
15- The following window will open. In the **Controllers** tab click the symbol  and the **DFI302** and **HI302** options will appear. Click again the symbol  in **DFI302** and select the controller module.



16- Right-clicking the controller the **Dfi Download Classic** and **Batch Download** options will appear. See the following figure.



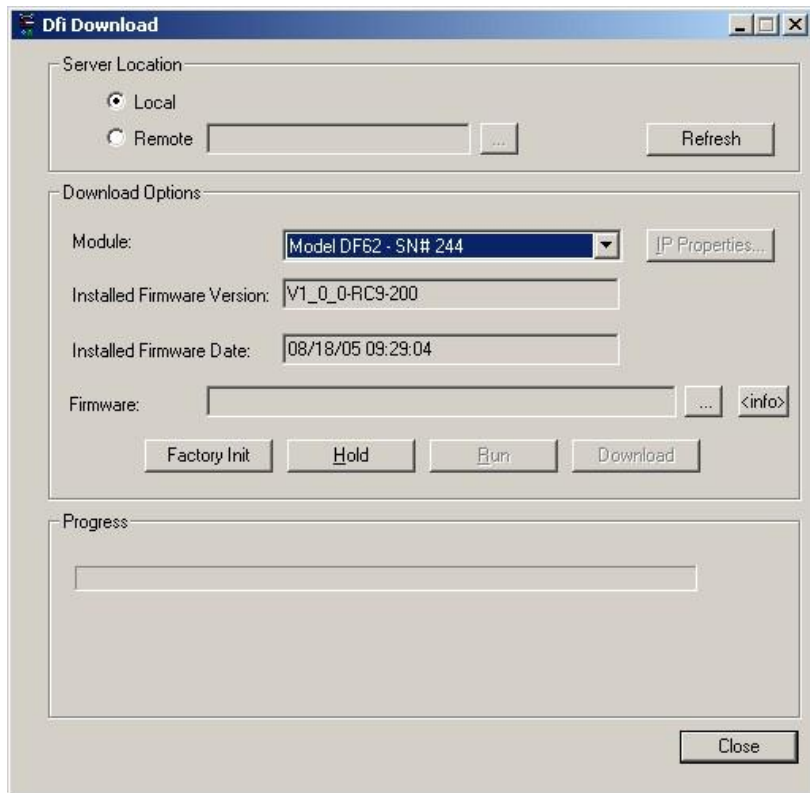
- 17- Select **Dfi Download Classic** and the following figure will appear. Select the DFI OLEServer path to be used (Local is the default path), and click **Connect**.



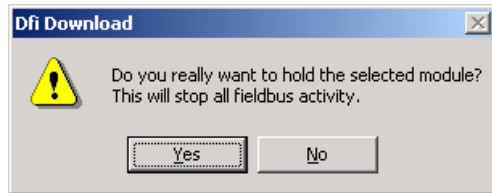
- 18- Select the controller in the **Module** box. Use the serial number as a reference that is in the external identification label.

**ATTENTION**

The non-observance of this step may imply in serious consequence.



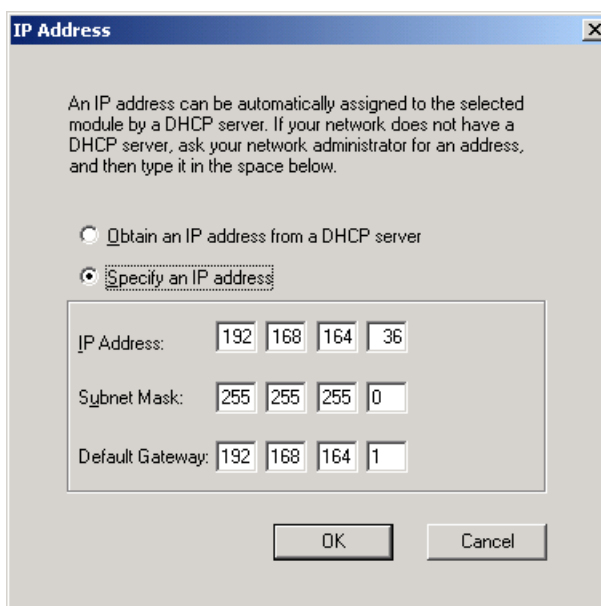
- 19- Click **Hold** to interrupt the firmware execution. When the user clicks the **Hold** button, the module will stop the firmware execution as well as all the activities in the fieldbus line. Confirm the operation by clicking **Yes**.



**ATTENTION**

This step will be necessary only if the **Hold** button is enabled; pointing out that the firmware is being fulfilled.

- 20- Check if the HOLD LED is ON. Click **IP Properties** to configure the IP address of the module. The IP Address dialog box will open.
- 21- The default option is to obtain the IP address from DHCP Server. Select the option **Specify an IP address** to change to another IP address.



- 22- Type the IP address, the subnet mask and the default gateway. The subnet mask should be the same of the user's computer original default address (Step 11). So, the computer settings can be restored later, and the network will show **DFI302** modules.

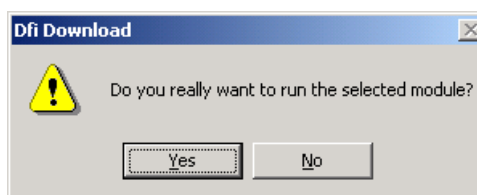
#### ATTENTION

Do not use the IP Address 192.168.164.100 (it is already being used by **DFI302**)

#### HINT

Write down the IP addresses that will be specified and the serial number of each controller module. It will help in the identification and diagnostics of possible failures.

- 23- Click **OK** to end up this operation. Go back to the **Internet Protocols (TCP/IP)** properties of the computer and restore the original values of the IP address and the subnet mask.
- 24- Click **Run** to execute the **DFI302** firmware again.
- 25- A dialog box will open to confirm the operation. Click **Yes** to continue.



- 26- The procedure to connect the **DFI302** to the subnet is complete. Repeat these steps above for the other modules.

#### NOTE

In case of there is more than one **DFI302** to be set up, perform the following command to clear **ARP table**, before setting up the next **DFI302**.

```
C:\>arp -d 192.168.164.100 < enter >
```

- 27- In the DOS prompt, type "C:\>arp -d 192.168.164.100 <enter>".



## Updating the Firmware

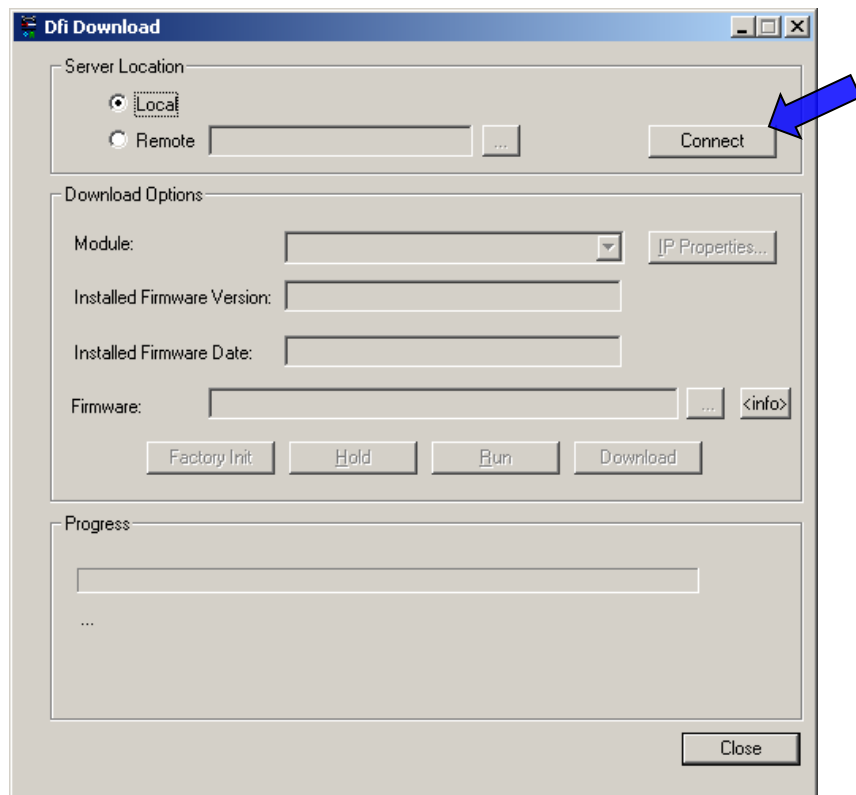
1. Make sure that the **DFI302** is ON and has been connected to the subnet, according to the procedures in "Connecting the DFI302 in the Subnet".
2. Run the **FBTools** as described in the step 14 of the previous topic.
3. Select the controller module and right-click it. Choose an option - **Dfi download Classic** or **Batch Download**.

The **Dfi Download Classic** option allows updating the firmware, changing the IPs of controllers and other devices.

The **Batch Download** option allows updating the firmware of up to 64 controllers simultaneously.

### DFi Download Classic

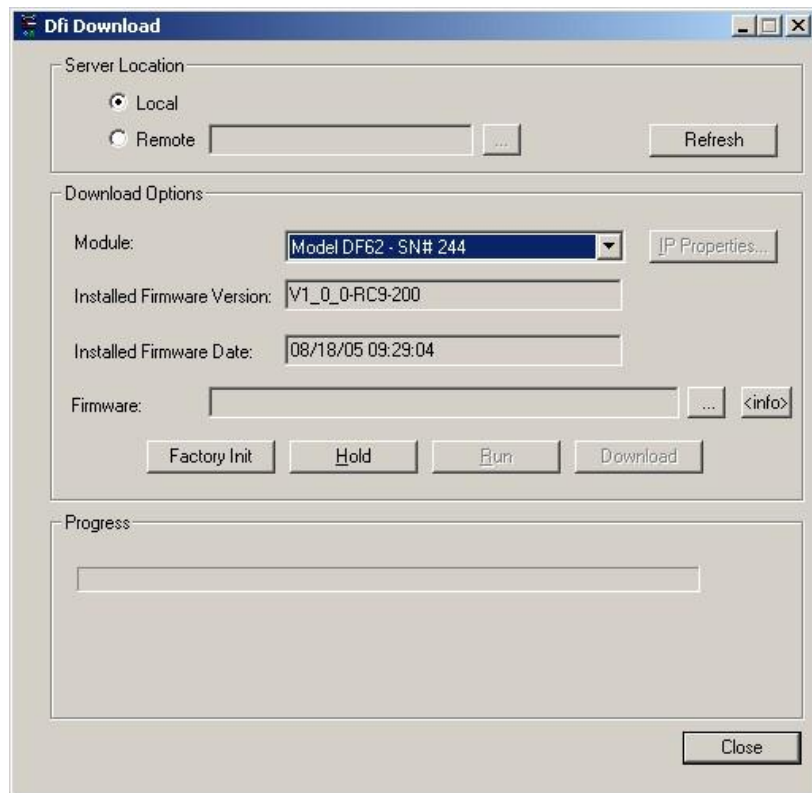
1. By selecting the **Dfi Download Classic** the **Dfi Download** window will open. Select the DFI OLEServer path to be used (Local is the default path), and click **Connect**.



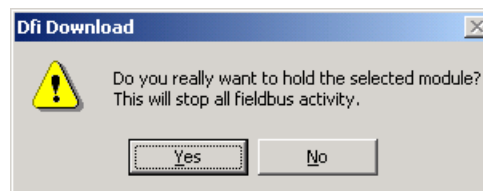
2. Select the controller module in the **Module** box. Use the serial number as a reference (see the external identification label).

#### ATTENTION

The non-observance of this step can imply in serious damages.




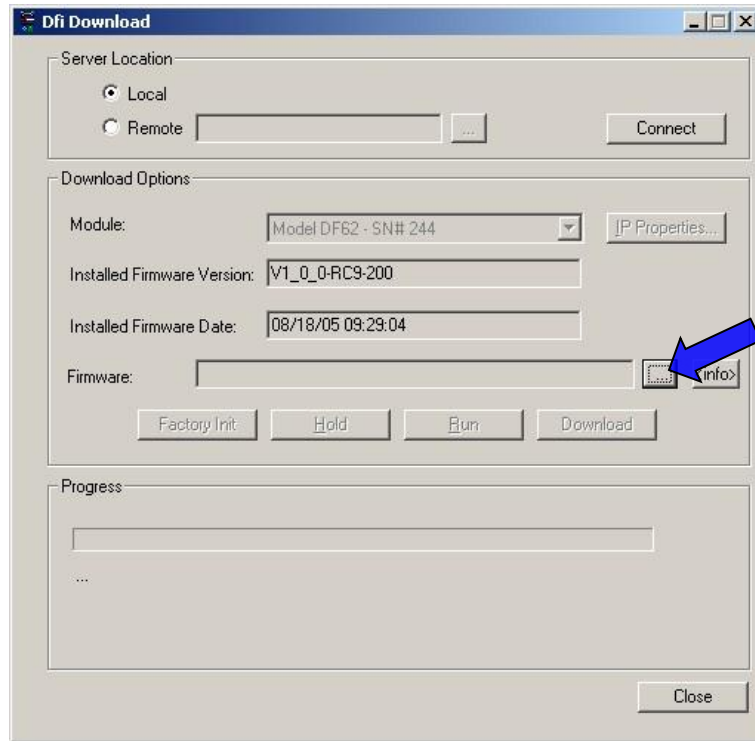
3. Click **Hold** to interrupt the firmware execution in the controller.
4. Afterwards all activities in the fieldbus network will be stopped. Confirm this operation by clicking **Yes**.



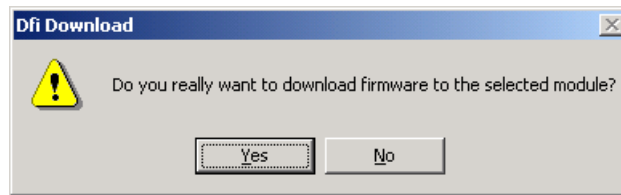
#### ATTENTION

For the steps below, it is necessary to have the **Hold** button enabled, indicating that the firmware is being executed.

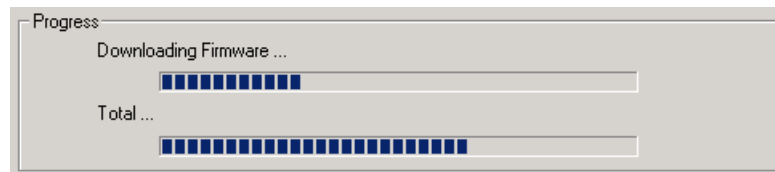
5. Check if the HOLD LED is ON.
6. Note that the **DFI Download** window shows the installed version and date of the current firmware loaded in the controller module.
7. Click the  button to select the firmware file to be downloaded (controller\*.abs file).



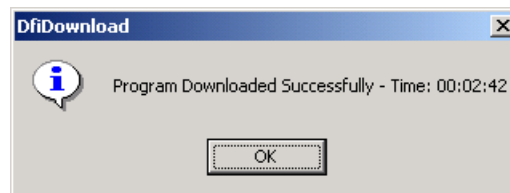
8. After selecting the firmware file, click **Connect**. The **Download** button will be enabled. Click it to start the firmware download.
9. A message box will come up requesting a confirmation. Click **Yes** to continue.



10. The progress bar at the bottom of the window will show the operation progress.



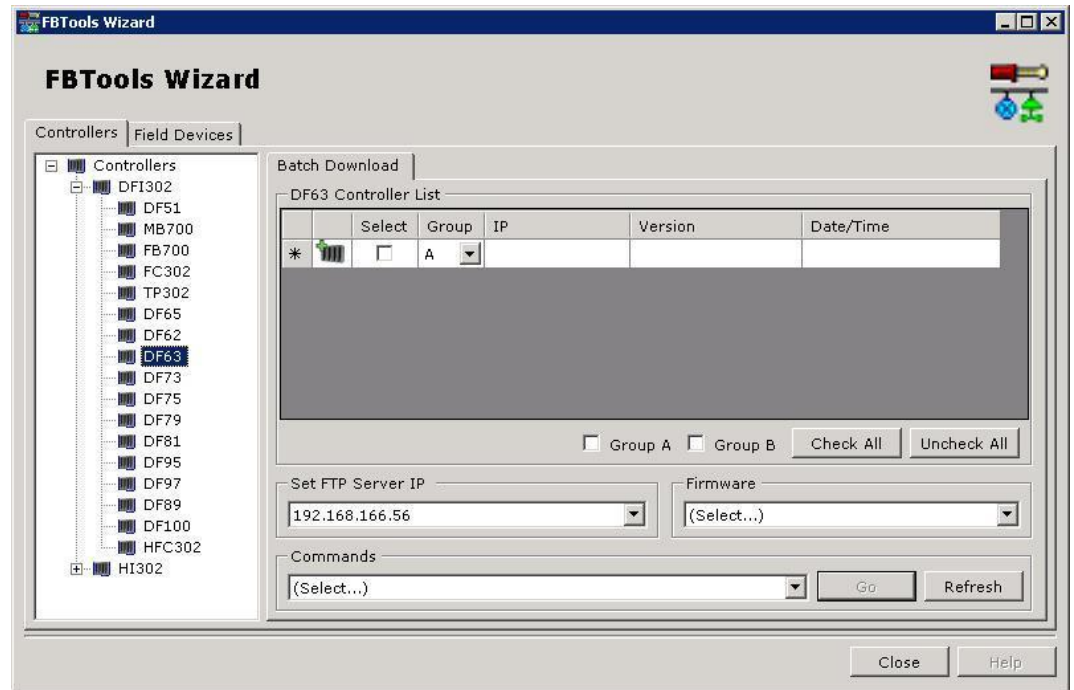
11. When the download is complete, a dialog box will appear confirming that the program was downloaded successfully. Click **OK** and wait a few minutes while the information is updated. The **DFI302** will be in "Run Mode". (Check if the RUN LED is ON.)



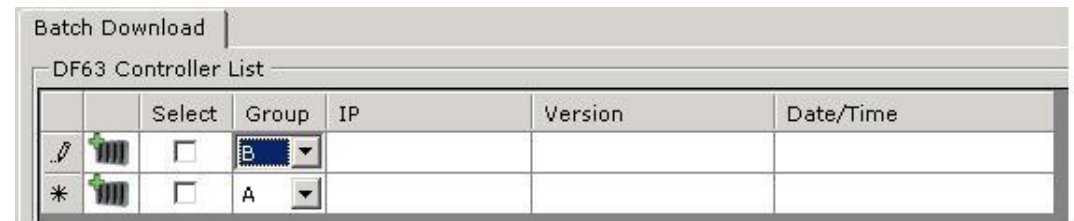
12. Click **Close** to close the **Dfi Download** window.

## Batch Download

By selecting the **Batch Download** option, the following window will appear:



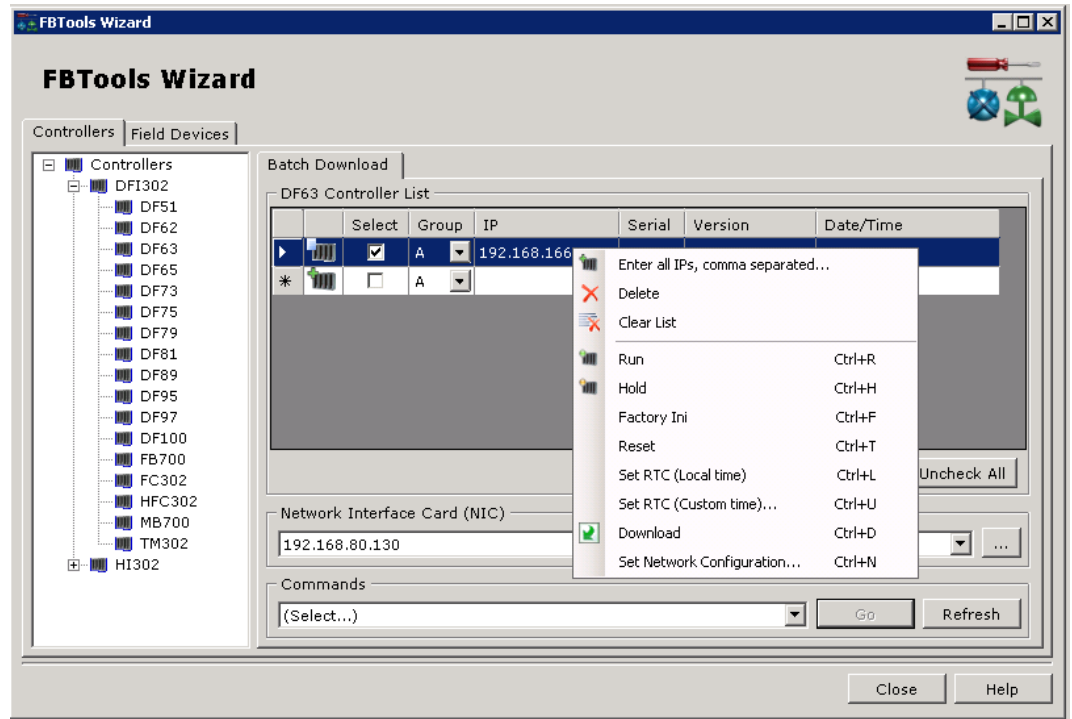
The controllers can be divided in two groups – A and B. The groups are used to classify the controllers. Typically when redundancy is used, there is the option to change the firmware of all secondary controllers first, and then the primary ones. This procedure facilitates the hot swap maintenance of the plant without requiring stops. For this, the group A is used to classify all primary controllers, and group B the secondary controllers. See the following figure.



The symbols of the previous figure have the following meanings:

|  |   |
|--|---|
|  | Editing mode of a controllers list field    |
|  | Empty list item                             |
|  | New controller can be inserted in this line |
|  | Controller already registered on the list   |

Right-clicking the controllers list the following options will appear:



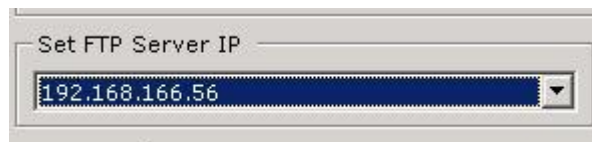
Through the **Enter all IPs, comma separated...** option the user can insert various IPs on the list simultaneously, separated by commas. After entering the IPs click **Insert** and make the association of groups A and B.

The **Delete** option deletes the selected IP and **Clear List** option clears the IPs list.

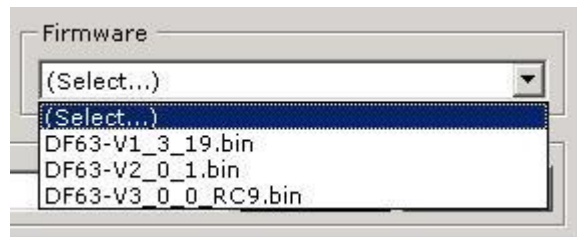
To select, or deselect, all controllers of groups A and B use the **Check All** or **Uncheck All** options, respectively. See the following figure:



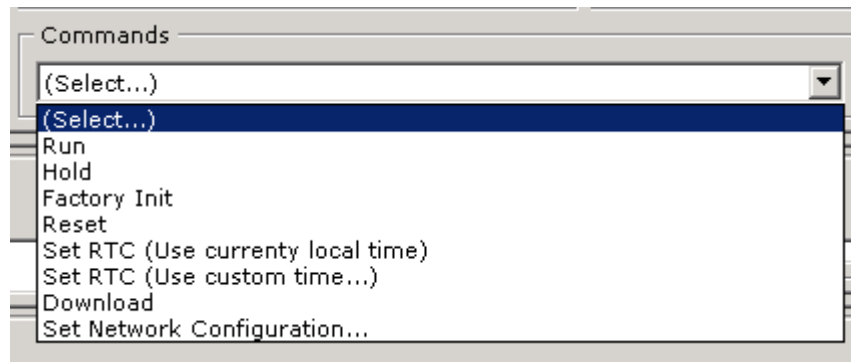
Up to 64 controllers can be updated simultaneously. The firmware file should have the **.bin** extension to be used by **Batch Download**. In the **FTP Server IP** field choose one of the options presented, because this IP chosen will be used by the controller to take the existent **.bin** file.



The available versions are in the **Firmware** field.

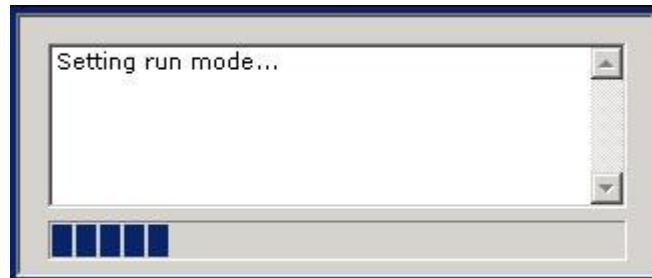


In the **Commands** field are the action options of the **Batch Download**. Select the controller, the command to be performed and click **Go**.

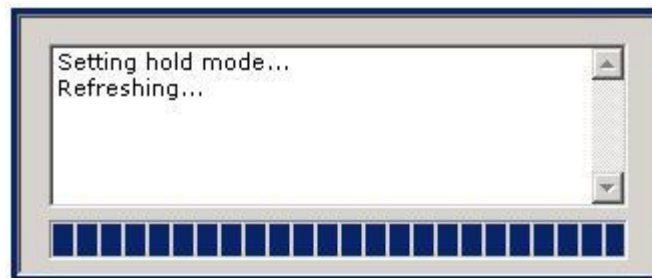


Here are the definitions of the above options:

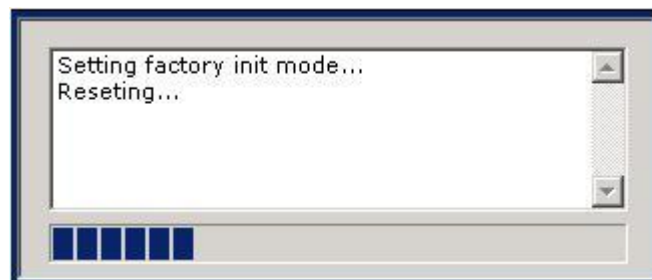
**Run** – Starts the firmware execution in the controller module. The following window will appear.



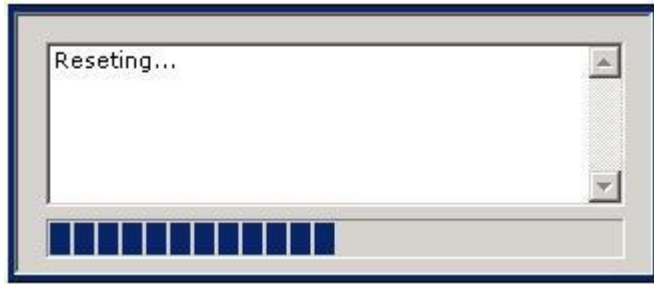
**Hold** - Interrupts the firmware execution in the controller. The following window will appear.



**Factory Init** – Erases the configurations of strategies and logics. It returns the controller to the same state it left the factory. The following window will appear:



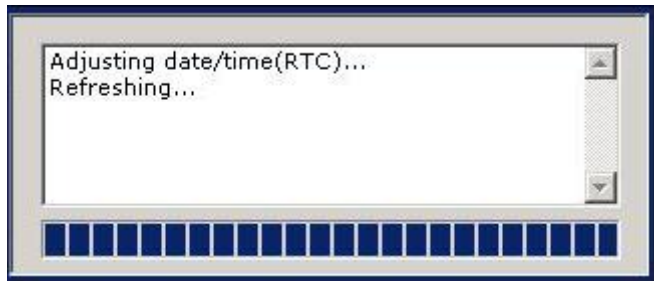
**Reset** – Restarts the controller, maintaining the configurations that were saved at the last download. Some dynamic parameters are erased, but not the static parameters. This is dependent on each function block. Refer to Function Blocks manual for further information. The following window will appear:



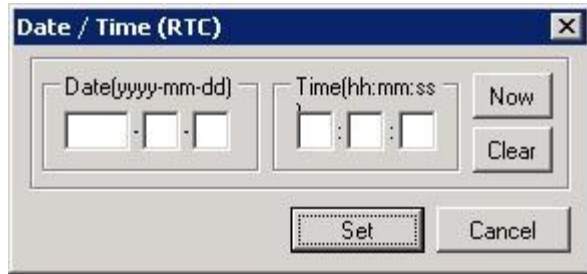
**NOTE**

In both cases, **Reset** and **Factory Init**, the firmware is kept. The controller’s IP may be change only if is set the option to obtain it via DHCP Server. Otherwise the controller will keep the last IP assigned.

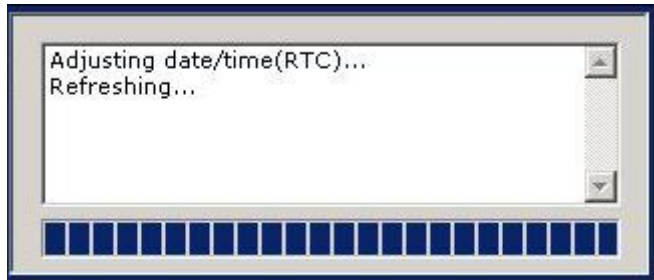
**SetRTC (use currently local time)** – Sends the *Localtime* to the controller. The following window will appear:



**SetRTC (use custom time)** – Sends the user-configured time to the controller in a properly window. See the following figure. Write the date and hour desired, and click **Set**. If you want to insert the current date and hour click **Now**. The **Clear** option clears the fields filled.



After filling the fields and click **Set** the following window will appear:

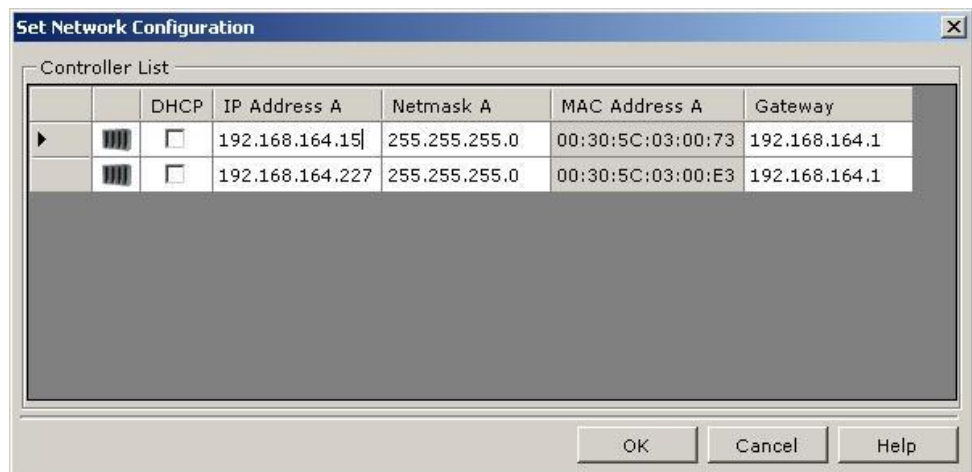


**Download** – Performs the firmware download. The following window will appear:

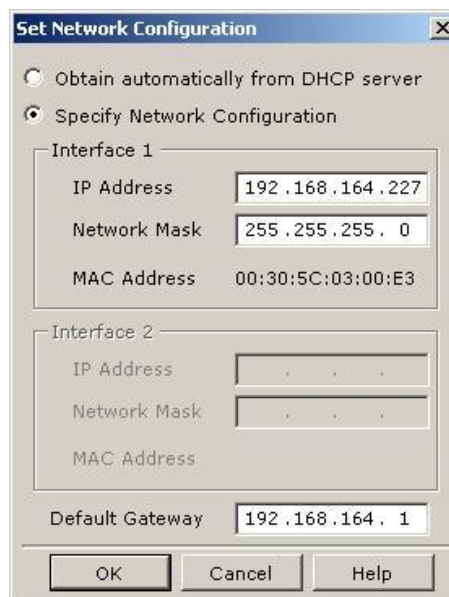


A progress bar will signal that the download is in progress. After this, confirm in the table that the information from the controller is corresponding to actions performed, for example, the firmware version.

**Set Network configuration** – This option allows controllers IP are changed in batch. The following figure will open:



If only one controller is selected the following figure will open:



For details about changing the controller's IP see the next topic.



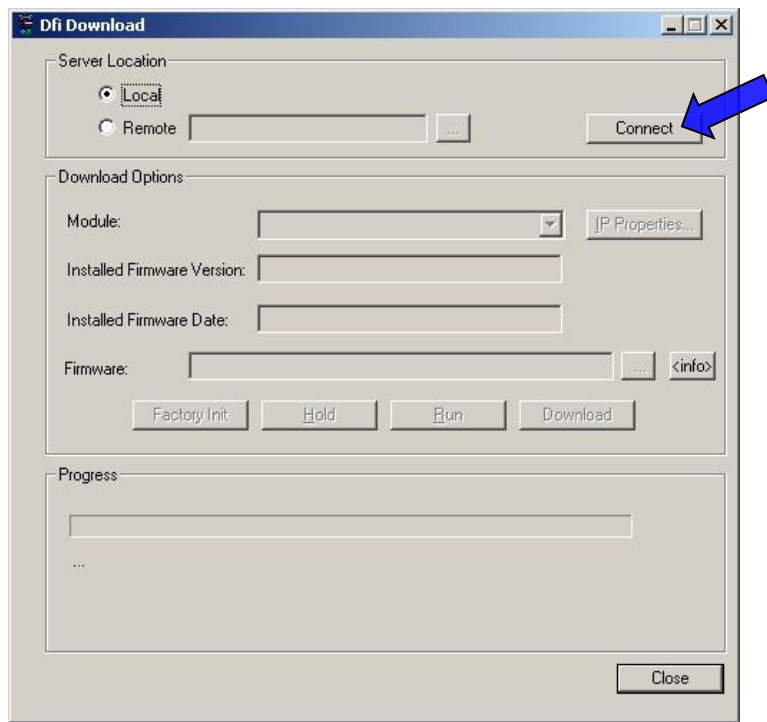
## Changing IP address

### Changing IP Controller

#### NOTE

To change the **DFI302** subnet, see the procedures in "Connecting the DFI302 in the Subnet". Follow these steps only to change the IP address.

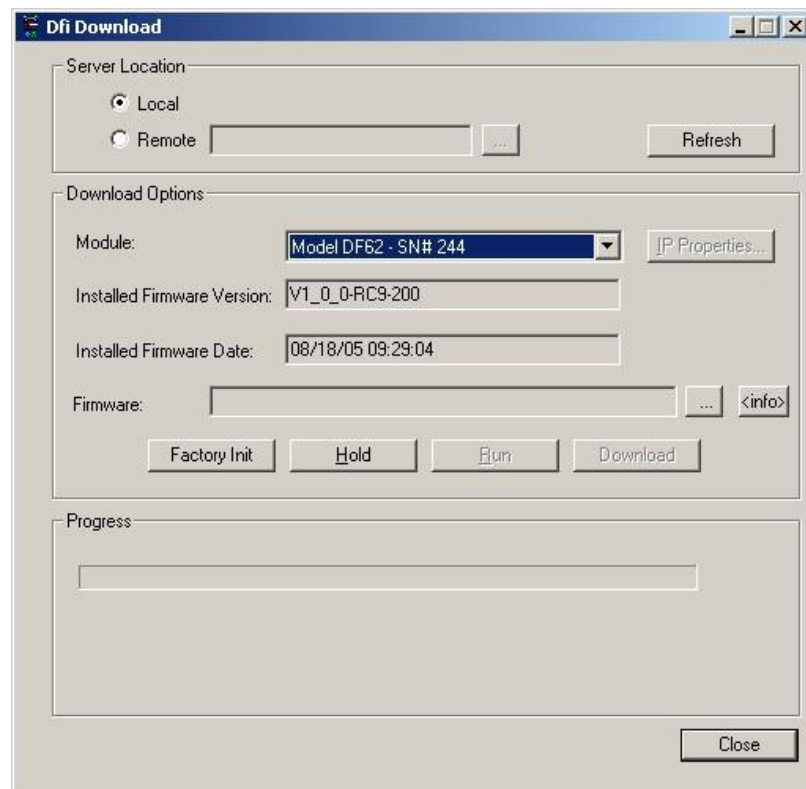
1. Make sure that the **DFI302** is ON and has been connected to the subnet, according to the procedures in "Connecting the DFI302 in the Subnet".
2. Run the **FBTools** as described in the previous topics.
3. Select the controller module, and click **Dfi Download Classic**. For the **Batch Download** option refer from step 4'.
4. The **DFi Download** dialog box will be open. Select the DFI OLEServer path to be used (Local is the default path) and click **Connect**.



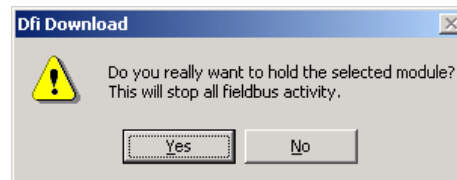
5. Select the controller module in the **Module** box. Use the serial number as a reference (see the external identification label).

#### ATTENTION

The non-observance of this step can imply in serious damages.



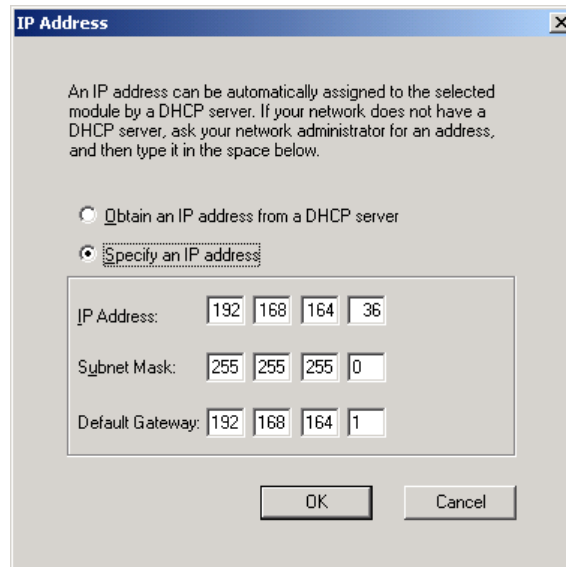
6. Click **Hold** to interrupt the firmware execution in the controller.
7. Afterwards all activities in the Fieldbus network will be stopped. Confirm this operation by clicking **Yes**.



#### ATTENTION

This step will be necessary only if the **Hold** button is enabled, indicating that the firmware is being fulfilled.

8. Check if the HOLD LED is ON.
9. Click **IP Properties** button at the **DFI Download** window. The **IP Address** window will open.
10. The default option is **Obtain the IP Address from a DHCP Server**. Click the **Specify an IP address** option to change to another IP address.



11. Type the IP address, the subnet mask and the default gateway (provided by the network administrator) to be associated to the **DFI302**.

#### ATTENTION

Do not use the IP Address 192.168.164.100 (it is already being used by **DFI302**). In addition, be sure that the chosen address is not in use.

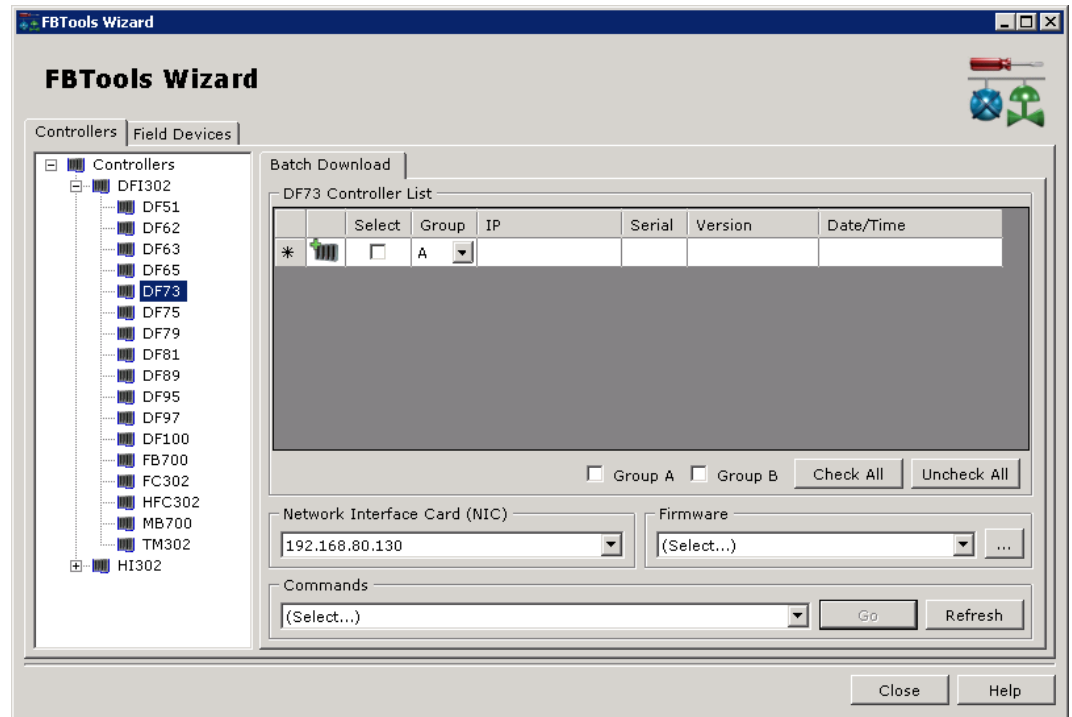
#### HINT

Write down the IP addresses that will be specified and the serial number of each controller module. It will help in the identification and diagnostics of possible failures.

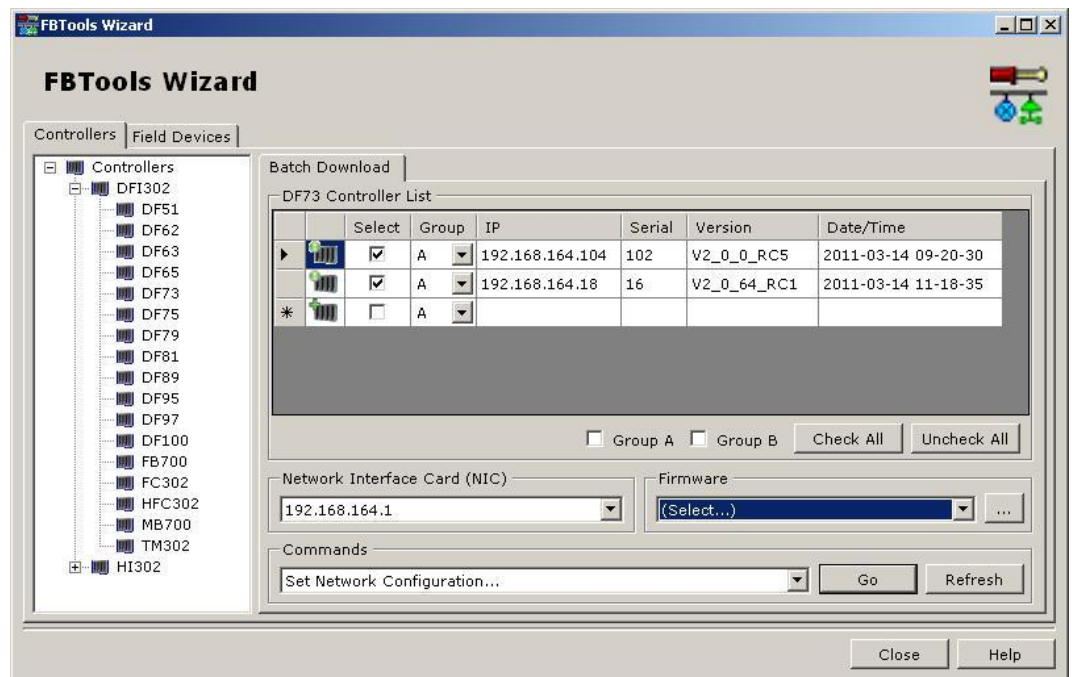
12. Click **OK** to conclude this operation.
13. After assigning a new IP address, the process will return to the **Dfi Download** window.
14. Click **Run** to execute the **DFI302** firmware again.
15. Click **Close** to close the **Dfi Download** window.

#### Batch Download

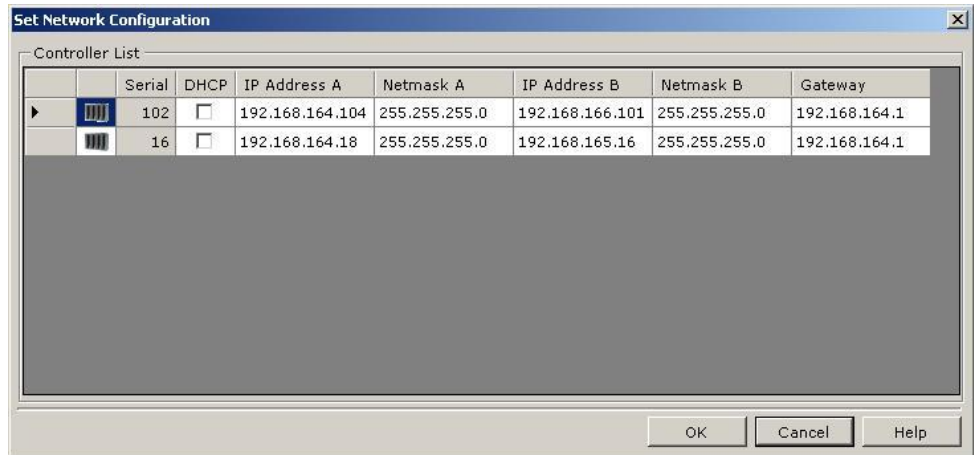
- 4'. The **Batch Download** window will open. With this interface multiple IPs can be changed simultaneously.



5'. Select the controller whose IP will be changed. See an example in the following window:



6'. In the **Commands** field select **Set Network Configuration** and click **Go**. The following window will open.



7'. Type the IP address, the subnet mask and the default gateway (provided by the network administrator) to be associated to the **DFI302**. Click **Ok** and the changes will be verified. For further information about error messages refer to the **FBTools** help.

#### ATTENTION

Do not use the IP Address 192.168.164.100 (it is already being used by **DFI302**). In addition, be sure that the chosen address is not in use.

#### HINT

Write down the IP addresses that will be specified and the serial number of each controller module. It will help in the identification and diagnostics of possible failures.

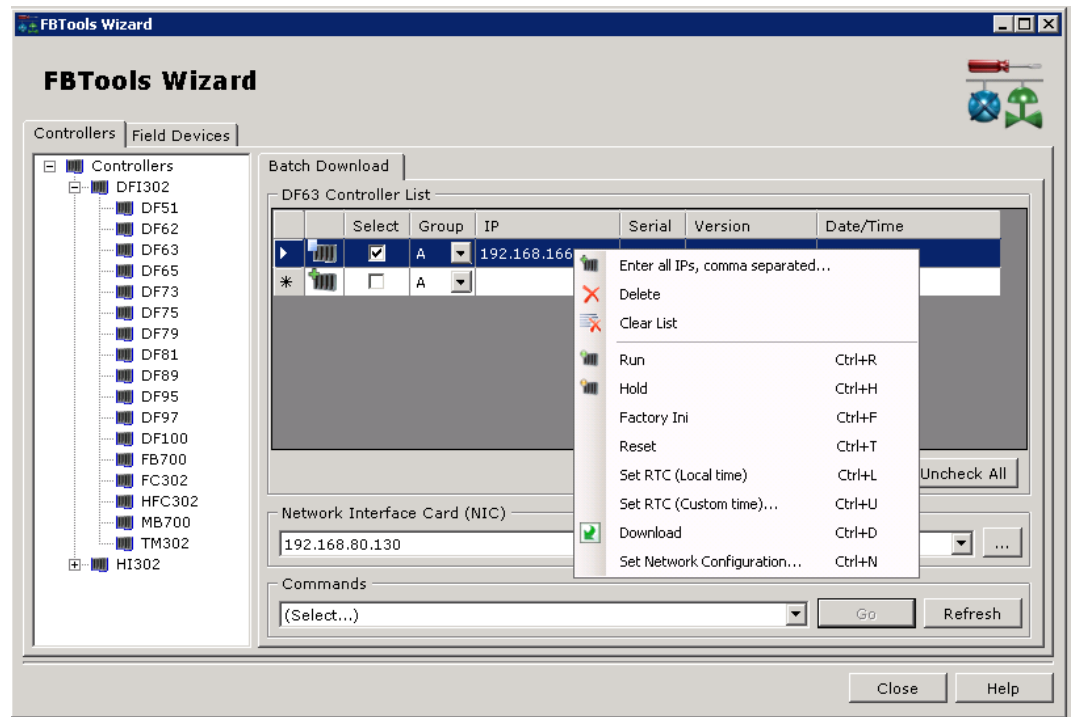
8'. After assigning a new IP address, the process will return to the **Batch Download** window.

9'. In the **Commands** field, select **Run** to execute the **DFI302** firmware again and click **Go**.

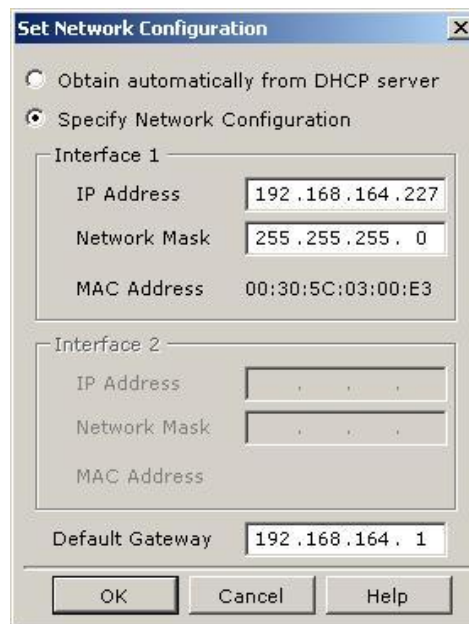
10'. Click **Close** to close the **Batch Download** window.

To change the IP address of only one controller the Batch Download option can be used. Follow the steps below:

1. Select the DFI302 controller;
2. Right-click it and the following window will appear:



3. Select **Set Network Configuration...** and the following window will appear:



4. The default option is **Obtain the IP Address from a DHCP Server**. Click the **Specify an IP address** option to change to another IP address.
5. Type the IP addresses, the subnet masks and the default gateways (provided by the network administrator) to be associated to the controller.

#### ATTENTION

Do not use the IP Address 192.168.164.100 (it is already being used by **DFI302**). In addition, be sure that the chosen address is not in use.

6. Click **Ok** to conclude this operation;

7. After assigning the new IP addresses, the process will return to the **Batch Download** window. In the **Commands** field select **Run** to execute the firmware again and click **Go**.
8. Click **Close** to close the **Batch Download** window.

## **Configuring the RTC**

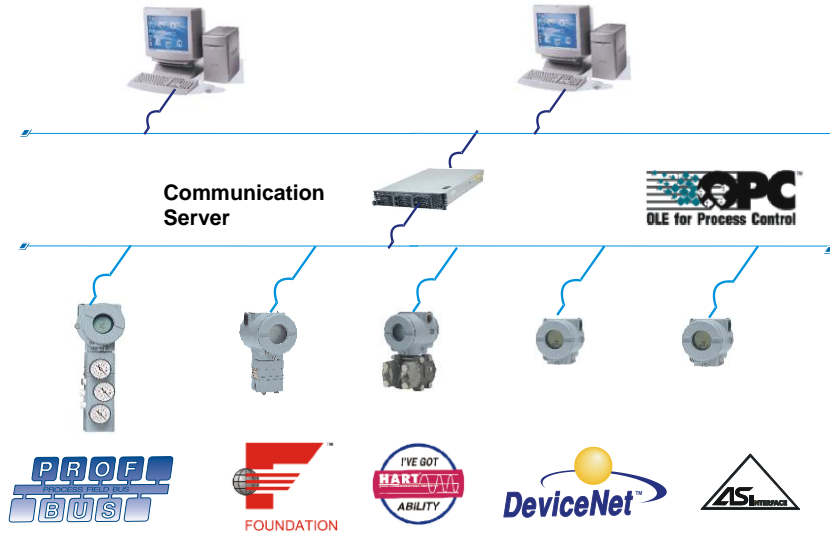
The Real Time Clock (RTC) of the DFI302 controllers, except DF51, can be configured manually, via **Batch Download** option of **FBTools**, and when available, maintained automatically synchronized via **SNTP**. For further information about **SNTP** refer to the **Server Manager** appendix in the **Studio302** manual.

To configure the RTC of the DF51 controller refer to the topic "Enabling the synchronism by **SNTP** of the DF51" in this manual.

## CONFIGURING THE OPC SERVERS

### Introduction

Using all the benefits of OPC, formerly defined as OLE for Process Control, and at present defined as **Open Connectivity**, the user can have Fieldbus client applications for client/server based on systems at a higher level of programming, without having to deal with the details of specific Fieldbus protocol. The OPC servers for Smar controllers provide a consistent set of functions for supervision and configuration. This consistency minimizes code changes needed to make if the underlying protocol changes.



### Client / server architecture via OPC

It is a distributed processing architecture, providing one single view of the system to users and applications, allowing use of services in a networked environment regardless of location, machine architecture or implementation environment.

### Win32-based platform

The server was designed for 32 bits systems. The client/server applications must be running under Windows™ platforms.

### OPC Compliant



Providing the server with an OPC interface allows any supervision client to access devices in a standard way. The OPC standard uniformizes information exchange among hardware manufacturers and supervisory (HMI - Human Machine Interface).

Smar OLE Servers are compliance-tested using OPC Foundation's Compliance Test Tool (CTT) and by attending Interoperability Workshops (IOP) annually.

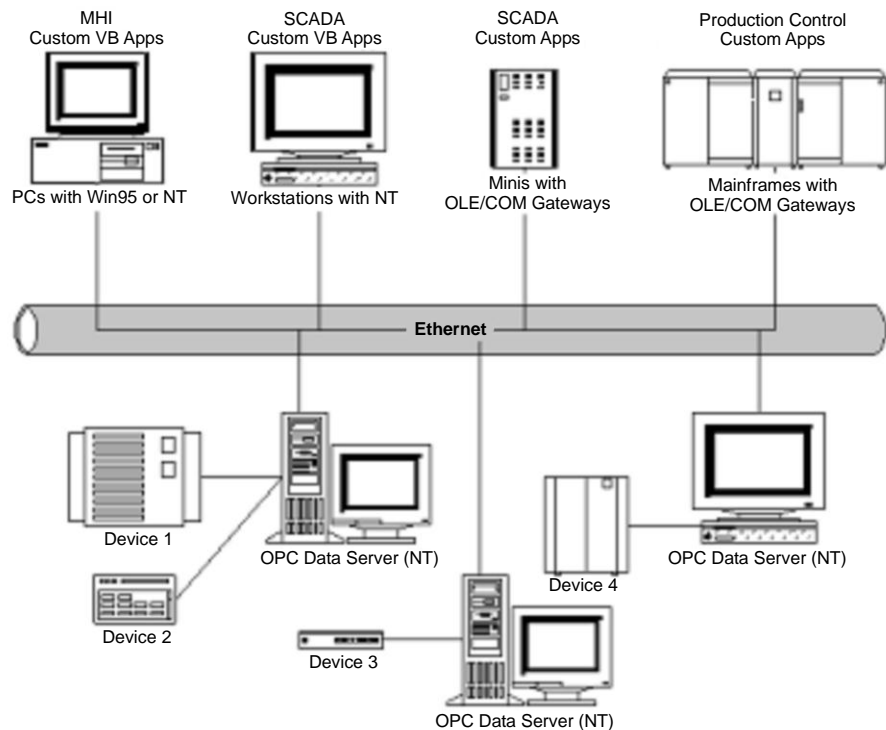
### OLE for Fieldbus Configuration (OFC)

Going further on OPC benefits Smar has developed a set of functions for plant configuration which is named OFC (**OLE for Fieldbus Configuration**). This provides a way to both supervision and configuration clients work at the same time, remotely or not.



## OPC – OLE for Process Control

OPC™ is a technology that allows business and supervision applications to access the plant floor data in a consistent manner. With wide industry acceptance and open architecture, OPC provides many benefits like the OPC Server where hardware manufacturers only have to make one set of software components for customers to utilize in their applications. Another benefit is the OPC Client where software developers will not have to rewrite drivers because of feature changes or additions in a new hardware release. With OPC, system integration in a heterogeneous computing environment will become simple. Through COM/DCOM the environment shown below becomes possible.



### Overview

OPC is based on Microsoft's OLE/COM technology. An OPC client can connect to OPC servers provided by one or more vendors.

Different vendors provide OPC servers. The code written by a vendor determines the devices and data that each server has access, the way how data items are named and the details about how the server physically accesses those data.

Within each server the client can define one or more OPC groups. The OPC groups provide a way for clients to organize the data which they are interested. For example, the group might represent items in a particular operator display or report. Data can be read and written. Connections based in exceptions can also be created between the client and the items in the group and can be enabled and disabled when is necessary. The 'freshness' (time resolution) of the data in the group can be specified. Within each group the client can define one or more OPC items.

The OPC items represent connections to data sources within the server. There is a value associated with each item, a quality mask and a time stamp. The quality mask is similar to that specified by Fieldbus. Note that the items are not the data sources - they are just connections to them. For example the tags in a DCS system exist regardless of whether an OPC client is currently accessing them.

## Local servers and remote servers

There are two ways of connecting OPC clients and OPC servers. The client can connect to a local server, running in the same machine. The other possibility is the connection with a remote server through the network, using the DCOM technology.

## Minimum DCOM settings

1. Please certify that the hardware is installed according to its specific user manual.
2. Log with administrative rights on the local machine.
3. Certify that the TCP/IP and RPC protocols are installed in the computer.
4. Certify that the operating system is Windows 2000 or Windows XP Professional.
5. Proceed with the installation using **SYSTEM302** setup.

## Client and server running in the same machine

The default setup is enough to get local access, regardless of the Windows operating system version being used.

## Client and server running in different machines

The user must perform two different configurations to be able to connect through DCOM: the client side one and the server side one. In the client side it may have an end-user program like Syscon and some components of Smar OLE Server software (CONFPPrx.dll, IProxy.dll and OPCProxy.dll files, and the required information to Windows registry). In the server side it must have the whole Smar OLE Server software in order to establish communication between software client(s) and hardware plugged in the computer.

The default DCOM settings are not enough to grant remote access to servers. Therefore, it is necessary to change these settings in order to access the servers. The adequate settings are based on the Windows operating system being used. There are three sets of configurations to be done, according to the following versions:

- Windows 2000
- Windows XP Professional and Windows Server 2003
- Windows XP Professional Service Pack 2 and Windows Server 2003 Service Pack 1

## Creating client/server connection in Windows 2000 with user specific security

- These settings must be used when it is desired to allow access to remote servers to a specific set of users (the users in the OLEGroup group).
- The steps below assume that the user wants to allow remote access to the HSE OLE Server. To allow remote access to other OLE servers from Smar, do the configurations replacing "Smar OPC & Conf Server for HSE" by one of the following:
  - For DFI OLE Server: "Smar OPC & Conf Server for DFI302"
  - For Alarm & Events Server: "Smar Alarm & Event Server"
  - For the SNMP server: "Smar SNMP OPC Server for DFI302"

### Step 1 - Configuring the network hosts

There are two possibilities when configuring the machines to be involved in DCOM communication. Only workstations (standalone) or workstations in a Windows domain can be used.

The advantages of one over another may depend on the local network architecture. Both processes require help of network administrator. To choose which one to use remember that domain based architecture has a single security database and thus is the simplest way.

### Option 1 - Network based on standalone workstations

1. Run the **User Manager** program on each machine and create a new group to the OLE based system (suggestion: call it *OLEGroup*).
2. In the **User Manager** program create on each machine a new user to the OLE based system (suggestion: call it *OLEUser*).
3. Still in the **User Manager** program, insert every user (including the one created before) which must have access to the OLE services (configuration, supervision, etc...) in the group created in item 1.
4. After inserting the users to the group, it is necessary to restart the machine.

### Option 2 - Network based on a Windows domain

1. Run the **User Manager** program on the domain server machine (PDC) and create a new group to the OLE based system (suggestion: call it *OLEGroup*).
2. In the **User Manager** program create a new user to the OLE based system (suggestion: call it *OLEUser*).
3. Still in the **User Manager** program, insert all the users (including the one created before) which must have access to the OLE services (configuration, supervision, etc...) in the group created in item 1.
4. Be sure that the workstations are members of the domain.

### Step 2 - Client side

1. Run the dcomcnfg.exe program:
  - 1.1 Click the **Start** button on Windows taskbar and choose the option **Run**.
  - 1.2 Fill the edit field with **dcomcnfg** and click the **OK** button.
2. Select the **Default Properties** folder and set the following fields:
  - 2.1  **Enable Distributed COM on this computer**.
  - 2.2 **Default Authentication Level: Connect**.
  - 2.3 **Default Impersonation Level: Identify**.
3. Select the **Default Security** folder.
  - 3.1. Click Edit Default button under **Default Access Permissions**
    - 3.1.1. Make sure **Administrators, INTERACTIVE, SYSTEM and Everyone** are added with **Allow Access**.
    - 3.2. Click Edit Default button under **Default Launch Permissions**.
      - 3.2.1. Make sure **Administrators, INTERACTIVE, SYSTEM and Everyone** are added with **Allow Launch**.
4. Select the **Applications** folder and double-click **Smar OPC & Conf Server for HSE**.
5. Select the **Local** folder and check the **Run application on this computer** option.
6. If the client application does not have the remote connection option, check **Run application on the following computer**: option, filling down with the computer name or IP that will be the server-side for this client-side.

### Step 3 - Server side

1. Run the dcomcnfg.exe program:
  - 1.1. Click the **Start** button on Windows taskbar and choose the option **Run**.
  - 1.2. Fill the edit field with **dcomcnfg** and click **OK**.

2. Select the **Default Properties** folder and set the following fields:
  - 2.1.  **Enable Distributed COM on this computer.**
  - 2.2. **Default Authentication Level: Connect.**
  - 2.3. **Default Impersonation Level: Identify.**
3. Select the **Applications** folder and double-click **Smar OPC & Conf Server for HSE.**
4. Select the **Location** folder and check the **Run application on this computer** option.
5. Select now the **Security** folder:
  - 5.1. Check the option **Use custom access permissions** and click the **Edit** button.
    - 5.1.1. It must have only the groups **SYSTEM** and **OLEGroup** with **Allow Access.**
  - 5.2. Check the option **Use custom launch permissions** and click the **Edit** button.
    - 5.2.1. It must have only the groups **SYSTEM** and **OLEGroup** with **Allow Launch.**
6. Select the **Identity** folder and check **The interactive user.**

### Creating client/server connection in Windows 2000 without user specific security

- These settings must be used when it is desired to allow access to remote servers to every user registered in the client and server machines.
- The steps below assume that the user wants to allow remote access to the HSE OLE Server. To allow remote access to other OLE servers from Smar, do the configurations replacing "Smar OPC & Conf Server for HSE" by one of the following:
  - For DFI OLE Server: "Smar OPC & Conf Server for DFI302"
  - For Alarm & Events Server: "Smar Alarm & Event Server"
  - For the SNMP server: "Smar SNMP OPC Server for DFI302"

#### Step 1 - Configuring users

1. Run the **User Manager** program on each machine and create the users involved in the process (or in the domain server machine if a domain is being used).

#### Step 2 - Client side

1. Run the `dcomcnfg.exe` program:
  - 1.1. Click the **Start** button on Windows taskbar and choose the option **Run.**
  - 1.2. Fill the edit field with `dcomcnfg` and click the button **OK.**
2. Select the **Default Properties** folder and set the following fields:
  - 2.1.  **Enable Distributed COM on this computer.**
  - 2.2. **Default Authentication Level: Connect.**
  - 2.3. **Default Impersonation Level: Identify.**
3. Select the **Default Security** folder.
  - 3.1. Click **Edit Default** button under **Default Access Permissions**
    - 3.1.1. Make sure **Administrators, INTERACTIVE, SYSTEM and Everyone** are added with **Allow Access.**
  - 3.2. Click **Edit Default** button under **Default Launch Permissions.**
    - 3.2.1. Make sure **Administrators, INTERACTIVE, SYSTEM and Everyone** are added with **Allow Launch**
4. Select the **Applications** folder and double-click on **Smar OPC & Conf Server for HSE.**
5. Select the **Location** folder and check **Run application on this computer** option.
6. If the client application does not have the remote connection option, check **Run application on the following computer:** option, filling down with the computer name or IP that will be the server-side for this client-side.

### Step 3 - Server side

1. Run the dcomcnfg.exe program:
  - 1.1. Click the **Start** button on Windows Taskbar and choose the option **Run**.
  - 1.2. Fill the edit field with *dcomcnfg* and click **OK**.
2. Select the **Default Properties** folder and set the following fields:
  - 2.1.  **Enable Distributed COM on this computer**.
  - 2.2. Default **A**uthentication Level: **Connect**.
  - 2.3. Default **I**mpersonation Level: **Identify**.
3. Select the **Default Security** folder.
  - 3.1. Click Edit Default button under **Default Access Permissions**
    - 3.1.1 Make sure **Administrators, INTERACTIVE, SYSTEM and Everyone** are added with **Allow Access**.
  - 3.2. Click Edit Default button under **Default Launch Permissions**
    - 3.2.1 Make sure **Administrators, INTERACTIVE, SYSTEM and Everyone** are added with **Allow Launch**.
4. Select the **Applications** folder and double-click on **Smar OPC & Conf Server for HSE**.
5. Select the **Location** folder and check **Run application on this computer** option.
6. Select now the **Security** folder.
  - 6.1. Check the **Use default access permissions** option.
  - 6.2. Check the **Use default launch permissions** option.
7. Select the **Identity** folder and check **The interactive user**.

## Configurations for Windows XP Professional and Windows Server 2003

Windows XP Professional and Windows Server 2003 DCOM configurations depend on the service pack installed in the machines. If Windows XP Professional Service Pack 2 (or a more recent one) or Windows Server 2003 Service Pack 1 (or a more recent one) are installed, the DCOM configurations are detailed in the next section. Otherwise, the configurations are exactly like the Windows 2000 configurations (detailed in the two previous sections). Regardless of the service pack being used, one additional step must be done in both client and server machines, detailed below.

1. Click the **Start** button in the Windows taskbar, and choose **Control Panel**.
2. Select **Administrative Tools**, then **Local Security Policy**, then **Local Policies** and finally **Security Options**.
3. Find the entry **Network Access: Sharing and security model for local accounts**.
4. Change the entry setting to **Classic – users authenticate as themselves**.

## Configurations for Windows XP Professional Service Pack 2 and Windows Server 2003 Service Pack 1 with user specific security

- These settings must be used when it is desired to allow access to remote servers to a specific set of users (the users in the OLEGroup group).
- The steps below assume that the user wants to allow remote access to the HSE OLE Server. To allow remote access to other OLE servers from Smar, do the configurations replacing “Smar OPC & Conf Server for HSE” by one of the following:
  - For DFI OLE Server: “Smar OPC & Conf Server for DFI302”
  - For Alarm & Events Server: “Smar Alarm & Event Server”
  - For the SNMP server: “Smar SNMP OPC Server for DFI302”
- If Windows Firewall is enabled, refer to the section “Configuring Windows Firewall”.

### Step 1 - Configuring the network hosts

There are two possibilities when configuring the machines to be involved in DCOM communication. Only workstations (standalone) or workstations in a Windows domain can be used. The advantages of one over another may depend on the local network architecture. Both processes require help of network administrator. To choose which one to use remember that domain based architecture has a single security database and thus is the simplest way.

### Option 1 - Network based on standalone workstations

1. Run the **User Manager** program on each machine and create a new group to the OLE based system (suggestion: call it *OLEGroup*).
2. In the **User Manager** program create on each machine a new user to the OLE based system (suggestion: call it *OLEUser*).
3. Still in the **User Manager** program, insert every user (including the one created before) which must have access to the OLE services (configuration, supervision, etc...) in the group created in item 1.
4. After inserting the users to the group, it is necessary to restart the machine.

### Option 2 - Network based on a Windows domain

1. Run the **User Manager** program on the domain server machine and create a new group to the OLE based system (suggestion: call it *OLEGroup*).
2. In the **User Manager** program create a new user to the OLE based system (suggestion: call it *OLEUser*).
3. Still in the **User Manager** program, insert all the users (including the one created before) which must have access to the OLE services (configuration, supervision, etc...) in the group created in item 1.
4. Be sure that the workstations are members of the domain.

### Step 2 – Client side

1. Run the **dcomcnfg.exe** program:
  - 1.1 Click the **Start** button on Windows taskbar and choose the option **Run**.
  - 1.2 Fill the edit field with **dcomcnfg** and click the **OK** button.
2. Click **Component Services** under the Console Root to expand it.
  - 2.1 Click **Computers** under Component Services to expand it.
  - 2.2 Right-click **My Computers** in the pane on the right and select **Properties**.
  - 2.3 Select the **Default Properties** tab and set the following fields:
  - 2.4  **Enable Distributed COM on this computer**.
  - 2.5 Default Authentication Level: **Connect**.
  - 2.6 Default Impersonation Level: **Identify**.
3. Select the **COM Security** folder.
  - 3.1. Click **Edit Limits** button under **Access Permissions**.
    - 3.1.1. Make sure **ANONYMOUS LOGON** and **Everyone** are added with **Local Access** and **Remote Access**.
  - 3.2. Click **Edit Limits** button under **Launch and Activation Permissions**.
    - 3.2.1. Make sure **Administrators** and **Everyone** are added with **Local Launch**, **Remote Launch**, **Local Activation** and **Remote Activation**.
  - 3.3. Click **Edit Default** button under **Access Permissions**.
    - 3.3.1 Make sure **Everyone** and **SYSTEM** are added with **Local Access** and **Remote Access**.
  - 3.4 Click **Edit Default** button under **Launch and Activation Permissions**.
    - 3.4.1 Make sure **Administrators**, **INTERACTIVE**, **Everyone** and **SYSTEM** are added with **Local Launch**, **Remote Launch**, **Local Activation** and **Remote Activation**.
- 4 Back to the **Component Services** window folder; look for the **DCOM Config** folder under **My Computer**.
  - 4.1 Right-click **Smar OPC & Conf Server for HSE** and select **Properties**.
  - 4.2. Select the **Location** tab and check the **Run application on this computer** option.
  - 4.3. If the client application does not have the remote connection option, check **Run application on the following computer**: option, filling down with the computer name or IP that will be the server-side for this client-side.

### Step 3 – Server side

1. Run the **dcomcnfg.exe** program:
  - 1.1. Click the **Start** button on Windows taskbar and choose the option **Run**.
  - 1.2. Fill the edit field with *dcomcnfg* and click **OK**.
2. Click **Component Services** under the **Console Root** to expand it.
  - 2.1. Click **Computers** under **Component Services** to expand it.
  - 2.2. Right-click **My Computers** in the pane on the right and select **Properties**.
  - 2.3. Select the **Default Properties** tab and set the following fields:
  - 2.4.  **Enable Distributed COM on this computer**.
  - 2.5. **Default Authentication Level: Connect**.
  - 2.6. **Default Impersonation Level: Identify**.
3. Select the **COM Security** folder.
  - 3.1. Click **Edit Limits** button under **Access Permissions**.
    - 3.1.1. Make sure **ANONYMOUS LOGON** and **Everyone** are added with **Local Access** and **Remote Access**.
  - 3.2. Click **Edit Limits** button under **Launch and Activation Permissions**.
    - 3.2.1. Make sure **Administrators** and **Everyone** are added with **Local Launch**, **Remote Launch**, **Local Activation** and **Remote Activation**.
4. Back to the **Component Services** window folder; look for the **DCOM Config** folder under **My Computer**.
  - 4.1. Right-click **Smar OPC & Conf Server for HSE** and select **Properties**.
  - 4.2. Select the **Location** tab and check the **Run application on this computer** option.
  - 4.3. Select the **Security** tab.
    - 4.3.1. Select the **Customize** option under **Launch and Activation Permissions**, and click **Edit**. Make sure **Administrators**, **INTERACTIVE**, **OLEGroup** and **SYSTEM** are added with **Local Launch**, **Remote Launch**, **Local Activation** and **Remote Activation**.
    - 4.3.2. Select the **Customize** option under **Access Permissions**, and click **Edit**. Make sure **INTERACTIVE**, **OLEGroup** and **SYSTEM** are added with **Local Access** and **Remote Access**.
  - 4.4. Select the **Identity** tab and check **The interactive user**.

## Configurations for Windows XP Professional Service Pack 2 and Windows Server 2003 Service Pack 1 without user specific security

- These settings must be used when it is desired to allow access to remote servers to every user registered in the client and server machines.
- The steps below assume that the user wants to allow remote access to the HSE OLE Server. To allow remote access to other OLE servers from Smar, do the configurations replacing “Smar OPC & Conf Server for HSE” by one of the following:
  - For DFI OLE Server: “Smar OPC & Conf Server for DFI302”
  - For Alarm & Events Server: “Smar Alarm & Event Server”
  - For the SNMP server: “Smar SNMP OPC Server for DFI302”
- If Windows Firewall is enabled, refer to the section “Configuring Windows Firewall”.

### Step 1 - Configuring users

1. Run the **User Manager** program on each machine and create the users involved in the process (or in the domain server machine if a domain is being used).

### Step 2 – Client side

1. Run the **dcomcnfg.exe** program:
  - 1.1. Click the **Start** button on Windows taskbar and choose the option **Run**.
  - 1.2. Fill the edit field with *dcomcnfg* and click the **OK** button.
2. Click **Component Services** under the **Console Root** to expand it.
  - 2.1. Click **Computers** under **Component Services** to expand it.
  - 2.2. Right-click **My Computers** in the pane on the right and select **Properties**.
  - 2.3. Select the **Default Properties** tab and set the following fields:
  - 2.4.  **Enable Distributed COM on this computer**.
  - 2.5. **Default Authentication Level: Connect**.
  - 2.6. **Default Impersonation Level: Identify**.

3. Select the **COM Security** folder.
  - 3.1. Click **Edit Limits** button under **Access Permissions**.
    - 3.1.1. Make sure **ANONYMOUS LOGON** and **Everyone** are added with **Local Access** and **Remote Access**.
  - 3.2. Click **Edit Limits** button under **Launch and Activation Permissions**.
    - 3.2.1. Make sure **Administrators** and **Everyone** are added with **Local Launch**, **Remote Launch**, **Local Activation** and **Remote Activation**.
  - 3.3. Click **Edit Default** button under **Access Permissions**.
    - 3.3.1. Make sure **Everyone** and **SYSTEM** are added with **Local Access** and **Remote Access**.
  - 3.4. Click **Edit Default** button under **Launch and Activation Permissions**.
    - 3.4.1. Make sure **Administrators**, **INTERACTIVE**, **Everyone** and **SYSTEM** are added with **Local Launch**, **Remote Launch**, **Local Activation** and **Remote Activation**.
4. Back to the **Component Services** window folder; look for the **DCOM Config** folder under **My Computer**.
  - 4.1. Right-click **Smarter OPC & Conf Server for HSE** and select **Properties**.
  - 4.2. Select the **Location** tab and check the **Run application on this computer** option.
  - 4.3. If the client application does not have the remote connection option, check **Run application on the following computer**: option, filling down with the computer name or IP that will be the server-side for this client-side.

### Step 3 – Server side

1. Run the **dcomcnfg.exe** program:
  - 1.1. Click the **Start** button on Windows taskbar and choose the option **Run**.
  - 1.2. Fill the edit field with **dcomcnfg** and click **OK**.
2. Click **Component Services** under the **Console Root** to expand it.
  - 2.1. Click **Computers** under **Component Services** to expand it.
  - 2.2. Right-click **My Computers** in the pane on the right and select **Properties**.
  - 2.3. Select the **Default Properties** tab and set the following fields:
  - 2.4.  **Enable Distributed COM on this computer**.
  - 2.5. Default Authentication Level: **Connect**.
  - 2.6. Default Impersonation Level: **Identify**.
3. Select the **COM Security** folder.
  - 3.1. Click **Edit Limits** button under **Access Permissions**.
    - 3.1.1. Make sure **ANONYMOUS LOGON** and **Everyone** are added with **Local Access** and **Remote Access**.
  - 3.2. Click **Edit Limits** button under **Launch and Activation Permissions**.
    - 3.2.1. Make sure **Administrators** and **Everyone** are added with **Local Launch**, **Remote Launch**, **Local Activation** and **Remote Activation**.
4. Back to the **Component Services** window folder; look for the **DCOM Config** folder under **My Computer**.
  - 4.1. Right-click **Smarter OPC & Conf Server for HSE** and select **Properties**.
  - 4.2. Select the **Location** tab and check the **Run application on this computer** option.
  - 4.3. Select the **Security** tab.
    - 4.3.1. Select the **Customize** option under **Launch and Activation Permissions**, and click the **Edit** button. Make sure **Administrators**, **INTERACTIVE**, **Everyone** and **SYSTEM** are added with **Local Launch**, **Remote Launch**, **Local Activation** and **Remote Activation**.
    - 4.3.2. Select the **Customize** option under **Access Permissions**, and click the **Edit** button. Make sure **INTERACTIVE**, **Everyone** and **SYSTEM** are added with **Local Access** and **Remote Access**.
  - 4.4. Select the **Identity** tab and check **The interactive user**.



## Configuring Windows Firewall

1. The Windows Firewall can be accessed by the **Control Panel**.
  - 1.1. Select the **Exceptions** tab and all OPC clients and OPC Servers to be used in the machine. To add the servers, use the **Add Program** button. In the **Add Program** dialog, there is a listing of applications on the machine. If the application to be added is not listed, use the **Browse** button to find it. Smar OLE servers are located at **\Program Files\Smar\OLEServers** folder.
  - 1.2. Also add Microsoft Management Console (mmc.exe) and OPC Server Enumerator utility (OPCEnum.exe). They can be found at **WINDOWS\system32** folder.
  - 1.3. Add TCP port 135 to the list of exceptions. This can be done clicking the **Add Port** button. In the **AddPort** dialog, fill the fields as follows:
    - Name: DCOM
    - Port number: 135
    - Choose the **TCP** button.

## DFI OLE Server details

DFI OLE Server is an OPC server (*server-side*) used to carry out connection between an OPC client/supervisory (*HMI Human Machine Interface*) and **DFI302** connected in the network.

- Please certify that **DFI302** is correctly installed in the network.
- File: DfiSvr.exe
- ProgID: Smar.DFIOLEServer.0
- Name: Smar OPC & Conf Server for DFI302

## HSE OLE Server details

HSE OLE Server is an OPC server (*server-side*) used to carry out connection between an OPC client/supervisory (*HMI Human Machine Interface*) and any HSE device connected in the network.

HSE device definition: Any FOUNDATION fieldbus device type connected directly to HSE media. All HSE devices contain a FDA Agent, an HSE SMK, and an HSE NMA VFD. Examples include Linking Devices, I/O Gateways, and HSE field devices. **DFI302** is a Linking Device.

- Please certify that **DFI302** or any HSE Device is correctly installed in the network.
- File: HseSvr.exe
- ProgID: Smar.HSEOLEServer.0
- Name: Smar OPC & Conf Server for HSE

## A&E OPC Server details

With the A&E OPC Server is possible that events and alarms of H1 fieldbus devices, correctly configured, on an HSE Fieldbus network generate alarms, and they can be seen with an OPC A&E client.

| IMPORTANT  |
|--|
| The Alarm and Events Server (A&E OPC Server) configuration requires prior knowledge of Fieldbus standard for function block configuration specially of those which are necessary to a fieldbus device generate events. |

The Syscon is a configuration tool for A&E Server (for further details refer to Syscon manual). Follow the next steps to configure a fieldbus device to generate events, and to prepare the OPC A&E Server to receive those events.

- Configure the offline parameters of H1 device, with **Syscon**;
- Use the **Export Tags (Syscon’s** function), enabling the option that generates information for Alarms and Events (refer to Syscon manual) in order to generate the AlarmInfo.ini file.
- Download the configuration;
- Run the OPC A&E client.

- File: AESvr.exe
- ProgID: Smar.AEServer.0
- Name: Smar Alarm & Event Server

## HDA OPC Server details

With the HDA OPC Server is possible that trends events generated from H1 fieldbus devices, correctly configured on an HSE Fieldbus network, can be stored and made available to an OPC HDA client.

The **Syscon** is a configuration tool for HDA Trend Server (for further details refer to **Syscon** manual). Follow the next steps to configure a fieldbus device to generate trend objects, and to prepare the HDA Server to receive those events.

- Select which devices and blocks will have their parameters monitored and stored by the HDA server (for further details refer to **Syscon** manual);
  - Download the configuration;
  - Use the **Export Tags** (**Syscon's** function) to generate the TrendInfo.ini file (it provides the information to the HDA server);
  - Run the OPC HDA client.
- 
- File: HDASvr.exe
  - ProgID: Smar.HDAServer.0
  - Name: Smar HDA OPC & Conf Server for System302

## HSE Device Definition

Any device FOUNDATION fieldbus can be connected directly with an HSE media. All the HSE Devices have one FDA Agent, one HSE SMK and one HSE NMA VFD. For instance, Linking Devices, I/O Gateways, and HSE field devices. The **DFI302** is a Linking Device.

- Please certify that **DFI302** or any HSE Device is installed correctly under the network.
- File: HseSvr.exe
- ProgID: Smar.HSEOLEServer.0
- Name: Smar OPC & Conf Server for HSE

## Information for firewall configuration

The OLE servers make extensive use of network resources to exchange data with **DFI302**. If the machines running the OLE servers are protected by a firewall, it is necessary to open the ports needed to make the network resources available. The following ports are used by the servers. The steps to be taken to open these ports are firewall-specific.

SE ports: 4987 (UDP) and 4988 (TCP)  
HSE ports: 1089, 1090, 1091 and 3622 (all UDP)  
SNTP port: 123 (TCP)  
Modbus TCP port: 502 (TCP)  
Telnet port: 23 (TCP)  
HTTP port: 80, 8080 (all TCP)  
DCOM port: 135 (TCP)  
SNMP port: 161 (UDP)

Since **DFI302** also acts as a client, it is necessary to open ports higher than 1024.

## SmarOleServer.ini Configuration

SmarOleServer.ini file, located under OleServers folder provides some SECTION and KEYS which are permitted enable and disable logs, set timeouts, configure network details, etc.

### IMPORTANT

Not all keys and sections of the SmarOleServer.ini file are described here. The access by ServerManager defines which parameters usually have to be modified. The change in advanced parameters for which the user has no technical knowledge can lead to a system malfunction, or even make it inoperable.

Let’s to describe these sections:

- In Log and LogForOPC Sections, it is possible to enable some log features and see the results in Events.log and EventOPC.log files respectively. Both files have its (.log#) file used for swap.

```
[Log]
GENERAL=0
DEBUG=0
MEMORY=0
INIT=1
DRIVER=0
TRANSFER=0
TRANSACTION=0
CONF=0
OPC=0
OPCDEBUG=0
IDSHELL=0
;=0      (Default) Log disabled
;=1      Enable log and see the results in Events.log and Events.log#
[LogForOPC]
GENERAL=0
;=0      (Default) Log disabled
;=1      Enable log and see the results in EventOPC.log and EventOPC.log#
```

- In NIC Adapter Section, in the case of more than one NIC adapter are installed in the machine, choose the desired NIC adapter to be connected with the local DFI OLE Server.

```
[NIC Adapter]
; If more than one NIC (Network Interface Card) are installed in the local machine
; it is necessary to inform the DFI OLE Server to use one (NIC) or two (NIC and NIC2) adapters.
; In the NIC key (next lines), set the IP which is configured in each NIC and remove ';'
;NIC=xxx.yyy.www.zz
```

- In DFI Time Settings Section, tune the better startup time which the DFI OLE Server takes to look for **DFI302** in the network. The default time use to be enough if not using routers.

```
[DFI Time Settings]
; Define a delay which the server will wait till complete DFI302 connection
;=13 (Default) 13 seconds before concluding server connection with DFI302s
NETWORK_STARTUP=13
```

- In Remote DFI Section, when using Routers in the Network topology, insert the other IPs located out of the local subnet. Do not forget to tune in DFI Time Settings Section, the better time necessary to DFI OLE Server.

```
[Remote DFI]
; Specify on this section IPs to be reached in remote networks.
; Remember to set Default Gateway under DFI settings using FBTools.
; Format: xxx.yyy.zzz.sss=1 enable IP polling.
;         xxx.yyy.zzz.sss=0 disable IP polling.
;192.168.164.100=0
```

- In the Supervision Section, it is possible to switch the Server (PCI or DFI) to emulation. This mode is only used for debug purposes.

```
[Supervision]
; This section is used for Supervision purposes.
; OPC_TIMEOUT is the maximum time which the Server waits for data refresh.
; EMULATION turns the Emulation on.
; EMULATION_RATE specifies the rate for refreshing of emulation.
OPC_TIMEOUT=30
;=30      (Default) 30 seconds

EMULATION=OFF
;=ON      Activate Emulation Mode for Supervision
;=OFF     (Default) Normal Mode

EMULATION_RATE=1000
;=1000   (Default) 1000 seconds, valid when EMULATION=ON
```

In the Configuration Section, it is possible to configure timeouts for each Syscon Configuration procedure. DO NOT CHANGE ANY VALUE IN THIS SECTION WITHOUT SMAR R&D RECOMMENDATION.

```
[Configuration]
;Default Timeout 10 seconds
Timeout.Default=30
Timeout.MULTILINKTOPOLOGYREQ=60
```

## Topology Upload

The topology upload allows the OPC Server to build a list with the Fieldbus network devices and the corresponding function blocks. This feature is enabled setting the **TOPOLOGY\_CACHE** parameter to **ON**, in the SmarOleServer.ini configuration file. The search for the function block when starting the supervision is optimized, because at the monitoring establishment the server has the block position that will be monitored, so it avoids multiple requests. The initial establishment of the supervision becomes a little slow. To balance this effect, it is possible to configure the quantity of supervision points will be requested for all devices, enabling them quickly, through the **BROADCAST\_LIMIT** parameter. Through setting this parameter, the supervision of the essential points is done quickly, the search of remain points is optimized, decreasing the Ethernet network traffic.

The part of the SmarOleServer.ini file with the setting is showed below:

```
TOPOLOGY_CACHE=OFF
; TOPOLOGY_CACHE defines if the server will upload the network topology. The topology is
; used to optimize the supervision, avoiding broadcasts on GetIDReq.
;=ON      Turn on this feature. It may take a little longer for the server to start receiving
; data.
;=OFF (Default) Turn off this feature. No topology information will be stored, and GetIDReq will
; be done using broadcast.

BROADCAST_LIMIT=100
; BROADCAST_LIMIT is used to speed up the supervision. The server will allow up to the limit
; value of items
; to be discovered by broadcast. This feature is useful when the server is instantiated and the user
; wants to supervise a set of items without waiting for the topology upload.
;=100 (Default)
```

## Smar Server Manager Application

**Smar Server Manager** has been developed to handle almost all configurable features available in Smar OPC Servers like that described in SmarOleServer.ini configuration section. For further details about **Smar Server Manager**, refer to the **Studio302** manual.

## Optimizing DF51 Access to Subnets

Once installed the original **SYSTEM302** package, defaults settings works fine for the most cases, when talking about DF51 connected to Ethernet; mainly when the typical system is composed by one computer, one Network Interface Adapter (NIC) and one subnet. If the topology is different, some steps are necessary to customize the access in optimal way, and sometimes to permit DF51 to work properly.

The SmarOleServer.ini file is used to configure many parameters related with subnet access, as seen previously.

Take a look in [NIC Adapter], [DFI Time Settings], [Remote DFI] and [Remote DFI2] sections, for more details.

### [NIC Adapter]

If more than one NIC (Network Interface Card) are installed in the local machine it is necessary to inform the DFI OLE Server to use one (NIC) or two (NIC and NIC2) adapters. In the NIC key (next lines), set the IP which is configured in each NIC and remove ';'.

```
NIC=192.168.164.20  
NIC2=192.168.165.17
```

### [DFI Time Settings]

The **NETWORK\_STARTUP** parameter defines a delay which the server will wait till complete DFI connection = 13 (Default value) 13 seconds before concluding server connection with DFIs.

```
NETWORK_STARTUP=13
```

The **LOCAL\_POLLING** parameter enables or disables local connection to DFIs. If this parameter is **ON** (Default), it will enable the connections to all available DFIs in the same subnet. If this parameter is **OFF**, it will disable the connections to all available DFIs in the same subnet. Only IPs listed in Remote DFI sections will be polled.

```
LOCAL_POLLING=ON
```

### [Remote DFI]

Specify in this section IPs to be reached in remote networks by NIC with redundancy. Specify also in this section desired local IPs when **LOCAL\_POLLING=OFF**. Remember to set Default Gateway under DFI settings using **FBTools**.

In the format xxx.yyy.zzz.sss, the IP polling can or not be enabled

- 1 enables IP polling.
- 0 disables IP polling.

```
192.168.161.72=1  
192.168.164.197=0
```

### [Remote DFI2]

Specify in this section IPs to be reached in remote networks by NIC2 with redundancy. Specify also in this section desired local IPs when **LOCAL\_POLLING=OFF**. Remember to set Default Gateway under DFI settings using **FBTools**.

In the format xxx.yyy.zzz.sss, the IP polling can or not be enabled

- 1 enables IP polling.
- 0 disables IP polling.

```
192.168.164.71=1  
192.168.161.19=1
```

## Enabling the Synchronism by SNTP

The SNTP (*Simple Network Time Protocol*) client was incorporated as a new feature in the DF1302 demanded by the Market. Its purpose is to establish a synchronism among all equipments in the control area through a time server. So, the reports can be done using a consistent (unique) time reference. The SNTP protocol enabling in the controllers is done as follows:

### Enabling the synchronism by SNTP in the DF51

It is implemented as a thread that sends SNTP unicast requests to specified servers. This thread may be started by the system if the user includes on the **Syscon** a DF1302 bridge (DF51), and in its transducer block, set a valid IP address in the **SNTP\_PRI\_TIME\_SRV** parameter. This address will be the SNTP primary server, already set in a workstation by the Administrator.

If the user has an additional time server, the **SNTP\_SEC\_TIME\_SRV** parameter can be used to configure the IP address of the secondary SNTP server.

The SNTP client sends and receives NTP IPv4 packages from the configured STNP/NTP servers. Such packages contain a timestamp indicating the current time. The package also contains information about where the server is in the hierarchy of time servers. The client will accept any NTP packages from servers using version 3 of the protocol.

If there are no packages from this primary server, after a time set on the **SNTP\_REQ\_TIMEOUT\_ms** parameter, the client (DF1302), automatically, will change its time requests to the another server which was set on the **SNTP\_SEC\_TIME\_SRV** parameter, and it will be responsible for the client synchronism.

If there are no responses from all configured servers, the **NOT SYNCHRONIZED** message will be indicated in the **SNTP\_PRI\_TIME\_SRV** and **SNTP\_SEC\_TIME\_SRV** parameters. After establishing the communication with, at least, one server, the set IPs will reappear in these parameters.

Another parameter than can be set is the **SNTP\_REQ\_INTERVAL\_ms** which determines the interval that the SNTP requests will be solicited to the NTP server.

The general algorithm is as follows: if the system clock has not been yet set via a NTP time updating, then the client will send out requests to SNTP server during the time intervals configured in the **SNTP\_REQ\_INTERVAL\_ms** parameter.

After the first clock synchronization of the equipment, the SNTP client will continue sending requests according to the value set in **SNTP\_REQ\_INTERVAL\_ms** parameter in order to keep the clock synchronized.

The system clock accuracy was defined in 1 second and is represented by **SNTP\_TARGET\_TIME\_PRECISION\_us** parameter. The SNTP client will update the system clock when the time difference with the received timestamp is greater than 0.5 seconds. The change is done as a step.

In the DF1302 transducer the parameter that will update the new time is **APPLICATION\_TIME** parameter.

### Setting SNTP Server on Windows Platform

In order to have the SNTP Client working, you will need a SNTP Server. This can be done in a computer running Windows™ Platform. Administrative knowledge will be necessary. Please, check the Network Administrator for further information.

## TROUBLESHOOTING

Some configurator systems use a Windows™ API in order to obtain the data and hour of the system. When the Daylight-saving time is established, this API will be based on the USA time zone. So, it can have difference between the SNTP client and server hour.

To solve this problem, the following steps should be followed for Windows™ platform:

- Click Start→Settings→Control Panel;
- Double-click Date/Time;
- Select the time zone tab and choose USA&Canadian option as default;
- Disable the Automatically adjust clock for daylight saving changes option;
- Adjust the clock for the correct hour.

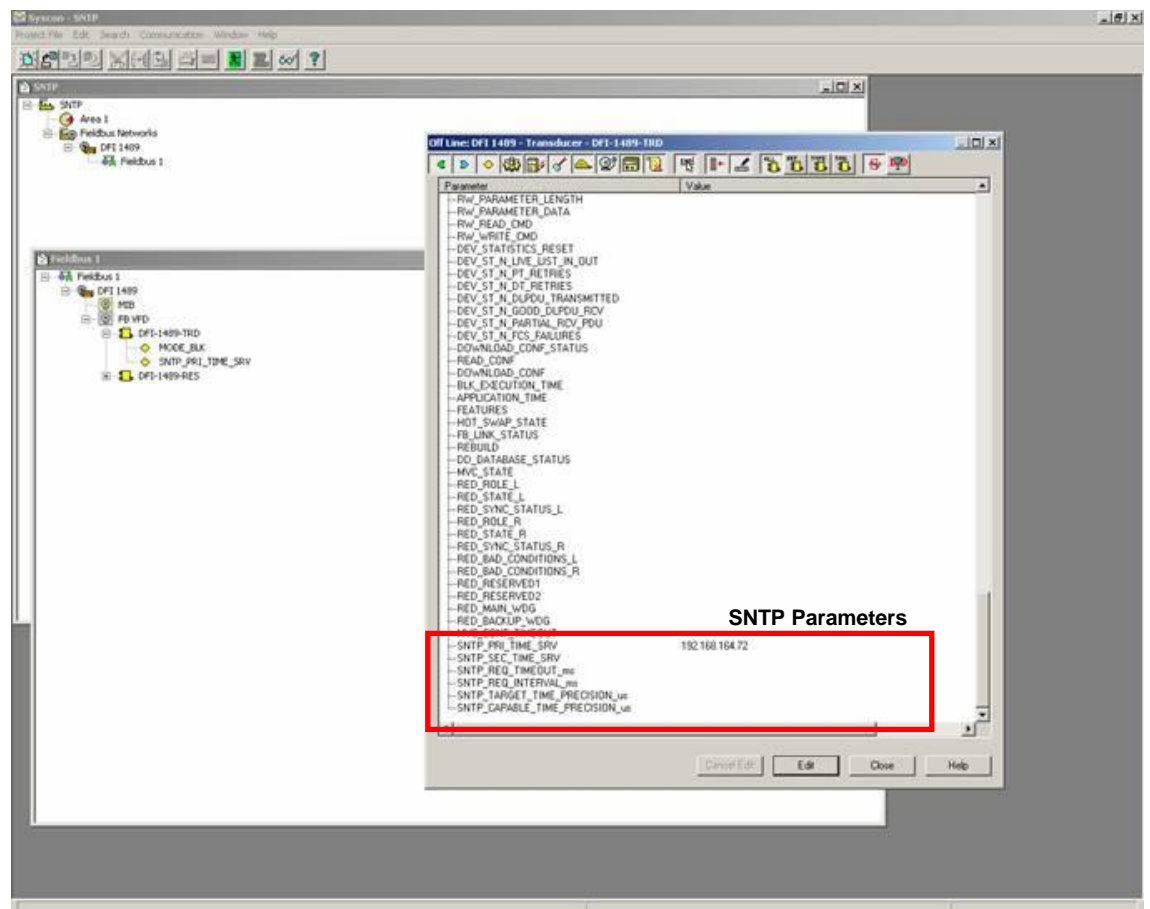
**Note:** This procedure must be done only when the local hour is different of that set in the configurator system.

## Syscon Configuration

On the **Syscon** create a new strategy, and add a DF51 bridge (firmware version 3.9.1 or later).

On this bridge inserts a Transducer Block, and set the IP Address of the SNTP server on the **SNTP\_PRI\_TIME\_SRV** parameter.

If the current server is running well, the **APPLICATION\_TIME** will be updated and the SNTP client will work without any problem. Otherwise, the **APPLICATION\_TIME** parameter will not be updated and the **NOT SYNCHRONIZED** message will be showed in the **SNTP\_PRI\_TIME\_SRV** and/or **SNTP\_SEC\_TIME\_SRV** parameter.



After the configuration download, it is possible in the Online mode to observe the update of the system clock in the **APPLICATION\_TIME** parameter.

## Device Revision and Capability Files

The SNTP protocol is available from the DD Rev 7. If the user does not have installed the files, contact Smar Technical support in order to get them, and if necessary, the firmware. Once getting the files (DD and Capability Files) copy them to the Device Support directory where the Smar applications are installed. For example: **C:\Program Files\Smar\Device Support\000302\0008.**

### DFI302 Oleserver

In order to read this **APPLICATION\_TIME** parameter on the supervisory, it is necessary to install the DFI302 OleServer version 3.8.1.3 or higher.

To receive data from Tags that are originally set do **BYTE ARRAY** as a formatted string, the **WORK\_WITH\_BSTR** key in the [Supervision] section of the SmarOleServer.ini file must be changed.

#### **WORK\_WITH\_BSTR=0**

```
; WORK_WITH_BSTR enable/disable the feature of dealing with data type BSTR
;=0 (default) default array - NO BSTR
;=1 Default array and can deal with BSTR when requested
;=2 Default BSTR (visible string Foundation)
```

Set this key to **WORK\_WITH\_BSTR=1** and in the OPC Client add the Tag using the requested data type.

**Syscon** will deal with this tag as usual, receiving as **BYTE ARRAY** and performing the change to see the time formatted as following:

**Nov 23, 2004 09:23:44:980 + 2/32 of a millisecond.**

The HMI requires the data type of the tag be in the string format. The DFI Server will perform the change, receiving **TIME\_STAMP** as **BYTE ARRAY** (8 bytes) and passing it on as String.

## Considerations about parameters and firmware

### About Parameters

Some pre-defined limits and conditions were imposed for some parameters in order to have the plain functionality of the SNTP Server.

The default values are:

```
SNTP_REQ_TIMEOUT_ms = 4000 (4s);
SNTP_REQ_INTERVAL_ms = 10000 (10s);
SNTP_TARGET_TIME_PRECISION_us (Read/Write) = 1000000 (1s)
SNTP_CAPABLE_TIME_PRECISION_us (Read Only) = 1000000 (1s).
```

Limits values are imposed for: **SNTP\_REQ\_INTERVAL\_ms** and **SNTP\_REQ\_TIMEOUT\_ms**. The first will support a minimum value of 2000 (2s) and free maximum value. The second one (timeout) must to be set to 1000 (1s), i.e., **SNTP\_MIN\_REQUEST\_TIME / 2** and a maximum value to the timeout parameters will be approximately 90% of the entered Request Interval value and never equals to or higher of it (otherwise it does not make any sense, the system will adjust the value automatically and will never work).

A special consideration should be done for **SNTP\_PRI\_TIME\_SRV** and **SNTP\_SEC\_TIME\_SRV** parameters. In these parameters, when the user sets the value 0 or the message **NOT SYNCHRONIZED** is being showed, the SNTP protocol will not work properly, and all tasks and connections will be stopped. On other hand, if the first parameter (**SNTP\_PRI\_TIME\_SRV**) does not have a valid IP address or it is blank, but the second has one, the communication with the server will not be established and the message **NOT SYNCHRONIZED** will be indicated in both parameters. So, it is necessary just one valid SNTP/NTP server and if it is unique, it must be set on the **SNTP\_SEC\_TIME\_SRV** parameter.

### About System302 and SNTP component

The SNTP feature is incorporated on **SYSTEM302** Version 6.1.9 or later.



## **Enabling the synchronism by SNTP in the DF62, DF63, DF73, DF75, DF79, DF81, DF89, DF95, DF97 and DF100 controllers**

To enable the synchronism by SNTP in the other DFI302 controllers refer to “How to synchronize the DFI302 Controllers with a common time” section in the **SYSTEM302 Handbook**.

# Section 5

## CONFIGURING STRATEGIES

### Introduction

**Syscon** is the configuration tool for the **SYSTEM302** package to develop system strategies.

Strategy examples will be explained in the following sections. They were developed by using some DFI302 controllers. There is a section which shows how to add discrete control through ladder logic by using Flexible Function Block (FFB).

To create the strategy, it is necessary create the area before, or use an area template.

It is possible to create, or edit, an area from the **Studio302**. In the **Studio302** interface select **Areas**. A window will appear listing all the areas of database.

To create a new area from the **Studio302**, left-click inside the window **Areas**, then choose **New Area**.

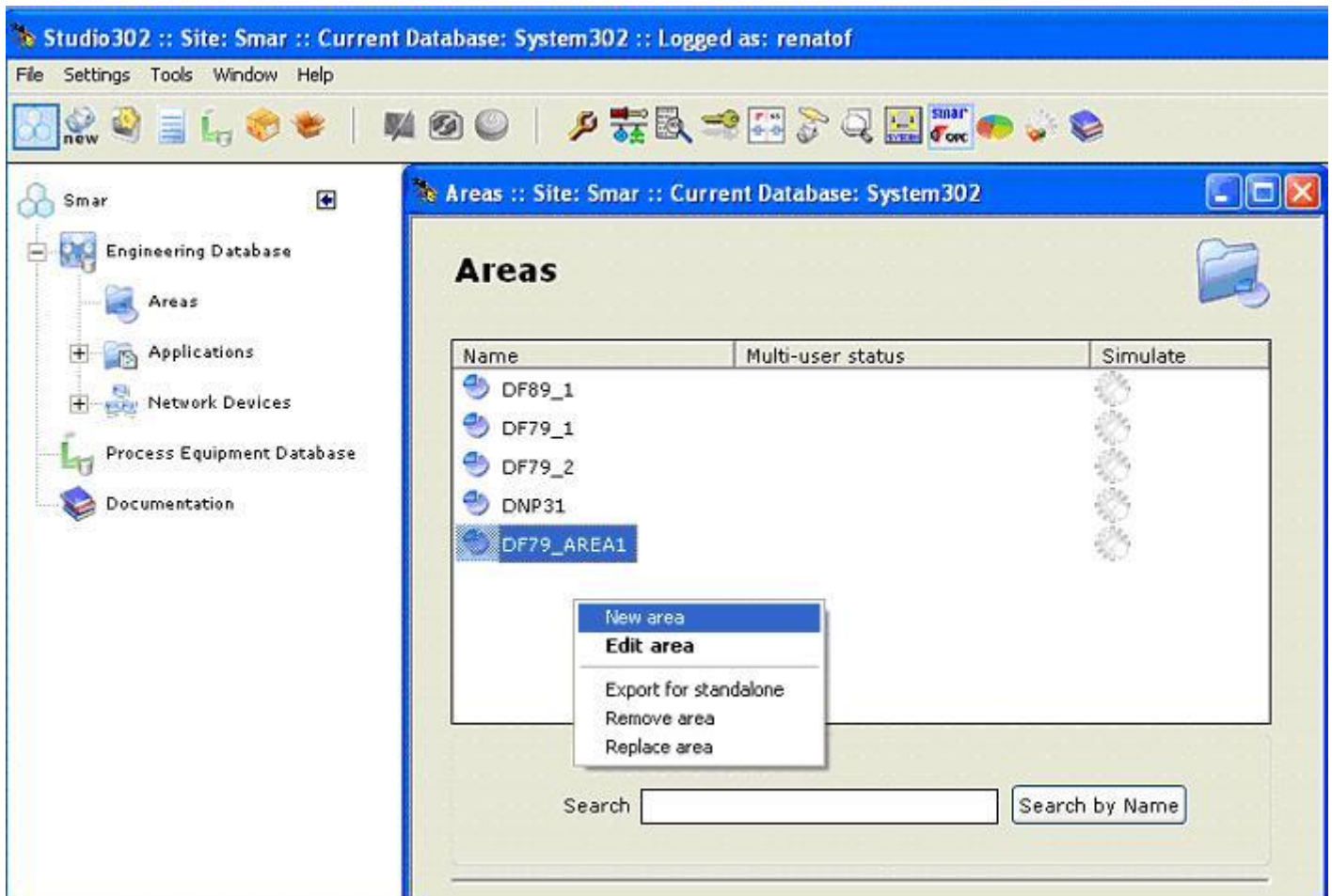


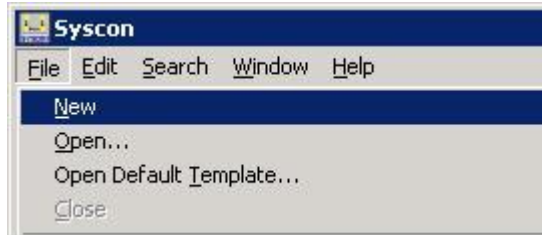


Figure 5. 1 – Creating an area from Studio302

Another way to create a new area is from **Syscon**. Click the icon  in the **Studio302** toolbar, and **Syscon** will be launched. Choose **File** → **New**, or through the **Syscon's** toolbar, choose **New** button . See the following figure.



**Figure 5. 2 – Creating new area from Syscon**

The user will be able to choose the area type from the pop-up menu shown below.



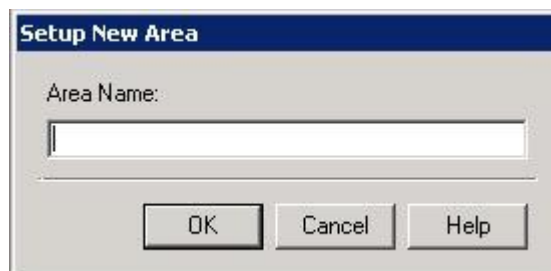
**Figure 5. 3 – Choosing the area type**

## **Area Types**

The area type options will be explained in the following topics.

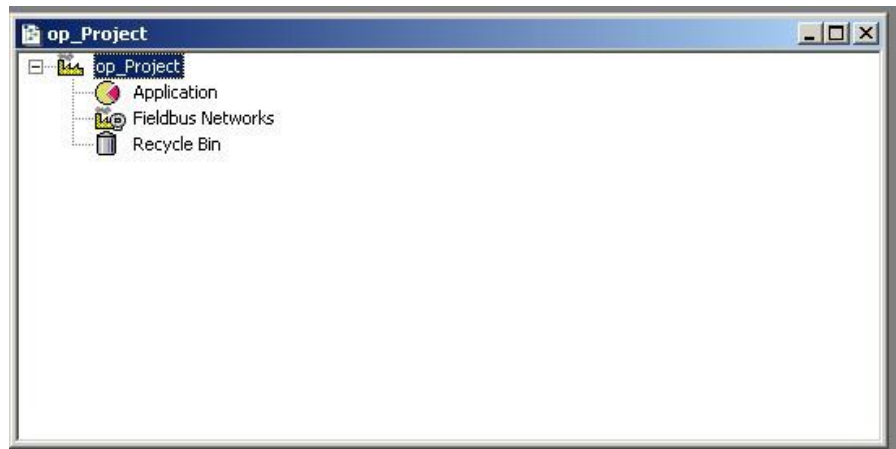
### **Area**

Choosing **Area** option, a window to give a name to the area will open, as shown in the next figure:.



**Figure 5. 4 – Naming the area**

Type the area name, click **OK** and the following window will open:



**Figure 5. 5 – Area option selected**

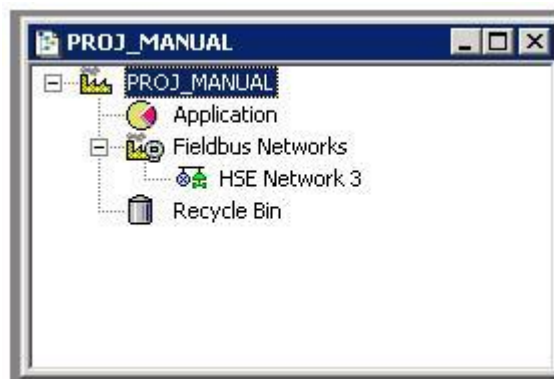
This window has the icons:

- **Application** – Logical Plant. To insert the control strategies into this part.
- **Fieldbus Networks** – Physical Plant. To insert devices and function blocks used in the project.

This area type may use the DF51 controller as bridge. For further details about this strategy type, refer to the section Creating a fieldbus strategy by using DF51.

## HSE Area


When choosing **HSE Area** option, a window to give a name to the area will open. After naming the area, the following window will open:



**Figure 5. 6 – HSE Area option selected**

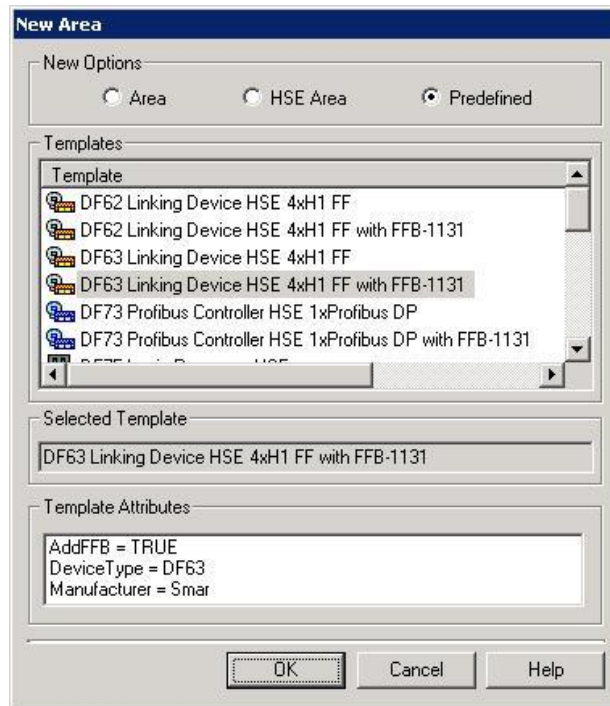
This window has the icons:

- **Application** – Logical Plant. To insert the control strategies into this part.
- **Fieldbus Networks** – Physical Plant. To insert devices and function blocks used in the project.

If the **Fieldbus Networks** is not expanded, click the  sign next to its icon, and this way, the HSE network of this area will be shown. For this area type can be developed strategies which have, for example, DF62 as bridge, or DF73 as controller. For further details refer to the sections Creating a FOUNDATION fieldbus strategy by using the DF62/DF63 and Creating a Profibus configuration by using the DF73, DF95, or DF97.

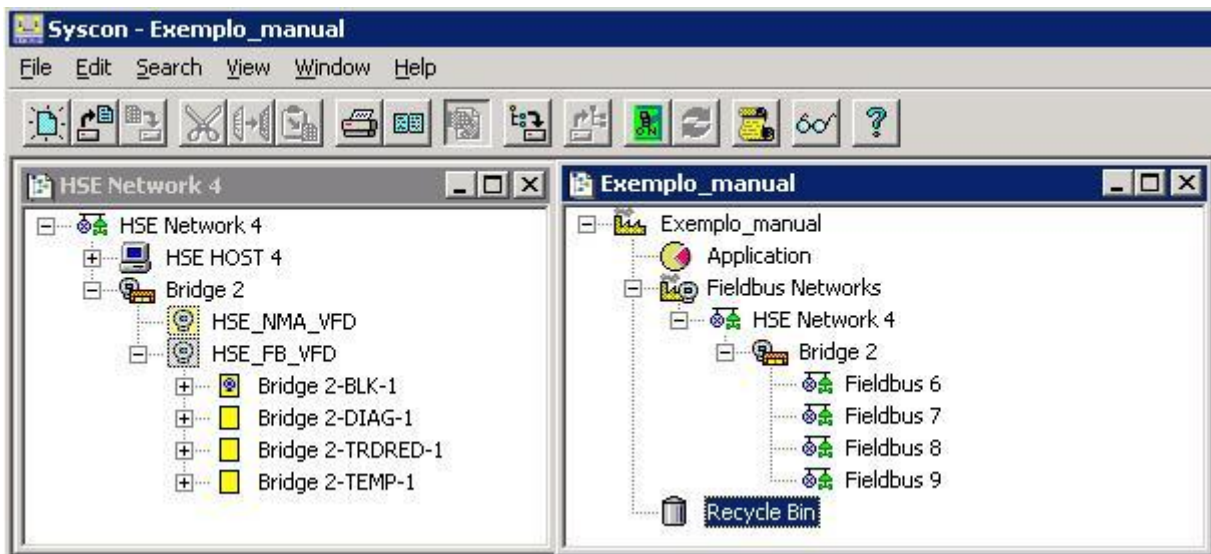
## Predefined Area

When the choice is **Predefined Area**, a window to select the area template is shown initially. The next figure shows this window with the template options:



*Figure 5.7 – Predefined Area option selected*

When choosing one option, a window to give a name to the area will open. After naming the area, the following window will open:



*Figure 5.8 – Predefined Area option windows*

To exemplify this area template, the DF62 was selected. For further details about this area type, refer to the **Syscon** manual.

## Strategy Template

Choosing **Strategy Template** option, it shows the window to add strategies:

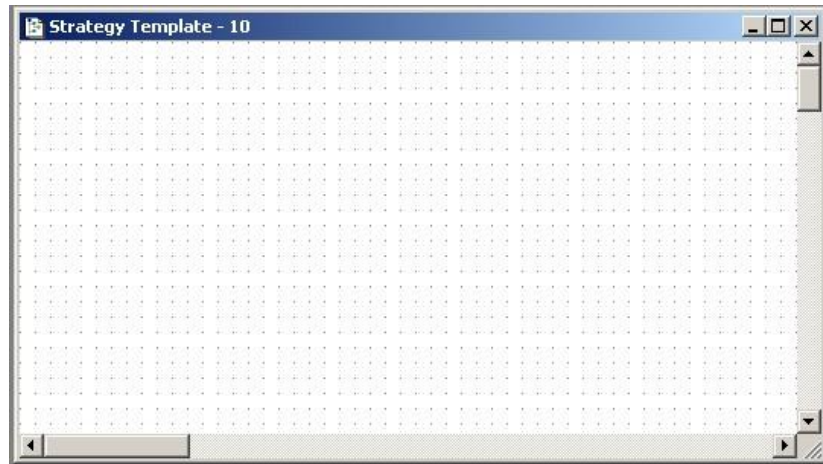


Figure 5. 9 – Strategy Template option

Using this option, many projects can use this strategy.

## Device Template

For the **Device Template** option, it shows the box to select the devices that will be templates for the project.

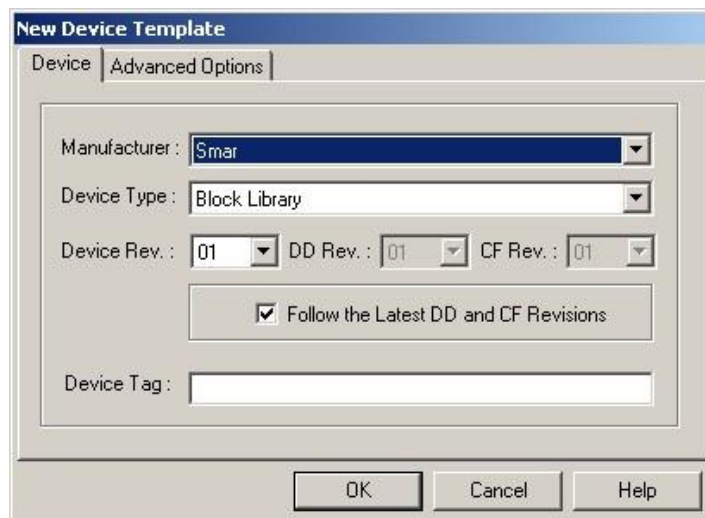
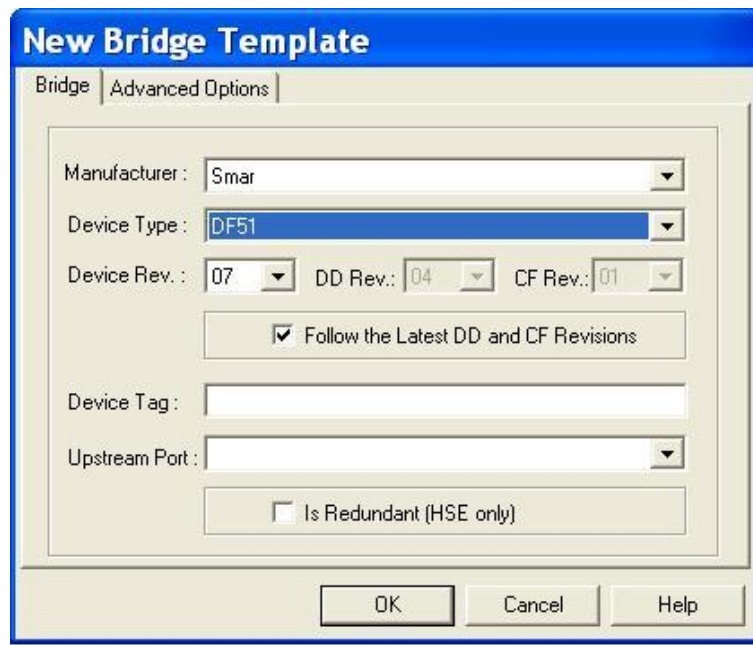


Figure 5. 10 – Device Template option

## Bridge Template

Choosing the **Bridge Template** option, it shows the box to select the device that will act as bridge for the area, as shown in the next figure:

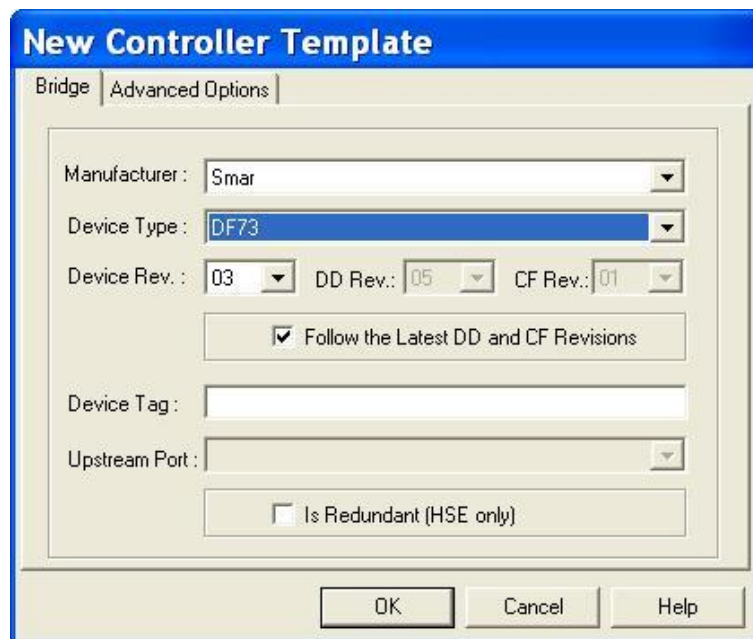


**Figure 5. 11 – Bridge Template option**

The **Device Type** box displays the controllers, such as DF51, DF62, DF63, and other devices that are able to act as bridge.

## Controller Template

Choosing the **Controller Template** option, it shows the box to select the device that will act as controller for the area, as shown in the next figure:



**Figure 5. 10 –Controller Template option**

The **Device Type** box displays the controllers, such as DF73, DF75, DF79, and others that act as controllers.

# Section 6

## ADDING FUNCTION BLOCKS

### Introduction

The **DFI302** and fieldbus devices use function blocks to build strategies, such as PID, AI blocks, etc. This means that **Syscon** can be used to set up every part of the system - transmitters, positioners and controller - in a same language.

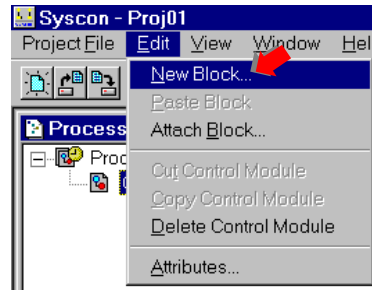
Using **Syscon** (for further details, see **Syscon** manual), follow the steps below to create a new block in the strategy.

### Creating a New Block

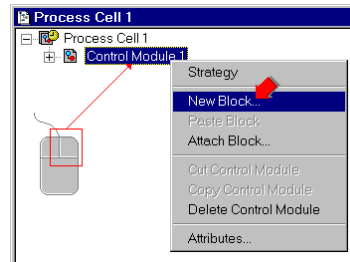
Create a new **Process Cell**, selecting the **Area** icon, and then **Edit** → **New Process Cell**.

Create a new **Control Module** opening the **Process Cell** window, and then selecting the **Process Cell** icon. Go to the **Edit** menu, and choose **New Control Module**.

And then, to create a new **Function Block**, select the **Control Module** icon on the **Process Cell** window, go to the **Edit** menu, and choose **New Block** (as shown in figure bellow).



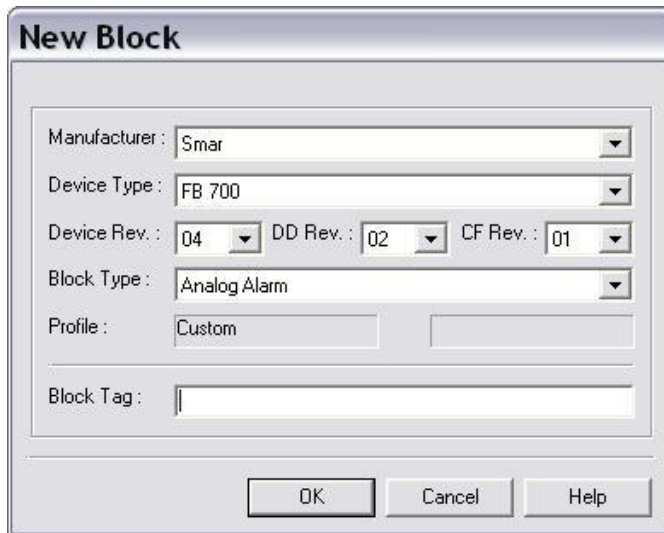
Another way to do this is right-clicking the **Control Module** icon to open its pop up menu. Click the **New Block** item. See the following figure:



The **New Block** dialog box will appear:

- a) Select a **Block Manufacturer** from the list.
- b) Select a **Device Type** provided by the selected manufacturer.
- c) Select the **Device Revision**.
- d) Select the **DD Revision**.
- e) Select the **CF Revision**.
- f) Select a **Block Type**.
- g) Type a related tag for the **Block**. Click **OK** to conclude the task.



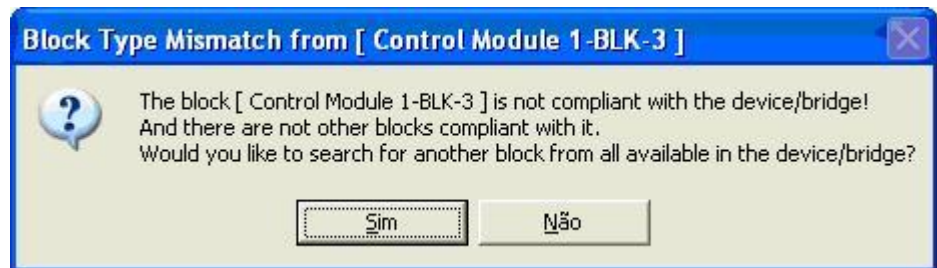


If the user does not type a tag, the default tag **Block1** will be assigned.

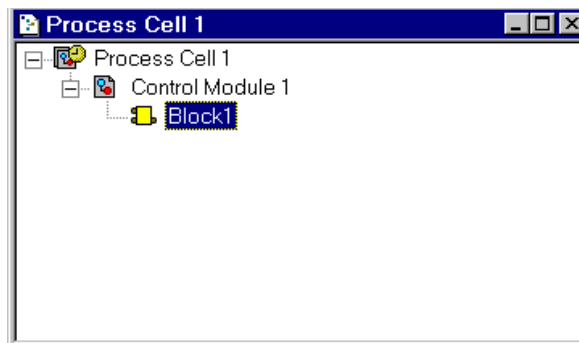
**Syscon** uses the latest revision of the **Device Revision** and the **DD Revision** as the default value for the new block. These values must be in according to the device used in the plant and its revision.

If a different Device Revision version is necessary, and the user already knows the corresponding value for the device, so the value can be changed in the window above.

Another way is to let the **Syscon** does the association automatically when the block is associated to the equipment. In this case, when a block is chosen in the strategy, and it is not supported by the equipment the **Syscon** shows the window below. It will allow the user to select another block which has equivalent functionalities of that does not exist. For further details refer to the **Syscon** manual.



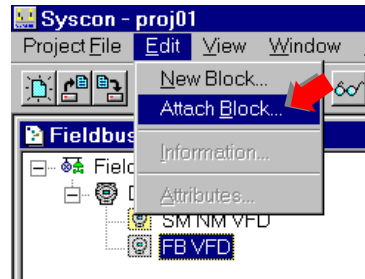
The **Process Cell** window will appear as shown in the figure below:



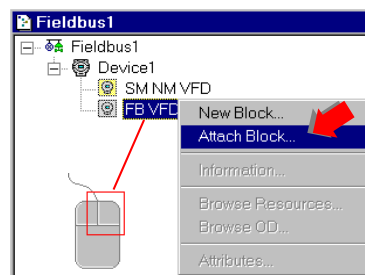
## Attaching New Block

If one block was added to the **Logical Project**, this block can be attached to the device in the **Physical Project**:

For this on the **Fieldbus** window, select the **FB VFD** icon of the block that will be attached. Go to the **Edit** menu, and choose **Attach Block**. See the following figure:

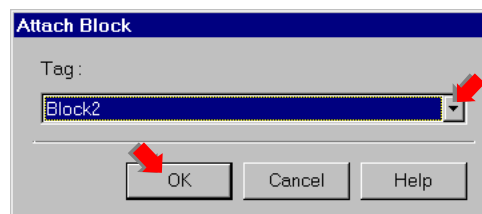


Or right-clicking the **FB VFD** a pop-up menu will appear. Choose **Attach Block**. See the following figure:



The **Attach Block** dialog box will appear.

Click the down arrow to select the block that will be attached. Click **OK** to add the block to the **Physical Project**:



Just click **Cancel** if you do not want to attach more blocks.



# Section 7

## ADDING LOGIC BY USING FLEXIBLE FUNCTION BLOCKS (FFB 1131)

### Introduction

DFI302 has an advanced configuration resource by using Flexible Function Block (FFB 1131). Its purpose is to provide the connection between the ladder logic (usually used for discrete control strategies) and the continuous control strategies, configured through function blocks.

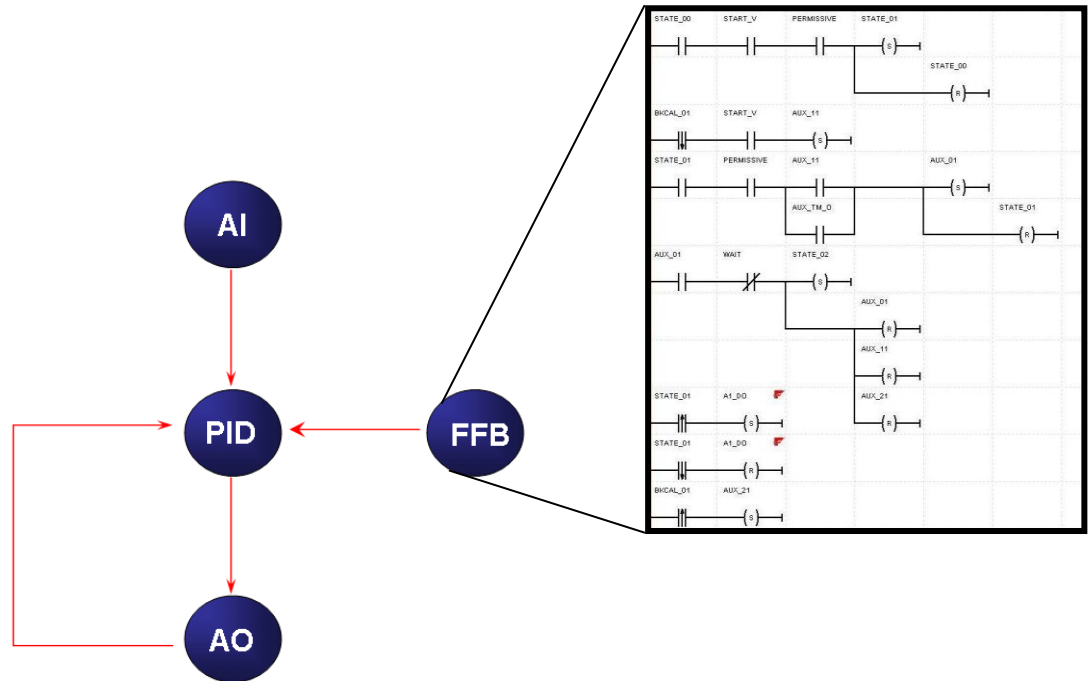


Figure 7.1 – Continuous and discrete control

**NOTE**  
The DF62, DF63, DF73, DF75, DF79, DF81, DF89, DF95, and DF97 controllers support the FFB 1131. So, the example that will be showed can be applied to any of these controllers.

## Area with FFB 1131

For the aimed application, there is an integration between 2 linking devices and also:

- 3 FOUNDATION™ fieldbus transmitters
- 10 FOUNDATION fieldbus valve positioners

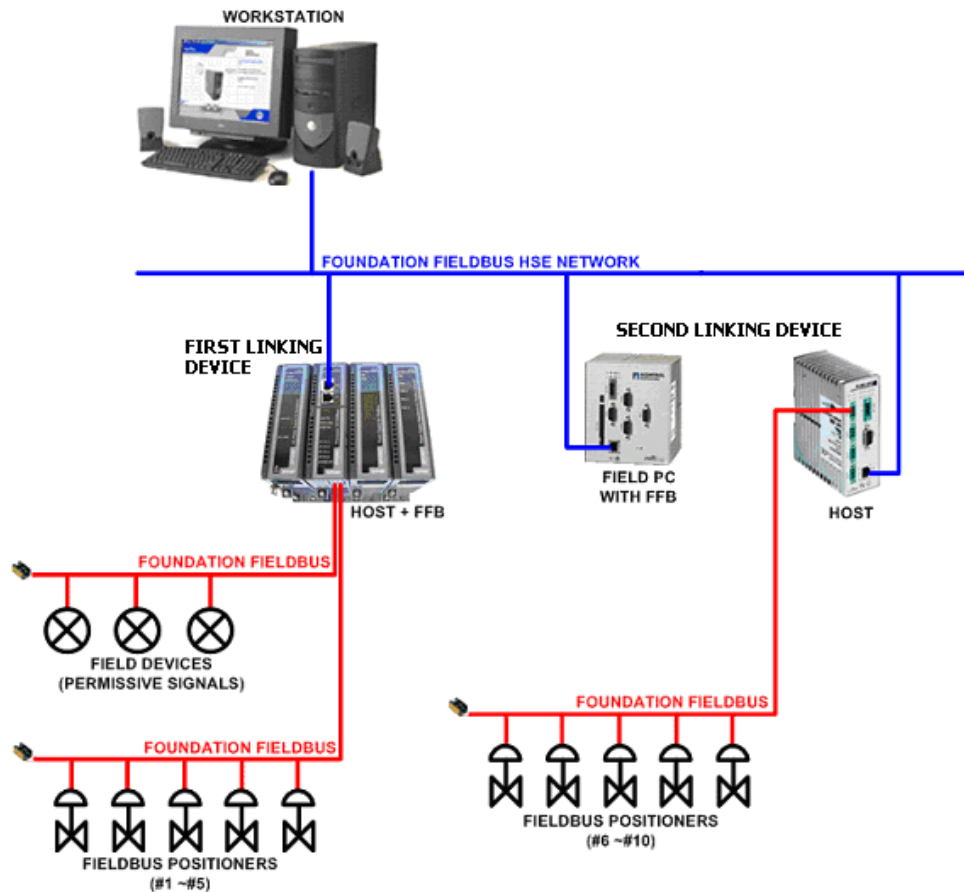


Figure 7.2 –Example of process


To create the control strategy using the FFB, it is necessary to open the **Syscon**. To create a new area on **Syscon**, choose **File** → **New**, or through the toolbar, choose **New** button . The dialog box shows the areas options. Select **Predefined Area** in the next figure:



Figure 7.3 –Area Options

The window with the options of areas templates will be showed next. The user should select one of the template types with FFB. The next figure shows the dialog box with one of the options selected.

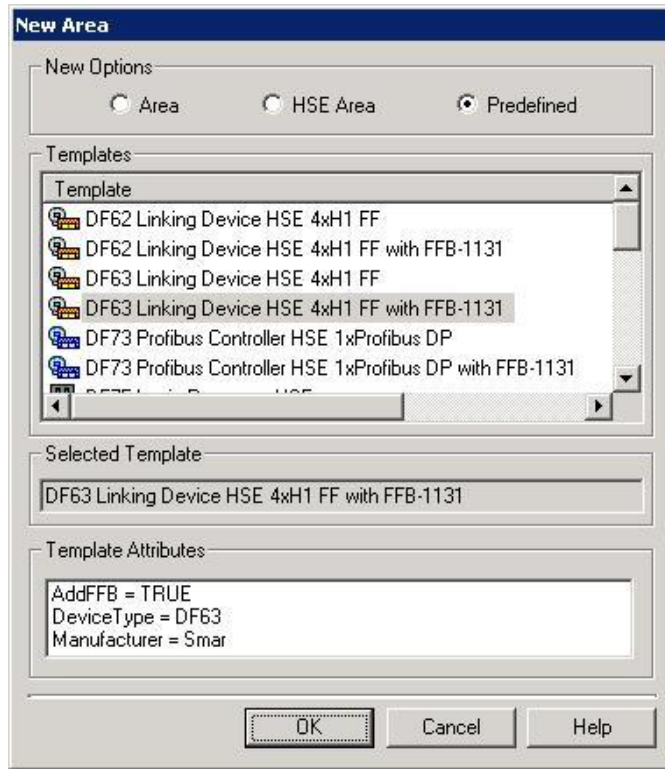


Figure 7.4 – Choosing the template using DF63

After choosing the area type, it opens a window to the user give a name to the new area. Type the name for the area in the **Area Name** box, and click **Ok**. Thus, two new windows will open in the **Syscon** automatically. See the following figure.

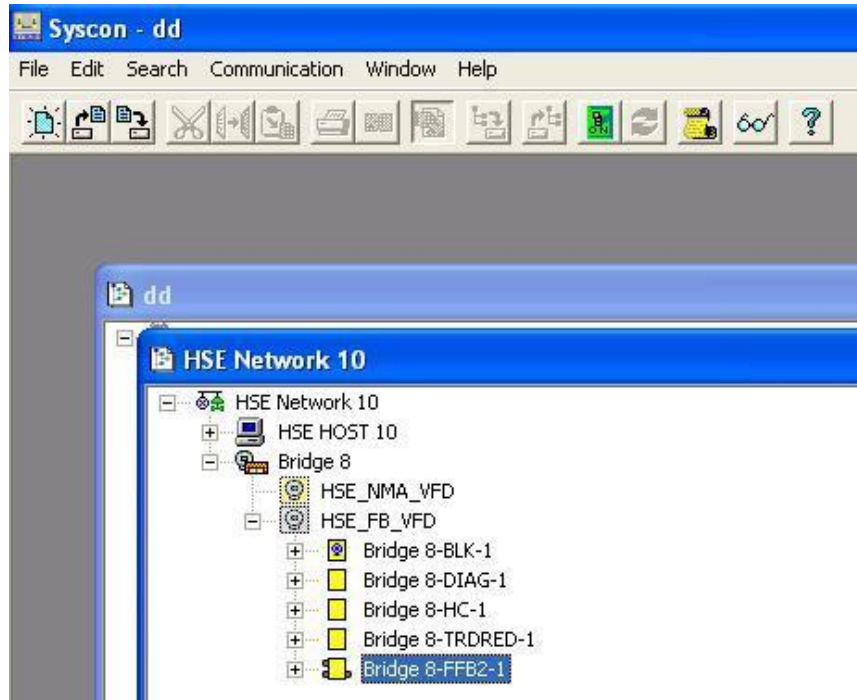


Figure 7.5 – Windows of Predefined Area

## Arranging the Syscon windows

For better view of the area, choose **Window** option on the **Syscon** toolbar, and then **Tile**. The next figure shows the available windows, at this moment, for the area:

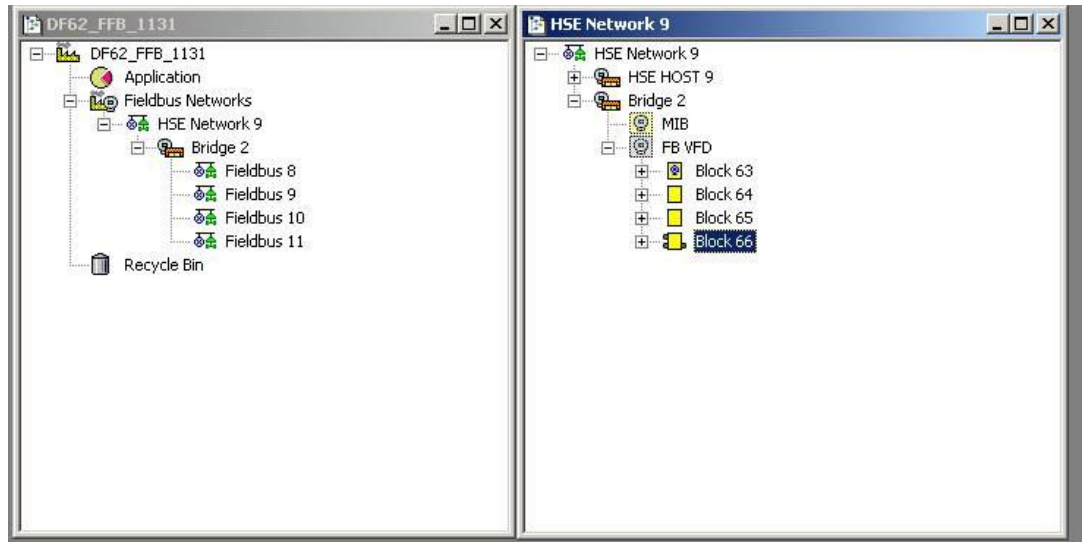



Figure 7.6 – Arranging the windows for the FFB area

## Defining the FFB Parameters

To see the elements, such as blocks that were added to the area, click the **Details** button on the toolbar, . So, a description will appear just after the tag of each element.

In the figure below, click the **HSE Network 9\*** window (this number is different if another area was created before. When a new HSE area is created, this number increases), and then, right-click the **Block 66**. The dialog box for the parameter definition will open:

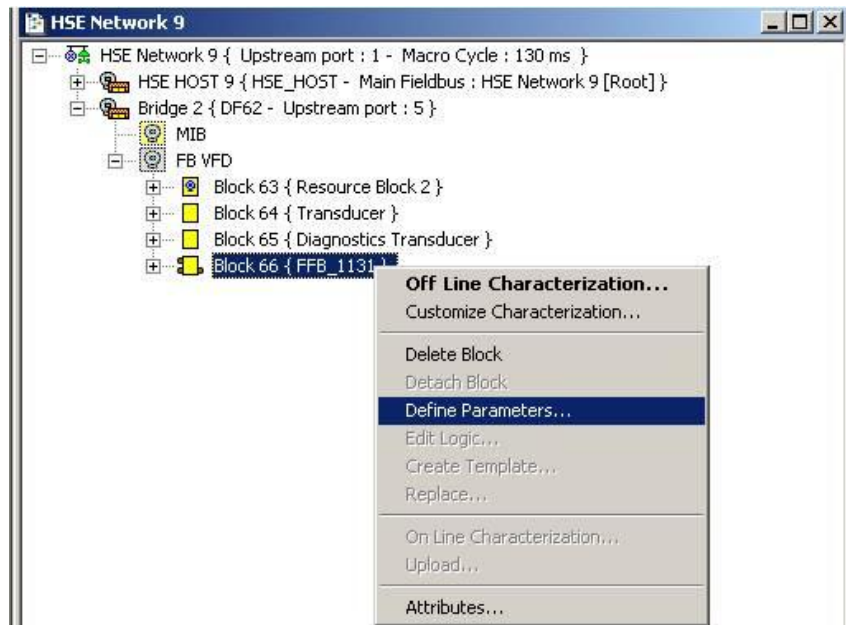


Figure 7.7 – Defining the FFB Parameters

To define which I/O types will be exchanged between the discrete and continuous logic, select **Define Parameters** option from the popup menu. The **FFB Parameters Definition** window will open as shown in the next figure:

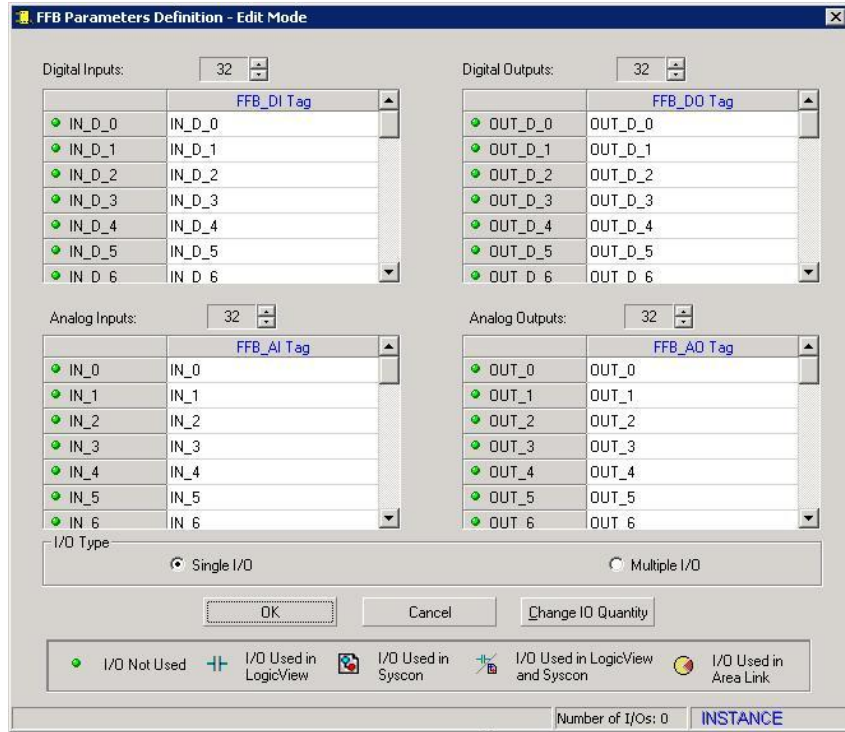


Figure 7.8 – Defining FFB Parameters

**NOTE**

From the 7.3 version of **SYSTEM302**, the FFB is automatically created, with the following number of parameters: 32 DO, 32 DI, 32 AO, 32 AI, 4 DO64, 4 DI64, 4 AI16, and 4 AO16, these last four types are created for the FFB2.

In the window above, the user can configure the number of analog and digital inputs and outputs: Analog Inputs, Analog Outputs, Digital Inputs, Digital Outputs, Analog Inputs16, Analog Outputs16, Digital Inputs64 or Digital Outputs64, respectively. After the user clicks **OK** the points DI, DO, AI, AO, DI64, DO64, AI16, and AO16 are generated. In **I/O Type** option are chosen how many and what parameters will be configured. In **Single I/O** option DI, DO, AI, and AO are configured. In **Multiple I/O** option DI64, DO64, AI16, and AO16 are configured. For further details about **FFB Parameters Definition** see the **Syscon's** manual.

To change the tags right-click the FFB block icon on **Syscon** (in the **Process Cell**, **Fieldbus** or **Strategy** window) and click **Edit User Parameter Tags**. The **User Parameter Tag** dialog box will open. For further information refer to **Syscon** manual.

If neither all I/O points are known at this moment, new I/O points may be defined later.

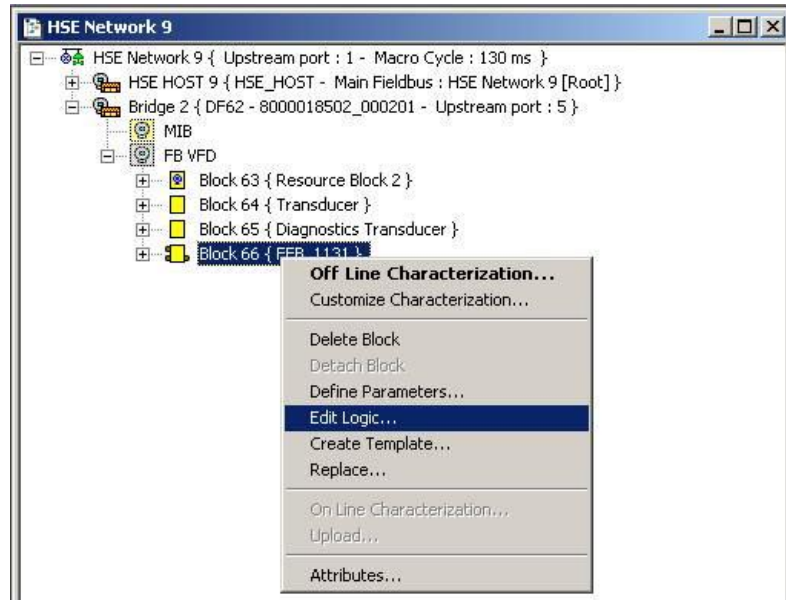
**IMPORTANT**

When a FFB block is used in a control strategy it is recommended to reserve extras parameters for future usage avoiding an impact of stopping the control during an incremental download. It will be necessary when a new strategy with new parameters were included. When new FFB parameters are added, as well as a change of parameter's name, the devices' DDs will be redefined, and this will demand a wider download, resulting in deleted links and deleted blocks, and the re-establishment of them. The utilization of extras parameters, which were previously defined, will not redefine new DDs and will demand only the establishment of new links which will use the reserved parameters.

However, from the 7.3 version of **SYSTEM302** when creating a new parameter, four other reserve parameters are automatically created for that same type.



Right-click the **FFB block** again. The dialog box to edit the logic will open. Now the user can select **Edit Logic** option to edit the internal logic of the function block.



**Figure 7.9 – Selecting the option to edit the logic**

Just clicking this option, a new window will open. The configuration tool specialized in ladder logic will allow the user to build the discrete control. For further details about the ladder logic edition, refer to the **LogicView for FFB** manual.

## ADDING I/O MODULES

### Introduction

The DFI302 was specifically, and primarily, designed to operate with Fieldbus instruments. All common field device types are available in fieldbus versions. Therefore the amount of conventional I/O points required in a system is drastically reduced and will eventually be eliminated. However, since many applications require connection with devices that do not have Fieldbus communication, the DFI302 may also be fitted with conventional discrete and analogue I/O on an extended backplane. Each controller module can be fitted with an I/O-subsystem for up to 256 points or 1024 depending on the controller specification.

There are many types of modules available for the DFI302, designed to fit a broad range of applications in the automation and process control industry.

The following tables show the available I/O module types.

| DISCRETE INPUTS |  |                    |
|-----------------|--|--------------------|
| MODEL           | DESCRIPTION                                  | I/O TYPE           |
| DF11            | 2 Groups of 8 Digital Inputs 24 Vdc - Sink   | 16-discrete input  |
| DF12            | 2 Groups of 8 Digital Inputs 48 Vdc - Sink   | 16- discrete input |
| DF13            | 2 Groups of 8 Digital Inputs 60 Vdc - Sink   | 16- discrete input |
| DF14            | 2 Groups of 8 Digital Inputs 125 Vdc - Sink  | 16- discrete input |
| DF15            | 2 Groups of 8 Digital Inputs 24 Vdc - Source | 16- discrete input |
| DF16            | 2 Groups of 4 Digital Inputs 120 Vac         | 8- discrete input  |
| DF17            | 2 Groups of 4 Digital Inputs 240 Vac         | 8- discrete input  |
| DF18            | 2 Groups of 8 Digital Inputs 120 Vac         | 16- discrete input |
| DF19            | 2 Groups of 8 Digital Inputs 240 Vac         | 16- discrete input |
| DF20            | 1 Group of 8 Push-Button Switches            | 8- discrete input  |

| DISCRETE OUTPUTS |  |                     |
|------------------|--|---------------------|
| MODEL            | DESCRIPTION  | I/O TYPE            |
| DF21             | 1 Group of 16 Digital Outputs 24 Vdc - Sink                      | 16- discrete output |
| DF22             | 2 Groups of 8 Digital Outputs 24 Vdc - Source                    | 16- discrete output |
| DF23             | 2 Groups of 4 Digital Outputs 120/240 Vac - Triac                | 8- discrete output  |
| DF24             | 2 Groups of 8 Digital Outputs 120/240 Vac - Triac                | 16- discrete output |
| DF25             | 2 Groups of 4 NO Relay Outputs                                   | 8- discrete output  |
| DF26             | 2 Groups of 4 NC Relay Outputs                                   | 8- discrete output  |
| DF27             | 1 Group of 4 NO and 4 NC Relay Outputs                           | 8- discrete output  |
| DF28             | 2 Groups of 8 NO Relay Outputs without RC Protection             | 16- discrete output |
| DF29             | 2 Groups of 4 NO Relay Outputs without RC protection             | 8- discrete output  |
| DF30             | 2 Groups of 4 NC Relay Outputs without RC protection             | 8- discrete output  |
| DF31             | 1 Group of 4 NO and 4 NC Relay Outputs without RC protection     | 8- discrete output  |
| DF69             | 2 Groups of 8 NO Relay Outputs                                   | 16-discrete output  |
| DF71             | 2 Groups of 4 NO Relay Outputs without RC protection - Max 10 mA | 8-discrete output   |
| DF72             | 2 Groups of 4 NC Relay Outputs without RC protection - Max 10 mA | 8-discrete output   |

| COMBINED DISCRETE INPUTS AND OUTPUTS |   |                                      |
|--------------------------------------|---|--------------------------------------|
| MODEL                                | DESCRIPTION   | I/O TYPE                             |
| DF32                                 | 1 Group of 8 24 Vdc Inputs and 1 Group of 4 NO Relay          | 8- discrete input/4- discrete output |
| DF33                                 | 1 Group of 8 48 Vdc Inputs and 1 Group of 4 NO Relay          | 8- discrete input/4- discrete output |
| DF34                                 | 1 Group of 8 60 Vdc Inputs and 1 Group of 4 NO Relay          | 8- discrete input/4- discrete output |
| DF35                                 | 1 Group of 8 24 Vdc Inputs and 1 Group of 4 NC Relay          | 8- discrete input/4- discrete output |
| DF36                                 | 1 Group of 8 48 Vdc Inputs and 1 Group of 4 NC Relay          | 8- discrete input/4- discrete output |
| DF37                                 | 1 Group of 8 60 Vdc Inputs and 1 Group of 4 NC Relay          | 8- discrete input/4- discrete output |
| DF38                                 | 1 Group of 8 24 Vdc Inputs and 1 Group of 2 NO and 2 NC Relay | 8- discrete input/4- discrete output |
| DF39                                 | 1 Group of 8 48 Vdc Inputs and 1 Group of 2 NO and 2 NC Relay | 8- discrete input/4- discrete output |
| DF40                                 | 1 Group of 8 60 Vdc Inputs and 1 Group of 2 NO and 2 NC Relay | 8- discrete input/4- discrete output |

| PULSE INPUTS |   |                |
|--------------|---|----------------|
| MODEL        | DESCRIPTION   | I/O TYPE       |
| DF41         | 2 Groups of 8 Low Frequency (0 - 100 Hz) 24 Vdc Pulse Inputs  | 16-pulse input |
| DF42         | 2 Groups of 8 High Frequency (0 - 10 KHz) 24 Vdc Pulse Inputs | 16-pulse input |
| DF67         | 2 Groups of 8 High Frequency (0 - 10 KHz) AC Pulse Inputs     | 16-pulse input |

| ANALOG INPUTS |   |                     |
|---------------|---|---------------------|
| MODEL         | DESCRIPTION   | I/O TYPE            |
| DF44          | 1 Group of 8 Voltage/Current Analogue Inputs with Internal Shunt Resistors              | 8-analog input      |
| DF57          | 1 Group of 8 Voltage/Current Differential Analogue Inputs with Internal Shunt Resistors | 8-analog input      |
| DF45          | 1 Group of 8 Low Signal Analogue Inputs for TC, RTD, mV and Ohm                         | 8-temperature input |

| ANALOG OUTPUTS |   |                 |
|----------------|---|-----------------|
| MODEL          | DESCRIPTION                                   | I/O TYPE        |
| DF46           | 1 Group of 4 Voltage/Current Analogue Outputs | 4-analog output |

| HART MODULES |   |                  |
|--------------|---|------------------|
| MODEL        | DESCRIPTION   | I/O TYPE         |
| DF116        | 8 analog inputs with HART master interface (4-20 mA)  | 8 analog inputs  |
| DF117        | 8 analog outputs with HART master interface (4-20 mA) | 8 analog outputs |

| INTERFACES FOR I/O MODULES AND THEIR ACCESSORIES* |   |
|---|---|
| CODE  | DESCRIPTION   |
| ITF - 005AC1                                      | Interface for 16 points of 120 Vac input compatible with DF15.  |
| ITF - 005AC2                                      | Interface for 16 points of 240 Vac input compatible with DF15.  |
| ITF - 001   | Interface for 16 points of 24 Vdc input compatible with DF11.   |
| ITF - 005DC                                       | Interface for 16 points of 24 Vdc input compatible with DF15.   |
| ITF - 101   | Interface for 16 points digital output for relay with NA and NC contact compatible DF21.                                    |
| ITF - 101FAC                                      | Interface for 16 points digital output for relay with NA and NC contact with fuse for AC load compatible with DF21.         |
| ITF - 101FDC                                      | Interface for 16 points digital output for relay with NA and NC contact with fuse for DC load compatible with DF21.         |
| ITF - 102   | Interface for 16 points digital output for relay with NA and NC contact compatible DF22.                                    |
| ITF - 102FAC                                      | Interface for 16 points digital output for relay with NA and NC contact with fuse for AC load compatible with DF22.         |
| ITF - 102FDC                                      | Interface for 16 points digital output relay for relay with NA and NC contact with fuse for DC load compatible with DF22.   |
| ITF - 120AC                                       | Interface for 8 points digital output for AC load relay compatible with DF25.   |
| ITF - 120DC                                       | Interface for 8 points digital output for DC load relay compatible with DF25.   |
| ITF - 123-7                                       | Interface for 16 points digital output for relay with NA and NC contact compatible for AC load with DF69.                   |
| ITF - 1237FAC                                     | Interface for 16 points digital output for relay with NA and NC contact with fuse for AC load compatible with DF28 or DF69. |
| ITF - 1237FDC                                     | Interface for 16 points digital output for relay with NA and NC contact with fuse for DC load compatible with DF28 or DF69. |
| ITF - 304   | Interface for 16 point AC pulse input compatible with DF67.   |
| ITF - 401   | Interface for 8 point analog input compatible with DF44 and DF57.   |
| ITF - 402   | Interface for 8 point analog input compatible with DF45.  |
| ITF - 501   | Interface for 8 point analog output without fuse compatible with DF46.  |
| ITF - QDA-AC                                      | Power distribution interface for 10 points 110/240 Vac @ 2A per point.  |
| ITF - QDA-DC                                      | Power distribution interface for 10 points 24 Vdc @ 2A per point.   |
| ITF - C-10  | Connection cable between DFI302 modules and ITF interfaces - 1.0 m.   |
| ITF - C-15  | Connection cable between DFI302 modules and ITF interfaces - 1.5 m.   |
| ITF - C-20  | Connection cable between DFI302 modules and ITF interfaces - 2.0 m.   |
| ITF - C-25  | Connection cable between DFI302 modules and ITF interfaces - 2.5 m.   |
| ITF - C-30  | Connection cable between DFI302 modules and ITF interfaces - 3.0m.  |
| ITF - C-35  | Connection cable between DFI302 modules and ITF interfaces - 3.5 m.   |
| ITF - C-40  | Connection cable between DFI302 modules and ITF interfaces - 4.0 m.   |
| ITF - C-45  | Connection cable between DFI302 modules and ITF interfaces - 4.5 m.   |
| ITF - C-50  | Connection cable between DFI302 modules and ITF interfaces - 5.0 m.   |

\*For further information, please refer to the Panel Interfaces manual.

| MODEL             | DESCRIPTION   |
|-------------------|---|
| DF0               | Blind module to fill empty slots  |
| DF1A              | Rack with 4 slots – support to shielded flat cable                        |
| DF2               | Terminator for last the rack – right side                                 |
| DF3,<br>DF4A~DF7A | Flat cableS to connect 2 racks  |
| DF9               | Support for a single module   |
| DF54              | Twisted pair cable 100 Base-TX  |
| DF55              | Twisted pair cable 100 Base-TX – cross cable – length 2m                  |
| DF59              | Cable RJ12 used to connect DF51 and DF58                                  |
| DF68              | Cable to connect redundant CPUs   |
| DF76              | Cable to connect coprocessors   |
| DF78              | Rack with 4 slots – It supports Hot Swap of CPUs and redundant I/O access |
| DF82              | Synchronism cable to connect redundant controllers – length 500 mm        |
| DF83              | Synchronism cable to connect redundant controllers – length 1800 mm       |
| DF84              | IMB Soft Starter  |

|       |   |
|-------|---|
| DF90  | IMB power cable   |
| DF91  | Lateral adapter   |
| DF92  | Rack with 4 slots for redundant CPUs, hot swap and diagnostic support |
| DF93  | Rack with 4 slots, with diagnostic                                    |
| DF96  | Terminator for the last rack – left side                              |
| DF101 | Flat cable to connect racks by left side – length 70 cm               |
| DF102 | Flat cable to connect racks by right side – length 65 cm              |
| DF103 | Flat cable to connect racks by right side – length 81 cm              |
| DF104 | Flat cable to connect racks by right side – length 98 cm              |
| DF105 | Flat cable to connect racks by right side – length 115 cm             |

## Steps to configure I/O Modules

The first steps to configure DFI302 with I/O modules, need the knowledge on “How to Add a Function Block” using **Syscon** (the configuration tool). See the section “Adding Function Blocks”, for further information.

Add one Resource Block, one Hardware Configuration Transducer (HC) and one or more Temperature Transducers (when using temperature modules).

After the resource and these transducers blocks, the user can add the other blocks (AI, MAI, AO, MAO, DI, MDI, DO, MDO).

### NOTES

1. From the 7.3 version of SYSTEM302 the function blocks (HCT, Temperature Transducers, AI, MAI, AO, MAO, DI, MDI, DO and MDO) can be used combined with FFB 1131 blocks. However, each output or temperature point must not be used simultaneously for function blocks and FFB 1131 blocks.
2. Using ladder logic (FFB 1131), for a better monitoring of the functional state of each used I/O module is recommended to use the **STATUS** block in the logic. Thus the system can be advised if some I/O module have a failure. So that is easier to find a damaged module. Insert and configure this block according to the **LogicView for FFB** manual.

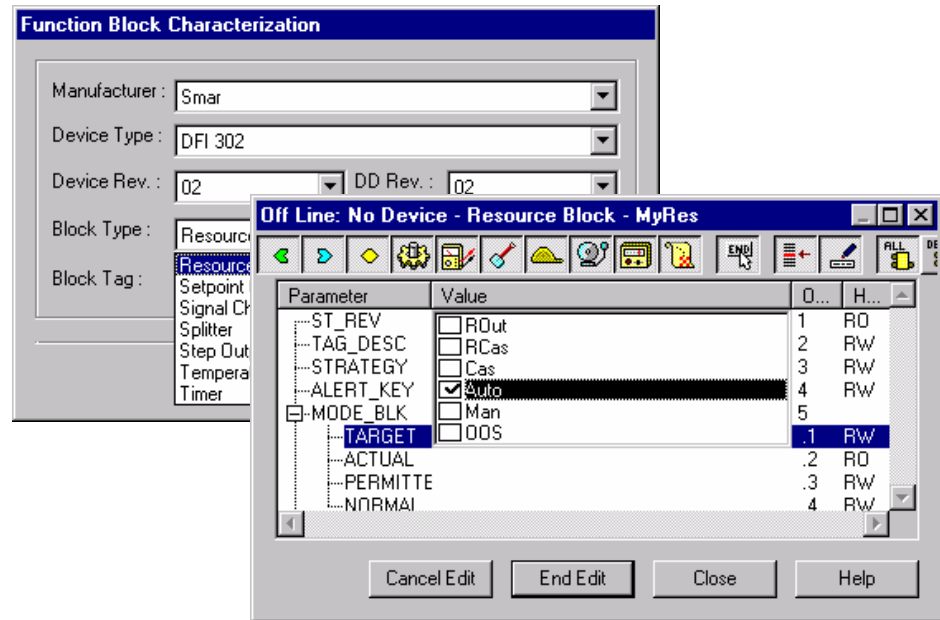
The order of the Resource, Transducers and block creation is very important because when **Syscon** does the configuration download, a lot of consistency checks will be done inside DFI302.

For instance, an AI block will not accept a channel configuration if the desired pointed hardware was not declared before in the Hardware Configuration Transducer.

A complete documentation about FOUNDATION fieldbus blocks and its parameters could be found under Function Blocks Manual inside the **SYSTEM302** documentation folder. The following steps are more related with details about DFI302, and the complete description about blocks will not be found here.

## RES – Resource Block

This function block has already been instantiated in the device. So, it is necessary set the MODE\_BLK.TARGET parameter to AUTO.



## HCT – Hardware Configuration Transducer

This transducer configures the module type for each slot in the DFI302. The execution method of this transducer block will write to all output modules and it will read all the input modules.

If any I/O module has failed in this scan, it will be indicated in BLOCK\_ERR as well in the MODULE\_STATUS\_x. It makes easy to find the module or even the sensor in failure. This function block has already been instantiated in the device, so set the MODE\_BLK parameter to AUTO and fill IO\_TYPE\_Rx parameters with its respective module that has been used.

| PARAMETER  | VALID RANGE/ OPTIONS | DEFAULT VALUE     | DESCRIPTION                       |
|------------|----------------------|-------------------|-----------------------------------|
| ST_REV     |                      | 0                 |                                   |
| TAG_DESC   |                      | Spaces            |                                   |
| STRATEGY   |                      | 0                 |                                   |
| ALERT_KEY  | 1 to 255             | 0                 |                                   |
| MODE_BLK   |                      | O/S               | See Mode Parameter                |
| BLOCK_ERR  |                      |                   |                                   |
| REMOTE_IO  |                      | Remote I/O Master | Reserved                          |
| IO_TYPE_R0 |                      | 0                 | Select module type for the rack 0 |
| IO_TYPE_R1 |                      | 0                 | Select module type for the rack 1 |
| IO_TYPE_R2 |                      | 0                 | Select module type for the rack 2 |
| IO_TYPE_R3 |                      | 0                 | Select module type for the rack 3 |
| IO_TYPE_R4 |                      | 0                 | Select module type for the rack 4 |
| IO_TYPE_R5 |                      | 0                 | Select module type for the rack 5 |
| IO_TYPE_R6 |                      | 0                 | Select module type for the rack 6 |
| IO_TYPE_R7 |                      | 0                 | Select module type for the rack 7 |
| IO_TYPE_R8 |                      | 0                 | Select module type for the rack 8 |
| IO_TYPE_R9 |                      | 0                 | Select module type for the rack 9 |

| PARAMETER            | VALID RANGE/ OPTIONS | DEFAULT VALUE | DESCRIPTION  |
|----------------------|----------------------|---------------|--|
| IO_TYPE_R10          |                      | 0             | Select module type for the rack 10   |
| IO_TYPE_R11          |                      | 0             | Select module type for the rack 11   |
| IO_TYPE_R12          |                      | 0             | Select module type for the rack 12   |
| IO_TYPE_R13          |                      | 0             | Select module type for the rack 13   |
| IO_TYPE_R14          |                      | 0             | Select module type for the rack 14   |
| MODULE_STATUS_R0_3   |                      |               | Status of modules in rack 0-3.   |
| MODULE_STATUS_R4_7   |                      |               | Status of modules in rack 4-7.   |
| MODULE_STATUS_R8_11  |                      |               | Status of modules in rack 8-11.  |
| MODULE_STATUS_R12_14 |                      |               | Status of modules in rack 12-14.   |
| UPDATE_EVT           |                      |               | This alert is generated by any change to the static data.  |
| BLOCK_ALM            |                      |               | The block alarm is used for all configuration, hardware, connection failure or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active status in the Status attribute. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active status, if the subcode has changed. |

### TEMP – Temperature Transducer

This is the transducer block for the module DF45, an eight low signal input module for RTD, TC, Ohm.

When using this module, the TEMP Transducer is necessary and must be added to **Syscon** Configuration, just before the Function Block, which will provide the interface with the I/O module. Therefore, create this block, set the MODE\_BLK parameter to AUTO and fill parameters with range, sensor, etc, that will be used by the Temperature Module.

| PARAMETER           | VALID RANGE/ OPTIONS                         | DEFAULT VALUE | DESCRIPTION   |
|---------------------|--|---------------|---|
| ST_REV              |  | 0             |   |
| TAG_DESC            |  | Spaces        |   |
| STRATEGY            |  | 0             |   |
| ALERT_KEY           | 1 to 255                                     | 0             |   |
| MODE_BLK            |  | O/S           | See Mode Parameter  |
| BLOCK_ERR           |  |               |   |
| CHANNEL             |  |               | The rack and slot number of the associated DF45 module coded as RRSXX.  |
| TEMP_0              |  |               | Temperature of point 0.   |
| TEMP_1              |  |               | Temperature of point 1.   |
| TEMP_2              |  |               | Temperature of point 2.   |
| TEMP_3              |  |               | Temperature of point 3.   |
| TEMP_4              |  |               | Temperature of point 4.   |
| TEMP_5              |  |               | Temperature of point 5.   |
| TEMP_6              |  |               | Temperature of point 6.   |
| TEMP_7              |  |               | Temperature of point 7.   |
| VALUE_RANGE_0       |  | 0-100%        | If it is connected to AI block, it is a copy of XD_SCALE. Otherwise the user can write in this scaling parameter. |
| SENSOR_CONNECTION_0 | 1 : differential<br>2 : 2-wire<br>3 : 3-wire | 3             | Connection of the sensor 0.   |
| SENSOR_TYPE_0       | See table below                              | Pt 100 IEC    | Type of sensor 0.   |

| PARAMETER           | VALID RANGE/ OPTIONS                         | DEFAULT VALUE | DESCRIPTION  |
|---------------------|--|---------------|--|
| VALUE_RANGE_1       |  | 0-100%        | If it is connected to AI block, it is a copy of XD_SCALE. Otherwise the user can write in this scaling parameter.  |
| SENSOR_CONNECTION_1 | 1 : differential<br>2 : 2-wire<br>3 : 3-wire | 3             | Connection of the sensor 1.  |
| SENSOR_TYPE_1       | See table below                              | Pt 100 IEC    | Type of sensor 1.  |
| VALUE_RANGE_2       |  | 0-100%        | If it is connected to AI block, it is a copy of XD_SCALE. Otherwise the user can write in this scaling parameter.  |
| SENSOR_CONNECTION_2 | 1 : differential<br>2 : 2-wire<br>3 : 3-wire | 3             | Connection of the sensor 2.  |
| SENSOR_TYPE_2       | See table below                              | Pt 100 IEC    | Type of sensor 2.  |
| VALUE_RANGE_3       |  | 0-100%        | If it is connected to AI block, it is a copy of XD_SCALE. Otherwise the user can write in this scaling parameter.  |
| SENSOR_CONNECTION_3 | 1 : differential<br>2 : 2-wire<br>3 : 3-wire | 3             | Connection of the sensor 3.  |
| SENSOR_TYPE_3       | See table below                              | Pt 100 IEC    | Type of sensor 3.  |
| VALUE_RANGE_4       |  | 0-100%        | If it is connected to AI block, it is a copy of XD_SCALE. Otherwise the user can write in this scaling parameter.  |
| SENSOR_CONNECTION_4 | 1 : differential<br>2 : 2-wire<br>3 : 3-wire | 3             | Connection of the sensor 4.  |
| SENSOR_TYPE_4       | See table below                              | Pt 100 IEC    | Type of sensor 4.  |
| VALUE_RANGE_5       |  | 0-100%        | If it is connected to AI block, it is a copy of XD_SCALE. Otherwise the user can write in this scaling parameter.  |
| SENSOR_CONNECTION_5 | 1 : differential<br>2 : 2-wire<br>3 : 3-wire | 3             | Connection of the sensor 5.  |
| SENSOR_TYPE_5       | See table below                              | Pt 100 IEC    | Type of sensor 5.  |
| VALUE_RANGE_6       |  | 0-100%        | If it is connected to AI block, it is a copy of XD_SCALE. Otherwise the user can write in this scaling parameter.  |
| SENSOR_CONNECTION_6 | 1 : differential<br>2 : 2-wire<br>3 : 3-wire | 3             | Connection of the sensor 6.  |
| SENSOR_TYPE_6       | See table below                              | Pt 100 IEC    | Type of sensor 6.  |
| VALUE_RANGE_7       |  | 0-100%        | If it is connected to AI block, it is a copy of XD_SCALE. Otherwise the user can write in this scaling parameter.  |
| SENSOR_CONNECTION_7 | 1 : differential<br>2 : 2-wire<br>3 : 3-wire | 3             | Connection of the sensor 7.  |
| SENSOR_TYPE_7       | See table below                              | Pt 100 IEC    | Type of sensor 7.  |
| UPDATE_EVT          |  |               | This alert is generated by any change to the static data.  |
| BLOCK_ALM           |  |               | The block alarm is used for all configuration, hardware, connection failure or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active status in the Status attribute. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active status, if the subcode has changed. |



## TBH – RIO HART Transducer Block

The **TBH** block (RIO HART Transducer Block) represents the HART device in the system. Through it the user can access any variable of the device.

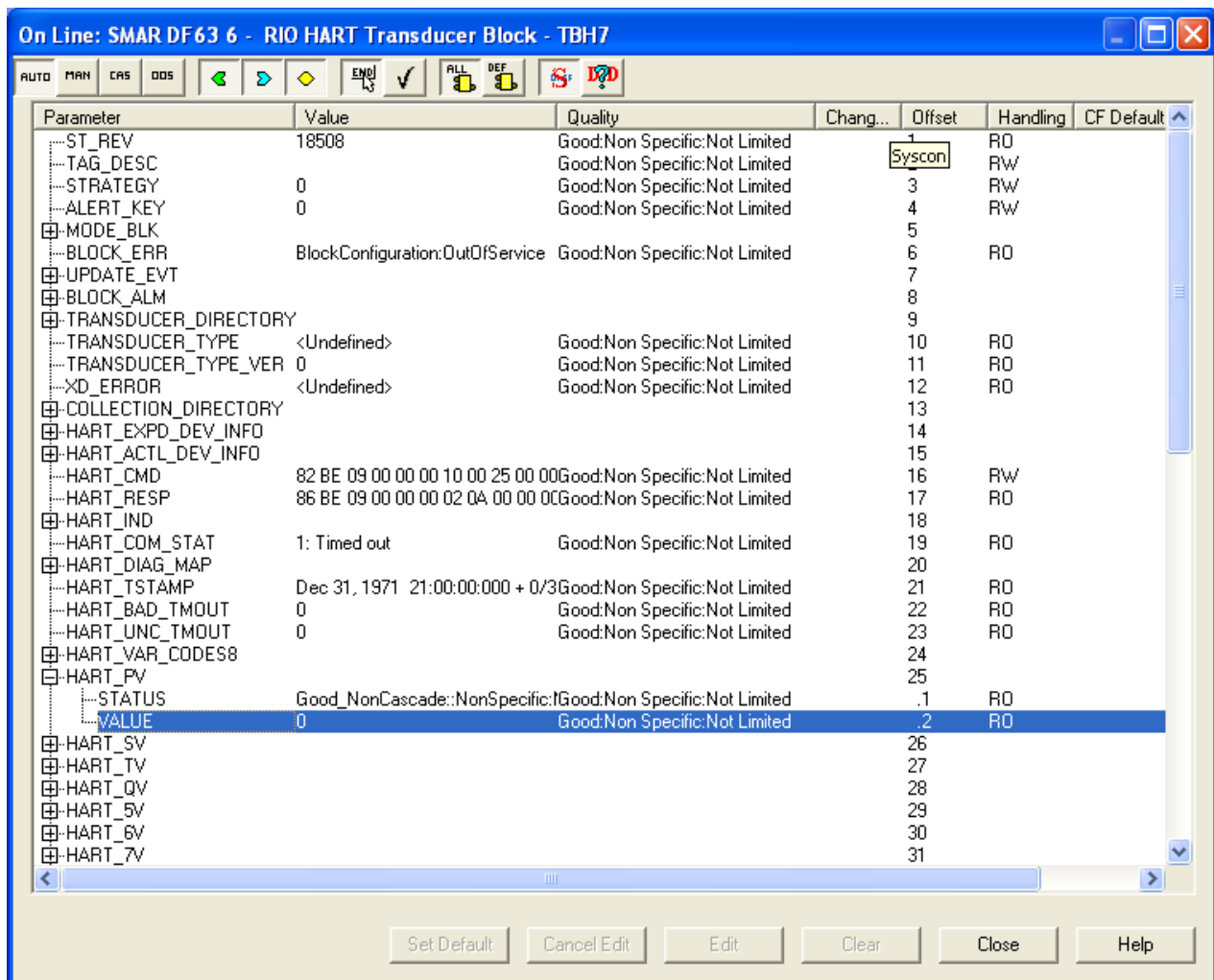
This block contains parameters for the process to be used in the control strategy and ladder logic, identification parameters, Burst and diagnosis, as well as Bypass parameters (**HART\_CMD**, **HART\_RESP** and **HART\_COM\_STAT**) that are used by the configuration and asset management tools for transmission and reception of HART messages.

For each HART device installed must exist one corresponding **TBH** block on the system. The association of this block to the physical device must be done through the **RRSGP** parameter, following the rule **RRSGP** where **RR**: rack, **S**: slot, **G**: group (0 - 7) and **P**: point (9). Examples:

- 209 – Rack 0, Slot 2, group 0 and point 9
- 12319 – Rack 12, slot 3, group 1 and point 9

The group represents the HART device. The DF116/DF117 modules support up to 8 HART devices.

The point has to be configured with 9 because it represents the access to all available variables in the HART device: **HART\_PV**, **HART\_SV**, **HART\_TV**, **HART\_QV**, **HART\_5V**, **HART\_6V**, **HART\_7V**, **HART\_8V** and **PRIMARY\_VALUE**.



**TBH Block (RIO HART Transducer Block)**

### Configuration of the dynamic variables in the TBH block

The **TBH** block is flexible and allows the user to configure up to 8 digital variables to be dynamically read from the HART device. The configuration has to be done in the **HART\_VAR\_CODES8** parameter using indexes. The value and status of the variable for the index are shown on the corresponding parameter. See the following table.

| HART_VAR_CODES8 |
|-----------------|
| [1] – HART_PV   |
| [2] – HART_SV   |
| [3] – HART_TV   |
| [4] – HART_QV   |
| [5] – HART_5V   |
| [6] – HART_6V   |
| [7] – HART_7V   |
| [8] – HART_8V   |

Table – HART\_VAR\_CODES8[n]

The index configured in the **HART\_VAR\_CODES8[n]** parameter defines which variable has to be read from the device and also the HART command used by the DF116/DF117 module to read the variable. See the following table.

| HART_VAR_CODES8[1..8] = 255  | HART_VAR_CODES8[n] = (0 - 254)   |
|--|--|
| <p>Read the variable by the <b>HART #3</b> command.</p> <p>The <b>#3</b> command is flexible and can return information with up to 4 process variables (PV, SV, TV, and QV). The number of variables returned by this command is determined by the device manufacturer according to their functionality.</p> <p>If the <b>HART_VAR_CODE8[n]</b> parameter is configured with the value 255, but there is not corresponding variable on <b>#3</b> command, the default value should appear in the associated parameter.</p> | <p>HART command used to read the variable in question depends on the version of the HART device.</p> <p>HART 5: <b>#33</b> command</p> <p>HART 6 and 7: <b>#9</b> command</p> <p>Both commands return information from variables whose indexes (Device Variable Code) are defined on HART request message. These commands are flexible and accept up to 4 indexes, except the <b>#9</b> command of HART 7 which accepts up to 8 indexes. For a list of indexes supported by the device, and the associated variables, is necessary to consult the manual or the manufacturer of the device.</p> <p>The list of variables of Smar's devices can be obtained in the "Indexes of Smar HART devices variables" topic on this document.</p> <p>If the index configured in the <b>HART_VAR_CODES8[n]</b> parameter does not exist in the device, the corresponding parameter and other parameters whose indexes are part of the same request message should appear with the default value.</p> |

#### HART commands

| NOTE  |
|---|
| <p><b>HART command</b> is a data structure used by the HART protocol to group variables and features of the device.</p> <p>Each command has an identification number, some commands, and therefore their IDs, are pre-defined by the HART specification. Other commands can be defined by the device manufacturer according to its functionality.</p> |

The composition/structure of HART and FOUNDATION fieldbus protocols differ in some points. Therefore, to ensure the integration of HART devices in FOUNDATION fieldbus systems in a transparent manner, some adjustments and conversions are required.

One of the necessary adjustments is related to the status of parameters associated to **HART\_VAR\_CODES8** (see table HART\_VAR\_CODES8[n]). In the HART protocol only the **#9**

command returns the variable status on its response.

Thus the parameters status whose variables are read by the # 3 or # 33 commands are obtained by interpreting the **DEVICE\_STATUS** byte present in responses from all messages from the HART device. The following table shows how the **DEVICE\_STATUS** bits are interpreted.

| STATUS BIT | DEVICE_STATUS                                   | HART STATUS             |
|------------|---|-------------------------|
| 2          | Loop Current Saturated                          | PoorAccuracy:NotLimited |
| 3          | Loop Current Fixed                              | ManualFixed:Constant    |
| 1          | Non-Primary Variable Out of Limits              | PoorAccuracy:NotLimited |
| 0          | Primary Variable Out of Limits                  | Bad:NotLimited          |
| 7          | Device Malfunction                              | Bad:Constant            |
| --         | -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- | Good:Constant           |

The HART commands (**#3**, **#9** and **#33**) also return the measurement unit of the variable that can be seen in the **VAR\_UNITS9[n]** parameter in the same position of the **HART\_VAR\_CODES8** parameter where the index variable was configured.

**Conversion of HART Status to FOUNDATION fieldbus**

The status from the HART device is converted to the corresponding FOUNDATION fieldbus status to fill the **TBH** block parameters that have status. See the following table:

| HART STATUS                | FOUNDATION FIELDBUS STATUS                   |
|----------------------------|--|
| Good:Constant              | GoodNonCascade:GoodNCNonSpecific:Constant    |
| Good:Low Limited           | GoodNonCascade:GoodNCNonSpecific:LowLimited  |
| Good:High Limited          | GoodNonCascade:GoodNCNonSpecific:HighLimited |
| Good:Not Limited           | GoodNonCascade:GoodNCNonSpecific:NotLimited  |
| Poor Accuracy:Constant     | Uncertain:UncertainNonSpecific:Constant      |
| Poor Accuracy:Low Limited  | Uncertain:UncertainNonSpecific:LowLimited    |
| Poor Accuracy:High Limited | Uncertain:UncertainNonSpecific:HighLimited   |
| Poor Accuracy: Not Limited | Uncertain:UncertainNonSpecific:NotLimited    |
| Manual Fixed:Constant      | GoodNonCascade:GoodNCNonSpecific:Constant    |
| Manual Fixed:Low Limited   | GoodNonCascade:GoodNCNonSpecific:LowLimited  |
| Manual Fixed:High Limited  | GoodNonCascade:GoodNCNonSpecific:HighLimited |
| Manual Fixed:Not Limited   | GoodNonCascade:GoodNCNonSpecific:NotLimited  |
| Bad:Constant               | Bad:BadNonSpecific:Constant                  |
| Bad:Low Limited            | Bad:BadNonSpecific:LowLimited                |
| Bad:High Limited           | Bad:BadNonSpecific:HighLimited               |
| Bad : Not Limited          | Bad:BadNonSpecific:NotLimited                |

**Access to current analog signal (4-20 mA)**

Each one of the 8 channels of DF116 and DF117 modules has analog circuit that allows the 4-20 mA current signal to be accessed in parallel to HART communication, without disturbing the communication signal. For it is essential that the physical installation of the module is correct.

The access to the input current (DF116) or to the output current (DF117) of the channel is done in the FOUNDATION fieldbus system through the **PRIMARY\_VALUE** parameter of **TBH** block. In each channel must be installed only one HART device and its address must be 0. The multidrop mode is not allowed. The **PRIMARY\_VALUE** parameter is associated to the current signal of the channel

where the device is installed.

The status of **PRIMARY\_VALUE** parameter is in compliance with the Namur Standard adapted to the standard of FOUNDATION fieldbus status as in the following table.

| CURRENT                     | FOUNDATION FIELDBUS STATUS                 |
|-----------------------------|--|
| 3.8 mA < current < 20.5 mA  | GoodNonCascade:GoodNCNonSpecific:Constant  |
| 3.6 mA < current ≤ 3.8 mA   | Uncertain:UncertainNonSpecific:LowLimited  |
| 20.5 mA ≤ current < 21.0 mA | Uncertain:UncertainNonSpecific:HighLimited |
| Current ≤ 3.6 mA            | Bad:NonSpecific:Constant                   |
| Current ≥ 21.0 mA           | Bad:NonSpecific:Constant                   |

The unit of **PRIMARY\_VALUE** parameter is available in the **VAR\_UNITS9[9]** parameter of the **TBH** block.

The DF117 module has a safe mode configured by the **SAFE\_BEHAVIOR** parameter of the **TBH** block, with the following values: 3.6 mA and 21 mA. These values represent the current value that will be controlled by the DF117 when, due to some fault in the controller (DF75), there is not data exchange between them.

### Default value of HART parameters of TBH block

In situations where it could not read the required information from the HART device by the HART parameter of **TBH** block, this will appear with the default value. The most common conditions for this to happen are:

- HART device has not yet been identified (startup, wrong address, wrong installation);
- No HART device installed in the channel indicated by the **RRSGP** parameter of the block;
- Parameter does not exist on HART device. This depends on the HART protocol version of the device and is also mandatory implementation of the HART command that reads the parameter in question;
- Invalid index in **HART\_VAR\_CODES8**.

The table below shows the default value of some HART parameters of the block

| PARAMETER      | DEFAULT VALUE      |
|----------------|--------------------|
| HART_PV.VALUE  | NAN (Not a number) |
| HART_PV.STATUS | Bad: Constant      |
| HART_SV.VALUE  | NAN (Not a number) |
| HART_SV.STATUS | Bad: Constant      |
| HART_TV.VALUE  | NAN (Not a number) |
| HART_TV.STATUS | Bad: Constant      |
| HART_5V.VALUE  | NAN (Not a number) |
| HART_5V.STATUS | Bad: Constant      |
| HART_6V.VALUE  | NAN (Not a number) |
| HART_6V.STATUS | Bad: Constant      |
| HART_7V.VALUE  | NAN (Not a number) |
| HART_7V.STATUS | Bad: Constant      |
| HART_8V.VALUE  | NAN (Not a number) |
| HART_8V.STATUS | Bad: Constant      |
| VARUNITS9.[1]  | 0 (None Units)     |
| VARUNITS9.[2]  | 0 (None Units)     |
| VARUNITS9.[3]  | 0 (None Units)     |
| VARUNITS9.[4]  | 0 (None Units)     |
| VARUNITS9.[5]  | 0 (None Units)     |

|               |                |
|---------------|----------------|
| VARUNITS9.[6] | 0 (None Units) |
| VARUNITS9.[7] | 0 (None Units) |
| VARUNITS9.[8] | 0 (None Units) |

**Input/output parameters (link) of TBH block**

The **TBH** block has 9 parameters that can be linked to other blocks to be used in the control strategy. The link is done through the **RRSGP** parameter according to the rule **RRSGP**.

The update time of HART parameters in the **TBH** block is indicated by **HART\_TSTAMP** parameter.

**Function Block Creation**

The DFI302 and fieldbus devices use function blocks to build strategies, such as PID, AI blocks, etc. This means that **Syscon** can be used to set up every part of the system - transmitters, positioners and controller - in a same language. Once built the control strategy and chose the function blocks to be located in DFI302, set up the CHANNEL parameter for that function block, which does the interface with I/O modules.

**CHANNEL Configuration**

Using DFI302, the user can configure the number of I/O modules as well the I/O type (input or output, discrete, analog, pulse etc). The DFI302 is the unique device classified as a configurable I/O device. All I/O modules have the I/O points arranged as follow:

|              |        |
|--------------|--------|
| <b>Rack</b>  | 0 ~ 14 |
| <b>Slot</b>  | 0 ~ 3  |
| <b>Group</b> | 0 ~ 1  |
| <b>Point</b> | 0 ~ 7  |

The value in the CHANNEL parameter is composed by these elements in the **RRSGP** form.

**Rack (R):** Each rack has four slots. The rack is numbered from 0 (first rack) till 14 (last rack). Therefore a single I/O point in the DFI302 can be identified by specifying the rack (R), slot (S), group (G) and point (P). The CHANNEL parameter in the multiple I/O blocks (MIO) must specify the whole group (8 points), the point must be 9, which mean the whole group.

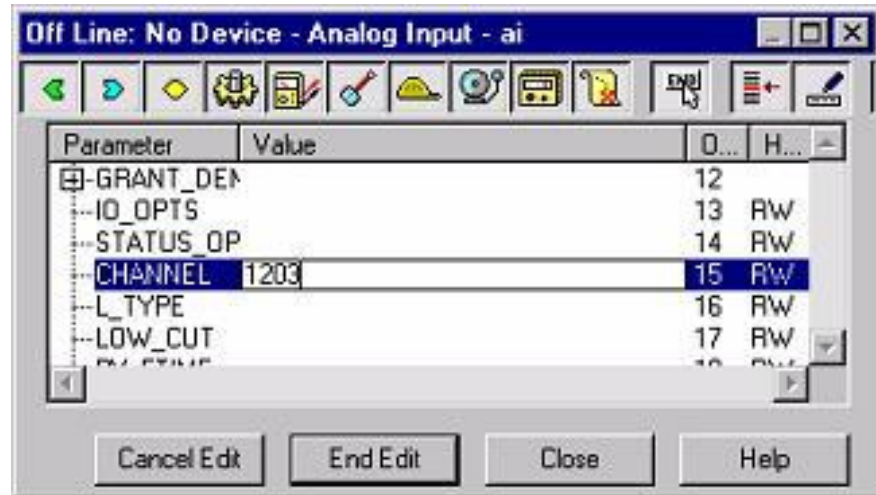
| NOTE  |
|---|
| <p>Each rack has a rotating switch to select address. The possible addresses are <b>0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F</b>. Note that the “F” address is not allowed when I/O is being accessed by HCT function block or DF65 co-processor. The address “F” is supported when the I/O access is done through FFB 1131, which may be configured using <b>LogicView for FFB</b> software. For further details about FFB1131 block refer to Adding Logic Using Flexible Function Blocks section.</p> |

**Slot (S):** One slot supports one I/O module, and it is numbered from 0 (first slot in the rack) till 3 (last slot in the rack).

**Group (G):** Ordinal number of group in the specified I/O module, it is numbered from 0 (first group) till number of groups minus 1.

**Point (P):** Ordinal number of I/O point in a group, it is numbered from 0 (first point) to 7(last point in the group), and 9 mean the whole group of points.

For example, a CHANNEL parameter equals to 1203, it means rack 1, slot 2, group 0 and point 3. If the CHANNEL parameter of a MAI block is 10119, it means rack 10, slot 1, group 1 and point 9 (whole group). Before setting the CHANNEL parameter, it is recommended to configure the hardware in the HCT block. Because the write check will verify if the I/O type configured in the HCT block is suitable for block type. Therefore setting the CHANNEL parameter of AI block to access an I/O type different of analog input will be rejected.



## Module Specification Standard

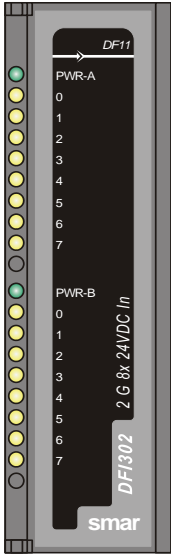
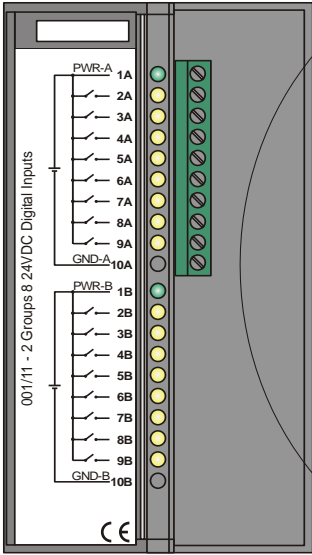
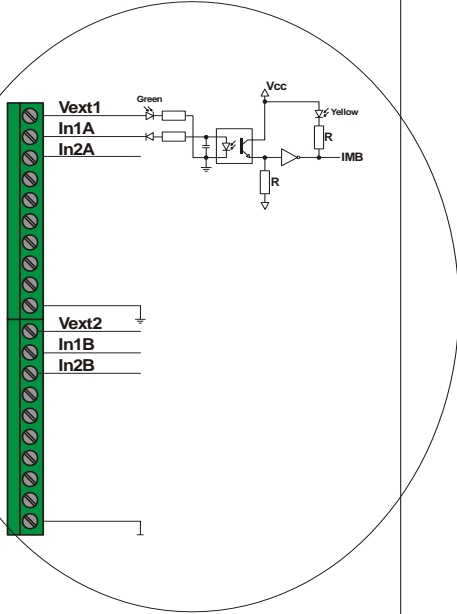
The module specification is shown in a format similar to the example below. All of the module specifications explain functionality, field connection, and electrical characteristics, and shows a simplified schematic of the interface circuit for better understanding.

For further details about the complete line of I/O modules refer to Digital and Analog Input/Output Modules of DFI302 can be obtained downloading the file MESDAME.pdf. (folder K) in the Smar website (www.smar.com).

### DF11/DF12/DF13/DF14 - DC Input Modules

DF11 (2 groups of 8 24 Vdc inputs isolated)  
 DF12 (2 groups of 8 48 Vdc inputs isolated)  
 DF13 (2 groups of 8 60 Vdc inputs isolated)  
 DF14 (2 groups of 8 125 Vdc inputs isolated)

**Description**  
 This module detects the DC input voltage and converts it in a TRUE (ON) or FALSE (OFF) logic signal . It has 2 groups isolated optically.

**Technical Specifications**

| ARCHITECTURE               |    |
|----------------------------|----|
| Number of Inputs           | 16 |
| Number of Groups           | 2  |
| Number of Points per Group | 8  |

Module Name

←

Part Number

←

Brief Module Description

←

Simplified Internal Circuit Diagram

←

Technical Specifications

←

## ADDING RACKS

### DF1A – Rack with 4 slots

#### Description

A rack is basically a plastic support for the IMB circuit that carries the connectors where the modules are plugged in. These connectors that fit the modules are called slots.

New racks can be added according to the project requirements. Up to 16 Racks are allowed. Racks can be connected for Local I/O expansion using flat cables (DF3, DF4A ~ DF7A).

Remember that the distance between the first module and the last module of a DFI302 system, expanded by flat cables cannot exceed 22.97ft (7 meters).

| NOTE  |
|---|
| Each Rack has a rotating switch to select the address. The possible addresses are <b>0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F</b> . Note that the “F” address is not allowed when I/O is being accessed by HCT function block or DF65 co-processor. The address “F” is supported when the I/O access is done through FFB 1131, which can be configured using <b>LogicView for FFB</b> software. For further details about FFB1131 block refer to Adding Logic Using Flexible Function Blocks section. |

There are restrictions related to the module location on the rack. The restrictions are as follows:

1. The first slot of rack 0 is always reserved for the power supply module.
2. The second slot of rack 0 is always reserved for the controller module.
3. All additional power Supplies need to be placed in the slot 0 of the desired Rack (jumper W1 in the rack must be cut before plugging the power supply).
4. The first rack must have a DF84 terminator when the controller (DF62, DF63, DF73, DF75, etc) executes local logic in discrete output cards.
5. The last rack must have a DF2 terminator installed.

#### Technical Specifications

| DIMENSIONS AND WEIGHT  |   |
|------------------------|---|
| Dimensions (W x H x D) | 148.5 x 25 x 163 mm ; (5.85 x 0.98 x 6.42 in) |
| Weight                 | 0.216 kg                                      |

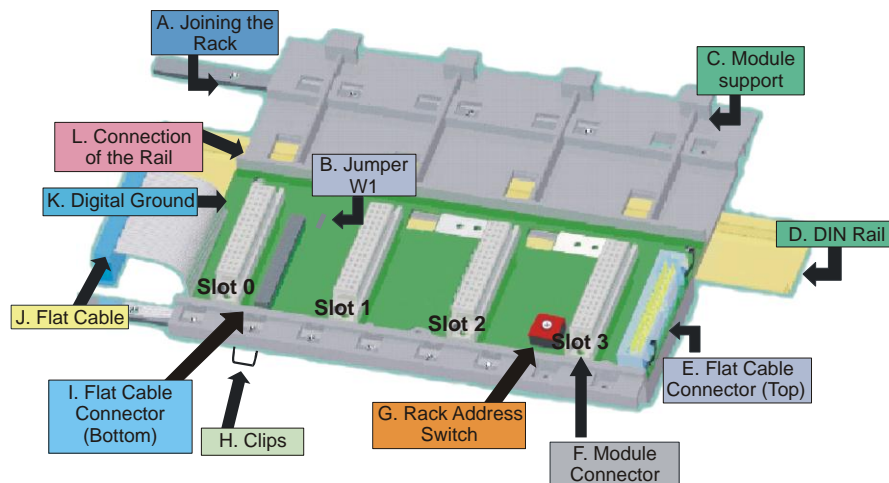


Figure 9. 1 – DF1A Rack



## DF78 - Rack with 4 slots for Redundant CPUs

### Description

The DF78 rack allows that two CPUs modules access the same I/O. This possibility is used when necessary redundancy and availability to the system. Up to 16 DF1A racks can be connected to DF78. Racks can be connected for Local I/O expansion using flat cables (DF3, DF4A ~ DF7A).

Remember that the distance between the first module and the last module of a DFI302 system, expanded by flat cables cannot exceed 22.97ft (7 meters).

There are restrictions related to the power supply and controllers position on the DF78 Rack. The restrictions are as follows:

1. The first and second slots of DF78 rack are always reserved for power supply modules.
2. The third and fourth slots on DF78 rack are always reserved for controller modules.

#### NOTE

Each Rack has a rotating switch to select the address. The possible addresses are **0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F**. Note that the “F” address is not allowed when I/O is being accessed by HCT function block or DF65 co-processor. The address “F” is supported when the I/O access is done through FFB 1131, which can be configured using **LogicView for FFB** software.

For further details about FFB1131 block refer to Adding Logic Using Flexible Function Blocks section.

### Technical Specifications

| DIMENSIONS AND WEIGHT  |   |
|------------------------|---|
| Dimensions (W x H x D) | 148.5 x 25 x 163 mm ; (5.85 x 0.98 x 6.42 in) |
| Weight                 | 0.216 kg                                      |

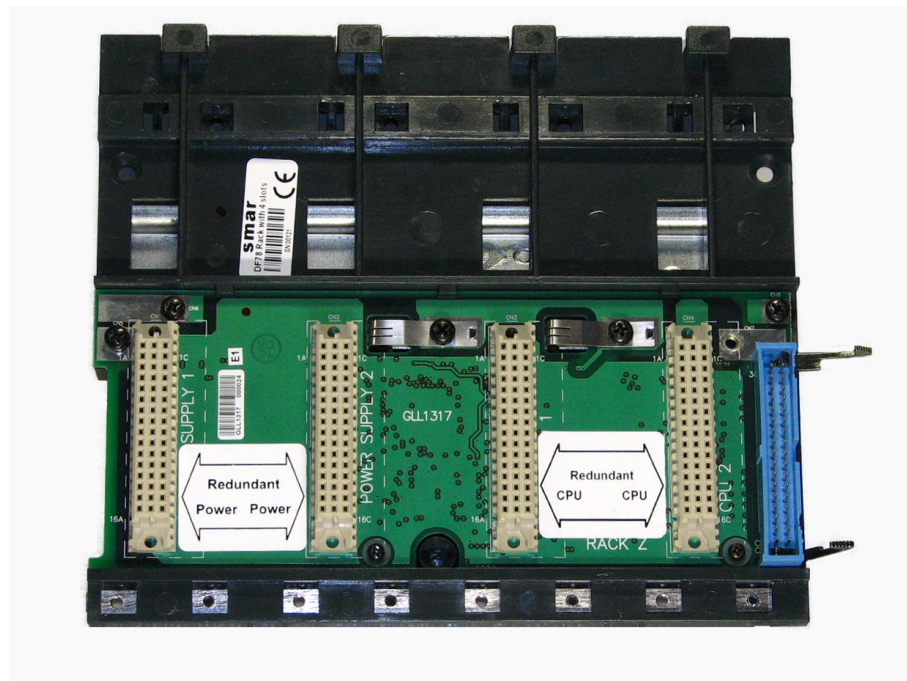


Figure 9. 2 – DF78 Rack

## DF93 - Rack with 4 slots (with diagnostic)

### Description

The DF93 rack is integral part of the new power system of DFI302. Its features provide low voltage drop through the IMB bus, so it is more efficient. Besides, the diagnostics resources of DF93 help in the problems detection minimizing the time stop and maintenance. The diagnostic can be obtained observing the diagnostics LEDs or through the status reading via controller.

The DF93 rack has Vcc and GND terminals at laterals (for power transmission). DF93's finishing avoids short circuits between the Vcc and GND connections at laterals.

As in the previous system, new racks can be added to the DFI302 system according to the application needs. Up to 16 racks are allowed. The racks can be connected among them (expanding the bus) using flat cables (DF101 to DF107), DF90 (IMB power cable), and DF91 (lateral adapter).

Remember that the distance between the first module and the last module of a DFI302 system, expanded by flat cables cannot exceed 22.97ft (7 meters).

#### NOTE

Each Rack has a rotating switch to select the address. The possible addresses are **0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F**. Note that the "F" address is not allowed when I/O is being accessed by HCT function block or DF65 co-processor. The address "F" is supported when the I/O access is done through FFB 1131, which can be configured using **LogicView for FFB** software. For further details about FFB1131 block refer to Adding Logic Using Flexible Function Blocks section.

There are restrictions related to the module location on the rack. The restrictions are as follows:

1. The first slot of rack 0 is always reserved for the power supply module.
2. The second slot of rack 0 is always reserved for the controller module.
3. All additional power supplies need to be placed in the slot 0 of the desired rack (jumper W1 in the rack must be cut and the DF90 cable from the previous racks must be disconnected before plugging the power supply).
4. The first rack must have a DF84 terminator when the controller (DF62, DF63, DF73, DF75, etc) executes local logic in discrete output cards.
5. The last rack must have a terminator installed - DF2 (right side) or DF96 (left side). For further details refer to Installing section.
6. Grounding terminals must be used.

### Technical Specifications

| DIMENSIONS AND WEIGHT  |   |
|------------------------|---|
| Dimensions (W x H x D) | 148.5 x 25 x 163 mm ; (5.85 x 0.98 x 6.42 in) |
| Weight                 | 0.216 kg                                      |

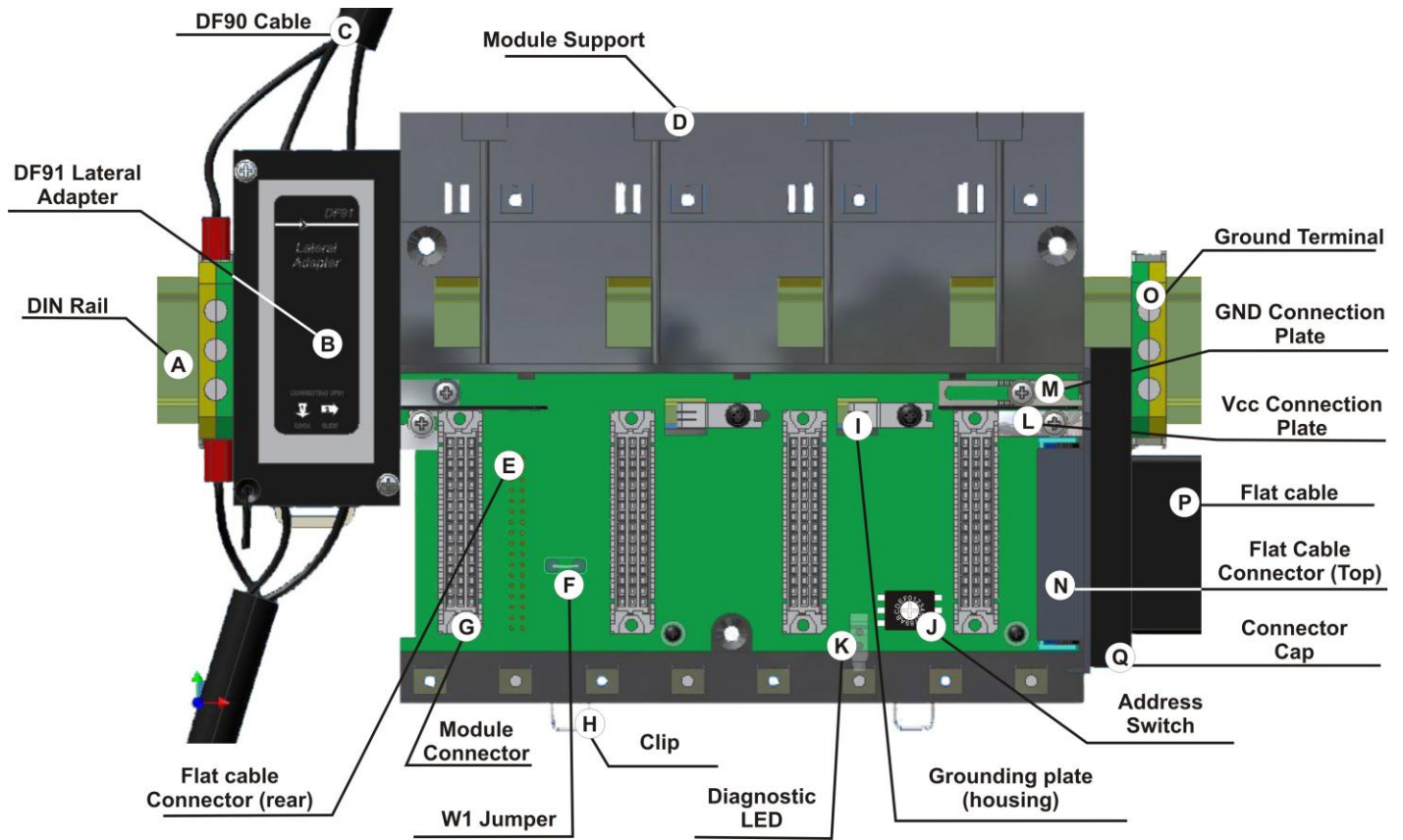


Figure 9. 3 – DF93 Rack

For compatibility with the EMC standards, if the power supply side connector on the left side of the rack is not connected, it should be capped with the left side protection according to the section Installing, Installing racks - DF92 and DF93 topic. This protection is provided along with the terminator DF2.

## DF92 - Rack with 4 slots for redundant CPUs (with diagnostic support)

### Description

The DF92 is the new rack for redundant controllers in the IMB. Its function is similar to the DF78, but DF92 is optimized to reduce voltage drop in the IMB, besides it has different pins to connect, in the future, power supplies with more than 3A.

The DF92 rack has Vcc and GND terminals at laterals (for power transmission). DF92's finishing avoids short circuits between the Vcc and GND connections at laterals.

Moreover, the DF92 supports power supplies diagnostics for those that have this feature. It helps in problems detection and giving the desired confidence in the availability offered by redundancy. The diagnostic can be obtained observing the diagnostics LEDs or through the status reading via controller.

The DF92 rack can be connected up to 16 DF93 racks. The racks can be connected among them (expanding the bus) using flat cables (DF101 to DF107), DF90 (IMB power cable) and DF91 (lateral adapter).

Remember that the distance between the first module and the last module of a DF1302 system, expanded by flat cables cannot exceed 22.97ft (7 meters).

There are restrictions related to the module location on the rack. The restrictions are as follows:

1. The first and second slots of DF92 rack are always reserved for power supply modules.
2. The third and fourth slots on DF92 rack are always reserved for controllers' modules.
3. Grounding terminals must be used.

#### NOTE

Each Rack has a rotating switch to select the address. The possible addresses are **0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F**. Note that the "F" address is not allowed when I/O is being accessed by HCT function block or DF65 co-processor. The address "F" is supported when the I/O access is done through FFB 1131, which can be configured using **LogicView for FFB** software. For further details about FFB1131 block refer to Adding Logic Using Flexible Function Blocks section.

### Technical Specifications

| DIMENSIONS AND WEIGHT  |   |
|------------------------|---|
| Dimensions (W x H x D) | 148.5 x 25 x 163 mm ; (5.85 x 0.98 x 6.42 in) |
| Weight                 | 0.216 kg                                      |

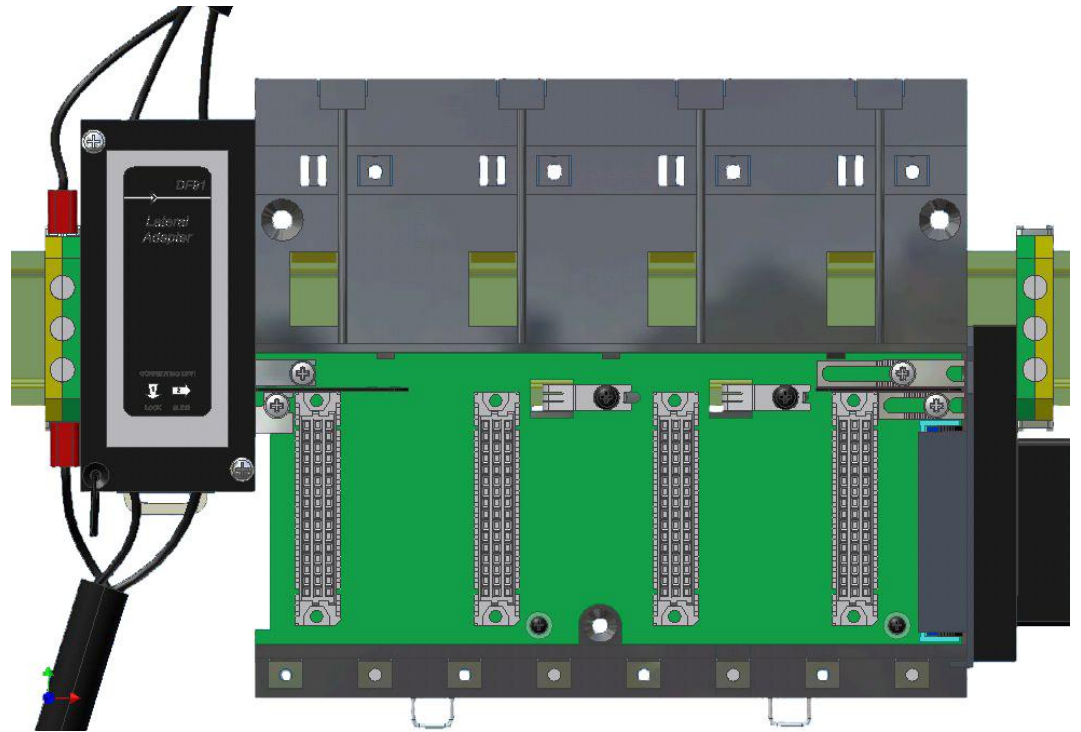


Figure 9. 4 – DF92 Rack

For compatibility with the EMC standards, if the power supply side connector on the left side of the rack is not connected, it should be capped with side protection according to the section Installing, Installing racks - DF92 and DF93 topic. This protection is provided along with the terminator DF2.

## TROUBLESHOOTING

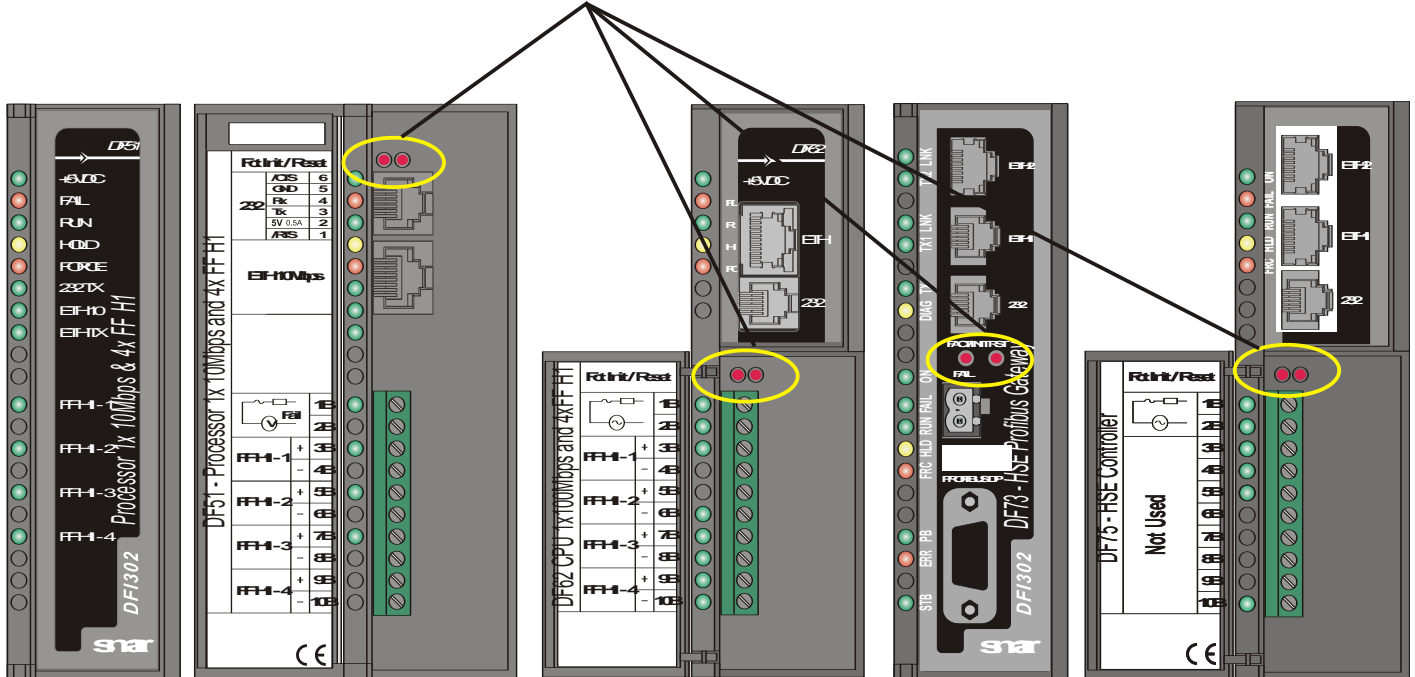
DFI302 has some initialization resources to solve certain kind of problems. Some resources will be described below.

Two small push buttons are available allowing the user to choose a specific controller action (see details in the following figure that shows two small buttons located in the controllers).

**ATTENTION**

Be aware that any of these procedures will cause a reset in the system.

### Factory Init/Reset



The next table summarizes the possible actions for the DF51 controller.

| Procedure Name               | Push Buttons procedure   | Controller action   |
|------------------------------|--|---|
| <b>Reset</b>                 | Press the right push-button.   | Controller will reset, taking some seconds for correct system initialization.<br>A new IP will be attributed automatically (when DHCP Server is available) or the last fixed configured IP will be kept, depending on the last setting via <b>FBTools</b> and/or Mode 3.<br>Controller should go to Run Mode always, in case of a valid firmware available.                                       |
| <b>Mode 1 – Factory Init</b> | Keep the left push-button pressed. Click the right push-button ensuring that the FORCE LED is blinking once a second. Release the left push-button and the system will execute the Reset, clearing previous configuration. | Controller will execute a factory initialization erasing the previous configurations downloaded via <b>Syscon</b> .<br>A new IP will be attributed automatically (when DHCP Server is available) or the last fixed configured IP will be kept, depending on the last setting via <b>FBTools</b> and/or Mode 3.<br>Controller should go to Run Mode always, in case of a valid firmware available. |
| <b>Mode 2 – Hold</b>         | Keep pressed the left push-button and double-click the right push-button ensuring that the FORCE LED is blinking twice a second. Release the left push-button. The   | Controller will fulfill a reset and will go to Hold mode. Verify that the HOLD and ETH10 LEDs remain ON. In this mode, you can use the FBTools Wizard to download the firmware or change IP address value and settings.   |

| Procedure Name                      | Push Buttons procedure  | Controller action  |
|-------------------------------------|---|--|
|                                     | system will execute the Reset and be in Hold. Check if the HOLD and ETH LNK LED are ON.   | If you want to go back to the execution mode (Run), press right push-button to reset.  |
| <b>Mode 3 – IP Automatic Assign</b> | Keep pressed the left push-button and click three times the right push-button ensuring that the FORCE LED is blinking three times per second. Release the left push-button. | A new IP will be attributed automatically (when DHCP Server is available) or the default IP address (192.168.164.100) will be set. Controller should go to Run Mode always, in case of a valid firmware available. |

The following table shows the actions for the DF62, DF63, DF73, DF75, DF79, DF81, DF89, DF95, and DF97 controllers:

| Procedure Name                      | Push Buttons procedure  | Controller action  |
|-------------------------------------|---|--|
| <b>Reset</b>                        | Press the right Push-button.  | Controller will reset, taking some seconds for correct system initialization.<br>A new IP will be attributed automatically (when DHCP Server is available) or the last fixed configured IP will be kept, depending on the last setting via <b>FBTools</b> and/or Mode 3.<br>Controller should go to Run or Hold mode depending on the last state before the Reset.                                       |
| <b>Mode 1 – Factory Init</b>        | Keep the left Push-button pressed. Click the right Push-button ensuring that the FORCE LED is blinking once a second. Release the left push-button and the system will execute the Reset, clearing previous configuration.  | Controller will execute a factory initialization erasing the previous configurations downloaded via <b>Syscon</b> .<br>A new IP will be attributed automatically (when DHCP Server is available) or the last fixed configured IP will be kept, depending on the last setting via <b>FBTools</b> and/or Mode 3.<br>Controller should go to Run or Hold mode depending on the last state before the Reset. |
| <b>Mode 2 – Hold</b>                | Keep pressed the left push-button and double-click the right push-button ensuring that the FORCE LED is blinking twice a second. Release the left push-button. System will execute the Reset and change the mode. The LED indicators will be HOLD or RUN depending on the mode. | Controller will execute a reset and will go to HOLD mode. Verify that the HOLD and ETH10 LED indicators remain ON. In this mode, you can use the <b>FBTools</b> Wizard to download the firmware or change IP address value and settings.<br>Execute the mode 2 again If you want to go back to the execution mode (RUN), press right push-button to reset.   |
| <b>Mode 3 – IP Automatic Assign</b> | Keep pressed the left push-button and click three times the right push-button ensuring that the FORCE LED is blinking three times per second. Release the left push-button.   | A new IP will be attributed automatically (when DHCP Server is available) or the default IP address (192.168.164.100 for port 0 or 192.168.165.100 for port 1, for all controllers, except for DF62) will be set. Controller should go to Run or Hold mode depending on the last state before the Reset.   |

| HINTS  |
|--|
| <ul style="list-style-type: none"> <li>- Once started any mode (Factory Init or Hold Mode) can be prevented. Remain the right push-button pressed, and release the left push-button first.</li> <li>- If the user loses how many times have pressed the right push-button, just verify the number of times that the FORCE LED is blinking per second. After the fourth touch it will come to blink once a second (this function is cyclic).</li> <li>- To press these push-buttons use some pointed instrument (for example a ballpoint pen).</li> </ul> |

| NOTE   |
|--|
| <p>In case of there is more than one <b>DFI302</b> to be set up, fulfill the following command to clear <b>ARP table</b>, before setting up the next <b>DFI302</b>.</p> <pre>C:\&gt;arp -d 192.168.164.100 &lt; enter &gt;</pre> |

## When to use the procedures of Factory Init/Reset

### 1. How to reset the DFI302 without disconnecting it?

Use the Reset procedure.

### 2. HOLD LED remains ON, how to proceed?

After turning on the DF51, if HOLD LED remains ON, the firmware may be invalid. The user should download it again. For further details refer to Setting Up section.

### 3. ETH10 LED does not turn on, how to proceed?

Check if the cable is connected correctly, or if it is not damaged. Check the specification of the cables:

DF54 – Standard Cable. To be used in network communication between DFI302 and Switch/Hub.

DF55 – Cross Cable. To be used in point-to-point communication between computer and DFI302.

### 4. The FORCE LED is blinking, how to proceed?

Make sure to turn ON the switch 1 in the controller module, knowing that the newest firmware versions are now blocking the boot procedure when the battery is turned off.

Make sure that the battery is under good conditions. Just go to a web browser, enter controller IP address and check under "Power off data retention" field, granting "Retention good (Vbatt >= 2.5V)". If the conclusion is to change the battery, send the equipment to repair. It is possible as a temporary procedure, to force the boot of the controller, just going to telnet and entering "unlockforce" command. But this is only recommended when missing spare controller.

Make sure that the power supply in the rack is working fine. Check the voltage between 16A and 16C pins and grant a minimal voltage of 4.95 Volts.

### 5. The FBTools does not show all the DFI302s that are in the subnet, how to proceed?

Probably there is an IP address conflict in this Subnet. Disconnect all the DFI302s from the Subnet and follow the procedures on "Connecting the DFI302 to its Subnet" for each module, ensuring that the addresses to be used are not associated with another device in the network.

### 6. The FBTools does not find the DF51.

- Make sure that the initial connection procedure was followed, the default IP address was assigned via Reset Mode 3, and the computer has the IP 192.168.164.101.
- The Ethernet cable used must be the DF54 when using Hub or Switch. For point-to-point connection (module DF51 linked directly to the computer) use cross cable (DF55).
- Check if the network adapter is OK, executing the **ping** command to its own IP, via DOS Prompt.
- Check if the Ethernet connection is OK, executing the **ping** command to the DF51.

### 7. The DF51 was operating correctly, I turned it off then turned it on and no type of reset works anymore and the HOLD LED remains lit or blinking constantly.

Some DF51 hardware versions (earlier than Revision 2 and Emission 1) do not have writing protections in the firmware and monitor areas. Occasionally, some wrong settings and software bugs would cause firmware and monitors crashes. In this case, the use of the Boot Flash is necessary.

### 8. How I have to use a Boot Flash to reload the Boot Program.

Send the device to our factory or contact the Smar technical support to get the Factory Procedure "How to load the DF51 Boot".

### 9. The license is not accepted by the LicenseView program.

Follow the procedure described below:

1. Try to register the DEMO license. In the **LicenseView** window there is a "Use a DEMO keys" button. If it works, the problem must be a mistake while typing the key.
2. If it still does not work, check the existence of SmarOlePath in System variables. Right-click on **My Computer** → **Properties** → **Advanced Tab** → **Environment Variables**. In case of



the non-existence of SmarOlePath variable, execute “Interface Setup” from Smar folder to create it.

**NOTE**

Use only numbers and dashes “-“. Do not use space or symbols such as: “@ # \$ % ^ & \* ( ) \_ + < > , . / ? \ | { } [ ] : ; ”.

3. Fulfill the server register again. In the SMAR shortcut folder (“**Program Files\Smar\OleServers**”) run **Register.Bat** program.
4. If any previous option fails, the License file can be generated manually.
  - Use an “ASC” text editor (notepad, for instance) because the file cannot contain format characters. The file name and its contents are shown below:

**File: Syscon.dat**

SMAR-MaxBlocks-55873-03243-22123-04737-10406

**File: OleServer.dat**

#PCI OLE Server  
SMAR-OPC\_NBLOCKS8-23105-23216-11827-2196

**File: DfiOleServer.dat**

#DFI OLE Server  
SMAR-DFIOPC\_NBLOCKS8-31297-58800-49898-13173

The keys presented are for DEMO license, the user can use its own keys.

**10.1 cannot switch the Modbus Blocks to “AUTO”, even setting the Mode Block target to “AUTO”, the actual mode block keeps on “O/S”.**

In order to set the Modbus Blocks to “AUTO”, it is necessary that the Mode Block of the DFI Resource Block has been set to “AUTO” and the LOCAL\_MOD\_MAP of each Modbus Block must be different from 255.

**11. I defined a value different from 255 to the LOCAL\_MOD\_MAP of a Modbus Block but it remains 255.**

Within the same type of Modbus Block (MBCM, MBCS, MBSS, MBSM), it is not possible to contain two blocks with the same LOCAL\_MOD\_MAP, whereas the value must be from 0 to 15.

**12. I tried to change the static value of a Modbus Block, but the value does not update.**

In order to update the static value of a Modbus Block, it is necessary to set the Block to “O/S”, so that the static values can be changed.

**13. After changing a static value of a block, and set the Mode Block target to “AUTO”, the actual one does not change into “AUTO”.**

If any static parameter of a Modbus Block has been changed, the Block only will be set to “AUTO” after accomplishing the “On\_Apply” in the Block MBCF.

## Section 11

# TECHNICAL SPECIFICATIONS FOR THE CONTROLLERS

### DFI302 Specifications

| ENVIRONMENT CONDITIONS |  |
|------------------------|--|
| Operating              | 0~60 °C, 20-90% RH non-condensing.   |
| Storage                | -20~80 °C, 20-90% RH non-condensing.<br>Exception: DF51 module<br>-20~25 °C, 20-90 %<br>(To achieve ten years of battery life, without excessive battery discharge). |

| PROTECTION DEGREE |  |
|-------------------|--|
| IP20              | 2 – Protected against solid objects with diameter bigger than 12 mm.<br>0 – Without specific protection against water. |

When possible it is recommended to keep the DFI302 firmware version updated according the following table. Consult updates in the download area for the DFI302 on Smar web site

| Controller | SYSTEM302<br>7.0.X | SYSTEM302<br>7.1.X | SYSTEM302<br>7.2.X | SYSTEM302<br>7.3.2 | SYSTEM302<br>7.3.4 | SYSTEM302<br>7.3.5 |
|------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| DF51       | V3.9.5             | V3.9.5             | V3.9.5             | V3.9.5             | V3.9.5             | V3.9.5             |
| DF62       | V1.3.27            | V1.3.27            | V2.1.3             | V3.0.5             | V4.2.0             | V4.2.0             |
| DF63       | V1.3.27            | V1.3.27            | V2.1.4             | V3.0.5             | V4.2.0             | V4.2.0             |
| DF73       | V1.0.21            | V2.0.73            | V2.0.73            | V3.0.4             | V4.0.1             | V4.2.0             |
| DF75       | V1.3.26            | V1.3.26            | V2.1.3             | V3.0.5             | V4.2.0             | V4.2.0             |
| DF79       | -                  | V1.0.0             | V1.1.1             | V2.0.4             | V3.0.2             | V3.0.4             |
| DF81       | -                  | -                  | V2.0.2             | V2.0.2             | V3.0.0             | V3.0.1             |
| DF89       | -                  | -                  | V1.0.0             | V2.0.4             | V3.0.2             | V4.2.0             |
| DF95       | -                  | -                  | V2.0.73            | V3.0.4             | V4.0.1             | V4.2.0             |
| DF97       | -                  | -                  | V2.0.73            | V3.0.4             | V4.0.1             | V4.2.0             |
| DF100      | -                  | -                  | -                  | -                  | V2.0.0             | V2.0.0             |

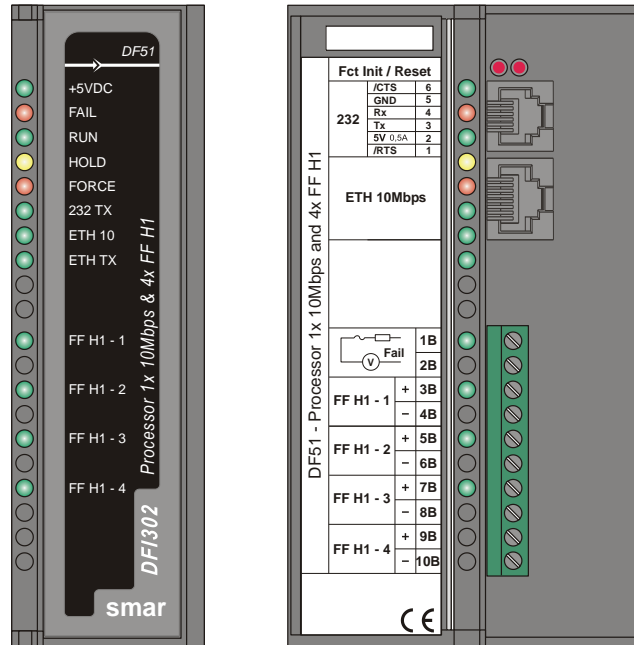
## DF51 Specifications

### Part Number

**DF51** – Controller with 1 Ethernet 10 Mbps port and 4 H1 channels.

### Description

The DF51 is the controller module that connects Fieldbus devices in the H1 bus, performing the LAS function (Link Active Schedule) in the network.



**DF51 – Controller Module**

### Technical Specifications

| DF51                        |  |                  |                         |                         |                 |           |                 |          |                          |                  |               |           |                        |
|-----------------------------|--|------------------|-------------------------|-------------------------|-----------------|-----------|-----------------|----------|--------------------------|------------------|---------------|-----------|------------------------|
| Type                        | 32-bit RISC  |                  |                         |                         |                 |           |                 |          |                          |                  |               |           |                        |
| Sustained Performance       | 50 MIPS  |                  |                         |                         |                 |           |                 |          |                          |                  |               |           |                        |
| Memory for Code             | 2MB, 32-bit Flash Memory (Firmware upgrade available).   |                  |                         |                         |                 |           |                 |          |                          |                  |               |           |                        |
| Memory for Data             | 2MB, 32-bit NVRAM (Data and configuration retention).  |                  |                         |                         |                 |           |                 |          |                          |                  |               |           |                        |
| Fieldbus Interface          | <table border="0"> <tr> <td>Numbers of Ports</td> <td>4, independent with DMA</td> </tr> <tr> <td>Physical Layer Standard</td> <td>ISA-S50.02-1992</td> </tr> <tr> <td>Baud Rate</td> <td>31.25 Kbps (H1)</td> </tr> <tr> <td>MAU Type</td> <td>Passive (no bus powered)</td> </tr> <tr> <td>Intrinsic Safety</td> <td>NOT Compliant</td> </tr> <tr> <td>Isolation</td> <td>500 Vac (each channel)</td> </tr> </table> | Numbers of Ports | 4, independent with DMA | Physical Layer Standard | ISA-S50.02-1992 | Baud Rate | 31.25 Kbps (H1) | MAU Type | Passive (no bus powered) | Intrinsic Safety | NOT Compliant | Isolation | 500 Vac (each channel) |
| Numbers of Ports            | 4, independent with DMA  |                  |                         |                         |                 |           |                 |          |                          |                  |               |           |                        |
| Physical Layer Standard     | ISA-S50.02-1992  |                  |                         |                         |                 |           |                 |          |                          |                  |               |           |                        |
| Baud Rate                   | 31.25 Kbps (H1)  |                  |                         |                         |                 |           |                 |          |                          |                  |               |           |                        |
| MAU Type                    | Passive (no bus powered)   |                  |                         |                         |                 |           |                 |          |                          |                  |               |           |                        |
| Intrinsic Safety            | NOT Compliant  |                  |                         |                         |                 |           |                 |          |                          |                  |               |           |                        |
| Isolation                   | 500 Vac (each channel)   |                  |                         |                         |                 |           |                 |          |                          |                  |               |           |                        |
| Operation Voltage/Current   | +5V ± 5% / 0.95A (typical).  |                  |                         |                         |                 |           |                 |          |                          |                  |               |           |                        |
| Connector Ethernet          | RJ-45.   |                  |                         |                         |                 |           |                 |          |                          |                  |               |           |                        |
| Connector EIA-232           | RJ-12.   |                  |                         |                         |                 |           |                 |          |                          |                  |               |           |                        |
| FOUNDATION™ Function Blocks | 100 (Maximum)  |                  |                         |                         |                 |           |                 |          |                          |                  |               |           |                        |

**Battery**

|                                   |  |
|-----------------------------------|--|
| Type of battery                   | Lithium  |
| Capacity                          | 950 mAh  |
| Devices maintained by the battery | RTC and NVRAM                                  |
| Voltage                           | 3.6 V ( subject to revision when below 2.5 V ) |
| Maximum life span                 | 11 years (typical charge of 10 $\mu$ A)        |

**Using the Fault Indication**

The 1B and 2B terminals available in the DF51 may be used in a Fault Indication application. Actually, these terminals are only a NC Relay.

The NC Relay supports:

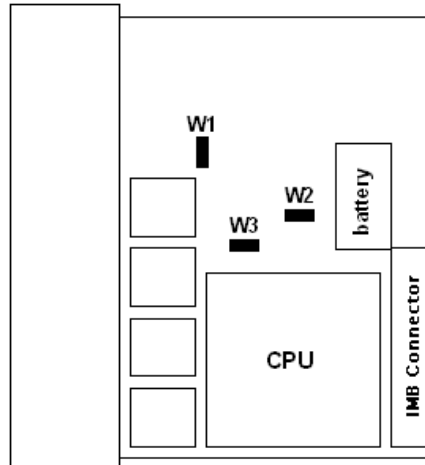
|                  |
|------------------|
| 0.50 A @ 125 Vac |
| 0.25 A @ 250 Vac |
| 2.00 A @ 30 Vdc  |

\* Valid data for resistive loads.

Normally, DF51 forces this relay to stay open, but if any bad condition crashes the CPU, the hardware will close it. This status may be used in redundancy situation where the backup controller reads this contact and knows about the fault. Another choice is to use it to goes off an alarm.

|  |
|--|
| <b>NOTE</b>  |
| To comply with the EMC standard, the length of the cable connected to the fault relay must be less than 30 meters. The power supply for the load must not be from an external network. |

## Jumpers on Board

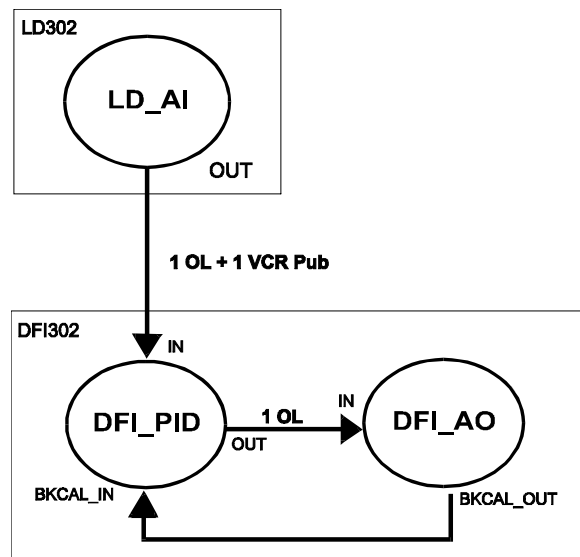


The W1 jumper (from DF51) must be enabled to make possible simulations through the Simulate (SIMULATE\_D or SIMULATE\_P) parameters of output and input function blocks.

Do not use W2 and W3 jumpers. They are only used to download firmware in the factory.

## Fieldbus Limits

FOUNDATION fieldbus protocol uses the Publisher/Subscriber model for the communication among devices. When a link is set between two function blocks, the device with the function block that sends the data is considered a publisher, and the device that has the block receiving the data is considered a subscriber. See the following figure:



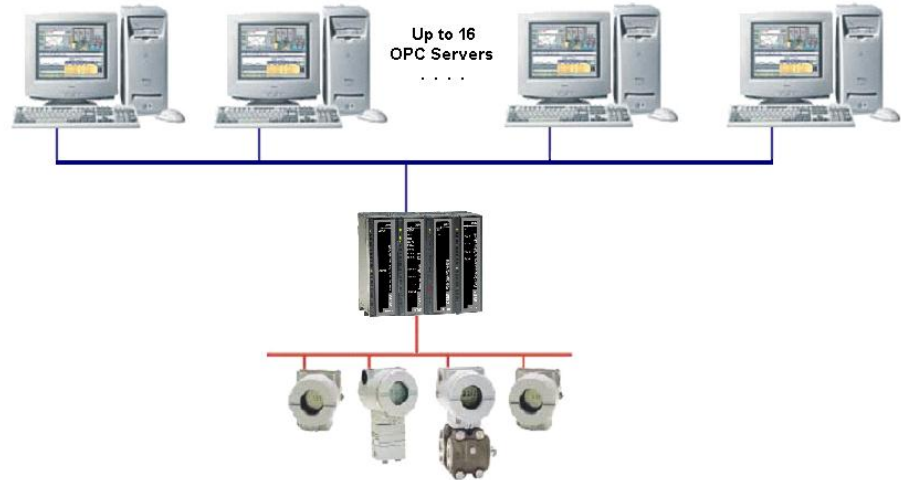
a) Internal links of the DF51 use only one Object Link (OL) and external links use 1OL + 1VCR Publisher (for blocks that send data) or 1OL + 1VCR Subscriber (for blocks that receive data). The DF51 can support up to 300 OLs (Object Links), 64 VCR publishers and 64 VCR subscribers.

b) The DFI302 controllers are responsible for executing the LAS table in the fieldbus networks where they are connected. The maximum entries limit that the DF51 is able to manage is equal to 70 between different field devices.

c) When using Smar field devices as Backup masters, pay attention to the maximum entries limit for LAS Table that is 50. So, it is necessary the planning for each fieldbus network in order to have until 50 links between different field devices when using Backup masters.

## Supervision Limits

Each DF51 can supervise up to 400 tags simultaneously and support up to 16 OPC Servers connected. The typical and recommended topology uses 2 OPC Servers.



## Modbus Limits

The DF51 can support up to 16 blocks for each type (MBCS, MBSM, MBCS and MBCM).

The DF51 has four types of Modbus function blocks that handle Modbus data: Modbus Control Master, Modbus Control Slave, Modbus Supervision Master and Modbus Supervision Slave. The first thing is to define if the DF51 will be Master or Slave.

The DF51 can have up to 16 blocks of one Modbus type. For example, if DF51 is master, it can have up to 16 blocks of each Master type. However, the user can have 16 Modbus Control Master and 16 Modbus Supervision Master Blocks. Each block has different numbers of inputs/outputs parameters. The numbers of inputs and outputs available are showed below:

### Modbus Control Master (MBCM)

- 16 x 4 digital inputs = 64
- 16 x 4 digital outputs = 64
- 16 x 4 analog inputs = 64
- 16 x 4 analog outputs = 64

### Modbus Supervision Master (MBSM)

- 16 x 2 float value = 32
- 16 x 2 percentage value = 32
- 16 x 2 integer value = 32
- 16 x 8 boolean value = 128

These scenarios show the DF51 controller as a Modbus Master device. Hence, the maximum number of Modbus blocks, inputs and outputs represents the Modbus limit.

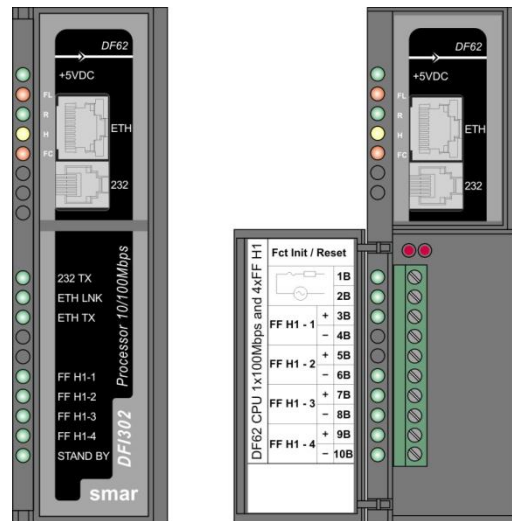
## DF62 Specifications

### Part Number

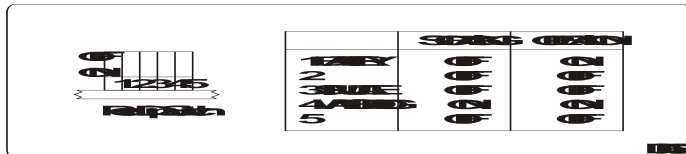
DF62 –HSE/ FOUNDATION fieldbus controller with 1 Ethernet port and 4 H1 channels

### Description

DF62 module is the second generation of Smar HSE Linking Devices. With four H1 channels (FOUNDATION fieldbus), one 10/100 Mbps Ethernet port and capability of block execution. DF62 can work as a bridge H1-H1 or a linking device H1-HSE, allowing a wide communication between field devices and greater flexibility in the project of strategies of continuous control. Through the I/O cards, it is also possible to execute discrete control via relay diagram logic (“Ladder Diagram”), allowing a single and integrated system. The module DF62 also can act as Modbus gateway, allowing the interconnection of modules that are not fieldbus or HSE. DF62 also has redundant operation, giving higher security level for industrial process.



DF62 – Controller module



### Characteristics and Controller Limits

- Four H1 channels (FOUNDATION fieldbus).
- It recommends the use of up to 32 field devices (8 devices per H1 channel). However, more devices can be used (up to 16 per H1 channel) under evaluation of performance according each application.
- Links characteristics:
  - 128 parameters can be linked externally via HSE and H1 (any proportion among HSE and H1 links totaling 128 links).
  - For external links among controller – H1 devices there is the limit of 16 Publisher links and 16 Subscribers links per each H1 port.
  - Regardless of the above limits there is the limit of 16 H1 bridge links (links among H1 ports of the same controller). This limit is shared by all ports, with no limit per port.
- Dynamic block instantiation.
- Maximum 100 function blocks.
- It supports Flexible Function Block with 242 parameters that can be linked by using interface between the discrete and analog control.
- LAS Function (“Link Active Scheduler”);

- It supports up to 16 HART modules (DF116/DF117).

| NOTE   |
|--|
| The limit of HART modules per controller is 16, but you must remember that when mapping the points through fieldbus function blocks strategy, one transducer block is used for each HART device. In this case, the system may be limited to less than 16 HART modules depending on the maximum number of fieldbus function blocks supported by the controller. |

## Continuous Control with FOUNDATION™ Fieldbus

The DF62 controller acts like a bridge for the HSE main bus. It performs four functions:

- Message forwarding using Client/Server relationships
- Data republishing using Publisher/subscriber relationships
- Report forwarding using Report source/sink relationships
- Application clock time distribution

## Discrete Control

DF62 module also has the capability of access I/O cards through the IMB (Inter-Module Bus), present in the backplane where the DF62 is mounted. Through the IMB, up to 16 racks DF1A or DF93 can be interconnected, each one having up to 4 cards. If there is a redundant controller is necessary the use of rack DF78 or DF92. If DF78 is used plus 16 racks DF1A can be added. If DF92 is used plus 16 racks DF93 can be used. Additional power supplies in other racks can be necessary depending on the quantity of cards.

| DISCRETE CONTROL CHARACTERISTICS   |   |
|--|---|
| I/O Points*  | 256 discrete or analog points (maximum)                                   |
| Auxiliary Points   | 1024 points (maximum)   |
| Ladder Function Blocks   | 300 blocks (maximum)  |
| Analog Points Supervision  | 2400 points (maximum)   |
| Configuration File   | 20 Kbytes (maximum)   |
| Program Execution Cycle for 1000 boolean operations (without redundancy) | 50 ms (minimum)**<br>90 ms (typical)***                                   |
| Program Execution Cycle with redundancy                                  | Increment of 10 ms (typical)**** up to 50ms (maximum) to execution cycle  |
| Execution Average Time   | 5.8 ms/Kbytes of program (minimum)<br>10.5 ms/Kbytes of program (typical) |

\* The whole number of points includes inputs and outputs, analog or digitals. Maximum may change according I/O type used.

\*\* 1131 Flexible Function Block adjusted to One (High Priority). Each 1000 boolean operations allocate 8.6 Kbytes.

\*\*\* Total execution time will change depending on the adjusted priority of 1131 FFB. The adjustment should be compatible with the quantity of function blocks and HSE links.

\*\*\*\* The whole execution time may change depending of the configuration file size.

## Flexible Function Block Usage

The interconnection between the discrete control and the ladder logic can be done by using Flexible Function Block. For further details about the Flexible Function Block usage, refer to the section Adding logic by using Flexible Function Block and the **LogicView for FFB** manual.

## Firmware version and Device Revision

Some Firmware Versions may change the Device Revision, so this is an important step to consider during the configuration procedure for the controller. The section “Adding Function Blocks” better describes the steps for this configuration. The current available versions are:

- Firmware version 1.x: Device Revision = 2
- Firmware version 2.x: Device Revision = 3
- Firmware version 3.x: Device Revision = 4
- Firmware version 4.x: Device Revision = 5



## Technical Specifications

### Memory

| TYPE                 | SIZE     |
|----------------------|----------|
| Volatile Memory      | 8 Mbytes |
| Non Volatile Memory  | 4 Mbytes |
| EEPROM               | 1 Kbytes |
| Flash to the program | 4 Mbytes |
| Flash to monitor     | 2 Mbytes |

### Battery

|                                   |  |
|-----------------------------------|--|
| Type of battery                   | Battery Panasonic BR-2/3AE2SP - Lithium      |
| Capacity                          | 1200 mAh                                     |
| Devices maintained by the battery | RTC and NVRAM                                |
| Minimum life span                 | 8 years (typical charge of 17 $\mu$ A)       |
| Maximum life span                 | 49 years (typical charge of 2.8 $\mu$ A)     |
| Voltage                           | 3 V ( subject to revision when below 2.5 V ) |

### Communication Ports and Channels

| ETHERNET PORT      |                   |
|--------------------|-------------------|
| Communication Rate | 10/100 Mbps       |
| Standard           | IEEE 802.3u       |
| Isolation          | 150 Vrms          |
| Operation Mode     | Full-duplex       |
| Connector          | RJ45 with shield* |

\* Grounded to the rail used for fixing the rack in which the DF62 is installed.

| H1 CHANNELS           |                           |
|-----------------------|---------------------------|
| Number of H1 Channels | 4                         |
| Communication Rate    | 31.25 kbps                |
| Standard              | EN 61158 EN 50170         |
| Physical Layer        | ISA-S50.02-1992           |
| H1 Modem              | FB3050P (3.3V)            |
| MAU Type              | Passive (bus not powered) |
| Isolation             | 500 Vac                   |
| Bus Current           | 40 mA                     |

| MODBUS PORT                   |                  |
|-------------------------------|------------------|
| Communication Rate (Maximum)* | 115200 bps       |
| Standard                      | EIA-232          |
| Connector**                   | RJ12 with shield |
| Maximum Current ***           | 0.5A @ 3.3V      |

\*There is an increase in error rate as we increase the communication rate over 19200 bps. In many situations these errors can be acceptable and they are not noticed by supervision.

\*\* Grounded to the rail used for fixing the rack in which the DF62 is installed.

\*\*\* Internally protected by solid state fuse.

| REDUNDANT PORT             |                  |
|----------------------------|------------------|
| Maximum Communication Rate | 115200 bps       |
| Standard                   | EIA-232          |
| Connector*                 | RJ12 with shield |
| Maximum Current **         | 0.5A @ 3.3V      |

\* Grounded to the rail used for fixing the rack in which the DF62 is installed.

\*\* Internally protected by solid state fuse.

| FAILURE RELAY   |   |
|---|---|
| Output Type   | Solid state relay, normally closed (NC), isolated |
| Maximum Voltage                                       | 30 Vdc  |
| Maximum Current                                       | 200 mA  |
| Overload Protection                                   | Not available. It must be provided externally     |
| Normal Operation                                      | Opened contacts                                   |
| Failure Condition                                     | Closed contacts                                   |
| Maximum cable length (maximum) connected to the relay | 30 m  |

Observation: The power supply for the load must not be from an external network (outside the panel).

| IMB BUS                      |                                      |
|------------------------------|--------------------------------------|
| Voltage                      | 5 Vdc                                |
| Bus                          | 8 bits                               |
| Failure Signal               | Yes                                  |
| Hot Swap                     | Yes                                  |
| Redundancy in the bus access | Yes, but only using the DF78 or DF92 |

### Module Features

| CONTROLLER        |                       |
|-------------------|-----------------------|
| CPU               | Family ARM7TDMI       |
| Bus               | 32 bits               |
| Architecture      | RISC                  |
| Performance       | 40 MIPS               |
| CPU Cache         | 8 Kbytes              |
| Clock             | 40 MHz                |
| DMA               | 10 channels           |
| Ethernet          | MAC 10/100 integrated |
| Watchdog          | Yes (200 ms of cycle) |
| Operation Voltage | 3.3 V for I/O         |

| MODULE                            |                                  |
|-----------------------------------|----------------------------------|
| Operation Voltage                 | 5 V ( $\pm$ 5% of tolerance)     |
| Typical Current                   | 550 mA                           |
| Real Consumption                  | 2,75 W                           |
| Environment Air Temperature       | 0 - 60° C (IEC 1131)             |
| Storage Temperature               | -20 - 80° C (IEC 1131)           |
| Relative Air Humidity (Operation) | 5% - 95% (non-condensing)        |
| Cooling Mode                      | Air Convection                   |
| Dimensions (H x W x D) in mm      | 149 x 40 x 138 (without package) |

### Electrical Certification

DF62 follows the immunity test specification to equipment to industrial installation, as IEC61326:2002 standard.

| ENCLOSE   |                       |
|---|-----------------------|
| Electrostatic discharge (IEC61000-4-2)            | 4 kV/8 kV contact/air |
| EM field (IEC61000-4-3)                           | 10 V/m                |
| Rated power frequency magnet field (IEC61000-4-8) | 30 A/m                |

| AC POWER  |                               |
|---|-------------------------------|
| Voltage dip/short interruptions (IEC61000-4-11) | 0,5 cycle, each polarity/100% |
| Burst (IEC61000-4-4)                            | 2 kV                          |
| Surge (IEC61000-4-5)                            | 1 kV/2 kV                     |
| Conducted RF (IEC61000-4-6)                     | 3 V                           |

| DC POWER                    |           |
|-----------------------------|-----------|
| Burst (IEC61000-4-4)        | 2 kV      |
| Surge (IEC61000-4-5)        | 1 kV/2 kV |
| Conducted RF (IEC61000-4-6) | 3 V       |

| I/O SIGNAL CONTROL          |      |
|-----------------------------|------|
| Burst (IEC61000-4-4)        | 1 kV |
| Surge (IEC61000-4-5)        | 1 kV |
| Conducted RF (IEC61000-4-6) | 3 V  |

| I/O SIGNAL CONTROL CONNECTED TO POWER SUPPLY |           |
|--|-----------|
| Burst (IEC61000-4-4)                         | 2 kV      |
| Surge (IEC61000-4-5)                         | 1 kV/2 kV |
| Conducted RF (IEC61000-4-6)                  | 3 V       |

**Emission Rate**

| ENCLOSE                                  |  |
|--|--|
| 30 to 230 MHz (CISPR 16-1, CISPR 16-2)   | 40 dB (uV/m) quasi peak, measured at 10 m distance |
| 239 to 1000 MHz (CISPR 16-1, CISPR 16-2) | 40 dB (uV/m) quasi peak, measured at 10 m distance |

| AC MAINS                                 |   |
|--|---|
| 0,15 to 0,5 MHz (CISPR 16-1, CISPR 16-2) | 79 dB (uV) quasi peak<br>66 dB (uV) average |
| 0,5 to 5 MHz (CISPR 16-1, CISPR 16-2)    | 73 dB (uV) quasi peak<br>60 dB (uV) average |
| 5 to 30 MHz (CISPR 16-1, CISPR 16-2)     | 73 dB (uV) quasi peak<br>60 dB (uV) average |

## Indication LEDs

The LED names, colors, descriptions and behaviors are showed in the table below.

| LED   | COLOR        | DESCRIPTION   | BEHAVIOR   |
|---|--------------|---|--|
| +5V DC (ON)                                 | Green        | It indicates when the module is ON.   | Solid green LED when power is on.  |
| FAIL (FAIL)                                 | Red          | It indicates hardware failure.  | Solid red LED when in fail.  |
| RUN (RUN)                                   | Green        | It indicates when the controller is operating in normal mode.   | Solid green LED when in operation.   |
| HOLD (HLD)                                  | Yellow       | It indicates when the controller is in hold mode. In this mode the controller does not perform any application and does not interfere on the plant operation (access via I/O cards or via digital bus are disabled)   | Solid yellow LED when the controller is in hold mode (HOLD).   |
| FORCE (FRC)                                 | Red          | <p>1 – It indicates different modes of startup or maintenance requested by the operator via push-buttons (FACT INIT, HOLD and IP Address).</p> <p>2 – It indicates power failure when the operating voltage decays down the expected value of 4.8 V (low line).</p> <p>3 – Indicates a battery problem.</p> | <p>1 - Depending on the number of times that the right push-button is pressed, the FRC LED blinks at a given rate for a limited time, indicating the chosen mode (refer to Troubleshooting section for further information).</p> <p>2 – Permanently solid red. The module will reset if the voltage reaches 4.6V. (HLD and FAIL LEDs light up together temporarily).</p> <p>3 –FRC LED blinking and HLD LED solid red during the module start up – indicates low battery or the battery rear DIP switch is turned off (refer to Troubleshooting section for further information)</p> |
| 232 TX                                      | Green        | It indicates activity in the RS-232 port.   | Blinking green LED when the RS-232 port is transmitting data.  |
| ETH LNK                                     | Green        | It indicates when the Ethernet link is active.  | Solid green LED when the Ethernet link is established.   |
| ETH TX                                      | Green        | It indicates communication activity in the Ethernet port.   | Blinking green LED when the Ethernet port.is transmitting data.  |
| FF H1-1,<br>FF H1-2,<br>FF H1-3,<br>FF H1-4 | 4 x<br>Green | It indicates H1 channel activity.   | Blinking green LED when the H1 channel is transmitting data.   |
| STANDBY                                     | Green        | <p>If the HOLD LED is solid yellow and the STB LED is blinking, the firmware is being updating.</p> <p>If the HOLD LED is off, it indicates the controller role on redundancy as well as the synchronism status.</p>  | There are several blinking patterns to indicate different synchronism status. Refer to redundancy section for further details.   |

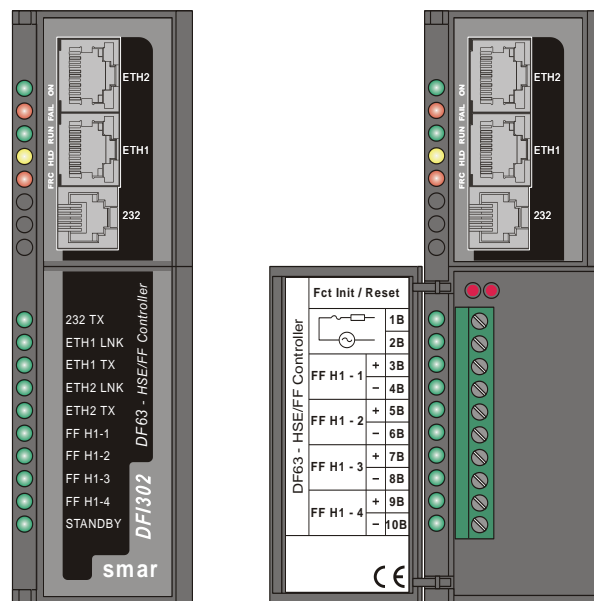
## DF63 Specifications

### Part Number

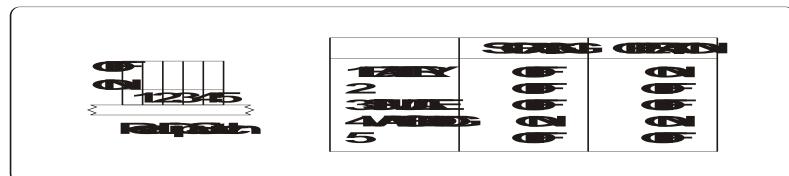
**DF63** –HSE/ FOUNDATION fieldbus Controller with 2 HSE Ethernet ports and 4 H1 channels

### Description

DF63 module is the second generation of Smar HSE Linking Devices. With four H1 channels (FOUNDATION™ fieldbus), two 10/100 Mbps Ethernet ports and capability of block execution. DF63 can work as a bridge H1-H1 or as linking device H1-HSE, allowing a wide communication between field devices and greater flexibility in the project of strategies of continuous control. It has two Ethernet ports for HSE network redundancy. Through the I/O cards, it is also possible to execute discrete control via relay diagram logic (“Ladder Diagram”), allowing a single and integrated system. The module DF63 also can act as Modbus gateway, allowing the interconnection of modules that are not fieldbus or HSE. DF63 also has redundant operation, giving higher security level for industrial process.



**DF63 – Controller module**



### Characteristics and Controller Limits

- Four H1 channels (FOUNDATION™ fieldbus).
- It is recommended the use of up to 32 field devices (8 devices per H1 channel). However, more devices can be used (up to 16 per H1 channel) under evaluation of performance according each application.
- Links characteristics:
  - 128 parameters can be linked externally via HSE and H1 (any proportion among HSE and H1 links totaling 128 links).
  - For external links among controller – H1 devices there is the limit of 16 Publisher links and 16 Subscribers links per each H1 port.
  - Regardless of the above limits there is the limit of 16 H1 bridge links (links among H1 ports of the same controller). This limit is shared by all ports, with no limit per port.

- Dynamic block instantiation.
- Maximum 100 function blocks.
- It supports Flexible Function Block with 242 parameters that can be linked by using interface between the discrete and analog control.
- LAS Function (“Link Active Scheduler”).
- It supports up to 16 HART modules (DF116/DF117).

| NOTE   |
|--|
| The limit of HART modules per controller is 16, but you must remember that when mapping the points through fieldbus function blocks strategy, one transducer block is used for each HART device. In this case, the system may be limited to less than 16 HART modules depending on the maximum number of fieldbus function blocks supported by the controller. |

## Continuous Control with FOUNDATION™ Fieldbus

The DF63 controller acts like a bridge for the HSE main bus. It performs four functions:

- Message forwarding using Client/Server relationships
- Data republishing using Publisher/subscriber relationships
- Report forwarding using Report source/sink relationships
- Application clock time distribution

## Discrete Control

DF63 module also has the capability of access I/O cards through the IMB (Inter-Module Bus), present in the backplane where the DF63 is mounted. Through the IMB, up to 16 racks can be interconnected, each one having up to 4 cards. If there is a redundant controller is necessary the use of rack DF78 or DF92. If DF78 is used plus 16 racks DF1A can be added. If DF92 is used plus 16 racks DF93 can be used. Additional power supplies in other racks can be necessary depending on the load of the cards.

| DISCRETE CONTROL CHARACTERISTICS   |   |
|--|---|
| I/O Points*  | 256 discrete or analog points (maximum)                                   |
| Auxiliary Points   | 1024 points (maximum)   |
| Ladder Function Blocks   | 300 blocks (maximum)  |
| Analog Points Supervision  | 2400 analog points (maximum)  |
| Configuration File   | 20 Kbytes (maximum)   |
| Program Execution Cycle for 1000 boolean operations (without redundancy) | 50 ms (minimum)**<br>90 ms (typical)***                                   |
| Program Execution Cycle with redundancy                                  | Increment of 10ms (typical)**** up to 50ms (maximum) to execution cycle   |
| Execution Average Time   | 5.8 ms/Kbytes of program (minimum)<br>10.5 ms/Kbytes of program (typical) |

\* The whole number of points includes inputs and outputs, analog or digitals. Maximum may change according I/O type used.

\*\* 1131 Flexible Function Block adjusted to One (High Priority). Each 1000 boolean operations allocate 8,6 Kbytes.

\*\*\* Total execution time will change depending on the adjusted priority of 1131 FFB. The adjustment should be compatible with the quantity of function blocks and HSE links.

\*\*\*\* The whole execution time may change depending of the configuration file size.

## Flexible Function Block Usage

The interconnection between the discrete control and the ladder logic can be done by using Flexible Function Block. For further details about the Flexible Function Block usage, refer to the section Adding logic by using Flexible Function Block and the LogicView for FFB manual.

## Firmware version and Device Revision

Some Firmware Versions may change the Device Revision, so this is an important step to consider during the configuration procedure for the controller. The section “Adding Function Blocks” better

describes the steps for this configuration. The current available versions are:

Firmware version 1.x: Device Revision = 1  
 Firmware version 2.x: Device Revision = 2  
 Firmware version 3.x: Device Revision = 3  
 Firmware version 4.x: Device Revision = 5

## Technical Specifications

### Memory

| TYPE                 | SIZE     |
|----------------------|----------|
| Volatile Memory      | 8 Mbytes |
| Non Volatile Memory  | 4 Mbytes |
| EEPROM               | 1 Kbytes |
| Flash to the program | 4 Mbytes |
| Flash to monitor     | 2 Mbytes |

### Battery

|                                   |  |
|-----------------------------------|--|
| Type of battery                   | Battery Panasonic BR-2/3AE2SP - Lithium      |
| Capacity                          | 1200 mAh                                     |
| Devices maintained by the battery | RTC and NVRAM                                |
| Minimum life span                 | 8 years (typical charge of 17 $\mu$ A)       |
| Maximum life span                 | 49 years (typical charge of 2.8 $\mu$ A)     |
| Voltage                           | 3 V ( subject to revision when below 2.5 V ) |

### Communication Ports and Channels

| ETHERNET PORTS     |                   |
|--------------------|-------------------|
| Communication Rate | 10/100 Mbps       |
| Standard           | IEEE 802.3u       |
| Isolation          | 150 Vrms          |
| Operation Mode     | Full-duplex       |
| Connector          | RJ45 with shield* |

\* Grounded to the rail used for fixing the rack in which the DF63 is installed.

| H1 CHANNELS           |                           |
|-----------------------|---------------------------|
| Number of H1 Channels | 4                         |
| Communication Rate    | 31.25 kbps                |
| Standard              | EN 61158 EN 50170         |
| Physical Layer        | ISA-S50.02-1992           |
| H1 Modem              | FB3050P (3.3V)            |
| MAU Type              | Passive (bus not powered) |
| Isolation             | 500 Vac                   |
| Bus Current           | 40mA                      |

| MODBUS PORT                   |                  |
|-------------------------------|------------------|
| Communication Rate (Maximum)* | 115200 bps       |
| Standard                      | EIA-232          |
| Connector**                   | RJ12 with shield |
| Maximum Current ***           | 0.5A @ 3.3V      |

\*There is an increase in error rate as we increase the communication rate over 19200 bps. In many situations these errors can be acceptable and they are not noticed by supervision.

\*\* Grounded to the rail used for fixing the rack in which the DF63 is installed.

\*\*\* Internally protected by solid state fuse.

| REDUNDANT PORT             |                  |
|----------------------------|------------------|
| Maximum Communication Rate | 115200 bps       |
| Standard                   | EIA-232          |
| Connector*                 | RJ12 with shield |
| Maximum Current **         | 0.5A @ 3.3V      |

\* Grounded to the rail used for fixing the rack in which the DF63 is installed.

\*\* Internally protected by solid state fuse.

| FAILURE RELAY                               |   |
|---|---|
| Output Type                                 | Solid state relay, normally closed (NC), isolated |
| Maximum Voltage                             | 30 Vdc  |
| Maximum Current                             | 200 mA  |
| Overload Protection                         | Not available. It must be provided externally     |
| Normal Operation                            | Opened contacts                                   |
| Failure Condition                           | Closed contacts                                   |
| Maximum cable length connected to the relay | 30 m  |

Observation: The power supply for the load must not be from an external network (outside the panel).

| IMB BUS                      |   |
|------------------------------|---|
| Voltage                      | 5 Vdc                                     |
| Bus                          | 8 bits                                    |
| Failure Signal               | Yes                                       |
| Hot Swap                     | Yes                                       |
| Redundancy in the bus access | Yes, but only using the DF78 or DF92 rack |

### Module Features

| CONTROLLER        |                       |
|-------------------|-----------------------|
| CPU               | Family ARM7TDMI       |
| Bus               | 32 bits               |
| Architecture      | RISC                  |
| Performance       | 40 MIPS               |
| CPU Cache         | 8 Kbytes              |
| Clock             | 40 MHz                |
| DMA               | 10 channels           |
| Ethernet          | MAC 10/100 integrated |
| Watchdog          | Yes (200ms of cycle)  |
| Operation Voltage | 3.3 V for I/O         |

| MODULE                            |                                  |
|-----------------------------------|----------------------------------|
| Operation Voltage                 | 5V ( $\pm$ 5% of tolerance)      |
| Typical Current                   | 550 mA                           |
| Real Consumption                  | 2.75 W                           |
| Environment Air Temperature       | 0 - 60° C (IEC 1131)             |
| Storage Temperature               | -20 - 80° C (IEC 1131)           |
| Relative Air Humidity (Operation) | 5% - 95% (non-condensing)        |
| Cooling Mode                      | Air Convection                   |
| Dimensions (H x W x D) in mm      | 149 x 40 x 138 (without package) |



## Electrical Certification

DF63 follows the immunity test specification to equipment to industrial installation, as IEC61326:2002 standard.

| ENCLOSE   |                       |
|---|-----------------------|
| Electrostatic discharge (IEC61000-4-2)            | 4 kV/8 kV contact/air |
| EM field (IEC61000-4-3)                           | 10 V/m                |
| Rated power frequency magnet field (IEC61000-4-8) | 30 A/m                |

| AC POWER  |                               |
|---|-------------------------------|
| Voltage dip/short interruptions (IEC61000-4-11) | 0,5 cycle, each polarity/100% |
| Burst (IEC61000-4-4)                            | 2 kV                          |
| Surge (IEC61000-4-5)                            | 1 kV/2 kV                     |
| Conducted RF (IEC61000-4-6)                     | 3 V                           |

| DC POWER                    |           |
|-----------------------------|-----------|
| Burst (IEC61000-4-4)        | 2 kV      |
| Surge (IEC61000-4-5)        | 1 kV/2 kV |
| Conducted RF (IEC61000-4-6) | 3 V       |

| I/O SIGNAL CONTROL          |      |
|-----------------------------|------|
| Burst (IEC61000-4-4)        | 1 kV |
| Surge (IEC61000-4-5)        | 1 kV |
| Conducted RF (IEC61000-4-6) | 3 V  |

| I/O SIGNAL CONTROL CONNECTED TO POWER SUPPLY |           |
|--|-----------|
| Burst (IEC61000-4-4)                         | 2 kV      |
| Surge (IEC61000-4-5)                         | 1 kV/2 kV |
| Conducted RF (IEC61000-4-6)                  | 3 V       |

### Emission Rate

| ENCLOSE                                  |   |
|--|---|
| 30 to 230 MHz (CISPR 16-1, CISPR 16-2)   | 40 dB (uV/m) quasi peak, measured at 10m distance |
| 239 to 1000 MHz (CISPR 16-1, CISPR 16-2) | 40 dB (uV/m) quasi peak, measured at 10m distance |

| AC MAINS                                 |   |
|--|---|
| 0,15 to 0,5 MHz (CISPR 16-1, CISPR 16-2) | 79 dB (uV) quasi peak<br>66 dB (uV) average |
| 0,5 to 5 MHz (CISPR 16-1, CISPR 16-2)    | 73 dB (uV) quasi peak<br>60 dB (uV) average |
| 5 to 30 MHz (CISPR 16-1, CISPR 16-2)     | 73 dB (uV) quasi peak<br>60 dB (uV) average |

## Indication LEDs

The LED names, colors, descriptions and behaviors are showed in the table below.

| LED   | COLOR        | DESCRIPTION   | BEHAVIOR   |
|---|--------------|---|--|
| +5V DC (ON)                                 | Green        | It indicates when the module is ON.   | Solid green LED when power is on.  |
| FAIL (FAIL)                                 | Red          | It indicates hardware failure.  | Solid red LED when in fail.  |
| RUN (RUN)                                   | Green        | It indicates when the controller is operating in normal mode.   | Solid green LED when in operation.   |
| HOLD (HLD)                                  | Yellow       | It indicates when the controller is in hold mode. In this mode the controller does not perform any application and does not interfere on the plant operation (access via I/O cards or via digital bus are disabled)   | Solid yellow LED when the controller is in hold mode (HOLD).   |
| FORCE (FRC)                                 | Red          | <p>1 – It indicates different modes of startup or maintenance requested by the operator via push-buttons (FACT INIT, HOLD and IP Address).</p> <p>2 – It indicates power failure when the operating voltage decays down the expected value of 4.8 V (low line).</p> <p>3 – Indicates a battery problem.</p> | <p>1 - Depending on the number of times that the right push-button is pressed, the FRC LED blinks at a given rate for a limited time, indicating the chosen mode (refer to Troubleshooting section for further information).</p> <p>2 – Permanently solid red. The module will reset if the voltage reaches 4.6V. (HLD and FAIL LEDs light up together temporarily).</p> <p>3 –FRC LED blinking and HLD LED solid red during the module start up – indicates low battery or the battery rear DIP switch is turned off (refer to Troubleshooting section for further information)</p> |
| 232 TX                                      | Green        | It indicates activity in the RS-232 port.   | Blinking green LED when the RS-232 port is transmitting data.  |
| ETH1 LNK                                    | Green        | It indicates when the Ethernet link is active (ETH1 port).  | Solid green LED when the Ethernet link is established (ETH1 port).   |
| ETH1 TX                                     | Green        | It indicates communication activity in the ETH1 port.   | Blinking green LED when the ETH1 port is transmitting data.  |
| ETH2 LNK                                    | Green        | It indicates when the Ethernet link is active (ETH2 port).  | Solid green LED when the Ethernet link is established (ETH2 port).   |
| ETH2 TX                                     | Green        | It indicates communication activity in the ETH2 port.   | Blinking green LED when the ETH2 port is transmitting data.  |
| FF H1-1,<br>FF H1-2,<br>FF H1-3,<br>FF H1-4 | 4 x<br>Green | It indicates H1 channel activity.   | Blinking green LED when the H1 channel is transmitting data.   |
| STANDBY                                     | Green        | <p>If the HOLD LED is solid yellow and the STB LED is blinking, the firmware is being updating.</p> <p>If the HOLD LED is off, it indicates the controller role on redundancy as well as the synchronism status.</p>  | There are several blinking patterns to indicate different synchronism status. Refer to redundancy section for further details.   |

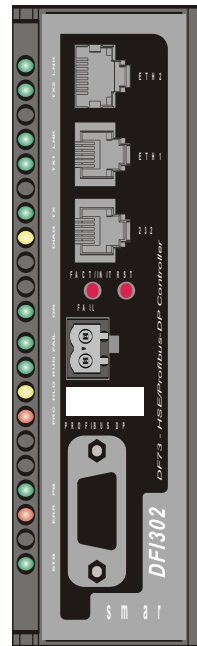
## DF73 Specifications

### Part Number

DF73 –HSE/Profibus DP Controller with 2 Ethernet ports e 1 Profibus DP channel

### Description

DF73 module is the Smar solution for Profibus applications. Its main feature is working as Profibus DP-HSE gateway to provide power to the connectivity and flexibility to the system application. It allows wide communication between the Profibus DP and PA field devices. Through the HSE network and other DFI302 modules, it is possible the communication between field devices and other industrial protocols, providing greater flexibility to the control strategy projects. Through the I/O cards, it is also possible to execute discrete control via relay diagram logic (“Ladder Diagram”), allowing a single and integrated system. The module DF73 also can act as Modbus gateway (slave), allowing the interconnection of modules that are not fieldbus or HSE.



DF73 – Controller module

Rear Dip Switch

|            | STORAGING | OPERATION |
|------------|-----------|-----------|
| 1 BATTERY  | OFF       | ON        |
| 2          | OFF       | OFF       |
| 3 SIMULATE | OFF       | OFF       |
| 4 WATCHDOG | ON        | ON        |
| 5          | OFF       | OFF       |

DF73

### Characteristics and Module Limits

- One Profibus DP channel supporting up to 12 Mbps;
- It supports up to 124 Profibus field devices;
- It supports up to 3584 bytes of input and 3584 bytes of output during the data interchange process;
- Limit of 64 external links by the HSE network;
- Up to 16 server sessions and 16 client sessions;
- Maximum of 250 function blocks per DF73;
- One (1) Flexible Function Block (counted into the 250 allowed blocks), with 242 linked parameter to interface between the discrete and continuous control.
- It supports up to 16 HART modules (DF116/DF117).

**NOTE**

The limit of HART modules per controller is 16, but you must remember that when mapping the points through fieldbus function blocks strategy, one transducer block is used for each HART device. In this case, the system may be limited to less than 16 HART modules depending on the maximum number of fieldbus function blocks supported by the controller.

**Continuous Control with Profibus**

DF73 is a complete Profibus HSE controller with capacity to execute function blocks. Through the available System302, Studio302 and Syscon configuration tools is possible to configure the DF73 totally.

HSE Communication:

- Maximum of 512 link objects;
- Up to 50 requests for non-connected services can be pendent per connection;
- Supervision up to 2000 points per second;
- Configurable Views.

**Discrete Control**

DF73 module also has the capability of access I/O cards through the IMB (Inter-Module Bus), present in the backplane where the DF73 is mounted. Through the IMB, up to 16 racks DF1A or DF93 can be interconnected, each one having up to 4 cards. If there is a redundant controller is necessary the use of rack DF78 or DF92. If DF78 is used plus 16 racks DF1A can be added. If DF92 is used plus 16 racks DF93 can be used. Additional power supplies in other racks can be necessary depending on the load of the cards.

**DISCRETE CONTROL CHARACTERISTICS**

|  |   |
|--|---|
| I/O Points*  | 1024 discrete points or 512 analog (maximum)                              |
| Ladder Function Blocks   | 2000 blocks (maximum)   |
| Configuration File   | 120 Kbytes (maximum)**  |
| Program Execution Cycle for 1000 boolean operations (without redundancy) | 50 ms (minimum)***<br>90 ms (typical)****                                 |
| Program Execution Cycle with redundancy                                  | Increment of 10ms (typical)***** up to 50 ms (maximum) to execution cycle |
| Execution Average Time   | 5.8 ms/Kbytes of program (minimum)<br>10.5 ms/Kbytes of program (typical) |

\* The whole number of points includes inputs and outputs, analog or digitals. Maximum may change according I/O type used.

\*\* 120 Kbytes are available in firmware version 2.x and later. Earlier versions limit is 60 Kbytes.

\*\*\* 1131 Flexible Function Block adjusted to One (High Priority). Each 1000 boolean operations allocate 8.6 Kbytes.

\*\*\*\* Total execution time will change depending on the adjusted priority of 1131 FFB. The adjustment should be compatible with the quantity of function blocks and HSE links.

\*\*\*\*\* The whole execution time may change depending of the configuration file size.

**NUMBER OF I/O POINTS**

|  |      |
|--|------|
| Number of Profibus devices per network | 125  |
| Number of virtual points               | 4096 |
| Number of Profibus discrete points     | 2048 |
| Number of Profibus analog points       | 512  |

**Firmware version and Device Revision**

Some Firmware Versions may change the Device Revision, so this is an important step to consider during the configuration procedure for the controller. The section “Adding Function Blocks” better describes the steps for this configuration. The current available versions are:

Firmware version 1\_0\_X: (Not supported from SYSTEM302 V7.2.x)

Firmware version 2\_0\_X: Device Revision = 3

Firmware version 3\_0\_X: Device Revision = 5

Firmware version 4\_0\_X: Device Revision = 6

## Technical Specifications

### Memory

| TYPE                    | SIZE     |
|-------------------------|----------|
| Volatile Memory         | 8 Mbytes |
| Non Volatile Memory *   | 4 Mbytes |
| EEPROM                  | 1 Kbytes |
| Flash to the program    | 4 Mbytes |
| Flash to monitor        | 2 Mbytes |
| Flash to EC1 (Profibus) | 4 Mbytes |

### Battery

|                                   |  |
|-----------------------------------|--|
| Type of battery                   | Battery Panasonic BR-2/3AE2SP - Lithium      |
| Capacity                          | 1200 mAh                                     |
| Devices maintained by the battery | RTC and NVRAM                                |
| Minimum life span                 | 8 years (typical charge of 17 $\mu$ A)       |
| Maximum life span                 | 49 years (typical charge of 2.8 $\mu$ A)     |
| Voltage                           | 3 V ( subject to revision when below 2.5 V ) |

### Communication Ports and Channels

| ETHERNET PORT  |                   |
|----------------|-------------------|
| Rate           | 10/100 Mbits/s    |
| Standard       | IEEE 802.3u       |
| Isolation      | 150 Vrms          |
| Operation mode | Full-duplex       |
| Connector      | RJ45 with shield* |

\* Grounded to the rail used for fixing the rack in which the DF73 is installed

| DP PROFIBUS CHANNEL |                               |
|---------------------|-------------------------------|
| Rate                | From 9.6 Kbit/s to 12 Mbits/s |
| Standard            | EN 50170 e EN 50254           |
| Physical Layer      | EIA RS-485                    |
| Profibus Modem      | EC1 (Hilscher)                |
| Connector           | DB9                           |

| MODBUS PORT        |                  |
|--------------------|------------------|
| Maximum rate*      | 115200 bps       |
| Standard           | EIA-232          |
| Connector**        | RJ12 with shield |
| Maximum Current*** | 0,5A @ 3.3V      |

\*There is an increase in error rate as we increase the communication rate over 19200 bps. In many situations these errors can be acceptable and they are not noticed by supervision.

\*\* Grounded to the rail used for fixing the rack in which the DF73 is installed

\*\*\* Internally protected by solid state fuse.

| REDUNDANCY PORT   |                  |
|-------------------|------------------|
| Maximum rate      | 115200 bps       |
| Standard          | EIA-232          |
| Connector*        | RJ12 with shield |
| Maximum Current** | 0.5A @ 3.3V      |

\* Grounded to the rail used for fixing the rack in which the DF73 is installed

\*\* Internally protected by solid state fuse.

| FAILURE RELAY                               |   |
|---|---|
| Output Type                                 | Solid state relay, normally closed (NC), isolated |
| Maximum voltage                             | 30 Vdc  |
| Maximum Current                             | 200 mA  |
| Overload Protection                         | Does not have. It must be provided externally     |
| Normal Operation                            | Opened contacts                                   |
| Failure Condition                           | Closed contacts                                   |
| Maximum cable length connected to the relay | 30 m  |

Observation: The power supply for the load must not be from an external network (outside the panel).

| IMB BUS            |        |
|--------------------|--------|
| Voltage            | 5 Vdc  |
| Bus                | 8 bits |
| Failure indication | Yes    |
| Hot swap           | Yes    |

### Module Characteristics

| CONTROLLER           |  |
|----------------------|--|
| CPU                  | Family ARM7TDMI                          |
| Bus                  | 32 bits                                  |
| Architecture         | RISC                                     |
| Performance          | 40 MIPS                                  |
| CPU Cache            | 8 Kbytes                                 |
| Clock                | 40 MHz                                   |
| DMA                  | 10 channels                              |
| Ethernet             | MAC 10/100 integrated                    |
| Watchdog             | Yes (200 ms of cycle)                    |
| Power Supply Voltage | 3.3 V for I/O and 2.5V for core (552 mW) |

| CARD                                   |   |
|--|---|
| Power Supply Voltage                   | 5 V ( $\pm$ 5% of tolerance)                    |
| Typical Current                        | 620 mA  |
| Real consumption                       | 2.75 W  |
| Environment Air Temperature            | 0 to 60° C according to the IEC 1131 standard   |
| Storage Temperature                    | -20 to 80° C according to the IEC 1131 standard |
| Relative Humidity of the Operation Air | 5% to 95% non condensing                        |
| Cooling Mode                           | Air convection                                  |
| Weight                                 | 0.318 kg  |
| Dimensions (H x W x D) in mm           | 149x40x138 (without enclose)                    |

## Electrical Certification

DF73 follows the immunity test specification to equipment to industrial installation, as IEC61326:2002 standard.

| ENCLOSE   |                       |
|---|-----------------------|
| Electrostatic discharge (IEC61000-4-2)            | 4 kV/8 kV contact/air |
| EM field (IEC61000-4-3)                           | 10 V/m                |
| Rated power frequency magnet field (IEC61000-4-8) | 30 A/m                |

| AC POWER  |                               |
|---|-------------------------------|
| Voltage dip/short interruptions (IEC61000-4-11) | 0,5 cycle, each polarity/100% |
| Burst (IEC61000-4-4)                            | 2 kV                          |
| Surge (IEC61000-4-5)                            | 1 kV/2 kV                     |
| Conducted RF (IEC61000-4-6)                     | 3 V                           |

| DC POWER                    |           |
|-----------------------------|-----------|
| Burst (IEC61000-4-4)        | 2 kV      |
| Surge (IEC61000-4-5)        | 1 kV/2 kV |
| Conducted RF (IEC61000-4-6) | 3 V       |

| I/O SIGNAL/CONTROL          |      |
|-----------------------------|------|
| Burst (IEC61000-4-4)        | 1 kV |
| Surge (IEC61000-4-5)        | 1 kV |
| Conducted RF (IEC61000-4-6) | 3 V  |

| I/O SIGNAL/CONTROL CONNECTED DIRECTLY TO POWER SUPPLY NETWORK |           |
|---|-----------|
| Burst (IEC61000-4-4)  | 2 kV      |
| Surge (IEC61000-4-5)  | 1 kV/2 kV |
| Conducted RF (IEC61000-4-6)                                   | 3 V       |

## Emission Rate

| ENCLOSE                                  |   |
|--|---|
| 30 to 230 MHz (CISPR 16-1, CISPR 16-2)   | 40 dB (uV/m) quasi peak, measured at 10m distance |
| 239 to 1000 MHz (CISPR 16-1, CISPR 16-2) | 40 dB (uV/m) quasi peak, measured at 10m distance |

| AC MAINS                                 |   |
|--|---|
| 0,15 to 0,5 MHz (CISPR 16-1, CISPR 16-2) | 79 dB (uV) quasi peak<br>66 dB (uV) average |
| 0,5 to 5 MHz (CISPR 16-1, CISPR 16-2)    | 73 dB (uV) quasi peak<br>60 dB (uV) average |
| 5 to 30 MHz (CISPR 16-1, CISPR 16-2)     | 73 dB (uV) quasi peak<br>60 dB (uV) average |

## Indication LEDs

The LED names, colors, descriptions and behaviors are showed in the table below.

| LED               | Color  | Description  | Behavior when Primary   | Function when Secondary                  | Function when in HOLD  |
|-------------------|--------|--|---|--|--|
| ETH LNK 2 (LNK)   | Green  | It indicates when the Ethernet link is active (ETH2 port).   | Solid green LED when the Ethernet link is established (ETH2 port).  | Same function and behavior when Primary. | Same function and behavior when Primary.   |
| ETH TX2 (TX2)     | Green  | It indicates communication activity in the ETH2 port.  | Blinking green LED when the ETH2 port is transmitting data.   | Same function and behavior when Primary. | Same function and behavior when Primary.   |
| ETH LNK 1 (LNK)   | Green  | It indicates when the Ethernet link is active (ETH1 port).   | Solid green LED when the Ethernet link is established (ETH1 port).  | Same function and behavior when Primary. | Same function and behavior when Primary.   |
| ETH TX1 (TX1)     | Green  | It indicates communication activity in the ETH1 port.  | Blinking green LED when the ETH1 port is transmitting data.   | Same function and behavior when Primary. | Same function and behavior when Primary.   |
| 232 TX (TX)       | Green  | It indicates activity in the RS-232 port.  | Blinking green LED when the RS-232 port is transmitting data.   | Same function and behavior when Primary. | Same function and behavior when Primary.   |
| Diagnostic (DIAG) | Yellow | It indicates the operation mode in the RS-232.   | OFF when the RS-232 port is connected to the NetArm processor.<br>Solid yellow when the RS-232 port is connected to the EC1 to execute operations related to the Profibus.  | Same function and behavior when Primary. | Must be ON.<br>ON – Ready for connection to EC1.<br>OFF – Not supported  |
| +5V DC (ON)       | Green  | It indicates when the module is ON.  | Solid green LED when the module is powered.   | Same function and behavior when Primary. | Same function and behavior when Primary.   |
| FAIL (FAIL)       | Red    | It indicates hardware failure.   | Solid red LED when in fail  | Same function and behavior when Primary. | Same function and behavior when Primary.   |
| RUN (RUN)         | Green  | It indicates when the controller is operating in normal mode.  | Solid green LED when in operation.  | Same function and behavior when Primary. | Must be OFF.<br>It is the inverse value of the HDL LED that indicates function in Monitor mode (maintenance mode of the device).         |
| HOLD (HLD)        | Yellow | It indicates when the controller is in hold mode. In this mode the controller does not perform any application and does not interfere on the plant operation (access via I/O cards or via digital bus are disabled)  | Solid yellow LED when the controller is in hold mode (HOLD).  | Same function and behavior when Primary. | Must be ON.  |
| FORCE (FRC)       | Red    | 1 – It indicates different modes of startup or maintenance requested by the operator via push-buttons (FACT INIT, HOLD and IP Address).<br>2 – It indicates power failure when the operating voltage decays down the expected value of 4.8 V (low line).<br>3 – Indicates a battery problem. | 1 - Depending on the number of times that the right push-button is pressed, the FRC LED blinks at a given rate for a limited time, indicating the chosen mode (refer to Troubleshooting section for further information).<br>2 – Permanently solid red. The module will reset if the voltage reaches 4.6V. (HLD and FAIL LEDs light up together temporarily).<br>3 –FRC LED blinking and HLD LED solid red during the module start up – indicates low battery or the battery rear DIP switch is turned off (refer to Troubleshooting section for further information) | Same function and behavior when Primary. | Hardware failure or power failure indication<br>ON – Failure of power supply or hardware<br>OFF – Power Ok.<br>BLINKING – Mode selection |



| LED                   | Color | Description  | Behavior when Primary   | Function when Secondary  | Function when in HOLD   |
|-----------------------|-------|--|---|--|---|
| Profibus Network (PB) | Green | It indicates Profibus channel activity.  | <p>ON – Profibus DP communication enabled</p> <p>OFF – Profibus DP communication disabled, communication (transmission) failure, short circuit on Profibus DP channel</p> <p>BLINKING – Multimaster mode operation</p>  | Same function and behavior when Primary.   | Must be OFF. Profibus DP communication is disabled in HOLD.               |
| Profibus Error (ERR)  | Red   | It indicates it there is an error related to the Profibus network.   | <p>ON - At least one slave device in this configuration is not communicating properly.</p> <p>OFF - All slave devices present in the configuration are communicating properly.</p> <p>BLINKING - Momentary failures in slaves or Primary recovering the Profibus DP channel.</p> <p>In the case of redundancy operation with no Profibus DP equipment in the network or Profibus DP cables disconnected the behavior is BLINKING.</p> | <p>ON – Failure on Profibus DP cable or on the Profibus DP configuration synchronism</p> <p>OFF – Synchronism OK and redundant master in standby</p> <p>BLINKING - Primary recovering the Profibus DP channel.</p> <p>This LED should always be OFF in the secondary. If it are ON some switchover failure may have occurred. The user must wait for recovery.</p> | <p>Must be OFF.</p> <p>Profibus DP communication is disabled in HOLD.</p> |
| STANDBY (STB)         | Green | <p>If the HOLD LED is solid yellow and the STB LED is blinking, the firmware is being updating.</p> <p>If the HOLD LED is off, it indicates the controller role on redundancy as well as the synchronism status.</p> | There are several blinking patterns to indicate different synchronism status. Refer to redundancy section for further details.  | Must be ON.  | BLINKING – Updating the firmware (saving the firmware on flash memory)    |

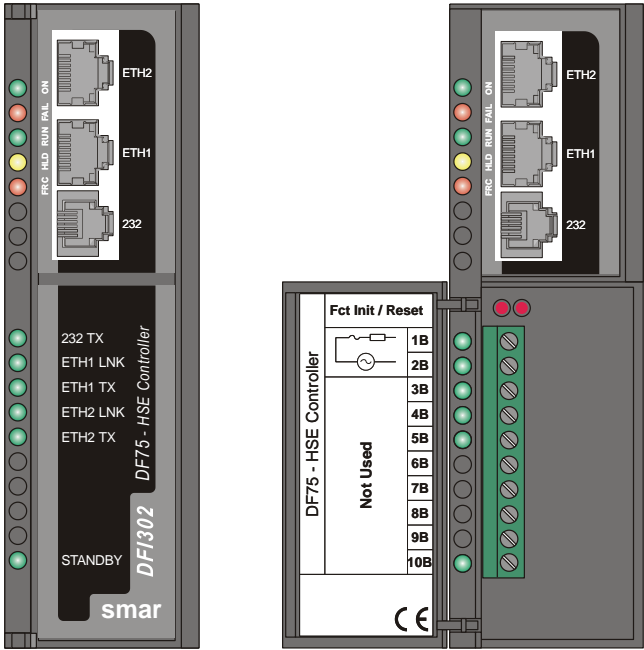
# DF75 Specifications

## Part Number

DF75 –HSE Controller

## Description

DF75 module is the second generation of Smar Logic Controller including 2 Ethernet ports for HSE protocol and capability of FOUNDATION™ fieldbus block execution. DF75 is a HSE field device whose main purpose is the discrete control associated with continuous control through the use of FOUNDATION™ fieldbus blocks. Through the I/O cards, it is possible to execute the discrete control via relay diagram logic (Ladder Diagram). Besides that DF75 has two Ethernet ports that guarantee high availability of control and supervision. DF75 also have redundant operation, giving higher availability security level for industrial process.



Rear Dip Switch

|            | STORAGING | OPERATION |
|------------|-----------|-----------|
| 1 BATTERY  | OFF       | ON        |
| 2          | OFF       | OFF       |
| 3 SIMULATE | OFF       | OFF       |
| 4 WATCHDOG | ON        | ON        |
| 5          | OFF       | OFF       |

DF75

## Characteristics and Controller Limits

- 2 10/100 Mbps Ethernet ports;
- Support up to 100 FOUNDATION™ fieldbus function blocks;
- 128 parameters can be linked externally via HSE links;
- Support Flexible Function Block (FFB);
- Discrete control via relay diagram;
- Access to I/O modules;
- Webserver;
- Modbus Gateway;
- Redundant operation;
- Real Time Clock (RTC) and watchdog;
- Supervision for up to 2000 points per second.
- It supports up to 16 HART modules (DF116/DF117).

**NOTE**

The limit of HART modules per controller is 16, but you must remember that when mapping the points through fieldbus function blocks strategy, one transducer block is used for each HART device. In this case, the system may be limited to less than 16 HART modules depending on the maximum number of fieldbus function blocks supported by the controller.

## Continuous Control with FOUNDATION™ Fieldbus

The DF75 module is a HSE device, with block execution capability. It has up to 100 blocks, including a Flexible Function Block to link FOUNDATION fieldbus control strategies with Ladder. Through configuration tools available in the **SYSTEM302**, such as the **Studio302** and **Syscon**, it is possible to configure the DF75 completely.

## Discrete Control

DF75 module also has the capability of access I/O cards through the IMB (Inter-Module Bus), present in the backplane where the DF75 is mounted. Through the IMB, up to 16 racks can be interconnected, each one having up to 4 cards. If there is a redundant controller is necessary the use of rack DF78 or DF92. If DF78 is used plus 16 racks DF1A can be added. If DF92 is used plus 16 racks DF93 can be used. Additional power supplies in others racks can be necessary depending on the load of the cards.

| DISCRETE CONTROL CHARACTERISTICS   |   |
|--|---|
| I/O Points*  | 1024 discrete points or 512 analog (maximum)                              |
| Auxiliary Points   | 4096 points (maximum)   |
| Ladder Function Blocks   | 2000 blocks (maximum)**   |
| Configuration File   | 120 Kbytes (maximum)**  |
| Program Execution Cycle for 1000 boolean operations (without redundancy) | 10 ms (minimum)***<br>32 ms (typical)****                                 |
| Program Execution Cycle with redundancy                                  | Increment of 10ms (typical)***** up to 50 ms (maximum) to execution cycle |
| Execution Average Time   | 1.1 ms/Kbytes of program (minimum)<br>3.7 ms/Kbytes of program (typical)  |

\* The whole number of points includes inputs and outputs, analog or digitals. Maximum may change according I/O type used.

\*\* 120 Kbytes and 2000 blocks are available in firmware version 2.x and later. Earlier versions limits are 60 Kbytes and 1200 blocks respectively.

\*\*\* 1131 Flexible Function Block adjusted to Zero (Very High Priority) and no other function blocks and HSE links are configured. Each 1000 boolean operations allocate 8.6 Kbytes.

\*\*\*\* Total execution time will change depending on the adjusted priority of 1131 FFB. The adjustment should be compatible with the quantity of function blocks and HSE links.

\*\*\*\*\* The whole execution time may change depending of the configuration file size.

## Flexible Function Block Usage

The interconnection between the discrete control and the ladder logic can be done by using Flexible Function Block. For further details about the Flexible Function Block usage, refer to the section Adding logic by using Flexible Function Block and the LogicView for FFB manual.

## Firmware version and Device Revision

Some Firmware Versions may change the Device Revision, so this is an important step to consider during the configuration procedure for the controller. The section “Adding Function Blocks” better describes the steps for this configuration. The current available versions are:

Firmware version 1.x: Device Revision = 1

Firmware version 2.x: Device Revision = 2

Firmware version 3.x: Device Revision = 3

Firmware version 4.x: Device Revision = 4

## Technical Specifications

### Memory

| TYPE                  | SIZE     |
|-----------------------|----------|
| Volatile Memory       | 8 Mbytes |
| Non Volatile Memory * | 4 Mbytes |
| EEPROM                | 1 Kbytes |
| Flash to the program  | 4 Mbytes |
| Flash to monitor      | 2 Mbytes |

\* It is kept by not rechargeable internal battery.

### Battery

|                                   |  |
|-----------------------------------|--|
| Type of battery                   | Battery Panasonic BR-2/3AE2SP - Lithium      |
| Capacity                          | 1200 mAh                                     |
| Devices maintained by the battery | RTC and NVRAM                                |
| Minimum life span                 | 8 years (typical charge of 17 $\mu$ A)       |
| Maximum life span                 | 49 years (typical charge of 2.8 $\mu$ A)     |
| Voltage                           | 3 V ( subject to revision when below 2.5 V ) |

### Communication Ports and Channels

| ETHERNET PORT      |                   |
|--------------------|-------------------|
| Communication Rate | 10/100 Mbps       |
| Standard           | IEEE 802.3u       |
| Isolation          | 150 Vrms          |
| Operation Mode     | Full-duplex       |
| Connector          | RJ45 with shield* |

\* Grounded to the rail used for fixing the rack in which the DF75 is installed.

| MODBUS PORT                   |                  |
|-------------------------------|------------------|
| Communication Rate (Maximum)* | 115200 bps       |
| Standard                      | EIA-232          |
| Connector**                   | RJ12 with shield |
| Maximum Current ***           | 0.5A @ 3.3V      |

\*There is an increase in error rate as we increase the communication rate over 19200 bps. In many situations these errors can be acceptable and they are not noticed by supervision.

\*\* Grounded to the rail used for fixing the rack in which the DF75 is installed.

\*\*\* Internally protected by solid state fuse.

| REDUNDANT PORT             |                    |
|----------------------------|--------------------|
| Maximum Communication Rate | 115200 bps*        |
| Standard                   | EIA-232            |
| Connector                  | RJ12 with shield** |
| Maximum Current ***        | 0.5A @ 3.3 V       |

\* Rate for control information. Data traffic through Ethernet.

\*\* Grounded to the rail used for fixing the rack in which the DF75 is installed.

\*\*\* Internally protected by solid state fuse.

| FAILURE RELAY   |   |
|---|---|
| Output Type   | Solid state relay, normally closed (NC), isolated |
| Maximum Voltage                                       | 30 Vdc  |
| Maximum Current                                       | 200 mA  |
| Overload Protection                                   | Not available. It must be provided externally     |
| Normal Operation                                      | Opened contacts                                   |
| Failure Condition                                     | Closed contacts                                   |
| Maximum cable length (maximum) connected to the relay | 30 m  |

Note: The power supply for the load must not be from an external network (outside the panel).

| IMB BUS                      |   |
|------------------------------|---|
| Voltage                      | 5 Vdc                                     |
| Bus                          | 8 bits                                    |
| Failure Signal               | Yes                                       |
| Hot Swap                     | Yes                                       |
| Redundancy in the bus access | Yes, but only using the DF78 or DF92 rack |

**Module Characteristics**

| CONTROLLER        |                       |
|-------------------|-----------------------|
| CPU               | Family ARM7TDMI       |
| Bus               | 32 bits               |
| Architecture      | RISC                  |
| Performance       | 40 MIPS               |
| CPU Cache         | 8 Kbytes              |
| Clock             | 40 MHz                |
| DMA               | 10 channels           |
| Ethernet          | MAC 10/100 integrated |
| Watchdog          | Yes (200 ms of cycle) |
| Operation Voltage | 3.3 V for I/O         |

| MODULE                            |                                  |
|-----------------------------------|----------------------------------|
| Operation Voltage                 | 5 V (± 5% of tolerance)          |
| Typical Current                   | 550 mA                           |
| Real Consumption                  | 2.75 W                           |
| Environment Air Temperature       | 0 - 60° C (IEC 1131)             |
| Storage Temperature               | -20 - 80° C (IEC 1131)           |
| Relative Air Humidity (Operation) | 5% - 95% (non-condensing)        |
| Cooling Mode                      | Air Convection                   |
| Dimensions (H x W x D) in mm      | 149 x 40 x 138 (without package) |

**Electrical Certification**

DF75 follows the immunity test specification to equipment to industrial installation, as IEC61326:2002 standard.

| ENCLOSE   |                       |
|---|-----------------------|
| Electrostatic discharge (IEC61000-4-2)            | 4 kV/8 kV contact/air |
| EM field (IEC61000-4-3)                           | 10 V/m                |
| Rated power frequency magnet field (IEC61000-4-8) | 30 A/m                |

| AC POWER  |                               |
|---|-------------------------------|
| Voltage dip/short interruptions (IEC61000-4-11) | 0.5 cycle, each polarity/100% |
| Burst (IEC61000-4-4)                            | 2 kV                          |
| Surge (IEC61000-4-5)                            | 1 kV/2 kV                     |
| Conducted RF (IEC61000-4-6)                     | 3 V                           |

| DC POWER                    |           |
|-----------------------------|-----------|
| Burst (IEC61000-4-4)        | 2 kV      |
| Surge (IEC61000-4-5)        | 1 kV/2 kV |
| Conducted RF (IEC61000-4-6) | 3 V       |

| I/O SIGNAL CONTROL          |      |
|-----------------------------|------|
| Burst (IEC61000-4-4)        | 1 kV |
| Surge (IEC61000-4-5)        | 1 kV |
| Conducted RF (IEC61000-4-6) | 3 V  |

| I/O SIGNAL CONTROL CONNECTED TO POWER SUPPLY |           |
|--|-----------|
| Burst (IEC61000-4-4)                         | 2 kV      |
| Surge (IEC61000-4-5)                         | 1 kV/2 kV |
| Conducted RF (IEC61000-4-6)                  | 3 V       |

**Emission Rate**

| ENCLOSE                                  |   |
|--|---|
| 30 to 230 MHz (CISPR 16-1, CISPR 16-2)   | 40 dB (uV/m) quasi peak, measured at 10m distance |
| 239 to 1000 MHz (CISPR 16-1, CISPR 16-2) | 40 dB (uV/m) quasi peak, measured at 10m distance |

| AC MAINS                                 |   |
|--|---|
| 0.15 to 0.5 MHz (CISPR 16-1, CISPR 16-2) | 79 dB (uV) quasi peak<br>66 dB (uV) average |
| 0.5 to 5 MHz (CISPR 16-1, CISPR 16-2)    | 73 dB (uV) quasi peak<br>60 dB (uV) average |
| 5 to 30 MHz (CISPR 16-1, CISPR 16-2)     | 73 dB (uV) quasi peak<br>60 dB (uV) average |

## Indication LEDs

The LED names, colors, descriptions and behaviors are showed in the table below.

| LED         | COLOR  | DESCRIPTION   | BEHAVIOR   |
|-------------|--------|---|--|
| +5V DC (ON) | Green  | It indicates when the module is ON.   | Solid green LED when power is on.  |
| FAIL (FAIL) | Red    | It indicates hardware failure.  | Solid red LED when in fail.  |
| RUN (RUN)   | Green  | It indicates when the controller is operating in normal mode.   | Solid green LED when in operation.   |
| HOLD (HLD)  | Yellow | It indicates when the controller is in hold mode. In this mode the controller does not perform any application and does not interfere on the plant operation (access via I/O cards or via digital bus are disabled)   | Solid yellow LED when the controller is in hold mode (HOLD).   |
| FORCE (FRC) | Red    | <p>1 – It indicates different modes of startup or maintenance requested by the operator via push-buttons (FACT INIT, HOLD and IP Address).</p> <p>2 – It indicates power failure when the operating voltage decays down the expected value of 4.8 V (low line).</p> <p>3 – Indicates a battery problem.</p> | <p>1 - Depending on the number of times that the right push-button is pressed, the FRC LED blinks at a given rate for a limited time, indicating the chosen mode (refer to Troubleshooting section for further information).</p> <p>2 – Permanently solid red. The module will reset if the voltage reaches 4.6V. (HLD and FAIL LEDs light up together temporarily).</p> <p>3 –FRC LED blinking and HLD LED solid red during the module start up – indicates low battery or the battery rear DIP switch is turned off (refer to Troubleshooting section for further information)</p> |
| 232 TX      | Green  | It indicates activity in the RS-232 port.   | Blinking green LED when the RS-232 port is transmitting data.  |
| ETH1 LNK    | Green  | It indicates when the Ethernet link is active (ETH1 port).  | Solid green LED when the Ethernet link is established (ETH1 port).   |
| ETH1 TX     | Green  | It indicates communication activity in the ETH1 port  | Blinking green LED when the ETH1 port is transmitting data.  |
| ETH2 LNK    | Green  | It indicates when the Ethernet link is active (ETH2 port).  | Solid green LED when the Ethernet link is established (ETH2 port).   |
| ETH2 TX     | Green  | It indicates communication activity in the ETH2 port .  | Blinking green LED when the ETH2 port is transmitting data.  |
| STANDBY     | Green  | <p>If the HOLD LED is solid yellow and the STB LED is blinking, the firmware is being updating.</p> <p>If the HOLD LED is off, it indicates the controller role on redundancy as well as the synchronism status.</p>  | There are several blinking patterns to indicate different synchronism status. Refer to redundancy section for further details.   |





**NOTE**

The limit of HART modules per controller is 16, but you must remember that when mapping the points through fieldbus function blocks strategy, one transducer block is used for each HART device. In this case, the system may be limited to less than 16 HART modules depending on the maximum number of fieldbus function blocks supported by the controller.

**Continuous Control with DeviceNet**

DF79 is a complete DeviceNet HSE controller with capacity to execute function blocks. Through the available **SYSTEM302**, **Studio302** and **Syscon** configuration tools is possible to configure the DF79 totally.

HSE Communication:

- Maximum of 512 link objects;
- Maximum of 250 function blocks;
- Up to 50 requests for non-connected services can be pendent per connection;
- Supervision up to 2000 points per second;
- Configurable Views.

**Discrete Control**

DF79 module also has the capability of access I/O cards through the IMB (Inter-Module Bus), present in the backplane where the DF79 is mounted. Through the IMB, up to 16 racks DF1A or DF93 can be interconnected, each one having up to 4 cards.

**DISCRETE CONTROL CHARACTERISTICS**

|  |   |
|--|---|
| I/O Points*  | Maximum of 2048 discrete points and 512 analog points in the DeviceNet network.<br>Maximum of 1024 discrete points and 512 analog points with modules in the IMB. |
| Auxiliary Points   | 4096 points (maximum)   |
| Ladder Function Blocks   | 1200 blocks (maximum)   |
| Configuration File   | 120kbytes (maximum)**   |
| Program Execution Cycle for 1000 boolean operations (without redundancy) | 50 ms (minimum)***<br>90 ms (typical)****   |
| Execution Average Time   | 5.8 ms/Kbytes of program (minimum)<br>10.5 ms/Kbytes of program (typical)   |

\* The whole number of points includes inputs and outputs, analog or digitals. Maximum may change according I/O type used.

\*\* 120 Kbytes are available in firmware version 2.x and later. For earlier versions the limit is 60 Kbytes.

\*\*\* 1131 Flexible Function Block adjusted to One (High Priority). Each 1000 boolean operations allocate 8.6 Kbytes.

\*\*\*\* Total execution time will change depending on the adjusted priority of 1131 FFB. The adjustment should be compatible with the quantity of function blocks and HSE links.

**Firmware version and Device Revision**

Some Firmware Versions may change the Device Revision, so this is an important step to consider during the configuration procedure for the controller. The section “Adding Function Blocks” better describes the steps for this configuration. The current available versions are:

- Firmware version 1.0: Device Revision = 1
- Firmware version 1.1: Device Revision = 2
- Firmware version 2.x: Device Revision = 3
- Firmware version 3.x: Device Revision = 4

## Technical Specifications

### Memory

| TYPE                  | SIZE     |
|-----------------------|----------|
| Volatile Memory       | 8 Mbytes |
| Non Volatile Memory * | 4 Mbytes |
| EEPROM                | 1 Kbytes |
| Flash to the program  | 4 Mbytes |
| Flash to monitor      | 2 Mbytes |

### Battery

|                                   |  |
|-----------------------------------|--|
| Type of battery                   | Battery Panasonic BR-2/3AE2SP - Lithium      |
| Capacity                          | 1200 mAh                                     |
| Devices maintained by the battery | RTC and NVRAM                                |
| Minimum life span                 | 8 years (typical charge of 17 $\mu$ A)       |
| Maximum life span                 | 49 years (typical charge of 2.8 $\mu$ A)     |
| Voltage                           | 3 V ( subject to revision when below 2.5 V ) |

### Communication Ports and Channels

| ETHERNET PORT  |                   |
|----------------|-------------------|
| Rate           | 10/100 Mbits/s    |
| Standard       | IEEE 802.3u       |
| Isolation      | 150 Vrms          |
| Operation mode | Full-duplex       |
| Connector      | RJ45 with shield* |

\* Grounded to the rail used for fixing the rack in which the DF79 is installed

| DEVICENET NETWORK   |  |
|---------------------|--|
| Power Supply        | 24 Vdc $\pm$ 20%<br>Maximum consumption of module: 100 mA                            |
| Connector           | Open style, from top to bottom: V-, CAN_L,<br>DRN, CAN_H, V+<br>Isolation: 1000 Vrms |
| Communication Rates | 125 kbps (trunk < 500 m)<br>250 kbps (trunk < 250 m)<br>500 kbps (trunk < 100 m)     |

| MODBUS PORT        |                  |
|--------------------|------------------|
| Maximum rate*      | 115200 bps       |
| Standard           | EIA-232          |
| Connector**        | RJ12 with shield |
| Maximum Current*** | 0,5A @ 3.3V      |

\*There is an increase in error rate as we increase the communication rate over 19200 bps. In many situations these errors can be acceptable and they are not noticed by supervision.

\*\* Grounded to the rail used for fixing the rack in which the DF79 is installed

\*\*\* Internally protected by solid state fuse.

| REDUNDANCY PORT (NOT OPERATIONAL - RESERVED) |                  |
|--|------------------|
| Maximum rate                                 | 115200 bps       |
| Standard                                     | EIA-232          |
| Connector*                                   | RJ12 with shield |
| Maximum Current**                            | 0.5A @ 3.3V      |

\* Grounded to the rail used for fixing the rack in which the DF79 is installed

\*\* Internally protected by solid state fuse.

| FAILURE RELAY                               |   |
|---|---|
| Output Type                                 | Solid state relay, normally closed (NC)       |
| Maximum voltage                             | 24 Vdc $\pm$ 20%                              |
| Maximum Current                             | 100 mA  |
| Isolation                                   | 1000 Vrms                                     |
| Overload Protection                         | Does not have. It must be provided externally |
| Normal Operation                            | Opened contacts                               |
| Failure Condition                           | Closed contacts                               |
| Maximum cable length connected to the relay | 30 m  |

Observation: The power supply for the load must not be from an external network (outside the panel).

| IMB BUS            |        |
|--------------------|--------|
| Voltage            | 5 Vdc  |
| Bus                | 8 bits |
| Failure indication | Yes    |
| Hot swap           | Yes    |

### Module Characteristics

| CONTROLLER           |  |
|----------------------|--|
| CPU                  | Family ARM7TDMI                          |
| Bus                  | 32 bits                                  |
| Architecture         | RISC                                     |
| Performance          | 40 MIPS                                  |
| CPU Cache            | 8 Kbytes                                 |
| Clock                | 40 MHz                                   |
| DMA                  | 10 channels                              |
| Ethernet             | MAC 10/100 integrated                    |
| Watchdog             | Yes (200 ms of cycle)                    |
| Power Supply Voltage | 3.3 V for I/O and 2.5V for core (552 mW) |

| CARD                                   |   |
|--|---|
| Power Supply Voltage                   | 5 V ( $\pm$ 10% of tolerance)                         |
| Typical Current                        | 620 mA  |
| Real consumption                       | 2.75 W  |
| Environment Air Temperature            | 0 to 60° C in compliance with the IEC 1131 standard   |
| Storage Temperature                    | -20 to 80° C in compliance with the IEC 1131 standard |
| Relative Humidity of the Operation Air | 5% to 95% non condensing                              |
| Cooling Mode                           | Air convection  |
| Weight                                 | 0.318 kg  |
| Dimensions (H x W x D) in mm           | 149x40x138 (without enclose)                          |

## Electrical Certification

DF79 follows the immunity test specification to equipment to industrial installation, as IEC61326:2002 standard.

| ENCLOSE   |                       |
|---|-----------------------|
| Electrostatic discharge (IEC61000-4-2)            | 4 kV/8 kV contact/air |
| EM field (IEC61000-4-3)                           | 10 V/m                |
| Rated power frequency magnet field (IEC61000-4-8) | 30 A/m                |

| AC POWER  |                               |
|---|-------------------------------|
| Voltage dip/short interruptions (IEC61000-4-11) | 0,5 cycle, each polarity/100% |
| Burst (IEC61000-4-4)                            | 2 kV                          |
| Surge (IEC61000-4-5)                            | 1 kV/2 kV                     |
| Conducted RF (IEC61000-4-6)                     | 3 V                           |

| DC POWER                    |           |
|-----------------------------|-----------|
| Burst (IEC61000-4-4)        | 2 kV      |
| Surge (IEC61000-4-5)        | 1 kV/2 kV |
| Conducted RF (IEC61000-4-6) | 3 V       |

| I/O SIGNAL/CONTROL          |      |
|-----------------------------|------|
| Burst (IEC61000-4-4)        | 1 kV |
| Surge (IEC61000-4-5)        | 1 kV |
| Conducted RF (IEC61000-4-6) | 3 V  |

| I/O SIGNAL/CONTROL CONNECTED DIRECTLY TO POWER SUPPLY NETWORK |           |
|---|-----------|
| Burst (IEC61000-4-4)  | 2 kV      |
| Surge (IEC61000-4-5)  | 1 kV/2 kV |
| Conducted RF (IEC61000-4-6)                                   | 3 V       |

### Emission Rate

| ENCLOSE                                  |   |
|--|---|
| 30 to 230 MHz (CISPR 16-1, CISPR 16-2)   | 40 dB (uV/m) quasi peak, measured at 10m distance |
| 239 to 1000 MHz (CISPR 16-1, CISPR 16-2) | 40 dB (uV/m) quasi peak, measured at 10m distance |

| AC MAINS                                 |   |
|--|---|
| 0,15 to 0,5 MHz (CISPR 16-1, CISPR 16-2) | 79 dB (uV) quasi peak<br>66 dB (uV) average |
| 0,5 to 5 MHz (CISPR 16-1, CISPR 16-2)    | 73 dB (uV) quasi peak<br>60 dB (uV) average |
| 5 to 30 MHz (CISPR 16-1, CISPR 16-2)     | 73 dB (uV) quasi peak<br>60 dB (uV) average |

## Indication LEDs

The LED names, colors, descriptions and behaviors are showed in the table below.

| LED             | COLOR  | DESCRIPTION  | BEHAVIOR  |
|-----------------|--------|--|---|
| ETH LNK 2 (LNK) | Green  | It indicates when the Ethernet link is active (ETH2 port).   | Solid green LED when the Ethernet link is established (ETH2 port).  |
| ETH TX2 (TX2)   | Green  | It indicates communication activity in the ETH2 port.  | Blinking green LED when the ETH2 port is transmitting data.   |
| ETH LNK 1 (LNK) | Green  | It indicates when the Ethernet link is active (ETH1 port).   | Solid green LED when the Ethernet link is established (ETH1 port).  |
| ETH TX1 (TX1)   | Green  | It indicates communication activity in the ETH1 port.  | Blinking green LED when the ETH1 port is transmitting data.   |
| 232 TX (TX)     | Green  | It indicates activity in the RS-232 port   | Blinking green LED when the RS-232 port is transmitting data.   |
| DIAG            | Yellow | It indicates the operation mode in the RS-232 port.  | <b>On:</b> RS232 port in local diagnostic mode.<br><b>Off:</b> RS232 port in normal operation mode (Modbus RTU)<br><b>Blinking:</b> NA  |
| +5 VDC (ON)     | Green  | It indicates when the module is ON.  | <b>On:</b> Module power supply is OK.<br><b>Off:</b> Without 5V of rack or hot swap circuit with problem.<br><b>Blinking:</b> NA  |
| FAIL            | Red    | It indicates hardware failure.   | Solid red LED when in fail  |
| RUN             | Green  | It indicates when the controller is operating in normal mode.  | Solid green LED when in operation.  |
| HOLD (HLD)      | Yellow | It indicates when the controller is in hold mode. In this mode the controller does not perform any application and does not interfere on the plant operation (access via I/O cards or via digital bus are disabled)  | Solid yellow LED when the controller is in hold mode (HOLD).  |
| FORCE (FRC)     | Red    | 1 – It indicates different modes of startup or maintenance requested by the operator via push-buttons (FACT INIT, HOLD and IP Address).<br>2 – It indicates power failure when the operating voltage decays down the expected value of 4.8 V (low line).<br>3 – Indicates a battery problem. | 1 - Depending on the number of times that the right push-button is pressed, the FRC LED blinks at a given rate for a limited time, indicating the chosen mode (refer to Troubleshooting section for further information).<br>2 – Permanently solid red. The module will reset if the voltage reaches 4.6V. (HLD and FAIL LEDs light up together temporarily).<br>3 –FRC LED blinking and HLD LED solid red during the module start up – indicates low battery or the battery rear DIP switch is turned off (refer to Troubleshooting section for further information) |
| DN              | Blue   | It indicates DeviceNet channel activity.   | <b>On:</b> The DeviceNet communication was activated and all active devices in the configuration are working normally.<br><b>Off:</b> DeviceNet network was not configured.<br><b>Blinking:</b> Some active device in the configuration is missing or has a problem. Verify the device or deactivate it in the configuration (a download is necessary).   |
| ERR             | Red    | It indicates it there is an error related to the DeviceNet network.  | <b>On:</b> Error in the DeviceNet network. The 24V is missing, some node is missing or with error.<br><b>Off:</b> The DeviceNet network is configured and all active devices are working normally.<br><b>Blinking:</b> The DeviceNet communication was deactivated.   |
| LINE            | Green  | It indicates that the bus is powered with 24 V.  | <b>On:</b> Powered bus.<br><b>Off:</b> Bus is not powered<br><b>Blinking:</b> NA  |
| STANDBY (STB)   | Green  | If the HOLD LED is solid yellow and the STB LED is blinking, the firmware is being updating. If the HOLD LED is off, it indicates the controller role on redundancy as well as the synchronism status.   | There are several blinking patterns to indicate different synchronism status. Refer to redundancy section for further details.  |

\*NA – Not applicable

# DF81 Specifications

## Part Number

DF81 – HSE/AS-i Controller with 2 Ethernet 100 Mbps ports and 2 AS-I channel.

## Description

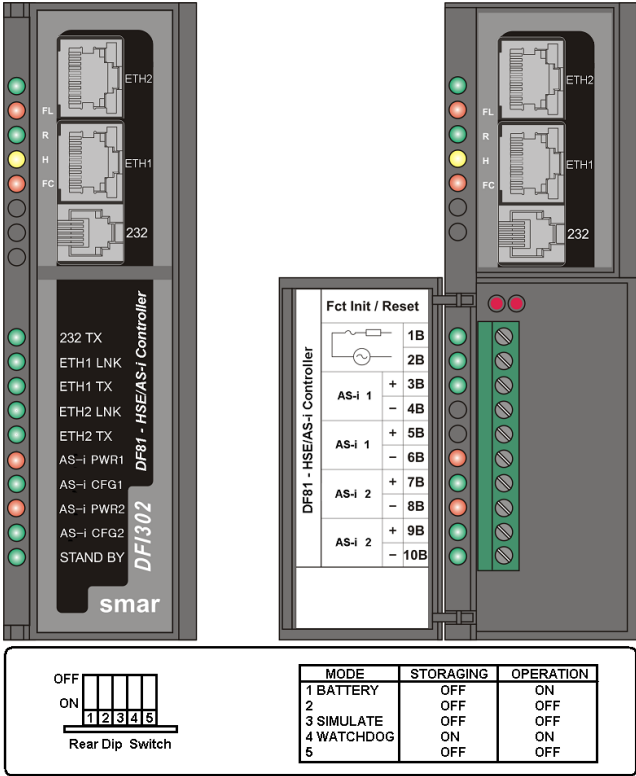
The HSE/AS-I controller follow the operation standard AS-i network and meets AS-i master requirements based on the version 2.1 (except analogical data treatment and of the flag Date Exchange of the masters).

DF81 meets the same quality principles and standards DFI302 family. It is composed by 2 AS-i bus (2 masters), 2 Ethernet 10/100 Mbps ports, 2 RS-232 serial ports (one for communication and other for synchronism) and ability for execution FOUNDATION™ fieldbus blocks.

Through the HSE network and other DFI302 modules, it is possible the communication between field devices and other industrial protocols, providing greater flexibility to the control strategy projects.

Through the I/O cards, it is also possible to execute discrete control via relay diagram logic (“Ladder Diagram”), allowing a single and integrated system.

The module DF81 also can act as Modbus gateway, allowing the interconnection of Modbus masters, network diagnostic by SNMP protocol (Simple Network Management Protocol), and AS-i network configuration by proprietary tool (**SMAR Network Configurator - SmarNetConf**).



DF81 – HSE/AS-i Controller

## Characteristics and Module Limits

- 2 AS-i channel (2 masters) – version 2.1 (only discrete);
- 2 Ethernet 10/100 Mbps ports;
- Supports up to 124 slaves AS-i discrete (62 for channel – version 2.1);
- Access I/O modules;
- Up to 1024 discrete points and 512 analog points with modules in the IMB (conventional I/O);

- Limit of 128 external links by the HSE network (64 VCRs *publishers* and 64 VCRs *subscribers*);
- Dynamic block instantiation;
- FOUNDATION™ fieldbus function blocks;
- One (1) Flexible Function Block with 242 linked parameter to interface between the discrete and continuous control;
- One (1) Transducer Block for AS-i network diagnostic;
- Integrated Modbus protocol;
- Integrated Webserver;
- Simple Network Management Protocol (SNMP);
- It supports up to 16 HART modules (DF116/DF117).

**NOTE**

The limit of HART modules per controller is 16, but you must remember that when mapping the points through fieldbus function blocks strategy, one transducer block is used for each HART device. In this case, the system may be limited to less than 16 HART modules depending on the maximum number of fieldbus function blocks supported by the controller.

### Continuous Control with AS-i

DF81 is a complete DeviceNet HSE controller with capacity to execute function blocks. Through the available **SYSTEM302**, **Studio302** and **Syscon** configuration tools is possible to configure the DF81 totally.

#### HSE Communication

- Maximum of 512 link objects;
- Maximum of 250 function blocks;
- Up to 50 requests for non connected services can be pendent per connection;
- Supervision up to 2000 points per second;
- Configurable Views.

### Discrete Control

DF81 module also has the capability of access up to 124 discrete AS-i slaves, being 62 per channel (version 2.1). According to the version 2.1 specification AS-i system, the scan time of the network devices is up to 10 ms per channel.

Besides discrete access of the AS-i devices, this module has ability to access I/O cards through IMB bus (Inter-Module Bus), present in the backplane where the DF81 is mounted.

Through IMB, up to 16 DF1A racks or DF93 can be interconnect, each one containing up to 4 cards. It is recommended, always, the use of bus terminator (BT302) for the last rack. In the AS-i bus it is not necessary to use terminators.

| <b>DISCRETE CONTROL CHARACTERISTICS</b>                                  |   |
|--|---|
| I/O Points*  | Maximum 868 discrete points on the AS-i network (434 per channel).<br>Maximum 1024 discrete points and 512 analog points with modules in the IMB. |
| Auxiliary Points   | Maximum 4096 points   |
| Function Blocks for Ladder   | Maximum 1200 blocks   |
| Configuration File   | Maximum 120 Kbytes  |
| Program Execution Cycle for 1000 boolean operations (without redundancy) | 50 ms (minimum)**<br>90 ms (typical)***   |
| Execution Average Time   | 5.8 ms/Kbytes of program (minimum)<br>10.5 ms/Kbytes of program (typical)   |

\* The whole number of points includes inputs and outputs, analog or digitals. Maximum may change according I/O type used.

\*\* 1131 Flexible Function Block adjusted to One (High Priority). Each 1000 boolean operations allocate 8.6 Kbytes.

\*\*\* Total execution time will change depending on the adjusted priority of 1131 FFB. The adjustment should be compatible with the quantity of function blocks and HSE links.

## Flexible Function Block Usage

The interconnection between the continuous control and the ladder logic can be done by using Flexible Function Block. For further details about the Flexible Function Block usage, refer to the section Adding logic by using Flexible Function Block and the **LogicView for FFB** manual.

## Firmware version and Device Revision

Some Firmware Versions may change the Device Revision, so this is an important step to consider during the configuration procedure for the controller. The section “Adding Function Blocks” better describes the steps for this configuration. The current available versions are:

Firmware version 1.x: Device Revision = 01  
 Firmware version 2\_0\_2: Device Revision = 02

## Technical Specifications

### Memory

| TYPE                 | SIZE     |
|----------------------|----------|
| Volatile Memory      | 8 Mbytes |
| Non Volatile Memory  | 4 Mbytes |
| EEPROM               | 1 Kbytes |
| Flash to the program | 4 Mbytes |
| Flash to monitor     | 2 Mbytes |

### Battery

| CHARACTERISTICS                   |  |
|-----------------------------------|--|
| Type of battery                   | Battery Panasonic BR-2/3AE2SP - Lithium    |
| Capacity                          | 1200 mAh                                   |
| Devices maintained by the battery | RTC and NVRAM                              |
| Minimum life span                 | 8 years (typical charge of 17 $\mu$ A)     |
| Maximum life span                 | 49 years (typical charge of 2.8 $\mu$ A)   |
| Voltage                           | 3 V (subject to revision when below 2.5 V) |

### Communication Ports and Channels

| ETHERNET PORT      |                   |
|--------------------|-------------------|
| Communication Rate | 10/100 Mbps       |
| Standard           | IEEE 802.3u       |
| Isolation          | 150 Vrms          |
| Operation Mode     | Full-duplex       |
| Connector          | RJ45 with shield* |

\* Grounded to the rail used for fixing the rack in which the DF81 is installed.

| AS-i CHANNEL                           |                                     |
|--|-------------------------------------|
| Number of H1 Channels                  | 2                                   |
| Communication Rate                     | 167 kbps                            |
| Standard                               | EN 50295 / IEC62026-2               |
| Modem AS-i (Physical Layer)            | A2SI (ZMD)                          |
| Maximum Voltage Supplied for Channel   | 24 Vdc, 8A                          |
| Maximum Consumption of Bus for Channel | 60 mA                               |
| Level in Industrial Communication      | Sensor-Actuator (bit oriented)      |
| Procedure of Bus Access                | Master-Slave through cyclic polling |



| MODBUS PORT                   |                  |
|-------------------------------|------------------|
| Communication Rate (Maximum)* | 115200 bps       |
| Standard                      | EIA-232          |
| Connector**                   | RJ12 with shield |
| Maximum Current ***           | 0.5A @ 3.3V      |

\*There is an increase in error rate as we increase the communication rate over 19200 bps. In many situations these errors can be acceptable and they are not noticed by supervision.

\*\* Grounded to the rail used for fixing the rack in which the DF81 is installed.

\*\*\* Internally protected by solid state fuse.

| REDUNDANT PORT (NON OPERATING – FUTURE USE) |                  |
|---|------------------|
| Maximum Communication Rate                  | 115200 bps       |
| Standard                                    | EIA-232          |
| Connector*                                  | RJ12 with shield |
| Maximum Current **                          | 0.5A @ 3.3V      |

\* Grounded to the rail used for fixing the rack in which the DF81 is installed.

\*\* Internally protected by solid state fuse.

| FAILURE RELAY   |   |
|---|---|
| Output Type   | Solid state relay, normally closed (NC), isolated |
| Maximum Voltage                                       | 30 Vdc  |
| Maximum Current                                       | 200 mA  |
| Overload Protection                                   | Not available. It must be provided externally     |
| Normal Operation                                      | Opened contacts                                   |
| Failure Condition                                     | Closed contacts                                   |
| Maximum cable length (maximum) connected to the relay | 30 m  |

Note: The power supply for the load must not be from an external network (outside the panel).

| IMB BUS                             |        |
|-------------------------------------|--------|
| Voltage                             | 5 Vdc  |
| Bus                                 | 8 bits |
| Access time for writing and reading | 450 ns |
| Failure Signal                      | Yes    |
| Hot Swap                            | Yes    |

**Module Features**

| CONTROLLER        |                       |
|-------------------|-----------------------|
| CPU               | Family ARM7TDMI       |
| Bus               | 32 bits               |
| Architecture      | RISC                  |
| Performance       | 40 MIPS               |
| CPU Cache         | 8 Kbytes              |
| Clock             | 40 MHz                |
| DMA               | 10 channels           |
| Ethernet          | MAC 10/100 integrated |
| Watchdog          | Yes (200 ms of cycle) |
| Operation Voltage | 3.3 V for I/O         |

| I/O MODULES                       |                                  |
|-----------------------------------|----------------------------------|
| Operation Voltage                 | 5 V ( $\pm$ 5% of tolerance)     |
| Typical Current                   | 550 mA                           |
| Real Consumption                  | 2,75 W                           |
| Environment Air Temperature       | 0 - 60° C (IEC 1131)             |
| Storage Temperature               | -20 - 80° C (IEC 1131)           |
| Relative Air Humidity (Operation) | 5% - 95% (non-condensing)        |
| Cooling Mode                      | Air Convection                   |
| Dimensions (H x W x D) in mm      | 149 x 40 x 138 (without package) |

### General Characteristics of the Network

| TOPOLOGY                                     |  |
|--|--|
| Maximum Number of Participants - version 2.1 | 2 Masters; 62 Discrete Slaves for Master |
| Maximum Number of Participants - version 2.0 | 2 Masters; 31 Discrete Slaves for Master |
| Maximum distance between Master-Slave        | 100 m; 300 m with repeater               |
| Maximum distance between Master-Slave        | 100 m; 500 m with repeater               |
| Network structures allowed                   | Tree, star, linear                       |

| AS-i CABLES                             |  |
|---|--|
| Number of conductors for data and power | 2 (yellow cable)   |
| Cable Type                              | Non-interlaced, without loop ground, without terminators (AS-i cables or 2x1,5 mm <sup>2</sup> parallel) |
| Secondary Supply Cable                  | Black Flexible Cable   |

| ENVIRONMENTAL CONDITIONS |                      |
|--------------------------|----------------------|
| Ambient Temperature      | 0 to 60 °C           |
| Ingress Protection       | Standard up to IP 20 |
| EMC (Emission)           | Up to Class A        |

### Electrical Certification

DF81 follows the immunity test specification to equipment to industrial installation, as IEC61326:2002 standard.

| ENCLOSE   |                       |
|---|-----------------------|
| Electrostatic discharge (IEC61000-42)             | 4 kV/8 kV contact/air |
| EM field  | 10 V/m                |
| Rated power frequency magnet field (IEC61000-4-8) | 30 A/m                |

| AC POWER  |                               |
|---|-------------------------------|
| Voltage dip/short interruptions (IEC61000-4-11) | 0,5 cycle, each polarity/100% |
| Burst (IEC61000-4-4)                            | 2 kV                          |
| Surge (IEC61000-4-5)                            | 1 kV/2 kV                     |
| Conducted RF (IEC61000-4-6)                     | 3 V                           |

| DC POWER                    |           |
|-----------------------------|-----------|
| Burst (IEC61000-4-4)        | 2 kV      |
| Surge (IEC61000-4-5)        | 1 kV/2 kV |
| Conducted RF (IEC61000-4-6) | 3 V       |

| I/O SIGNAL/CONTROL          |      |
|-----------------------------|------|
| Burst (IEC61000-4-4)        | 1 kV |
| Surge (IEC61000-4-5)        | 1 kV |
| Conducted RF (IEC61000-4-6) | 3 V  |

| I/O SIGNAL/CONTROL CONNECTED DIRECTLY TO POWER SUPPLY NETWORK |           |
|---|-----------|
| Burst (IEC61000-4-4)  | 2 kV      |
| Surge (IEC61000-4-5)  | 1 kV/2 kV |
| Conducted RF (IEC61000-4-6)                                   | 3 V       |

**Emission Rate**

| ENCLOSE                                  |   |
|--|---|
| 30 to 230 MHz (CISPR 16-1, CISPR 16-2)   | 40 dB (uV/m) quasi peak, measured at 10m distance |
| 239 to 1000 MHz (CISPR 16-1, CISPR 16-2) | 40 dB (uV/m) quasi peak, measured at 10m distance |

| AC MAINS                                 |   |
|--|---|
| 0,15 to 0,5 MHz (CISPR 16-1, CISPR 16-2) | 79 dB (uV) quasi peak<br>66 dB (uV) average |
| 0,5 to 5 MHz (CISPR 16-1, CISPR 16-2)    | 73 dB (uV) quasi peak<br>60 dB (uV) average |
| 5 to 30 MHz (CISPR 16-1, CISPR 16-2)     | 73 dB (uV) quasi peak<br>60 dB (uV) average |

## Indication LEDs

The LED names, colors, descriptions and behaviors are showed in the table below.

| LED                | COLOR  | DESCRIPTION   | BEHAVIOR   |
|--------------------|--------|---|--|
| <b>+5 Vdc (ON)</b> | Green  | It indicates when the module is on.   | Solid green LED when power is on.  |
| <b>FAIL (FL)</b>   | Red    | It indicates hardware failure.  | Solid red LED when in fail.  |
| <b>RUN (R)</b>     | Green  | It indicates when the controller is operating in normal mode.   | Solid green LED when in operation.   |
| <b>HOLD (H)</b>    | Yellow | It indicates when the controller is in hold mode. In this mode the controller does not perform any application and does not interfere on the plant operation (access via I/O cards or via digital bus are disabled)   | Solid yellow LED when the controller is in hold mode (HOLD).   |
| <b>FORCE (FC)</b>  | Red    | <p>1 – It indicates different modes of startup or maintenance requested by the operator via push-buttons (FACT INIT, HOLD and IP Address).</p> <p>2 – It indicates power failure when the operating voltage decays down the expected value of 4.8 V (low line).</p> <p>3 – Indicates a battery problem.</p> | <p>1 - Depending on the number of times that the right push-button is pressed, the FRC LED blinks at a given rate for a limited time, indicating the chosen mode (refer to Troubleshooting section for further information).</p> <p>2 – Permanently solid red. The module will reset if the voltage reaches 4.6V. (HLD and FAIL LEDs light up together temporarily).</p> <p>3 –FRC LED blinking and HLD LED solid red during the module start up – indicates low battery or the battery rear DIP switch is turned off (refer to Troubleshooting section for further information)</p> |
| <b>232 TX (TX)</b> | Green  | It indicates activity in the RS-232 port.   | Blinking green LED when the RS-232 port is transmitting data.  |
| <b>ETH1 LNK</b>    | Green  | It indicates when the Ethernet link is active (ETH1 port).  | Solid green LED when the Ethernet link is established (ETH1 port).   |
| <b>ETH1 TX</b>     | Green  | It indicates communication activity in the ETH1 port  | Blinking green LED when the ETH1 port is transmitting data.  |
| <b>ETH2 LNK</b>    | Green  | It indicates when the Ethernet link is active (ETH2 port).  | Solid green LED when the Ethernet link is established (ETH2 port).   |
| <b>ETH2 TX</b>     | Green  | It indicates communication activity in the ETH2 port.   | Blinking green LED when the ETH2 port is transmitting data.  |
| <b>STANDBY</b>     | Green  | <p>If the HOLD LED is solid yellow and the STB LED is blinking, the firmware is being updating.</p> <p>If the HOLD LED is off, it indicates the controller role on redundancy as well as the synchronism status.</p>  | There are several blinking patterns to indicate different synchronism status. Refer to redundancy section for further details.   |

### LEDs connected to the AS-i bus:

| LED                            | COLOR/STATE      |                  | DESCRIPTION   | BEHAVIOR   |
|--------------------------------|------------------|------------------|---|--|
|                                | Red              | Green            |   |  |
| <b>AS-i PWR1<br/>AS-i CFG1</b> | On               | Off              | It indicates supply failure ( <i>Power Fail</i> )   | LED: red on and green off  |
|                                | Blinking Quickly | Off              | Channel powered ( <i>Power On</i> ) and masters not running ( <i>Not ready</i> )  | Blinking Quickly and pre-set intervals of red and green LED off    |
|                                | Off              | Blinking Quickly | Channel powered ( <i>Power On</i> ), there is not power failure, but the state master in Offline state                        | Red LED Blinking Quickly off and on pre-set intervals of green LED |
| <b>AS-i PWR2<br/>AS-i CFG2</b> | Off              | Blinking Slowly  | It indicates when the NORMAL_OPERATION flag is off OR its CONFIG_OK flag is not active OR the master is in configuration mode | Red LED off and green blinking slowly                              |
|                                | Off              | On               | It indicates normal operation, CONFIG_OK flag is active and the master is in protected mode                                   | Red LED off and green on   |

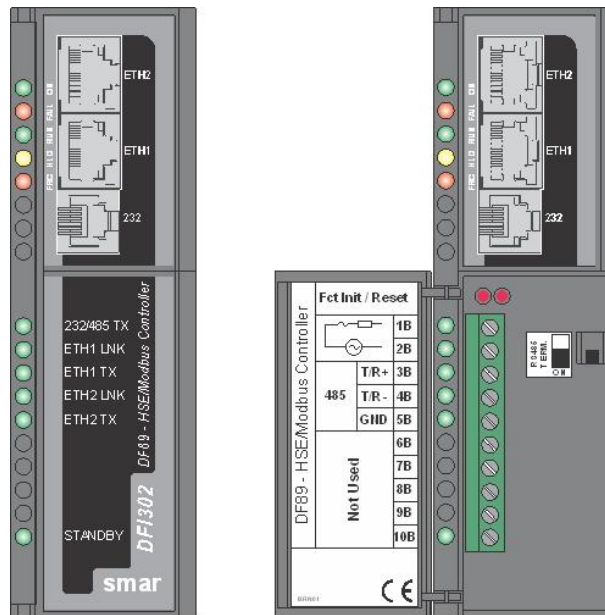
## DF89 Specifications

### Part Number

DF89 –HSE/Modbus Controller

### Description

DF89 module is the Smar solution for Modbus applications in the **SYSTEM302**. Its main feature is working as Modbus-HSE controller to provide power to the connectivity and flexibility to the system application. Through the HSE network and other DFI302 modules, it is possible the communication between field devices and other industrial protocols, providing greater flexibility to the control strategy projects. Through the I/O cards, it is also possible to execute discrete control via relay diagram logic (“Ladder Diagram”), allowing a single and integrated system.



DF89 – HSE/Modbus Controller

Rear Dip Switch

|            | STORAGING | OPERATION |
|------------|-----------|-----------|
| 1 BATTERY  | OFF       | ON        |
| 2          | OFF       | OFF       |
| 3 SIMULATE | OFF       | OFF       |
| 4 WATCHDOG | ON        | ON        |
| 5          | OFF       | OFF       |

DF89

### Characteristics and Controller Limits

- 2 10/100 Mbps Ethernet Ports;
- 1 RS-232/RS-485 Modbus RTU port (See NOTE DF89);
- Support up to 100 FOUNDATION™ fieldbus function blocks;
- Support Flexible Function Block (FFB);
- Discrete control via relay diagram;
- Access to I/O modules;
- Webserver;
- Modbus master and slave;
- Redundant operation;
- Real Time Clock (RTC) and watchdog;
- Supervision for up to 2000 points per second.
- It supports up to 16 HART modules (DF116/DF117).

**NOTE**

The limit of HART modules per controller is 16, but you must remember that when mapping the points through fieldbus function blocks strategy, one transducer block is used for each HART device. In this case, the system may be limited to less than 16 HART modules depending on the maximum number of fieldbus function blocks supported by the controller.

**Continuous Control with FOUNDATION™ Fieldbus**

The DF89 module is a HSE device, with block execution capability. It has up to 100 blocks, including a Flexible Function Block (FFB) to link FOUNDATION fieldbus control strategies with Ladder diagrams. Through configuration tools available in the **SYSTEM302** it is possible to configure the DF89 completely.

**HSE Communication**

- Maximum of 512 link objects;
- Limit of 128 linked parameters
- Dynamic block instantiation. Maximum of 100 function blocks;
- Support for Flexible Function Block, with 242 parameters which can be linked to interface between the discrete and continuous control.

**Discrete Control**

DF89 module also has the capability of access I/O cards through the IMB (Inter-Module Bus), present in the backplane where the DF89 is mounted. Through the IMB, up to 16 racks can be interconnected, each one having up to 4 cards. If there is a redundant controller is necessary the use of rack DF78 or DF92. If DF78 is used plus 16 racks DF1A can be added. If DF92 is used plus 16 racks DF93 can be used. Additional power supplies in others racks can be necessary depending on the load of the cards.

| DISCRETE CONTROL CHARACTERISTICS   |   |
|--|---|
| I/O Points*  | 512 discrete points or<br>256 analog (maximum)  |
| Auxiliary Points   | 4096 points (maximum)   |
| Ladder Function Blocks   | 1200 blocks (maximum)   |
| Configuration File   | 60 Kbytes (maximum)   |
| Program Execution Cycle for 1000 boolean operations (without redundancy) | 50 ms (minimum)**<br>90 ms (typical)***   |
| Program Execution Cycle with redundancy                                  | Increment of 10ms (typical)**** up to 50 ms (maximum) to execution cycle  |
| Execution Average Time   | 5.8 ms/Kbytes of program (minimum)<br>10.5 ms/Kbytes of program (typical)   |
| Modbus   | Modbus RTU Slave in the RS-232/RS-485 serial port and Modbus TCP Slave in the Ethernet port.  |
| TCP/RTU Modbus Master (See NOTE DF89)                                    | Up to 1024 discrete points and 512 analog.<br>Up to 32 serial Modbus devices and 32 TCP Modbus.<br>Up to 12 Modbus TCP connections. |

\* The whole number of points includes inputs and outputs, analog or digitals. Maximum quantity may change according I/O type used.

\*\* Priority of 1131 Flexible Function Block adjusted to Zero (Very High Priority) and no other function blocks and HSE links are configured. Each 1000 boolean operations allocate 8.6 Kbytes.

\*\*\* Total execution time will change depending on the adjusted priority of 1131 FFB. The adjustment should be compatible with the quantity of function blocks and HSE links.

\*\*\*\* The whole execution time may change depending of the configuration file size.

| NOTE DF89  |  |
|--|--|
| <ul style="list-style-type: none"> <li>• The characteristic of the DF89 as Modbus master described in “Creating a Modbus configuration using the DF89” section is only available from firmware version 4 (V4.xx) with Device Description 4.xx. Earlier versions of firmware and DD only support the features of slave Modbus described in “Adding Modbus” section.</li> <li>• The DF89 has only RS-485 port from the serial number SN623. Modules with serial numbers less than SN623 support the version 4 of firmware and Modbus master and slave features described in “Creating a Modbus configuration using the DF89” section only for the RS-232 serial port.</li> </ul> |  |

### Flexible Function Block Usage

The interconnection between the discrete control and the ladder logic can be done by using Flexible Function Block. For further details about the Flexible Function Block usage, refer to the section Adding logic by using Flexible Function Block and the LogicView for FFB manual.

### Firmware version and Device Revision

Some firmware versions may change the Device Revision, so this is an important step to consider during the configuration procedure for the controller. The section “Adding Function Blocks” better describes the steps for this configuration. The current available versions are:

- Firmware version 1.x: Device Revision = 1 (Only Modbus slave)
- Firmware version 2.x: Device Revision = 2 (Only Modbus slave)
- Firmware version 3.x: Device Revision = 3 (Only Modbus slave)
- Firmware version 4.x: Device Revision = 4 (Modbus master and slave)

### Technical Specifications

#### Memory

| TYPE                  | SIZE     |
|-----------------------|----------|
| Volatile Memory       | 8 Mbytes |
| Non Volatile Memory * | 4 Mbytes |
| EEPROM                | 1 Kbytes |
| Flash to the program  | 4 Mbytes |
| Flash to monitor      | 2 Mbytes |

\* It is kept by not rechargeable internal battery.

#### Battery

|                                   |   |
|-----------------------------------|---|
| Type of battery                   | Battery Panasonic BR-2/3AE2SP - Lithium     |
| Capacity                          | 1200 mAh                                    |
| Devices maintained by the battery | RTC and NVRAM                               |
| Minimum life span                 | 8 years (typical charge of 17 $\mu$ A)      |
| Maximum life span                 | 49 years (typical charge of 2.8 $\mu$ A)    |
| Voltage                           | 3 V (subject to revision when below 2.5 V ) |

#### Communication Ports and Channels

| ETHERNET PORT      |                   |
|--------------------|-------------------|
| Communication Rate | 10/100 Mbps       |
| Standard           | IEEE 802.3u       |
| Isolation          | 150 Vrms          |
| Operation Mode     | Full-duplex       |
| Connector          | RJ45 with shield* |

\* Grounded to the rail used for fixing the rack in which the DF89 is installed.

| MODBUS PORT (SEE NOTE DF89)   |  |
|-------------------------------|--|
| Communication Rate (Maximum)* | 115200 bps   |
| Standard                      | RS-232 and RS-485 (one port with two physical media) |
| RS-232 Connector**            | RJ12 with shield                                     |
| RS-485 Connector              | 3-pin terminal block                                 |
| Maximum Current ***           | 0.5A @ 3.3V  |

\*There is an increase in error rate as we increase the communication rate over 19200 bps. In many situations these errors can be acceptable and they are not noticed by supervision.

\*\* Grounded to the rail used for fixing the rack in which the DF89 is installed.

\*\*\* Internally protected by solid state fuse.

| REDUNDANT PORT             |                    |
|----------------------------|--------------------|
| Maximum Communication Rate | 115200 bps*        |
| Standard                   | RS-232             |
| Connector                  | RJ12 with shield** |
| Maximum Current ***        | 0.5A @ 3.3 V       |

\* Rate for control information. Data traffic through Ethernet.

\*\* Grounded to the rail used for fixing the rack in which the DF89 is installed.

\*\*\* Internally protected by solid state fuse.

| FAILURE RELAY   |   |
|---|---|
| Output Type   | Solid state relay, normally closed (NC), isolated |
| Maximum Voltage                                       | 30 Vdc  |
| Maximum Current                                       | 200 mA  |
| Overload Protection                                   | Not available. It must be provided externally     |
| Normal Operation                                      | Opened contacts                                   |
| Failure Condition                                     | Closed contacts                                   |
| Maximum cable length (maximum) connected to the relay | 30 m  |

The power supply for the load must not be from an external network (outside the panel).

| IMB BUS                      |   |
|------------------------------|---|
| Voltage                      | 5 Vdc                                     |
| Bus                          | 8 bits                                    |
| Failure Signal               | Yes                                       |
| Hot Swap                     | Yes                                       |
| Redundancy in the bus access | Yes, but only using the DF78 or DF92 rack |

**Module Characteristics**

| CONTROLLER        |                       |
|-------------------|-----------------------|
| CPU               | Family ARM7TDMI       |
| Bus               | 32 bits               |
| Architecture      | RISC                  |
| Performance       | 40 MIPS               |
| CPU Cache         | 8 Kbytes              |
| Clock             | 40 MHz                |
| DMA               | 10 channels           |
| Ethernet          | MAC 10/100 integrated |
| Watchdog          | Yes (200 ms of cycle) |
| Operation Voltage | 3.3 V for I/O         |

**MODULE**



|                                   |                                  |
|-----------------------------------|----------------------------------|
| Operation Voltage                 | 5 V (± 5% of tolerance)          |
| Typical Current                   | 550 mA                           |
| Real Consumption                  | 2.75 W                           |
| Environment Air Temperature       | 0 – 60 °C (IEC 1131)             |
| Storage Temperature               | -20 – 80 °C (IEC 1131)           |
| Relative Air Humidity (Operation) | 5% - 95% (non-condensing)        |
| Cooling Mode                      | Air Convection                   |
| Dimensions (H x W x D) in mm      | 149 x 40 x 138 (without package) |

## Electrical Certification

DF89 follows the immunity test specification to equipment to industrial installation, as IEC61326:2002 standard.

| ENCLOSE   |                       |
|---|-----------------------|
| Electrostatic discharge (IEC61000-4-2)            | 4 kV/8 kV contact/air |
| EM field (IEC61000-4-3)                           | 10 V/m                |
| Rated power frequency magnet field (IEC61000-4-8) | 30 A/m                |

| AC POWER  |                               |
|---|-------------------------------|
| Voltage dip/short interruptions (IEC61000-4-11) | 0.5 cycle, each polarity/100% |
| Burst (IEC61000-4-4)                            | 2 kV                          |
| Surge (IEC61000-4-5)                            | 1 kV/2 kV                     |
| Conducted RF (IEC61000-4-6)                     | 3 V                           |

| DC POWER                    |           |
|-----------------------------|-----------|
| Burst (IEC61000-4-4)        | 2 kV      |
| Surge (IEC61000-4-5)        | 1 kV/2 kV |
| Conducted RF (IEC61000-4-6) | 3 V       |

| I/O SIGNAL CONTROL          |      |
|-----------------------------|------|
| Burst (IEC61000-4-4)        | 1 kV |
| Surge (IEC61000-4-5)        | 1 kV |
| Conducted RF (IEC61000-4-6) | 3 V  |

| I/O SIGNAL CONTROL CONNECTED TO POWER SUPPLY |           |
|--|-----------|
| Burst (IEC61000-4-4)                         | 2 kV      |
| Surge (IEC61000-4-5)                         | 1 kV/2 kV |
| Conducted RF (IEC61000-4-6)                  | 3 V       |

## Emission Rate

| ENCLOSE                                  |   |
|--|---|
| 30 to 230 MHz (CISPR 16-1, CISPR 16-2)   | 40 dB (uV/m) quasi peak, measured at 10m distance |
| 239 to 1000 MHz (CISPR 16-1, CISPR 16-2) | 40 dB (uV/m) quasi peak, measured at 10m distance |

## AC MAINS

|  |   |
|--|---|
| 0.15 to 0.5 MHz (CISPR 16-1, CISPR 16-2) | 79 dB (uV) quasi peak<br>66 dB (uV) average |
| 0.5 to 5 MHz (CISPR 16-1, CISPR 16-2)    | 73 dB (uV) quasi peak<br>60 dB (uV) average |
| 5 to 30 MHz (CISPR 16-1, CISPR 16-2)     | 73 dB (uV) quasi peak<br>60 dB (uV) average |

## Indication LEDs

The LED names, colors, descriptions and behaviors are showed in the table below.

| LED         | COLOR  | DESCRIPTION   | BEHAVIOR   |
|-------------|--------|---|--|
| +5V DC (ON) | Green  | It indicates when the module is ON.   | Solid green LED when power is on.  |
| FAIL (FAIL) | Red    | It indicates hardware failure.  | Solid red LED when in fail..   |
| RUN (RUN)   | Green  | It indicates when the controller is operating in normal mode.   | Solid green LED when in operation.   |
| HOLD (HLD)  | Yellow | It indicates when the controller is in hold mode. In this mode the controller does not perform any application and does not interfere on the plant operation (access via I/O cards or via digital bus are disabled)   | Solid yellow LED when the controller is in hold mode (HOLD).   |
| FORCE (FRC) | Red    | <p>1 – It indicates different modes of startup or maintenance requested by the operator via push-buttons (FACT INIT, HOLD and IP Address).</p> <p>2 – It indicates power failure when the operating voltage decays down the expected value of 4.8 V (low line).</p> <p>3 – Indicates a battery problem.</p> | <p>1 - Depending on the number of times that the right push-button is pressed, the FRC LED blinks at a given rate for a limited time, indicating the chosen mode (refer to Troubleshooting section for further information).</p> <p>2 – Permanently solid red. The module will reset if the voltage reaches 4.6V. (HLD and FAIL LEDs light up together temporarily).</p> <p>3 –FRC LED blinking and HLD LED solid red during the module start up – indicates low battery or the battery rear DIP switch is turned off (refer to Troubleshooting section for further information)</p> |
| 232 TX      | Green  | It indicates activity in the RS-232 port.   | Blinking green LED when the RS-232 port is transmitting data.  |
| ETH1 LNK    | Green  | It indicates when the Ethernet link is active (ETH1 port).  | Solid green LED when the Ethernet link is established (ETH1 port).   |
| ETH1 TX     | Green  | It indicates communication activity in the ETH1 port  | Blinking green LED when the ETH1 port is transmitting data.  |
| ETH2 LNK    | Green  | It indicates when the Ethernet link is active (ETH2 port).  | Solid green LED when the Ethernet link is established (ETH2 port).   |
| ETH2 TX     | Green  | It indicates communication activity in the ETH2 port.   | Blinking green LED when the ETH2 port is transmitting data.  |
| STANDBY     | Green  | <p>If the HOLD LED is solid yellow and the STB LED is blinking, the firmware is being updating.</p> <p>If the HOLD LED is off, it indicates the controller role on redundancy as well as the synchronism status.</p>  | There are several blinking patterns to indicate different synchronism status. Refer to redundancy section for further details.   |

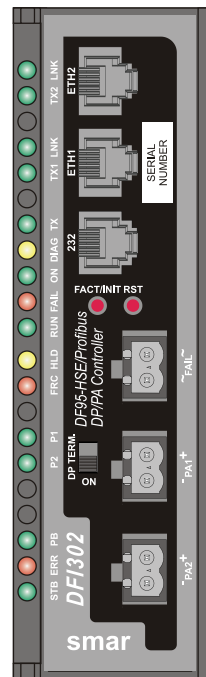
## DF95 Specifications

### Part Number

**DF95** –HSE/Profibus DP Controller with 2 Ethernet 100 Mbps ports, 1 serial port, 2 Profibus PA ports and 1 Profibus DP channel

### Description

DF95 module is the Smar solution for Profibus applications Its main feature is working as Profibus DP-HSE gateway to provide power to the connectivity and flexibility to the system application. It allows wide communication between the Profibus DP and PA field devices. Through the HSE network and other DFI302 modules, it is possible the communication between field devices and other industrial protocols, providing greater flexibility to the control strategy projects. Through the I/O cards, it is also possible to execute discrete control via relay diagram logic (“Ladder Diagram”), allowing a single and integrated system. The module DF95 also can act as Modbus gateway (slave), allowing the interconnection of modules that are not fieldbus or HSE.



**DF95 – Controller module**

Rear Dip Switch

|            | STORAGING | OPERATION |
|------------|-----------|-----------|
| 1 BATTERY  | OFF       | ON        |
| 2          | OFF       | OFF       |
| 3 SIMULATE | OFF       | OFF       |
| 4 WATCHDOG | ON        | ON        |
| 5          | OFF       | OFF       |

DF95

### Characteristics and Module Limits

- One Profibus DP channel supporting up to 12 Mbps;
- Two Profibus PA ports supporting up to 32 devices for channel;
- It supports up to 124 Profibus DP and PA field devices;
- It supports up to 3584 bytes of input and 3584 bytes of output during the data interchange process;
- Limit of 64 external links by the HSE network;
- Maximum of 250 function blocks per DF95;
- One (1) Flexible Function Block (counted into the 250 allowed blocks), with 242 linked parameter to interface between the discrete and continuous control.
- It supports up to 16 HART modules (DF116/DF117).

**NOTE**

The limit of HART modules per controller is 16, but you must remember that when mapping the points through fieldbus function blocks strategy, one transducer block is used for each HART device. In this case, the system may be limited to less than 16 HART modules depending on the maximum number of fieldbus function blocks supported by the controller.

**Continuous Control with Profibus**

DF95 is a complete Profibus HSE controller with capacity to execute function blocks. Through the available **SYSTEM302**, **Studio302** and **Syscon** configuration tools is possible to configure the DF95 totally.

**HSE Communication:**

- Maximum of 512 link objects;
- Supervision up to 2000 points per second;

**Discrete Control**

DF95 module also has the capability of access I/O cards through the IMB (Inter-Module Bus), present in the backplane where the DF95 is mounted. Through the IMB, up to 16 racks DF1A or DF93 can be interconnected, each one having up to 4 cards.

| DISCRETE CONTROL CHARACTERISTICS   |   |
|--|---|
| I/O Points*  | 1024 discrete points or 512 analog (maximum)                              |
| Ladder Function Blocks   | 2000 blocks (maximum)   |
| Configuration File   | 120 Kbytes (maximum)  |
| Program Execution Cycle for 1000 boolean operations (without redundancy) | 50 ms (minimum)**<br>90 ms (typical)***                                   |
| Program Execution Cycle with redundancy                                  | Increment of 10ms (typical)**** up to 50 ms (maximum) to execution cycle  |
| Execution Average Time   | 5.8 ms/Kbytes of program (minimum)<br>10.5 ms/Kbytes of program (typical) |

\* The whole number of points includes inputs and outputs, analog or digitals. Maximum may change according I/O type used.

\*\* 1131 Flexible Function Block adjusted to One (High Priority). Each 1000 boolean operations allocate 8.6 Kbytes.

\*\*\* Total execution time will change depending on the adjusted priority of 1131 FFB. The adjustment should be compatible with the quantity of function blocks and HSE links.

\*\*\*\* The whole execution time may change depending of the configuration file size.

| NUMBER OF I/O POINTS                   |      |
|--|------|
| Number of Profibus devices per network | 125  |
| Number of virtual points               | 4096 |
| Number of Profibus discrete points     | 2048 |
| Number of Profibus analog points       | 512  |

**Firmware version and Device Revision**

Some Firmware Versions may change the Device Revision, so this is an important step to consider during the configuration procedure for the controller. The section “Adding Function Blocks” better describes the steps for this configuration. The current available versions are:

- Firmware version 2\_0\_X: Device Revision = 1
- Firmware version 3\_0\_X: Device Revision = 2
- Firmware version 4\_0\_X: Device Revision = 3

## Technical Specifications

### Memory

| TYPE                    | SIZE     |
|-------------------------|----------|
| Volatile Memory         | 8 Mbytes |
| Non Volatile Memory *   | 4 Mbytes |
| EEPROM                  | 1 Kbytes |
| Flash to the program    | 4 Mbytes |
| Flash to monitor        | 2 Mbytes |
| Flash to EC1 (Profibus) | 4 Mbytes |

### Battery

|                                   |   |
|-----------------------------------|---|
| Type of battery                   | Battery Panasonic BR-2/3AE2SP - Lithium     |
| Capacity                          | 1200 mAh                                    |
| Devices maintained by the battery | RTC and NVRAM                               |
| Minimum life span                 | 8 years (typical charge of 17 $\mu$ A)      |
| Maximum life span                 | 49 years (typical charge of 2.8 $\mu$ A)    |
| Voltage                           | 3 V (subject to revision when below 2.5 V ) |

### Communication Ports and Channels

| ETHERNET PORT  |                   |
|----------------|-------------------|
| Rate           | 10/100 Mbits/s    |
| Standard       | IEEE 802.3u       |
| Isolation      | 150 Vrms          |
| Operation mode | Full-duplex       |
| Connector      | RJ45 with shield* |

\* Grounded to the rail used for fixing the rack in which the DF95 is installed

| DP PROFIBUS CHANNEL |                               |
|---------------------|-------------------------------|
| Rate                | From 9.6 Kbit/s to 12 Mbits/s |
| Standard            | EN 50170 e EN 50254           |
| Physical Layer      | EIA RS-485                    |
| Profibus Modem      | EC1 (Hilscher)                |
| Connector           | M12                           |

| PROFIBUS PA CHANNELS  |                           |
|-----------------------|---------------------------|
| Number of H1 Channels | 2                         |
| Communication Rate    | 31.25 kbps                |
| Standard              | EN 61158 EN 50170         |
| Physical Layer        | ISA-S50.02-1992           |
| MAU Type              | Passive (bus not powered) |
| Isolation             | 500 Vac                   |

| MODBUS PORT        |                  |
|--------------------|------------------|
| Maximum rate *     | 115200 bps       |
| Standard           | EIA-232          |
| Connector**        | RJ12 with shield |
| Maximum Current*** | 0,5A @ 3.3V      |

\*There is an increase in error rate as we increase the communication rate over 19200 bps. In many situations these errors can be acceptable and they are not noticed by supervision.

\*\* Grounded to the rail used for fixing the rack in which the DF95 is installed

\*\*\* Internally protected by solid state fuse.

| REDUNDANCY PORT   |                  |
|-------------------|------------------|
| Maximum rate      | 115200 bps       |
| Standard          | EIA-232          |
| Connector*        | RJ12 with shield |
| Maximum Current** | 0.5A @ 3.3V      |

\* Grounded to the rail used for fixing the rack in which the DF95 is installed

\*\* Internally protected by solid state fuse.

| FAILURE RELAY                               |   |
|---|---|
| Output Type                                 | Solid state relay, normally closed (NC), isolated |
| Maximum voltage                             | 30 Vdc  |
| Maximum Current                             | 200 mA  |
| Overload Protection                         | Does not have. It must be provided externally     |
| Normal Operation                            | Opened contacts                                   |
| Failure Condition                           | Closed contacts                                   |
| Maximum cable length connected to the relay | 30 m  |

Observation: The power supply for the load must not be from an external network (outside the panel).

| IMB BUS            |        |
|--------------------|--------|
| Voltage            | 5 Vdc  |
| Bus                | 8 bits |
| Failure indication | Yes    |
| Hot swap           | Yes    |

#### Module Characteristics

| CONTROLLER – MAIN BOARD |  |
|-------------------------|--|
| CPU                     | Family ARM7TDMI                          |
| Bus                     | 32 bits                                  |
| Architecture            | RISC                                     |
| Performance             | 40 MIPS                                  |
| CPU Cache               | 8 Kbytes                                 |
| Clock                   | 40 MHz                                   |
| DMA                     | 10 channels                              |
| Ethernet                | MAC 10/100 integrated                    |
| Watchdog                | Yes (200 ms of cycle)                    |
| Power Supply Voltage    | 3.3 V for I/O and 2.5V for core (552 mW) |

| CONTROLLER – SECONDARY BOARD |   |
|------------------------------|---|
| FPGA                         | Changes CycloneIII  |
| Storage Memory               | 4KB   |
| Processor                    | NiosII  |
| Running Memory               | 1MB   |
| Clock                        | 85 MHz  |
| Operating Voltage            | 3.3 V for I/O, 2.5V for PLL, 1.2V for core and 5V for communication channels. |

| CARD                                   |   |
|--|---|
| Power Supply Voltage                   | 5 V ( $\pm$ 5% of tolerance)                    |
| Typical Current                        | 750 mA  |
| Real consumption                       | 2.75 W  |
| Environment Air Temperature            | 0 to 60° C according to the IEC 1131 standard   |
| Storage Temperature                    | -20 to 80° C according to the IEC 1131 standard |
| Relative Humidity of the Operation Air | 5% to 95% non-condensing                        |
| Cooling Mode                           | Air convection                                  |
| Weight                                 | 0.318 kg  |
| Dimensions (H x W x D) in mm           | 149x40x138 (without enclose)                    |

## Indication LEDs

The LED names, colors, descriptions and behaviors are showed in the table below.

| LED               | Color  | Description  | Behavior when Primary  | Function when Secondary                  | Function when in HOLD  |
|-------------------|--------|--|--|--|--|
| ETH LNK 2 (LNK)   | Green  | It indicates when the Ethernet link is active (ETH2 port).   | Solid green LED when the Ethernet link is established (ETH2 port).   | Same function and behavior when Primary. | Same function and behavior when Primary.   |
| ETH TX2 (TX2)     | Green  | It indicates communication activity in the ETH2 port.  | Blinking green LED when the ETH2 port is transmitting data.  | Same function and behavior when Primary. | Same function and behavior when Primary.   |
| ETH LNK 1 (LNK)   | Green  | It indicates when the Ethernet link is active (ETH1 port).   | Solid green LED when the Ethernet link is established (ETH1 port).   | Same function and behavior when Primary. | Same function and behavior when Primary.   |
| ETH TX1 (TX1)     | Green  | It indicates communication activity in the ETH1 port.  | Blinking green LED when the ETH1 port is transmitting data.  | Same function and behavior when Primary. | Same function and behavior when Primary.   |
| 232 TX (TX)       | Green  | It indicates activity in the RS-232.port.  | Blinking green LED when the RS-232 port is transmitting data.  | Same function and behavior when Primary. | Same function and behavior when Primary.   |
| Diagnostic (DIAG) | Yellow | It indicates the operation mode in the RS-232.   | OFF when the RS-232 port is connected to the NetArm processor.<br>Solid yellow when the RS-232 port is connected to the EC1 to execute operations related to the Profibus.   | Same function and behavior when Primary. | Must be ON.<br>ON – Ready for connection to EC1.<br>OFF – Not supported  |
| +5V DC (ON)       | Green  | It indicates when the module is ON.  | Solid green LED when the module is powered.  | Same function and behavior when Primary. | Same function and behavior when Primary.   |
| FAIL (FAIL)       | Red    | It indicates hardware failure.   | Solid red LED when in fail.  | Same function and behavior when Primary. | Same function and behavior when Primary.   |
| RUN (RUN)         | Green  | It indicates when the controller is operating in normal mode.  | Solid green LED when in operation.   | Same function and behavior when Primary. | Must be OFF.<br>It is the inverse value of the HDL LED that indicates function in Monitor mode (maintenance mode of the device).         |
| HOLD (HLD)        | Yellow | It indicates when the controller is in hold mode. In this mode the controller does not perform any application and does not interfere on the plant operation (access via I/O cards or via digital bus are disabled)  | Solid yellow LED when the controller is in hold mode (HOLD).   | Same function and behavior when Primary. | Must be ON.  |
| FORCE (FRC)       | Red    | 1 – It indicates different modes of startup or maintenance requested by the operator via push-buttons (FACT INIT, HOLD and IP Address).<br>2 – It indicates power failure when the operating voltage decays down the expected value of 4.8 V (low line).<br>3 – Indicates a battery problem. | 1 - Depending on the number of times that the right push-button is pressed, the FRC LED blinks at a given rate for a limited time, indicating the chosen mode (refer to Troubleshooting section for further information).<br>2 – Permanently solid red. The module will reset if the voltage reaches 4.6V. (HLD and FAIL LEDs light up together temporarily).<br>3 –FRC LED blinking and HLD LED solid red during the module start up – indicates low battery or the battery | Same function and behavior when Primary. | Hardware failure or power failure indication<br>ON – Failure of power supply or hardware<br>OFF – Power Ok.<br>BLINKING – Mode selection |



| LED                   | Color | Description   | Behavior when Primary  | Function when Secondary   | Function when in HOLD  |
|-----------------------|-------|---|--|---|--|
|                       |       |   | rear DIP switch is turned off (refer to Troubleshooting section for further information)   |   |  |
| Profibus Network (PB) | Green | It indicates Profibus channel activity.   | ON – Profibus DP communication enabled<br><br>OFF – Profibus DP communication disabled, communication (transmission) failure, short circuit on Profibus DP channel<br><br>BLINKING – Multimaster mode operation  | Same function and behavior when Primary.  | Must be OFF. Profibus DP communication is disabled in HOLD.            |
| Profibus Error (ERR)  | Red   | It indicates it there is an error related to the Profibus network.  | ON - At least one slave device in this configuration is not communicating properly.<br>OFF - All slave devices present in the configuration are communicating properly.<br>BLINKING - Momentary failures in slaves or Primary recovering the Profibus DP channel.<br><br>In the case of redundancy operation with no Profibus DP equipment in the network or Profibus DP cables disconnected the behavior is BLINKING. | ON – Failure on Profibus DP cable or on the Profibus DP configuration synchronism<br><br>OFF – Synchronism OK and redundant master in standby<br><br>BLINKING - Primary recovering the Profibus DP channel.<br><br>This LED should always be OFF in the secondary. If it are ON some switchover failure may have occurred. The user must wait for recovery. | Must be OFF.<br><br>Profibus DP communication is disabled in HOLD.     |
| PA-1<br>PA-2          | Green | It indicates Profibus channel activity.   | ON - Indicates that there is at least one slave communicating in the PA channel.<br>OFF - Indicates that there is not communication with any slave.<br>It should always be ON in the case of slaves connected to the channel.  | It must be OFF because on secondary the PA channel is OFF.  | Must be OFF. Profibus PA communication is disabled in HOLD.            |
| STANDBY (STB)         | Green | If the HOLD LED is solid yellow and the STB LED is blinking, the firmware is being updating.<br>If the HOLD LED is off, it indicates the controller role on redundancy as well as the synchronism status. | There are several blinking patterns to indicate different synchronism status. Refer to redundancy section for further details.   | Must be ON.   | BLINKING – Updating the firmware (saving the firmware on flash memory) |

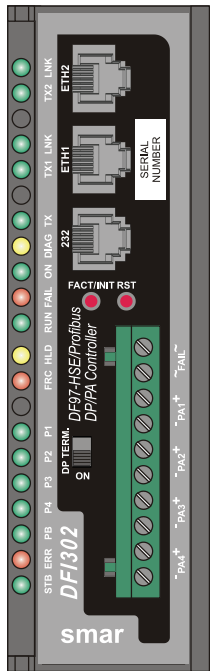
# DF97 Specifications

## Part Number

**DF97** –HSE/Profibus DP Controller with 2 Ethernet 100 Mbps ports, 1 serial port, 4 Profibus PA ports and 1 Profibus DP channel

## Description

DF97 module is the Smar solution for Profibus applications Its main feature is working as Profibus DP-HSE gateway to provide power to the connectivity and flexibility to the system application. It allows wide communication between the Profibus DP and PA field devices. Through the HSE network and other DF1302 modules, it is possible the communication between field devices and other industrial protocols, providing greater flexibility to the control strategy projects. Through the I/O cards, it is also possible to execute discrete control via relay diagram logic (“Ladder Diagram”), allowing a single and integrated system. The module DF97 also can act as Modbus gateway (slave), allowing the interconnection of modules that are not fieldbus or HSE.



**DF97 – Controller module**

Rear Dip Switch

|            | STORAGING | OPERATION |
|------------|-----------|-----------|
| 1 BATTERY  | OFF       | ON        |
| 2          | OFF       | OFF       |
| 3 SIMULATE | OFF       | OFF       |
| 4 WATCHDOG | ON        | ON        |
| 5          | OFF       | OFF       |

DF97

## Characteristics and Module Limits

- One Profibus DP channel supporting up to 12 Mbps;
- Four Profibus PA ports supporting up to 32 devices for channel;
- It supports up to 124 Profibus DP and PA field devices;
- It supports up to 3584 bytes of input and 3584 bytes of output during the data interchange process;
- Limit of 64 external links by the HSE network;
- Maximum of 250 function blocks per DF95;
- One (1) Flexible Function Block (counted into the 250 allowed blocks), with 242 linked parameter to interface between the discrete and continuous control.
- It supports up to 16 HART modules (DF116/DF117).

**NOTE**

The limit of HART modules per controller is 16, but you must remember that when mapping the points through fieldbus function blocks strategy, one transducer block is used for each HART device. In this case, the system may be limited to less than 16 HART modules depending on the maximum number of fieldbus function blocks supported by the controller.

**Continuous Control with Profibus**

DF97 is a complete Profibus HSE controller with capacity to execute function blocks. Through the available **SYSTEM302**, **Studio302** and **Syscon** configuration tools is possible to configure the DF97 totally.

HSE Communication:

- Maximum of 512 link objects;
- Supervision up to 2000 points per second;

**Discrete Control**

DF97 module also has the capability of access I/O cards through the IMB (Inter-Module Bus), present in the backplane where the DF97 is mounted. Through the IMB, up to 16 racks DF1A or DF93 can be interconnected, each one having up to 4 cards.

**DISCRETE CONTROL CHARACTERISTICS**

|  |   |
|--|---|
| I/O Points*  | 1024 discrete points or 512 analog (maximum)                              |
| Ladder Function Blocks   | 2000 blocks (maximum)   |
| Configuration File   | 120 Kbytes (maximum)  |
| Program Execution Cycle for 1000 boolean operations (without redundancy) | 50 ms (minimum)**<br>90 ms (typical)***                                   |
| Program Execution Cycle with redundancy                                  | Increment of 10ms (typical)**** up to 50 ms (maximum) to execution cycle  |
| Execution Average Time   | 5.8 ms/Kbytes of program (minimum)<br>10.5 ms/Kbytes of program (typical) |

\* The whole number of points includes inputs and outputs, analog or digitals. Maximum may change according I/O type used.

\*\* 1131 Flexible Function Block adjusted to One (High Priority). Each 1000 boolean operations allocate 8.6 Kbytes.

\*\*\* Total execution time will change depending on the adjusted priority of 1131 FFB. The adjustment should be compatible with the quantity of function blocks and HSE links.

\*\*\*\* The whole execution time may change depending of the configuration file size.

**NUMBER OF I/O POINTS**

|  |      |
|--|------|
| Number of Profibus devices per network | 125  |
| Number of virtual points               | 4096 |
| Number of Profibus discrete points     | 2048 |
| Number of Profibus analog points       | 512  |

**Firmware version and Device Revision**

Some Firmware Versions may change the Device Revision, so this is an important step to consider during the configuration procedure for the controller. The section “Adding Function Blocks” better describes the steps for this configuration. The current available versions are:

Firmware version 2\_0\_X: Device Revision = 1

Firmware version 3\_0\_X: Device Revision = 2

Firmware version 4\_0\_X: Device Revision = 3

## Technical Specifications

### Memory

| TYPE                    | SIZE     |
|-------------------------|----------|
| Volatile Memory         | 8 Mbytes |
| Non Volatile Memory *   | 4 Mbytes |
| EEPROM                  | 1 Kbytes |
| Flash to the program    | 4 Mbytes |
| Flash to monitor        | 2 Mbytes |
| Flash to EC1 (Profibus) | 4 Mbytes |

### Battery

|                                   |   |
|-----------------------------------|---|
| Type of battery                   | Battery Panasonic BR-2/3AE2SP - Lithium     |
| Capacity                          | 1200 mAh                                    |
| Devices maintained by the battery | RTC and NVRAM                               |
| Minimum life span                 | 8 years (typical charge of 17 $\mu$ A)      |
| Maximum life span                 | 49 years (typical charge of 2.8 $\mu$ A)    |
| Voltage                           | 3 V (subject to revision when below 2.5 V ) |

### Communication Ports and Channels

| ETHERNET PORT  |                   |
|----------------|-------------------|
| Rate           | 10/100 Mbits/s    |
| Standard       | IEEE 802.3u       |
| Isolation      | 150 Vrms          |
| Operation mode | Full-duplex       |
| Connector      | RJ45 with shield* |

\* Grounded to the rail used for fixing the rack in which the DF97 is installed

| DP PROFIBUS CHANNEL |                               |
|---------------------|-------------------------------|
| Rate                | From 9.6 Kbit/s to 12 Mbits/s |
| Standard            | EN 50170 e EN 50254           |
| Physical Layer      | EIA RS-485                    |
| Profibus Modem      | EC1 (Hilscher)                |
| Connector           | M12                           |

| PROFIBUS PA CHANNELS  |                           |
|-----------------------|---------------------------|
| Number of H1 Channels | 2                         |
| Communication Rate    | 31.25 kbps                |
| Standard              | EN 61158 EN 50170         |
| Physical Layer        | ISA-S50.02-1992           |
| MAU Type              | Passive (bus not powered) |
| Isolation             | 500 Vac                   |

| MODBUS PORT        |                  |
|--------------------|------------------|
| Maximum rate*      | 115200 bps       |
| Standard           | EIA-232          |
| Connector**        | RJ12 with shield |
| Maximum Current*** | 0,5A @ 3.3V      |

\*There is an increase in error rate as we increase the communication rate over 19200 bps. In many situations these errors can be acceptable and they are not noticed by supervision.

\*\* Grounded to the rail used for fixing the rack in which the DF97 is installed

\*\*\* Internally protected by solid state fuse.

| REDUNDANCY PORT   |                  |
|-------------------|------------------|
| Maximum rate      | 115200 bps       |
| Standard          | EIA-232          |
| Connector*        | RJ12 with shield |
| Maximum Current** | 0.5A @ 3.3V      |

\* Grounded to the rail used for fixing the rack in which the DF97 is installed

\*\* Internally protected by solid state fuse.

| FAILURE RELAY                               |   |
|---|---|
| Output Type                                 | Solid state relay, normally closed (NC), isolated |
| Maximum voltage                             | 30 Vdc  |
| Maximum Current                             | 200 mA  |
| Overload Protection                         | Does not have. It must be provided externally     |
| Normal Operation                            | Opened contacts                                   |
| Failure Condition                           | Closed contacts                                   |
| Maximum cable length connected to the relay | 30 m  |

Observation: The power supply for the load must not be from an external network (outside the panel).

| IMB BUS            |        |
|--------------------|--------|
| Voltage            | 5 Vdc  |
| Bus                | 8 bits |
| Failure indication | Yes    |
| Hot swap           | Yes    |

### Module Characteristics

| CONTROLLER – MAIN BOARD |  |
|-------------------------|--|
| CPU                     | Family ARM7TDMI                          |
| Bus                     | 32 bits                                  |
| Architecture            | RISC                                     |
| Performance             | 40 MIPS                                  |
| CPU Cache               | 8 Kbytes                                 |
| Clock                   | 40 MHz                                   |
| DMA                     | 10 channels                              |
| Ethernet                | MAC 10/100 integrated                    |
| Watchdog                | Yes (200 ms of cycle)                    |
| Power Supply Voltage    | 3.3 V for I/O and 2.5V for core (552 mW) |

| CONTROLLER – SECONDARY BOARD |   |
|------------------------------|---|
| FPGA                         | Changes CycloneIII  |
| Storage Memory               | 4KB   |
| Processor                    | NiosII  |
| Running Memory               | 1MB   |
| Clock                        | 85 MHz  |
| Operating Voltage            | 3.3 V for I/O, 2.5V for PLL, 1.2V for core and 5V for communication channels. |

| <b>CARD</b>                            |   |
|--|---|
| Power Supply Voltage                   | 5 V ( $\pm$ 5% of tolerance)                    |
| Typical Current                        | 620 mA  |
| Real consumption                       | 2.75 W  |
| Environment Air Temperature            | 0 to 60° C according to the IEC 1131 standard   |
| Storage Temperature                    | -20 to 80° C according to the IEC 1131 standard |
| Relative Humidity of the Operation Air | 5% to 95% non-condensing                        |
| Cooling Mode                           | Air convection                                  |
| Weight                                 | 0.318 kg  |
| Dimensions (H x W x D) in mm           | 149x40x138 (without enclose)                    |

## Indication LEDs

The LED names, colors, descriptions and behaviors are showed in the table below.

| LED               | Color  | Description  | Behavior when Primary   | Function when Secondary                  | Function when in HOLD  |
|-------------------|--------|--|---|--|--|
| ETH LNK 2 (LNK)   | Green  | It indicates when the Ethernet link is active (ETH2 port).   | Solid green LED when the Ethernet link is established (ETH2 port).  | Same function and behavior when Primary. | Same function and behavior when Primary.   |
| ETH TX2 (TX2)     | Green  | It indicates communication activity in the ETH2 port.  | Blinking green LED when the ETH2 port is transmitting data.   | Same function and behavior when Primary. | Same function and behavior when Primary.   |
| ETH LNK 1 (LNK)   | Green  | It indicates when the Ethernet link is active (ETH1 port).   | Solid green LED when the Ethernet link is established (ETH1 port).  | Same function and behavior when Primary. | Same function and behavior when Primary.   |
| ETH TX1 (TX1)     | Green  | It indicates communication activity in the ETH1 port.  | Blinking green LED when the ETH1 port is transmitting data.   | Same function and behavior when Primary. | Same function and behavior when Primary.   |
| 232 TX (TX)       | Green  | It indicates activity in the RS-232.port.  | Blinking green LED when the RS-232 port is transmitting data.   | Same function and behavior when Primary. | Same function and behavior when Primary.   |
| Diagnostic (DIAG) | Yellow | It indicates the operation mode in the RS-232.   | OFF when the RS-232 port is connected to the NetArm processor.<br>Solid yellow when the RS-232 port is connected to the EC1 to execute operations related to the Profibus.  | Same function and behavior when Primary. | Must be ON.<br>ON – Ready for connection to EC1.<br>OFF – Not supported  |
| +5V DC (ON)       | Green  | It indicates when the module is ON.  | Solid green LED when the module is powered.   | Same function and behavior when Primary. | Same function and behavior when Primary.   |
| FAIL (FAIL)       | Red    | It indicates hardware failure.   | Solid red LED when in fail.   | Same function and behavior when Primary. | Same function and behavior when Primary.   |
| RUN (RUN)         | Green  | It indicates when the controller is operating in normal mode.  | Solid green LED when in operation.  | Same function and behavior when Primary. | Must be OFF.<br>It is the inverse value of the HDL LED that indicates function in Monitor mode (maintenance mode of the device).         |
| HOLD (HLD)        | Yellow | It indicates when the controller is in hold mode. In this mode the controller does not perform any application and does not interfere on the plant operation (access via I/O cards or via digital bus are disabled)  | Solid yellow LED when the controller is in hold mode (HOLD).  | Same function and behavior when Primary. | Must be ON.  |
| FORCE (FRC)       | Red    | 1 – It indicates different modes of startup or maintenance requested by the operator via push-buttons (FACT INIT, HOLD and IP Address).<br>2 – It indicates power failure when the operating voltage decays down the expected value of 4.8 V (low line).<br>3 – Indicates a battery problem. | 1 - Depending on the number of times that the right push-button is pressed, the FRC LED blinks at a given rate for a limited time, indicating the chosen mode (refer to Troubleshooting section for further information).<br>2 – Permanently solid red. The module will reset if the voltage reaches 4.6V. (HLD and FAIL LEDs light up together temporarily).<br>3 –FRC LED blinking and HLD LED solid red during the module start up – indicates low | Same function and behavior when Primary. | Hardware failure or power failure indication<br>ON – Failure of power supply or hardware<br>OFF – Power Ok.<br>BLINKING – Mode selection |

| LED                          | Color | Description  | Behavior when Primary   | Function when Secondary  | Function when in HOLD   |
|------------------------------|-------|--|---|--|---|
|                              |       |  | battery or the battery rear DIP switch is turned off (refer to Troubleshooting section for further information)   |  |   |
| Profibus Network (PB)        | Green | It indicates Profibus channel activity.  | <p>ON – Profibus DP communication enabled</p> <p>OFF – Profibus DP communication disabled, communication (transmission) failure, short circuit on Profibus DP channel</p> <p>BLINKING – Multimaster mode operation</p>  | Same function and behavior when Primary.   | Must be OFF. Profibus DP communication is disabled in HOLD.               |
| Profibus Error (ERR)         | Red   | It indicates it there is an error related to the Profibus network.   | <p>ON - At least one slave device in this configuration is not communicating properly.</p> <p>OFF - All slave devices present in the configuration are communicating properly.</p> <p>BLINKING - Momentary failures in slaves or Primary recovering the Profibus DP channel.</p> <p>In the case of redundancy operation with no Profibus DP equipment in the network or Profibus DP cables disconnected the behavior is BLINKING.</p> | <p>ON – Failure on Profibus DP cable or on the Profibus DP configuration synchronism</p> <p>OFF – Synchronism OK and redundant master in standby</p> <p>BLINKING - Primary recovering the Profibus DP channel.</p> <p>This LED should always be OFF in the secondary. If it are ON some switchover failure may have occurred. The user must wait for recovery.</p> | <p>Must be OFF.</p> <p>Profibus DP communication is disabled in HOLD.</p> |
| PA-1<br>PA-2<br>PA-3<br>PA-4 | Green | It indicates Profibus channel activity.  | <p>ON - Indicates that there is at least one slave communicating in the PA channel.</p> <p>OFF - Indicates that there is not communication with any slave.</p> <p>It should always be ON in the case of slaves connected to the channel.</p>  | It must be OFF because on secondary the PA channel is OFF.   | Must be OFF. Profibus PA communication is disabled in HOLD.               |
| STANDBY (STB)                | Green | <p>If the HOLD LED is solid yellow and the STB LED is blinking, the firmware is being updating.</p> <p>If the HOLD LED is off, it indicates the controller role on redundancy as well as the synchronism status.</p> | <p>There are several blinking patterns to indicate different synchronism status. Refer to redundancy section for further details.</p>   | Must be ON.  | BLINKING – Updating the firmware (saving the firmware on flash memory)    |



## DF100 Specifications

**DF100** – HSE/*WirelessHART*™ Controller with 2 Ethernet 100 Mbps ports, 1 RS-485 port, and 1 *WirelessHART* channel

### Description

The DF100 controller is a key element in the distributed architecture of the field control systems. Combines powerful communication features with access to field devices via *WirelessHART*™ protocol.

This controller has features entirely new when compared with the DFI302 modular line. The DF100 can be used in outdoors, because it has ingress protection IP66. In addition, it makes possible to work with the new specification HSE WIO of Fieldbus Foundation, and Modbus communication via RS-485 port.

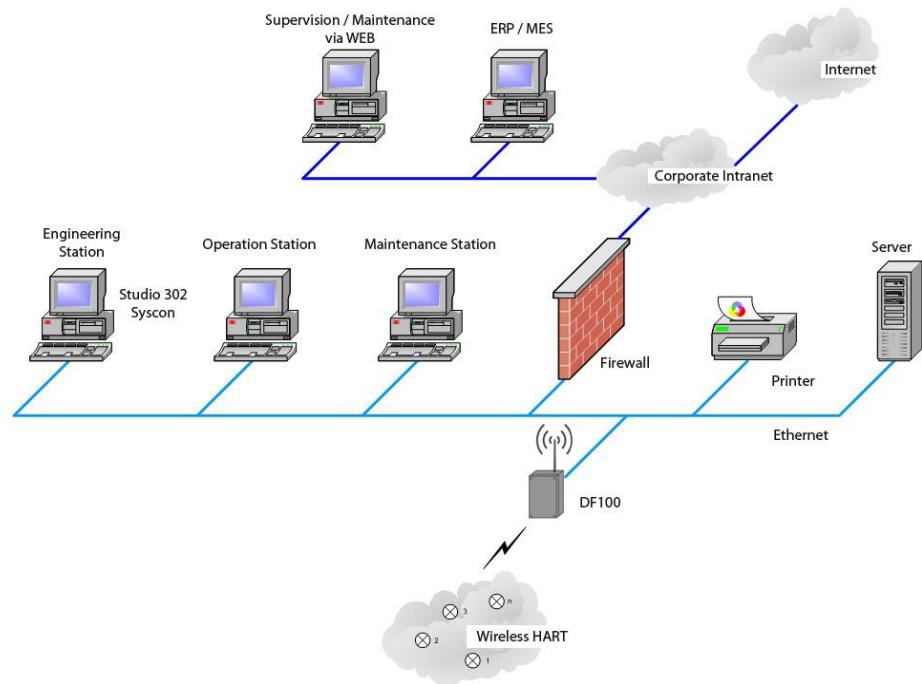


**DF100 – WirelessHART/HSE controller**

The adoption of wireless technology in the industry is a strategic decision to significantly reduce costs related to cabling, trays, and technical/engineering hours spent on maintaining the network.

A standardized wireless network infrastructure at this stage of the project meets the emerging standard *WirelessHART*™ and eliminates the costs and risks associated with the acquisition of proprietary wireless networks and instrumentation of a single supplier.

The project basic topology is shown in the following figure. It has two control network segments interconnected to corporate networks. On the control network is added the DF100 controller. Finally, supervision and control stations complete the interconnection system.



**Wireless architecture for the control network**

Tools such as **Syscon** and **Studio302** are related to the architecture to integrate the controller and the wireless network to others industrial automation protocols.

## General characteristics and limits

The following characteristics are in all issues of DF100.

- 1 *WirelessHART™* channel (HART 7 specification of HART Communication Foundation);
- 2 10/100 Mbps Ethernet ports;
- 1 RS-485 port (for Modbus communication)
- It integrates up to 100 *WirelessHART* devices<sup>1</sup>;
- Modbus gateway;
- Integrated webservice;
- Real Time Clock (RTC) and watchdog;
- Support for HSE WIO of Fieldbus Foundation architecture;
- Ingress protection IP66 (supports outdoor);
- Operation temperature: -40 °C to 60 °C;
- Operation voltage: 20Vdc to 30Vdc, 11W maximum.

## Continuous Control with FOUNDATION™ Fieldbus

The DF100 module is a HSE device, with block execution capability. Through configuration tools available in the **SYSTEM302**, such as the **Studio302** and **Syscon**, it is possible to configure the DF100 completely.

### HSE Communication

- Maximum of 300 link objects;
- Limit of 128 linked parameters
- Dynamic block instantiation. Maximum of 170 function blocks;

### HSE WIO Function Blocks and Transducers

The DF100 is in compliance with the new requirements of FOUNDATION fieldbus remote I/O based on

<sup>1</sup> The maximum number of *WirelessHART* devices may be less depending on the update rate desired.

High Speed Ethernet (HSE) and the integration of HART field devices through the *WirelessHART*.

These requirements allow that the industrial automation suppliers develop Wireless and Remote I/O (WIO) gateways running in a wireless HSE backhaul. The new HSE WIO function blocks and transducers that meet those requirements are listed below:

| MNEMONIC | DESCRIPTION                              |
|----------|--|
| TBHG     | Transducer Block for HART Gateway        |
| TBWH     | Transducer Block for <i>WirelessHART</i> |
| WAI      | WIO Analog Input                         |
| MAI16    | Multiple Analog Input 16                 |

### Firmware version and Device Revision

Some firmware versions may change the Device Revision, so this is an important step to consider during the configuration procedure for the controller. The section “Adding Function Blocks” better describes the steps for this configuration. The current available version is:

Firmware version 2.x: Device Revision = 2

### Technical Specifications

#### Memory

| TYPE                  | SIZE     |
|-----------------------|----------|
| Volatile Memory       | 8 Mbytes |
| Non Volatile Memory * | 4 Mbytes |
| EEPROM                | 1 Kbytes |
| Flash to the program  | 4 Mbytes |
| Flash to monitor      | 2 Mbytes |

\* It is maintained by the primary internal battery (not rechargeable)

#### Battery

|                                   |   |
|-----------------------------------|---|
| Type of battery                   | Battery Panasonic BR-2/3AE2SP - Lithium     |
| Capacity                          | 1200 mAh                                    |
| Devices maintained by the battery | RTC and NVRAM                               |
| Lifespan                          | More than 10 years*                         |
| Voltage                           | 3 V (subject to revision when below 2.5 V ) |

\* The battery switch (DIP Switch W1, position 1 on the CPU board) has to be turned off (position OFF) when the module is powered down and is getting out of operation for long periods of time, not being necessary to maintain the configuration data (data from volatile memory and RTC are lost, but can be reloaded later).

If you need powering down the module for short periods of time without losing the configuration, the switch (W1, position 1) of the battery must not be turned off. In this case, the battery can keep data for more than 10 years at 25 °C, or at least 2.6 years in the worst temperature conditions.

#### Communication Ports and Channels

| ETHERNET PORT      |                   |
|--------------------|-------------------|
| Communication Rate | 10/100 Mbps       |
| Standard           | IEEE 802.3u       |
| Isolation          | 150 Vrms          |
| Operation Mode     | Full-duplex       |
| Connector          | RJ45 with shield* |

| MODBUS PORT                  |                                  |
|------------------------------|----------------------------------|
| Communication Rate (Maximum) | 19200 bps                        |
| Standard                     | EIA-485                          |
| Connector                    | Male, 3-pin, quick coupling type |

| WIRELESSHART PORT   |                     |
|---------------------|---------------------|
| Operation Frequency | 2.4 – 2.4835 GHz    |
| Standard            | 802.15.4 (DSSS)     |
| Number of channels  | 16 (IEEE 802.15.4)* |

\* You can make unavailable one or more channels as required by the regulatory agency of the country where it is installed.

| FAILURE RELAY   |   |
|---|---|
| Output Type   | Solid state relay, normally closed (NC), isolated |
| Maximum Voltage                                       | 30 Vdc  |
| Maximum Current                                       | 200 mA  |
| Overload Protection                                   | Not available. It must be provided externally     |
| Normal Operation                                      | Opened contacts                                   |
| Failure Condition                                     | Closed contacts                                   |
| Maximum cable length (maximum) connected to the relay | 30 m  |

The power supply for the load must not be from an external network (outside the panel).

### Module Characteristics

| PROCESSOR         |                       |
|-------------------|-----------------------|
| CPU               | Family ARM7TDMI       |
| Bus               | 32 bits               |
| Architecture      | RISC                  |
| Performance       | 40 MIPS               |
| CPU Cache         | 8 Kbytes              |
| Clock             | 40 MHz                |
| DMA               | 10 channels           |
| Ethernet          | MAC 10/100 integrated |
| Watchdog          | Yes (1.6 s of cycle)  |
| Operation Voltage | 3.3 V for I/O         |

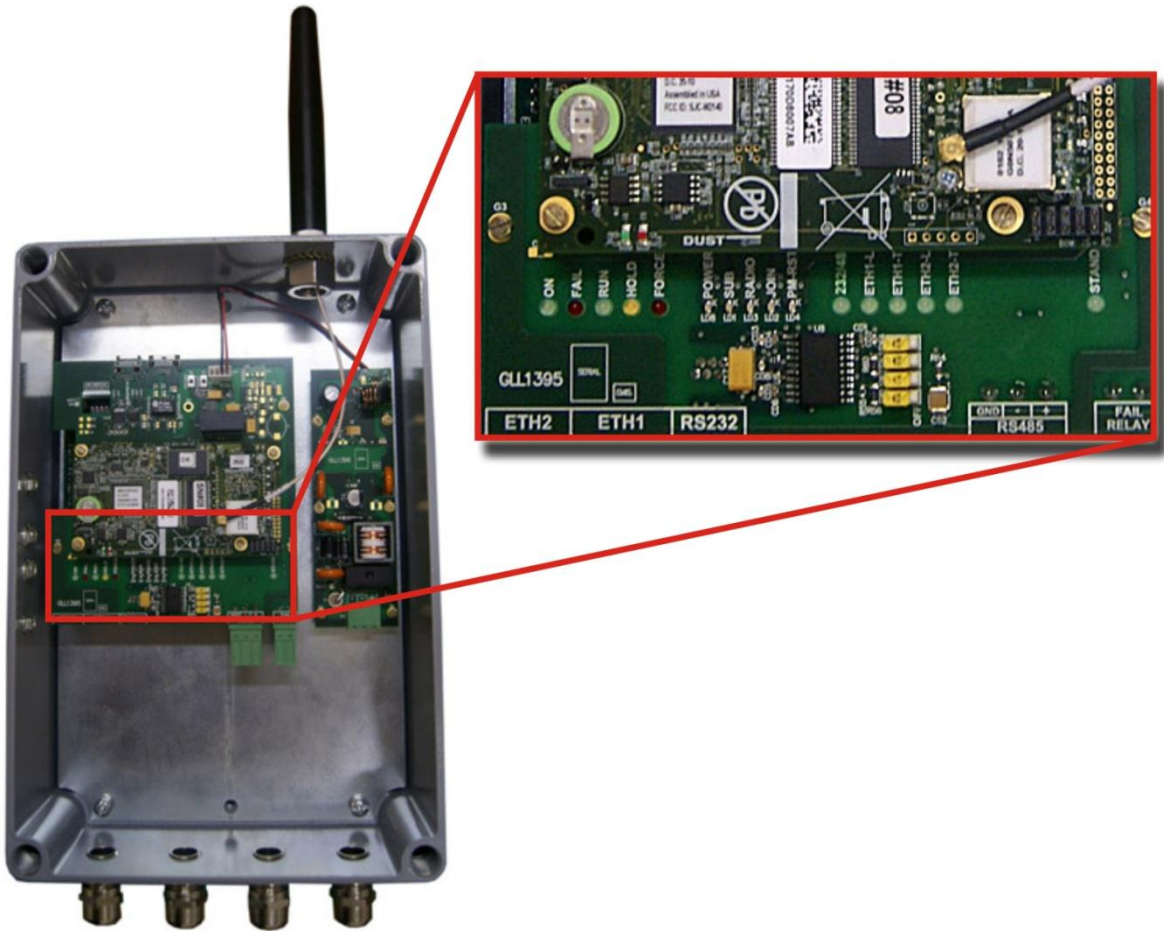
| DF100 CONTROLLER                  |   |
|-----------------------------------|---|
| Operation Voltage                 | 20 Vdc to 30 Vdc                        |
| Typical Current                   | 444 mA (average); 600 mA (peak) @ 18Vdc |
| Real Consumption                  | 8 W (average), 11 W (peak)              |
| Environment Air Temperature       | -40 to 60 °C                            |
| Storage Temperature               | -40 to 60 °C                            |
| Relative Air Humidity (Operation) | 10% - 90% (non-condensing)              |
| Cooling Mode                      | Air Convection                          |
| Dimensions (H x W x D) in mm      | 300 x 200 x 120 (without package)       |

## Indication LEDs

The LED names, colors, descriptions and behaviors are showed in the table below.

| LED         | COLOR  | DESCRIPTION   | BEHAVIOR   |
|-------------|--------|---|--|
| +5Vdc (ON)  | Green  | It indicates when the module is ON.   | Solid green LED when power is on.  |
| FAIL (FAIL) | Red    | It indicates hardware failure.  | Solid red LED when in fail.  |
| RUN (RUN)   | Green  | It indicates when the controller is operating in normal mode.   | Solid green LED in operation.  |
| HOLD (HLD)  | Yellow | It indicates when the controller is in hold mode. In this mode the controller does not perform any application and does not interfere on the plant operation (access via I/O cards or via digital bus are disabled)   | Solid yellow LED when the controller is in hold mode (HOLD).   |
| FORCE (FRC) | Red    | <p>1 – It indicates different modes of startup or maintenance requested by the operator via push-buttons (FACT INIT, HOLD and IP Address).</p> <p>2 – It indicates power failure when the operating voltage decays down the expected value of 4.8 V (low line).</p> <p>3 – Indicates a battery problem.</p> | <p>1 - Depending on the number of times that the right push-button is pressed, the FRC LED blinks at a given rate for a limited time, indicating the chosen mode (refer to Troubleshooting section for further information).</p> <p>2 – Permanently solid red. The module will reset if the voltage reaches 4.6V. (HLD and FAIL LEDs light up together temporarily).</p> <p>3 –FRC LED blinking and HLD LED solid red during the module start up – indicates low battery or the battery rear DIP switch is turned off (refer to Troubleshooting section for further information)</p> |
| 232/485 TX  | Green  | It indicates activity in the RS-485 port.   | Blinking green LED when the RS-485 port is transmitting data.  |
| ETH1 LNK    | Green  | It indicates when the Ethernet link is active (ETH1 port).  | Solid green LED when the Ethernet link is established (ETH1 port).   |
| ETH1 TX     | Green  | It indicates communication activity in the ETH1 port  | Blinking green LED when the ETH1 port is transmitting data.  |
| ETH2 LNK    | Green  | It indicates when the Ethernet link is active (ETH2 port).  | Solid green LED when the Ethernet link is established (ETH2 port).   |
| ETH2 TX     | Green  | It indicates communication activity in the ETH2 port.   | Blinking green LED when the ETH2 port is transmitting data.  |
| STANDBY     | Green  | It indicates if module is operating as Primary Master or if the firmware is being updating.   | Solid green LED when the controller is active and it is the Primary.   |

The indication LEDs above mentioned can be viewed through the DF100 interface board, after opening the front cover. See the following figure.



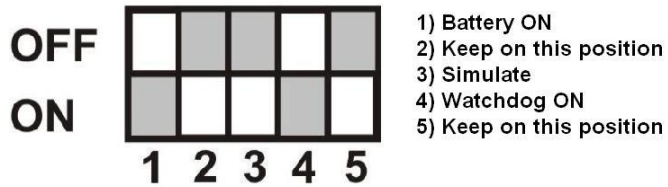
Detail of the indication LEDs in the DF100 interface board

**LEDS related to *WirelessHART* Manager**

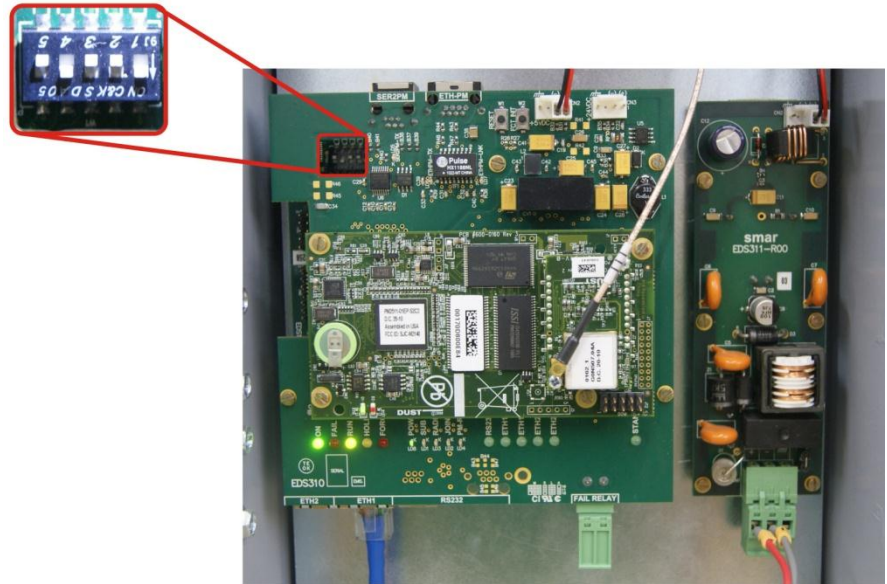
| LED                | COLOR  | DESCRIPTION   | BEHAVIOR   |
|--------------------|--------|---|--|
| Power              | Green  | It indicates when the <i>WirelessHART</i> Manager is ON.  | Solid green LED when the <i>WirelessHART</i> Manager is powered.                             |
| Subscription (SUB) | Yellow | It indicates that a client program is connected to the <i>WirelessHART</i> Manager and it is ready to receive notifications of data, alarms and events. | Solid yellow LED when a client receives a notification from the <i>WirelessHART</i> Manager. |
| Radio              | Yellow | It indicates activity on the <i>WirelessHART</i> radio.   | Blinking yellow LED when there is communication activity.                                    |
| JOIN               | Yellow | Indicates when the <i>WirelessHART</i> Manager has a <i>WirelessHART</i> field instrument in the process of addition (joining) to the network           | Blinking yellow LED when an instrument is in joining process.                                |
| PM-RST             | Red    | Indicates that the DF100 controller restarted the <i>WirelessHART</i> Manager and it is out of service.   | Solid red LED while the <i>WirelessHART</i> Manager is out of service.                       |

**Hardware configuration**

**DIP Switch W1:** To the DF100 operation, turn on the switches 1 (Battery on) and 4 (Watchdog on), keeping them in ON as in the following figure.



The **DIP Switch W1** is installed on the CPU board; it can be accessed via DF100 interface board.



**RS-485 Switches:** the switches **SW1**, **SW2**, **SW3** and **SW4** are specific to Modbus communication operation via RS-485 port. The RS-485 switches are installed on the DF100 interface board, next to the RS-485 connector.

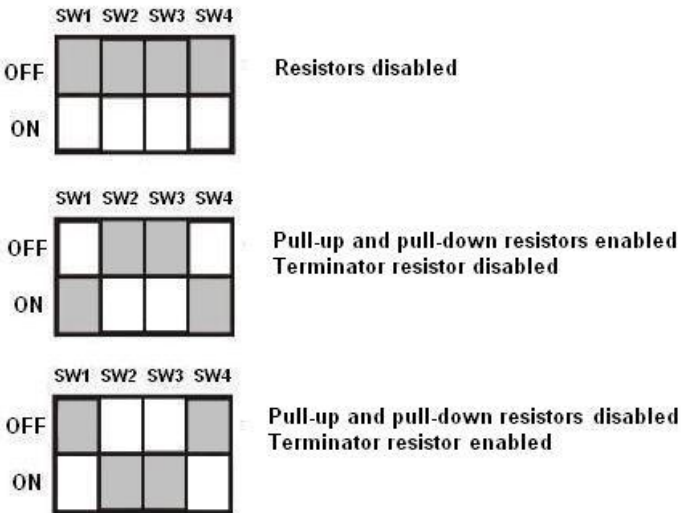
The **SW1** switch can be used to enable the pull-up resistor. When enabled (ON position), this switch connects the pull-up resistor to the **TX+** line (pin + of the RS-485 connector) of the RS-485 bus. On the other hand, the **SW4** switch controls the pull-down resistor enabling. When it is enabled (ON position), connects the pull-down resistor to the line **RX-** (pin – of the RS-485 connector) of the RS-485 bus. We recommend the use of these resistors to prevent noisy signals is interpreted as having valid data on a bus without communication.



**ATTENTION**

Just a single set of pull-up and pull-down resistors can be enabled in the RS-485 bus.

The **SW2** and **SW3** switches can be used (simultaneously) to enable the terminator resistor of the DF100. A terminator resistor has the function to avoid signal reflections on the RS-485 bus. The RS-485 bus usually uses a terminator resistor at each end of the bus. It is recommended to enable the terminator for high rates of communication and use of long cables to cover long distances between devices connected to the RS-485 bus.



SW1) Pull-up resistor  
SW2) Terminator  
SW3) Terminator  
SW4) Pull-down resistor

Refer to the Modbus Network section, item Bus Terminators and Stub lengths of the **SYSTEM302** Electric Installation Guide for further information.





## CABLE SPECIFICATIONS

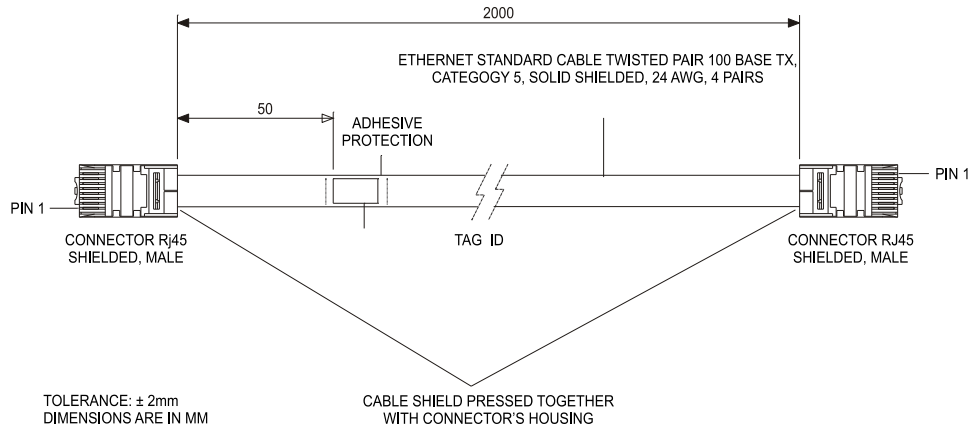
### Ethernet Cable Specifications

To assembly a new Ethernet cable, the user should follow the specifications of the twisted cable pair, according to the part number DF54 or DF55.

#### DF54/DF55

**DF54- Standard cable. To be used in network communication between controllers and Switch/HUB.**

**DF55- Cross cable. To be used in a point-to-point communication between PC and controller.**



CABLE CONNECTION DIAGRAM

#### DF54

|   |              |   |
|---|--------------|---|
| 1 | WHITE GREEN  | 1 |
| 2 | GREEN        | 2 |
| 3 | WHITE ORANGE | 3 |
| 4 | BLUE         | 4 |
| 5 | WHITE BLUE   | 5 |
| 6 | ORANGE       | 6 |
| 7 | WHITE BROWN  | 7 |
| 8 | BROWN        | 8 |

#### DF55 CROSS

|   |              |   |
|---|--------------|---|
| 1 | WHITE GREEN  | 3 |
| 2 | GREEN        | 6 |
| 3 | WHITE ORANGE | 1 |
| 4 | BLUE         | 4 |
| 5 | WHITE BLUE   | 5 |
| 6 | ORANGE       | 2 |
| 7 | WHITE BROWN  | 7 |
| 8 | BROWN        | 8 |

OBS: COLORS ARE MERELY A SUGGESTION.  
IS IMPORTANT TO OBEY THE COLORS PAIRS AS THE CABLE CONNECTION DIAGRAM.

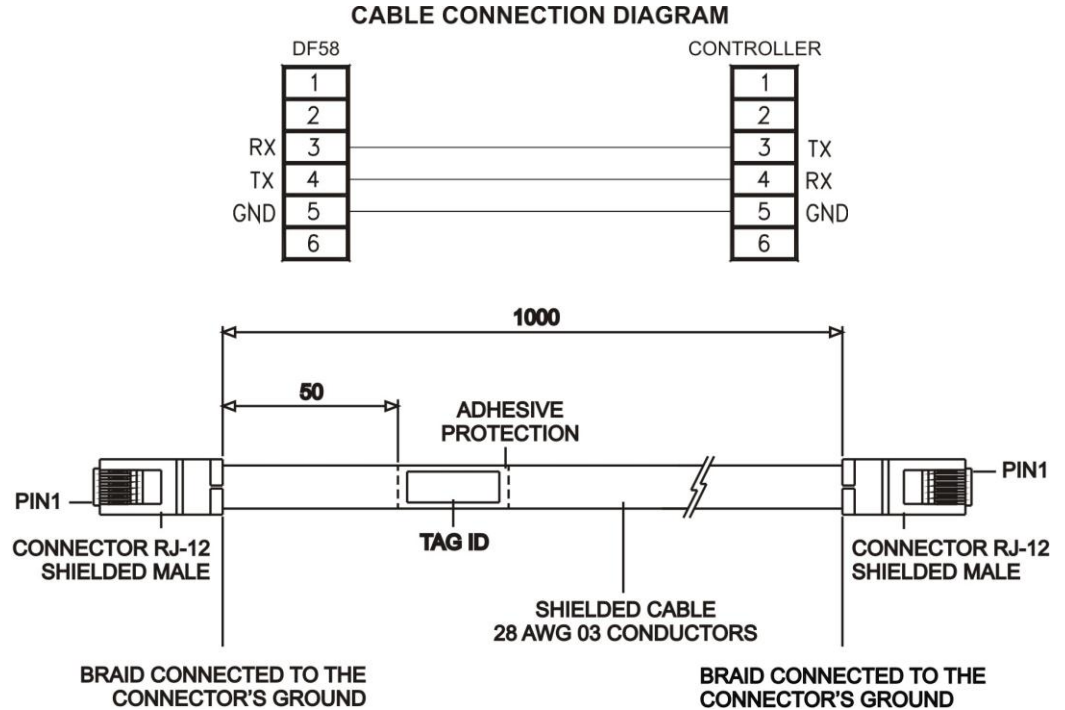
The DF54 cable has the following length options:

| PRODUCT          | CLASS | OPTION                                |
|------------------|-------|---------------------------------------|
| <b>DF54</b>      |       | <b>TWISTED PAIR CABLE 100 BASE TX</b> |
| 1 – CABLE LENGTH | 1     | 0.5 m                                 |
|                  | 2     | 2 m                                   |
|                  | 3     | 3 m                                   |
|                  | 4     | 5 m                                   |
|                  | 5     | 10 m                                  |

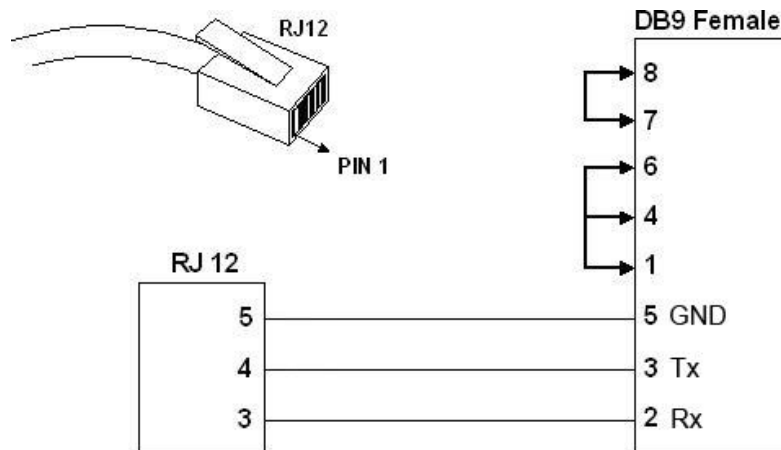
## Serial Cable Specifications

### DF59

To assembly a serial cable between **controller and DF58 (RS232/RS485 Interface)**, the user has to follow the specifications of the part number **DF59**.



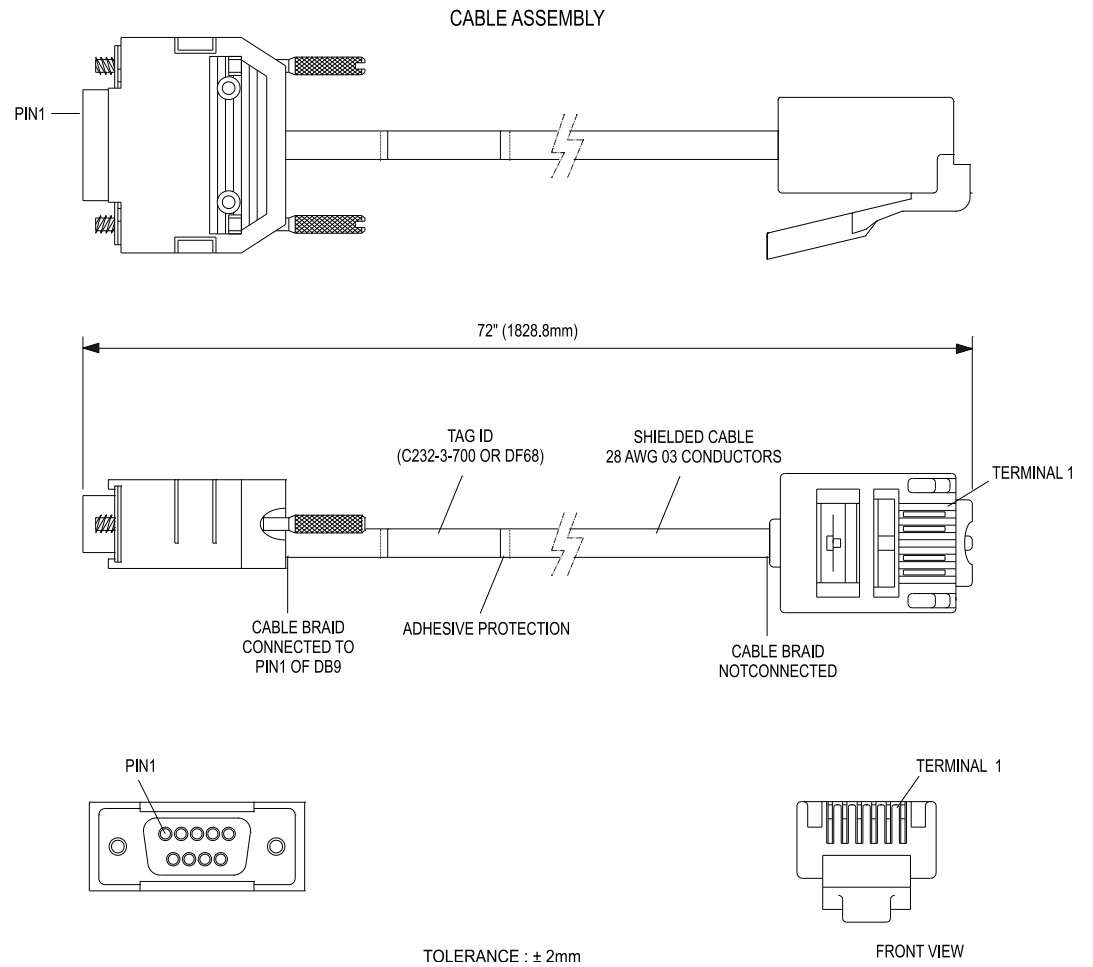
To assembly a serial cable between **controller and computer**, or between **DF58 (interface) and computer** see the following instructions that show a connection between RJ12 (used in the controller and DF58) and a female-DB9 connector (used in the computer):



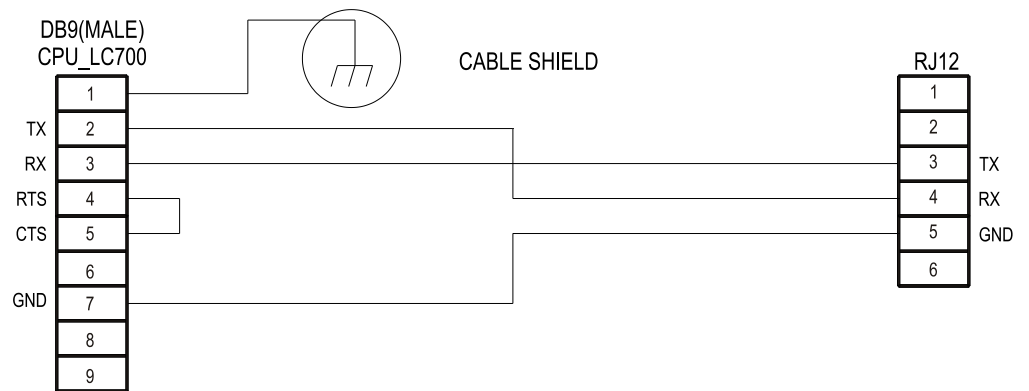
The jumpers under DB9 side are recommended but not necessary. It depends on the application running in the computer.

## DF68

To assembly a serial cable between **DF51 controller** and **DF65 coprocessor**, the user should follow the specifications of the part number DF68.

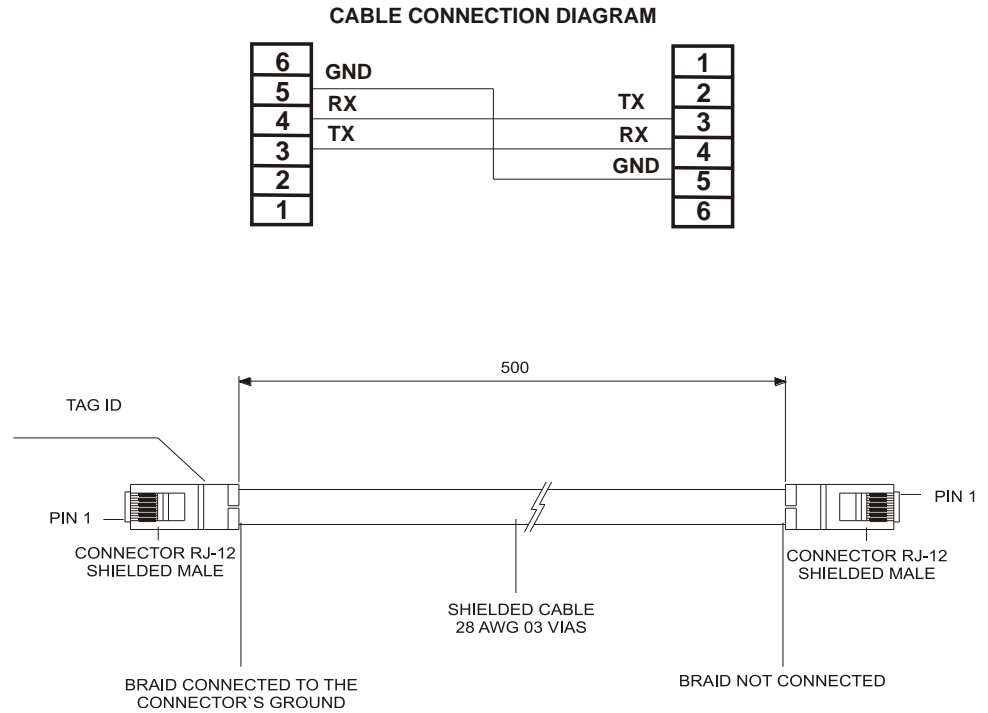


### CABLE CONNECTION DIAGRAM



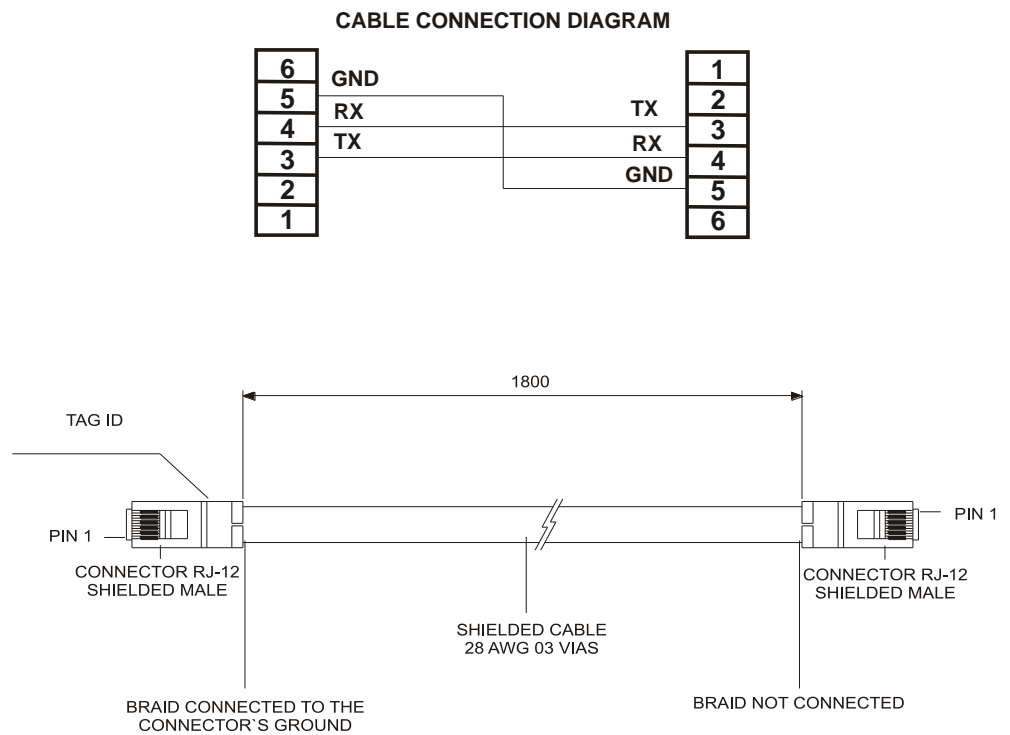
## DF82

DF82 cable interconnects redundant controllers. The figure below shows the cable connection diagram.



## DF83

DF83 cable interconnects redundant controllers. The figure below shows the cable connection diagram.



## Cables for Racks Interconnection and Power Distribution

Depending on the rack model different types of cables are necessary to interconnect racks and for power distribution throughout the IMB bus. In the following table are the available cable types.

| Code                                 | Description  |
|--------------------------------------|--|
| <b>System based on DF1A and DF78</b> |  |
| DF3                                  | DFI302 flat cable to connect two racks – length 6.5 cm             |
| DF4A                                 | DFI302 flat cable to connect two racks – length 65 cm              |
| DF5A                                 | DFI302 flat cable to connect two racks – length 81.5 cm            |
| DF6A                                 | DFI302 flat cable to connect two racks – length 98 cm              |
| DF7A                                 | DFI302 flat cable to connect two racks – length 110 cm             |
| <b>System based on DF92 and DF93</b> |  |
| DF90                                 | IMB power cable  |
| DF101                                | Shielded flat cable to connect racks by left side – length 70 cm   |
| DF102                                | Shielded flat cable to connect racks by right side – length 65 cm  |
| DF103                                | Shielded flat cable to connect racks by right side – length 81 cm  |
| DF104                                | Shielded flat cable to connect racks by right side – length 98 cm  |
| DF105                                | Shielded flat cable to connect racks by right side – length 115 cm |

For further details about the correct cable installation, please, refer to Installing section.

### Expansion flat cables for systems based on DF92 and DF93

These flat cables are used when the DFI302 is expanded in more than one row of racks (DF92 or DF93), i.e., in different DIN rail segments, one below the other. To ground the flat cables' shield, use ground terminals next to the connections among flat cables and racks.

- **DF101 - Flat cable to connect racks by left side**

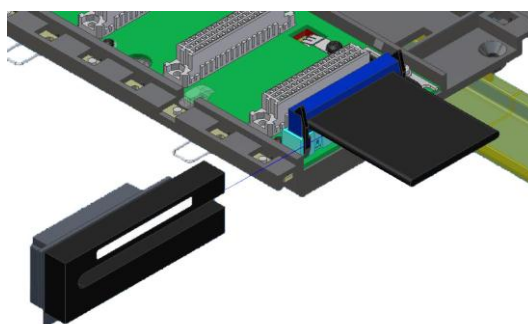
The DF101 is installed on the rear connectors of the left extremity rack of each row of racks, interconnecting the rows 2-3, 4-5 and 6-7 (if they exist). The available terminal next to each DF91 can be used for grounding. See the Installing section.

- **DF102, DF103, DF104 and DF105 - Flat cable to connect racks by right side**

They are installed on the upper connectors of the right extremity rack of each row of racks, interconnecting the rows 1-2, 3-4 and 5-6 (if they exist). See the Installing section.

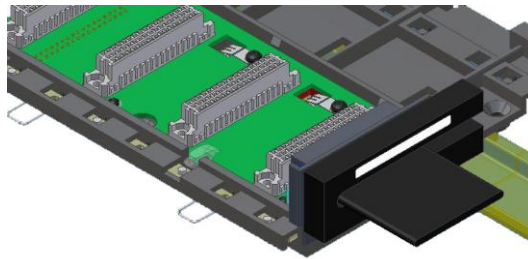
### Flat cables protector (connector cap)

To meet the EMC requirements an ESD protector has to be installed on the flat cables connection, at right. In the following figure a flat cable protector is shown when it is being installed on the cable connector.



*Installing the flat cables protector*

The following figure shows the flat cable protector installed.



*Flat cable protector installed*

### **DF90 cable**

The power expansion has to be used when the DFI302 is expanded in more than one row of racks, i.e., in different DIN rail segments, one below the other. The DF90 is the IMB power transmission cable. Its features provide low voltage drop and protection against electromagnetic interference.

The cable DF90 must be connected only through DF91. It cannot be directly installed in the racks, because it can damage the racks. For further details, see the Installing section.



*IMB power cable (DF90)*

# Section 13

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## ADDING POWER SUPPLIES

### Introduction

There are some recommendations when adding power supply modules to the system which should be considered.

First of all, an overview of the whole system is necessary at this time to better choose the modules (power supply, impedance etc). Each controller module needs at least one power supply for backplane. The addition of I/Os modules requires new calculations to the power supply.

#### NOTE

Using ladder logic (FFB 1131), for a better monitoring of the functional state of each used I/O module is recommended to use the **STATUS** block in the logic. Thus the system can be advised if some I/O module have a failure. So that is easier to find a damaged module. Insert and configure this block according to the **LogicView for FFB** manual.

The following table shows the available modules used as power supply, intrinsic safety barrier and fieldbus impedances.

| MODEL   | DESCRIPTION   |
|---------|---|
| DF50    | Power Supply for Backplane 90-264 Vac                                 |
| DF56    | Power Supply for Backplane 20-30 Vdc                                  |
| DF52    | Power Supply for Fieldbus 90-264 Vac                                  |
| DF60    | Power Supply for Fieldbus 20-30 Vdc                                   |
| DF53    | Power Supply Impedance for Fieldbus (4 ports)                         |
| DF47-12 | Intrinsic Safety Barrier for Fieldbus                                 |
| DF47-17 |   |
| DF87    | Power Supply for Backplane 20-30 Vdc, 5 A, redundant, with diagnostic |
| DF98    | High Current Power Supply Impedance for Fieldbus                      |



## DF50 – Power Supply Module for Backplane (Redundant)

### Description

This redundant power supply works independently or together with another redundant power supply module to ensure a constant supply of power to the application.

When two redundant power supplies are used, if one of them fails, the backup will automatically assume the operation. A relay is provided to indicate failure on each power supply giving the user a chance to replace the faulty one.

This module provides two voltage outputs:

- a) **5 Vdc @ 3 A:** distributed by Power Lines in the Inter-Module-Bus (IMB) throughout the racks to supply the module circuits;
- b) **24 Vdc @ 300 mA:** for external use through the terminals 1B and 2B.

The applied AC voltage, the 5 Vdc and the 24 Vdc are all isolated between them.

### Installation and Configuration

For systems based on DF92 and DF93 rack, with DF90 and DF91

#### Redundant mode options

- **Splitting Power concept:** In this situation, two modules will supply power to a bus segment. If one of them was turned off or fails, the other power supply must be able to supply energy, alone, to the segment.  
The **CH1** jumper (power supply) must be set in **R** position for both modules and **W1** jumper (power supply) must be opened for both modules.
- **Standby concept:** In this case, just one power supply provides energy to the system. If it was turned off or fails, the backup module will assume the operation. In both modules, the jumper **CH1** (power supply) must be set in the **R** position and **W1** jumper (power supply) must be placed only in the backup module.

#### Expansion of load capacity by adding power supplies or pairs of redundant power supplies

If the system consumption is greater than 3A, it can be subdivided in up to 8 groups sized for consumption of up to 3A each, and each group is individually powered by a power supply, or redundant pair of power supplies. More details on the Power supplies positioning topic.

#### Power supplies positions in the racks

On **DF92**, the pair of redundant power supplies must be installed in the first and second slots.

On **DF93** is recommended the placement of the redundant pair in the first and second slots, but it can be installed in any slots if necessary.

#### Configuration of “W1” and “CH1” jumpers

The **DF50 CH1** jumper always must be connected to the **R** position. The **W1** jumper (power supply) must be connected only in the **DF50** modules configured as “backup”, in the standby concept, as above mentioned in the redundant mode options.

#### For systems based on DF1A and DF78 racks

**Non-redundant (single module):** power consumption **limited** to 3A:

There is an addressing restriction related to the power supply location. The restriction is that the first rack (address 0) must always contain a power supply module at the first slot. In the power supply module the **CH1** jumper must be set in **E** position.

**Non-redundant (more than one module):** power consumption **bigger** than 3A:

Additional modules are placed in the bus in parallel, but isolated one of the other. For systems based on **DF1A rack**, the power supplies modules must always be placed at the first rack’s slot. The jumper **W1** (in the rack), where is the new power supply module, must be cut. The new power supply module will only supply power to the rack where it is sitting on and to the consecutive ones (never backwards).

In all power supplies modules, the **CH1** jumper must be set in **E** position.

**Redundant mode**

- **Splitting Power concept:** In this case of redundancy, the user may have two power supplies modules in parallel in first and third slots of rack **DF1A** or in the first and second slots of rack **DF78**. The **CH1** jumper (power supply) must be set in **R** position for both modules and **W1** jumper (power supply) must be opened for both modules. In this situation, the two modules will supply power to the bus.
- **Standby concept:** In this case, the main module must be placed in the first slot and the backup module in the third slot of rack **DF1A** or in the first and second slots of rack **DF78**. In both modules, the **CH1** jumper (power supply) must be set in the position **R** and **W1** jumper (power supply) must be placed only in the backup module.

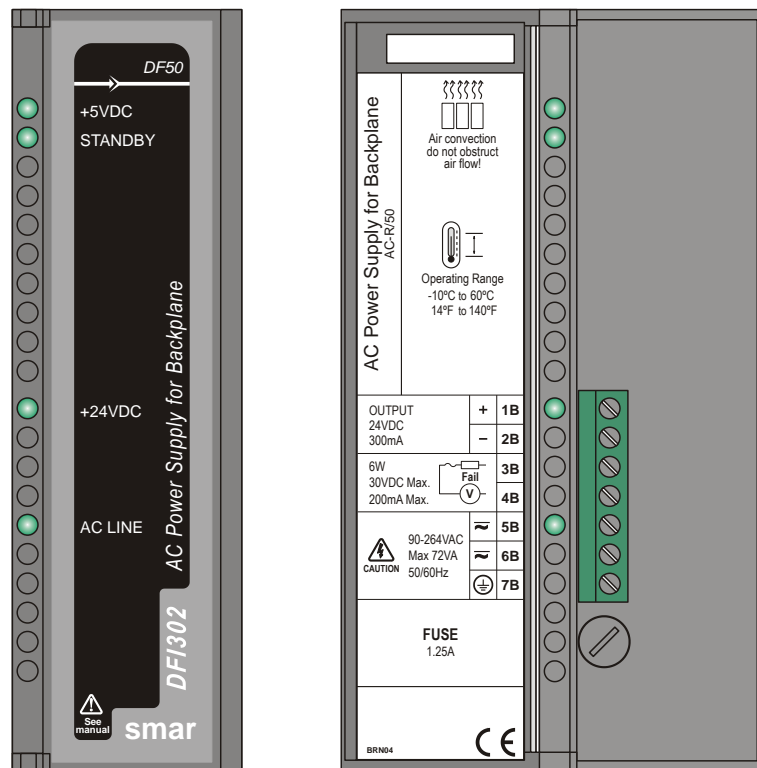


Figure 13.1 - AC Power Supply Module: DF50

**Technical Specifications**

| INPUTS                |  |
|-----------------------|--|
| DC                    | 127 to 135 Vdc   |
| AC                    | 90 to 264 VAC, 50/60 Hz (nominal), 47 to 63 Hz (range) |
| Inrush Current        | < 36 A @ 220 Vac [ $\Delta T < 740 \mu s$ ]            |
| Time until Power Fail | 6 ms @ 102 Vac (120 Vac – 15%) [Full Load]             |
| Time until Shutdown   | 27 ms @ 102 Vac; > 200ms @ 220 Vac [Full Load]         |
| Maximum consumption   | 72 VA  |
| Indicator             | AC LINE (Green LED)                                    |

| OUTPUTS                    |                               |
|----------------------------|-------------------------------|
| a) Output 1 (internal use) | 5.2 Vdc +/- 2%                |
| Current                    | 3 A Maximum                   |
| Ripple:                    | 100 mVpp Maximum              |
| Indicator                  | +5 Vdc (Green LED)            |
| Hold up Time               | > 40 ms @ 120 Vac [Full Load] |
| b) Output 2 (external use) | 24 Vdc +/- 10%                |
| Current                    | 300 mA Maximum                |
| Ripple                     | 200 mVpp Maximum              |
| Short Circuit Current      | 700 mA                        |
| Indicator                  | +24Vdc (Green LED)            |

| ISOLATION   |           |
|---|-----------|
| Input signal, internal outputs and the external output are isolated among them. |           |
| Between the outputs and the ground  | 1000 Vrms |
| Between the input and output  | 2500 Vrms |

| FAILURE RELAY                      |   |
|------------------------------------|---|
| Type of Output                     | Solid state relay, normally closed (NC), isolated |
| Limits                             | 6 W, 30 Vdc Max, 200 mA Max                       |
| Maximum Initial Contact Resistance | <13Ω  |
| Overload Protection                | Should be provided externally                     |
| Operation Time                     | 5 ms maximum                                      |

| TEMPERATURE |                                   |
|-------------|-----------------------------------|
| Operation   | -10 °C to 60 °C (14 °F to 140 °F) |

| DIMENSIONS AND WEIGHT  |   |
|------------------------|---|
| Dimensions (W x H x D) | 39.9 x 137.0 x 141.5 mm;<br>(1.57 x 5.39 x 5.57 in) |
| Weight                 | 0.450 kg  |

| CABLES    |                               |
|-----------|-------------------------------|
| One wire  | 14 AWG (2 mm <sup>2</sup> )   |
| Two wires | 20 AWG (0.5 mm <sup>2</sup> ) |

| NOTES |   |
|-------|---|
| 1)    | If the power consumption exceeds the power supplied, the DFI302 system may operate in an unpredictable manner that may causes damages to the equipment or risk of personal injury. Hence, the power consumption must be calculated correctly and install more power supplies modules, if it is necessary. |
| 2)    | To increase the service life of your contacts and protect the modules from potential reverse voltage damage, connect externally a clamping diode in parallel with each inductive DC load or connect an RC snubber circuit in parallel with each inductive AC load.  |
| 3)    | The redundancy feature is only guaranteed for racks with GLL1270 Revision 2 or greater. For the models with their revisions less than the mentioned above, the technical support must be consulted in order to check the compatibility.   |
| 4)    | To meet the EMC standards requirements, the wires’ length to the failure relay must be less than 30 meters. The power supply of activated load by the failure relay must not be from external network.  |

## DF56 – Power Supply for Backplane (Redundant)

### Description

This redundant power supply works independently or with another redundant power supply module to assure a constant power supply to the application. When two redundant power supply modules are used, both split the energy that is needed to supply the system. When one power supply fails, the other, automatically, will assume the operation. Each power supply has a relay to indicate failures allowing the user to replace damage modules.

This module has two voltage outputs:

a) **5 Vdc @ 3A** distributed by power lines in the Inter-Module-Bus (IMB) through racks to supply module circuits;

b) **24 Vdc @ 300 mA** for external use through terminals 1B and 2B.

The DC applied voltage and the 5Vdc and 24 Vdc are isolated.

### Installation and Configuration

**For systems based on DF92 and DF93 rack, with DF90 and DF91**

#### Redundant mode

**Splitting Power concept:** In this situation, two modules will supply power to a bus segment. If one of them was turned off or fails, the other power supply must be able to supply energy, alone, to the segment.

#### Expansion of load capacity by adding power supplies or pairs of redundant power supplies

If the system consumption is greater than 3A, it can be subdivided in up to 8 groups sized for consumption of up to 3A each, and each group is individually powered by a power supply, or redundant pair of power supplies. More details on the Power supplies positioning topic.

#### Power supplies positions in the racks

On DF92, the pair of redundant power supplies must be installed in the first and second slots.

On DF93 is recommended the placement of the redundant pair in the first and second slots, but it can be installed in any slots if necessary.

#### Configuration of CH1 jumper

The DF56 **CH1** jumper always must be connected to the **R** position.

**For systems based on DF1A and DF78 racks**

**Single Module:** Less than 3 A are required.

There is an address restriction related to the location of the power supply. This restriction is the first rack (address 0) must have a power supply module in the first slot. The **CH1** jumper (power supply) must be set in the **E** position.

**More Than One Module:** More than 3 A are required.

For systems based on **DF1A rack** they must be placed in the first slot of the rack. Jumper **W1** on the rack that has the new power supply must be cut. Every new power supply will only supply energy to the rack in which it is located and, with the jumper cut off, it will not supply energy to the previous racks. All modules must have the **CH1** jumper (power supply) set in the **E** position.

**Redundant Mode:**

In redundant mode, the power supply modules must be placed in the first and third slots of rack **DF1A** or first and second slots of rack **DF78**. In both, the **CH1** jumper (power supply) must be set in the **R** position. In this condition, the power supply modules will split the power. This topology is called "split power mode".

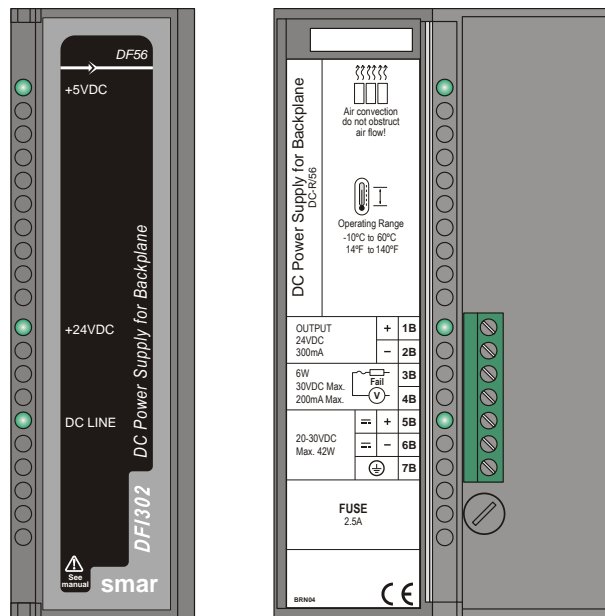


Figure 13.2 - DC Power Supply Module: DF56

## Technical Specifications

| INPUTS              |  |
|---------------------|--|
| DC                  | 20 to 30 Vdc                                 |
| Inrush Current      | < 20.6 A @ 30 Vdc [ $\Delta T < 430 \mu s$ ] |
| Maximum Consumption | 42 W   |
| Indicator           | DC LINE (Green LED)                          |

| OUTPUTS                    |                              |
|----------------------------|------------------------------|
| a) Output1 (internal use)  | 5.2 Vdc +/- 2%               |
| Current                    | 3 A Maximum                  |
| Ripple                     | 100 mVpp Maximum             |
| Indicator                  | +5 Vdc (Green LED)           |
| Hold up Time               | > 47 ms @ 24 Vdc [Full Load] |
| b) Output 2 (external use) | 24 Vdc +/- 10%               |
| Current                    | 300 mA Maximum               |
| Ripple                     | 200 mVpp Maximum             |
| Short Circuit Current      | 700 mA                       |
| Indicator                  | +24 Vdc (Green LED)          |

| ISOLATION   |           |
|---|-----------|
| Input signal, internal outputs and the external output are isolated between them. |           |
| Between outputs and ground  | 500 Vrms  |
| Between input and output  | 1500 Vrms |

| FAILURE RELAY                      |   |
|------------------------------------|---|
| Type of Output                     | Solid state relay, normally closed (NC), isolated |
| Limits                             | 6 W, 30 Vdc Max, 200 mA Max                       |
| Maximum Initial Contact Resistance | <13 $\Omega$                                      |
| Overload Protection                | Should be provided externally.                    |
| Operation Time                     | 5 ms maximum                                      |

| TEMPERATURE |                                   |
|-------------|-----------------------------------|
| Operation   | -10 °C to 60 °C (14 °F to 140 °F) |

| DIMENSIONS AND WEIGHT  |  |
|------------------------|--|
| Dimensions (W x H x D) | 39.9 x 137.0 x 141.5 mm ;<br>(1.57 x 5.39 x 5.57 in) |
| Weight                 | 0.450 kg   |

| CABLES    |                               |
|-----------|-------------------------------|
| One wire  | 14 AWG (2 mm <sup>2</sup> )   |
| Two wires | 20 AWG (0.5 mm <sup>2</sup> ) |

| NOTES   |  |
|---|--|
| <p>1. If the power consumption exceeds the power supplied, the DFI302 system may operate in an unpredictable manner that may causes damages to the equipment or risk of personal injury. Therefore, the power consumption must be calculated correctly and a detailed analysis should be performed to define the installation of extra power supply modules.</p> <p>2. The hardware revisions which are GLL1279 Rev1 and previous revisions do not support redundancy feature.</p> <p>3. To meet the EMC standards requirements, the wires' length to the failure relay must be less than 30 meters. The power supply of activated load by the failure relay must not be from external network.</p> |  |

## **DF87 – Power Supply for Backplane (5 A, Redundant, with diagnostic)**

### **Description**

This redundant power supply works independently or with another redundant power supply module to assure a constant power supply to the backplane. When two redundant power supply modules are used, both split the energy that is needed to supply the system. When one power supply fails, the other, automatically, will assume the operation.

This module provides a 5 Vdc output voltage, isolated from the input, with capacity of 5 A.

The DF87 has advanced diagnostics, which are indicated by LEDs, and can be read by the DFI302 controller. It also has a relay that is activated (closed) to indicate failures.

The DF87 has three ranges to signal the diagnostics. The diagnostic signal **OK** means the DF87 is operating in correct range, ensuring that is far from the fault limits. If the DF87 is out of this range, before reaching the limits that stop its operation, warning diagnostics are flagged, allowing intervention before potential failures may occur. If the fault limits are reached, the DF87 stops the operation, disconnecting to the bus. Thus, the failure does not affect the performance of redundancy, the failure relay is activated (closed), and the possible causes of failures are indicated.

### **Installation and Configuration**

#### **Operation without Redundancy**

Each DF87 powers one bus segment.

#### **Redundant mode**

Two modules will supply power to a bus segment. If one of them was turned off or fails, the other power supply must be able to supply energy, alone, to the segment.

#### **For systems based on DF92 and DF93 rack, with DF90 and DF91**

##### **Expansion of load capacity by adding power supplies or pairs of redundant power supplies**

If the system consumption is greater than 5A, it can be subdivided in up to 8 groups sized for consumption of up to 5A each, and each group is individually powered by a power supply, or redundant pair of power supplies. More details on the Power supplies positioning topic.

##### **Power supplies positions in the slots**

On DF92, the pair of redundant power supplies must be installed in the first and second slots.

On DF93 is recommended the placement of the redundant pair in the first and second slots, but it can be installed in any slots if necessary.

#### **For systems based on DF1A**

##### **Expansion of load capacity by adding power supplies or pairs of redundant power supplies**

With the DF1A is possible reach up to 3A per slot. If the system consumption is greater than 3A, it can be subdivided in up to 8 groups sized for consumption of up to 3A each, and each group is individually powered by a power supply, or redundant pair of power supplies. More details on the Power supplies positioning topic.

##### **Power supplies positions in the slots**

On DF1A, the pair of redundant power supplies must be installed in the first and third slots.



**ATTENTION**

- The power supply DF87 is not compatible with the DF78 rack. Use the DF92 rack if redundant controllers are needed together with the DF87.
- Even using the power supply DF87, the DF1A rack only supports 3A per slot.

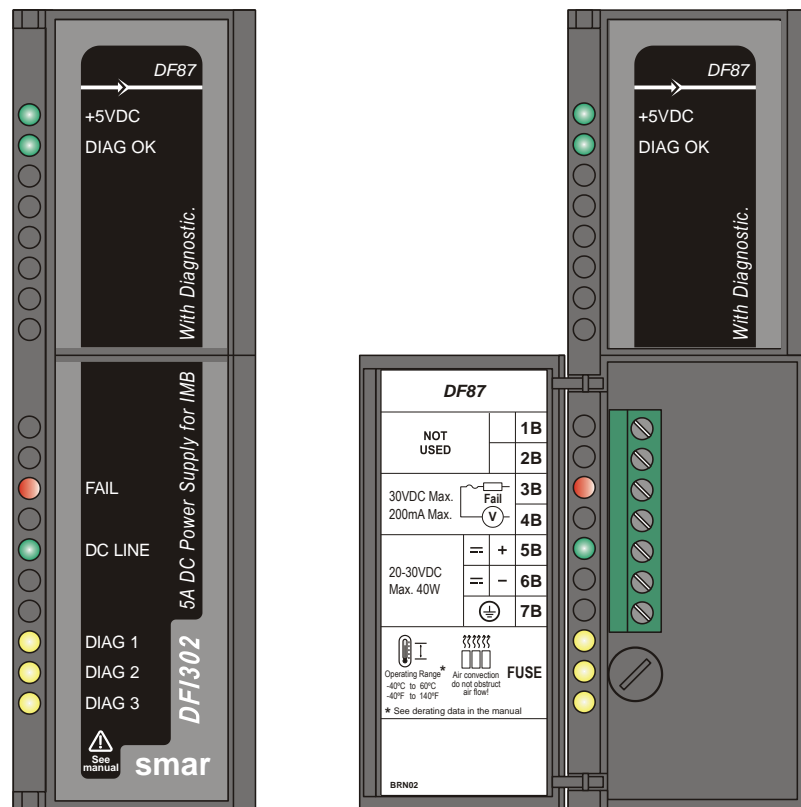


Figure 13.3 - DC Power Supply Module: DF87

## Technical Specifications

| INPUTS              |                                |
|---------------------|--------------------------------|
| DC                  | 20 to 30 Vdc<br>24 Vdc nominal |
| Maximum Consumption | 40 W (@ 5A output)             |
| Indicator           | DC LINE (Green LED)            |
| Fuse                | 8A 250V 5X20mm                 |

| OUTPUTS               |  |
|-----------------------|--|
| Output (internal use) | 5.2 Vdc +/- 2%   |
| Current               | 5 A Maximum<br>(See derating curve in the figure 13.6) |
| Ripple                | 100 mVpp Maximum                                       |
| Indicator             | +5 Vdc (Green LED)                                     |
| Hold up Time          | > 4.7 ms @ 24 Vdc [Full Load]                          |

| ISOLATION                  |          |
|----------------------------|----------|
| Between outputs and ground | 1500 Vdc |
| Between input and output   | 1500 Vdc |



| FAILURE RELAY                      |   |
|------------------------------------|---|
| Type of Output                     | Solid state relay, normally closed (NC), isolated |
| Limits                             | 6 W, 30 Vdc Max, 200 mA Max                       |
| Maximum Initial Contact Resistance | <13 Ω   |
| Overload Protection                | Should be provided externally.                    |
| Operation Time                     | 12 ms maximum                                     |

| TEMPERATURE |   |
|-------------|---|
| Operation   | -40 °C to 60 °C (-40 °F to 140 °F)<br>(See derating curve in the figure 13.6) |

| DIMENSIONS AND WEIGHT  |  |
|------------------------|--|
| Dimensions (W x H x D) | 39.9 x 137.0 x 141.5 mm ;<br>(1.57 x 5.39 x 5.57 in) |
| Weight                 | 0,453 Kg   |

| CABLES    |                               |
|-----------|-------------------------------|
| One wire  | 14 AWG (2 mm <sup>2</sup> )   |
| Two wires | 20 AWG (0.5 mm <sup>2</sup> ) |

**NOTE**

To meet the EMC standards requirements, IEC 61326, the wires’ length to the failure relay must be less than 30 meters. The power supply of the load activated by the failure relay must not be from external network.

If the power cables of the input are greater than 3 m, install the ferrite core “FAIR-RITE V0”, attached to the product packing. To install it, involve with the ferrite core all cables that are connected to the 5B, 6B and 7B contacts of the front terminal block near to DF87.

### Diagnostics LEDs

The power supply DF87 has the following frontal LEDs, indicating the following situations shown in the figure below.

|           |                    |
|-----------|--------------------|
| ● +5VDC   | Power converter on |
| ● DIAG OK | Operation OK       |
| ● FAIL    | Fail               |
| ● DC LINE | Input power on     |
| ● DIAG 1  | Diagnostic code    |
| ● DIAG 2  | Diagnostic code    |
| ● DIAG 3  | Diagnostic code    |

**Figure 13.4 - DF87 frontal LEDs**

The following is a summary of situations and the status of the LEDs for warning diagnostics, allowing intervention before potential failures may occur in the DF87 power supply.

| OK        | Input Voltage Low | Input Voltage High | Output Current | Internal Temperature | Unrecognized | Out Protection Acting | Internal Problem (ripple, etc) |
|-----------|-------------------|--------------------|----------------|----------------------|--------------|-----------------------|--------------------------------|
| ● DIAG OK | ● DIAG OK         | ● DIAG OK          | ● DIAG OK      | ● DIAG OK            | ● DIAG OK    | ● DIAG OK             | ● DIAG OK                      |
| ● DIAG 1  | ● DIAG 1          | ● DIAG 1           | ● DIAG 1       | ● DIAG 1             | ● DIAG 1     | ● DIAG 1              | ● DIAG 1                       |
| ● DIAG 2  | ● DIAG 2          | ● DIAG 2           | ● DIAG 2       | ● DIAG 2             | ● DIAG 2     | ● DIAG 2              | ● DIAG 2                       |
| ● DIAG 3  | ● DIAG 3          | ● DIAG 3           | ● DIAG 3       | ● DIAG 3             | ● DIAG 3     | ● DIAG 3              | ● DIAG 3                       |

Figure 13.5 - Diagnostics LEDs

The FAIL LED indicates failure when is ON.

The following graph shows the behavior of the output current within the operation range of the DF87 in environments without artificial ventilation.

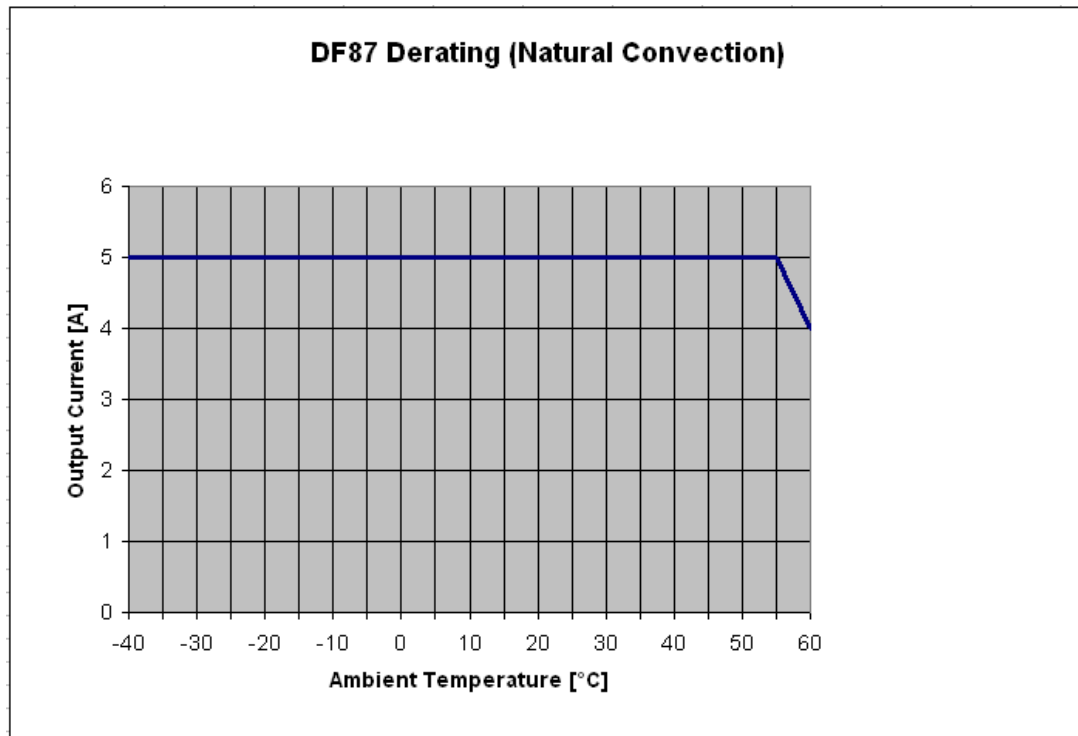


Figure 13.6 - Derating curve of the output current versus temperature, for environments without ventilation

## Calculating the Power Consumption

Since the power available in the power supply is limited, it is important to calculate the power consumption of modules in use. The user can create a worksheet to summarize all supplied and required current from each module and associated equipment (such as operator interface).

Example of worksheet with the module’s consumption, and some power supplies’ specification.

| <b>DFI302 Power Budget</b> |                            |          |                             |      |                  |             |                        |      |                  |      |
|----------------------------|----------------------------|----------|-----------------------------|------|------------------|-------------|------------------------|------|------------------|------|
| Module                     | Description                | Qty.     | Consumption Unit Power (mA) |      | Total Power (mA) |             | Supply Unit Power (mA) |      | Total Power (mA) |      |
|                            |                            |          | @24 V                       | @5 V | @24 V            | @5 V        | @24 V                  | @5 V | @24 V            | @5 V |
| DF51                       | Controller                 | 1        | 0                           | 950  | 0                | 950         |                        |      |                  |      |
| DF62                       | Controller                 |          | 0                           | 550  | 0                | 0           |                        |      |                  |      |
| DF63                       | Controller                 |          | 0                           | 550  | 0                | 0           |                        |      |                  |      |
| DF73                       | Controller                 |          | 0                           | 650  | 0                | 0           |                        |      |                  |      |
| DF75                       | Controller                 |          | 0                           | 550  | 0                | 0           |                        |      |                  |      |
| DF11                       | 2*8 DI 24 Vdc              |          | 0                           | 80   | 0                | 0           |                        |      |                  |      |
| DF12                       | 2*8 DI 48 Vdc              |          | 0                           | 80   | 0                | 0           |                        |      |                  |      |
| DF13                       | 2*8 DI 60 Vdc              |          | 0                           | 80   | 0                | 0           |                        |      |                  |      |
| DF14                       | 2*8 DI 125 Vdc             |          | 0                           | 80   | 0                | 0           |                        |      |                  |      |
| DF15                       | 2*8 DI 24 Vdc (sink)       |          | 0                           | 80   | 0                | 0           |                        |      |                  |      |
| DF16                       | 2*4 DI 120 Vac             |          | 0                           | 50   | 0                | 0           |                        |      |                  |      |
| DF17                       | 2*4 DI 240 Vac             |          | 0                           | 50   | 0                | 0           |                        |      |                  |      |
| DF18                       | 2*8 DI 120 Vac             |          | 0                           | 87   | 0                | 0           |                        |      |                  |      |
| DF19                       | 2*8 DI 240 Vac             | 2        | 0                           | 87   | 0                | 174         |                        |      |                  |      |
| DF20                       | 8 switches                 |          | 0                           | 45   | 0                | 0           |                        |      |                  |      |
| DF44                       | 8 AI                       |          | 0                           | 320  | 0                | 0           |                        |      |                  |      |
| DF57                       | 8 AI                       |          | 0                           | 320  | 0                | 0           |                        |      |                  |      |
| DF45                       | 8 Temperature inputs       |          | 0                           | 55   | 0                | 0           |                        |      |                  |      |
| DF21                       | 16 DO (transistor)         |          | 65                          | 70   | 0                | 0           |                        |      |                  |      |
| DF22                       | 2*8 DO (transistor)        |          | 65                          | 70   | 0                | 0           |                        |      |                  |      |
| DF23                       | 8 DO (triac)               |          | 0                           | 70   | 0                | 0           |                        |      |                  |      |
| DF24                       | 2*8 DO (triac)             |          | 0                           | 115  | 0                | 0           |                        |      |                  |      |
| DF25                       | 2*4 DO (relay)             |          | 134                         | 20   | 0                | 0           |                        |      |                  |      |
| DF26                       | 2*4 DO (relay)             |          | 134                         | 20   | 0                | 0           |                        |      |                  |      |
| DF27                       | 2*4 DO (relay)             |          | 134                         | 20   | 0                | 0           |                        |      |                  |      |
| DF28                       | 2*8 DO (relay)             |          | 180                         | 30   | 0                | 0           |                        |      |                  |      |
| DF29                       | 2*4 DO (relay)             |          | 134                         | 20   | 0                | 0           |                        |      |                  |      |
| DF30                       | 2*4 DO (relay)             |          | 134                         | 20   | 0                | 0           |                        |      |                  |      |
| DF31                       | 2*4 DO (relay)             |          | 134                         | 20   | 0                | 0           |                        |      |                  |      |
| DF46                       | 4 AO                       |          | 180                         | 20   | 0                | 0           |                        |      |                  |      |
| DF32                       | 8 DI 24 Vdc, 4 DO (relay)  |          | 67                          | 60   | 0                | 0           |                        |      |                  |      |
| DF33                       | 8 DI 48 Vdc, 4 DO (relay)  |          | 67                          | 60   | 0                | 0           |                        |      |                  |      |
| DF34                       | 8 DI 60 Vdc, 4 DO (relay)  |          | 67                          | 60   | 0                | 0           |                        |      |                  |      |
| DF35                       | 8 DI 24 Vdc, 4 DO (relay)  |          | 67                          | 60   | 0                | 0           |                        |      |                  |      |
| DF36                       | 8 DI 48 Vdc, 4 DO (relay)  |          | 67                          | 60   | 0                | 0           |                        |      |                  |      |
| DF37                       | 8 DI 60 Vdc, 4 DO (relay)  |          | 67                          | 60   | 0                | 0           |                        |      |                  |      |
| DF38                       | 8 DI 24 Vdc, 4 DO (relay)  |          | 67                          | 60   | 0                | 0           |                        |      |                  |      |
| DF39                       | 8 DI 48 Vdc, 4 DO (relay)  |          | 67                          | 60   | 0                | 0           |                        |      |                  |      |
| DF40                       | 8 DI 60 Vdc, 4 DO (relay)  |          | 67                          | 60   | 0                | 0           |                        |      |                  |      |
| DF53                       | 4 Fieldbus Power Impedance | 1        | 1500                        | 0    | 1500             | 0           |                        |      |                  |      |
| <b>TOTAL</b>               |                            | <b>4</b> |                             |      | <b>1500</b>      | <b>1074</b> |                        |      |                  |      |
| DF50                       |                            | 1        |                             |      |                  |             | 300                    | 3000 | 300              | 3000 |

| DFI302 Power Budget |             |          |                             |      |                  |      |                        |      |                  |             |
|---------------------|-------------|----------|-----------------------------|------|------------------|------|------------------------|------|------------------|-------------|
| Module              | Description | Qty.     | Consumption Unit Power (mA) |      | Total Power (mA) |      | Supply Unit Power (mA) |      | Total Power (mA) |             |
|                     |             |          | @24 V                       | @5 V | @24 V            | @5 V | @24 V                  | @5 V | @24 V            | @5 V        |
| DF52                |             | 1        |                             |      |                  |      | 1500                   | 0    | 1500             | 0           |
| <b>TOTAL</b>        |             | <b>6</b> |                             |      |                  |      |                        |      | <b>1800</b>      | <b>3000</b> |

## Power supplies and racks positioning

### For systems based on DF92 and DF93 racks with DF90 and DF91

A power supply connected to a rack, in a system, provides current to the racks row that are horizontally interconnected to it by their terminals of lateral connections, and vertically through DF90 cables, thus forming a group of rows of racks that use the same power supply.

The system can have only one power supply (or pair of redundant power supplies) or it can be subdivided in several of these groups<sup>1</sup>, each one powered by a power supply (or pair of redundant power supplies).

The recommended way to distribute the power is to divide the system in groups of horizontal rows of racks. In this scheme, each power supply must be positioned on the top left of the group of rows of racks that it powers. The rack where is the power supply must be the **W1** jumper cut and the DF90 cable must not be connected to the rows powered by other power supplies (top rows). See in the following figure an example of system powered by two power supplies, each one powers a part of rows represented in green and blue.

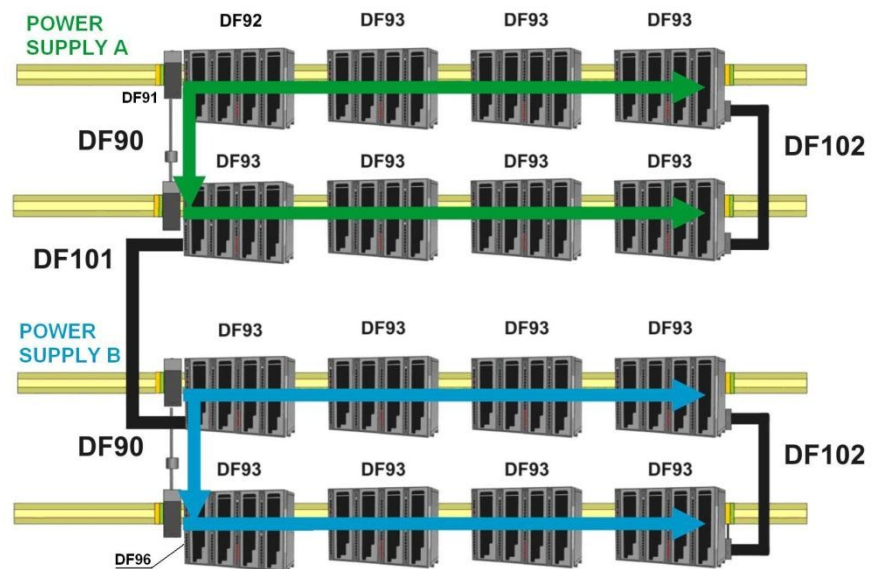


Figure 13.7 - System powered by two power supplies

Note that this system, for greater efficiency, is optimized for power distribution by groups of rows of racks. Thus, a power supply powers a whole number of rows it supports. However, in rare cases, with long rows or many modules with great consumption in the same row, there is the option to add power supplies in the middle of the row, dividing the power within this row. In this case, the power supply added powers only the modules positioned on the right in the same row, up to the end, or even where there is another power supply added. In the rack where the power supply was added, in this scheme, the **W1** jumper must be cut and left lateral connection terminal (+5 Vdc) must be disconnected (collapsed).

<sup>1</sup> Maximum 8 groups allowed when the DF50, DF56 or DF87 power supplies are used.

The system has diagnostic for voltage level distributed to racks. It also supports modules with great power consumption in any place on the bus. Nevertheless, is recommended to place those modules close to the power supplies, to avoid unnecessary power transmission.

**Practical Rules for Projects**

1. The system can have up to 17 racks (up to 16 DF93 racks and up to 1 DF92 rack).
2. A group of racks that consumes up to 5A of the same power supply must be physically placed within the limits specified in the table below, respecting the limit of 17 racks of previous item and the limits of power supply used. So that it is possible to power complete typical systems with a single power supply or redundant pair of power supplies.

| N° of rows | Limited in:                            |
|------------|--|
| 1 row      | Up to 12 racks in the row <sup>2</sup> |
| 2 rows     | Up to 9 racks on each row              |
| 3 rows     | Up to 6 racks on each row              |
| 4 rows     | Up to 5 racks on each row              |
| 5 rows     | Up to 4 racks on each row              |

**Table 1 - Limits for systems with DF90, DF91, DF92 and DF93, with consumption of up 5A**

3. Place the power supply always at the top left of the group that it powers.
4. Modules with consumption greater than 320 mA must be placed in the row where the power supply is, in the 4 racks closest of it. The other modules can be in any position, but is recommended to place the modules with great consumption close to the power supplies, to avoid unnecessary power transmission.
5. The rack where is the power supply must be the **W1** jumper cut. The power supply of this rack must not be connected to racks powered by other power supplies (disconnect the DF90 cable or the Vcc connection plate which would connect it to another power supply).
6. On DF92, the pair of redundant power supplies must be installed in the first and second slots.
7. On DF93 is recommended the placement of the redundant pair in the first and second slots, but it can be installed in any slots if necessary.
8. In this system, **DF50** and **DF56** must be their **CH1** jumper always configured in **R**, even if they are not in redundant pairs.



**ATTENTION**

A mixture of these power supplies with the **CH1** configured in **R** and in **E** in any **DFI302** system, is not allowed!

**Using third-party power supplies**

The STEP OS 1AC 5DC 6.5.power supply from Phoenix Contact can be used to power a DFI302 system with DF90, DF91, DF92 and DF93, following the additional rules specified below:

1. Racks positioned according to the following limitations, for up 5A:

| N° of rows | Limited in:        |
|------------|--------------------|
| 3 rows     | 4 racks in the row |

2. Adjust the power supply output voltage in  $5.19V \pm 0.8\%$  <sup>3</sup> (with current of  $0.5A \pm 10\%$ , at  $25^{\circ}C \pm 10^{\circ}C$ )

<sup>2</sup> If the system consumes up to 3A, a single row of up to 17 racks can be powered by a single power supply located on the first rack.

**ATTENTION**

Voltage above 6V can damage the system. Check the voltage of the third-party power supply before connecting it to the system.

3. The power supply output must be connected to DF91 of the first row, using one of the cable type recommended above, with a ferrite installed in this cable, near to DF91. This ferrite is the same used in the DF90 cable, (code 0431164181 from the manufacturer FAIR-RITE). The recommended cables are:

- The DF90;
- or up to 0.43 m of copper cable, parallel or twisted, 4 mm<sup>2</sup> gauge;
- or up to 0.64 m of copper cable, parallel or twisted, 6 mm<sup>2</sup> gauge;
- or up to 1.07 m of copper cable, parallel or twisted, 10 mm<sup>2</sup> gauge.

4. To use redundant power supplies, connect them to the same DF90.

### For systems based on DF78 and DF1A Racks (legacy systems)

1. Observe the maximum current values from the power supply module specification. The limit for DF50 is 3 A, and for DF87 is 5 A.

2. After the connection with long cables (DF4A, DF5A, DF6A and/or DF7A) you have to put another power supply module in the first slot of the first rack.

3. Use up to 6 modules DF44/DF57 per power supply; always place consecutively the DF44/DF57 and close to the power supply. Because of the high current consumption of the modules DF44/DF57, a not desired voltage drop in the bus can occur if these modules are placed after other modules.

4. When is necessary to add interface modules, such as HI302, MB700, DF58, in the same bus which is used by output and input modules, is recommended that these modules are placed close to the power supply, because in the same way as described in the previous item, a not desired voltage drop in the bus can occur if these modules are placed after other modules.

5. Adding a new power supply module

- Determine the rack where the new power supply will be installed.
- Cut the jumper **W1** of the rack.
- Plug the new power supply at the first slot of the rack (slot 0).
- In this case, the **CH1** jumper of all modules **DF50** must be set in **E** position.

**ATTENTION**

- The power supply DF87 is not compatible with the DF78 rack. Use the DF92 rack if redundant controllers are needed together with the DF87.
- Even using the power supply DF87, the DF1A rack only supports 3A per slot.

<sup>3</sup> Example of calibration procedure of the STEP OS 1AC 5DC 6.5.power supply from Phoenix Contact to use it with DF1302: Adjust the power supply output between 5.17V to 5.21V, trying to get 5.19V (using voltmeter with a maximum of 0.4 % of total uncertainty – e.g.. multimeters Fluke 83III, 85 III, or 87 III, with annual calibration), at ambient temperature of 25°C ± 10°C.

## Fault diagnostic in IMB

### IMPORTANT

The diagnostic and security feature **IMB Fault State**, in this section, is available for the following controllers and their firmware versions:

- DF62/DF63/DF75: from firmware version V4\_0\_5 and higher
- DF73/DF95/DF97: from firmware version V4\_1\_0 and higher
- DF89: from firmware version V4\_2\_0 and higher

The **IMB Fault State** feature allows detecting undervoltage conditions at the IMB bus when the DF93 rack, which supports diagnostic, is used.

In the **IMB Fault State** condition the access to I/O cards can be harmed. Thus, once detected this fault condition, the controller shall take the following actions:

- Total interruption of access to I/O cards;
- Signaling the condition in Force LED (FRC) of the frontal, blinking every 2s;
- Indication on **Resource** function block:
  - **BLOCK\_ERR** parameter, with **DeviceFaultState** value;
  - **FAULT\_STATE** parameter with **Active** value;
- Indication of bad (value 1) in the **Status** block of ladder logic (requires that there be some I/O card with recognized ID and being accessed in the same rack);
- Indication of racks statuses via **SNMP OPC Server** (pwr subgroup).

### Conditions that may cause IMB Fault State:

- DF50 power supplies distributed over the IMB racks are undersized;
- Turning off some of the power supplies over the IMB racks;
- Turning off some of the connections between racks;
- Failures of hardware elements that may cause current leakage.

The IMB Fault State feature must be enabled on the **Resource** function block by setting the **FEATURE\_SEL** parameter with **Fault State** bit. This configuration can be done via **Online Characterization** and does not require a new configuration download.

## DF52 / DF60 – Power Supply for Fieldbus

### Description

These modules were specially designed to supply the Fieldbus networks. The only difference between them is the input voltage:

**DF52** (90 ~ 264 Vac)

**DF60** (20 ~ 30 Vdc)

The **DF52** power supply is a non-intrinsically safe equipment with an universal AC input (90 to 264 Vac, 47 to 63 Hz or 127 to 135 Vdc), and a 24 Vdc output, isolated, with short circuit and overcurrent protection, ripple and fault indication, proper to power fieldbus elements.

The **DF60** power supply unit is a non-intrinsically safe equipment with a DC input (20 to 30 Vdc) and a 24 Vdc output, isolated, with short circuit and overcurrent protection, ripple and fault indication, proper to power fieldbus elements.

The interconnection of Fieldbus elements to the **DF52/DF60** is indicated in figure bellow. There is no overshoot when it is switched on or off. The **DF52/DF60** can power up to 4 fully loaded fieldbus networks.

#### NOTE

The length of the cables that interconnect the DF52/DF60 to the DF53/DF98 modules must not exceed 3 meters.

If any abnormal condition occurs in the output, such as overloading or short circuit, the **DF52/DF60** internal switches are automatically switched off to protect its circuit. When the outputs return to normal operation conditions, the circuit is automatically switched on.

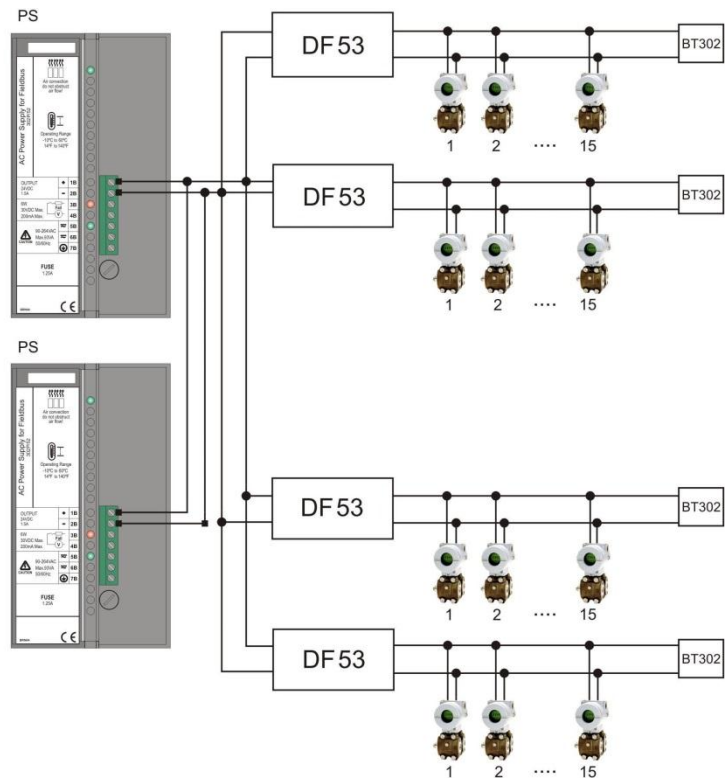


Figure 13.8 - System powered by DF52



The DF52/DF60 modules allow redundancy without any component connected to their outputs.

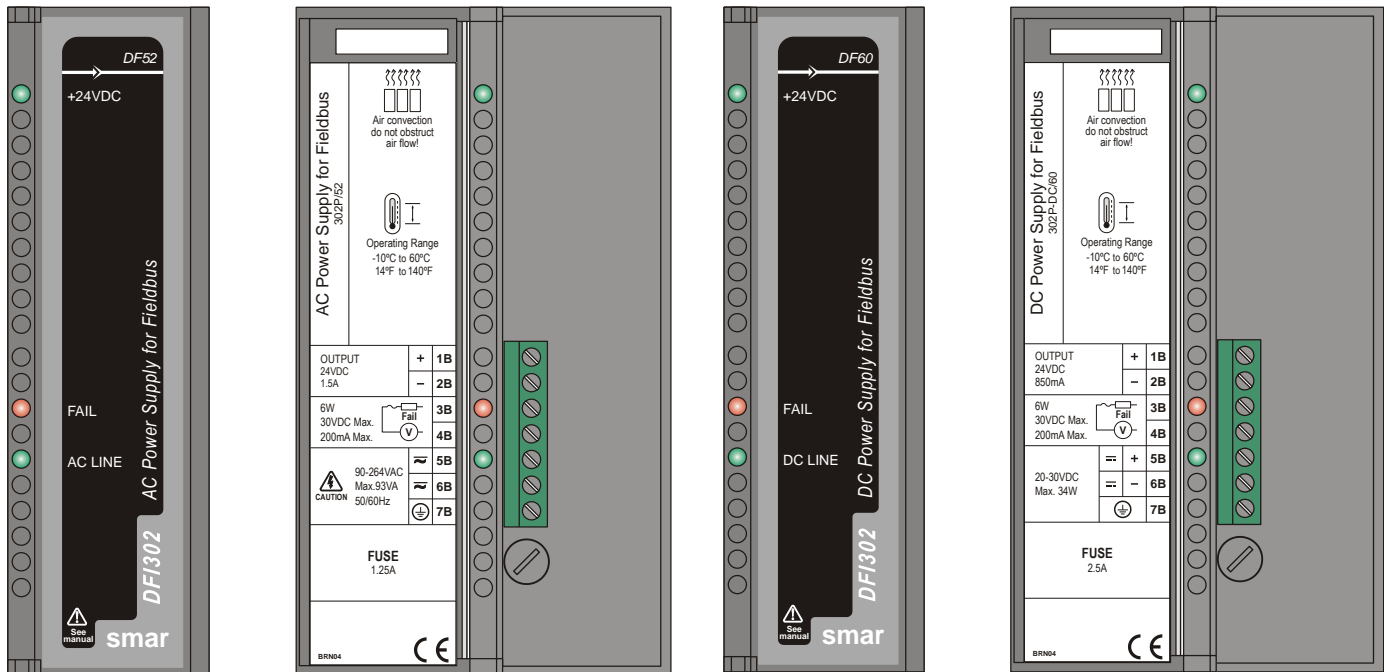


Figure 13.9 - Power Supply Module for Fieldbus: DF52/DF60

### Technical Specifications

| INPUTS DF52            |   |
|------------------------|---|
| DC                     | 127 to 135 Vdc  |
| AC                     | 90 to 264 Vac, 50/60 Hz (nominal),<br>47 to 63 Hz (range) |
| Maximum Inrush Current | < 30 A @ 220 Vac [ $\Delta T < 640 \mu s$ ]               |
| Maximum Consumption    | 93 VA   |
| Indicator              | AC LINE (Green LED)                                       |

| INPUTS DF60            |  |
|------------------------|--|
| DC                     | 20 to 30 Vdc                               |
| Maximum Inrush Current | < 24 A @ 30 Vdc [ $\Delta T < 400 \mu s$ ] |
| Maximum Consumption    | 34 W                                       |
| Indicator              | DC LINE (Green LED)                        |

| OUTPUTS    |                     |                  |
|------------|---------------------|------------------|
| Output     | 24 Vdc $\pm$ 1%     |                  |
| Current    | <b>DF52</b>         | <b>DF60</b>      |
|            | 1.5 A (maximum)     | 850 mA (maximum) |
| Ripple     | 20 mVpp (maximum)   |                  |
| Indicators | +24 Vdc (Green LED) |                  |
|            | FAIL (Red LED)      |                  |

| ISOLATION  |             |             |
|--|-------------|-------------|
| Input signal, internal outputs and the external output are isolated among them | <b>DF52</b> | <b>DF60</b> |
| Among outputs and ground   | 1000 Vrms   | 500 Vrms    |
| Between input and output   | 2500 Vrms   | 1500 Vrms   |

| FAILURE RELAY                      |   |
|------------------------------------|---|
| Type of Output                     | Solid state relay, normally closed (NC), isolated |
| Limits                             | 6 W, 30 Vdc Max, 200 mA Max                       |
| Maximum Initial Contact Resistance | <13Ω  |
| Overload Protection                | Should be provided externally                     |
| Operation Time                     | 5 ms maximum                                      |

| DIMENSIONS AND WEIGHT  |  |
|------------------------|--|
| Dimensions (W x H x D) | 39.9 x 137.0 x 141.5 mm ;<br>(1.57 x 5.39 x 5.57 in) |
| Weight                 | 0.450 kg   |

| TEMPERATURE |                                   |
|-------------|-----------------------------------|
| Operation   | -10 °C to 60 °C (14 °F to 140 °F) |
| Storage     | -30 °C to 70 °C                   |

| NOTE   |  |
|--|--|
| To meet the EMC standards requirements, the wires' length to the failure relay must be less than 30 meters. The power supply of activated load by the failure relay must not be from external network. |  |

## DF53/DF98 – Power Supply Impedance for Fieldbus

### Description

These modules were specially designed to provide appropriate impedance for fieldbus networks.

**DF53 (4 ports)**  
**DF53-FC (4 ports)**  
**DF98 (2 ports)**

The purpose of this impedance is to implement an output circuit where the impedance is greater than  $3\text{ K}\Omega$ , and when assembling in parallel with two  $100\ \Omega \pm 2\%$  terminators, it results in a  $50\ \Omega$  line impedance approximately. This impedance can be implemented in a passive mode ( $50\ \Omega$  resistance in series with a  $100\text{ mH}$  inductance) or in an active mode, through an impedance control circuit.

The fieldbus power supply impedance is a non-isolated, active impedance control device, in compliance with IEC 61158-2 standard. This device provides an output impedance which, in parallel with the two bus terminators (a  $100\ \Omega$  resistor in series with a  $1\ \mu\text{F}$  capacitor) required by the standard, results in a pure resistive line impedance for a broad frequency range. The **DF53** and **DF98** cannot be used in intrinsic safety areas.

The figure shows the device block diagram. The **DF53/DF98** can be used in redundancy, connecting its output (+ and -) in parallel. In this case, use an external bus terminator (**BT302**) to allow maintenances or replacing the **DF53/DF98** in case of failure without interrupting the fieldbus communication.

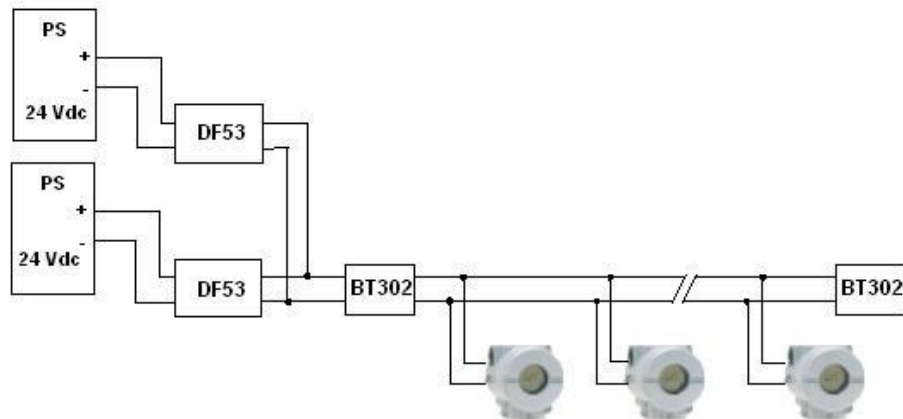


Figure 13.10 – System using the impedance DF53

The **DF53/DF98** modules have LEDs to indicate power supply and overcurrent. The input terminal block has two terminals (1A and 2A) that are connected to the external 24 Vdc. The power supply indication LED is green and it is energized while there is an external 24 Vdc power supply.

The overcurrent indication LED is red and it is energized only in case of an overcurrent caused by a short circuit in the plant or by an excessive number of devices connected. The following figure shows a **DF53/DF98** layout.

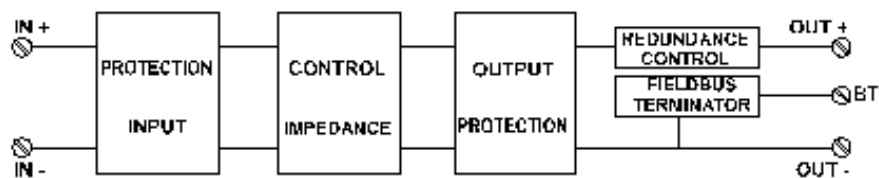


Figure 13.11 – DF53/DF98 block diagram

**DF53:** Eight terminals (3A to 10A) implementing four independent Fieldbus ports, four DIP switches for activating the bus termination, one green LED for power status, and four red LEDs indicating overcurrent.

**DF53-FC:** It has the same characteristics of DF53 and meets the requirements for hardware tests of OIML R117-1 (Flow Measurement System of Liquids).

**DF98:** Four terminals (3A/4A and 9A/10A) implementing two independent Fieldbus ports, two DIP switches for activating the bus termination, one green LED for power status, and two red LEDs indicating overcurrent.

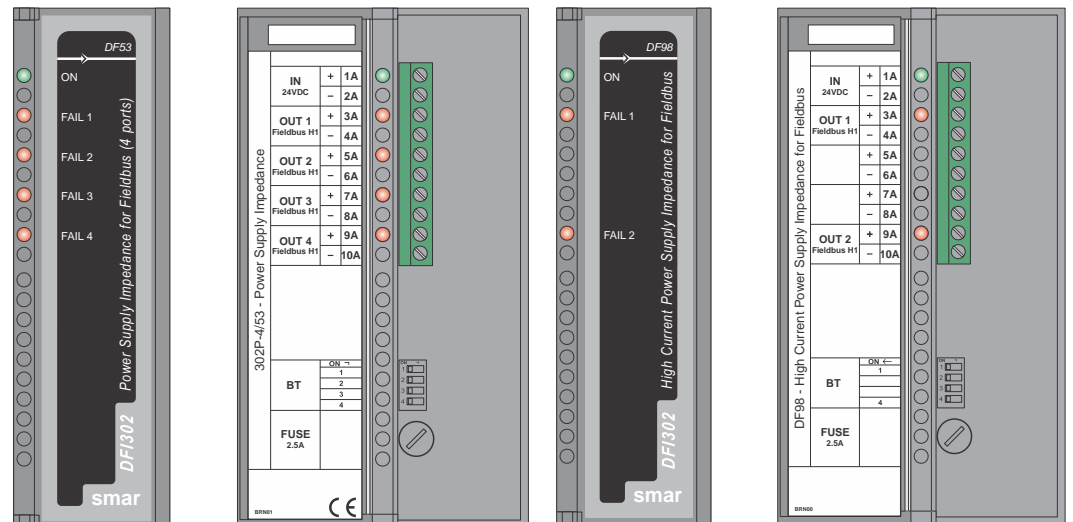


Figure 13.12 – Impedance for Fieldbus Module: DF53/DF98

### Technical Specifications

| INPUT                    |  |
|--------------------------|--|
| DC                       | 24 to 32 Vdc +/- 10%                                 |
| OUTPUT                   |  |
| Current                  | DF53: 340 mA per channel<br>DF98: 500 mA per channel |
| INPUT FILTER             |  |
| Attenuation              | 10 dB in the input power ripple @60 Hz               |
| CONSUMPTION              |  |
| Maximum power dissipated | DF53: 2,26 W per channel<br>DF98: 3,43 W per channel |
| DIMENSIONS AND WEIGHT    |  |
| Dimensions (W x H x D)   | 39.9 x 137.0 x 141.5 mm;<br>(1.57 x 5.39 x 5.57 in)  |
| Weight (without package) | 260 g  |
| TEMPERATURE              |  |
| Operation                | 0 °C to 60 °C  |
| Storage                  | -30 °C to 70 °C                                      |

| SAFETY                 |   |
|------------------------|---|
| Output Overcurrent     | DF53: 450 mA<br>DF98: 600 mA                        |
| Input Fuse             | 2.5 A   |
| Atmospheric Discharges | Input and output protected by transient suppressors |
| Intrinsic Safety       | It cannot be applied directly                       |

| MAXIMUM LENGTH OF FIELDBUS WIRING |               |         |
|-----------------------------------|---------------|---------|
| DF53/DF98                         | No redundancy | 1.900 m |
|                                   | Redundant     | 1.900 m |
| DF53-FC                           | No redundancy | 1.900 m |
|                                   | Redundant     | 1.000 m |

## Installation

The **DF53/DF98** is a device specially designed for panel installation and it cannot be installed in unsheltered locations, as it cannot be exposed directly to the weather. The module can be connected to the panel directly on the DIN rail or using the auxiliary support provided with the module, fixed with screws. Refer to the “Installing” section for further details about installation and dimensional drawings of the module.

## Maintenance and troubleshooting

The **DF53/DF98** is a robust device which basically requires no preventive maintenance. It is simply recommended to protect it from excessive dust accumulation and humid environments which might affect its output impedance.

The modules have LEDs which inform their operation status – one green LED which informs that the module is properly powered, and one red LED for each channel, that will be lit if any abnormal condition occurs in the field wiring.

These LEDs detect most of the problems which may occur in a Fieldbus installation. However, they might not detect other problems, such as:

- Excessive noise caused by the external power supply;
- Impedance lower than 20Ω in the communication line (note that such impedance may not be pure resistive and, therefore not detectable by the overcurrent circuit).

Such abnormal conditions may be easily detected by measurement instruments.

Because the **DF53/DF98** is a simple and compact device, it is recommended to replace faulty modules instead of electronic components during repair services.

## DF47-12 and DF47-17 – Intrinsic Safety Barrier for Fieldbus

### Description

The Intrinsically Safe (I.S.) technology incorporated in the DF47-12 and DF47-17 totally isolates the control network on the hazardous side of the barrier. The I.S. values of the power supply are designed for fieldbus devices, which are in compliance with the FISCO model.

The incorporation of a fieldbus repeater in compliance with IEC 61158-2 (31.25 kbits/s) essentially filters and boosts the incoming communication signal transmitting it to hazardous environment. The networks of the hazardous and safe sides of the DF47-12 and DF47-17 are completely independent from one another.

In addition the bus termination for the hazardous network is incorporated into the DF47-12 and DF47-17, which means that only a single far terminator is required.

#### NOTES

1. If the terminator of the DF53 module is not being used, it is necessary to install another external terminator in the safe area.
2. The model DF47 was discontinued due to the new FISCO requirements. The replacement by DF47-12 or DF47-17 models should be evaluated according to the current limits. The model DF47-17 supports up to 7 Smar's devices of the 302 series. If the replacement is using the DF47-12 model, it supports up to 5 Smar's devices of the 302 series.

- H1 Isolated Barrier and IS Power Supply in compliance with the FISCO Model.
- H1 Fieldbus Signal Repeater.
- In compliance with the IEC 61158-2, 31.25 kbits/s standard for fieldbus. (FOUNDATION fieldbus and PROFIBUS PA).
- IEC, FM & CENELEC Intrinsic Safety standards certified.
- In compliance with IEC 60079-27, FISCO and FNICO Power Supply.
- Dual Marking in compliance with IEC 60079-11 and IEC 60079-27.
- Bus terminator on hazardous area.

### Installation

The selection and installation of the barrier should always be accomplished by competent technical personnel. Please contact Smar or our local representative if further information is required. According to the standards for hazardous areas the barrier DF47-12 or DF47-17 must be installed out of hazardous area. The inputs parameters for installation in hazardous area are in the Certificates for Hazardous Areas topic.

The barrier has to be installed on DF1A, DF93 or DF9 and fixed in a DIN rail. For further details see the section Installing.

#### Installation Principles

1. Ensure that there is an appropriate separation of intrinsically safe and non-intrinsically safe circuits (more than 50 mm or 1.97 inches), so the ignition energy from non-intrinsically safe circuit does not intrude into the intrinsically safe circuit.
2. Ensure that the limiting parameters of system design, for example total inductance and capacitance, upon which system approval is based are not exceeded.
3. Ensure that power system faults and ground potential differences do not generate system ignition.

#### Location

The barrier is normally installed in a dust-free and moisture-free enclosure located in the non-hazardous area. The enclosure should be as close as possible to the hazardous area to reduce cable runs and increased capacitance. If the barrier is installed in a hazardous area, it must be in a proper enclosure suited for the intended area. The only intrinsically safe terminals are at the barrier output.

Wiring

Intrinsically safe circuits may be wired in the same manner as conventional circuits installed for hazardous areas with two exceptions summarized as separation and identification. The intrinsically safe conductors must be separated from all other cables by placing them in separate conduits or by a separation of more than 50 mm or 1.97 inches of air. The raceways, cable trays, open wiring, and terminal boxes must be labeled “Intrinsically Safe Wiring” to prevent interference with other circuits.

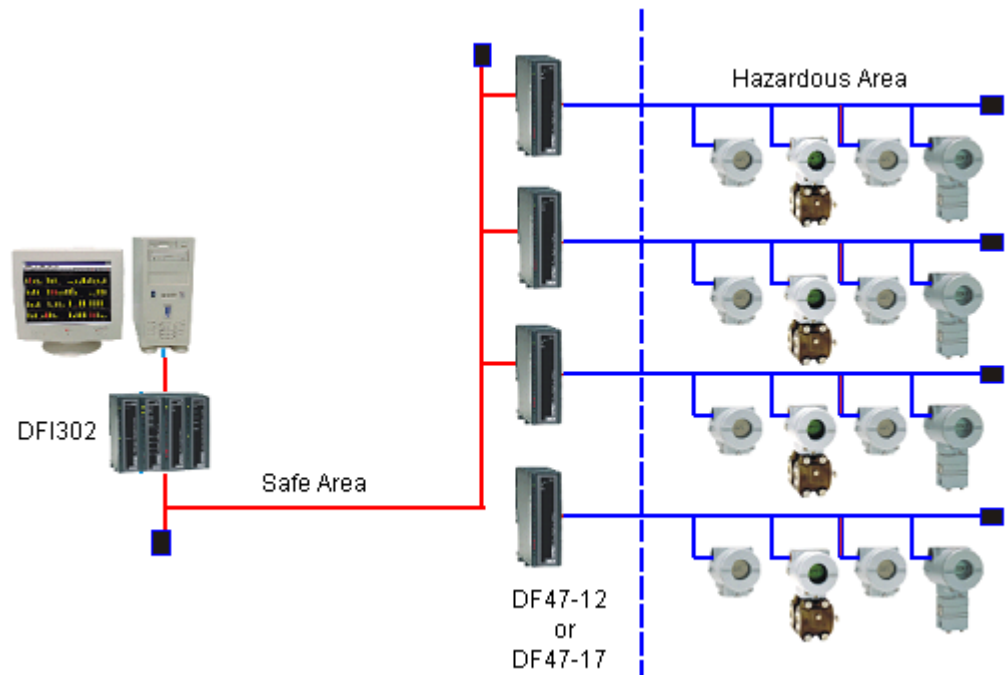


Figure 13.13 – DF47 installation

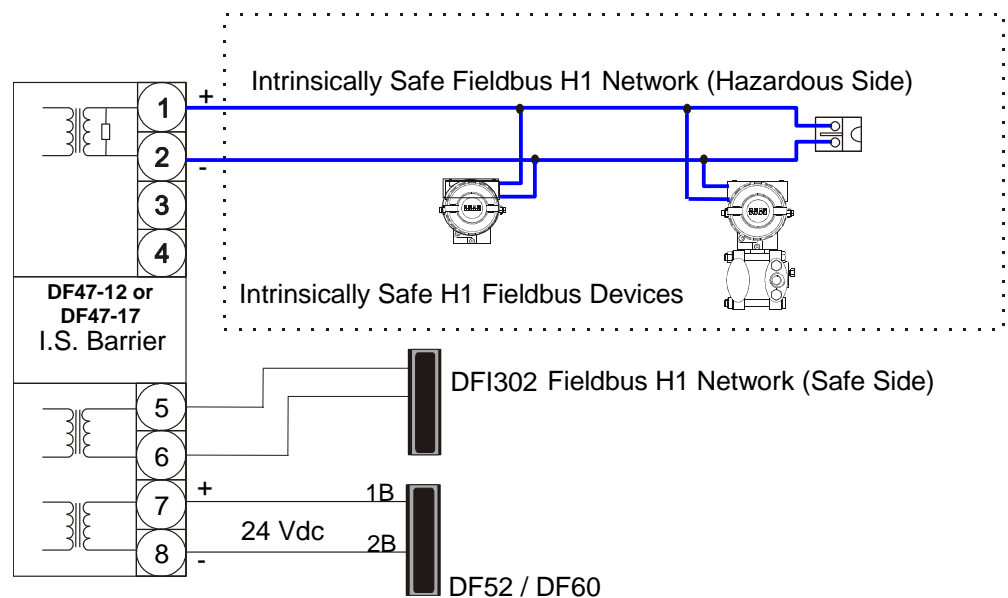


Figure 13.14 – DF47 installation

## Technical Specifications

| POWER              |                               |
|--------------------|-------------------------------|
| Power Supply Input | Voltage: 24Vdc $\pm$ 5%       |
|                    | Current (max.): 350mA @ 24Vdc |

| HAZARDOUS AREA                     |   |
|------------------------------------|---|
| Power Supply Output                | Maximum voltage available at the barrier terminals: $U_s = 13.8$ Vdc  |
|                                    | Maximum Current in typical operation (considering $U_s = 13.8$ Vdc)<br>DF47-12: $I_s = 65$ mA<br>DF47-17: $I_s = 90$ mA   |
|                                    | Current limiting resistor (typical)<br>DF47-12: $R_i \geq 247.5$ $\Omega$<br>DF47-17: $R_i \geq 176.22$ $\Omega$  |
|                                    | Maximum output power<br>DF47-12: $P_o = 1.2$ W<br>DF47-17: $P_o = 1.72$ W   |
| Safety Parameters (Hazardous Area) | Refer to the item "Hazardous locations approvals"   |
| Internal Dissipation               | 3W maximum at 24Vdc input, nominal conditions (for non intrinsically safe circuits)   |
| Cable Length, Number of Devices    | Maximum cables lengths are determined by IS requirements, and depend on both the number of devices attached and the maximum acceptable voltage drop along the cable. Use FISCO cable. |
| Digital Signal Transmission        | Compatible with 31.25 kbps – Fieldbus systems.  |
| Fuse                               | In order to guarantee the product safe, the internal fuse change must be executed only by the manufacturer.   |
| Terminals                          | Accommodate conductors up to 2.5 mm <sup>2</sup> (22AWG).   |
| Isolation                          | 2500V galvanic isolation among input, output, and power supply terminals. Tested at 1500 Vrms minimum between hazardous and safe area terminals.                                      |

| ENVIRONMENTAL CONDITIONS |                             |
|--------------------------|-----------------------------|
| Ambient Temperature      | 0 to +60 °C (operation)     |
|                          | -30 °C to 70 °C (storage)   |
| Humidity                 | 5% to 95% relative humidity |

| IMPORTANT   |  |
|---|--|
| By using active junction boxes you must consider their current consumption to calculate the total consumption of segment. |  |



## Certification Information

### Approved Manufacturing Locations

Smar Equipamentos Industriais Ltda – Sertãozinho, São Paulo, Brazil  
Smar Research Corporation – Ronkonkoma, New York, USA

### European Directive Information

This product complies with following European Directives:

#### **EMC Directive (2004/108/EC) - Electromagnetic Compatibility**

The equipment is in compliance with the directive and EMC test was performed according to IEC standards: IEC61326-1:2005 and IEC61326-2-3:2006. See table 2 from IEC61326-1:2005.

To comply with the EMC directive the installation must follow these special conditions:

- Use shielded, twisted-pair cable for powering the instrument and signal wiring.
- Keep the shield insulated at the instrument side, connecting the other one to the ground.

#### **ATEX Directive (94/9/EC) - Electrical equipment and protective system intended for use in potential explosive atmospheres**

The EC-Type Examination Certificate had been released by Nemko AS (CE0470) and/or DEKRA EXAM GmbH (CE0158), according to European Standards.

The certification body for Production Quality Assurance Notification (QAN) and IECEx Quality Assessment Report (QAR) is Nemko AS (CE0470).

Consult [www.smar.com](http://www.smar.com) for the EC declarations of conformity for all applicable European directives and certificates.

### Hazardous locations general information

#### **Ex Standards:**

IEC 60079-0 General Requirements

IEC 60079-11 Intrinsic Safety “i”

IEC 60079-27 Fieldbus intrinsically safe concept (FISCO)

#### **Customer responsibility:**

IEC 60079-10 Classification of Hazardous Areas

IEC 60079-14 Electrical installation design, selection and erection

IEC 60079-17 Electrical Installations, Inspections and Maintenance



#### **WARNING**

#### **Explosions can result in death or serious injury, besides financial damage.**

Installation of this instrument in an explosive environment must be in compliance with the national standards and according to the local environmental protection method. Before proceeding with the installation match the certificate parameters from the barrier, cable and device according to the environmental classification.

### General Notes

#### **Maintenance and Repair**

The instrument modification or replaced parts supplied by any other supplier than authorized representative of Smar Equipamentos Industriais Ltda is prohibited and will void the Certification.

#### **Marking Label**

Once a device labeled with multiple approval types is installed, do not reinstall it using any other approval types. Scratch off or mark unused approval types on the approval label.

#### **For Ex-i protection application**

- Connect the instrument to a proper intrinsically safe barrier.
- Check the intrinsically safe parameters involving the barrier, equipment including the cable and connections.
- Associated apparatus ground bus shall be insulated from panels and mounting enclosures.
- When using shielded cable, isolate the not grounded cable end.
- Cable capacitance and inductance plus  $C_i$  and  $L_i$  must be smaller than  $C_o$  and  $L_o$  of the Associated Apparatus.

**For FISCO System requirements (IEC 60079-27:2008)**

**FISCO Power Supplies**

General

The power supply shall be resistive limited or have trapezoidal output characteristic. The maximum output voltage,  $U_o$ , shall be not greater than 17.5V nor less than 14V under the conditions specified in IEC60079-11 for the respective level of protection.

The maximum unprotected internal capacitance  $C_i$  and inductance  $L_i$  shall be not greater than 5nF and 10 $\mu$ H, respectively.

The output of the power supply may be connected to earth.

No specification of the internal capacitance  $C_i$  and  $L_i$  or the maximum external parameters  $L_o$  and  $C_o$  is required on the certificate or label.

The determination of power supply output parameters shall into account the possible opening, shorting and grounding of field wiring connected to the field terminals of the apparatus.

Additional requirements of "ia" and "ib" FISCO power supplies

The maximum output current  $I_o$  for any "ia" or "ib" FISCO power supply shall be determined in accordance with IEC60079-11 but shall not exceed 380 mA.

Table 1 – Assessment of maximum output current for use with "ia" and "ib" FISCO power supplies

| $U_o$  | Permissible current , for IIC<br>(includes 1.5 safety factor) | Permissible current , for IIB<br>(includes 1.5 safety factor) |
|--|---|---|
| 14V  | 183 mA  | 380 mA  |
| 15V  | 133 mA  | 354 mA  |
| 16V  | 103 mA  | 288 mA  |
| 17V  | 81 mA   | 240 mA  |
| 17,5V  | 75 mA   | 213 mA  |
| Note: The two largest current values for IIB are derived from 5.32W. |   |   |

Additional requirements of "ic" FISCO power supplies

The maximum output current  $I_o$  for an "ic" FISCO power supply shall be determined in accordance with IEC60079-11.

Table 2 - Assessment of maximum output current for use with "ic" FISCO power supplies

| $U_o$ | Permissible current , for IIC<br>(includes 1.5 safety factor) | Permissible current , for IIB<br>(includes 1.5 safety factor) |
|-------|---|---|
| 14V   | 274 mA  | 570 mA  |
| 15V   | 199 mA  | 531 mA  |
| 16V   | 154 mA  | 432 mA  |
| 17V   | 121 mA  | 360 mA  |
| 17,5V | 112 mA  | 319 mA  |

## GENERAL NOTES

- The intrinsically safe conductors must be of blue colored, based in the IEC standards.
  - If one component of the intrinsically safe system is not FISCO comply, it is necessary to match all safety parameters among cable, device and barrier.
  - Designated for connection to a Fieldbus system in compliance FISCO Model with parameters as follows:
    - Intrinsically safe apparatus interconnected to the power supply circuit (Fieldbus) shall be passive current sink (not supplying) and effective internal inductance/capacitance shall be within the following maximum values:
      - $Li \leq 10 \mu\text{H}$
      - $Ci \leq 5 \text{ nF}$
    - With regard to cable-length parameters of Fieldbus interconnection-cable shall be within the following ranges:
      - Resistance per unit length  $15 \Omega/\text{km} \leq R' \leq 150 \Omega/\text{km}$
      - Inductance per unit length  $0.4 \text{ mH}/\text{km} \leq L' \leq 1\text{mH}/\text{km}$
      - Capacitance per unit length (including shield)  $80 \text{ nF}/\text{km} \leq C' \leq 200 \text{ nF}/\text{km}$
- Where:
- $C' = C' \text{ wire/wire} + 0.5 \times C' \text{ wire/shield}$  when Fieldbus-circuit insulated.
- $C' = C' \text{ wire/wire} + C' \text{ wire/shield}$  when shield is connected to the output of the Fieldbus power supply.
- Maximum length of each spur cable: 60m in IIC/IIB.
- A Fieldbus-data-signal terminator, providing a capacitance less than or equal to  $1.1 \mu\text{F}$  connected in series with a resistor greater than or equal to  $100 \Omega$ , is integrated in the Barrier DF47-12 and DF47-17; similar terminator may be connected to the other end of the Fieldbus circuit.
  - When meeting the parameter mentioned above, maximum permissible Fieldbus-cable length including length of all spur cables for Group IIC is 1000 m.
  - When meeting the parameter mentioned above, maximum permissible Fieldbus-cable length including length of all spur cables for Group IIB and Group I is 5000 m.

\* $C_i$  : Input's capacitance,  $L_i$  : Input's inductance,  $C_o$  : Output's capacitance,  $L_o$  : Output's inductance

## Hazardous locations approvals

### FM Approvals (Factory Mutual)

**DF47-12 FISCO Power Supply**
**Associated Intrinsic Safety** (FM 3017363)

AIS Class I, Division 1, Groups A, B, C and D

AIS Class II, Division 1, Groups E, F and G

AIS Class III, Division 1

AIS Class I, Zone 0 [AEx ia], Group IIC

**Special conditions for safe use:**

Entity FISCO Trapezoidal Characteristic:

Terminals 1 and 2 Groups A/B IIC:

 $V_{oc} (U_o) = 15.0 \text{ V}$ ,  $I_{sc} (I_o) = 140 \text{ mA}$ ,  $I_{knee} (I_s) = 82 \text{ mA}$ ,  $P_o = 1.2 \text{ W}$ ,  $C_a (C_o) = 0.23 \mu\text{F}$ ,  $L_a (L_o) = 0.15 \text{ mH}$ 

Terminals 1 and 2 Groups C IIB

 $V_{oc} (U_o) = 15.0 \text{ V}$ ,  $I_{sc} (I_o) = 140 \text{ mA}$ ,  $I_{knee} (I_s) = 82 \text{ mA}$ ,  $P_o = 1.2 \text{ W}$ ,  $C_a (C_o) = 0.75 \mu\text{F}$ ,  $L_a (L_o) = 0.5 \text{ mH}$ 

 Integral Terminator:  $R = 100 \Omega$ ,  $C = 1.0 \mu\text{F}$ ,  $C_i = 0$ ,  $L_i = 0$ 

Note: The Fieldbus Isolated Barrier shall be installed in compliance with the enclosure, mounting, spacing and segregation requirements of the ultimate application, including a tool removable cover.

 Ambient Temperature:  $-20^\circ\text{C} \leq T_a \leq +60^\circ\text{C}$ 
**DF47-17 FISCO Power Supply**
**Associated Intrinsic Safety** (FM 3017363)

AIS Class I, Division 1, Groups A, B, C and D

AIS Class II, Division 1, Groups E, F and G

AIS Class III, Division 1

AIS Class I, Zone 0 [AEx ia], Group IIC

**Special conditions for safe use:**

Entity FISCO Trapezoidal Characteristic:

Terminals 1 and 2 Groups A/B IIC:

 $V_{oc} (U_o) = 15.0 \text{ V}$ ,  $I_{sc} (I_o) = 197 \text{ mA}$ ,  $I_{knee} (I_s) = 115 \text{ mA}$ ,  $P_o = 1.72 \text{ W}$ ,  $C_a (C_o) = 0.21 \mu\text{F}$ ,  $L_a (L_o) = 0.15 \text{ mH}$ 

Terminals 1 and 2 Groups C IIB

 $V_{oc} (U_o) = 15.0 \text{ V}$ ,  $I_{sc} (I_o) = 197 \text{ mA}$ ,  $I_{knee} (I_s) = 115 \text{ mA}$ ,  $P_o = 1.72 \text{ W}$ ,  $C_a (C_o) = 0.7 \mu\text{F}$ ,  $L_a (L_o) = 0.5 \text{ mH}$ 

 Integral Terminator:  $R = 100 \Omega$ ,  $C = 1.0 \mu\text{F}$ ,  $C_i = 0$ ,  $L_i = 0$ 

Note: The Fieldbus Isolated Barrier shall be installed in compliance with the enclosure, mounting, spacing and segregation requirements of the ultimate application, including a tool removable cover.

 Ambient Temperature:  $-20^\circ\text{C} \leq T_a \leq +60^\circ\text{C}$ 

### EXAM (BBG Prüf - und Zertifizier GmbH)

Non Intrinsically safe circuits Parameters:

 Power Supply  $U_n = 24 \text{ Vdc}$ ,  $U_m = 250 \text{ Vac}$ ,  $P_n = 3 \text{ W}$ 

 Fieldbus signal circuits  $U_m = 250 \text{ Vac}$ 
**DF47-12 FISCO Power Supply**
**Associated Intrinsic Safety (BVS 03ATEX E 411X)**

Group II, Category (1) G, [Ex ia, EPL Ga], Groups IIB/ IIC FISCO Power Supply

Group I, Category (M2) [Ex ia, EPL Mb], Group I

Intrinsically safe fieldbus supply and signal circuit (FISCO-Model):

Safety parameters:

 $U_o = 15.0 \text{ Vdc}$ ,  $I_o = 140.12 \text{ mA}$ ,  $I_s = 80 \text{ mA}$ ,  $P_o = 1200 \text{ mW}$ ,  $R_i \geq 247.5 \Omega$ ,

Characteristics trapezoidal

**Special conditions for safe use**

The Fieldbus-Isolated Barrier type DF47 -\*\* shall be installed outside the hazardous area.

Wiring in the terminal box must satisfy the conditions of clause 6.3.11 and clause 7.6.e of EN60079-11:2007

Terminals or connectors for the intrinsically safe fieldbus supply and signal circuit circuits shall be arranged according to clause 6.21 or 6.2.2 of EN 60079-11:2007 respectively.

Local installation rules to determine Lo and Co are replaced by apparatus- and cable-parameters in clause 15.3.2.

For Group I application interconnection of fieldbus-apparatus to an intrinsically safe electrical system shall be assessed in a System Certificate, if required in local installation rules.

Ambient Temperature:  $-20^{\circ}\text{C} \leq T_a \leq +60^{\circ}\text{C}$

**The Essential Health and Safety Requirements are assured by compliance with:**

- EN 60079-0:2009 General Requirements
- EN 60079-11:2007 Intrinsic Safety “i”
- EN 60079-26:2007 Equipment with equipment protection level (EPL) Ga
- EN 60079-27:2008 Fieldbus intrinsically safe concept (FISCO)

**DF47-17 FISCO Power Supply**

**Associated Intrinsic Safety (BVS 03ATEX E 411X)**

Group II, Category (1) G, [Ex ia, EPL Ga], Groups IIB/ IIC FISCO Power Supply

Group I, Category (M2) [Ex ia, EPL Mb] Group I

Intrinsically safe fieldbus supply and signal circuit (FISCO-Model):

Safety parameters:

$U_o = 15.0 \text{ Vdc}$ ,  $I_o = 197 \text{ mA}$ ,  $I_s = 115 \text{ mA}$ ,  $P_o = 1720 \text{ mW}$ ,  $R_i \geq 176.22 \Omega$ ,

Characteristics trapezoidal

**Special conditions for safe use**

The Fieldbus-Isolated Barrier type DF47 -\*\* shall be installed outside the hazardous area.

Wiring in the terminal box must satisfy the conditions of clause 6.3.11 and clause 7.6.e of EN60079-11:2007

Terminals or connectors for the intrinsically safe fieldbus supply and signal circuit circuits shall be arranged according to clause 6.21 or 6.2.2 of EN 60079-11:2007 respectively.

Local installation rules to determine Lo and Co are replaced by apparatus- and cable-parameters in clause 15.3.2.

For Group I application interconnection of fieldbus-apparatus to an intrinsically safe electrical system shall be assessed in a System Certificate, if required in local installation rules.

Ambient Temperature:  $-20^{\circ}\text{C} \leq T_a \leq +60^{\circ}\text{C}$

**The Essential Health and Safety Requirements are assured by compliance with:**

- EN 60079-0:2009 General Requirements
- EN 60079-11:2007 Intrinsic Safety “i”
- EN 60079-26:2007 Equipment with equipment protection level (EPL) Ga
- EN 60079-27:2008 Fieldbus intrinsically safe concept (FISCO)

**CEPEL (Centro de Pesquisa de Energia Elétrica)**

Non Intrinsically safe circuits parameters:

Power Supply  $U_n = 24 \text{ Vdc}$ ,  $P_n = 3 \text{ W}$

**DF47-12 FISCO Power Supply**

**Associated Intrinsic Safety (CEPEL 06.1095 X)**

[Ex ia, EPL Ga], Group IIB

Nominal values of the terminals Intrinsically safe (FISCO-Model):

$U_n = 14.0 \text{ V}$ ,  $I_n = 75 \text{ mA}$ ,  $P_n = 1200 \text{ mW}$

Safety parameters:

$U_m = 250 \text{ V}$ ,  $U_o = 15 \text{ V}$ ,  $I_o = 140.12 \text{ mA}$ ,  $I_s = 80 \text{ mA}$ ,  $P_o = 1200 \text{ mW}$ ,  $R_i \geq 247.5 \Omega$

Ambient Temperature:  $-20$  to  $60 \text{ }^{\circ}\text{C}$

**Special conditions for safe use**

The certificate number with “X” indicates that:

- a) The equipment was projected to connect with a fieldbus system according to FISCO model, as IEC60079-27:2008. The Fieldbus intrinsic safety device connected to the fieldbus terminator must be current passive consumer (not generator) and must display  $C_i \leq 5 \text{ nF}$  and  $L_i \leq 10 \text{ } \mu\text{H}$ ;
- b) Wiring in the terminal box must satisfy the conditions:
  - Resistance:  $15 \Omega/\text{km} \leq R_c \leq 1500/\text{km}$
  - Capacitance (including loop):  $45 \text{ nF}/\text{km} \leq C_c \leq 200 \text{ nF}/\text{km}$
  - Inductance:  $0,4 \text{ mH}/\text{km} \leq L_c \leq 1\text{mH}/\text{km}$

- c) The maximum length allowed for Fieldbus cables is 1000 m for Group IIC and 5000m for Group IIB

**The Essential Health and Safety Requirements are assured by compliance with:**

ABNT NBR IEC 60079-0:2008 General Requirements

ABNT NBR IEC 60079-11:2009 Intrinsic Safety "i"

ABNT NBR IEC 60079-26:2008 Equipment with equipment protection level (EPL) Ga

IEC 60079-27:2008 Fieldbus intrinsically safe concept (FISCO)

**DF47-17 FISCO Power Supply**

**Associated Intrinsic Safety (CEPEL 06.1095 X)**

[Ex ia, EPL Ga], Group IIB

Nominal values of the terminals Intrinsically safe (FISCO-Model):

$U_n = 14.0 \text{ V}$ ,  $I_n = 110 \text{ mA}$ ,  $P_n = 1700 \text{ mW}$

Safety parameters:

$U_m = 250 \text{ V}$ ,  $U_o = 15 \text{ V}$ ,  $I_o = 197 \text{ mA}$ ,  $I_s = 115 \text{ mA}$ ,  $P_o = 1720 \text{ mW}$ ,  $R_i \geq 176,22 \Omega$

Ambient Temperature: -20 to 60 °C

**Special conditions for safe use**

The certificate number with "X" indicates that:

- a) The equipment was projected to connect with a Fieldbus System according to FISCO model, as IEC60079-27:2008. The Fieldbus intrinsic safety device connected to the Fieldbus terminator must be current passive consumer (not generator) and must display  $C_i \leq 5 \text{ nF}$  and  $L_i \leq 10 \mu\text{H}$ ;
- b) Wiring in the terminal box must satisfy the conditions:
  - Resistance:  $15 \Omega/\text{km} \leq R_c \leq 1500/\text{km}$
  - Capacitance (including loop):  $45 \text{ nF}/\text{km} \leq C_c \leq 200 \text{ nF}/\text{km}$
  - Inductance:  $0,4 \text{ mH}/\text{km} \leq L_c \leq 1\text{mH}/\text{km}$
- c) The maximum length allowed for Fieldbus cables is 1000 m for Group IIC and 5000m for Group IIB

**The Essential Health and Safety Requirements are assured by compliance with:**

ABNT NBR IEC 60079-0:2008 General Requirements

ABNT NBR IEC 60079-11:2009 Intrinsic Safety "i"

ABNT NBR IEC 60079-26:2008 Equipment with equipment protection level (EPL) Ga



IEC 60079-27:2008 Fieldbus intrinsically safe concept (FISCO)


## Identification labels and control drawings

### DF47-12 – Intrinsic Safety Barrier for Fieldbus

#### Labels


**DF47-12 INTRINSIC SAFETY BARRIER FOR FIELDBUS**  
Safety Parameters:

|   |   |
|---|---|
|  | Intrinsically Safe Connections for,<br>CL I, DIV1, GP ABCDEFG and CL I, ZONE 0, GP IIC [AEx ia] IIC<br>"See Instalation drawing 102A0948 for FM FISCO parameters" |
|  | BVS 03 ATEX E 411 X<br>II (1)G [Ex ia Ga] IIB / IIC FISCO Power Supply<br>I (M2) [Ex ia Mb] I   |

 **0470**



**Non Intrinsically Safe Fieldbus signal circuits.**  
Voltage  $U_m$  AC 250 V - Max. Tamb. 60 °C

|   |             |    |           |
|---|-------------|----|-----------|
| <b>Intrinsically Safe Fieldbus supply - and signal circuit (FISCO).</b> |             |    |           |
| Voltage   | (Uo) Voc    | DC | 15.0 V    |
| Short circuit current   | (Io) Isc    |    | 140 mA    |
| Supply current at 15V   | (Is) Iknee  |    | 82 mA     |
| Power   | Po          |    | 1.2 W     |
| Current limiting resistor   | Ri          | ≥  | 247.5 ohm |
| Characteristics   | trapezoidal |    |           |





**DF47-12 Barreira de Segurança Intrinseca Fieldbus**

**FISCO Power Supply**  
[Ex ia Ga] IIB CEPEL 06.1095 X  
 $U_m = 250Vca$   $T_{amb}: -20^{\circ}C$  a  $60^{\circ}C$

|  |                         |                                       |
|--|-------------------------|---------------------------------------|
| <br><br> | <b>Valores Nominais</b> | <b>[Ex ia Ga] IIB CEPEL 06.1095 X</b> |
|  | $U_N = 14Vcc$           | $U_o = 15V$                           |
|  | $I_N = 75mA$            | $I_o = 140,12mA$                      |
|  | $P_N = 1200mW$          | $P_o = 1200mW$                        |
|  |                         | $I_s = 80mA$                          |
|  | $R_i \geq 247,5 \Omega$ |                                       |
| $T_{amb}: -20^{\circ}C$ a $60^{\circ}C$  |                         |                                       |

Circuito não Intrinsecamente Seguro  
 $U_m = 250Vca$   $U_N = 24Vcc$   $P_N = 3W$

**HAZARDOUS (CLASSIFIED) LOCATION  
CLASS I, II, III, GROUPS A, B, C, D, E, F, G.**

**REQUIREMENTS:**

1- THE MAXIMUM NON-HAZARDOUS LOCATION VOLTAGE IS 250 VAC/DC.

INSTALLATION MUST BE IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE (NFPA 70, ARTICLE 504 OR 505) AND ANSI/ISA-RP12.06.01.

**NON-HAZARDOUS LOCATION**

|  |             |
|--|-------------|
| Intrinsically safe fieldbus supply<br>-and signal circuit (FISCO). |             |
| Voltage (Lo) Voc   | DC 15.0V    |
| Short circuit current (Io) Isc                                     | 140mA       |
| Supply current at 15V (Is) Iknep                                   | 82mA        |
| Power Po   | 1.2W        |
| Current limiting resistor Ri                                       | ≥ 247.5ohm  |
| Characteristics  | trapezoidal |

INTRINSICALLY SAFE OUTPUT FOR CLASS I, DIV. 1, GP A,B,C,D,E,F,G AND CLASS I, ZONE 0, [AEX ia II C];

CABLE PARAMETERS R=15 TO 150ohms per Km, L= 0.4 to 1mH per km, C= 80 to 200nF per km, INCLUDING SCREEN IF APPLICABLE

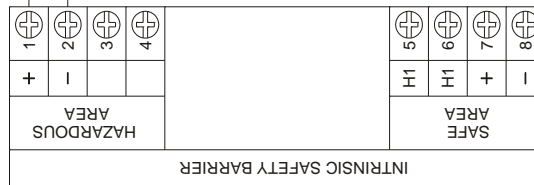
C= C' CONDUCTOR / CONDUCTOR + 0.5 C' CONDUCTOR / SCREEN, IFBUS CIRCUIT IS POTENTIAL FREE (BALANCED).


C= C' CONDUCTOR / CONDUCTOR + C' CONDUCTOR / SCREEN IF SCREEN IS CONNECTED WITH ONE TERMINAL OF THE BARRIER.

BARRIER INCLUDES TERMINATOR R=100ohms, C=1uF, Ci=0, Li=0

GP A,B/IC Ca (Co) = 0.23uF, La (Lo) = 0.15mH

GP C,D/IB,IIA Ca (Co) = 0.75uF, La (Lo) = 0.5mH





APPROVED

smar

|                    |                |           |
|--------------------|----------------|-----------|
| NUMBER<br>102A0948 |                | REV<br>02 |
| SCALE              | SHEET<br>01/01 |           |




|                               |                     |                    |                   |
|-------------------------------|---------------------|--------------------|-------------------|
| APPROVAL CONTROLLED BY C.A.R. |                     |                    |                   |
|                               | / /                 | / /                |                   |
| 2                             | MARCIAL<br>17/09/07 | DÉLCIO<br>17/09/07 | ALT-DE<br>0049/07 |
| 1                             | MOACIR<br>29/11/04  | DÉLCIO<br>29/11/04 | ALT-DE<br>0119/04 |
| REV                           | BY                  | APPROVAL           | DOC               |


|                             |                                 |                                |                                |
|-----------------------------|---------------------------------|--------------------------------|--------------------------------|
| DRAWN<br>MOACIR<br>03/02/03 | CHECKED<br>SINASTRE<br>03/02/03 | PROJECT<br>BASÍLIO<br>03/02/03 | APPROVAL<br>DÉLCIO<br>03/02/03 |
| EQUIPMENT: DF47-12          |                                 |                                |                                |
| CONTROL DRAWING             |                                 |                                |                                |






DF47-17 – Intrinsic Safety Barrier for Fieldbus

Labels

| <b>DF47-17 INTRINSIC SAFETY BARRIER FOR FIELDBUS</b>                              |   |
|---|---|
| Safety Parameters:  |   |
|  | Intrinsically Safe Connections for,<br>CL I, DIV1, GP ABCDEFG and CL I, ZONE 0, GP IIC [AEx ia] IIC<br>"See Instalation drawing 102A0949 for FM FISCO parameters"                 |
|  | BVS 03 ATEX E 411 X<br>II (1)G [Ex ia Ga] IIB / IIC FISCO Power Supply <br>I (M2) [Ex ia Mb] I |
| <b>Non Intrinsically Safe Fieldbus signal circuits.</b>                           |   |
| Voltage $U_m$ AC 250 V - Max. Tamb. 60 °C   |   |
| <b>Intrinsically Safe Fieldbus supply - and signal circuit (FISCO).</b>           |   |
| Voltage   | (U <sub>o</sub> ) Voc DC 15.0 V   |
| Short circuit current   | (I <sub>o</sub> ) Isc 197 mA  |
| Supply current at 15V   | (I <sub>s</sub> ) Iknee 115 mA  |
| Power   | P <sub>o</sub> 1.72 W   |
| Current limiting resistor   | R <sub>i</sub> ≥ 176.22 ohm   |
| Characteristics   | trapezoidal   |



| <b>DF47-17 Barreira de Segurança Intrinseca Fieldbus</b>                            |  |
|---|--|
| <b>FISCO Power Supply</b>   |  |
| [Ex ia Ga] IIB CEPTEL 06.1095 X   |  |
| $U_m = 250Vca$  | $T_{amb}: -20^{\circ}C a 60^{\circ}C$  |
|  | <b>Valores Nominais [Ex ia Ga] IIB CEPTEL 06.1095 X</b>  |
| $U_N = 14Vcc$   | $U_o = 15V$  |
| $I_N = 110mA$   | $I_o = 197mA$  |
| $P_N = 1700mW$  | $P_o = 1720mW$   |
|   | $I_s = 115mA$  |
|   | $R_i \geq 176,22 \Omega$   |
| $T_{amb}: -20^{\circ}C a 60^{\circ}C$   |  |
| <b>Circuito não Intrinsecamente Seguro</b>  |  |
| $U_m = 250Vca$  | $U_N = 24Vcc$ $P_N = 3W$  |



**HAZARDOUS (CLASSIFIED) LOCATION  
CLASS I, II, III, GROUPS A, B, C, D, E, F, G.**

**REQUIREMENTS:**

1- THE MAXIMUM NON-HAZARDOUS LOCATION VOLTAGE IS 250 V AC/DC.

INSTALLATION MUST BE IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE (NFPA 70, ARTICLE 504 OR 505) AND ANSI/ISA-RP12.06.01.

**NON-HAZARDOUS LOCATION**

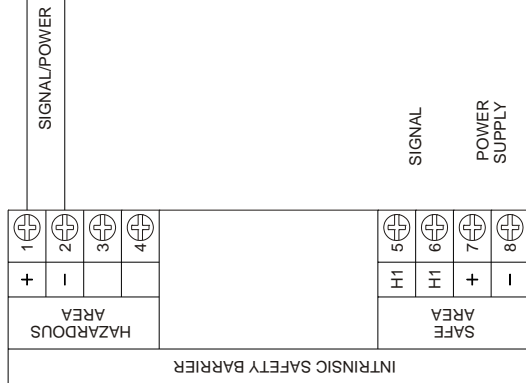
**Intrinsically safe fieldbus supply  
-and signal circuit (FISCO):**



|                           |                                    |             |
|---------------------------|------------------------------------|-------------|
| Voltage                   | (U <sub>0</sub> )Voc               | 15.0V DC    |
| Short circuit current     | (I <sub>0</sub> )Isc               | 197mA       |
| Supply current at 15V     | (I <sub>s</sub> )I <sub>knee</sub> | 115mA       |
| Power                     | P <sub>0</sub>                     | 1.72W       |
| Current limiting resistor | R <sub>i</sub>                     | ≥ 176.22ohm |
| Characteristics           |                                    | trapezoidal |

INTRINSICALLY SAFE OUTPUT FOR CLASS I, DIV. 1, GP A,B,C,D,E,F,G AND CLASS I, ZONE 0, [AEX ia II C];  
CABLE PARAMETERS R'=15 TO 150ohms per Km, L= 0.4 to 1mH per km, C= 80 to 200nF per km, INCLUDING SCREEN IF APPLICABLE  
C= C' CONDUCTOR / CONDUCTOR + 0.5 C' CONDUCTOR / SCREEN, IF BUS CIRCUIT IS POTENTIAL FREE (BALANCED);  
C= C' CONDUCTOR / CONDUCTOR + C' CONDUCTOR / SCREEN IF SCREEN IS CONNECTED WITH ONE TERMINAL OF THE BARRIER.

BARRIER INCLUDES TERMINATOR R=100ohms, C=1uF, Ci=0, Li=0

GP A,B/IC Ca (Co) = 0.21uF, La (Lo) = 0.15mH  
GP C,D/IB,IIA Ca (Co) = 0.7uF, La (Lo) = 0.5mH



|                               |                         |                        |                   |                        |                          |                         |                        |   |   |
|-------------------------------|-------------------------|------------------------|-------------------|------------------------|--------------------------|-------------------------|------------------------|---|---|
| APPROVAL CONTROLLED BY C.A.R. |                         |                        |                   | DRAWN                  | CHECKED                  | PROJECT                 | APPROVAL               | <br>APPROVED |   |
|                               |                         |                        |                   | MOACIR<br>03 / 02 / 03 | SINASTRE<br>03 / 02 / 03 | BASÍLIO<br>03 / 02 / 03 | DÉLCIO<br>03 / 02 / 03 |   |  |
| 2                             | MARCIAL<br>17 / 09 / 07 | DÉLCIO<br>17 / 09 / 07 | ALT-DE<br>0049/07 | EQUIPMENT: DF47-17     |                          |                         |                        | NUMBER<br>102A0949  |   |
| 1                             | MOACIR<br>29 / 11 / 04  | DÉLCIO<br>29 / 11 / 04 | ALT-DE<br>0119/04 | CONTROL DRAWING        |                          |                         |                        | SCALE   | SHEET<br>01/01  |
| REV                           | BY                      | APPROVAL               | DÓC               |                        |                          |                         |                        |   |   |



# Section 14

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## ADDING INTERFACES

### *Introduction*

There are several interface modules available for DFI302 that provide a wide connectivity to different media used in the Automation and Process Control Industry.

In applications that connect Modbus RTU to DFI302, and require more than one Modbus device in the same Modbus network, it is necessary the use of RS-232/RS-485 module interface to provide a multipoint communication.

In the cases where only one Modbus device is used, and the distance between both devices are longer than 15 meters, the RS-232/RS-485 module interface is also necessary.

Originally, the controllers were designed to be connected to the Ethernet 10 Mbps port. In order to connect it in an Ethernet 100 Mbps Local Area Network, add the Ethernet Switch 10/100 Mbps module.

The following table shows the available Interface module types.

| INTERFACES |                             |          |
|------------|-----------------------------|----------|
| MODEL      | DESCRIPTION                 | I/O TYPE |
| DF58       | RS-232/RS-485 Interface     | No I/O   |
| DF61       | Ethernet Switch 10/100 Mbps | No I/O   |

The specifications for each module are shown is the next pages.

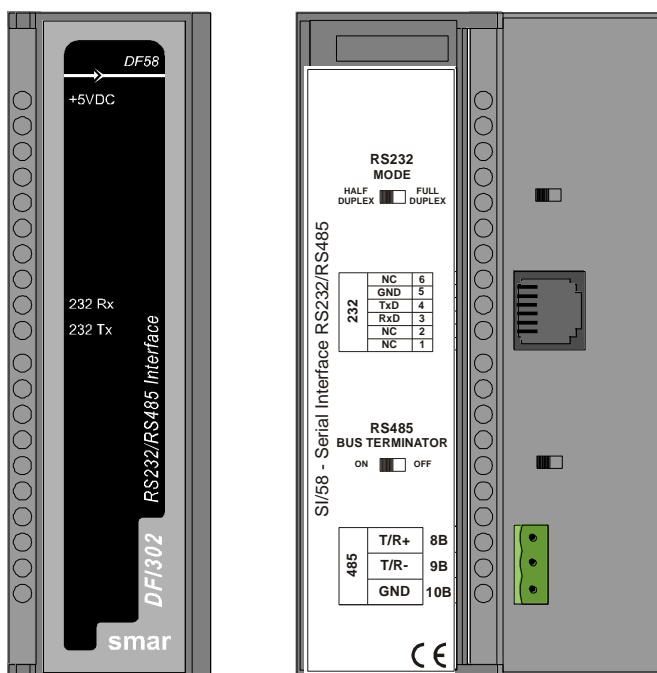
## DF58 – RS-232/RS-485 Interface

### Description

This module converts the electrical characteristics of the communication signal from the RS-232 to RS-485 specifications. Due to the different purposes of use between RS-232 and RS-485, where the first one is proper to peer-to-peer applications, this module was implemented to work automatically.

No control signal is necessary to control the RS-485 bus. Simply connect the transmission and reception lines on the both sides to have the interface operational.

The converter circuit isolates the signal to guarantee a safe connection between both systems. This module was designed to be use with DFI302/LC700 platforms and, no power supply was embedded in the board. It uses the +5 Vdc voltage from the rack to energize the circuit.



### Interface Settings

There are two interfaces settings located on the front panel to adapt the interface to the applications: RS-232 Mode and RS-485 Bus Terminator.

#### RS-232 Mode: Half-Duplex/Full-Duplex

The RS-232 Mode setting adapts the use of RS-232/RS-485 Interface to the communication driver RS-232. Usually, these interfaces connect unidirectional buses with bidirectional buses. The unidirectional bus can contain Full-Duplex features caused by echoes of the transmitted message.

If the driver does not support the reception/transmission simultaneously, because the reception disables or discards the reflected message, select the **Half-Duplex** option. If the reflected message does not disturb the applications, select the **Full-Duplex** option.

#### RS-485 Bus Terminator: On/Off

The RS-485 is a multidrop bus. The transmitter driver is set to high impedance (Hi-Z) state when there is no message to be transmitted. However, the RS-485 bus requires a bus terminator in order to avoid noise problems during the idle time of the RS-485. A perfect line impedance match is necessary to activate only one terminator by bus. The other terminators must be deactivated.

## Connectors

Two connectors are available on the front panel to interconnect two communication systems: RJ-12 type connector, used in RS-232 systems; and a terminal block type connector, used in RS-485 systems.

### RJ12 Pin Assignment

| PIN NUMBER | DESCRIPTION                              |
|------------|--|
| 1          | Connected to pin 6                       |
| 2          | Not used                                 |
| 3          | RxD: RS-232 input signal - reception     |
| 4          | TxD: RS-232 output signal - transmission |
| 5          | GND: RS-232 grounding signal             |
| 6          | Connected to pin 1                       |

#### NOTE

Pins 1 and 6 are interconnected to allow the interconnection of the modem signals requested by communication drivers, such as Clear-To-Send (CTS) with Request-To-Send (RTS).

### Block Terminal Pin Assignment

| PIN NUMBER | DESCRIPTION                                     |
|------------|---|
| 1          | +: RS-485 Non-inverting signal                  |
| 2          | -: RS-485 Inverting Signal                      |
| 3          | GND: Reference for RS-485 Communication Signal. |

#### NOTE

The pin GND sets the voltage reference for all RS-485 nodes. The RS-485 side of the RS-232/RS-485 Interface is isolated and left on floating state. To avoid undesirable high common mode voltage, it is recommended to set all RS-485 nodes to the same reference voltage by connecting all pins GND together and grounding at the same point.

## Technical Specifications

| GENERAL FEATURES                |   |
|---------------------------------|---|
| Number of Communication Channel | 1   |
| Data Communication Interface    | RS-232 / RS-485                                 |
| Data rate                       | Up to 200 Kbps                                  |
| RS-232 side                     | Enables RS-232 Half-Duplex or Full-Duplex mode  |
| RS-485 side                     | Enables Embedded Bus Terminator activation      |
| Isolation                       | 1600 Vrms @ 1 minute, typical                   |
| Power Supply                    | Provided by the IMB bus, +5 Vdc @ 60 mA Typical |

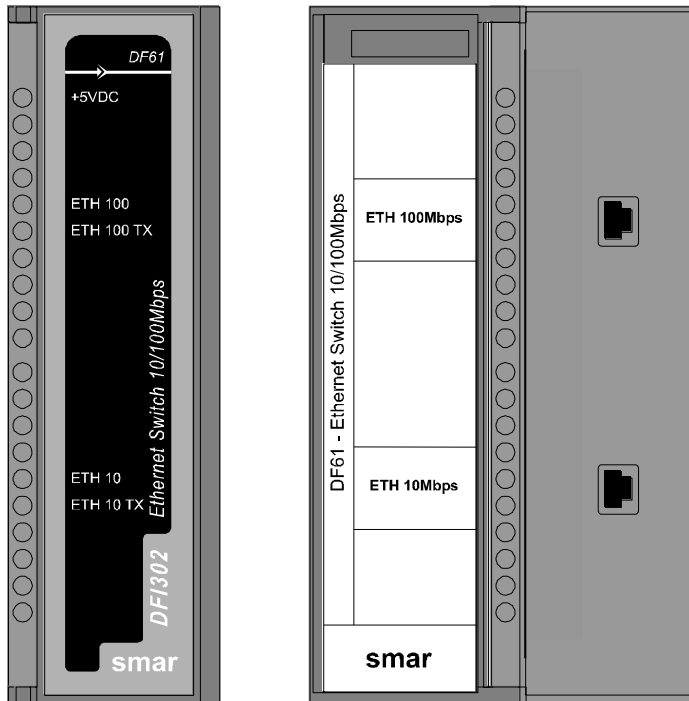
## DF61 – Ethernet Switch 10/100 Mbps

This module connects the DF51 directly to an Ethernet 100 Mbps Local Area Network (LAN).

The only procedures to follow are:

- 1 - Fix the DF61 in a rack, and
- 2 - Using DF54 cable, connect DF61 to the 10 Mbps port of the DF51. Afterwards, the 100 Mbps port will be ready to be connected to the LAN.

Make sure that the Ethernet is perfectly communicating, check if the ETH10 and ETH100 LED indicators are ON (link connected), and ETH10TX and ETH100TX are blinking in the same rate of DF51.



## ADDING MODBUS

### Introduction

Several features of the DFI302 were designed to slowly migration of the existing plants to Fieldbus, protecting at the same time, as much as possible, the industry investments avoiding the requirements of the new devices. One of these features is the RS-232 Serial Communication Port, on the controller module that allows the connection to a wide range of legacy common devices in the existing plants using the Modbus Protocol.

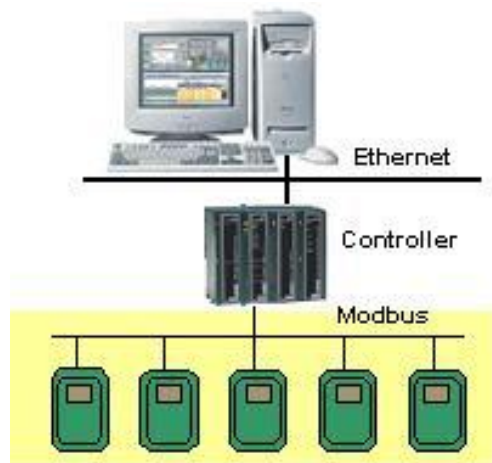
The Modbus protocol has become one of the most popular factory standards. Existing projects have many devices and subsystems using this protocol.

The controller modules can act as master or slave device, and allows the communication through RS-232 or Ethernet ports, using in this last case, Modbus TCP/IP. The RS-232 Serial Port is integrated into the CPU module. When the RS-485 port is necessary, it is necessary to add an additional Interface Module (DF58).

| NOTE DF89  |
|--|
| The controller DF89 has different treatment and Modbus configurations according to the firmware version:   |
| <ul style="list-style-type: none"><li>• From firmware version 4 and Device Description 4 the DF89 supports the master and slave Modbus features. The module configuration is different from the configuration of other DFI302 controllers. In this case refer to “Creating a Modbus configuration using the DF89” section.</li><li>• For firmware up to version 3 and Device Description 3 the DF89 only has the characteristic of Modbus slave. In this case, it has the same Modbus features of other controllers described in this section.</li></ul> |

In master mode, the DFI302 can read and write data to the Modbus slaves.

The DFI302 uses the standard Modbus commands for read and write data, making the slave data available for use in the control strategy or, for displaying and trending in the operator workstation. Operator can also operate the slave devices and execute other supervisory functions. The inputs are available as normal parameters that can be used in the control strategy or simply for monitoring, alarm and trend.



Most of the systems, such as DCS or PLC, have serial interface modules that support Modbus. These modules can be used to supervise Fieldbus instruments through the DFI302 controller as a gateway.

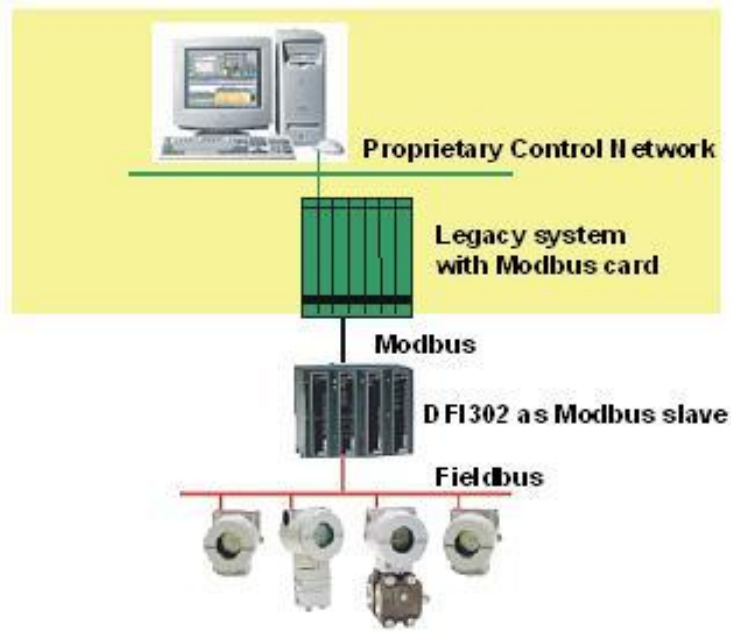
For the system connections, some extra interfaces can be necessary:

- For applications which the controller is connected through Modbus RTU protocol to the Modbus



network with many Modbus devices, it is necessary the RS-232/RS-485 converter interface in order to provide the multipeer communication functionality;

- For the peer-to-peer applications where the Modbus device is used, but the distance with the controller is larger than 15 meters, it is also required a RS-232/RS-485 converter interface.



The DFI302 data can be read or written by the master, when the DFI302 operates in a slave mode. The data can be accessed in a binary format (functions 1, 2, 5 and 15) or through registers (functions 3, 4, 6 and 16).

Through DFI302, Fieldbus devices can be connected to an existing legacy control system allowing the existing system accesses some of the capabilities provided by Fieldbus devices. Traditional process variables and controller gains can be mapped from the Fieldbus to the database of existing system, but this system does not have the control level networking bandwidth and software capability, i.e., the fully benefits from the Fieldbus technology. However, this solution can be applied during the transition period to an open system.

It is easy to use the Modbus port. No DIP switches are required. The status LED on the front panel indicates active communication.

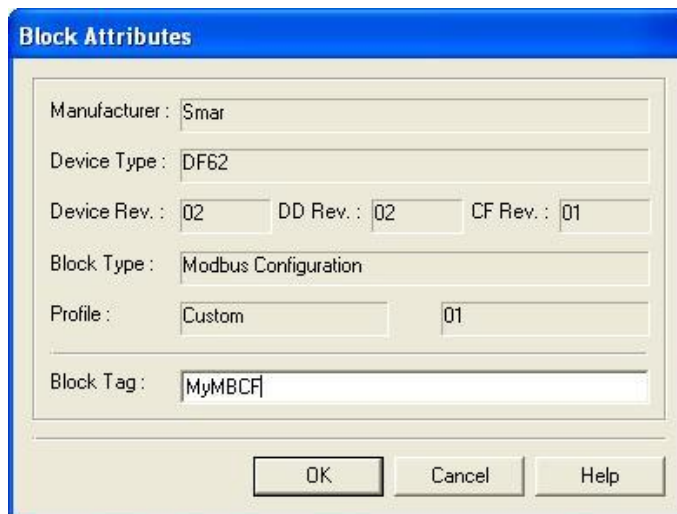
## Steps to Configure Modbus

DFI302 uses **Syscon** to create all the required functionality, including Modbus. Refer to the chapter “**Adding Function Blocks**” for further information on adding function blocks to the **Syscon** configuration. Remember that Modbus function blocks are available in different DD revisions.

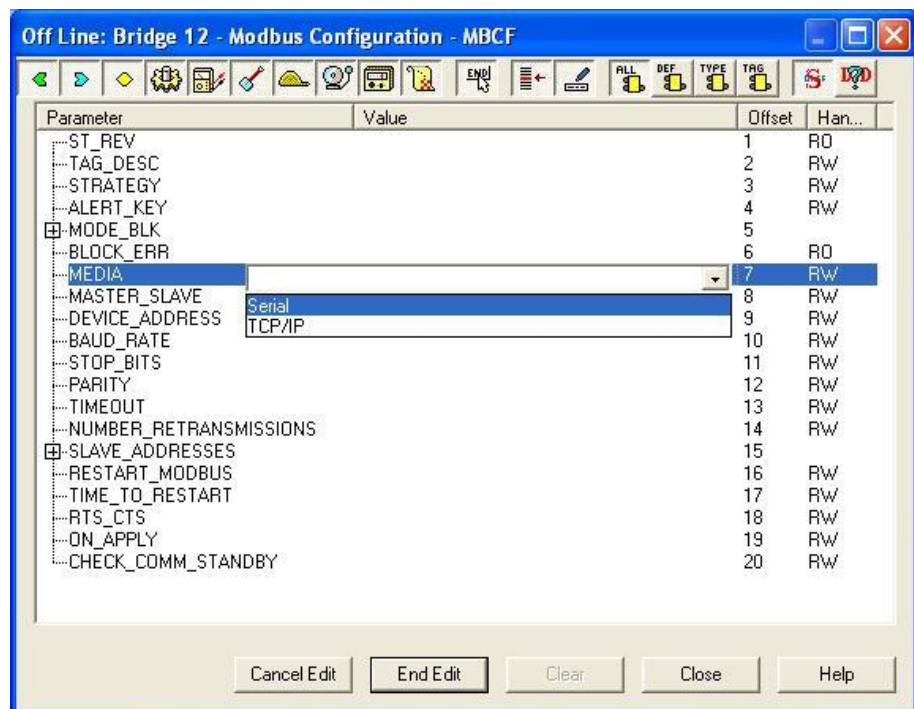
- 1) In order to include Modbus functionality inside DFI302, create first a MBCF block (Modbus Configuration Block).

**NOTE**

Remember that the Resource block must be created previously and set to **AUTO**.



- 2) Set parameters according to media, baud rate, addresses, etc.



## MBCF - Parameters Description

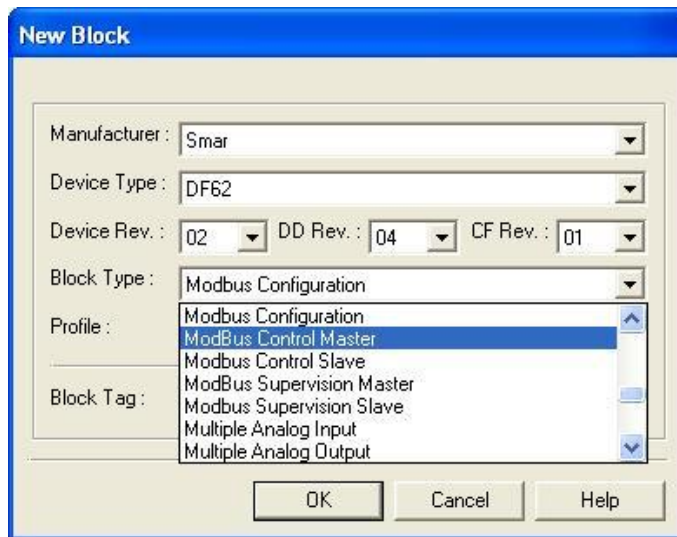
For further information about parameters description, please see Function Blocks Manual.

| Idx | Parameter               | Data Type (length) | Valid Range/ Options  | Default Value | Units | Store/ Mode | Description  |
|-----|-------------------------|--------------------|---|---------------|-------|-------------|--|
| 1   | ST_REV                  | Unsigned16         |   | 0             | None  | S/RO        |  |
| 2   | TAG_DESC                | OctString(32)      |   | Spaces        | Na    | S           |  |
| 3   | STRATEGY                | Unsigned16         |   | 0             | None  | S           |  |
| 4   | ALERT_KEY               | Unsigned8          | 1 to 255  | 0             | None  | S           |  |
| 5   | MODE_BLK                | DS-69              |   | O/S           | Na    | S           | See Mode Parameter   |
| 6   | BLOCK_ERR               | Bitstring(2)       |   |               | E     | D / RO      |  |
| 7   | MEDIA                   | Unsigned8          | 0:Serial, 1:TCP/IP  | Serial        | E     | S           | Define the type of Modbus channel.   |
| 8   | MASTER_SLAVE            | Unsigned8          | 0:Master, 1:Slave   | Slave         | E     | S           | Define if DFI is master or slave.  |
| 9   | DEVICE_ADDRESS          | Unsigned8          | 1-247   | 1             | E     | S           | Define the DFI Modbus address (only for DFI slave).  |
| 10  | BAUD_RATE               | Unsigned8          | 0:110, 1:300, 2:600, 3:1200, 4:2400, 5:4800, 6:9600, 7:19200, 8:38400, 9:57600, 10:115200 | 19200         | E     | S           | Define the baud rate (only for media serial).  |
| 11  | STOP_BITS               | Unsigned8          | 0:1, 1:2  | 1             | E     | S           | Define the number of stop bits (only for media serial).  |
| 12  | PARITY                  | Unsigned8          | 0:None, 1:Even, 2:Odd.  | Even          | E     | S           | Define the parity (only for media serial).   |
| 13  | TIMEOUT                 | Unsigned16         | 200-65535   | 2000          | ms    | S           | Time value to wait a response from a slave (for DFI master), or time to wait the OUTs are updated (for DFI slave).   |
| 14  | NUMBER_RETRANS MISSIONS | Unsigned8          | 0-255   | 1             |       | S           | Number of retransmission if DFI doesn't receive response from slave.   |
| 15  | SLAVE_ADDRESSES         | DS-263             |   |               |       | S           | IP number and Modbus addresses of slaves ( only for DFI master in TCP/IP media);   |
| 16  | RESTART_MODBUS          | Boolean            |   | FALSE         |       | S           | Not used.  |
| 17  | TIME_TO_RESTART         | Unsigned16         | 100-65535 (Master)<br>0-65535 (Slave)   | 500           | ms    | S           | When the device is working as master, it is the scan cycle of Modbus requests. When the device is working as slave, it is the delay for responses in Modbus TCP, aimed at restricting too short cycle by the master. |
| 18  | RTS_CTS                 | Boolean            |   | FALSE         |       | S           | Enable or not handshaking.   |
| 19  | ON_APPLY                | Unsigned8          | 0:None, 1: Apply  | None          | E     | S           | Apply the changes made in the Modbus blocks.   |
| 20  | CHECK_COMM_STANDBY      | Unsigned8          | 0 ~ 255   | 0             | NA    | S / RW      | It configures for the Standby if it will test the Modbus communication with the slave devices.<br><br>0: Disable test.<br>1 – 255: Enable test defining the time interval between each test (s).                     |

Legend: E – Enumerated parameter; Na – Dimensionless parameter; RO – Read only; D – dynamic; N – non-volatile; S – Static  
Gray Background Line: Default Parameters of Syscon

When using the RS-232, install the DF58 module (RS-232/RS-485 Interface Module) if it is necessary to communicate with more than one Modbus instrument, that is, in a multipoint network. Refer to chapter “**Adding Interfaces**”.

- Now, create the other blocks. The Modbus available blocks are: MBSS (Modbus Supervision Slave), MBSM (Modbus Supervision Master), MBCS (Modbus Control Slave) and MBCM (Modbus Control Master).



When using these blocks, set the **MODE\_BLK.TARGET** to **AUTO**.

**IMPORTANT**

After downloading the whole configuration to DFI302, all the Modbus blocks will keep the element **MODE\_BLK.ACTUAL** in **Out of Service**.

This protection allows the user to create all the necessary blocks, and adjust all the parameters, even in Online Characterization, and change the **MODE\_BLK** to **AUTO** simultaneously, configuring the MBCF block and setting **ON\_APPLY** parameter to **APPLY**.

Other important parameter that should be defined for all blocks is **LOCAL\_MOD\_MAP** (0 - 15). Sixteen blocks are accepted per each functionality. For MBSS and MBCS blocks, the **LOCAL\_MOD\_MAP** parameter is used as offset for calculation of the Modbus slave addresses. The 255 value (default) disable the block.



**COMMUNICATION TIPS**

1. For a better synchronization of the Modbus blocks, execute **ON\_APPLY** in the master controller after the slave are already configured and running.
2. If the communication was not established on the first **ON\_APPLY**, just do another **ON\_APPLY** in the controller.

**RESTRICTIONS**

1. The MBSS block is only available at the DF51 controller.
2. The way that the Modbus works at DF73, DF75, DF79, DF81, DF89\*, DF95 and DF97 controllers is different from other controllers available in the DFI302 system. The MBCF must be configured and is not necessary to instantiate any Modbus function blocks. All the internal values existing in FFB (flexible function blocks) are automatically mapped in Modbus registers. See details in this section under item “Using Modbus in DF73, DF75, DF79, DF81, DF89\*, DF95 and DF97controllers”.
3. The roles of DF73, DF75, DF79, DF81, DF89\*, DF95 and DF97at Modbus are only Slave.

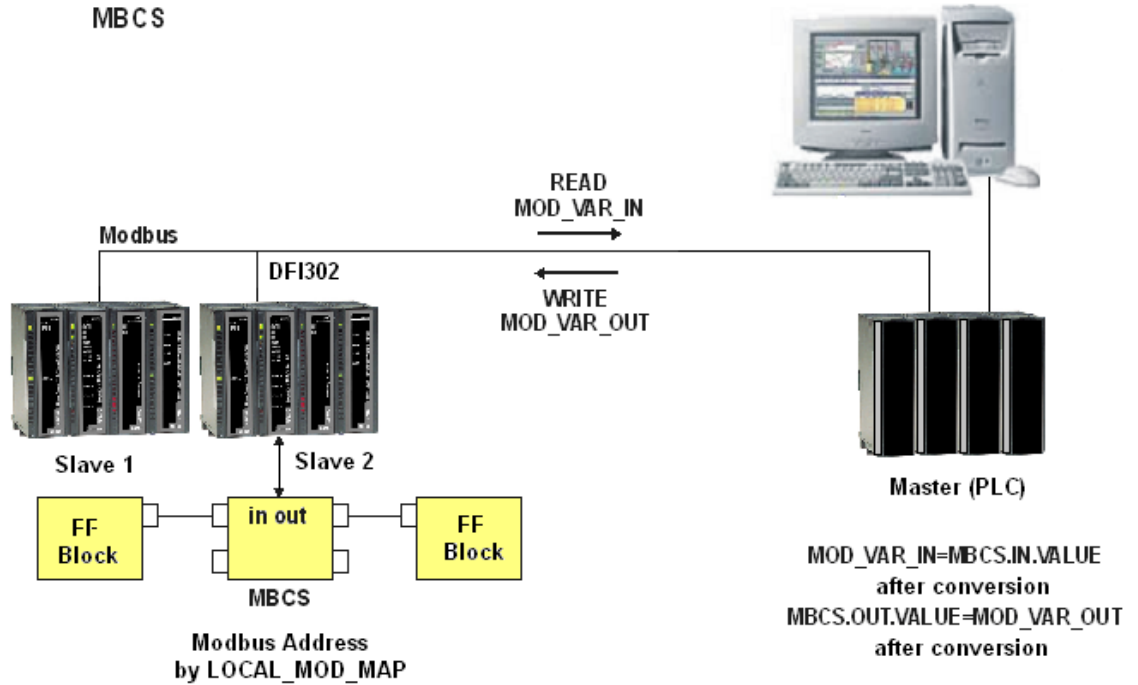
See “NOTE DF89”

The following scenarios summarize some of the applications that use the DFI302 Modbus functionality.

## MBCS – Modbus Control Slave

A master Modbus device needs to read and/or write some DFI302 Modbus registers, mapped directly to input and output variables at Fieldbus network.

Using **Syscon**, create one MBCF block and MBCS blocks (1 to 16 blocks are available). In the **Strategy** window, link these blocks with other FOUNDATION fieldbus blocks.



When setting the parameters, define **LOCAL\_MOD\_MAP** (0 - 15) and the **IN** and **OUT** parameters will point to pre-defined Modbus addresses. See **Modbus Slave Addresses** section for further information.

## Parameters Description

For further information about the parameters description, please refer to Function Blocks Manual.

| Idx | Parameter       | Data Type (length) | Valid Range/ Options | Default Value | Units | Store / Mode | Description  |
|-----|-----------------|--------------------|----------------------|---------------|-------|--------------|--|
| 1   | ST_REV          | Unsigned16         |                      | 0             | None  | S/RO         |  |
| 2   | TAG_DESC        | OctString(32)      |                      | Spaces        | Na    | S            |  |
| 3   | STRATEGY        | Unsigned16         |                      | 0             | None  | S            |  |
| 4   | ALERT_KEY       | Unsigned8          | 1 to 255             | 0             | None  | S            |  |
| 5   | MODE_BLK        | DS-69              |                      | O/S           | Na    | S            | See Mode Parameter.  |
| 6   | BLOCK_ERR       | Bitstring(2)       |                      |               | E     | D / RO       |  |
| 7   | LOCAL_MOD_MAP   | Unsigned8          | 0 to 15              | 0             |       | S / O/S      | Define the Modbus addresses.   |
| 8   | IN1             | DS-65              |                      |               |       | N            | Analog input 1   |
| 9   | SCALE_CONV_IN1  | DS-256             |                      |               |       | S / O/S      | Information to generate constants A and B in equation $Y=A*X+B$ .  |
| 10  | IN2             | DS-65              |                      |               |       | N            | Analog input 2   |
| 11  | SCALE_CONV_IN2  | DS-256             |                      |               |       | S / O/S      | Information to generate constants A and B in equation $Y=A*X+B$ .  |
| 12  | IN3             | DS-65              |                      |               |       | N            | Analog input 3   |
| 13  | SCALE_CONV_IN3  | DS-256             |                      |               |       | S / O/S      | Information to generate constants A and B in equation $Y=A*X+B$ .  |
| 14  | IN4             | DS-65              |                      |               |       | N            | Analog input 4   |
| 15  | SCALE_CONV_IN4  | DS-256             |                      |               |       | S / O/S      | Information to generate constants A and B in equation $Y=A*X+B$ .  |
| 16  | IN_D1           | DS-66              |                      |               |       | N            | Discrete input 1   |
| 17  | IN_D2           | DS-66              |                      |               |       | N            | Discrete input 2   |
| 18  | IN_D3           | DS-66              |                      |               |       | N            | Discrete input 3   |
| 19  | IN_D4           | DS-66              |                      |               |       | N            | Discrete input 4   |
| 20  | OUT1            | DS-65              |                      |               |       | N / Man      | Analog output 1  |
| 21  | SCALE_CONV_OUT1 | DS-257             |                      |               |       | S / O/S      | Information to generate constants A and B in equation $Y=A*X+B$ plus output status.  |
| 22  | OUT2            | DS-65              |                      |               |       | N / Man      | Analog output 2  |
| 23  | SCALE_CONV_OUT2 | DS-257             |                      |               |       | S / O/S      | Information to generate constants A and B in equation $Y=A*X+B$ plus output status.  |
| 24  | OUT3            | DS-65              |                      |               |       | N / Man      | Analog output 3  |
| 25  | SCALE_CONV_OUT3 | DS-257             |                      |               |       | S / O/S      | Information to generate constants A and B in equation $Y=A*X+B$ plus output status.  |
| 26  | OUT4            | DS-65              |                      |               |       | N / Man      | Analog output 4  |
| 27  | SCALE_CONV_OUT4 | DS-257             |                      |               |       | S / O/S      | Information to generate constants A and B in equation $Y=A*X+B$ plus output status.  |
| 28  | OUT_D1          | DS-66              |                      |               |       | N / Man      | Discrete output 1  |
| 29  | STATUS_OUT_D1   | Unsigned8          |                      |               |       | S / O/S      | Status to OUT_D1 if master will not update.  |
| 30  | OUT_D2          | DS-66              |                      |               |       | N / Man      | Discrete output 2  |
| 31  | STATUS_OUT_D2   | Unsigned8          |                      |               |       | S / O/S      | Status to OUT_D2 if master will not update.  |
| 32  | OUT_D3          | DS-66              |                      |               |       | N / Man      | Discrete output 3  |
| 33  | STATUS_OUT_D3   | Unsigned8          |                      |               |       | S / O/S      | Status to OUT_D3 if master will not update.  |
| 34  | OUT_D4          | DS-66              |                      |               |       | N / Man      | Discrete output 4  |
| 35  | STATUS_OUT_D4   | Unsigned8          |                      |               |       | S / O/S      | Status to OUT_D4 if master will not update.  |
| 36  | UPDATE_EVT      | DS-73              |                      |               | Na    | D            | This alert is generated by any change to the static data.  |
| 37  | BLOCK_ALM       | DS-72              |                      |               | Na    | D            | The block alarm is used for all configuration, hardware, and connection failure or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active status in the Status attribute. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active status, if the subcode has changed. |

Legend: E – Enumerated parameter; Na – Dimensionless parameter; RO – Read only; D – dynamic; N – non-volatile; S – Static  
 Gray Background Line: Default Parameters of Syscon

**NOTES**

The **STATUS\_OUT\_Dx** and **STATUS\_OUTPUT** components, used in **OUT** parameters, define the following rules to **OUTPUT STATUS** parameters:

- Once the user defines this component as “Set by master”, the output status will behave exactly as FOUNDATION fieldbus protocol works. In other words, the status will reflect the value, which the master is writing, but if after the **TIMEOUT** (defined in MBCF block) the status is not be updated, this status will be forced to **BAD COMMUNICATION**.
- Once the user defines this element with anything different from “Set by master”, this value will be reflected in output status, while communication is good. Otherwise, status goes to **BAD COMMUNICATION**.

**Inputs and Outputs**

This block has 4 digital inputs, 4 analog inputs, 4 digital outputs and 4 analog outputs that may be connected to others in Fieldbus or Modbus function blocks.

- IN1, IN2, IN3 and IN4 are analog inputs.
- IN\_D1, IN\_D2, IN\_D3 and IN\_D4 are digital inputs.
- OUT1, OUT2, OUT3 and OUT4 are analog outputs.
- OUT\_D1, OUT\_D2, OUT\_D3 and OUT\_D4 are digital outputs.

The digital inputs and outputs are **DS-66** data types, which have **Status** and **Value** (both Unsigned8) parameters. The analog inputs and outputs are **DS-65** data type, containing **Status** and **Value** parameters as well. The type of value parameters is float.

**Scale Conversion Parameters**

Each analog input or output has an extra parameter that should be set in order to use this block properly. This is done through the **SCALE\_CONV\_INn** and **SCALE\_CONV\_OUTn** parameters. These parameters are **DS-256** and **DS-257** represented by data structures:

The **DS-256** data structure has 5 elements to be configured:

- From EU 100 %
- From EU 0 %
- To EU 100 %
- To EU 0 %
- Data Type

The **DS-257** data structure has 6 elements to be configured:

- From EU 100 %
- From EU 0 %
- To EU 100 %
- To EU 0 %
- Data Type
- Output Status

**Data Types**

It is necessary to configure the data type, because Modbus variables have different formats.

This parameter only displays a number that refers to a specific format:

| DATA TYPE NUMBER | DATA TYPE   |
|------------------|-------------|
| 1                | Float       |
| 2                | Unsigned 8  |
| 3                | Unsigned 16 |
| 4                | Unsigned 32 |
| 5                | Integer8    |
| 6                | Integer16   |
| 7                | Integer32   |



| DATA TYPE NUMBER | DATA TYPE           |
|------------------|---------------------|
| 8                | Swapped Float       |
| 9                | Swapped Unsigned 8  |
| 10               | Swapped Unsigned 16 |
| 11               | Swapped Unsigned 32 |
| 12               | Swapped Integer 8   |
| 13               | Swapped Integer 16  |
| 14               | Swapped Integer 32  |

The swapped data types were created in order to support the communication between Modbus devices and Profibus devices. Normally, it has the following options:

**4 Bytes (2 Registers – Word)**

Normal Data type: Inside Word – Motorola  
 Inside Register – Intel  
 Swapped Data type: Inside Word – Motorola  
 Inside Register – Motorola

**2 Bytes**

Swapped Data type: Status information is in the Most Significant Byte (MSB)

**1 Byte**

Swapped Data type: Value (MSB) and Status (LSB) are in the same register.

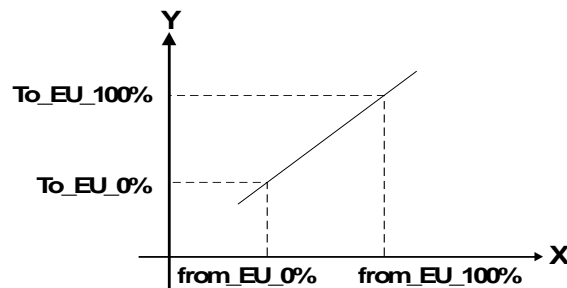
In case of the Swapped Integer 16 data type no change is done.

**Procedures to convert FOUNDATION fieldbus parameter to Modbus variable:**

Load **INn\_VALUE**.  
 Calculate  $Y = A * INn\_VALUE + B$ .  
 Convert Y to **DATA\_TYPE\_IN**, generating **MOD\_VAR\_IN**.  
 Store **MOD\_VAR\_IN**.

**Procedures to convert Modbus variable to FOUNDATION fieldbus parameter:**

Load **MOD\_VAR\_OUT**.  
 Convert **MOD\_VAR\_OUT** to float, generating Y  
 Calculate  $OUTn\_VALUE = (A * Y + B)$ .  
 Store **OUTn\_VALUE**.



$$A = (To\_EU\_100\% - To\_EU\_0\%) / (From\_EU\_100\% - From\_EU\_0\%)$$

$$B = To\_EU\_0\% - A * From\_EU\_0\%;$$

**INn\_VALUE, OUTx\_VALUE:** FOUNDATION fieldbus parameters

**MOD\_VAR\_IN, MOD\_VAR\_OUT:** Modbus variables

Y: auxiliary float variable.

**Output Status**

If Modbus master does not update the **OUTs** parameters in a time specified by user (parameter **TIMEOUT** in MCBF), a “BAD STATUS” will be generated. If **TIMEOUT** < Macrocycle, **TIMEOUT** = Macrocycle.

## MBSS – Modbus Supervision Slave

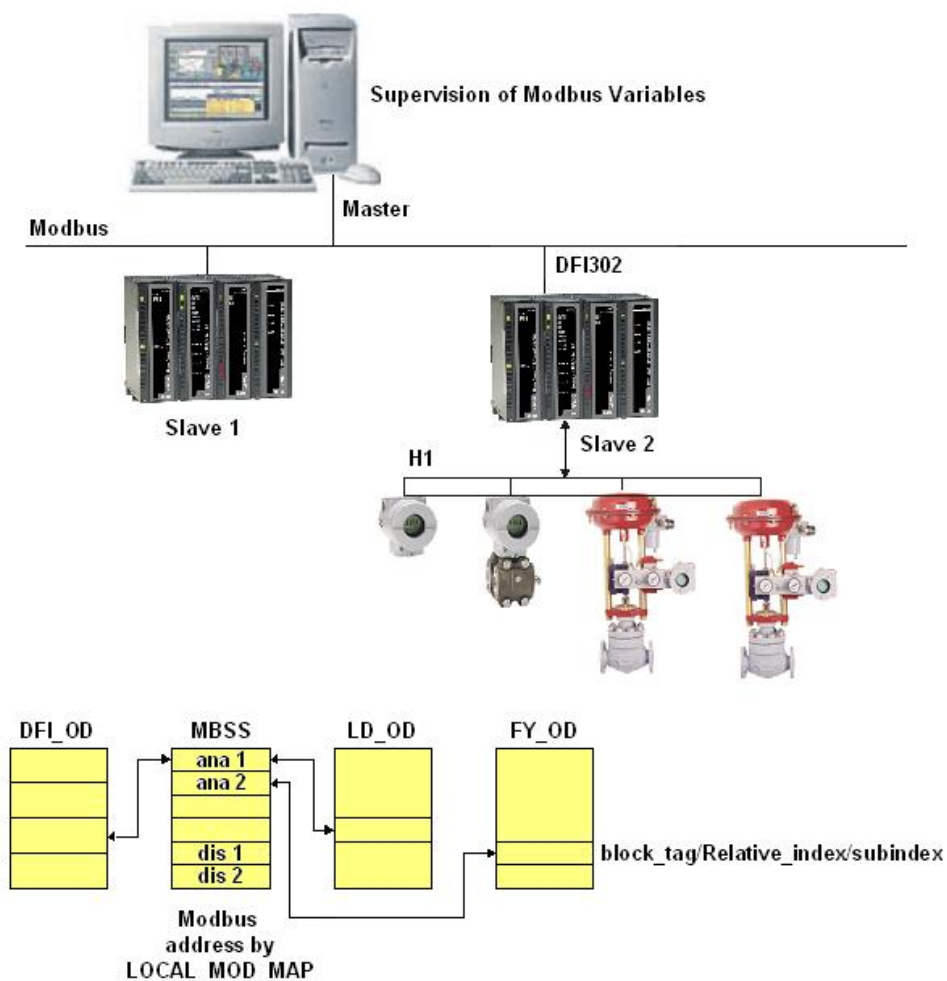
A master Modbus device needs to read and/or write some DFI302 Modbus registers, mapped directly to any variables at Fieldbus network. Using **Syscon**, create one MBCF and MBSS blocks (1 to 16 blocks are available). In the Characterization window, configure the blocks parameters setting Tag, Relative Index and Subindex of other parameters included in FOUNDATION fieldbus blocks.

**ATTENTION**

The MBSS block is available in the DF51 controller.

It is recommended the use of MBCS blocks instead of MBSS blocks. This provides a better performance to data obtainment and for transmission.

### MBSS



When setting the parameters, define **LOCAL\_MOD\_MAP** (0 - 15) the **INs** and **OUTs** parameters will point to pre-defined Modbus addresses. Refer to **Modbus Slave Addresses** section for further information.

## Parameters Description

For further information about parameters description, please refer to Function Blocks Manual.

| Idx | Parameter     | Data Type (length) | Valid Range/ Options | Default Value | Units | Store / Mode | Description  |
|-----|---------------|--------------------|----------------------|---------------|-------|--------------|--|
| 1   | ST_REV        | Unsigned16         |                      | 0             | None  | S/RO         |  |
| 2   | TAG_DESC      | OctString(32)      |                      | Spaces        | Na    | S            |  |
| 3   | STRATEGY      | Unsigned16         |                      | 0             | None  | S            |  |
| 4   | ALERT_KEY     | Unsigned8          | 1 to 255             | 0             | None  | S            |  |
| 5   | MODE_BLK      | DS-69              |                      | O/S           | Na    | S            | See Mode Parameter   |
| 6   | BLOCK_ERR     | Bitstring(2)       |                      |               | E     | D / RO       |  |
| 7   | LOCAL_MOD_MAP | Unsigned8          | 0 to 15              | 0             |       | S / O/S      | Define the ModBus addresses.   |
| 8   | F_ID1         | DS-262             |                      |               |       | S / O/S      | Information to locate float parameter.   |
| 9   | FVALUE1       | Float              |                      | 0             |       | N            | Value from requested float parameter.  |
| 10  | F_ID2         | DS-262             |                      |               |       | S / O/S      | Information to locate float parameter.   |
| 11  | FVALUE2       | Float              |                      | 0             |       | N            | Value from requested float parameter.  |
| 12  | F_ID3         | DS-262             |                      |               |       | S / O/S      | Information to locate float parameter.   |
| 13  | FVALUE3       | Float              |                      | 0             |       | N            | Value from requested float parameter.  |
| 14  | F_ID4         | DS-262             |                      |               |       | S / O/S      | Information to locate float parameter.   |
| 15  | FVALUE4       | Float              |                      | 0             |       | N            | Value from requested float parameter.  |
| 16  | F_ID5         | DS-262             |                      |               |       | S / O/S      | Information to locate float parameter.   |
| 17  | FVALUE5       | Float              |                      | 0             |       | N            | Value from requested float parameter.  |
| 18  | F_ID6         | DS-262             |                      |               |       | S / O/S      | Information to locate float parameter.   |
| 19  | FVALUE6       | Float              |                      | 0             |       | N            | Value from requested float parameter.  |
| 20  | F_ID7         | DS-262             |                      |               |       | S / O/S      | Information to locate float parameter.   |
| 21  | FVALUE7       | Float              |                      | 0             |       | N            | Value from requested float parameter.  |
| 22  | F_ID8         | DS-262             |                      |               |       | S / O/S      | Information to locate float parameter.   |
| 23  | FVALUE8       | Float              |                      | 0             |       | N            | Value from requested float parameter.  |
| 24  | I_ID1         | DS-262             |                      |               |       | S / O/S      | Information to locate integer parameter.   |
| 25  | IVALUE1       | Integer32          |                      | 0             |       | N            | Value from requested integer parameter.  |
| 26  | I_ID2         | DS-262             |                      |               |       | S / O/S      | Information to locate integer parameter.   |
| 27  | IVALUE2       | Integer32          |                      | 0             |       | N            | Value from requested integer parameter.  |
| 28  | I_ID3         | DS-262             |                      |               |       | S / O/S      | Information to locate integer parameter.   |
| 29  | IVALUE3       | Integer32          |                      | 0             |       | N            | Value from requested integer parameter.  |
| 30  | I_ID4         | DS-262             |                      |               |       | S / O/S      | Information to locate integer parameter.   |
| 31  | IVALUE4       | Integer32          |                      | 0             |       | N            | Value from requested integer parameter.  |
| 32  | B_ID1         | DS-262             |                      |               |       | S / O/S      | Information to locate boolean parameter.   |
| 33  | BVALUE1       | Boolean            |                      | TRUE          |       | N            | Value from requested boolean parameter.  |
| 34  | B_ID2         | DS-262             |                      |               |       | S / O/S      | Information to locate boolean parameter.   |
| 35  | BVALUE2       | Boolean            |                      | TRUE          |       | N            | Value from requested boolean parameter.  |
| 36  | B_ID3         | DS-262             |                      |               |       | S / O/S      | Information to locate boolean parameter.   |
| 37  | BVALUE3       | Boolean            |                      | TRUE          |       | N            | Value from requested boolean parameter.  |
| 38  | B_ID4         | DS-262             |                      |               |       | S / O/S      | Information to locate boolean parameter.   |
| 39  | BVALUE4       | Boolean            |                      | TRUE          |       | N            | Value from requested boolean parameter.  |
| 40  | UPDATE_EVT    | DS-73              |                      |               | Na    | D            | This alert is generated by any change to the static data.  |
| 41  | BLOCK_ALM     | DS-72              |                      |               | Na    | D            | The block alarm is used for all configuration, hardware, and connection failure or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active status in the Status attribute. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active status, if the subcode has changed. |
| 42  | BAD_STATUS    | BitString (2)      |                      |               |       | D/RO         | This parameter indicates if the status of correspondent variable is bad or not.  |

Legend: E – Enumerated parameter; Na – Dimensionless parameter; RO – Read only; D – dynamic; N – non-volatile; S – Static  
 Gray Background Line: Default Parameters of Syscon

**NOTE**

Every time a Modbus parameter changes, it is necessary to set the **ON\_APPLY** parameter of the MBCF block to **APPLY**. Otherwise, these alterations will not be applied.

**I\_IDn, F\_IDn, D\_IDn parameters**

The **I\_IDn** are integer variables, **F\_IDn** are float variables and **D\_IDn** refers to boolean variables.

These parameters are **DS-262** data type. This data type has 3 elements:

- **Block Tag:** Indicates the Tag of the block that contains the variable that will be supervised. For example, if it is necessary to supervise the gain value of a PID block. Insert the Tag of the PID block that contains the gain parameter required to visualize the Modbus master device.
- **Relative Index:** Each parameter of a function block has this index. It is the first column of all function blocks parameters tables. Insert the relative index related to the desired parameter to be supervised. In the case above in order to monitor the gain parameter of the PID function block, the relative index is 23.
- **Subindex:** The Subindex is used for parameters that have a structure. In this case, it is necessary to indicate which element of the structure is being referred.

**BVALUEx and IVALUEx parameters**

The **BVALUEx** parameters can address FOUNDATION fieldbus block parameters of the following data types: Boolean, Integer8 and Unsigned8. Those data types are automatically converted to bit (0 or 1) and vice-versa for Modbus supervision and also converted to boolean parameter (**BVALUEx**).

The **IVALUEx** parameters can address FOUNDATION fieldbus block parameters of the following data types: Integer8, Integer16, Integer32, Unsigned8, Unsigned16 and Unsigned32.

Each analog parameter (**IVALUEx**) is mapped as two analog registers in Modbus, i.e., four bytes. Thus, when addressing a FOUNDATION fieldbus block parameter with one or two bytes, such parameter will be promoted to Unsigned32 or Integer32.

If Relative Index = 5 (**MODE\_BLK**) e Subindex = 0, it is performed a writing in Subindex 1 and a reading in Subindex 2.

**BAD\_STATUS Parameter**

This parameter indicates if the communication with master device is working properly. If the correspondent bit is in logic level 1 means that an error occurred during writing/reading in this respective parameter. The table below shows the values for this status parameter. If the communication with the specific parameter is good, there is no indication in **BAD\_STATUS**. However, if the communication is bad, **BAD\_STATUS** will indicate which parameter failed in the communication.

**Relation between the bits in BAD\_STATUS and Modbus addresses**

| BIT | VARIABLE |
|-----|----------|
| 0   | FVALUE1  |
| 1   | FVALUE2  |
| 2   | FVALUE3  |
| 3   | FVALUE4  |
| 4   | FVALUE5  |
| 5   | FVALUE6  |
| 6   | FVALUE7  |
| 7   | FVALUE8  |
| 8   | IVALUE1  |
| 9   | IVALUE2  |
| 10  | IVALUE3  |
| 11  | IVALUE4  |
| 12  | BVALUE1  |
| 13  | BVALUE2  |
| 14  | BVALUE3  |
| 15  | BVALUE4  |

**NOTE**

Each bit corresponds to an OR function between the value and status, indicating if the communication with master is good or bad.

**Data Type and Supported Structures by MBSS**

The Modbus supervision blocks (MBSS) used in the controllers configured as slave, have some restrictions about data types and structures that they support when supervising the block parameters tags. In such case, the next table shows the data types and structures which can be monitored by the MBSS block.

| DATA TYPE * |
|-------------|
| Boolean     |
| Float       |
| Unsigned 8  |
| Unsigned 16 |
| Unsigned 32 |
| Integer8    |
| Integer16   |
| Integer32   |

| STRUCTURE TYPES |
|-----------------|
| DS-65           |
| DS-66           |
| DS-68           |
| DS-69           |
| DS-71           |
| DS-72           |
| DS-74           |
| DS-159 (DC302)  |
| DS-160 (DC302)  |

\*For the DF51 controller the data types Swapped Float and Swapped Integer can be obtained by setting the **RTS\_CTS** parameter to TRUE value in the MBSS block.

For further information about the blocks parameters and their data and structures types, as mentioned in the previous table, please see the Function blocks manual and in the **Data Type** field of each table presented in the manual.



## Parameters Description

For further information about parameters description, please refer to Function Blocks Manual.

| Idx | Parameter      | Data Type (length) | Valid Range/ Options | Default Value | Units | Store / Mode | Description   |
|-----|----------------|--------------------|----------------------|---------------|-------|--------------|---|
| 1   | ST_REV         | Unsigned16         |                      | 0             | None  | S/RO         |   |
| 2   | TAG_DESC       | OctString(32)      |                      | Spaces        | Na    | S            |   |
| 3   | STRATEGY       | Unsigned16         |                      | 0             | None  | S            |   |
| 4   | ALERT_KEY      | Unsigned8          | 1 to 255             | 0             | None  | S            |   |
| 5   | MODE_BLK       | DS-69              |                      | O/S           | Na    | S            | See Mode Parameter  |
| 6   | BLOCK_ERR      | Bitstring(2)       |                      |               | E     | D / RO       |   |
| 7   | LOCAL_MOD_MAP  | Unsigned8          | 0 to 15              | 0             |       | S / O/S      | Define the Modbus addresses.  |
| 8   | BAD_STATUS     | Bitstring(2)       |                      | 0             | E     | D / RO       | Indicate if communication from slave is good or not (each bit corresponds to a Modbus variable).      |
| 9   | IN1            | DS-65              |                      |               |       | N            | Analog input 1  |
| 10  | SCALE_LOC_IN1  | DS-259             |                      |               |       | S / M        | Information to generate constants A and B in equation $Y=A*X+B$ plus the addresses in a slave device. |
| 11  | IN2            | DS-65              |                      |               |       | N            | Analog input 2  |
| 12  | SCALE_LOC_IN2  | DS-259             |                      |               |       | S / M        | Information to generate constants A and B in equation $Y=A*X+B$ plus the addresses in a slave device. |
| 13  | IN3            | DS-65              |                      |               |       | N            | Analog input 3  |
| 14  | SCALE_LOC_IN3  | DS-259             |                      |               |       | S / M        | Information to generate constants A and B in equation $Y=A*X+B$ plus the addresses in a slave device. |
| 15  | IN4            | DS-65              |                      |               |       | N            | Analog input 4  |
| 16  | SCALE_LOC_IN4  | DS-259             |                      |               |       | S / M        | Information to generate constants A and B in equation $Y=A*X+B$ plus the addresses in a slave device. |
| 17  | IN_D1          | DS-66              |                      |               |       | N            | Discrete input 1  |
| 18  | LOCATOR_IN_D1  | DS-261             |                      |               |       | S / O/S      | Addresses in a slave device.  |
| 19  | IN_D2          | DS-66              |                      |               |       | N            | Discrete input 2  |
| 20  | LOCATOR_IN_D2  | DS-261             |                      |               |       | S / O/S      | Addresses in a slave device.  |
| 21  | IN_D3          | DS-66              |                      |               |       | N            | Discrete input 3  |
| 22  | LOCATOR_IN_D3  | DS-261             |                      |               |       | S / O/S      | Addresses in a slave device.  |
| 23  | IN_D4          | DS-66              |                      |               |       | N            | Discrete input 4  |
| 24  | LOCATOR_IN_D4  | DS-261             |                      |               |       | S / O/S      | Addresses in a slave device.  |
| 25  | OUT1           | DS-65              |                      |               |       | N / Man      | Analog output 1   |
| 26  | SCALE_LOC_OUT1 | DS-259             |                      |               |       | S / M        | Information to generate constants A and B in equation $Y=A*X+B$ plus the addresses in a slave device. |
| 27  | OUT2           | DS-65              |                      |               |       | N / Man      | Analog output 2   |
| 28  | SCALE_LOC_OUT2 | DS-259             |                      |               |       | S / M        | Information to generate constants A and B in equation $Y=A*X+B$ plus the addresses in a slave device. |
| 29  | OUT3           | DS-65              |                      |               |       | N / Man      | Analog output 3   |
| 30  | SCALE_LOC_OUT3 | DS-259             |                      |               |       | S / M        | Information to generate constants A and B in equation $Y=A*X+B$ plus the addresses in a slave device. |
| 31  | OUT4           | DS-65              |                      |               |       | N / Man      | Analog output 4   |
| 32  | SCALE_LOC_OUT4 | DS-259             |                      |               |       | S / M        | Information to generate constants A and B in equation $Y=A*X+B$ plus the addresses in a slave device. |
| 33  | OUT_D1         | DS-66              |                      |               |       | N / Man      | Discrete output 1   |
| 34  | LOCATOR_OUT_D1 | DS-261             |                      |               |       | S / O/S      | Addresses in a slave device.  |
| 35  | OUT2_D2        | DS-66              |                      |               |       | N / Man      | Discrete output 2   |
| 36  | LOCATOR_OUT_D2 | DS-261             |                      |               |       | S / O/S      | Addresses in a slave device.  |
| 37  | OUT_D3         | DS-66              |                      |               |       | N / Man      | Discrete output 3   |
| 38  | LOCATOR_OUT_D3 | DS-261             |                      |               |       | S / O/S      | Addresses in a slave device.  |
| 39  | OUT_D4         | DS-66              |                      |               |       | N / Man      | Discrete output 4   |
| 40  | LOCATOR_OUT_D4 | DS-261             |                      |               |       | S / O/S      | Addresses in a slave device.  |

| Idx | Parameter  | Data Type (length) | Valid Range/ Options | Default Value | Units | Store / Mode | Description  |
|-----|------------|--------------------|----------------------|---------------|-------|--------------|--|
| 41  | UPDATE_EVT | DS-73              |                      |               | Na    | D            | This alert is generated by any change to the static data.  |
| 42  | BLOCK_ALM  | DS-72              |                      |               | Na    | D            | The block alarm is used for all configuration, hardware, and connection failure or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active status in the Status attribute. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active status, if the subcode has changed. |

Legend: E – Enumerated parameter; Na – Dimensionless parameter; RO – Read only; D – Dynamic; N – Non-volatile; S – Static  
 Gray Background Line: Default Parameters of Syscon

**NOTE**

Every time a Modbus parameter is changed it is necessary to set the **ON\_APPLY** parameter of the MBCF block to “**APPLY**”. Otherwise these alterations will not be effective.

**NOTES**

The **MODBUS\_ADDRESS\_OF\_STATUS** components define the following rules to **OUTPUT STATUS** parameters:

- Once the user defines this component with a value different from ZERO, the output status will behave exactly as Fieldbus protocol works. The status will reflect the value which the master is reading but if after **TIMEOUT** (defined in MBCF block) the status is not updated, this status will be forced to **BAD COMMUNICATION**.
- Once the user defines this component with a value ZERO, the output status will be set automatically to **Good::NonCascade** and will also accept a characterization via **Syscon** (e.g. **Good::NonCascade**, etc). However, if after **TIMEOUT** (defined in MBCF block) the communication with the Modbus device is not running properly, the status will be forced to **BAD COMMUNICATION**.

**LOCAL\_MODE\_MAP Parameter**

All MBCM blocks added to the strategy must have different values for **LOCAL\_MODE\_MAP**. Otherwise the block will not work properly.

**Inputs and Outputs**

This block has 4 digital inputs and outputs and 4 analog inputs and outputs. These inputs and outputs may be connected to other FOUNDATION fieldbus function blocks to be connected to Modbus I/O modules or registers.

**INn**: Analog input. **DS-65** data type. **Value** and **Status**. In this parameter user will visualize the value of the parameter set for this input and its status.

**IN\_Dn**: Digital input. **DS-66** data type. **Value** and **Status**. In this parameter user will visualize the value of the parameter set for this input and its status.

**OUTn**: Analog output. **DS-65** data type. **Value** and **Status**. In this parameter user will visualize the value of the parameter set for this output and its status.

**OUT\_Dn**: Digital output. **DS-66** data type. **Value** and **Status**. In this parameter user will visualize the value of the parameter set for this output and its status.

**SCALE\_LOC\_INn and SCALE\_LOC\_OUTn Parameters**

These parameters are **DS-259** data type. They both convert the value to Engineering Units and address the variable in the Modbus network. The INn and OUTn inputs and outputs have **SCALE\_LOC\_INn** and **SCALE\_LOC\_OUTn** parameters associated. It is necessary to set these parameters, so the monitoring and data exchanges are properly made.



These parameters consist of the following elements:

- From Eu 100 %
- From Eu 0 %
- To Eu 100 %
- To Eu 0 %
- Data type

See in the following item how to set these elements.

**Data Type:** It is necessary to inform the data type of the variable. This parameter only displays a number that refers to a specific format:

| DATA TYPE NUMBER | DATA TYPE           |
|------------------|---------------------|
| 1                | Float               |
| 2                | Unsigned 8          |
| 3                | Unsigned 16         |
| 4                | Unsigned 32         |
| 5                | Integer8            |
| 6                | Integer16           |
| 7                | Integer32           |
| 8                | Swapped Float       |
| 9                | Swapped Unsigned 8  |
| 10               | Swapped Unsigned 16 |
| 11               | Swapped Unsigned 32 |
| 12               | Swapped Integer 8   |
| 13               | Swapped Integer 16  |
| 14               | Swapped Integer 32  |

The swapped data types were created in order to support the communication of Modbus devices with Profibus devices. Normally we have the following cases:

**4 Bytes (2 Registers – Word)**

- Normal Data type: Inside Word – Motorola  
Inside Register – Intel
- Swapped Data type: Inside Word – Motorola  
Inside Register – Motorola

**2 Bytes**

- Swapped Data type: Status information is in the Most Significant Byte (MSB)

**1 Byte**

- Swapped Data type: Value (MSB) and Status (LSB) are in the same register.

In case of the Swapped Integer 16 data type no change is done.

**Slave Address:** Inform the address of the slave required to reference to the IN input. For example, suppose a LC700 with device address equal to 3 and in this LC700 it is necessary to connect one of its inputs or outputs. Thus, slave address must be equal to 3.

**Modbus Address of Value:** Inform the Modbus address of the variable it will be referenced to the input or output. In the example of the previous element, suppose the Modbus address of the variable it will be referenced is 40032. So this element must receive this address.

**Modbus Address of Status:** In this parameter user informs the Modbus address where the status will be read or written. Each input and output has a correspondent status. The status interpretation follows the standard of the Fieldbus Foundation.

The treatment of inputs and outputs are described in the following table.

| INPUT/OUPUT                               | STATUS CONFIGURED<br>(Modbus_Address_Of_Status ≠ 0)  | STATUS NOT CONFIGURED<br>(Modbus_Address_Of_Status = 0)  |
|---|--|--|
| <p><b>Inputs</b><br/>(IN_n , IN_Dn)</p>   | <p>The block sends to the Modbus slave device the status corresponding of its input. (The status has the FOUNDATION fieldbus standard format)</p>                            | <p>No status information is sent to the slave device.</p>  |
| <p><b>Outputs</b><br/>(OUT_n, OUT_Dn)</p> | <p>The block reads from the slave device the corresponding status. (The block interprets that the Modbus variable has the same format of the FOUNDATION fieldbus Status)</p> | <p>- The block updates the status to "Good Non Cascade" when the communication with the Modbus slave device is ok.<br/>- The block updates the status to "Bad No Communication with last value" when the communication with the Modbus slave device is not ok.</p> |

Float values use two Modbus registers, but it is necessary only to inform the first.

**Procedure to convert FOUNDATION fieldbus parameter to Modbus variable:**

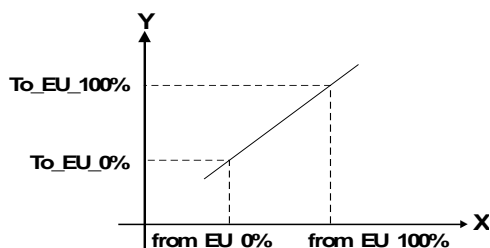
Load **INx\_VALUE**.  
 Calculate  $Y = (A * INx\_VALUE + B)$ .  
 Convert Y to **DATA\_TYPE\_IN**, generating **MOD\_VAR\_IN**.  
 Write **MOD\_VAR\_IN**.

**Procedure to convert Modbus variable to FOUNDATION fieldbus parameter:**

Read **MOD\_VAR\_OUT**.  
 Convert **MOD\_VAR\_OUT** to float, generating Y  
 Calculate  $OUTx\_VALUE = (A * Y + B)$ .  
 Store **OUTx\_VALUE**.

$$A = (To\_EU\_100\% - To\_EU\_0\%) / (From\_EU\_100\% - From\_EU\_0\%)$$

$$B = To\_EU\_0\% - A * From\_EU\_0\%;$$



**IN\_VALUE, OUT\_VALUE:** FOUNDATION fieldbus parameters  
**MOD\_VAR\_IN, MOD\_VAR\_OUT:** Modbus variables  
 Y: auxiliary float variable

**Setting Inputs and Outputs of the MBCM block**

To read a Modbus variable, connect it to an output of the MBCM function block. To write in a Modbus register, connect it to an input of the MBCM block.

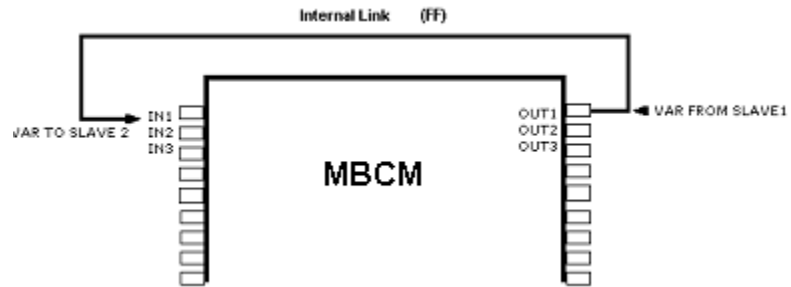
The Modbus protocol specifies the division of the address range to the variables.

- 00001 to 09999 → Digital Outputs.
- 10001 to 19999 → Digital Inputs.
- 30001 to 39999 → Analog Inputs.
- 40001 to 49999 → Analog Outputs.

Once the variables are mapped, defined and referenced in the MBCM block, it is possible to set the strategy.

The variables can be connected to other FOUNDATION fieldbus function blocks (connect the output or input of the block to blocks in the strategy), write in Modbus registers (connect the input of the MBCM block to a Modbus register).

Exchange data between two slaves (set the input of the MBCM block with the slave address and specific Modbus address where the value will be written and set the output of the MBCM block with the slave address and Modbus address of the variable where the value will be read). This last application is showed below:



### BAD\_STATUS Parameter

This parameter indicates if the communication between slaves was established properly. If the correspondent bit is in logic level 1 this means there was an error during writing/reading of the respective parameter. The table below indicates the values for these status values. If the communication with the specific parameter is good, there is no indication in **BAD\_STATUS**, however, if the communication is bad, in the **BAD\_STATUS** will be indicated which parameter fails in the communication.

### Relation between the bits in BAD\_STATUS and Modbus addresses

| BIT | VARIABLE |
|-----|----------|
| 0   | IN1      |
| 1   | IN2      |
| 2   | IN3      |
| 3   | IN4      |
| 4   | IN_D1    |
| 5   | IN_D2    |
| 6   | IN_D3    |
| 7   | IN_D4    |
| 8   | OUT1     |
| 9   | OUT2     |
| 10  | OUT3     |
| 11  | OUT4     |
| 12  | OUT_D1   |
| 13  | OUT_D2   |
| 14  | OUT_D3   |
| 15  | OUT_D4   |

### NOTE

Each bit corresponds to an **OR** between the value and status, indicating if communication with slave is good or bad.

If it is only used the value, the status is considered zero.

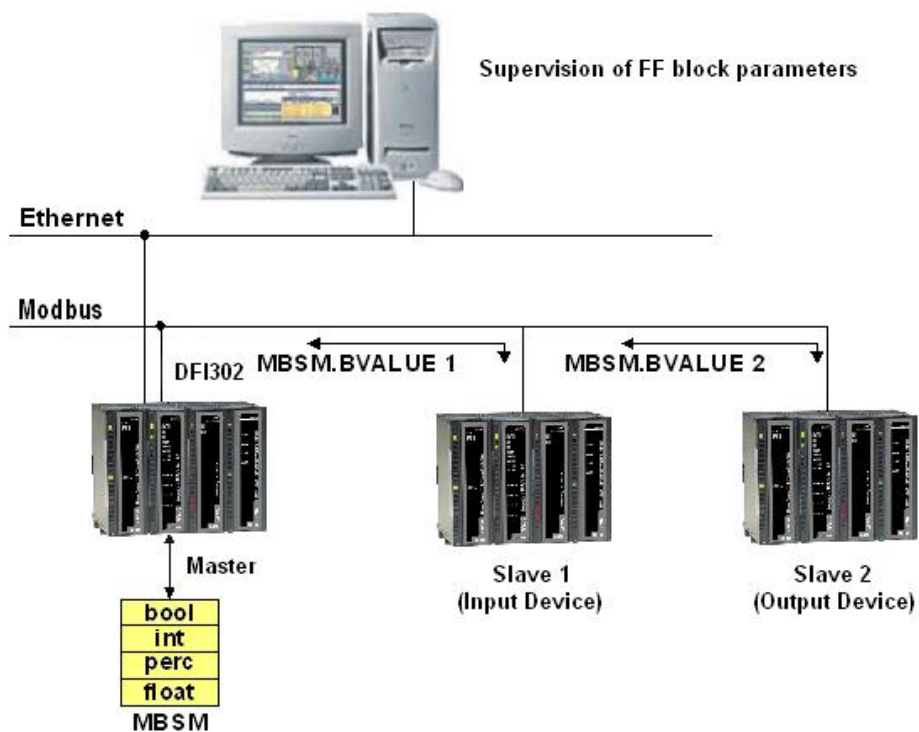
If it is only used the status, the value is considered zero.

## MBSM – Modbus Supervision Master

A supervisory system connected to the processor, via **OPC Server**, needs to read and/or write some parameters, mapped directly in some Modbus registers.

Using **Syscon**, create one MBSM and MBSM blocks (1 to 16 blocks are available). In the Characterization window, configure these blocks setting parameters as slave address and parameter address.

### MBSM



Configure the **MASTER\_SLAVE** parameter to Master in the MBSM block. Define **LOCAL\_MOD\_MAP** (0 ~ 15).

## Parameters Description

For further information about parameters description, please refer to Function Blocks Manual.

| Idx | Parameter     | Data Type (length) | Valid Range/ Options | Default Value | Units | Store / Mode | Description  |
|-----|---------------|--------------------|----------------------|---------------|-------|--------------|--|
| 1   | ST_REV        | Unsigned16         |                      | 0             | None  | S/RO         |  |
| 2   | TAG_DESC      | OctString(32)      |                      | Spaces        | Na    | S            |  |
| 3   | STRATEGY      | Unsigned16         |                      | 0             | None  | S            |  |
| 4   | ALERT_KEY     | Unsigned8          | 1 to 255             | 0             | None  | S            |  |
| 5   | MODE_BLK      | DS-69              |                      | O/S           | Na    | S            | See Mode Parameter   |
| 6   | BLOCK_ERR     | Bitstring(2)       |                      |               | E     | D / RO       |  |
| 7   | LOCAL_MOD_MAP | Unsigned8          | 0 to 15              | 0             |       | S / O/S      | Define the Modbus addresses.   |
| 8   | BAD_STATUS    | Bitstring(2)       |                      | 0             | E     | D / RO       | Indicate if communication from slave is good or not (each bit corresponds to a Modbus variable).   |
| 9   | FLOCATOR1     | DS-260             |                      |               |       | S / O/S      | Information to locate float parameter  |
| 10  | FVALUE1       | Float              |                      | 0             |       | N            | Value from requested address.  |
| 11  | FLOCATOR2     | DS-260             |                      |               |       | S / O/S      | Information to locate float parameter  |
| 12  | FVALUE2       | Float              |                      | 0             |       | N            | Value from requested address.  |
| 13  | PLOCATOR1     | DS-258             |                      |               |       | S / O/S      | Information to locate percentage parameter   |
| 14  | PVALUE1       | Float              |                      | 0             |       | N            | Value from requested address.  |
| 15  | PLOCATOR2     | DS-258             |                      |               |       | S / O/S      | Information to locate percentage parameter   |
| 16  | PVALUE2       | Float              |                      | 0             |       | N            | Value from requested address.  |
| 17  | ILOCATOR1     | DS-260             |                      |               |       | S / O/S      | Information to locate integer parameter  |
| 18  | ILENGTH1      | Integer8           | 1,2,4                | 2             |       | S / O/S      | Data length.   |
| 19  | IVALUE1       | Interge32          |                      | 0             |       | N            | Value from requested address.  |
| 20  | ILOCATOR2     | DS-260             |                      |               |       | S / O/S      | Information to locate integer parameter  |
| 21  | ILENGTH2      | Integer8           | 1,2,4                | 2             |       | S / O/S      | Data length.   |
| 22  | IVALUE2       | Interge32          |                      | 0             |       | N            | Value from requested address.  |
| 23  | BLOCATOR1     | DS-260             |                      |               |       | S / O/S      | Information to locate boolean parameter  |
| 24  | BVALUE1       | Boolean            |                      | TRUE          |       | N            | Value from requested addresses.  |
| 25  | BLOCATOR2     | DS-260             |                      |               |       | S / O/S      | Information to locate boolean parameter  |
| 26  | BVALUE2       | Boolean            |                      | TRUE          |       | N            | Value from requested addresses.  |
| 27  | BLOCATOR3     | DS-260             |                      |               |       | S / O/S      | Information to locate boolean parameter  |
| 28  | BVALUE3       | Boolean            |                      | TRUE          |       | N            | Value from requested addresses.  |
| 29  | BLOCATOR4     | DS-260             |                      |               |       | S / O/S      | Information to locate boolean parameter  |
| 30  | BVALUE4       | Boolean            |                      | TRUE          |       | N            | Value from requested addresses.  |
| 31  | BLOCATOR5     | DS-260             |                      |               |       | S / O/S      | Information to locate boolean parameter  |
| 32  | BVALUE5       | Boolean            |                      | TRUE          |       | N            | Value from requested addresses.  |
| 33  | BLOCATOR6     | DS-260             |                      |               |       | S / O/S      | Information to locate boolean parameter  |
| 34  | BVALUE6       | Boolean            |                      | TRUE          |       | N            | Value from requested addresses.  |
| 35  | BLOCATOR7     | DS-260             |                      |               |       | S / O/S      | Information to locate boolean parameter  |
| 36  | BVALUE7       | Boolean            |                      | TRUE          |       | N            | Value from requested addresses.  |
| 37  | BLOCATOR8     | DS-260             |                      |               |       | S / O/S      | Information to locate boolean parameter  |
| 38  | BVALUE8       | Boolean            |                      | TRUE          |       | N            | Value from requested addresses.  |
| 39  | UPDATE_EVT    | DS-73              |                      |               | Na    | D            | This alert is generated by any change to the static data.  |
| 40  | BLOCK_ALM     | DS-72              |                      |               | Na    | D            | The block alarm is used for all configuration, hardware, and connection failure or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active status in the Status attribute. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active status, if the subcode has changed. |

Legend: E – Enumerated parameter; Na – Dimensionless parameter; RO – Read only; D – Dynamic; N – Non-volatile; S – Static  
 Gray Background Line: Default Parameters of Syscon

**LOCAL\_MODE\_MAP Parameter**

All MBSM blocks added to the strategy must have different values for **LOCAL\_MODE\_MAP**. Otherwise the block will not work properly.

**FVALUEn, PVALUEn, IVALUEn and BVALUEn Parameters**

The user may select these parameters according to the configuration requirements. If the variable to be supervised is float, it is necessary to use a **FVALUE** parameter. If it is a percentage, the **PVALUEn** will work. **IVALUE** refers to integer values and **BVALUE** refers to boolean values.

For each of these parameters are associated parameters to address them in the Modbus network, so that the MBSM block knows their location.

**FLOCATORn Parameter**

It refers to the **FVALUEn** parameter.

This parameter is of the data type **DS-260**, so it is required to set two elements for this parameter:

**Slave Address:** Insert the Address of the slave where it is located the variable required to monitor. For example, if in an application one LC700 was set with Device Address equal to 1. Thus, slave address must be equal to 1.

**Modbus Address of Value:** Type the Modbus address of the variable it will be monitored in the MBSM block. Suppose user needs to monitor the variable with Modbus address 40001 located in an I/O module of the slave with Device Address 1. Thus, **MODBUS\_ADDRESS\_OF\_VALUE** must be equal to 40001.

The **FVALUEn** parameters will display the values of the variables set in **FLOCATORn**. Float values use two Modbus registers, but it is necessary only to inform the first.

**Modbus Addresses**

- 00001 to 09999 → Digital Outputs.
- 10001 to 19999 → Digital Inputs.
- 30001 to 39999 → Analog Inputs.
- 40001 to 49999 → Analog Outputs.

**PLOCATORn Parameter**

It refers to the **PVALUEn** parameter.

These parameters are **DS-258** data type. They both convert the value to Engineering Units and address the variable in the Modbus network. It is necessary to set these parameters so the monitoring is properly made.

Each of these parameters consists of the following elements:

- From Eu 100 %
- From Eu 0 %
- To Eu 100 %
- To Eu 0 %
- Data Type

See in the following item how to set these elements.

**Data Type:** It is necessary to inform the data type of the variable.

This parameter only displays a number that refers to a specific format.

| DATA TYPE NUMBER | DATA TYPE MEANING   |
|------------------|---------------------|
| 1                | Float               |
| 2                | Unsigned 8          |
| 3                | Unsigned 16         |
| 4                | Unsigned 32         |
| 5                | Integer8            |
| 6                | Integer16           |
| 7                | Integer32           |
| 8                | Swapped Float       |
| 9                | Swapped Unsigned 8  |
| 10               | Swapped Unsigned 16 |
| 11               | Swapped Unsigned 32 |
| 12               | Swapped Integer 8   |
| 13               | Swapped Integer 16  |
| 14               | Swapped Integer 32  |

The swapped data types were created in order to support the communication of Modbus devices with Profibus devices. Normally, there are the following cases:

**4 Bytes (2 Registers – Word)**

Normal Data type: Inside Word – Motorola  
 Inside Register – Intel

Swapped Data type: Inside Word – Motorola  
 Inside Register – Motorola

**2 Bytes**

Swapped Data type: Status information is in the Most Significant Byte (MSB)

**1 Byte**

Swapped Data type: Value (MSB) and Status (LSB) are in the same register.

In case of the Swapped Integer 16 data type no change is necessary.

**Slave Address:** Inform the address of the slave it is required to reference to the parameter **PVALUEn**. For example, suppose there is a LC700 with Device Address equal to 3 and in this LC700 it is required to monitor a specific variable. Thus, slave address must be equal to 3.

**Modbus Address of Value:** Inform the Modbus address of the variable it will be monitored. In the example of the previous element, suppose the Modbus address of the monitored variable is 40032. So this element must receive this address.

**Procedure to convert FOUNDATION fieldbus parameter to Modbus variable:**

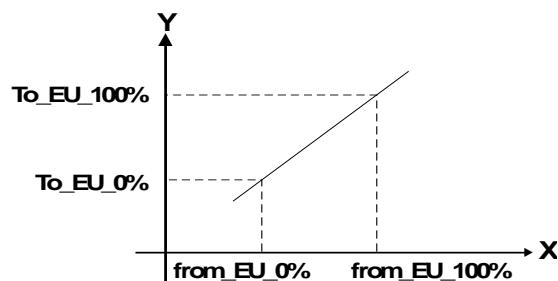
Load **VALUEn**.  
 Calculate  $Y = (A * VALUEn + B)$ .  
 Convert Y to **DATA\_TYPE\_IN**, generating **MOD\_VAR\_IN**.  
 Write **MOD\_VAR\_IN**.

**Procedure to convert Modbus variable to FOUNDATION fieldbus parameter:**

Read **MOD\_VAR\_OUT**.  
 Convert **MOD\_VAR\_OUT** (from the data type) to float, generating Y  
 Calculate **PVALUE = (A \* Y + B)**.  
 Store **OUTx\_VALUE**.

$$A = (To\_EU\_100\% - To\_EU\_0\%)/(From\_EU\_100\% - From\_EU\_0\%)$$

$$B = To\_EU\_0\% - A*From\_EU\_0\%;$$



**PVALUE<sub>n</sub>**: FOUNDATION fieldbus parameters

**MOD\_VAR\_IN, MOD\_VAR\_OUT**: Modbus variables

Y: auxiliary float variable

#### **ILOCATOR<sub>n</sub> Parameter**

It refers to the **IVALUE<sub>n</sub>** parameter:

**Slave Address**: Insert the address of the slave where it is located the variable to be monitored. For example, if in an application one LC700 was set with Device Address equal to 1. Thus, slave address must be equal to 1.

**Modbus Address of Value**: Type the Modbus address of the variable to be monitored in the MBSM block. Suppose it is necessary to monitor the variable with Modbus address 40001 located in an I/O module of the slave with Device Address 1. Thus, **MODBUS\_ADDRESS\_OF\_VALUE** must be equal to 40001.

The **IVALUE<sub>n</sub>** parameters will display the values of the variables set in **ILOCATOR<sub>n</sub>**.

#### **BLOCATOR<sub>n</sub> Parameter**

It refers to the **BVALUE<sub>n</sub>** parameter.

This parameter is data type **DS-260**, so this parameter has two elements to be configured:

**Slave Address**: Insert the address of the slave where it is located the variable to be monitored. For example, if in an application one LC700 was set with Device Address equal to 1. Thus, slave address must be equal to 1.

**Modbus Address of Value**: Type the Modbus address of the variable to be monitored in the MBSM block. Suppose it is necessary to monitor the variable with Modbus address 40001 located in an I/O module of the Slave with Device Address 1. Thus, **MODBUS\_ADDRESS\_OF\_VALUE** must be equal to 00001.

The **BVALUE<sub>n</sub>** parameters will display the values of the variables set in **BLOCATOR<sub>n</sub>**.



**BAD\_STATUS Parameter**

This parameter indicates if the communication between slaves was established properly. If the correspondent bit is in logic level 1 this means there was an error during writing/reading of the respective parameter. The table below shows the values for these status values.

**Relation between the bits in BAD\_STATUS and Modbus addresses**

| BIT | VARIABLE |
|-----|----------|
| 0   | B1       |
| 1   | B2       |
| 2   | B3       |
| 3   | B4       |
| 4   | B5       |
| 5   | B6       |
| 6   | B7       |
| 7   | B8       |
| 8   | I1       |
| 9   | I2       |
| 10  | P1       |
| 11  | P2       |
| 12  | F1       |
| 13  | F2       |

## Modbus Slave Addresses

| MBCS          |  |                             |
|---------------|--|-----------------------------|
| PARAMETER     | LOCAL_MOD_MAP = x<br>OFFSET = 40 * x<br>x = 0 ~ 15 | e.g.<br>LOCAL_MOD_MAP<br>=1 |
| IN1-Value     | 40001+ OFFSET<br>40002+ OFFSET                     | 40041<br>40042              |
| IN2-Value     | 40003+ OFFSET<br>40004+ OFFSET                     | 40043<br>40044              |
| IN3-Value     | 40005+ OFFSET<br>40006+ OFFSET                     | 40045<br>40046              |
| IN4-Value     | 40007+ OFFSET<br>40008+ OFFSET                     | 40047<br>40048              |
| OUT1-Value    | 40009+ OFFSET<br>40010+ OFFSET                     | 40049<br>40050              |
| OUT2-Value    | 40011+ OFFSET<br>40012+ OFFSET                     | 40051<br>40052              |
| OUT3-Value    | 40013+ OFFSET<br>40014+ OFFSET                     | 40053<br>40054              |
| OUT4-Value    | 40015+ OFFSET<br>40016+ OFFSET                     | 40055<br>40056              |
| IN1-Status    | 40017+ OFFSET                                      | 40057                       |
| IN2-Status    | 40018+ OFFSET                                      | 40058                       |
| IN3-Status    | 40019+ OFFSET                                      | 40059                       |
| IN4-Status    | 40020+ OFFSET                                      | 40060                       |
| OUT1-Status   | 40021+ OFFSET                                      | 40061                       |
| OUT2-Status   | 40022+ OFFSET                                      | 40062                       |
| OUT3-Status   | 40023+ OFFSET                                      | 40063                       |
| OUT4-Status   | 40024+ OFFSET                                      | 40064                       |
| IN_D1-Status  | 40025+ OFFSET                                      | 40065                       |
| IN_D2-Status  | 40026+ OFFSET                                      | 40066                       |
| IN_D3-Status  | 40027+ OFFSET                                      | 40067                       |
| IN_D4-Status  | 40028+ OFFSET                                      | 40068                       |
| OUT_D1-Status | 40029+ OFFSET                                      | 40069                       |
| OUT_D2-Status | 40030+ OFFSET                                      | 40070                       |
| OUT_D3-Status | 40031+ OFFSET                                      | 40071                       |
| OUT_D4-Status | 40032+ OFFSET                                      | 40072                       |
| IN_D1-Value   | 1+ OFFSET  | 41                          |
| IN_D2-Value   | 2+ OFFSET  | 42                          |
| IN_D2-Value   | 3+ OFFSET  | 43                          |
| IN_D2-Value   | 4+ OFFSET  | 44                          |
| OUT_D1-Value  | 5+ OFFSET  | 45                          |
| OUT_D2-Value  | 6+ OFFSET  | 46                          |
| OUT_D3-Value  | 7+ OFFSET  | 47                          |
| OUT_D4-Value  | 8+ OFFSET  | 48                          |

| MBSS      |  |                             |
|-----------|--|-----------------------------|
| PARAMETER | LOCAL_MOD_MAP = x<br>OFFSET = 40 * x<br>x = 0 ~ 15 | e.g.<br>LOCAL_MOD_MAP<br>=1 |
| F_ID1     | 42601+ OFFSET<br>42602+ OFFSET                     | 42641<br>42642              |
| F_ID2     | 42603+ OFFSET<br>42604+ OFFSET                     | 42643<br>42644              |
| F_ID3     | 42605+ OFFSET<br>42606+ OFFSET                     | 42645<br>42646              |
| F_ID4     | 42607+ OFFSET<br>42608+ OFFSET                     | 42647<br>42648              |
| F_ID5     | 42609+ OFFSET<br>42610+ OFFSET                     | 42649<br>42650              |
| F_ID6     | 42611+ OFFSET<br>42612+ OFFSET                     | 42651<br>42652              |
| F_ID7     | 42613+ OFFSET<br>42614+ OFFSET                     | 42653<br>42654              |
| F_ID8     | 42615+ OFFSET<br>42616+ OFFSET                     | 42655<br>42656              |
| I_ID1     | 42617+ OFFSET<br>42618+ OFFSET                     | 42657<br>42658              |
| I_ID2     | 42619+ OFFSET<br>42620+ OFFSET                     | 42659<br>42660              |
| I_ID3     | 42621+ OFFSET<br>42622+ OFFSET                     | 42661<br>42662              |
| I_ID4     | 42623+ OFFSET<br>42624+ OFFSET                     | 42663<br>42664              |
| B_ID1     | 2601+ OFFSET                                       | 2641                        |
| B_ID2     | 2602+ OFFSET                                       | 2642                        |
| B_ID3     | 2603+ OFFSET                                       | 2643                        |
| B_ID4     | 2604+ OFFSET                                       | 2644                        |

**NOTES****MBCS**

The second column of the previous table shows the values that are attributed to the Inputs and Outputs of the MBCS block according to the value set for **LOCAL\_MODE\_MAP**. For example, if **LOCAL\_MODE\_MAP** is set equal to 1 it will result in the Modbus range of addresses showed in the third column. It must be clear that when this parameter is set, a whole range is selected, not a specific address.

INn and OUTn values use two Modbus registers (for example IN1, 40041 and 40042) because their data type is float. IN\_Dn and OUT\_Dn values use one Modbus register (for example IN\_D1, 41). Status values also use only one register.

Once this Modbus range is defined, it is possible to set how the Modbus master will read them.

**MBSS**

Once values for **LOCAL\_MODE\_MAP** are set, Modbus Addresses are given to the variables to monitor. So, each integer, float or boolean variable will have a Modbus address associated with it.

For example, suppose **LOCAL\_MODE\_MAP** = 1 and a float value will be monitored. Setting the **F\_ID1**:

F\_ID1.Tag = Tag of the float parameter necessary to monitor.

F\_ID1.Index= Index of the first column of the parameter necessary to monitor.

F\_ID1.subindex = The Sub Index is used for parameters that have a structure. In this case it is necessary to indicate which element of the structure is being referred.

See the table **Modbus Slave Address** The Modbus addresses given to this parameter (remember, float values use two Modbus registers) are 42641 and 42642.

**ATTENTION**

The MBSS block is valid for DF51 controller.

It is recommended the use of MBCS block instead of MBSS block. This provides a better performance to data obtainment and for transmission.

## Modbus Commands

When the DFI302 works as master, that is, reading the Modbus addresses, it uses the commands 1 (addresses from 1 to 9999), 2 (addresses from 10001 to 19999), 3 (addresses from 40001 to 49999) and 4 (addresses from 30001 to 39999).

When the DFI302 writes on the Modbus addresses, it uses, regarding the MBCM block, the commands 15 (addresses from 0 to 9999) and 16 (addresses from 40001 to 49999). Regarding the MBSM block, the DFI302 uses the commands 5 (addresses from 0 to 9999) and 6 (addresses from 40001 to 49999).

If the DFI302 works as slave, it responds to any of the commands above.

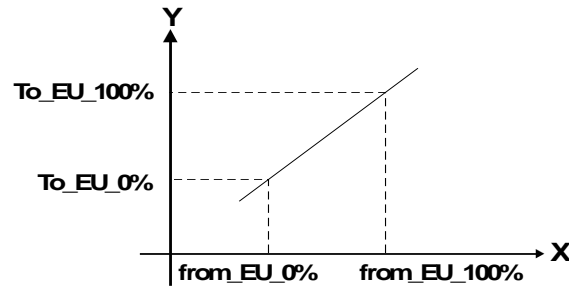
### PERFORMANCE TIPS

For a better protocol performance, and an optimized response time among master and slaves communication, it is recommended that:

- a) The baud rate parameter to the serial communication should be configured to 38400 bps in both Modbus master and slave devices;
- b) The Timeout should be adjusted conveniently (as small as possible) for a shorter response time among the masters and slaves devices, and if any failures occur, the communication status is updated. For a problem related with “links” and “status” oscillations due to the configuration network is necessary to increase the timeout in the master device.
- c) The address mapping in the Modbus blocks has to be sequential. For example, when a master Modbus controller communicates with other slave Modbus device, in the MBCM and/or MBSM block you should configure the **SCALE\_LOC\_INX**, **SCALE\_LOC\_OUTX**, **FLOCATORX**, **PLOCATORX**, **ILOCATORX**, **BLOCATORX** parameters to sequential addresses, i.e., IN1: 40001, IN2: 40003, IN3: 40005 etc. In this way, the command is grouped in just one packet and is sent to the slave. This optimizes the traffic in the network.
- d) A better response time you will get as much as you succeed in the sequential addressing for the inputs parameters (IN\_n and IN\_Dn).
- e) In the outputs (OUT\_n and OUT\_Dn), each command can be group in just one packet if the addresses in the parameters has a gap less than 125 points to the analog and 2000 points to the discrete. For example, if in the OUT\_n parameter the address is 45200 and in other parameter is 45570, there is a gap of 370 points (> 125), then you will have 2 commands in the bus. On the other hand, if it is possible to map the address in a range where its gap is less than 125, just one command will be sent in the line for the analog data. Similarly, this is applied to the discrete data if gaps less than 2000.
- f) Do not instantiate blocks that are not being used in the configuration or address whose slave devices that does not exist. This will reduce the CPU performance and the Timeout may occur prejudicing the communication of the others controllers.
- g) More tips can be found in the **Troubleshooting** section.

## Scaling Conversion

This data structure consists of data used to generate constants A and B in equation  $Y = A * X + B$ .



| E | ELEMENT  | DATA TYPE | SIZE |
|---|--|-----------|------|
| 1 | From EU 100%   | Float     | 4    |
| 2 | From EU 0%   | Float     | 4    |
| 3 | To EU 100%   | Float     | 4    |
| 4 | To EU 0%   | Float     | 4    |
| 5 | Data Type<br>( Use this parameter to convert Fieldbus to Modbus or Modbus to Fieldbus, where Modbus should be ... )<br><br>Float = 1<br>Unsigned8 = 2<br>Unsigned16 = 3<br>Unsigned32 = 4<br>Integer8 = 5<br>Integer16 = 6<br>Integer32 = 7<br>Swapped Float = 8<br>Swapped Unsigned8 = 9<br>Swapped Unsigned16 = 10<br>Swapped Unsigned32 = 11<br>Swapped Integer8 = 12<br>Swapped Integer16 = 13<br>Swapped Integer32 = 14 | Unsigned8 | 1    |

## Redundancy and Modbus

The redundancy in Modbus communication may be mapped to many possible scenarios. Some of them are supported by the controllers. The restrictions which should be considered are described below:

1. The Modbus TCP in the DF63 will be established in both Ethernet ports (ETH1 and ETH2). It is recommended to use both ports only in the scenarios where the DF63 is slave. When running as Modbus Master, the DF63 should not be configured to use ETH2 to avoid duplication in the bandwidth and it may damage the communication performance.
2. The both Ethernet ports (ETH1 and ETH2) DF73, DF75, DF79, DF81, DF89 (see note below), DF95 and DF97 controllers, which can be slaves only, are available to answer the Modbus requests.
3. Switch over conditions are related to bad conditions in the Primary controller (see description of these bad conditions in another section of this manual "Adding Redundancy to DFI302 HSE Controllers"). As slave Modbus, the controllers will not generate a switch over condition because of communication failures. It is always the master who should switch over in such conditions. When using TCP and all IPs are in the same subnet, the master should to decide when switch the request to other slave Ethernet connection.
4. As Modbus Master, DF62/DF63 (either TCP or Serial RTU) only switch over if the Primary does not have any answer from all slave modules.

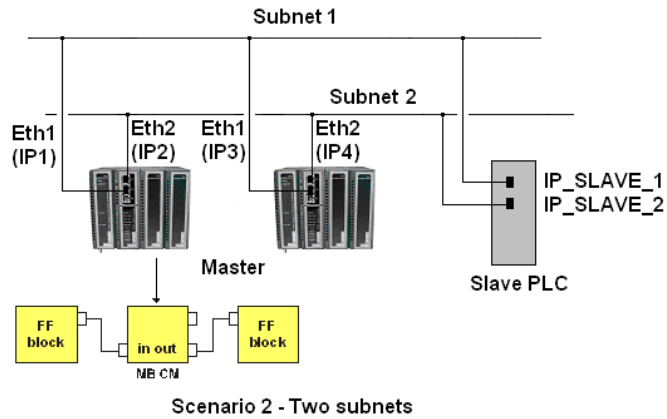
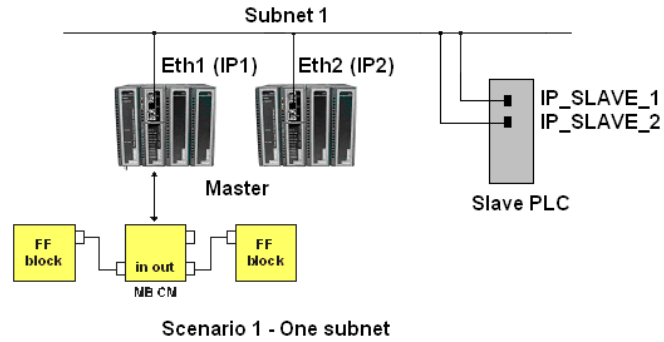
### NOTE

This DF89 redundancy is valid for firmware versions up to version V4.xx and DD 04.xx. From this version, the DF89 has other configuration form that is shown in detail in the "Creating a Modbus configuration using the DF89."

### Redundant DF63 as master and redundant PLC as slave, using Modbus TCP

There are two possible scenarios, in the first only one subnet is used and all IPs of equipment are on the same subnet.

In the second scenario, two subnets are used, and each device has an Ethernet port connected to one of them, see the following figure. The second scenario is the most recommended if the availability of the Modbus communication is an important factor, because in this case if there is some failure in one switch the another network/subnet will cover this failure.



**Network topologies for DF63 redundant master and slave PLC with two Ethernet ports**

The redundant PLC can either use two Ethernet cards or one card with two Ethernet ports.

Once the Primary DF63 executes the requests, it is assumed that any of the slave connections may receive and process the request. If one connection is not running properly the primary DF63 will use another available connection (connection switching).

If the Primary DF63 did not receive response to any of the connections and the Secondary DF63 has response to at least one of the connections, the DF63 pair will switch over (scenario Bad Condition/ controller switching).

**IMPORTANT**

For scenarios in which the two Ethernet ports of the slave PLC are used for connection to the Master via TCP, the **MBCF** block of the master has to be configured as follows:

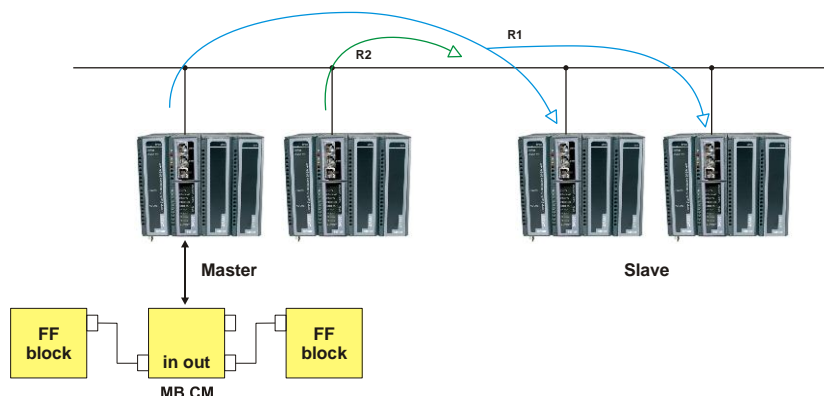
- The **SLAVE\_ADDRESSES** parameter with the IPs of the slave’s ports (**IP\_SLAVE\_1** and **IP\_SLAVE\_2** parameters). No more than two IPs are supported by the same slave.
- In the **MODBUS\_ADDRESS\_SLAVE\_1** and **MODBUS\_ADDRESS\_SLAVE\_2** parameters must be configured the Modbus Address related to the slave, identical for both parameters because it is the same slave (see example in figure below).

| MODBUS_CONFIGURATION   |                 | 14  | 15 |
|------------------------|-----------------|-----|----|
| SLAVE_ADDRESSES        |                 |     |    |
| IP_SLAVE_1             | 192.168.164.200 | .1  | RW |
| IP_SLAVE_2             | 192.168.165.200 | .2  | RW |
| IP_SLAVE_3             |                 | .3  | RW |
| IP_SLAVE_4             |                 | .4  | RW |
| IP_SLAVE_5             |                 | .5  | RW |
| IP_SLAVE_6             |                 | .6  | RW |
| MODBUS_ADDRESS_SLAVE_1 | 1               | .7  | RW |
| MODBUS_ADDRESS_SLAVE_2 | 1               | .8  | RW |
| MODBUS_ADDRESS_SLAVE_3 |                 | .9  | RW |
| MODBUS_ADDRESS_SLAVE_4 |                 | .10 | RW |
| MODBUS_ADDRESS_SLAVE_5 |                 | .11 | RW |
| MODBUS_ADDRESS_SLAVE_6 |                 | .12 | RW |
| RESTART MODBUS         |                 | .16 | RW |

**Partial view of the MBCF block - parameters related to the Modbus slave**

**Redundant DF63 as master and redundant PLC as slave, using Modbus RTU**

In this scenario, the DF63 is redundant, using 232 serial port, and it is connected via multidrop to redundant PLC (both ports), using 232/485 converter. Once the active DF63 executes the requests (see R1 in the following picture), it is assumed that only one slave will process the request. In case of any “bad condition” the DF63 will switch over (see R2 in the following figure).



**Redundant DF63 as slave and redundant PLC as Master, using Modbus TCP**

In this scenario, the Primary and Slave DF63 will answer the reads requested by the Master PLC. The writes will be executed only by the Primary DF63. If for any reason the Secondary DF63 receives a write, so this request will be forwarded via redundancy path from Secondary DF63 to Primary DF63.

**Redundant DF63 as slave and redundant PLC as Master, using Serial RTU**

In this scenario, only the Primary DF63 will answer the reads and writes requested by the Master PLC.

**Using Modbus in controllers DF73, DF75, DF79, DF81, DF89, DF95 and DF97**

The use of Modbus in DF73, DF75, DF79, DF81, DF89 (see NOTE DF89), DF95 and DF97 controllers is different from the way used by other controllers. This difference customizes the need for high performance in discrete and continuous Logic Ladder.

The main requirement for this module is simultaneously support Modbus through Serial port (RS-232) and TCP/IP. Therefore some rules must be followed in the MBCF block.

The instantiation and configuration of the MBCF block in the **Syscon** is mandatory to permit reading and writing operations via Modbus. Some block parameters are already configured automatically (see the following table in Parameters Description topic).

**NOTE**

The Modbus Supervision Slave (MBSS), Modbus Control Slave (MBCS), Modbus Supervision Master (MBSM), Modbus Control Master (MBCM) blocks and the bypass functionality (Modbus masters) they are not available for DF73, DF75, DF79, DF81, DF89, DF95 and DF97 controllers.

**Communication Channel**

The DF73, DF75, DF79, DF81, DF89, DF95 and DF97 controllers work simultaneously via RS-232 and TCP/IP (Default state). Therefore there will be answer for Modbus Master requests in the RS-232 port and in the Ethernet ports of the DF73, DF75, DF79, DF81, DF89, DF95 and DF97 controllers (Modbus slaves).

For this type of communication is recommended a maximum of 5 Modbus connections masters (4 via Ethernet port and 1 via Serial port) with the DF73, DF75, DF79, DF81, DF89, DF95 and DF97 (Modbus slaves).



Is recommended that master’s scan does not overload the slave with more than two requests per second.

**Modbus Addresses**

The DF73, DF75, DF79, DF81, DF89, DF95 and DF97 Modbus addresses are automatically generated by **LogicView for FFB** for any Ladder input and output. There is the possibility to manually configure the addresses.

Further information about the **LogicView for FFB** Modbus addresses generation, please consult the section "Adding Logic using Functional Blocks (FFB 1131 - Flexible Function Blocks) " and the **LogicView for FFB** manual.

**Parameters Description**

For further details about the parameters description omitted in this section, please consult the Function Blocks Manual.

| Idx | Parameter              | Data type (Comp.) | Valid Strip / Options  | Value Default | Units     | Memory / Way | Description  |
|-----|------------------------|-------------------|--|---------------|-----------|--------------|--|
| 1   | ST_REV                 | Unsigned16        |  | 0             | None      | S/RO         |  |
| 2   | TAG_DESC               | OctString(32)     |  | Spaces        | Na        | S            |  |
| 3   | STRATEGY               | Unsigned16        |  | 0             | None      | S            |  |
| 4   | ALERT_KEY              | Unsigned8         | 1a 255   | 0             | None      | S            |  |
| 5   | <b>MODE_BLK</b>        | <b>DS-69</b>      |  | <b>O/S</b>    | <b>Na</b> | <b>S</b>     | <b>See MODE_BLK parameter in the Function Blocks manual.</b>   |
| 6   | BLOCK_ERR              | BitString(2)      |  |               | E         | D/RO         |  |
| 7   | MEDIA                  | Unsigned8         | 0:Serial, 1:TCP/IP   | Serial        | E         | S            | Parameter not used. Always Serial.   |
| 8   | MASTER_SLAVE           | Unsigned8         | 0:Master, 1:Slave  | Slave         | E         | S            | Parameter not used. Always Slave.  |
| 9   | <b>DEVICE_ADDRESS</b>  | <b>Unsigned8</b>  | <b>1-247</b>   | <b>1</b>      | <b>E</b>  | <b>S</b>     | <b>Defines the DFI modbus address (only for DFI slave).</b>  |
| 10  | <b>BAUD_RATE</b>       | <b>Unsigned8</b>  | <b>0:110, 1:300, 2:600, 3:1200, 4:2400, 5:4800, 6:9600, 7:19200, 8:38400, 9:57600, 10:115200</b> | <b>19200</b>  | <b>E</b>  | <b>S</b>     | <b>Defines the transmission rate (only for communication serial).</b>  |
| 11  | <b>STOP_BITS</b>       | <b>Unsigned8</b>  | <b>0:1, 1:2</b>  | <b>1</b>      | <b>E</b>  | <b>S</b>     | <b>Defines the number of stop bits (only for media serial).</b>  |
| 12  | <b>PARITY</b>          | <b>Unsigned8</b>  | <b>0: None, 1:Odd, 2:Even.</b>   | <b>Odd</b>    | <b>E</b>  | <b>S</b>     | <b>Defines the parity (only for communication serial).</b>   |
| 13  | TIMEOUT                | Unsigned16        | 0-65535  | 1000          | ms        | S            | Parameter not used.  |
| 14  | NUMBER_RETRANSMISSIONS | Unsigned8         | 0-255  | 1             |           | S            | Parameter not used.  |
| 15  | SLAVE_ADDRESSES        | DS-263            |  |               |           | S            | Parameter not used.  |
| 16  | RESTART_MODBUS         | Boolean           |  | False         |           | S            | Parameter not used.  |
| 17  | TIME_TO_RESTART        | Unsigned16        | 1-65535  | 0             | ms        | S            | When the device is working as master, it is the time between the periodic scan of those commands. When the device is working as slave, it is the minimum time between each Modbus request and Modbus response. When the device is working as master, the default value is 1000 ms and when it is slave the default value is 0. |
| 18  | RTS_CTS                | Boolean           |  | False         |           | S            | Parameter not used.  |
| 19  | <b>ON_APPLY</b>        | <b>Unsigned8</b>  | <b>0: None, 1:Apply</b>  | <b>None</b>   | <b>E</b>  | <b>S</b>     | <b>Applies the changes done in the Modbus blocks.</b>  |
| 20  | CHECK_COMM_STANDBY     | Unsigned8         | 0-255  | 0             | Na        | S/RW         | Parameter not used.  |

Legend: E – Parameters List; Na – Parameter Dimensionless; RO – Read Only; D – Dynamic; N – Not Volatile; S - Static Line with Completion of Gray Fund: Main parameters to be configured and Default of the Syscon.

## Troubleshooting

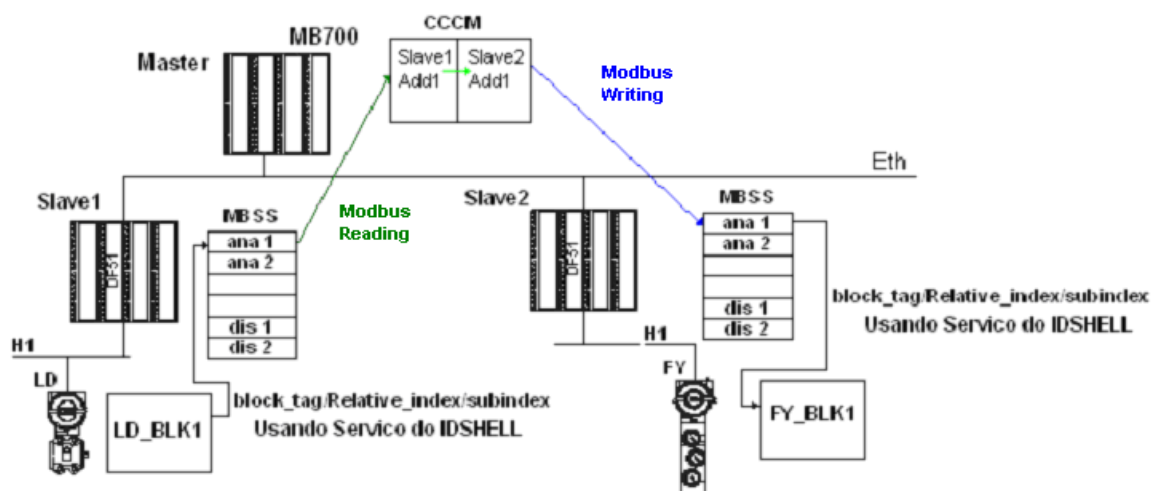
### A) The communication or supervision with the bridge was lost due to the use of MBSS block

**Problem:** Modbus Supervision Slave block (MBSS) is used to control where master writes cyclically in the MBSS block. For this case, the writing/reading queue of the DF equipment line will be full. The possible causes are supervision stops or lose the communication between **Syscon** and bridge. This problem occurs when there are writings of MBSS in other block, if the MBSS is writing in the DF51 or in another transmitter.

**Cause:** The MBSS block aims supervision tasks (**IDSHELL**) and it is not its purpose receives cyclic writings. Another relevant point is that the writing has priority over the supervision. So, when Modbus master writes cyclically in the MBSS block and mainly in the TCP (where media is faster), and with frequent writings, the consequence will be the full supervision/writings queue in the **IDSHELL** block (DF51), so only Modbus tasks will be executed and it will not have time to execute other tasks.

**Example for this scenario:** MB700 working as master of DF51 (slave) in the TCP/IP media.

In the example below, Concentrate Control Master block (CCCM) of MB700 reads **LD\_BLK1** data (which is in the LD302 transmitter) of the slave1 and writes data for the slave2 (writing in the **FY\_BLK1** block of FY302).



#### Solution:

1) It recommends use the MBCS block when Modbus master writes cyclically, because this block does not use supervision tasks (**IDSHELL**) to send data for the Modbus. That means the data in the slave will be written during the block macro cycle time.

In the example of the previous figure, if the MBSS data direction is from slave2 to control block, then the MBSS block must be replaced by a MBCS block, which the **OUT\_xx** of the MBCS will link to the control block.

2) If the MBSS block is necessary, the update time must be set long in the master device (time about some seconds). This time setting can be done in the **CONTROL\_OFF\_DUTY** parameter of the MB700 and in the **TIME\_TO\_RESTART** parameter of the DF51.

**Observations:** For cyclic writing in transmitters, the minimum time between the writings must be at least 2 seconds to not stop the supervision in the DF51.

**B) Writing in static parameters of transmitters causes decrease of the EEPROM service life of the device**

**Problem:** Using the MBSS block, master writes cyclically in static parameters of field devices. In this case, it can cause the decrease of the EEPROM service life because frequent writing.

**Example for this scenario:** MB700 working as master of the DF51 (slave) in the TCP/IP.

Using the example of the previous figure, the Concentrate Control Master block (CCCM) of MB700 writes cyclically in the **CT\_VAL\_1** parameter (which is a static parameter) of the Constant block (**FY\_BLK1**) that is in the FY302 of slave2.

**Solution:**

One solution is to avoid writing in static parameters. An example is showed by using the Constant block. Instead of writing in the **CT\_VAL\_xx** parameter (which is a static parameter) with the block in **AUTO** mode, it is possible to write in the **OUT\_xx** parameter (which is a dynamic parameter) with the block in **MAN** mode. In this case, when a reset occurs in the transmitter, the Constant block output will be zero (default) until the communication between the Modbus master and slave comes to normal situation.

**C) Optimizing the communication by reducing the number of Modbus commands**

**Problem:** When using Modbus writing commands is necessary to avoid gaps between the addresses. Gaps are intervals between two consecutive addresses. For example, there is writing for the addresses 2001 and 2005, and there is no writing for the addresses 2002, 2003 and 2004.

This problem is lesser for readings, because the reading supports gaps between the addresses and also it has a limit. The limit for discrete points is 1200 (it supports up to 1200 points in the same command. For example, the range address is from 2001 to 3201 and this range is in the same command). The analog points limit is 120.

**Example for this scenario:** MB700 working as master of a slave LC700 in the serial media.

Concentrate Control Master blocks are set in MB700 and there are cyclical writings (**IN\_x** parameters) in the Modbus slave. In this configuration the Modbus points 1, 5, 6, 9, 11, 13, 15 are used. For this case are set six Modbus commands and only one can be used for that. Considering the baud rate equals to 9600 and the time equals to 100ms to execute each command, the writing of all variables will take 600 ms, and the writing in an optimized way will take only 100ms.

**Solution:**

If the DF51 is the slave device, it must be use variables in sequence of the same block OUT\_1, OUT\_2, OUT\_3, etc.

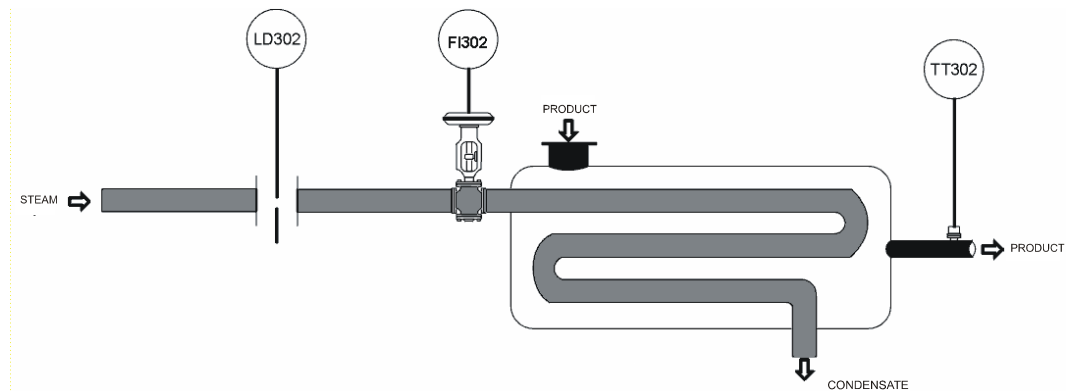
## Section 16

# CREATING A FIELDBUS STRATEGY BY USING DF51

### Introduction

This section describes the strategy configuration by using the DF51 controller as Bridge. The control loop is shown below.

### PROJ\_DF51



**Figure 16. 1 – Example of temperature control process**

The purpose of this process is to control the fluid output temperature (controlled variable) using steam flow rate (manipulated variable) to heat it. The fluid temperature will be sent to the master controller, where it will be compared to a temperature set point.

The master output would be the slave controller set point, which will control the steam flow rate to the heat exchanger.

## Starting the Area

### Step 1

It is possible to create, or edit, an area from the **Studio302**. In the **Studio302** interface select **Areas**. A window will appear listing all areas of database.

To create a new area from the **Studio302**, left-click inside the **Areas** window, then choose **New Area**.

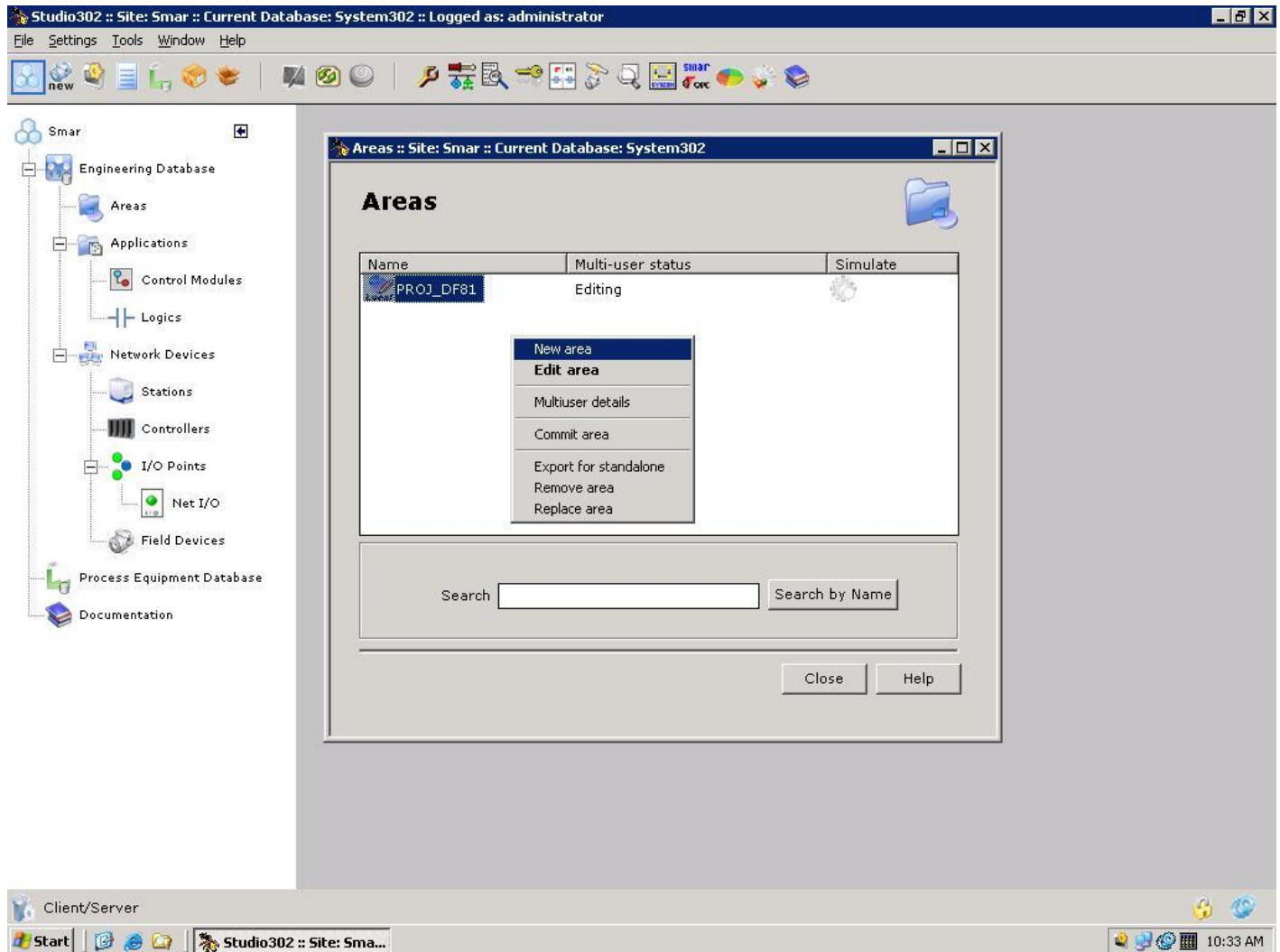


Figure 16. 2 – Creating a new area

Another way to create a new area is from **Syscon**. Click the icon  in the **Studio302** toolbar.


To create a new area on **Syscon**, choose **File → New**, or through the toolbar, choose **New** button . The dialog box shows the areas options. Select **Area** as shown in next figure:



Figure 16. 3 – Options to create Syscon areas

After choosing the area type, it opens a window to the user give a name to the new area.



Figure 16. 4 – New area name

Type the name for the area in the **Area Name** box, and click **Ok**. For this example, it chooses **Proj\_DF51** name.

A new window will appear. This window has:

- **Application** – Logical Plant. To insert control strategies into this part.
- **Fieldbus Networks** – Physical Plant. To add devices and function blocks to the area into this part.



Figure 16. 5 – Area divisions

## Physical Plant Project

### Step 2


In the main window, PROJ\_DF51, right-click the **Fieldbus Networks** icon, , to select the Server. Choose **Communication Settings** option, or through the toolbar, choose **Communication→Settings**. The communication settings dialog box will open:



Figure 16. 6 – Choosing the Server

Confirm if the **Smar.DFIOLEServer.0** option has already been selected. Otherwise, the user must select it, and then click **OK**.

## Arranging Fieldbus windows

### Step 3

Right-click the **Fieldbus Networks** icon, and then choose **New Fieldbus** option.

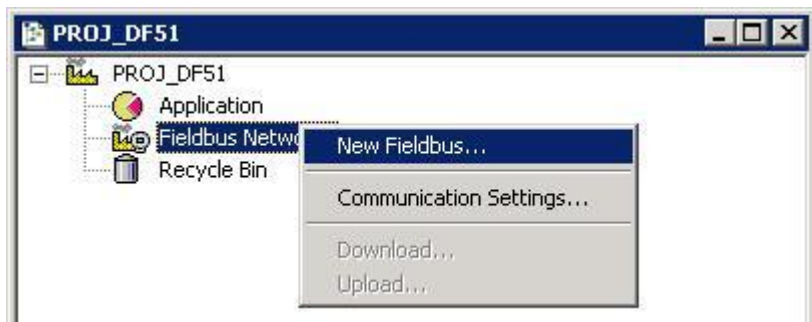


Figure 16. 7 – Adding a Fieldbus channel

When selecting the **New Fieldbus** option, the dialog box to choose the channel type and name it with tags opens. If the user needs to name the channel with a specific tag, it must be written in this box. After that, click **OK**. Otherwise, the default tag will be attributed to the channel.



Figure 16. 8 – Selecting the Fieldbus channel and naming it with a tag

In the **PROJ\_DF51** window, the **CANAL\_00** will be inserted into the **Fieldbus Networks**:

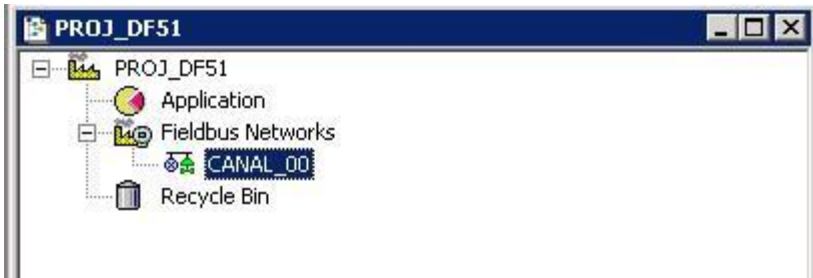


Figure 16. 9 – Fieldbus channel inserted

Right-click the **CANAL\_00** icon and choose **Expand**. A new window will appear.

To arrange the screen, click the main area window. So, choose **Window** menu on the **Syscon** toolbar, and then choose **Tile** option.

### Adding Bridges

#### Step 4

Now the bridges that will be used for this area can be added.

First, the DF51 controller must be inserted. In the **PROJ\_DF51** window, right-click the **CANAL\_00** icon. Select **New** → **Bridge** as shown in the next figure:

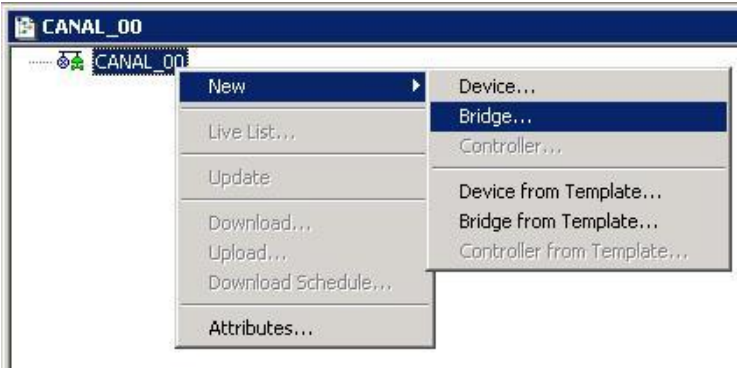


Figure 16. 10 – Inserting the bridge to the area

After inserting the Bridge, it opens a window as shown below.

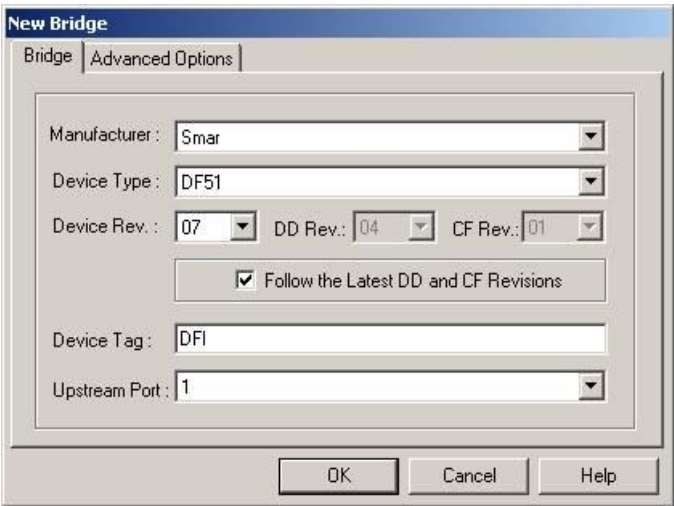


Figure 16. 11 – Setting the Bridge



Select **DF51** in the **Device Type** box. In the **Device Tag** box, type **DFI** or another tag, and click **OK**.

| IMPORTANT  |
|--|
| <p>Not all characters are valid when naming the elements, so pay attention:<br/>           The valid characters are:<br/>           A-Z a-z 0-9 # { } [ ] ( ) + -<br/>           The invalid characters are:<br/>           ~ ` ! @ # \$ % ^ &amp; * =   : ; , . &lt; &gt; ? / ' " \</p> |


In the **CANAL\_00** window, right-click the **DFI** icon, , Select **Attributes** option to see the bridge’s attributes and, if necessary, change its tag. Click **OK**. See the next figure:



Figure 16. 12 – Bridge attributes

## Adding Fieldbus Devices

### Step 5

After adding the bridge for the area, it is possible to insert the field devices. First, return to the **PROJ\_DF51** window and right-click the **CANAL\_00** channel. Select **New→Device**

The dialog box for choosing the device and naming it with a tag will be shown. The user can select **Smar** in the **Manufacturer** box, select **TT302** in the **Device Type** box, and then name this device with the tag **TIC001**, or with another tag. After finishing, click **OK**:

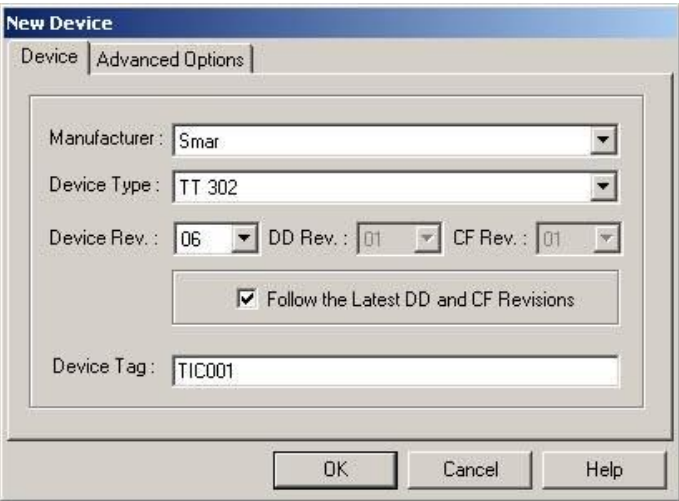


Figure 16. 13 – Setting the Fieldbus Device

Repeat this procedure to add a transmitter (LD302) and a converter (FI302) in the flow control.


After adding the devices to the area, the **CANAL\_00** channel will be as shown in the following figure:



Figure 16. 14 – Device added into the Fieldbus channel

### Adding Function Blocks

#### Step 6

Now the user can add Function Blocks. To add a new Function Block (FB), click the  sign, and right-click the **Virtual Field Device (FB VFD)** icon. Select **New Block** item.

The FB VFD is responsible for the data management.

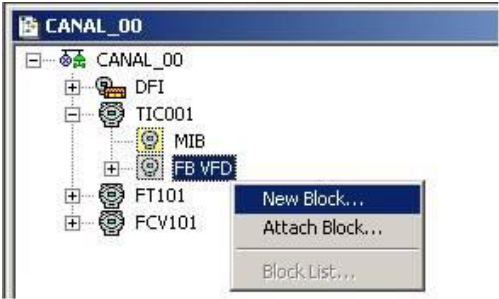


Figure 16. 15 – Selecting new blocks

The **Function Block Characterization** dialog box will appear. The **Block Type** option shows the Smar's FB.

Select the block in the **Block Type** box and name it in the **Block Tag** box. The next figure shows adding the Analog Input function block.

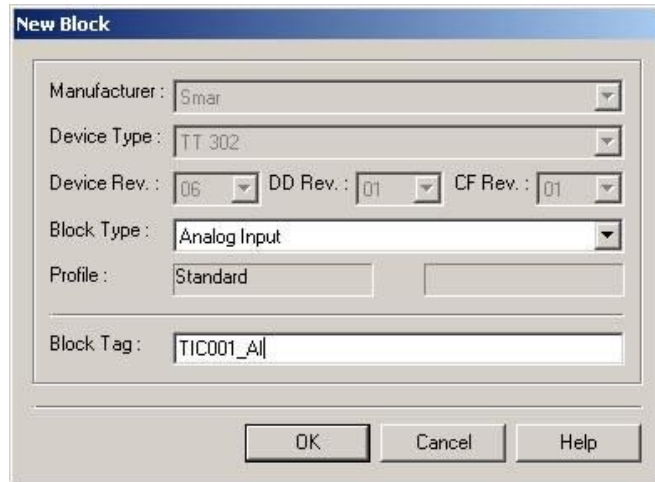


Figure 16. 16 – Adding function blocks to the device

For this example, it is necessary to add AI, PID and AO function blocks to build a cascade control configuration.

**NOTE**

From the **Syscon** version 6.00, it is not necessary to configure the Transducer (TRD), Resource Block (RES), Diagnostics (DIAG) and Display (DSP) blocks, because they are preinstantiated in the devices.

The channel configuration with all function blocks and devices is showed below. For better identification of the Transducer, Resource and Diagnostics function blocks name them with specific tags.

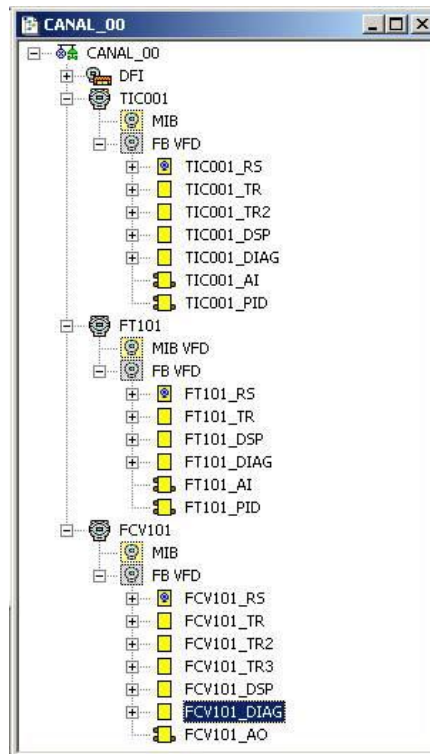


Figure 16. 17 – Fieldbus channel composition

Now the strategy on the Application (Logical Plant) can be developed. First it is necessary to establish a new process cell.

## Creating New Process Cells

### Step 7

The **Logical Plant** can be divided in several process cells, according to the plant.

To create a new process cell, right-click the **Application** icon and select **New Process Cell** item.

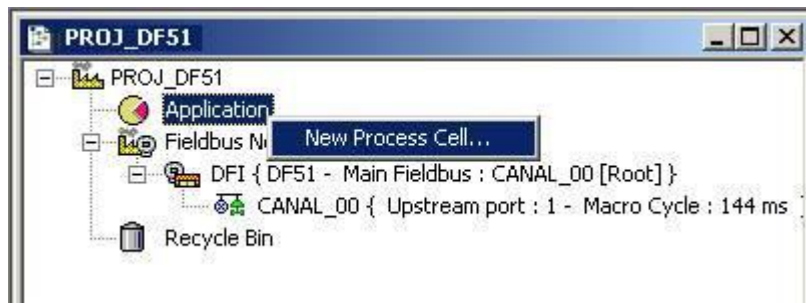


Figure 16. 18 – Adding a Process Cell

The dialog box to attribute the tag to the **Process Cell** will open:

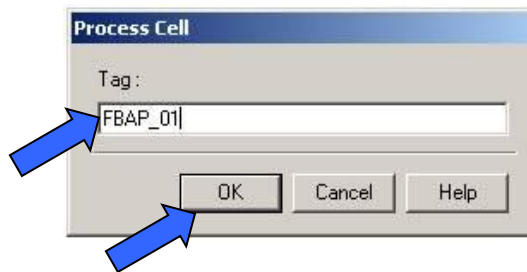


Figure 16. 19 – Attributing tag to the Process Cell

If the user needs name the Process Cell with a specific tag, can enter it in the **Tag** box, and click **OK**. To create more process cells, the procedure above has to be repeated.

After inserting the Process Cell, the **PROJ\_DF51** window will be according to the following figure:

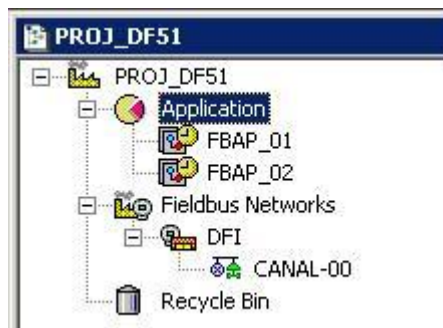


Figure 16. 20 – Area window after inserting the Process Cell

#### NOTE

The user must remember that **Application** is a virtual division. It only divides a large plant. For example: if the plant has two networks, they can be FB (**FBApplications**) in the **Syscon**. One **Application** can have several **FB Applications**, but a **FB Application** can not be in more than one **Application**.

## Creating a Control Module (FBApplication)

### Step 8

Now the user can create a Function Block Application, Control Module, in the **Application** section.

Right-click the **FBAP\_01** icon and select **Expand** item.

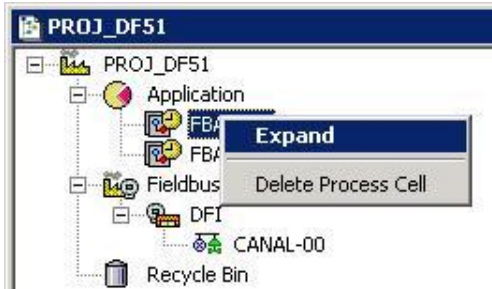


Figure 16. 21 – Creating a FB Application

To arrange the screen, click the area window. So, choose the **Window** menu on the **Syscon** toolbar and then choose **Tile** option.

Return to the **FBAP\_01** window. Right-click the **FBAP\_01** item and choose **New Control Module**. See the next figure.

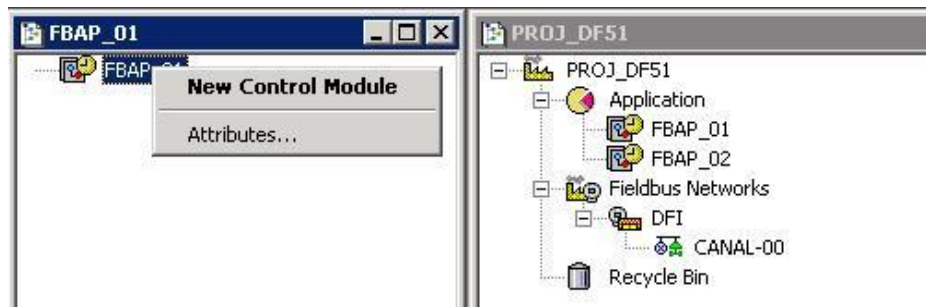


Figure 16. 22 – Creating the new Control Module

The **Control Module** dialog box will appear. Name it with a tag related to the Process Cell. Click **OK** to conclude this task.

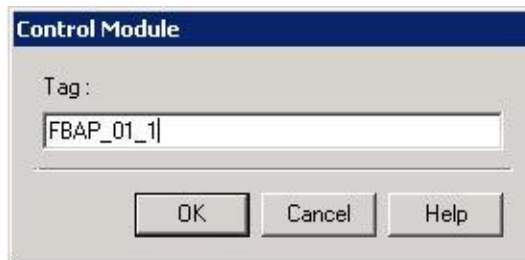


Figure 16. 23 – Attributing tag to the Control Module

### IMPORTANT

Remember that not all characters are valid when naming the elements with tags.

The valid characters are:

A-Z a-z 0-9 # { } [ ] ( ) + -

The invalid characters are:

~ ` ! @ # \$ % ^ & \* = | : ; , . < > ? / ' " \

## Inserting Blocks in the Control Module

### Step 9

Now the user can add function blocks for the devices in the Logical Plant. Right-click the **FBAP\_01\_1** item and select **Attach Block** option, as shown in the next figure.



Figure 16. 24 – Attaching blocks to the FBAP

The **Attach Block** dialog box will open:



Figure 16. 25 – Inserting blocks to the FB Application

The available function blocks for the Control Module are showed in the **Attach Block** box. For the aimed strategy, the function blocks that must be inserted will appear in the box. So, select them one by one, and click **OK**.

When the Attach Block process ends, the Control Module will be as shown in the next figure:

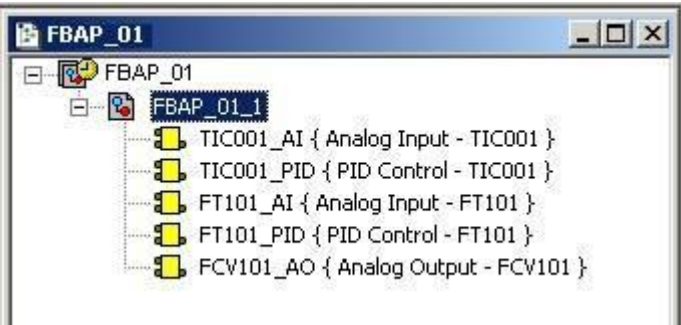


Figure 16. 26 – Blocks added to the FB Application

Another way to attach the blocks to the Control Module is left-clicking the element and drop it to the window.

## Configuring the Control Strategy

### Step 10

Now the user is ready to develop the control strategy.

First, right-click the FBAP icon and choose **Strategy**. The **Strategy** window will appear as shown in the following figure.

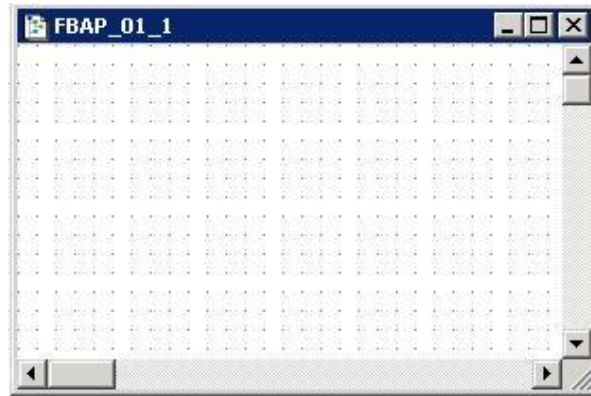


Figure 16. 27 – Strategy window

At this moment there are 3 or 4 windows opened in the **Syscon**. Minimize the **CANAL\_00** window. To arrange these windows, click the **FBApplication** window, and then the **Proj\_DF51** window. On the toolbar, choose **Window → Tile**.


If the user does not have a monitor upper than 17", it is recommended to minimize the strategy window. Thus the whole area can be visualized.

The strategy window offers several tools for drawing. Refer to the **Syscon**'s Help for further details.

## Adding Blocks to the Strategy window

### Step 11

Now the function blocks can be added to the **FBAP\_01\_1** window.

In order, click the first block,  TIC001\_AI1 , and drop it into the strategy window. A function block will be created automatically.

The following figure shows the function block added to the strategy window:

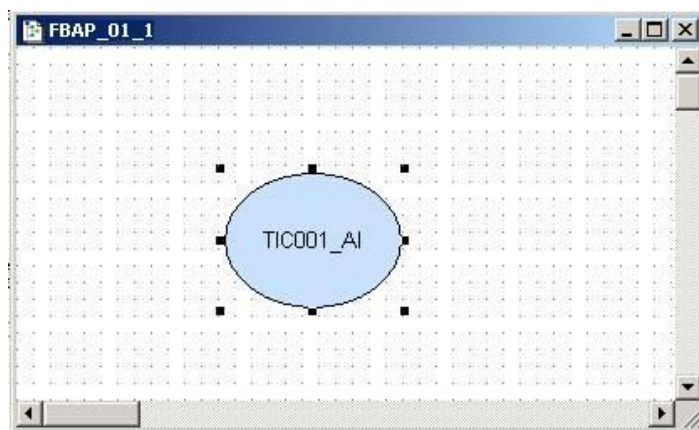


Figure 16. 28 – Block inserted into the strategy window

The drag-and-drop procedure must be repeated for the other blocks such as TIC001\_PID, FT101\_AI, FT101\_PID e FCV101\_AO.

## Linking the Blocks

### Step 12

There is a specific tool to link the blocks, the **Link** button, , on the **Strategy** toolbar.

Click this button on the toolbar, and then in the TIC001\_AI function block. The dialog box for linking the input and output parameters will appear. Select **OUT**, and then click the **OK** button as shown in the following figure.

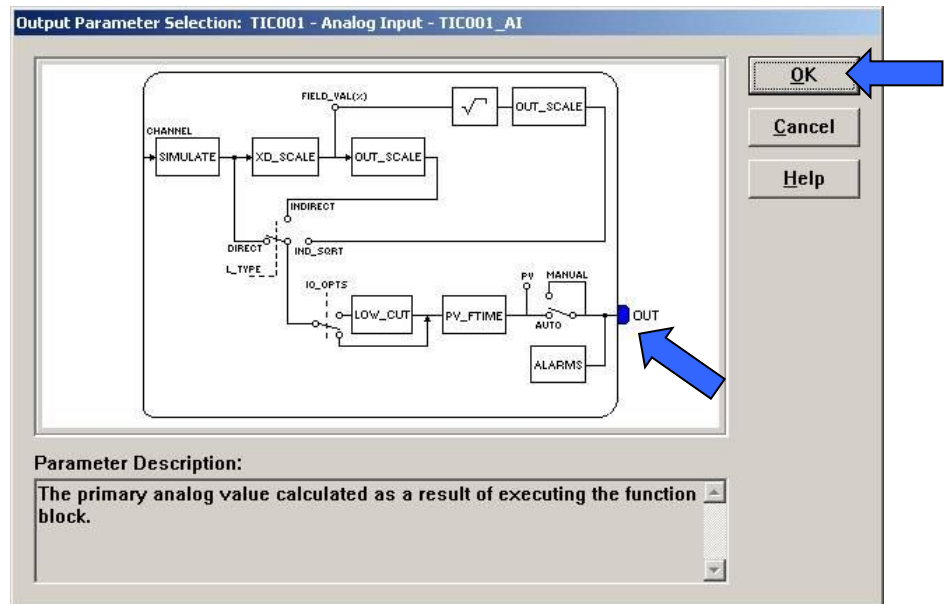


Figure 16. 29 – Linking the function blocks

Move the mouse cursor up to the block that will be linked.

The user also does the fast link procedure just right-clicking the function block.

The links necessary for this strategy are:

#### Direct Links:

- OUT(TIC001\_AI) → IN(TIC001\_PID)
- OUT(TIC001\_PID) → INFT101\_PID)
- OUT(FT101\_PID) → CAS\_IN(FCV101\_AO)
- OUT(FT101\_AI) → CAS\_IN(FT101\_PID)

#### Back Links:

- BKCAL\_OUT(PID\_LD302) → CAS\_IN(PID\_TT302)
- BKCAL\_OUT(AO\_FI302) → BKCAL\_IN(PID\_LD302)

After linking the parameters specified above, the strategy window will be as shown in the following figure.



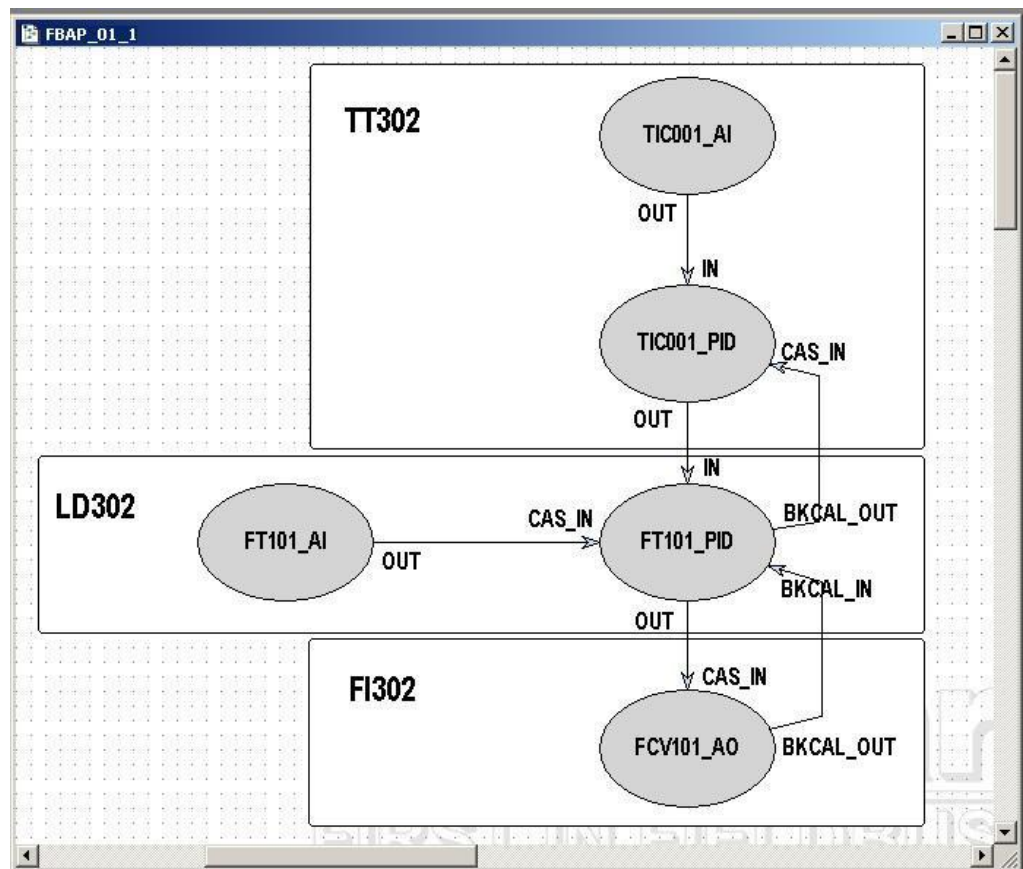


Figure 16. 30 – Links among function blocks

## Function Block Characterization

### Step 13

The function blocks must be set according to the application for them. So, it is necessary to do the block characterization.

The online and offline modes are possible for the block characterization. In the offline mode, the parameters are set before starting the communication between the devices. The online characterization is executed directly in the devices when the plant is already communicating.

To change the function block parameters, consider the following topics:

#### 1. In the Strategy window

Select the block to characterize. Right-click it, and select the **Off Line Characterization** option, or double-click it. The following figure shows the block that is being done the offline characterization:

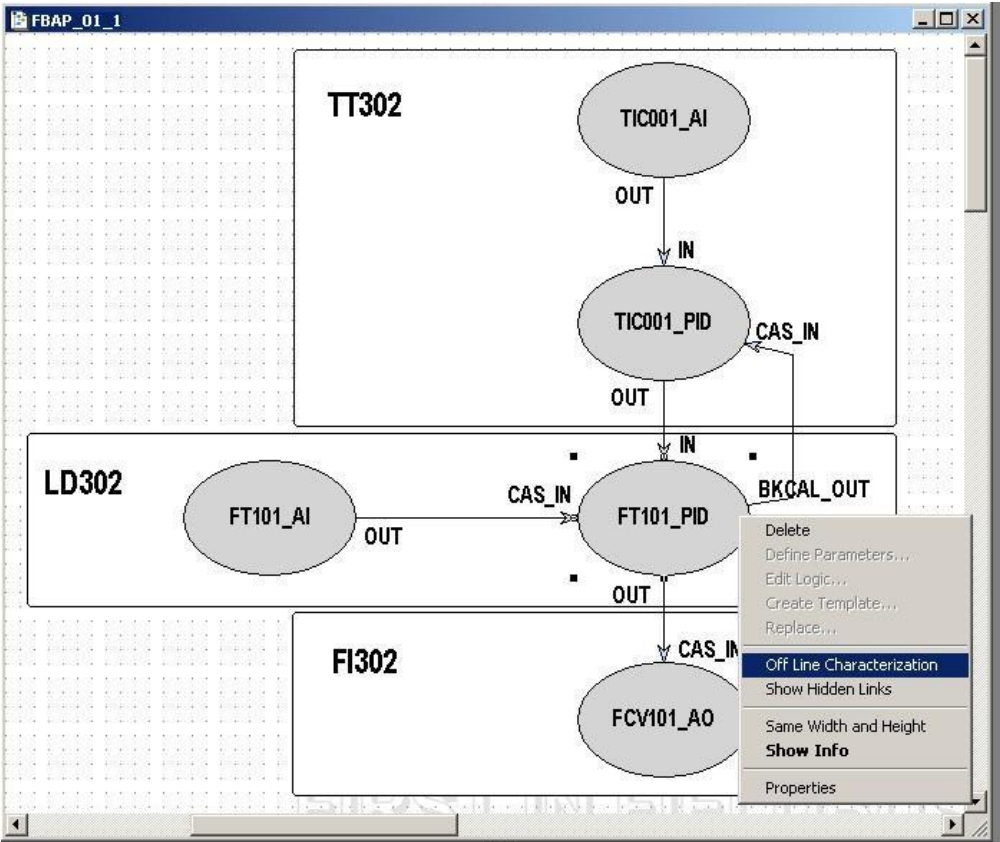


Figure 16. 31 – Offline characterization in the Strategy window

2. In the CANAL\_00 window

Another way to do the offline characterization is right-clicking the function block, and then selecting the **Off Line Characterization** option, as shown in the next figure:

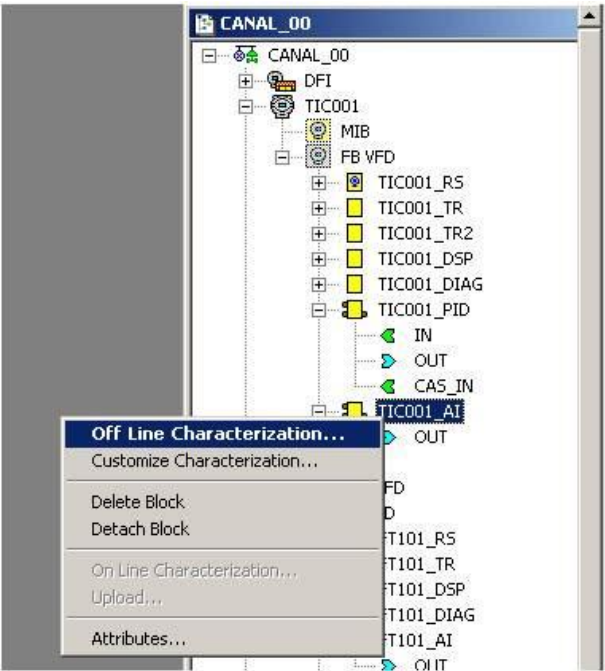
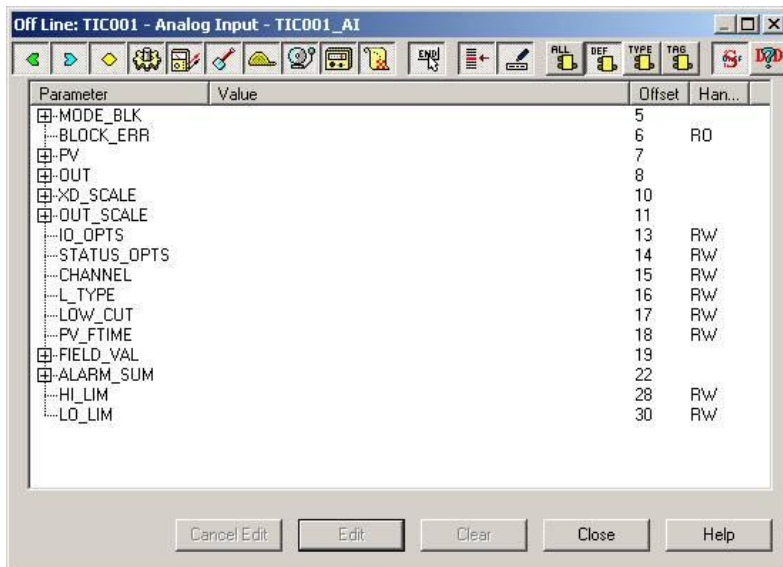


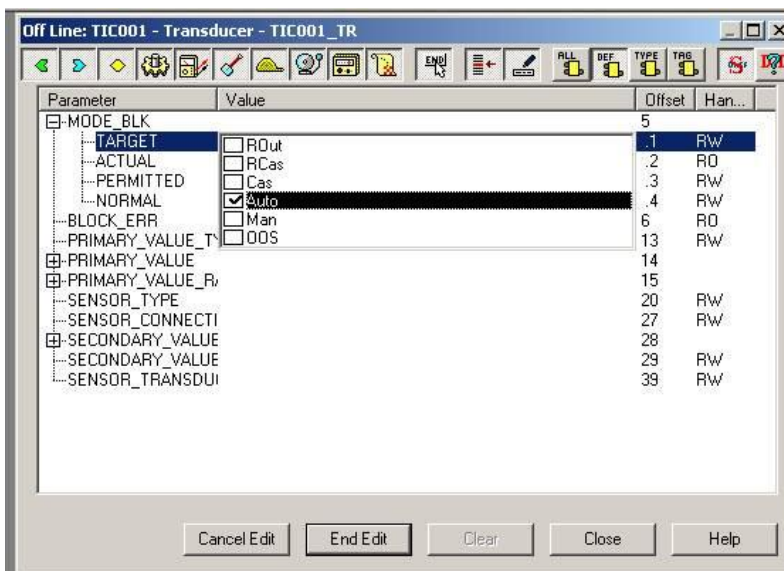
Figure 16. 32 – Offline characterization in the Fieldbus channel window

For both situations, the **Off Line Characterization** dialog box will appear:



**Figure 16. 33 – Function Block Characterization dialog box**

Double-click at the right side of the parameter to change it. Another option is click once, and then in the **Edit** button to start editing the parameter value. At the ending, click the **End Edit** button.



**Figure 16. 34 – Editing the parameter in the Function block Characterization box**


The list below shows the parameters that must be set for this area:

| DEVICE                    | TAG   | BLOCK             | PARAMETER                         |
|---------------------------|-------|-------------------|-----------------------------------|
| LD302                     | FT101 | TR                | MODE_BLK.Target = AUTO            |
|                           |       | RS                | MODE_BLK.Target = AUTO            |
|                           |       | DSP               | MODE_BLK.Target = AUTO            |
|                           |       |                   | BLOCK_TAG_PARAM_1= FT101_AI       |
|                           |       |                   | INDEX_RELATIVE_1 = 8              |
|                           |       |                   | MNEMONIC_1 = VAZAO                |
|                           |       |                   | ACCESS_1 = MONITORING             |
|                           |       |                   | ALPHA_NUM_1 = MNEMONIC            |
|                           |       |                   | DISPLAY_REFRESH = UPDATE DISPLAY  |
|                           |       | AI                | MODE_BLK.Target = AUTO            |
|                           |       |                   | XD_SCALE.EU_100 = 100             |
|                           |       |                   | XD_SCALE.EU_0 = 0                 |
|                           |       |                   | XD_SCALE.UNITS_INDEX = inH2O(4°C) |
|                           |       |                   | OUT_SCALE.EU_100 = 100            |
|                           |       |                   | OUT_SCALE.EU_0 = 0                |
|                           |       |                   | OUT_SCALE.UNITS_INDEX = %         |
|                           |       | CHANNEL = 1       |                                   |
|                           |       | L_TYPE = INDIRECT |                                   |
|                           |       | PID_1             | MODE_BLK.Target = AUTO            |
|                           |       |                   | PV-SCALE.EU_100 = 100             |
| PV-SCALE.EU_0 = 0         |       |                   |                                   |
| PV-SCALE.UNITS_INDEX = %  |       |                   |                                   |
| OUT_SCALE.EU_100 = 100    |       |                   |                                   |
| OUT_SCALE.EU_0 = 0        |       |                   |                                   |
| OUT_SCALE.UNITS_INDEX = % |       |                   |                                   |
| GAIN = 0.5                |       |                   |                                   |
| RESET = 1                 |       |                   |                                   |
| RATE = 0                  |       |                   |                                   |

| DEVICE            | TAG                      | BLOCK       | PARAMETER                        |
|-------------------|--------------------------|-------------|----------------------------------|
| TT302             | TIC001                   | TR          | MODE_BLK.Target = AUTO           |
|                   |                          |             | SENSOR_TYPE = PT100IEC           |
|                   |                          |             | SENSOR_CONNECTION = THREE WIRES  |
|                   |                          |             | SENSOR_TRANSDUCER_NUMBER = 1     |
|                   |                          | RS          | MODE_BLK.Target = AUTO           |
|                   |                          | DSP         | MODE_BLK.Target = AUTO           |
|                   |                          |             | BLOCK_TAG_PARAM_1 = TT100_AI     |
|                   |                          |             | INDEX_RELATIVE_1 = 8             |
|                   |                          |             | MNEMONIC_1 = TEMP                |
|                   |                          |             | ACCESS_1 = MONITORING            |
|                   |                          |             | ALPHA_NUM_1 = MNEMONIC           |
|                   |                          |             | DISPLAY_REFRESH = UPDATE DISPLAY |
|                   |                          | AI          | MODE_BLK.Target = AUTO           |
|                   |                          |             | XD_SCALE.EU_100 = 500            |
|                   |                          |             | XD_SCALE.EU_0 = 0                |
|                   |                          |             | XD_SCALE.UNITS_INDEX = °C        |
|                   |                          |             | OUT_SCALE.EU_100 = 100           |
|                   |                          |             | OUT_SCALE.EU_0 = 0               |
|                   |                          |             | OUT_SCALE.UNITS_INDEX = %        |
|                   |                          | CHANNEL = 1 |                                  |
| L_TYPE = INDIRECT |                          |             |                                  |
| PID               | MODE_BLK.Target = AUTO   |             |                                  |
|                   | PV_SCALE.EU_100 = 100    |             |                                  |
|                   | PV_SCALE.EU_0 = 0        |             |                                  |
|                   | PV_SCALE.UNITS_INDEX = % |             |                                  |
|                   | SP = 50                  |             |                                  |
|                   | GAIN = 0.5               |             |                                  |
|                   | RESET = 1                |             |                                  |
| RATE = 0          |                          |             |                                  |

| DEVICE               | TAG                       | BLOCK | PARAMETER                        |
|----------------------|---------------------------|-------|----------------------------------|
| FI302                | FCV101                    | TR    | MODE_BLK.Target = AUTO           |
|                      |                           |       | TERMINAL_NUMBER = 1              |
|                      |                           | RS    | MODE_BLK.Target = AUTO           |
|                      |                           |       | MODE_BLK.Target = AUTO           |
|                      |                           | DSP   | BLOCK_TAG_PARAM_1 = FCV102_AO    |
|                      |                           |       | INDEX_RELATIVE_1 = 9             |
|                      |                           |       | MNEMONIC_1 = VALVULA             |
|                      |                           |       | ACCESS_1 = MONITORING            |
|                      |                           |       | ALPHA_NUM_1 = MNEMONIC           |
|                      |                           |       | DISPLAY_REFRESH = UPDATE DISPLAY |
|                      |                           | AO    | MODE_BLK.Target = AUTO           |
|                      |                           |       | PV_SCALE.EU_100 = 100            |
|                      |                           |       | PV_SCALE.EU_0 = 0                |
|                      |                           |       | PV_SCALE.UNITS_INDEX = %         |
| XD_SCALE.EU_100 = 20 |                           |       |                                  |
| XD_SCALE.EU_0 = 4    |                           |       |                                  |
|                      | XD_SCALE.UNITS_INDEX = mA |       |                                  |

After the parameter setting, the user can start the equipment communication. It is necessary commissioning the devices in order to attribute the tags, IDs and device addresses properly. If this procedure is not executed, the **Syscon** will detect the noncommissioned device and the download for this device will be aborted. Finishing the equipment commissioning, the download process can start. The download process can be executed, for example, returning to the **Proj\_DF51** window,

right-clicking the **Fieldbus Networks** icon, , and selecting the **Download** option. For further details about the available download types, refer to the **Syscon** manual.

## Optimizing the Supervision

There are some important steps to be done in the DF51 configuration that can improve the supervision time. Before starting these procedures, a brief description of the System302 architecture is presented to facilitate the understanding of the effects of changes in each parameter.

Take a look in the next figure. The user will be able to follow the data flow from source (field device) to the destination (HMI). Starting in the field device, the data is collected by DFI302 during the **Background** time included in the Fieldbus macrocycle. When using **MVC** (Multiple Variable Container), these data are grouped in an optimized way. The **Supervision Time** controls the rate that a MVC is read from the field device. Each **Update Time**, DFI302 sends the data to DFI OLE Server which updates its database. All the OPC Groups will be updated according to the **OPC Update Rate**.

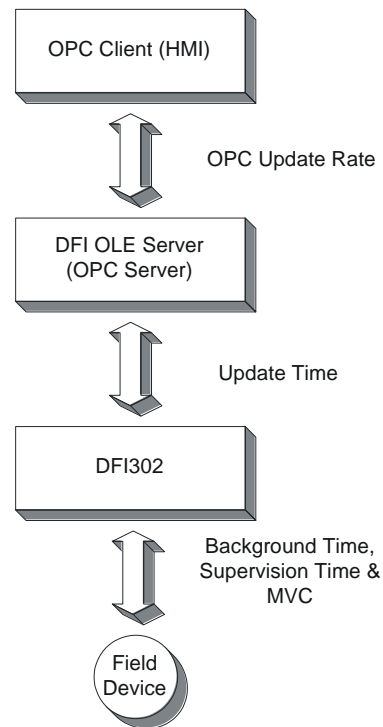


Figure 16. 35 – SYSTEM302 Architecture

The next steps must be configured in order to get a better and optimized time for each system.

## Background time

One of the first parameters to be set is Background time (or Background traffic). The **Syscon** calculates the macrocycle according to the number of links in the configuration and allows the user to add a Background time. A minimum value is automatically set by **Syscon**, and must be calculate to have an ideal background to each Fieldbus Network.

The Background time is calculated based on the formula used for the Fieldbus macrocycle. The macrocycle is composed of Operational and Background traffics.

The ideal macrocycle for non-Redundant Systems is:

$$\text{Ideal macrocycle non-Redundant} = ((30 \cdot \text{NDEV}) + (30 \cdot \text{NEL})) \cdot 1.2$$

The ideal macrocycle for Redundant Systems is:

$$\text{Ideal macrocycle Reduntant} = ((60 \cdot \text{NDEV}) + (30 \cdot \text{NEL})) \cdot 1.2$$

Where, NDEV is the Number of Field Devices in the Fieldbus Network  
NEL is the Number of External Links (between Field Devices)

After you know the ideal macrocycle, go to Fieldbus Attributes on **Syscon** and adjust the Background Traffic to the new and acceptable value.

### IMPORTANT

Once adjusted in every Fieldbus Channel, run a complete configuration download.

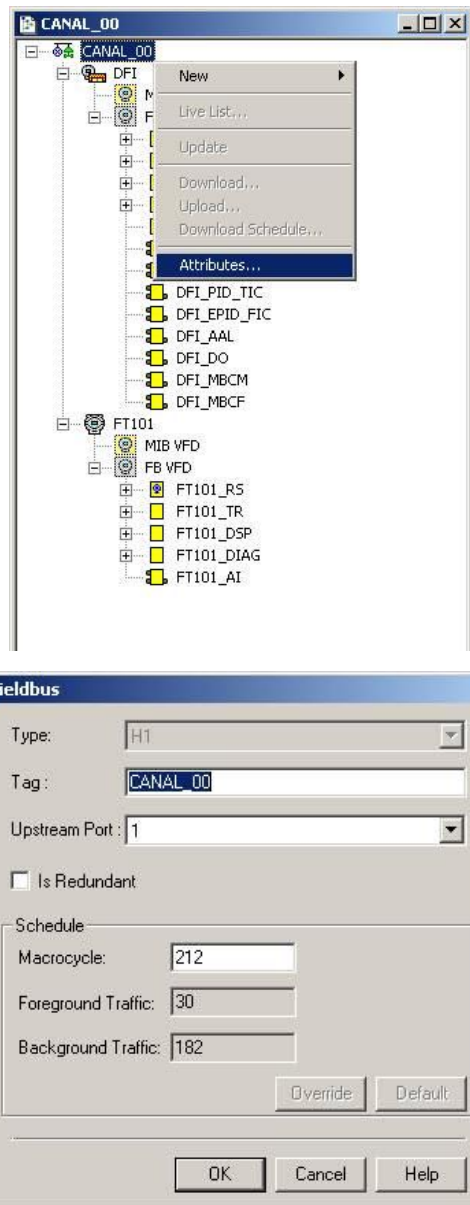


Figure 16.36 – Adjusting the macrocycle

## MVC (Multiple Variable Containers)

Multiple variable containers are a data container that will have all device data. If this parameter is disabled, the data are sent through block views. Each block has four views that give a lot of overhead to the communication.

The MVCs come to optimize this communication sending only one big packet per device instead of four small ones per block. Just set the **MVC\_ENABLE** parameter inside the **DF51 Transducer Block** to enable this feature. All changes done on this parameter will take effect only after new Supervision startup.

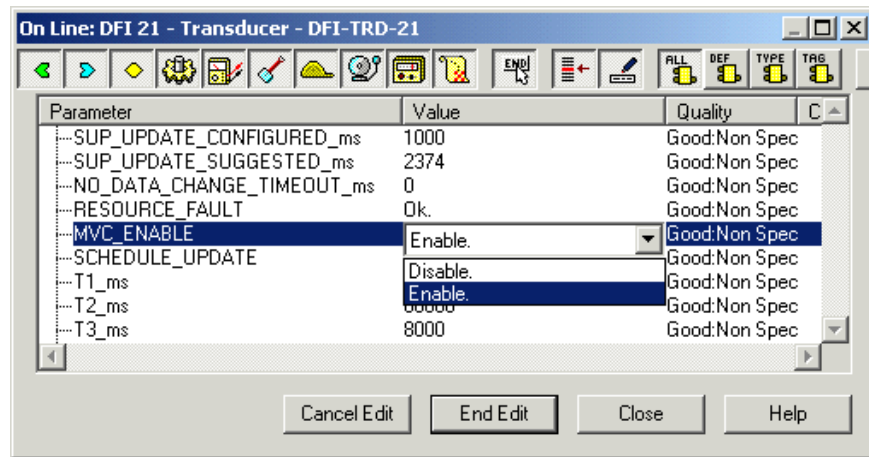


Figure 16. 37 – Setting the MVC\_ENABLE parameter

## Supervision Time

The Supervision Time is the time required for the DF51 to collect all field device's data and submit to the supervision workstation. Remember that these data are sent through the Background time of the macrocycle.

During the Supervision time, the internal database is refreshed. Therefore, this procedure only makes sense in a system that is already up and running, together with all HMI (Human Machine Interface) software.

The DF51 transducer block has three other parameters that are also used to optimize the supervision in System302.

- Parameter 1: **SUP\_UPDATE\_CONFIGURED\_ms**
- Parameter 2: **SUP\_UPDATE\_SUGGESTED\_ms**

These two parameters define the time that the bridge has to poll the supervision data from the devices. Start setting up the **SUP\_UPDATE\_CONFIGURED\_ms** as 2 times the ideal macrocycle. After 10 minutes approximately, the parameter **SUP\_UPDATE\_SUGGESTED\_ms** will indicate an optimal time and a change may be done again.

- Parameter 3: **NO\_DATA\_CHANGE\_TIMEOUT\_ms**

**On data change** is a mechanism to optimize the data transference between the bridge and the HMI software. With this mechanism the bridge will only send data that has changed.

The HMI has a timeout for the data, i.e., if it does not receive a communication point after a certain period it will indicate lack of communication. Here is the point where **NO\_DATA\_CHANGE\_TIMEOUT\_ms** comes in. This parameter defines the timeout to the bridge. If a certain value does not change over that period, it will be sent to the HMI anyway, avoiding the expiration of the HMI timeout.

### NOTES

- Good values for the **NO\_DATA\_CHANGE\_TIMEOUT\_ms** parameter are between 2500 and 6000, depending on the loaded configuration.
- All the changes done on this parameter takes effect after new Supervision startup.

## Update Time

The **UPDATE\_TIME** is used by DF51 to refresh the DFI OLE Server database.

Normally only the dynamic data are refreshed. Static data are refreshed each **NO\_DATA\_CHANGE\_TIMEOUT**.



Using **Syscon**, open the Online Characterization for DF51 Transducer Block, and adjust the parameters **UPDATE\_TIME** and **NO\_DATA\_CHANGE\_TIMEOUT** to the values. Have in mind that adjusting **UPDATE\_TIME** to 200 ms, the DF51 will refresh the data more frequently than the default value (1000 ms) and it will load a little bit more the Ethernet traffic.

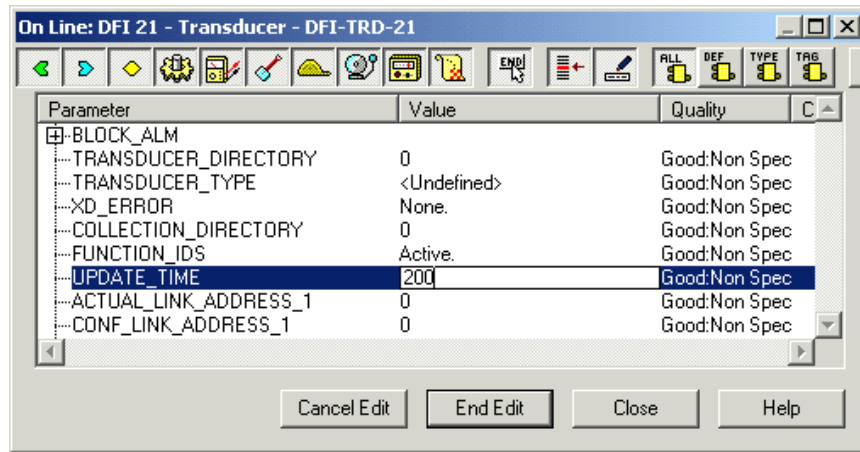


Figure 16. 38 – Setting the **UPDATE\_TIME** parameter

### OPC Update Rate

The client (HMI) can specify an “update rate” for each group. This determines the time between when the exception limit is checked. In other words, if the group is set to 1 second, but the data is changing each 500 ms, the client will be advised each 1 second. The update rate is a request from the client and the server will respond with an update rate that is as close as possible to that requested.

Each client has specific ways to configure this rate. Consult the manual for the HMI and do it as necessary.

# ADDING REDUNDANCY TO THE DF51 CONTROLLER

## Introduction

The main key for fault tolerance and in order to achieve the great system availability is to have redundant devices. DF51 controllers are able to work in a Hot Standby\* redundancy mode, which offers redundancy for all its functionalities and databases.

Also there is an option to work with the legacy mode LAS (Link Active Scheduler) redundancy. This chapter will present the characteristics of each mode and the procedures that the user should follow to configure the system in a redundant way. Here follows an overview of the modes.

### Hot Standby Redundancy

With the Hot Standby mode full redundancy is achieved, heavily improving the plant availability and safety. This mode offers redundancy for all the DF51 functionalities and databases:

- Gateway: 1 Ethernet port ↔ 4 H1 ports;
- Link Active Scheduler (LAS);
- Controller (running Function blocks);
- Modbus Gateway.

#### NOTE

A **Link Active Scheduler (LAS)**, equipment is the entity in the FOUNDATION™ fieldbus H1 network responsible for coordinating the communication, i.e. it basically dictates when each device is allowed to publish/subscribe data to/from the FOUNDATION fieldbus H1 network.

That is, the same redundancy capability achieved with the legacy mode “LAS redundancy”, with the Hot Standby mode is achieved too.

This mode suits specially the cases where the DF1302 has function blocks in its configuration. Function blocks on DF1302 can be interesting mainly in two cases:

- Integration to legacy systems through Modbus protocol (using Modbus function blocks);
- Advanced function blocks or strategies (DF1302 execute function blocks with much better performance than the field devices).

The procedures for configuration and maintenance are as simple as for a non-redundant system, saving time to get the system running. Only one configuration download is necessary to configure the redundant pair at the first plant start-up. And in the case of replacement of a failed module none download of configuration or user intervention is necessary. The new module inserted is automatically commissioned, receiving the whole configuration from the module in operation.

Since the system supports the modules placed physically separated (even far from each other), common fault causes are avoided. In other words, with the processor modules placed at different backplanes, or even at different rooms, failures in one of the backplanes or in one of the rooms will not affect the whole system.

---

\* Hot Standby: “Redundancy strategy where the Standby module is powered and synchronized with the Active module, standing ready to assume if necessary”.

| NOTES  |
|--|
| <ul style="list-style-type: none"> <li>- The 4<sup>TH</sup> FOUNDATION fieldbus H1 channel is used as the synchronization path between the modules. Thus, this channel will not be used as a usual FOUNDATION fieldbus H1 channel and should not have devices connected.</li> <li>- DF51 in Hot Standby mode uses the flat address “0x05” when it publishes. Because third-party devices do not support the flat address, they are not able to establish links with the DF51 in Hot Standby redundancy.</li> <li>- Hot Standby redundancy is available only for <b>SYSTEM302</b> Version 6.1.7 and above.</li> </ul> |

### Link Active Scheduler (LAS) Redundancy

This is a legacy mode of redundancy suitable only for the case where DF51 does not have function blocks in its configuration. That is, in such case the function blocks are on the field devices. This is a completely distributed control philosophy where DF51 perform two main functions:

- Gateway: 1 Ethernet port ↔ 4 H1 ports;
- Link Active Scheduler.

For this scenario, with the LAS redundancy the control, operation, and supervision redundancies are also guaranteed.

### Redundant System Architecture

In order to have a true redundant system, not just all the devices must be redundant but also the entire system topology must be thought as redundant. The more elements with redundancy ability the system have, better reliability and availability can be achieved. A typical and simple redundant topology based on DF51 can be seen in figure 17.1.

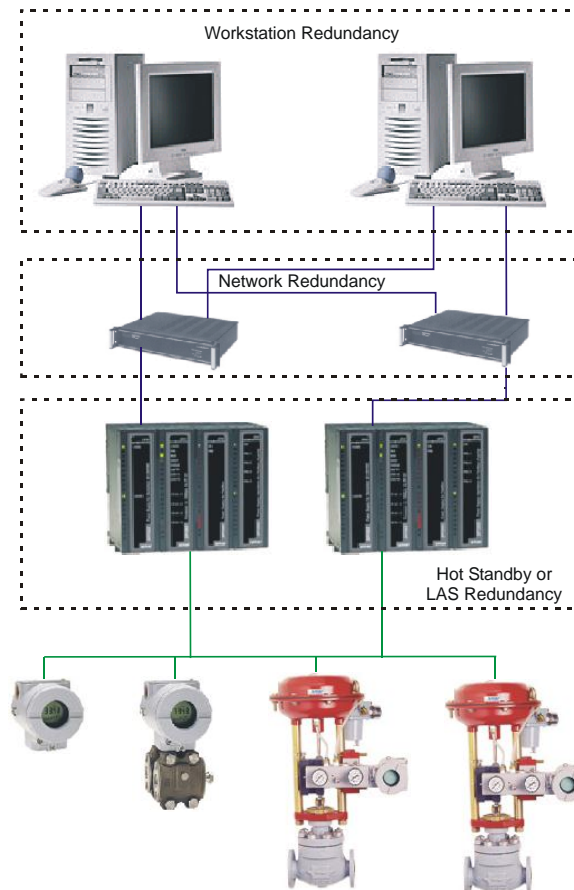


Figure 17.1 – Redundant System Architecture

## System Pre-requirements

The requirements listed here apply to both redundancy modes.

The version of firmware for redundant systems has the termination "R". It indicates a firmware suitable for redundant applications. With the redundant firmware, the module initializes by default in Hot Standby mode, in a safety state called "Sync\_Idle". The user as will be seen forth can change the redundancy mode later, if necessary.

The **Syscon** configuration should be created as it is usually done for a non-redundant system (in case of questions, please refer to section 3 of this manual). The unique difference (now that redundancy is involved) is that it is necessary to add a transducer function block to the bridge. This transducer will be used then to initialize the redundancy.

In the **Syscon** configuration, the tag for the transducer block can be any, preferentially a meaningful tag concerned to the DF51 tag or to the plant. Be careful to not use tags already in use in the same plant. Further information on **Syscon** operation, can be found in its own manual.

For any of the redundancy modes it is necessary first of all to configure the network redundancy. Refer to the Configuring Servers section for further details.

## Configuring Hot Standby Redundancy

In order to enable the Hot Standby redundancy and monitor its status, some parameters available in the DF51 transducer block should be used.

Most redundancy parameters have a suffix. The suffix "L" means Local, or that the parameter brings information of the module that is being monitored directly through the DFI OLE Server. The suffix "R" means Remote, or that the parameter brings information that the Local module knows about the other module through the synchronization path.

Here is presented a functional description of these parameters in order to understand how the Hot Standby redundancy works. For further information on these parameters see also the transducer block description table (Function Blocks manual).

### TAG\_DESCRIPTION

This parameter shows the DF51 serial number to allow the identification of controller with problem.

| Parameter               | Value                | Quality              | Chang... | Offset | Handli... |
|-------------------------|----------------------|----------------------|----------|--------|-----------|
| ST_REV                  | 1                    | Good:Non Specific:Nc | 1        |        | RO        |
| TAG_DESC                | SN# 1854 : Sync Main | Good:Non Specific:Nc | 2        |        | RW        |
| STRATEGY                | 0                    | Good:Non Specific:Nc | 3        |        | RW        |
| ALERT_KEY               | 0                    | Good:Non Specific:Nc | 4        |        | RW        |
| MODE_BLK                |                      |                      | 5        |        |           |
| BLOCK_ERR               | <None>               | Good:Non Specific:Nc | 6        |        | RO        |
| UPDATE_EVT              |                      |                      | 7        |        |           |
| BLOCK_ALM               |                      |                      | 8        |        |           |
| TRANSDUCER_DIRECTORY0   |                      | Good:Non Specific:Nc | 9        |        | RO        |
| TRANSDUCER_TYPE         | <Undefined>          | Good:Non Specific:Nc | 10       |        | RO        |
| XD_ERROR                | None.                | Good:Non Specific:Nc | 11       |        | RO        |
| COLLECTION_DIRECTORY0   |                      | Good:Non Specific:Nc | 12       |        | RO        |
| FUNCTION_IDS            | Sync_Main.           | Good:Non Specific:Nc | 13       |        | RW        |
| UPDATE_TIME             | 1000                 | Good:Non Specific:Nc | 14       |        | RW        |
| ACTUAL_LINK_ADDRESS_0   |                      | Good:Non Specific:Nc | 15       |        | RO        |
| CONF_LINK_ADDRESS_1     | 0                    | Good:Non Specific:Nc | 16       |        | RW        |
| ACTUAL_LINK_ADDRESS_292 |                      | Good:Non Specific:Nc | 17       |        | RO        |
| CONF_LINK_ADDRESS_2     | 0                    | Good:Non Specific:Nc | 18       |        | RW        |
| ACTUAL_LINK_ADDRESS_293 |                      | Good:Non Specific:Nc | 19       |        | RO        |
| CONF_LINK_ADDRESS_3     | 0                    | Good:Non Specific:Nc | 20       |        | RW        |
| ACTUAL_LINK_ADDRESS_294 |                      | Good:Non Specific:Nc | 21       |        | RO        |
| CONF_LINK_ADDRESS_4     | 0                    | Good:Non Specific:Nc | 22       |        | RW        |
| SELECT_IDS              | 0                    | Good:Non Specific:Nc | 23       |        | RW        |

Figure 17.2 – TAG\_DESCRIPTION parameter shows the DF51 Serial Number

**FUNCTION\_IDS**

This is the unique parameter to be configured. The user must assign one module to be the **Main** setting **Sync\_Main**. After that, through the synchronism path the other one automatically will be set as **Backup**. This designates physically who should be, in other words, the Preferential and the Redundant processor module respectively. This way, **Main** and **Backup** can be understood simply as labels.

**RED\_ROLE\_L / RED\_ROLE\_R**

It reflects the configuration made at **FUNCTION\_IDS**, identifying the **Role** of the module, **Sync\_Main** or **Sync\_Backup**.

**RED\_STATE\_L / RED\_STATE\_R**

**Active** - runs all the tasks and generates all the data.

**Standby** – does not run the tasks, but just receives all the data generated by the other one and stands ready to assume, if necessary.

**Not Ready** – redundancy is not available.

The different failures that may occur in such system, lead it to a switch over, when the **Standby** becomes **Active** and vice-versa in a bumpless way. The possible reasons for a switch over, divided in two types, are as follows:

**General Failures**

When the whole processor module fails, this comprises:

- Hardware failure
- Power off
- Removal of the processor module from the backplane.

**Bad Condition Failures**

When one of the processor module interfaces fails:

- Modbus communication failure (hardware or cable; in case of operating as master).
- H1 channel failure (hardware or cable).

The system is capable of checking which one has the best conditions, electing it as the **Active**.

It is certain the recovery of one failure at a time. That is, once a fail has occurred, a second fail will be recovered by redundancy just if the first fail has been fixed. While the failure is not fixed, the system has the redundancy not fully available (in case of **Bad Condition Failures**) or even not available (in case of **General Failures**).

For the case of **General Failures**, as soon as the failed module recovers a healthy state or is replaced, the modules automatically become a redundant pair again. That is, the system automatically recognizes a new inserted module.

**RED\_SYNC\_STATUS\_L / RED\_SYNC\_STATUS\_R**

This parameter reflects all the possible status of the synchronism between the modules.

| SYNC STATUS     | DESCRIPTION   |
|-----------------|---|
| Stand Alone     | Just one module is operating. If the system has been synchronized at least once, and this value appears, it indicates that the other module had a General Failure.  |
| Synchronizing   | The modules are checking their configuration with each other in order to reach the Synchronized status. It can take up to 9 minutes at maximum (while the system waits for the module in “Not Ready” state get its live lists completed). |
| Updating Remote | Just after the download of the configuration, the module transfers the whole configuration to the other one through the synchronism path.   |
| Maintenance     | The module is being configured by the other module through the synchronism path or by the <b>Syscon</b> . If it appears for both “L” and “R” parameters it indicates that none of the modules have been configured.                       |
| Synchronized    | The modules are in perfect synchronism. The Active continuously updates the Standby databases.  |

| SYNC STATUS                   | DESCRIPTION  |
|-------------------------------|--|
| Warning: Role Conflict        | If a spare module is connected in the panel with the same Role of that one is already running, this warning is shown. The procedure to fix this conflict is to perform a Factory Init in the spare module.                                     |
| Warning: Sync Cable Fail      | If a failure occurs in the synchronism cable, this warning is shown. The system will not have the redundancy until the synchronism cable is fixed.   |
| Warning: Updating Remote Fail | If a failure occurs in the transfer of configuration from the Active to the Standby, this warning is shown. The procedure is to perform a Factory Init in the module that is not Active and wait until the transfer is completed successfully. |

**RED\_BAD\_CONDITIONS\_L / RED\_BAD\_CONDITIONS\_R**

It can present one or more value (concatenated) as follows:

| BIT | BAD CONDITION | DESCRIPTION   |
|-----|---------------|---|
| 0   | Modbus        | When working as master and if no Modbus slave device answers, it means that Modbus communication is in bad conditions. It can be caused by failures on the communication path or even a failure on the slave. |
| 1   | H1-1          | Indicates failure on an H1 channel, specifying each channel had the failure.  |
| 2   | H1-2          |   |
| 3   | H1-3          |   |
| 4   | LiveList      | Indicates that the some Live List was not completed.  |

The desirable and most probable value is **<none>** for both modules (L and R), which assures good conditions for both, and therefore, redundancy fully available. This parameter can have two functions as follows:

A **Bad Condition failure** for the Active module leads the system to a switch over. In this case, this parameter acts as record of the reason of the last switch over.

When a **Bad Condition failure** occurs for the standby module this parameter shows this condition as an alarm. Thus, warning the operator that the standby presents a specific problem, it allows proactive maintenance in order to have redundancy fully available.

**RED\_MAIN\_WDG / RED\_BACKUP\_WDG**

These are watchdogs that indicate the communication status between the HMI and the processor modules. While their values are incrementing within 2 seconds the respective network connections (Main and Backup) are working fine.

As a simple rule, the redundancy is fully available, ONLY if the modules are **Synchronized** and have **<none>** in **BAD\_CONDITIONS** parameters (L and R).



The following operations can be performed without process interruption: replacing a module with failure, fixing the system when the H1 cable breaks, firmware update, and adding redundancy to a system in operation.

| NOTE   |
|--|
| The most new DF51 modules have a LED labeled as "Standby" at the front to indicate the redundancy state of the module.<br>When the LED is "on", it means that the module is in standby. When the LED is "off", the module may be either in <b>Active</b> or <b>Not Ready</b> . If one of the modules is in <b>Standby</b> , the other is surely in <b>Active</b> . |

In the next paragraph there are some steps for the Hot Standby Redundancy configuration and maintenance. It is recommended that the steps are all read and understood before are executed.

## First time configuration procedure

This is the procedure to configure the system with Hot Standby Redundancy for the first time, at the plant start-up.

- 1 - With the H1 connector disconnected, execute a Factory Init in both modules in order to grant the default state.
- 2 - Connect both modules together, through the H1 channels (1 to 4).
- 3 - Open the desired configuration in the **Syscon** and put it in **On-line mode**. Right-click the **bridge** icon and in the option **Attributes** choose one of the modules listed in the field **Device Id**. The chosen module will be that one to be configured as **Main**. In the main window, right-click the icon  and then select **Export Tags** option on the popup menu.
- 4 - Even in the bridge icon, right-click the field **FB VFD**, and then choose **Block List**. A new window will open showing all the blocks pre-instantiated in the module. In this window, right-click the **transducer**  performing an **Assign Tag** with the tag that is predicted in the configuration. Close the **Block List** window.
- 5 - Right-click the **transducer** icon in the **bridge** and choose **On Line Characterization** (see note about operation modification of DF51 in the **SYSTEM302 V7.x** or higher). Set the parameter **FUNCTION\_IDS** as **Sync\_Main**. Through the synchronism path, the other module automatically will be initialized as **Backup**. After that, both the parameters **RED\_SYNC\_STATUS** (L and R) will indicate **Maintenance**, which means that neither of the modules was configured yet.
- 6 - If necessary, perform **Assign Tag** for all the field devices. Wait until the Live Lists of all the channels are complete. So, configure the system through the Active module executing all necessary downloads exactly the same way for a non-redundant DFI302 system.

7 – As soon as downloads are completed successfully, the transducer will show the following phases:

- The Active will transfer the whole configuration to the other module (**RED\_SYNC\_STATUS\_L** as **Updating Remote** and **RED\_SYNC\_STATUS\_R** as **Maintenance**).
- After the configuration is successfully transferred, the modules can take some time to synchronize (**RED\_SYNC\_STATUS** parameters (L and R) as **Synchronizing**). This is the time necessary to the modules to check the configuration with each other.
- Finally, the modules will synchronize (**RED\_SYNC\_STATUS** parameters (L and R) as **Synchronized** and **RED\_STATE\_R** as **Standby**). Once the system is on these conditions, the Active will be constantly updating the Standby.

### NOTE

#### About operation modification of DF51 in the System302 V7.x or higher

Any change of name and number of blocks in DF51 will only be recognized by **SYSTEM302 v7.x** after new startup of OPC Server. This is due to change in the default configuration of **TOPOLOGY\_CACHE = ON** parameter in the configuration file **SmarOleServer.ini**.

Firmware version V3.9.5 or higher eliminates the need to restart the OPC server.

## Changing the configuration

Just follow the steps 6 and 7 of the section “First time configuration procedure”.

## Replacing a module with failure

- 1 - With the H1 connector disconnected, insert the new module in the backplane.
- 2 - Update the firmware in the new module, if necessary. Perform a Factory Init in the new module in order to grant the default state.
- 3 - Connect the H1 connector to the new module.

4 - The new module will be automatically recognized by the Active and both will stay in Synchronizing for some time. As soon the system get the **Synchronized** status and **<none>** in the **BAD CONDITIONS** parameters, the redundancy will be fully available and failure simulations can be performed.

### **Fixing the system when the H1 cable breaks**

If a fail occurs in a segment of H1 line such that it affects only one module, the redundancy will cover this fail. But, if the H1 cable is reconnected at once, the noise introduced in the line will cause communication problems for some time. In order to avoid that problem, follow the procedure below.

1 - Put the module affected by H1 cable fail in **Hold**.

2 - Fix up the cable connection.

3 - Perform a Reset in the affected module in order it returns operating. The module will be automatically recognized by the Active and both will stay in Synchronizing for some time. As soon the system get the **Synchronized** status and **<none>** in the parameters **BAD CONDITIONS**, the redundancy will be fully available and failure simulations can be performed.

### **Firmware update without process interruption**

This procedure describes how to update the firmware of both the modules without process interruption.

1 – Be sure the system is in the **Synchronized** status and it has **<none>** in the parameters **BAD CONDITIONS**. So, use **FBTools** to update the firmware of the Active module. At this moment, the other module will take over.

2 - After the firmware update was finished, the modules will start to synchronize with each other, with the Active transferring all the configuration to the other one. Wait for the system get the **Synchronized** status and it has **<none>** in the **BAD\_CONDITIONS** parameters.

3 - Use **FBTools** to update the firmware of the Active module. At this moment, the other module will take over.

4 - After the firmware update was finished, the modules will start to synchronize with each other, with the Active transferring all the configuration to the other one. As soon the system get the **Synchronized** status and has **<none>** in the parameters **BAD\_CONDITIONS**, the redundancy is fully available again and failure simulations can be performed.

### **Adding redundancy to a system in operation**

If a non redundant system is intended to be redundant in the future, at the plant start-up, the following conditions must be obeyed:

1 - The 4<sup>th</sup> H1 port should be reserved as synchronization path. That is, this port should not have devices connected to it.

2 - Predict H1 channels cabling considering that a Backup module will be added in the future (the H1 channels of the Main module should be connected in parallel with the respective H1 channels of the Backup module).

3 - Predict that the LAN architecture can be expanded, in order to attend what is described in the Redundant System Architecture.

4 - The single module should use a redundant firmware (a version terminated in R). The **FUNCTION\_IDS** parameter should be set as **Sync\_Main**. This way the module will work in **Stand Alone** state and will be ready to recognize a new pair inserted at any time.

Obeying these conditions, redundancy can be added at a later time without process interruption. The procedure to add redundancy to the system is just follow the same steps described in the section “Replacing a module with failure”.



## Configuring LAS Redundancy

In the next paragraph there are some steps for the configuration and maintenance of this legacy mode. It is recommended that the steps are all read and understood before are executed.

### First time configuration procedure

This is the procedure to configure the system with LAS Redundancy for the first time, at the plant startup.

#### Active Module

1 - With the H1 connector disconnected, execute a Factory Init in both modules to grant the default state.

2 – Connect the H1 connector to the Active module. Keep the Backup module with the H1 connector disconnected for a while.

3 - Open the desired configuration in the **Syscon** and put it in **On-line** mode. Right-click the **bridge** icon and with the option **Attributes** choose the module to be configured as **Active** in the field Device Id.

4 - Even in the bridge icon, right-click the field **FB VFD**, and then click **Block List**. A new window will be opened showing all the blocks preinstantiated in the module. Then, in this window, right-click the **transducer** performing an **Assign Tag** with the tag that is predicted for the Active in the configuration. Close the **Block List** window. In the main menu go to **Export** and click **Tags**.

5 - Right-click the **transducer** icon in the bridge and choose **On Line Characterization** (see note about operation modification of DF51 in the **SYSTEM302 V7.x** or higher). Set the **FUNCTION\_IDS** parameter as **Active**.

6 - Even in the transducer, set the **SYSTEM\_OPERATION** parameter as **Redundant**.

7 - If necessary, perform Assign Tag for all the field devices. Wait until the Live Lists of all the channels are complete. So, configure the system through the Active module executing all necessary downloads exactly the same way for a non-redundant DFI302 system.

#### NOTE

##### About operation modification of DF51 in the **SYSTEM302 V7.x** or higher

Any change of name and number of blocks in DF51 will only be recognized by **SYSTEM302 v7.x** after new startup of OPC Server. This is due to change in the default configuration of **TOPOLOGY\_CACHE = ON** parameter in the configuration file **SmarOleServer.ini**. Firmware version **V3.9.5** or higher eliminates the need to restart the OPC server.

#### Backup module

**IMPORTANT** – before connecting the H1 connector to the Backup module, follow the steps below:

1 - Right-click the **bridge** icon and with the option **Attributes** choose the module to be configured as Backup in the field Device Id.

2 - In the configuration change temporarily the tag of the transducer (Backup must have it different from that one used for Active). In the main menu go to **Export** and click **Tags**.

3 - Even in the bridge icon, right-click the field **FB VFD** and then click **Block List**. A new window will be opened showing all the blocks pre-instantiated in the module. Then, in this window, right-click the **transducer** performing an **Assign Tag** with the tag that is predicted for the Backup in the configuration. Close the **Block List** window.

4 - Right-click the **transducer** icon in the bridge and choose **On Line Characterization**. Set the **FUNCTION\_IDS** parameter as **Passive**.

5 – And then, connect the H1 connector to the new module, and after that set the **FUNCTION\_IDS** parameter as Backup.

6 - Even in the transducer, set the **SYSTEM\_OPERATION** parameter as **Redundant**. Wait until the Live Lists of all the channels are complete.

7 - For each one of the channels used in the configuration right-click the **Fieldbus** icon and choose the option **Download Schedule**.

**NOTE**

The **SCHEDULE\_UPDATE** parameter in the transducer should not be used anymore. Instead of it use the option **Download Schedule** as described in the step above.

## Replacing an Active module with failure

If the Active module fails, the Backup module takes over as LAS (Link Active Scheduler).

This is the procedure for the case the Active module must be replaced:

1 - With the H1 connector disconnected, insert the new module in the backplane.

2 - Update the firmware in the new module, if necessary. Perform a **Factory Init** in the new module in order to grant the default state.

IMPORTANT- before connecting the H1 connector to the new module, the user must follow the steps below:

3 - Open the desired configuration in the **Syscon** and put it in On-line mode. Right-click the **bridge** icon and with the option **Attributes** choose the module to be configured as **Active** in the field **Device Id**.

4 - Even in the bridge icon, right-click the field **FB VFD** and then click **Block List**. A new window will be opened showing all the blocks pre-instantiated in the module. Then, in this window, right-click the **transducer** performing an **Assign Tag** with the tag that is predicted for the Active in the configuration. Close the **Block List** window. In the main menu go to **Export** and click **Tags**.

5 – Right-click the **transducer** icon in the bridge and choose **On Line Characterization**. Configure the **FUNCTION\_IDS** parameter as **Passive**.

6 – And then, connect the H1 connector to the new module, and after that set the **FUNCTION\_IDS** parameter as **Active Not Link Master**.

7 – Even in the transducer, set the **SYSTEM\_OPERATION** parameter as **Redundant**. Wait until the Live Lists of all channels are completed.

8 - For each one of the channels used in the configuration right-click the **Fieldbus** icon and choose the option **Download Schedule**.

9 – Change the **FUNCTION\_IDS** parameter from Active Not Link Master to **Active**.

## Replacing a Backup module with failure

If the Backup module fails the Active module remains as LAS (Link Active Scheduler).

The procedure for the case the Backup module must be replaced is the following:

1 - With the H1 connector disconnected, insert the new module in the backplane.

2 - Update the firmware in the new module, if necessary. Perform a Factory Init in the new module in order to grant the default state.

IMPORTANT – before connecting the H1 connector, the user must follow the steps below:

3 – Right-click the **bridge** icon and with the option **Attributes**, choose the module to be configured as **Backup** in the **Device Id** option.

4 – In the configuration, change, for a while, the transducer tag (the Backup module must have a different tag in comparison with the Active). In the **Syscon** main menu, go to **Export** and click **Tags**.

5 – Even in the **bridge** icon, right-click **FB VFD**, and then click **Block List**. A new window will open showing the pre-instantiated blocks in the module. So, in this window, right-click in the **transducer** to do an **Assign Tag** with the tag that is the Backup in the configuration. Close the **Block List** window.

6 – Right-click in the **bridge** icon of the transducer and choose **On Line Characterization**. Configure the **FUNCTION\_IDS** parameter as **Passive**.

7 – And then, connect the H1 connector to the new module, and after that set the **FUNCTION\_IDS** parameter as **Backup**.

8 – Even in the transducer, configure the **SYSTEM\_OPERATION** parameter as **Redundant**. Wait until the Live Lists of all channels are completed.

9 – For each one of the channels used for the configuration, right-click in the **Fieldbus** icon and choose the **Download Schedule** option.

## Placing the system into operation after a general power failure

There is also a procedure to place the modules into operation after both have been turned off. If you turn them on at the same time, there will be many collisions on the H1 network because both modules (Active and Backup) will try to become the LAS at the same time. It will cause a delay for the perfect communication to be established. In order to avoid this problem, turn on first the Active module and wait until it is on line. Then, turn the Backup module on.

## Fixing the system when the H1 cable breaks

If a fail occurs in a segment of H1 line such that it affects only one module, the redundancy will cover this fail. But, if the H1 cable is reconnected at once, the noise introduced in the line will cause communication problems for some time.

In order to avoid that problem, follow the procedure below.

1 - Put the module affected by H1 cable fail in Hold.

2 - Fix up the cable connection.

3 - Perform a Reset in the affected module in order it returns operating. The redundancy will be fully available and failure simulations can be performed.

## Firmware update without process interruption

This procedure describes how to update the firmware of both the modules without process interruption.

1 - Use **FBTools** to update the firmware of the Active module. At this moment, the other module will take over.

2 - After the firmware update had finished successfully, follow the steps 4 to 9 of “Replacing an Active module with failure”.

3 – Wait around one minute in order the Active module become the LAS again (the Active is always the preferential in this mode of redundancy).

4 - Use **FBTools** to update the firmware of the Backup module.

5 – After the firmware update had finished successfully, follow the steps 1 to 6 of the section “Configuring the system for the first time- Backup Module”.

# ADDING LOGIC CONFIGURATION USING CO-PROCESSORS MODULES

### NOTE

This section refers to the configuration between the DF51 controller and the DF65 co-processor. Therefore, this feature (adding logic) is also supported by DF62, DF63, DF73, DF75, DF79, DF81, DF89, DF95, and DF97 controllers but using the Flexible Function Block (FFB). See the Adding logic by using flexible function blocks section.

## Introduction

As described previously, the DFI302 allows the users use several function blocks that can access input and output modules. However, for some applications, the logic configuration using function blocks is not suitable.

Using DF65 (co-processor module), users can implement a logic configuration through ladder language, and interact with all modules of the DFI302 system.

The figure below shows the system overview:



Figure 18. 1 - DFI302 System and Co-processor

## DF65 Configuration

The DF65 co-processor uses the **LogicView** software for its configuration. Remember that the DF51 (Processor) must be configured as Master, and the DF65 (co-processor) must be configured as Slave. The physical connection between both is done via DF68 when using a RS-232 port. Another option could be using the DF58 module to allow a RS-485 connection.

In order to set the configuration parameters of the DF65, it is necessary to put the communication switch in the default position, if the user does not know how the DF65 was set or it is the first time you are testing this communication.

## Serial Communication Settings

The DF65 has a group of 4 switches located between the communication ports. Using a small screwdriver and make sure that the lower switch is pointing to the left.

The switch in this position sets the DF65 on the Modbus default communication parameters. This means that the Device ID, also called Device Address, is number 1, the baud rate is 9600 bps and the parity bit is even. These parameters can be changed later using the **LogicView** software, but they will only take effect when the Communication Switch is back to the Non-Default position.

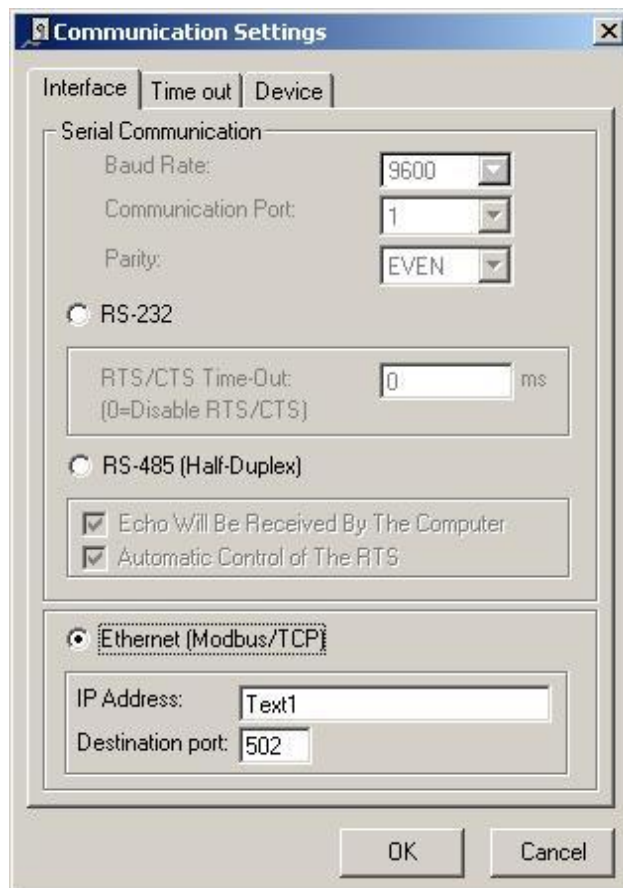
## Physical Layer and Timeout

In order to visualize the DF51 in the **LogicView** software it is necessary to configure some parameters in advance.

Using **FBTools**, check the IP address of the DF51 to be configured in the **LogicView**. Thus, every configuration performed will be sent to DF65, this means that the DF51 will act as bypass.

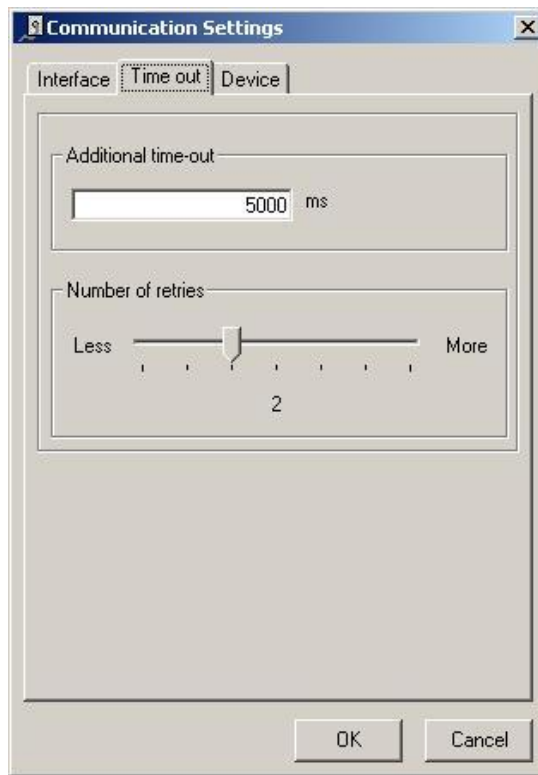
Remember that the DF65 must have the same baud rate as DF51 (9600 bps default).

Choose **Comm. Settings** on the **Tools** menu. Select the **Interface** tab, and then **Ethernet (Modbus/TCP)**. Enter the IP address of the DF51 that the **LogicView** will establish communication. See the figure below:



**Figure 18.2 – Setting the IP address of DF51**


Next, select the **Time out** tab. Then set the time out and the number of retries for the computer in case of bad communication.



**Figure 18.3 –Setting the Time out parameter**

Now the user can create the network ladder configuration and send it to the DF65. In case of plant startup see the **LogicView** manual for further details.

## Changing DF65 Communication Settings

Open the **DF65 Online** box using the menu **Tools → Online**, or click .

The **LogicView** will connect to the DF65 as soon as the online mode is established. If the **LogicView** cannot detect any DF65 co-processor, it will wait in “time out” state and the **DF65 Online** dialog box will keep opened. This gives the user a chance to modify some parameters to correctly set the communication. If the **LogicView** finds that the DF65 matches the communication parameters already configured, it will add information to the *Device Version*, *Device Release*, *Device Configuration Name* and to the present *Status*.

Remember that the DF65 has a communication switch indicating that the default communication parameters are active. In this case, the address is number 1, the baud rate is 9600 bps and parity is even.

To see the DF51 parameters, select **Default** option under **Communication Parameter**. In this condition it is not possible to make changes in the Serial Port frame. Refer to **LogicView** manual for further details.

## Logic Configuration Download

Make sure that all steps described above were performed correctly:

- ✓ Physical connection (cables).
- ✓ Location of DF51 in the subnet via **FBTools**.
- ✓ Correct configuration of the serial communication between DF65 and DF51 (DF65 DIP switches, baud rate, parity, serial communication channel, etc).

- ✓ Correct configuration of the communication between **LogicView** and DF65, that is., through Ethernet using the DF51 as a bridge to bypass Modbus data.

In **LogicView**, create a new Logic Ladder configuration or load an existing one. Send the configuration to the DF65.

## Configuring DF51 Modbus Blocks

To establish the communication between the DF51 and the co-processor, it is necessary to add Modbus blocks to control the communication, the supervision and the data exchange between the DF65 and DF51.

To add these Modbus blocks in the **Syscon**, the user must work with two DD versions. To add Modbus blocks the user must select Dev Rev = 02 and DD Rev = 01 and insert them into the **Process Cell**. In order to do this, the user should right-click the **FB VFB** of the DFI302, which is added to **Fieldbus Networks**. Then select “**Attach Block**”, or use the “**drag-and-drop**” option to move the blocks.

In the **Syscon**’s Logic Plant (whose tag is Area 1, for example), click the **Area 1** and choose **New Process Cell**. Select the necessary Modbus blocks for the configuration.

For further information about how to insert Modbus blocks, the user should consult the Adding Modbus section. The user must include a Resource block and a MBCF block (Modbus Configuration Block) before starting the configuration of the MBSM supervision block and the MBCM control block.

## Supervising DF65 Co-processor data using MBSM Block

After configuring the MBSM block, it is necessary to select the Modbus addresses of the input and output variables to be monitored.

In the **LogicView** program, choose **Modbus Address** on the toolbar, then read and write the Modbus addresses.

In the **Syscon** Logic Plant, create a MBSM block and configure all the necessary parameters by inserting the Modbus addresses of the variables. Thus, the user will be able to monitor the Modbus variables in the **Syscon**.

## Data Exchange between DF65 co-processor and DF51 using MBCM block

Add a MBCM block to the Logic Plant. Select the Modbus addresses of the variables to be controlled and monitored.

The MBCM block can be configured to read Modbus variables. Then write them on the DF51. It can also be configured to read Fieldbus variables, and then should be written on the DF65.

Another possibility is to connect two DF65 peer-to-peer communications. See in the figure below:

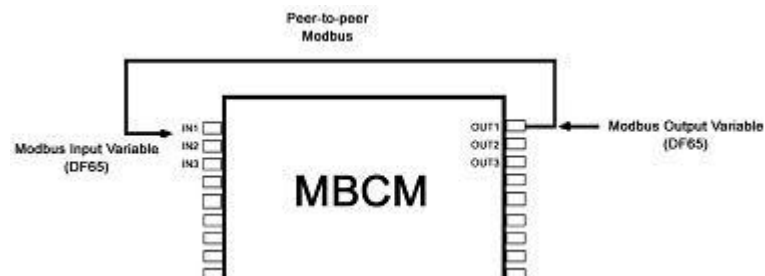


Figure 18. 4 –Setting the MBCM block

This figure shows how to configure MBCM parameter blocks.

**Modbus Input variables** - transmitters, discrete sensor data, etc, mapped to the Fieldbus world through a MBCM block. The user inserts the Modbus variable address on the configuration parameters of the MBCM block.

**Modbus Output variables** - data mapped to Modbus environment as, for example, an alarm signal, an interlock, etc, can be sent to the Logic Co-processor System through the block MBCM. The user inserts the Modbus variable address on the configuration parameters of the MBCM block.

**Peer-to-Peer** - it is possible to read a variable of a module connected to the DF65 and write its value in other module through the MBCM block. The following example describes a simple application of these function features. In order to make the explanation easier, discrete output and input modules are used, although it is possible to use the same procedure to analog variables.

### Example of communication between DF51 and DF65 with Ladder Logic

In the example above, there are two modules: a DF20 digital ON/OFF switch input module, and a digital relay output module. Two configurations will be done to implement the communication, supervision and data exchange between DF65 and DF51.

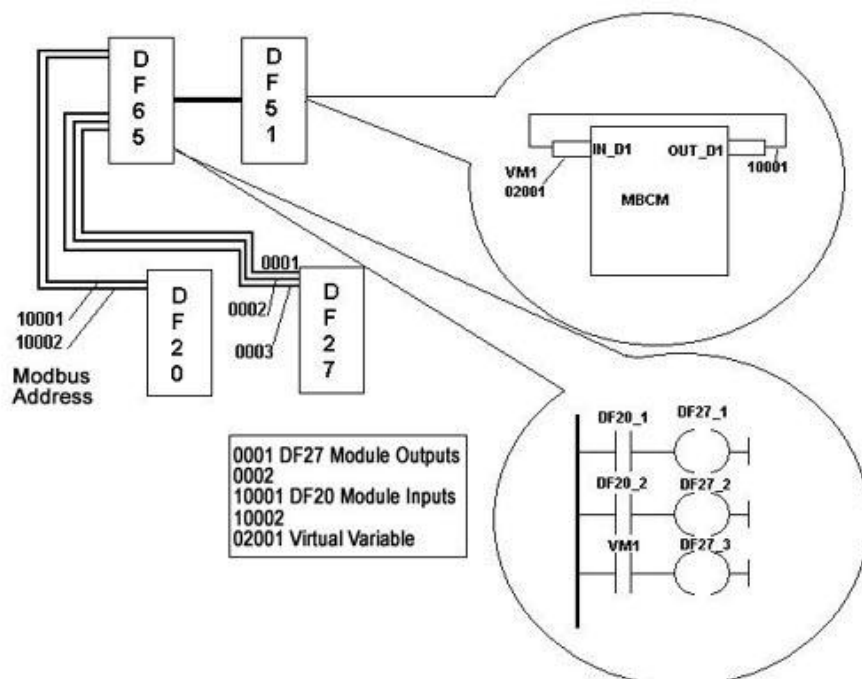


Figure 18. 5 – Communication between DF51 and DF65 with ladder logic

In **LogicView**, begin a new configuration. Add the DF20 and DF27 modules, and a virtual module. Then insert the following simple ladder logic.

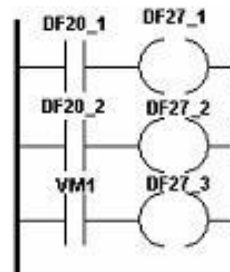


Figure 18. 6 –Ladder logic example

Switches 1 and 2 on module DF20 are connected to the contacts, and the outputs of these contacts are connected to two coils connected to the module DF27 outputs. Similarly, a virtual variable was assigned to a third contact. The Modbus addresses of these variables are:



- DF20\_1 → 10001
- DF20\_2 → 10002
- DF27\_1 → 1
- DF27\_2 → 2
- DF27\_2 → 3
- VM1 → 02001

In the **Syscon**, create a new configuration. Add Resource, MBCF, MBSM and MBCM blocks. Remember that a Modbus input variable must be inserted in an output parameter of the MBCM block. Thus, the Modbus 10001 address in **LOCATOR\_OUT\_D1.Modbus\_ADDRESS\_OF\_VALUE**. After, make a copy of the Modbus input variable of the DF20\_1. The **LOCATOR\_OUT\_D1.Modbus\_ADDRESS\_OF\_VALUE** parameter must be 02001. So, the input value of the MBCM block will be written in the address 02001, and in this case is a virtual variable associated to the contact.

To finish the configuration, open the control strategy (Logic Part) in the **Syscon** and connect the IN\_D1 input to the OUT\_D1 output.

This example uses only discrete variables and modules, however analog input and output variables and modules can also be used, as well as Fieldbus modules connected to Modbus modules and variables. For example, an alarm block output can be associated with the output of a module connected to a DF65. A PID block output can be associated with the output of an analog output module connected to the DF65. Thus, it is possible to split the plant control, so that, while the DF65 performs the discrete control, the DF51 performs the process control.

## ***How to configure the communication and data exchange between the DF65 and the DF51***

### **In LogicView**

- ✓ On the **Tools** menu choose **Comm. Settings**, then select **Ethernet Modbus(TCP/IP)** and insert the DF51 IP address in which the DF65 will communicate.
- ✓ Test the communication between **LogicView** and DF65, which is done via Ethernet and the serial connection. In case of failure, check using the **FBTools** if the IP of the DFI address is correct. See if the DF65 communication switches are correct. The fourth switch must be pointing to the left. Check if the cables are connected correctly.
- ✓ In the **LogicView**, create a new configuration or open an existing one. Download the configuration to the DF65.

### **In Syscon**

- ✓ Open the **Syscon**. On **Project File** menu choose **New**, and then choose **Project**. The **Syscon** will open a window to save the configuration. Save it.
- ✓ Right-click the **Area 1** icon and choose **New Process Cell**. Assign a tag to this process cell. Right-click the **Process Cell** and choose **Expand**. On the new window, right-click the **New Control Module** and assign a tag.
- ✓ Right-click the **Control Module** and choose **New Block**. Select Resource and MBCF blocks, and configure them as described in this manual. Add the MBSM and MBCM blocks according to the project requirements. Right-click **Fieldbus Networks** and choose **New Fieldbus**.
- ✓ Right-click **New Fieldbus** and choose **Expand**. Click the **Fieldbus** and choose **New Bridge**. Then, select **Smar** and **DFI302**, making sure that the DD will support the Modbus blocks. Then, right-click **FB VFD** and choose **Attach Block** on the popup menu. Attach all blocks created before and, if necessary, create other Modbus function blocks.
- ✓ Choose **Strategy** by right-clicking **Control Module**. Drag the blocks to the new window that need to have two inputs set. Remember that the Resource, MBCF and MBSM blocks do not need to be included in this strategy.
- ✓ In the main project window, right-click the project icon and choose **Export Tags**. Click **OK**.

- ✓ Right-click the **Fieldbus Network** icon and choose **Comm. Settings**. Check if the server ID is Smar.DFIOLESERVER.0.
- ✓ Click the DFI located in the main project window. Make sure that the Device ID is correct.
- ✓ Download the configuration.
- ✓ In the MBCF block, choose **On Line Characterization** and change the **ON\_ APPLY** parameter to **Apply**.
- ✓ The user will be able to monitor the system through the **LogicView** and **Syscon**, simultaneously.

## DF65 – Co-processor Module

- DF65** - Co-processor module with 28 Kbytes of non-volatile memory for user configuration and a microcontroller of 15 MHz with real time clock and master of remote I/O system.
- DF65R** - Co-processor module with 23 Kbytes of non-volatile memory for user configuration and a microcontroller of 15 MHz with real time clock and Redundant master of remote I/O system.
- DF65E** - Co-processor module with 52 Kbytes of non-volatile memory for user configuration and a microcontroller of 15 MHz with real time clock and master of remote I/O system.
- DF65ER** - Co-processor module with 44 Kbytes of non-volatile memory for user configuration and a microcontroller of 15 MHz with real time clock and Redundant master of remote I/O system.

|                                      | DF65 | DF65R | DF65E | DF65ER |
|--------------------------------------|------|-------|-------|--------|
| Configuration Memory Size            | 28K  | 23K   | 52K   | 44K    |
| Discrete Points (physical + virtual) | 1024 | 1024  | 2000  | 2000   |
| Analog Points                        | 1024 | 1024  | 1024  | 1024   |

## Description

The DF65 is the logical co-processor module for the DFI302 system. It is the module that runs the programmed configuration and interacts with all the other modules of the DF65 System.

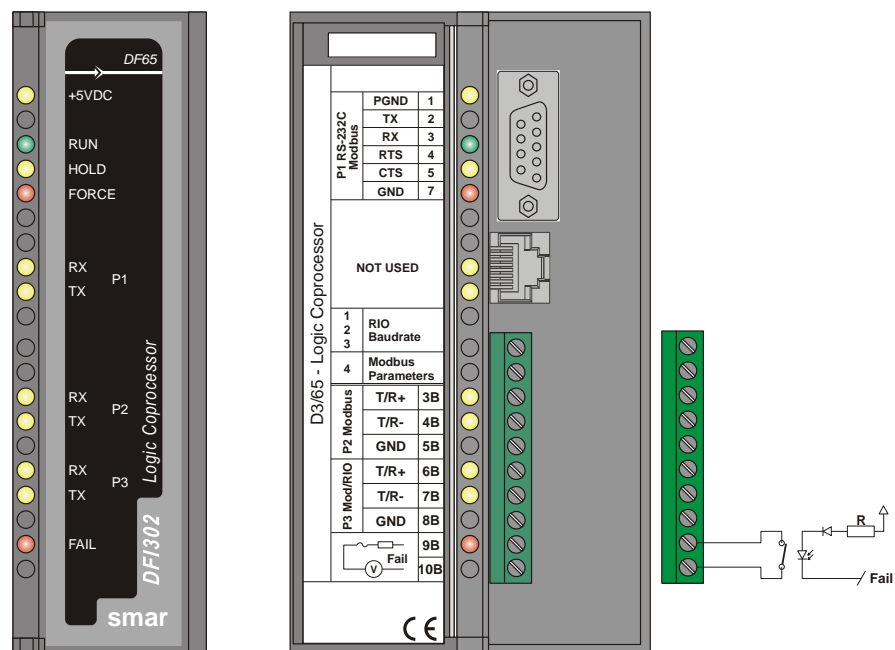


Figure 18. 7 –Co-processor Module

It must be plugged into the second slot of the rack addressed with 0 (zero). This rack number is adjusted through a rotating switch located in the electronic circuit of the rack. The first slot of rack 0 must always be reserved for the power supply module.  
 The firmware update is done using SMAR’s software **DF65Tools**.

| <b>NOTE</b>  |  |
|--|--|
| The DF65 can read all I/O modules that support Module ID since the option “Use Module I/O with ID” in the <b>LogicView</b> is enabled. Thus, in systems having modules that do not have these features or systems that combine modules with these features it is necessary to disable flag in the <b>LogicView</b> . |  |
| In case the connection of the DB9 port is permanent, the DB9-EXT cable must be used which allows the user to close the module front panel.   |  |

## Technical Specifications

| <b>MEMORY</b>  |  |
|----------------|--|
| Type           | Electrical Erasable Programmable Read Only Memory (EEPROM)               |
| Available Size | DF65 – 28Kbytes, DF65R – 23Kbytes<br>DF65E – 52Kbytes, DF65ER – 44Kbytes |

| <b>CONFIGURATION/OPTIMIZATION</b> |   |
|-----------------------------------|---|
| Software Package                  | <b>LogicView</b> Version 6.5 or higher  |
| Operating System                  | Windows NT, Windows 2000 and Windows XP |

| <b>COMMUNICATION PORTS</b>         |  |
|------------------------------------|--|
| Quantity                           | 3  |
| Types                              | 1-EIA-232-C (P1)<br>2-EIA-485 (multidrop, P2 and P3)   |
| Connectors                         | Female DB9 to EIA-232-C (P1)<br>Terminal blocks for EIA-485, DF66  |
| Label                              | See Modules and Accessories  |
| Baud Rate/Address                  | P1: 9600 bps<br>P2 9600-115200 bps<br>P3 (Modbus): 9600 bps ~115200 bps<br>P3 (RIO): 57600 bps ~230400 bps |
| Protocol                           | Modbus RTU (Slave)   |
| Slave Address                      | 2 a 127, Set by User(1 is default)<br>2 to 121, set by user (1 is the default address)                     |
| Maximum number of DF65 per network | 31   |

| <b>INTERNAL POWER</b>     |                  |
|---------------------------|------------------|
| Provided by the IMB Bus   | 5 Vdc @ 320 mA   |
| Total Maximum Dissipation | 1.6 W            |
| Power Indicator           | Green LED +5 Vdc |

| <b>FAILURE RELAY</b>               |  |
|------------------------------------|--|
| Output Type                        | Solid state relay, normally close (NC) |
| Limits                             | 6 W, 30 Vdc Max, 200 mA Max.           |
| Maximum Initial Contact Resistance | <13Ω                                   |
| Status Indication                  | Red LED- Fail                          |
| Logic Indicator                    | LED ON (relay closed)                  |
| Over Load Protection:              | Should be provided externally          |
| Operation Time                     | 5 ms maximum                           |

| OTHER LEADS |    |   |
|-------------|----|---|
| RUN         |    | Green LED- indicates program running                                |
| HOLD        |    | Yellow LED- indicates program in hold mode                          |
| FORCE       |    | Red LED- indicates all inputs and/or outputs are in the force mode. |
| Rx<br>Tx    | P1 | Displays Modbus Communication (EIA-232)<br>RX (Yellow) TX(Green)    |
| Rx<br>Tx    | P2 | Displays Modbus Communication (EIA-485)<br>RX (Yellow) TX(Green)    |
| Rx<br>Tx    | P3 | Displays Modbus Communication (EIA-485)<br>RX (Yellow) TX(Green)    |
| FAIL        |    | Red LED- Indication of failure                                      |

| DIMENSIONS AND WEIGHT  |  |
|------------------------|--|
| Dimensions (W x H x D) | 39.9 x 137.0 x 141.5 mm<br>(1.57 x 5.39 x 5.57 in) |
| Weight                 | 0.286 kg   |

| CABLES    |                               |
|-----------|-------------------------------|
| One Wire  | 14 AWG (2 mm <sup>2</sup> )   |
| Two Wires | 20 AWG (0.5 mm <sup>2</sup> ) |

| NOTES   |
|---|
| To increase service of life of the relays and to protect the modules from reverse voltage damages, externally connect a clamping diode in parallel with each inductive DC load or externally connect an RC snubber circuit in parallel with each inductive AC load. |

## Communication Channels

The DF65 has three communication channels that supply the user with 3 independent channels (ports) identified as P1 (EIA-232), P2 (EIA-485) and P3 (EIA-485).

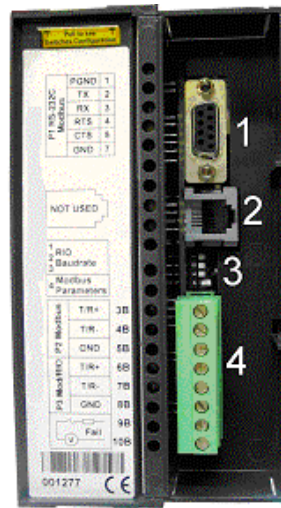
The three channels may be used at the same time with the following features:

- P1 (EIA-232) is for programming and monitoring, point-to-point short connections.
- P2 (EIA-485) is for programming and monitoring, point-to-point or multidrop in long industrial connections.
- P3 can mimic P2 or act as a Master channel for a DF66 connection DF66 interface module (DF66). A rotary switch on the co-processor module card can set the P3 channel behavior.
- Any of the ports can be connected to the Smar ENET-700 or ENET-710 (Ethernet-Serial) converter module.

Due to communication requirements, the DF65 has a Modbus ID that is unique and a different baud rates for P1 and P2/P3. The Modbus baud rates are set through the software **LogicView**.

### Restrictions:

- Only one channel can be used at the same time to monitor the network through the **LogicView**. Other channels will be locked after the first one begins.
- All channels are referred with the same address.
- Channels P2 and P3 shares the same baud rate. P1 has a dedicated one.



**Figure 18.8 – DF65 Communication Channels**

In the previous figure is shown:

- 1- DF65 P1 port. It is an EIA-232 channel;
- 2- SSIO channel used by the redundant DF65. See “DF65 Redundant Module” for further information.
- 3- DIP switches used to change the co-processor communication parameters.
- 4- Ports P2 and P3 of the DF65. These are EIA-485 channels.

There are three serial communication ports on the co-processor: one EIA-232 port (P1) and two EIA-485 ports (P2 and P3). The user should set to any of these ports: baud rate, parity and other specific parameters.

#### **Port P1**

Baud rate (9600 bps) for DF65.  
 Baud rate (9600 bps) for DF65R.  
 Parity (Odd or Even)

#### **RTS/CTS Timeout**

CTS: Signal that indicates the device is ready for transmission.  
 RTS: Signal to request data transmission

The PC requests a connection with the co-processor. The DF65 receives this request and processes it. Next, the DF65 sends the RTS signal and it waits for the CTS signal during the time interval set on the RTS/CTS Timeout parameter.

#### **OFF Duty**

Available time for communication when the co-processor is not running a ladder diagram. The biggest value set for Off Duty, the biggest time available for communication.

#### **Time Delay**

The PC sends a frame to the DF65, i.e., makes a communication request. The DF65 waits the amount of time set on Time Delay to process the frame request and send the answer.

#### **NOTES**

For **better performance** of the system, it is recommended:

- Off duty must be set as 20% of the Ladder execution cycle.
- **Time Delay** depends on the Workstation’s processor. If the processor is higher than a Pentium MMX 233 MHz, set the Time Delay to 5 ms. Otherwise the Time Delay must be set with the default value.
- When the DIP switch 4 is in the default position or if the value set for Off duty is equal to zero, then the real value set for Off duty will be 20% of the cycle (modules scan plus Ladder execution).

## Device Communication Baud Rate and Device Address

The co-processor module has a key where the user may select default communication parameters (DCP, Switch 4 ON) or programmed communication parameters (PCP, Switch 4 OFF). Default parameters are address 1 and baud rate 9600 bits/s.

In the PCP position the user can select a new address and/or baud rate, using **LogicView**. The new adjustment of parameters will be accepted only after the key being moved to the PCP position. In the PCP position the user is also able to change the communication parameters. In this case they will be accepted immediately after they have been sent.

The default values apply to three channels: P1, P2 and P3. The user can set the DIP switches using a key as shown in the next the figure:

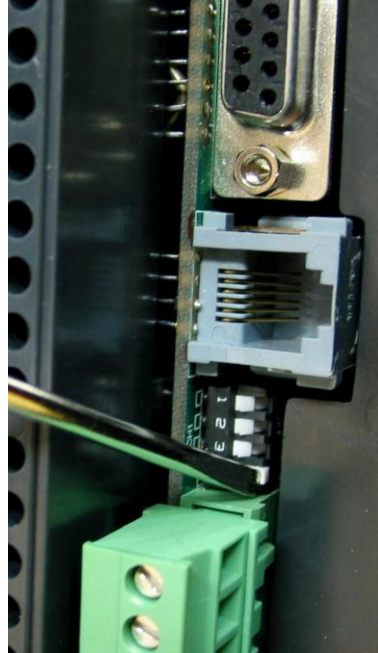


Figure 18. 9 – Setting the Communication Parameters of the DF65

## Operation Modes

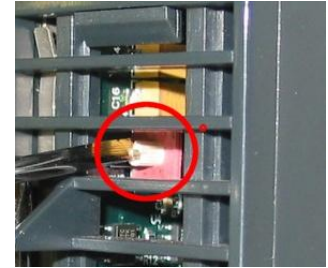
The DF65 may act as:

- A co-processor with three Modbus/RTU channels
- Master co-processor in a system with DF66, where 2 channels work as Modbus/RTU and the remaining one (P3) as remote master channel.

In order to change the operation mode of the DF65 the user needs to change the Rotary Switch position. This rotary key is located underneath the DF65 module. See the next figure to locate it.



Figure 18. 10 – Locating the DF65 Rotary Switch



Detail: The Rotary Switch

## DF65 with Three Modbus RTU Channels

When the DF65 is used as a regular co-processor, it means that no DF66 module is being used. Also, either P3 as P1 and P2 may act are available as Modbus/RTU channels. Note that none of them can act as a Modbus master.

P1, P2 and P3 are independent Modbus/RTU slave channels. They can be used at the same time. P1 is recommended for point-to-point connections whereas P2 and P3 may be used in two different networks (master and slave) to increase accessibility of the co-processor through two computers (masters) or in a redundant architecture where the user can alternate between the channels in a failure situation.

Settings:

- The rotary key must be in the position 8;
- One Modbus ID set for P1, P2 and P3 (set on **LogicView**);
- The P1, P2 and P3 baud rates are set on **LogicView**.

## DF65 Master in a DF66 System

The DF65 can be also a master in a DF66 system. This means that the DF65 acts as the main processing unit acquiring data from the DF66 modules in its own IMB and also from any DF66 connected to it.

In this case P3 is completely dedicated to DF66 communication data. P1 and P2 are slave Modbus/RTU independent channels. P1 is used for point-to-point applications whereas P2 may be used in a multidrop network.

Settings:

- The rotary Switch must be in the position 0;
- One ID Modbus for P1 and P2 set on **LogicView**;
- P1 and P2 baud rates are set on **LogicView**;
- P3, the remote channel, has its own dedicated baud rate set through the frontal DIP switch.

## Factory Init

The user can carry out a procedure to make the DF65 to assume its factory configuration. This procedure is called factory init.

To do it:

1. Remove the DF65 from the power supply;
2. Put the Rotary Switch on the position 7;
3. Put the DIP Switch 4 in the default position;
4. Connect the DF65 to the power supply and wait until the HOLD LED starts to blink;
5. Remove the DF65 from the power supply;
6. Set the rotary switch.

**NOTE**

After the factory init procedure the user must set the rotary switch when a new download is done.

## DF66 – Remote I/O Communication Interface

**DF66** – 28 kbytes of non-volatile configuration memory and a microcontroller of 15 MHz with DF66 (Slave)

**DF66E** – 52 kbytes of non-volatile configuration memory and a microcontroller of 15 MHz with DF66 (Slave)

### Description

DF66 modules are located close to the field devices and allow a flexible architecture to the system. DF66 units use the same I/O modules designed for the regular DF65 system combined with the DF66 module.

The DF66 module must be used together with DF65 and DF65R.

The DF66E module must be used together with DF65E and DF65ER.

**NOTE**

The DF65 firmware update is done by the SMAR **DF65Tools** software.

### Adding a DF66 unit

To add a DF66 system, click the **Go to I/O module page**, and then click the **Add/Delete DF66** system. As shown in the following figure.

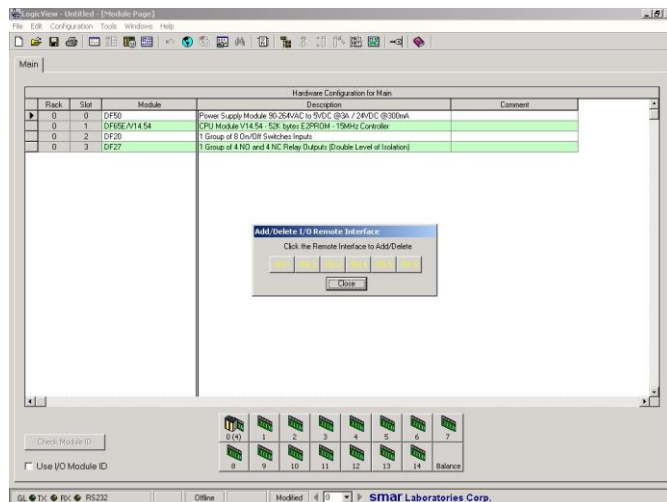


Figure 18. 11 – Adding a remote system

Choose a DF66 system, and click the corresponding button.

**ATTENTION**

The address and baud rate of the DF66 interface module must be set. Interface and Power Supply modules for DF66 are automatically set.



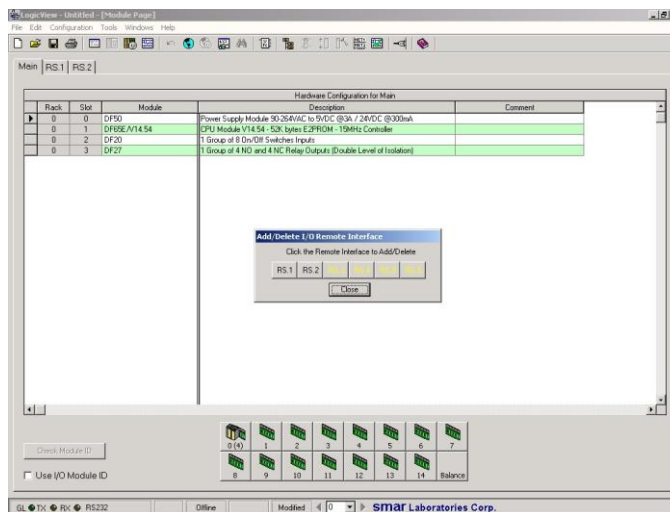


Figure 18. 12 – Adding or removing a remote system

### Remote I/O Architecture

The DF66 System is basically composed of a Master Unit and up to 6 Slave Units. Master Unit and Slave Units are connected through a multidrop cable that can reach a total length of 4000 ft. The proper cable length and baud rate depend on the level of noise in the application environment.

The available Rack/Slots will limit the total number of modules per system and the maximum number of Discrete and Analog Points that the DF65 will be able to work. Each DF66 needs, at least, one power supply. A DF65/ DF66 system structure is shown as follows:

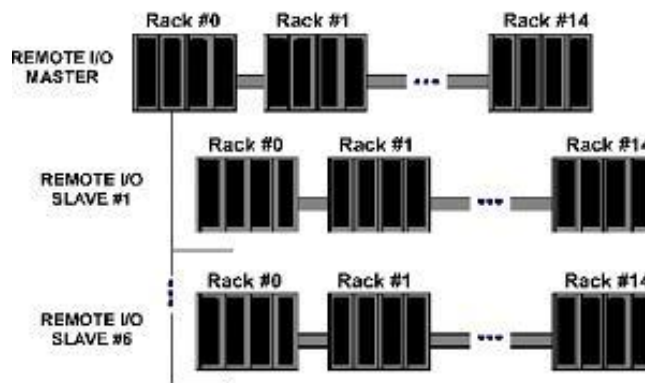


Figure 18. 13 – DF66 Architecture

### Baud rate and Address Setting

#### Baud Rate Settings

Each DF66 Interface Module (Master or Slave) has a DIP switch to set the baud rate (communication speed). The DIP switch is located in the frontal panel of the module and can be accessed with a small screwdriver.

Make sure to disconnect the module while setting the switch.

Also note that both the Master and Slave I/O interface must be configured with the same baud rate.

#### Setting Address of the DF66 Interface Module

There is also a dedicated rotary switch at the bottom of the slave module to set the slave device address. Each remote unit connected to the master unit must have a unique address. The available addresses are: 1, 2, 3, 4, 5 and 6.

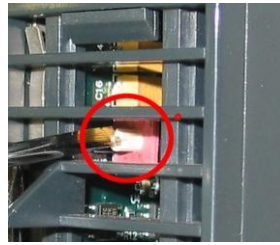


Figure 18. 14 – Setting Address of the DF66 Interface Module

## DF65R/DF65ER – Redundant Co-processor Module

### Introduction

The redundancy with the DF65 is based on a hot-standby mechanism. Therefore, just one co-processor runs the ladder logic as well as the communication with HMI at a specific moment. The active co-processor scans the DF66 module while the passive co-processor monitors the status of the active co-processor through another port.

However, there is communication between the co-processors in order to keep the synchronization of the configuration and also provide fresh dynamic data to the passive co-processor. For example: the Modbus variables.

The algorithm responsible for choosing the active co-processor tries to minimize the number of control switches; therefore, if a co-processor runs as active, it remains in this state, unless something happens to put this co-processor in bad conditions.

### Terminology and Initial Descriptions

#### Main and Backup Co-processors

The redundancy status depends on a lot of items as: configuration of the co-processor, communication status through SSIO, communications with the DF66 modules DF66. This status defines whether the co-processor will run the ladder logic as well as scanning the RIOs.

The co-processor can assume two roles: active and passive. The active co-processor runs the ladder logic and scans the Modbus variables. The passive co-processor periodically checks the active co-processor in order to check if it is necessary to take control.

The co-processor's configuration is set through the rotary switch in the co-processor module:

- **Rotary Switch in the position 0 (Main):** When both co-processors are powered-up at the same time and, the algorithm checks the rotary switch position (of both co-processors) to choose which co-processor is active and which one is the passive.
- **Rotary Switch in the position 9 (Backup):** The co-processor set as backup transfers the control to the other co-processor its current status is both passive or both active. This configuration is used only when the co-processors are simultaneously powered and when both are passive or active at the same time before the last power-down.

#### Configuration Transfer

During the power up procedure, the configuration of the active co-processor is passed to the passive co-processor.

This transfer is always done from active to passive and never in the contrary direction and it uses the Synchronous Serial I/O (SSIO) Port of the Co-processor. This synchronous serial communication channel is used exclusively to transfer the configuration.

During this process two new terms need to be defined:

- **Sender:** This is the co-processor responsible for the communication. The sender co-processor handles the configuration transfer between the co-processors.
- **Addresser:** This is the co-processor that receives the configuration.

**Configuration synchronism between the Co-processors**

This is accomplished in two main phases:

**Phase 1- Configuration Transfer**

When a sequential power up procedure takes place, the first co-processor powered-up becomes the active co-processor and it transfers the configuration to the other one.

**Phase 2- Updating Transfer**

After the Configuration Transfer Phase, it is necessary to transfer only the dynamic variables and the settings that can be done without configuration download.

| ATTENTION   |  |
|---|--|
| This refers to Modbus variables, configuration of switches in the co-processor module and communication settings. |  |

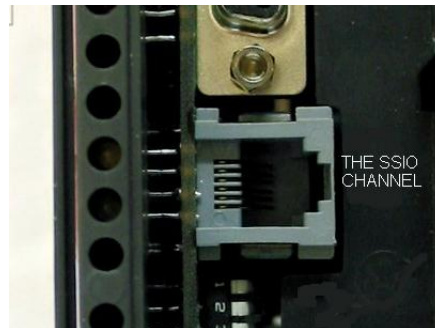
**Rules to Select the Sender and Addresser**

When the co-processor detects the presence of other co-processor through the SSIO, they exchange some status information to decide which will be the sender of configuration.

Three main cases can occur:

| # | RULE   | SCENARIO  |
|---|--|---|
| 0 | If configuration name, date and time in both co-processors are the same and Good-Config, the rules to select the active co-processor will be applied, and the active co-processor will be also the Sender. | Power cycle of configured system                                      |
| 1 | If configurations mismatch and a sequential power up happened and the first co-processor has a Good-Config, then the first co-processor to power up will be the sender.                                    | Replace of co-processor module  |
| 2 | All other cases (configuration mismatch and simultaneous power up OR one or both with bad-config): co-processors do not enter transfer status.   | First power up of system after a firmware download or abnormal cases. |

**The SSIO port Diagram**



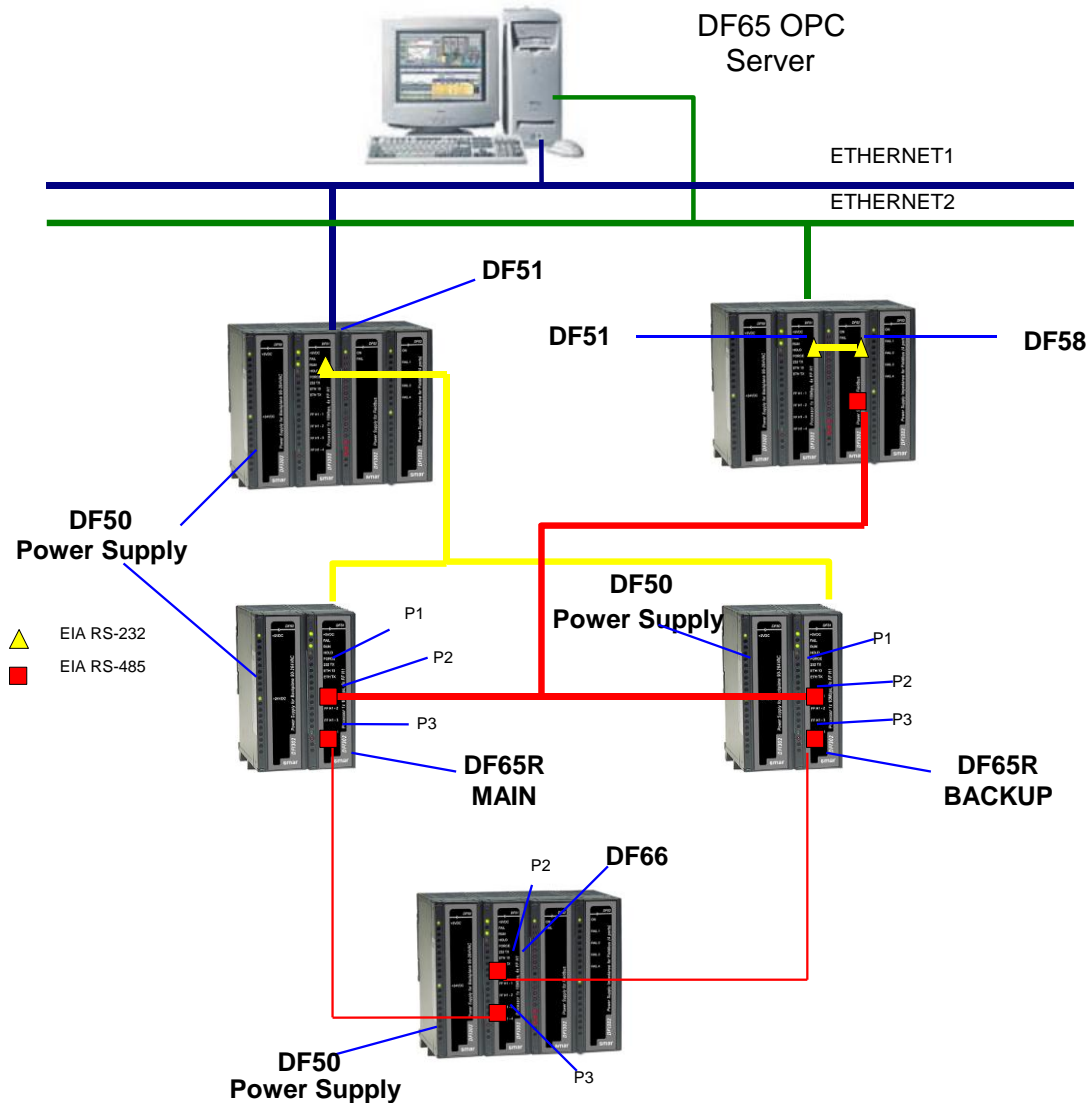
**Figure 18. 15 – The SSIO channel**

In order to transfer the configuration from the active co-processor to the passive it is necessary to use a special cable to connect the two co-processors. The cable part number is DF76.

This port cable is a 4 wires-cable that implements a full-duplex channel whose baud rate is 1.875 Mbps.

## Architecture

Consider the figure below:



**Figure 18. 16 – Redundant Architecture Example**

The above architecture shows an illustrative example of the hardware used in the DF65R redundancy.

- Two Ethernet paths;
- Two DF50 modules allow complete redundancy;
- Two co-processors with main and backup roles;
- A DF66 module scans the Modbus variables;
- The DF76 cable connects the two co-processors.

### NOTE

The I/O modules are only included in the racks where the DF66 module is present.

## Power up Procedures

### Breakers

- One breaker to the main co-processor.
- One breaker to the backup co-processor.
- One breaker to the DF66 modules.

### Power up sequence

Power up sequence refers to the order that each co-processor is turned on. There is a specific breaker configuration.

1. First, the breaker of the power supplies of the DF66 modules is turned on.
2. Next, each one of the two breakers of each co-processor is turned on.
3. Before the co-processors start searching for another co-processor the state of both becomes passive.
4. After powering up a co-processor and if it does not find an active co-processor, then, during a two seconds interval it will search for another co-processor.
5. If it does not find another active co-processor it becomes the active co-processor.

**I** - The algorithm checks which co-processor was active in the last power down. The active co-processor in the last power down becomes the current active co-processor. The co-processor passive in the last power down becomes the current passive.

**II** - If both co-processors were passive or active simultaneously in the last power down, the algorithm checks the rotary keys to define which co-processor will be active. If the rotary key is in the main position (0), then the co-processor is considered active. If the rotary is in the backup position, then the algorithm considers this co-processor as passive.

For further explanation, please check the flowchart in the next page.



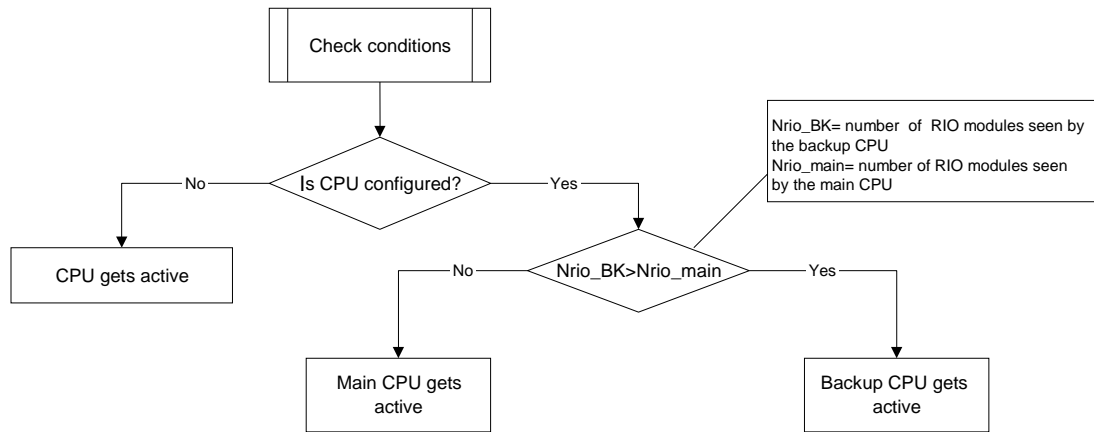


Figure 18. 18 – Flow chart representing the check conditions procedure

## Communication with Remote Input and Output (RIO) Modules

The DF66 modules are scanned only if the name of the configuration and date are the same in the main co-processor and DF66. The passive co-processor sends polling commands to check periodically whether it is necessary to assume the control.

As seen in the system architecture figure, the DF66 modules are connected to the system through two different and redundant channels.

There are two ports to be considered:

**DF66 Active Port:** Port being scanned by the active co-processor, i.e., through this port the Modbus variables are read and written.

**DF66 Passive Port:** In this port the passive co-processor checks the conditions of the active and passive ports.

### Switch Over Procedure

During the normal functioning of the system, there's a switching procedure. It is based on the number of the DF66 that the active co-processor can communicate with (**NRIO active**) and the number of DF66s that the passive co-processor can communicate with (**NRIO passive**).

If NRIO active is shorter than NRIO passive, then there is a switching over procedure that makes the current active co-processor the passive co-processor and the old passive co-processor the current active co-processor. This procedure ensures that the system reads the biggest amount of I/O Modbus variables.

## LEDS for Status Indication

- A solid RUN LED (green, ON or OFF) indicates if the co-processor is in active state while a blink RUN LED indicates that the co-processor is in passive state.
- A solid HOLD LED (yellow, ON or OFF) indicates if the co-processor has been configured properly, while a blink HOLD LED indicates that it was not.
- A solid FORCE LED (red, ON or OFF) indicates if the co-processor is in FORCE-IN, FORCE-OUT or SAFE-OUT mode, or not.
- FORCE LED indicator on passive co-processor is blinking. It indicates that the hardware settings are not correct (rotary switch, BR for DF66 or firmware version).

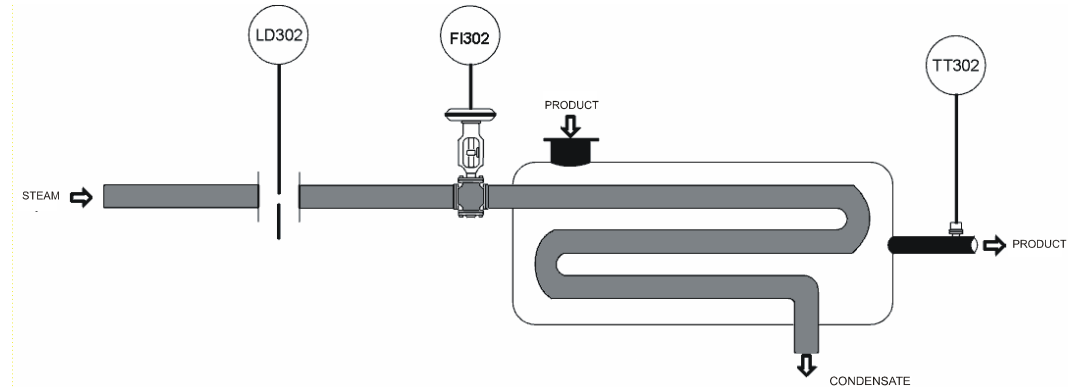
## Section 19

# CREATING A FOUNDATION FIELDBUS STRATEGY BY USING DF62/DF63

### Introduction

This section describes the strategy configuration by using the DF62 controller as bridge. The control loop is shown below:

#### PROJ\_DF62



**Figure 19. 1 - Example of temperature control process**

The purpose of the process is to control the fluid output temperature (controlled variable) using steam flow rate (manipulated variable) to heat it. The fluid temperature will be sent to the master controller, where it will be compared to a temperature set point.

The master output would be the slave controller set point, which will control the steam flow rate to the heat exchanger.

#### NOTE

This strategy can also be done by using the DF63 controller.



## Starting the Area

### Step 1

It is possible to create, or edit, an area from the **Studio302**. In the **Studio302** interface select **Areas**. A window will appear listing all areas of database.

To create a new area from the **Studio302**, left-click inside the **Areas** window, then choose **New Area**.

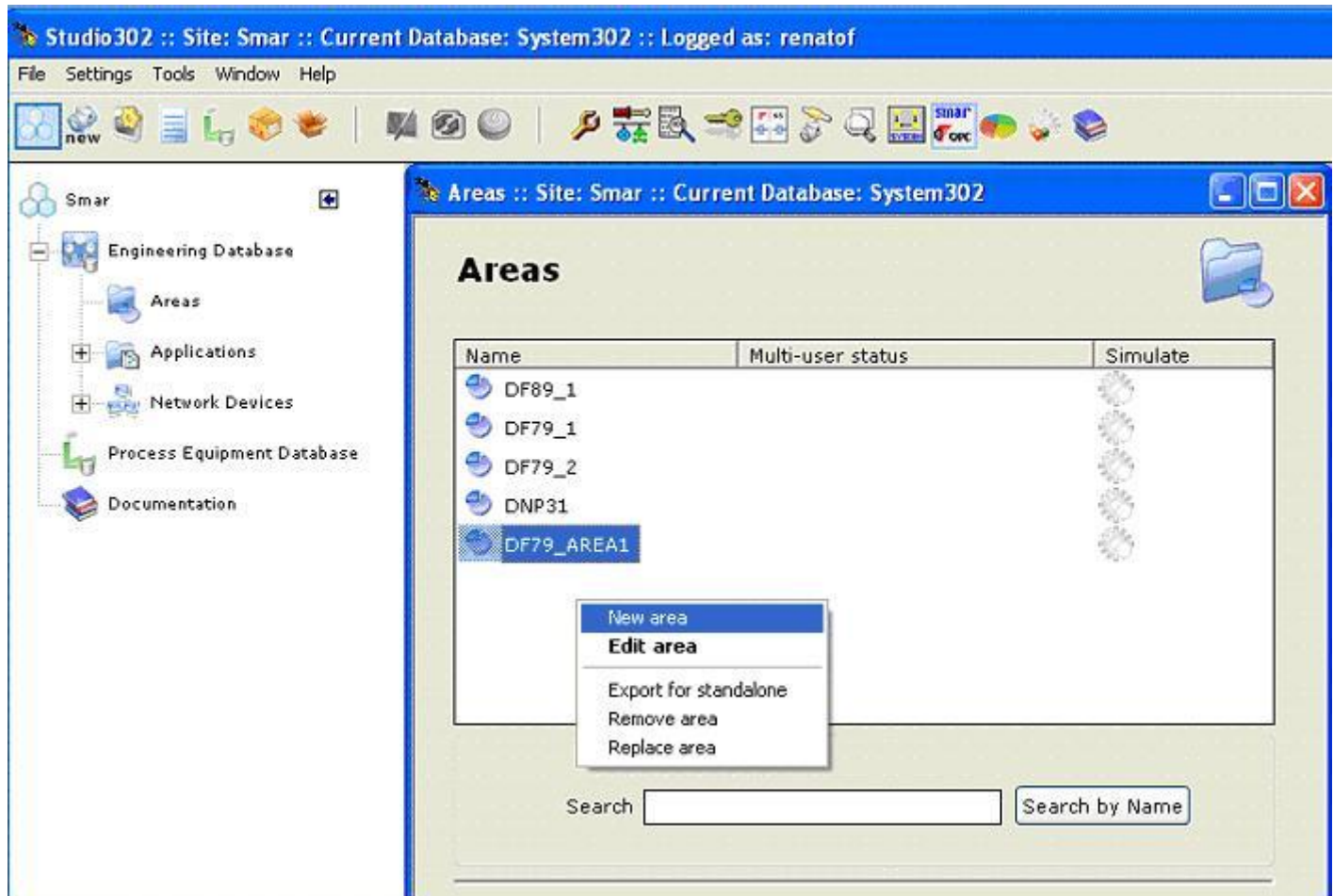


Figure 19.2 – Creating a new area

Another way to create a new area is from **Syscon**. Click the icon  in the **Studio302** toolbar.


To create a new area on **Syscon**, choose **File → New**, or through the toolbar, choose **New** button . The dialog box shows the areas options. Select **HSE Area** as shown in next figure:



Figure 19. 3 – Options to create Syscon areas

After choosing the area type, it opens a window to the user give a name to the new area.



Figure 19. 4 – New area name

Type the name for the area in the **Area Name** box, and click **Ok**. For this example, it chooses **Proj\_DF62** name.

A new window will appear. This window has:


- **Application** – Logical Plant. To insert control strategies into this part.
- **Fieldbus Networks** – Physical Plant. To add devices and function blocks to the area into this part.

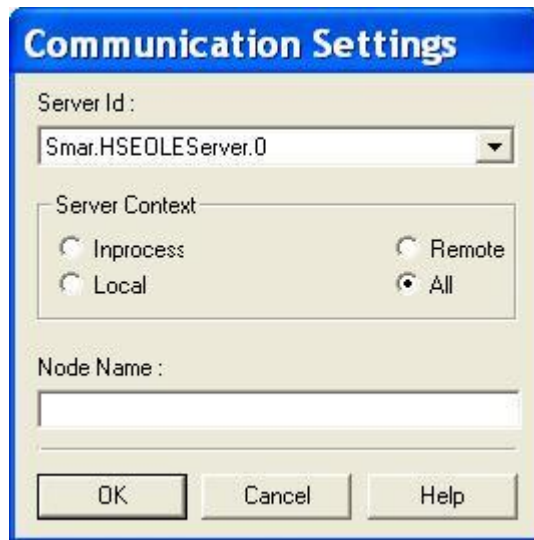


Figure 19. 5 – Area divisions

## Physical Plant Project

### Step 2

In the main window, **Proj\_DF62**, right-click the **Fieldbus Networks** icon, , to choose the Server. Choose **Communication Settings** option, or through the toolbar, choose **Communication**→**Settings**. The communication settings dialog box will open.




**Figure 19.6 – Choosing the Server**

Confirm if the **Smar.HSEOLEServer.0** option has already been selected. Otherwise, the user must select it, and then click **OK**.

## Arranging the Fieldbus windows

### Step 3

After selecting the Server for the area, click the  sign placed at left of the **New Fieldbus**. The HSE network will appear with a tag, for example, **HSE Network 1\***. Right-click this item and choose **Expand** option. The Figure below shows the HSE network:



**Figure 19.7 – Creating a HSE network**

To arrange the screen, click the area window. So, choose **Window** menu on the **Syscon** toolbar, and then **Tile** option.

## Adding the Bridge

### Step 4

Right-clicking the **HSE Network 8**, it opens a dialog box to add new devices. Choosing **New** option, it is possible to select devices such as **Bridges**, **Controllers** and **Devices** for the area. For the aimed control, choose **Bridge** option. Confirm this choice observing the following figure.

\* This number changes if another area was created before. When a new HSE area is created, this number increases.

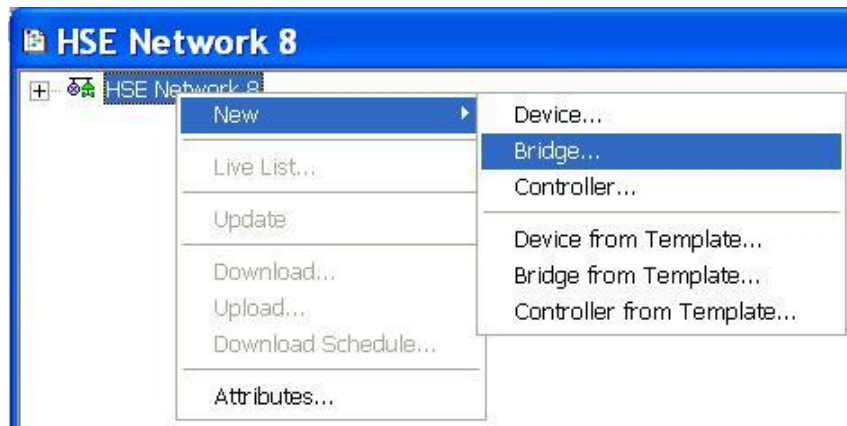


Figure 19. 8 – Choosing the Bridge

After selecting that option, it opens a window as shown in the next figure.

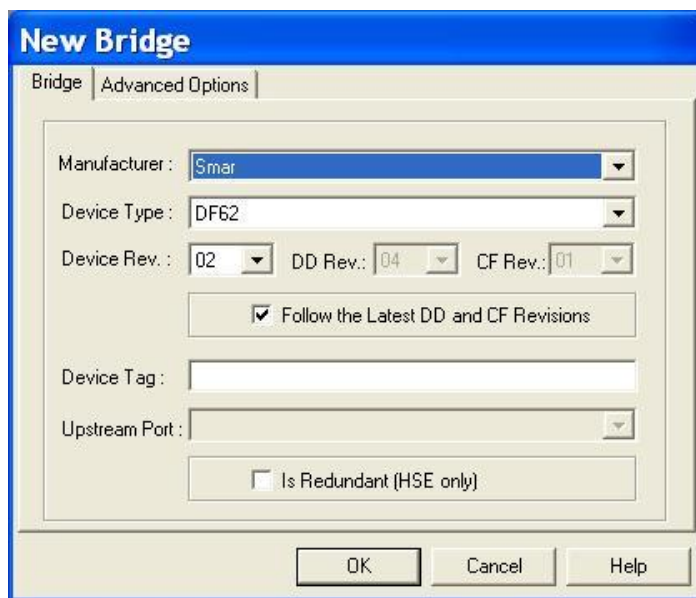


Figure 19. 9 – Setting the Bridge

Select the **DF62** device in the **Device Type** box. In the **Device Tag** box, enter **DF62** or another tag, and click **OK**.

| IMPORTANT  |
|--|
| <p>Not all characters are valid when naming the elements, so pay attention;<br/>                     The valid characters are:<br/>                     A-Z a-z 0-9 # { } [ ] ( ) + -</p> <p>The invalid characters are:<br/>                     ~ ` ! @ # \$ % ^ &amp; * =   ; : , . &lt; &gt; ? / ' " \</p> |

Return to the **HSE Network 8** window. Right-click the **Bridge** icon, **DF62**, and select **Attributes** item, as shown in the next figure:



Figure 19. 10 – Setting the bridge attributes

Thus, the bridge attributes can be seen and, if necessary, changes its tag. Click **Ok**. See the next figure.

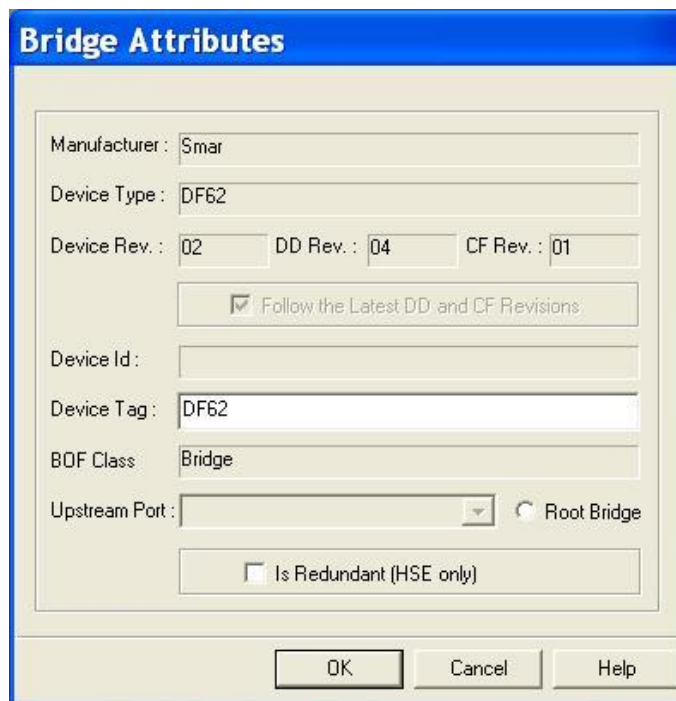


Figure 19. 11 – Bridge attributes

## Adding Fieldbus Devices

### Step 5

After adding the bridge, it is possible to insert the field devices. First, return to the **Proj\_DF62** window and right-click the **DF62** bridge. To configure the DF62 channels, select **New Fieldbus** option. The following figure shows the Fieldbus channel creation:



Figure 19. 12 – Creating Fieldbus channels

When choosing **New Fieldbus** option, the dialog box to choose the channel type and name it with tags opens:

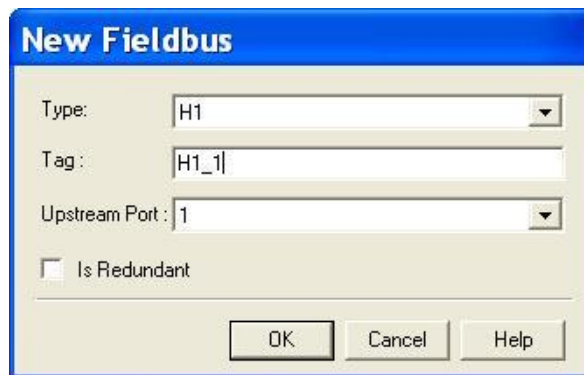


Figure 19. 13 – Attributing tags to the Fieldbus channels

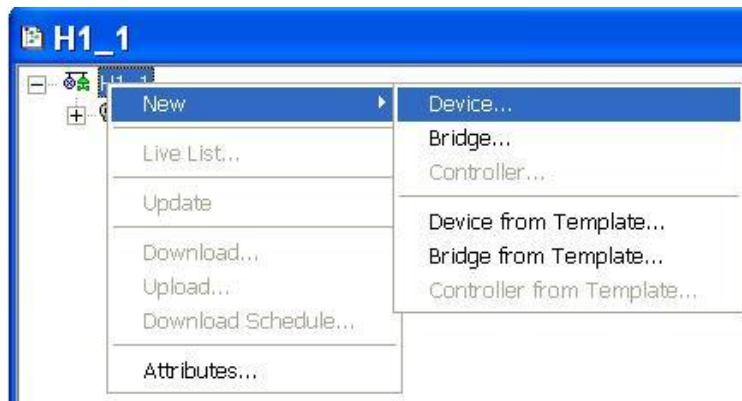
Choose the fieldbus type and name it with a tag. If the user does not name it with a specific tag, the default tag will be *Fieldbus 1* (This number changes if another channel was created previously). To rename the fieldbus channel, right-click it, and then choose **Expand** item. When the Fieldbus window opens, right-click it and choose **Attributes** option. So, the user can rename the fieldbus channel.

Return to the **Proj\_DF62** window. Right-click the fieldbus channel created and choose **Expand** option on the popup menu. The figure below shows the fieldbus channel:



Figure 19. 14 – Creating the Fieldbus channel

In the **H1\_1** window, right-click **H1\_1** to choose **New→Device**. The next figure shows adding devices on the network:



**Figure 19. 15 – Adding devices in the Fieldbus channel**

The dialog box to select and name the devices opens. Choose **SMAR** in the **Manufacturer** box, and then select **TT302** in the **Device Type** box. Name the device with a tag, and click **OK**:



**Figure 19. 16 – Setting the Fieldbus devices**

Repeat this procedure to add a transmitter (LD302) and a converter (FI302) in the flow control.


After adding the devices to the area, the **H1\_1** channel will be according to the following figure:



**Figure 19. 17 – Devices added into the Fieldbus channel**

## Adding Function Blocks

### Step 6

Now the user can add Function Blocks. To add a new Function Block (FB), click the  sign, and right-click the **Virtual Field Device** (FB VFD) icon. Choose **New Block** option.

The FB VFD is responsible for the data management.

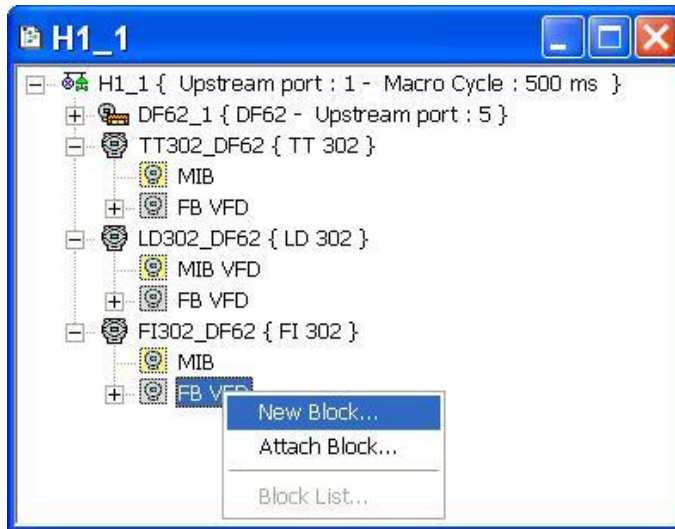


Figure 19. 18 – Choosing New Blocks

The **Function Block Characterization** dialog box will appear. The **Block Type** option shows the SMAR's FB.

Select the block in the **Block Type** box, and name it in the **Block Tag** box. The following figure shows adding the Analog Input function block.

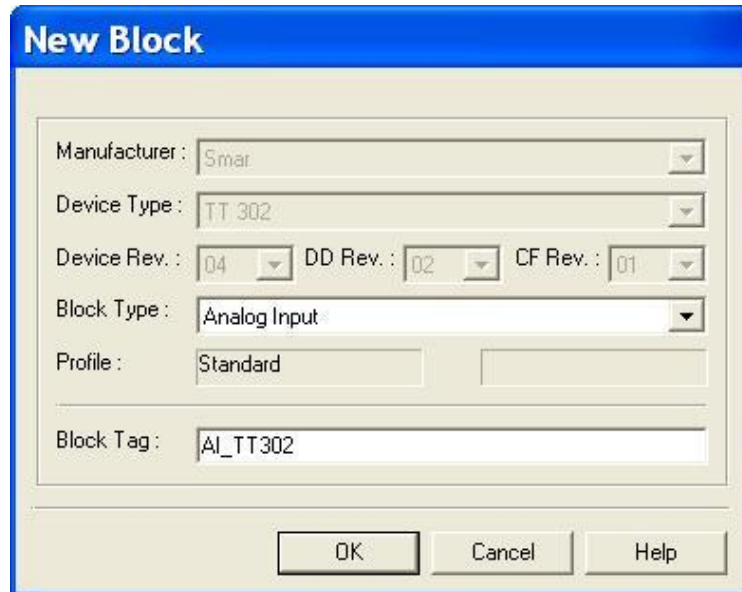


Figure 19. 19 – Adding function blocks

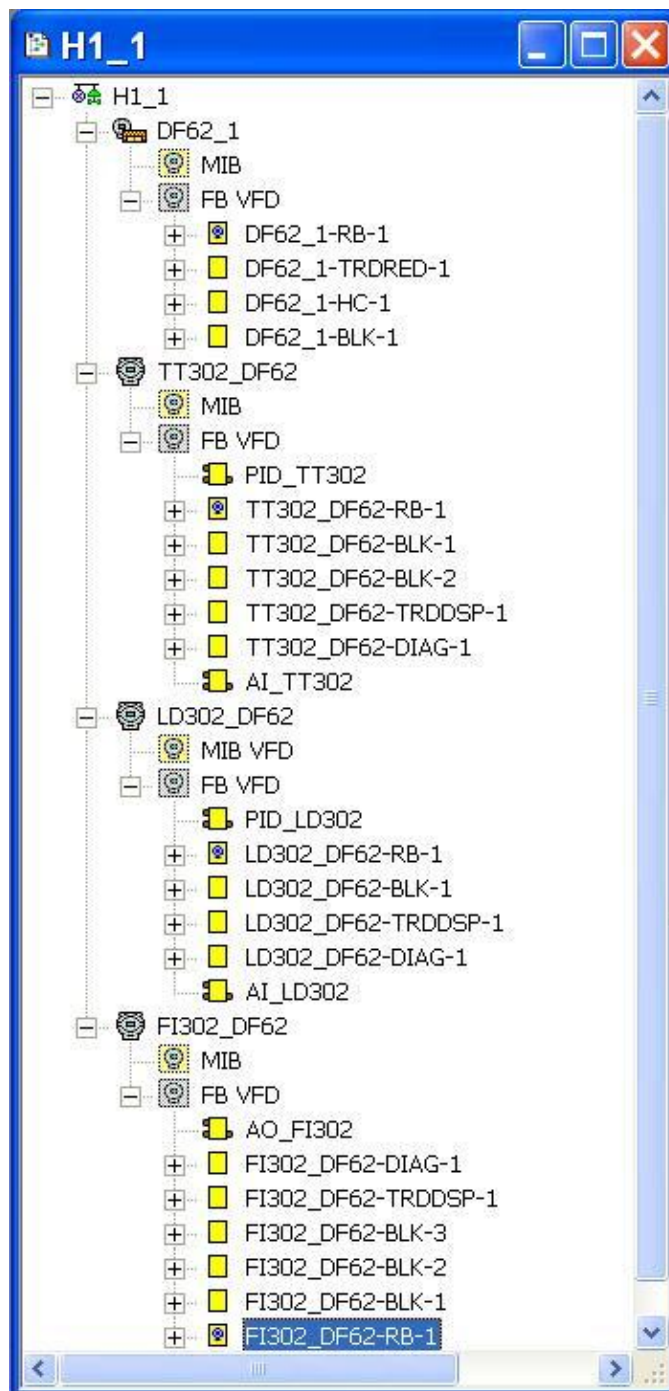
For this example, it is necessary to add AI, PID, and AO function blocks to build a cascade control configuration.

**NOTE**

From the **Syscon** version 6.00, it is not necessary to configure the Transducer (TRD), Resource Block (RES), Diagnostics (DIAG) and Display (DSP) blocks, because they are preinstantiated in the devices.

The channel configuration with all function blocks and devices is presented in the next figure. For better identification of the Transducer, Resource and Diagnostics function blocks name them with specific tags.





**Figure 19. 20 – Fieldbus channel composition**

Now the strategy area Application (Logical Plant) can be developed. First it is necessary to establish a new process cell.

## Creating New Process Cells

### Step 7

The **Logical Plant** can be divided in several process cells, according to the plant.

To create a new Process Cell, right-click the **Application** icon, and select **New Process Cell** item.

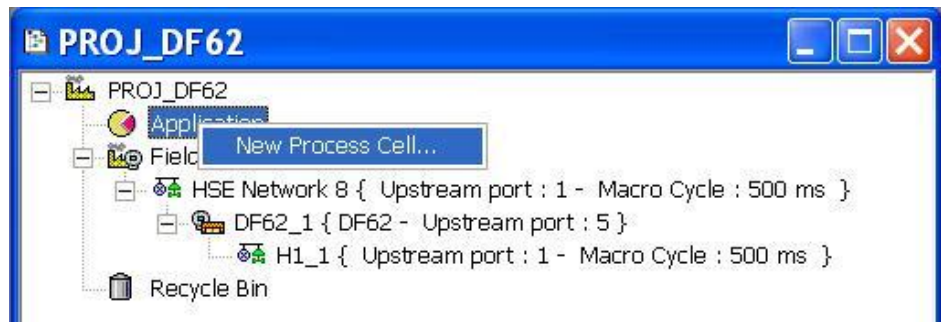


Figure 19. 21 – Inserting the Process Cell

The dialog box to name the **Process Cell** will open:

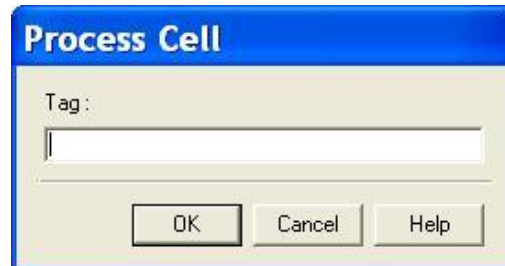


Figure 19. 22 –Attributing tag to the Process Cell

If the user needs name the Process Cell with a specific tag. Enter it in the **Tag** box, and click **OK**. To create more process cells, the procedure above can be repeated.

After inserting the Process Cell, the **Proj\_DF62** window will be according to the next figure:

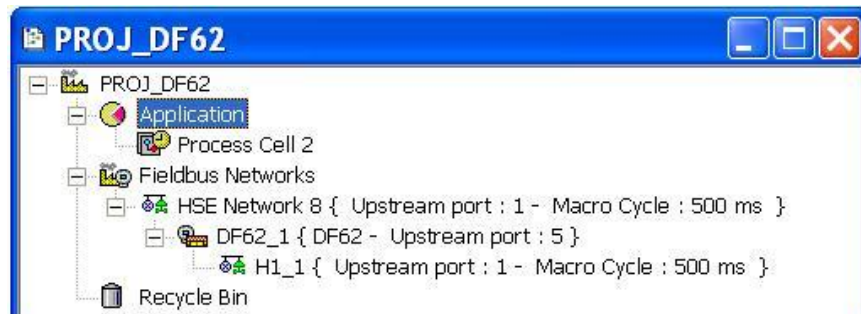


Figure 19. 23 – Area window after inserting the Process Cell

**NOTE**

The user must remember that **Application** is a virtual division. It only divides a large plant. For example: if the plant has two networks, they can be **Process Cells** in the **Syscon**. One **Application** can have several **Process Cells**, but a **Process Cell** cannot be in more than one **Application**.

## Creating a Control Module

### Step 8

Now the user can create a Control Module in the Application section.

Right-click the **Process Cell2** icon, and choose **Expand** item.

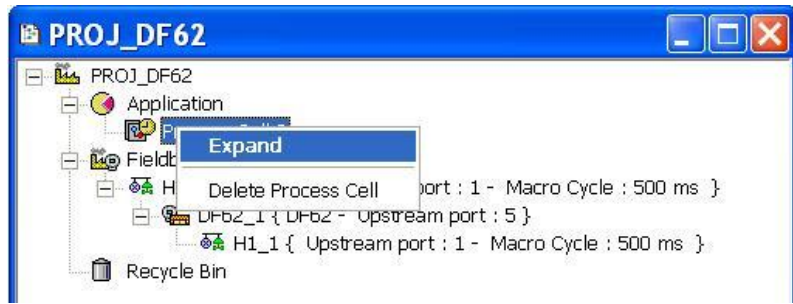


Figure 19.24 – Creating the Control Module

To arrange the screen, click the area window. So, choose **Window** menu on the **Syscon** toolbar, and then **Tile** option.

As following, return to the **Process Cell2** window. Right-click the **Process Cell2** item, and choose **New Control Module**. The figure below shows creating the New Control Module.



Figure 19.25 – Creating the New Control Module

The **New Control Module** dialog box will appear. Name it with the tag related to the application. To continue, click **OK**.

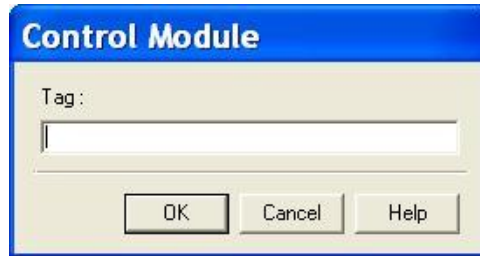


Figure 19.26 – Attributing tag to the Control Module

**IMPORTANT**

Remember that not all characters are valid when naming the elements with tags.

## Inserting Blocks in the Control Module

### Step 9

Now the user can add function blocks for the devices in the **Logical Plant**. Right-click the **Control Module 2** item, and choose **Attach Block** option, as shown in the next figure:

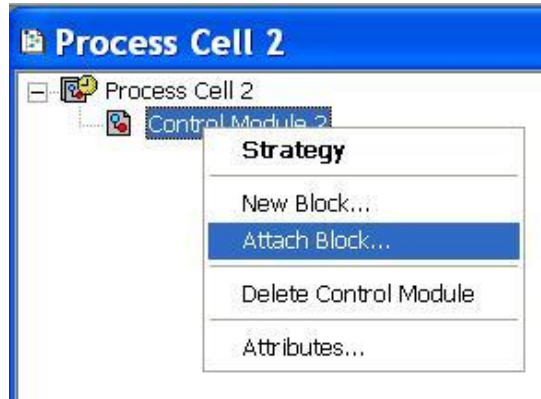


Figure 19. 27 – Adding new functions blocks to the FBAP

The **Attach Block** dialog box will open as shown below:



Figure 19. 28 – Attaching blocks to the Control Module

The available function blocks for the application are showed in the **Attach Block** box. For the aimed control, the function blocks that must be inserted will appear in the box. So, select them one by one, and click the **OK** button.

When the Attach Block process ends, the application will be as shown in the following figure:

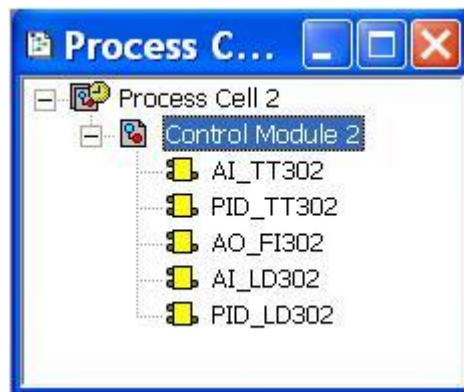


Figure 19. 29 – Blocks added to the Control Module

Another way to attach the blocks is left-clicking the element and drop it to the window.

A new tag can be done to the **Control Module** right-clicking it, and selecting **Attributes**. For the aimed example will be attributed **Estrategia\_ProjDF62**.

## Configuring the Control Strategy

### Step 10

Now the user is ready to develop the control strategy.

First, right-click the **Estrategia\_ProjDF62** icon, and select **Strategy**. The **Strategy** window will appear as shown in the following figure.

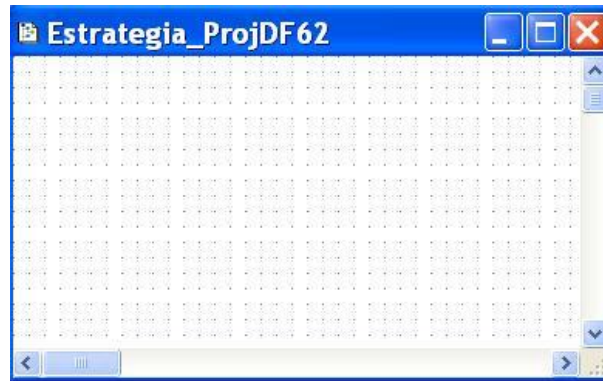


Figure 19. 30 – Strategy window

At this moment there are 3 or 4 windows opened in the **Syscon**. Minimize the **H1\_1** window. Click the **Proj\_DF62** window. On the toolbar, choose **Window → Tile**.


If the user does not have a monitor upper than 17", it is recommended to minimize the strategy window. Thus, it is possible to see the whole area.

The strategy window offers several tools for drawing. Refer to the **Syscon** manual for further details.

## Adding Blocks to the Strategy window

### Step 11

Now the function blocks can be added to the **Estrategia\_Proj\_DF62** window.

In order, click the first block,  **AI\_TT302**, and drop it into the strategy window. A function block will be created automatically.

The next figure shows the function block added to the strategy window:



Figure 19. 31 – Block inserted into the strategy window

Repeat the drag-and-drop procedure for the other blocks such as **AI\_LD302**, **PID\_LD302**, **PID\_TT302**, and **AO\_FI302**.

## Linking the Blocks

### Step 12

There is a specific tool to link the blocks, the **Link** button, , on the **Strategy** toolbar.

Click this button on the toolbar, and then in the TT302\_AI function block. The dialog box for linking the input and output parameters will appear. Select **OUT**, and then click the **OK** button as shown in the following figure.

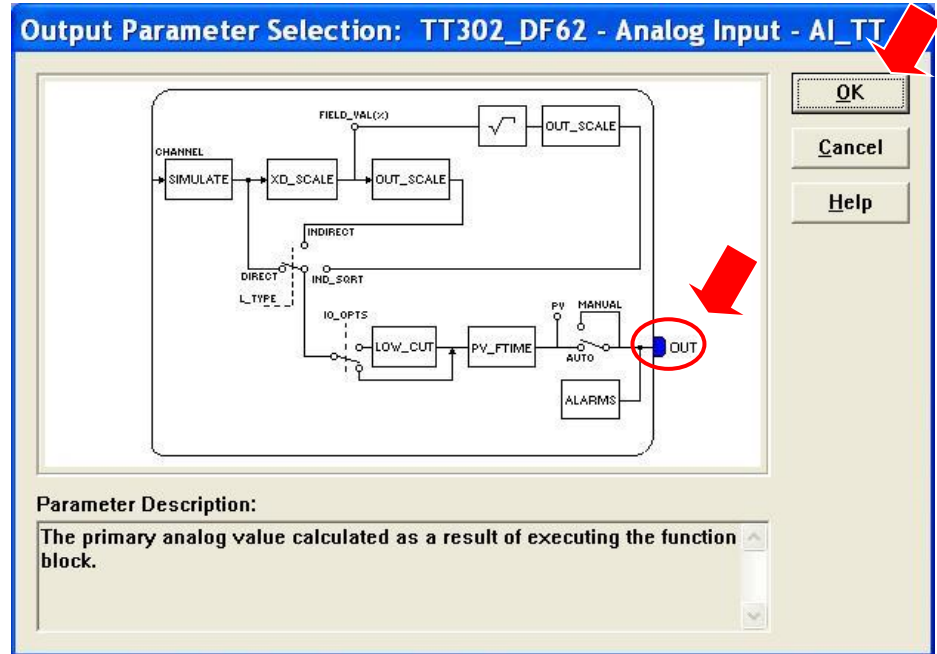


Figure 19. 32 – Linking the Function Blocks

Move the mouse cursor up to the block that will be linked.

The user also does the fast link procedure just right-clicking the function block. The links necessary for this strategy are:

#### Direct Links:

- OUT(AI\_TT302) → IN(PID\_TT302)
- OUT(PID\_TT302) → IN(PID\_LD302)
- OUT(PID\_LD302) → CAS\_IN(AO\_FI302)
- OUT(AI\_LD302) → CAS\_IN(PID\_LD302)

#### Back Links:

- BKCAL\_OUT(PID\_LD302) → CAS\_IN(PID\_TT302)
- BKCAL\_OUT(AO\_FI302) → BKCAL\_IN(PID\_LD302)

After linking the parameters specified above, the strategy window will be as shown in the following figure:

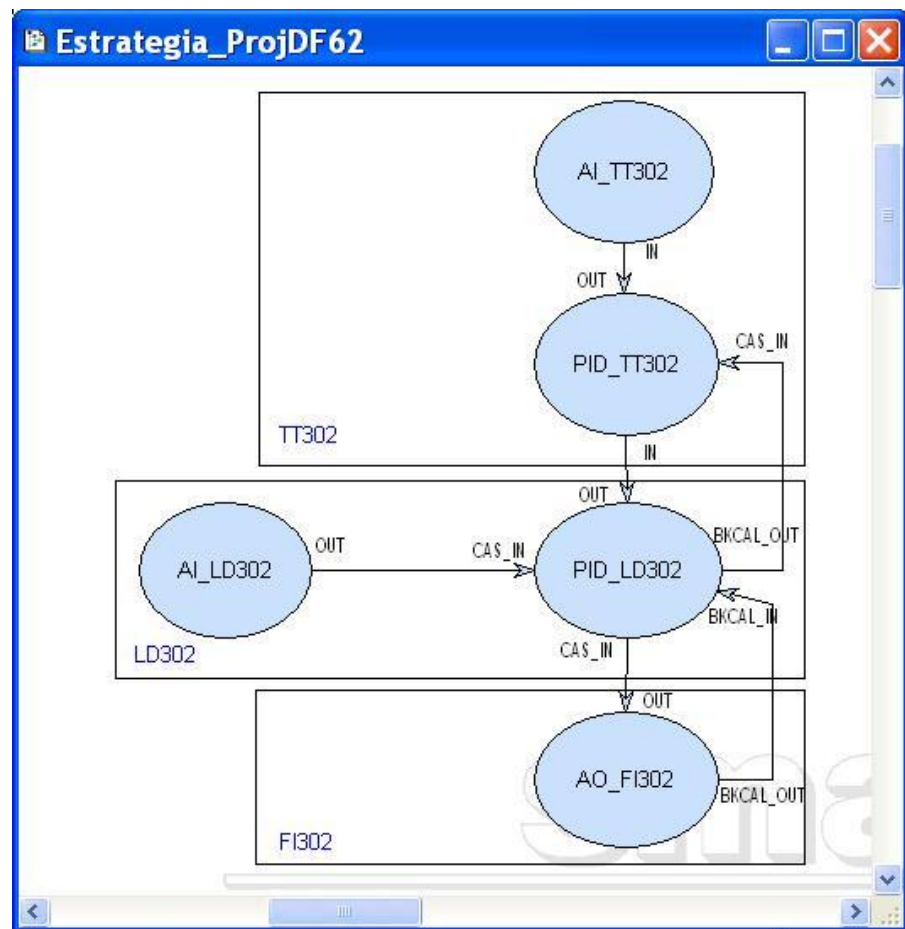


Figure 19. 33 – Links between the Function Blocks

## Function Block Characterization

### Step 13

The function blocks that are in the strategy must be set according to the application for them. So, it is necessary to do the block characterization.

The online and offline modes are possible for the block characterization. In the offline mode, the parameters are set before starting the communication between the devices. The online characterization is executed directly in the devices when the plant is already communicating.

To change the Function Block parameters, consider the following topics:

#### 1. In the Strategy window

Select the block to characterize. Right-click it, and select the **Off Line Characterization** option, or double-click it. The following figure shows the block that is being done the offline characterization:

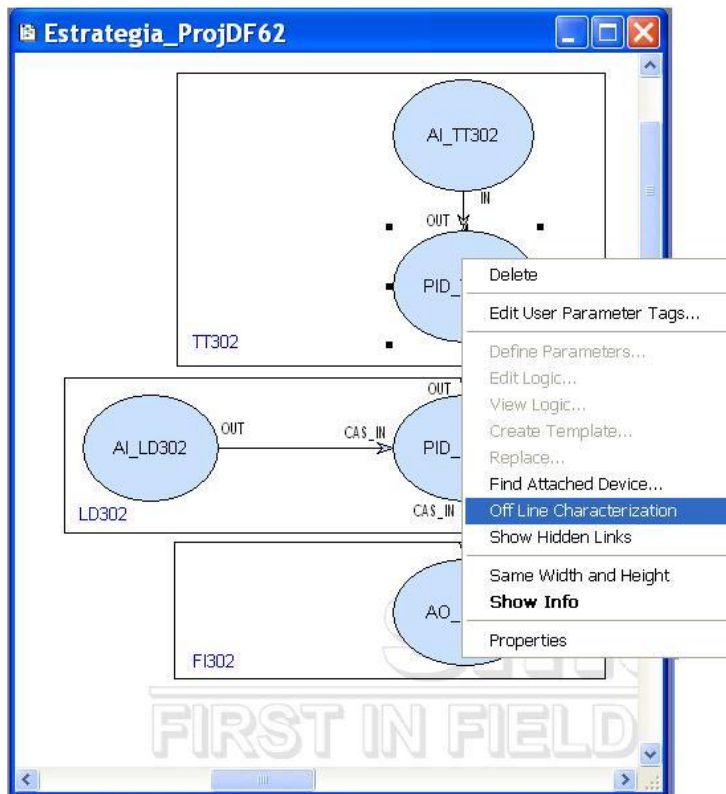


Figure 19. 34 – Offline characterization in the Strategy window

2. In the H1\_1 window

Another way to do the offline characterization is right-clicking the function block, and then selecting the **Off Line Characterization** option, as shown in the following figure:

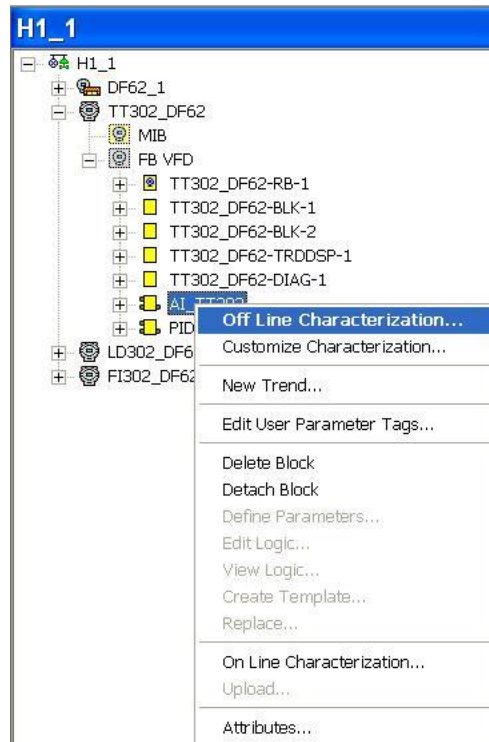


Figure 19. 35 – Offline characterization in the Fieldbus channel window



For both situations, the **Off Line Characterization** dialog box will appear:

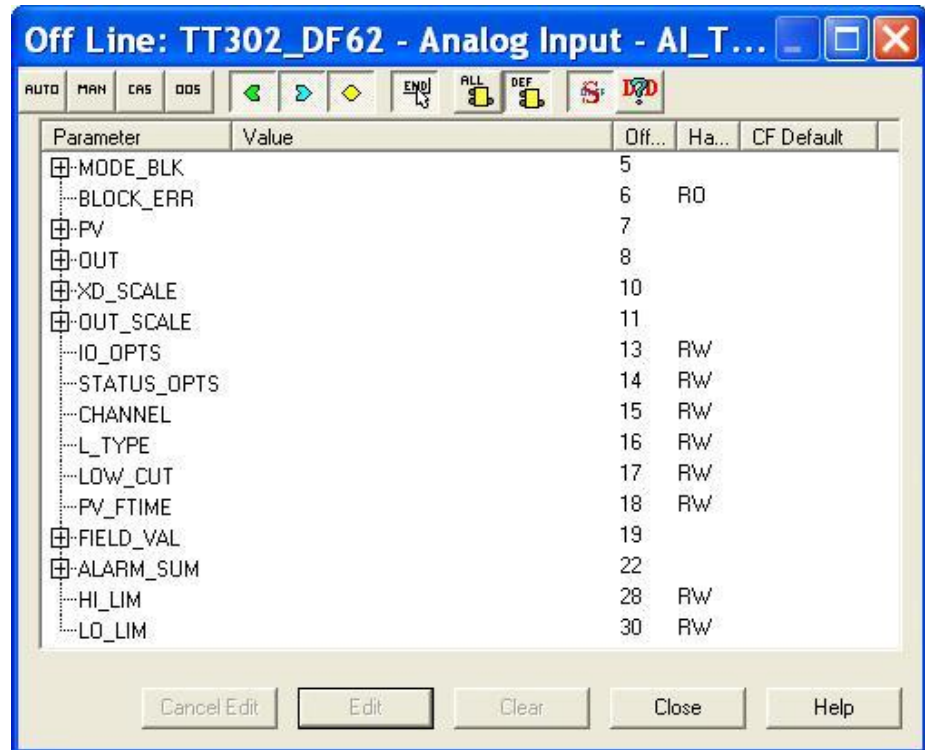


Figure 19. 36 – Function Block Characterization dialog box

Double-click at the right side of the parameter to change it. Another option is click it once, and then in **Edit** to start editing the parameter value. At the ending, click **End Edit**.

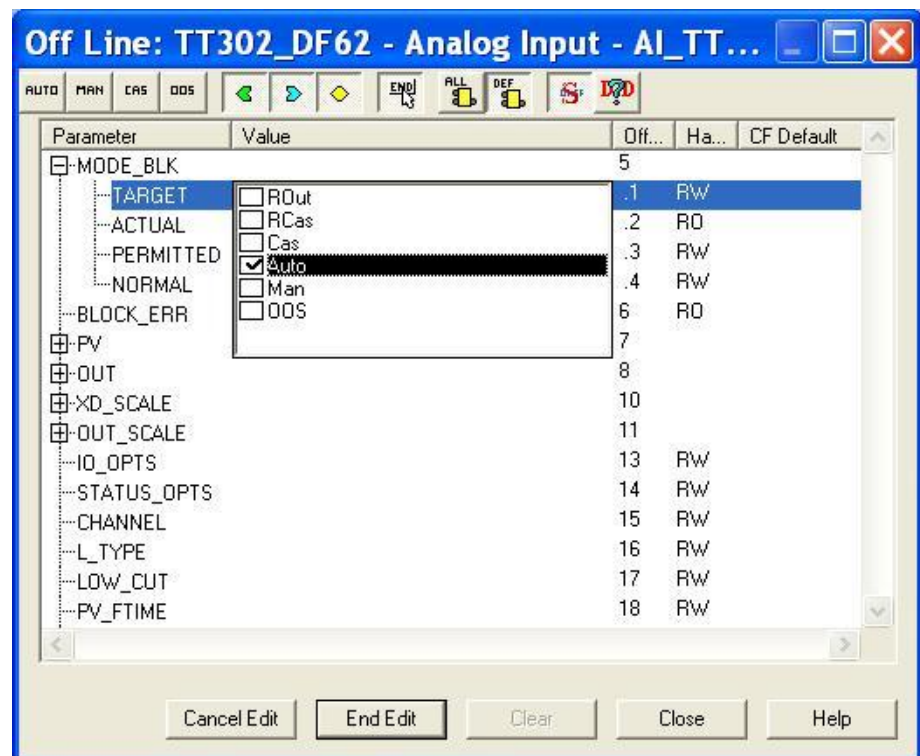


Figure 19. 37 – Editing the parameter in the Function Block Characterization box


The list below shows the parameters that must be set for this area:

| DEVICE                    | TAG               | BLOCK             | PARAMETER                         |
|---------------------------|-------------------|-------------------|-----------------------------------|
| <b>LD302</b>              | <b>LD302_DF62</b> | TR                | MODE_BLK.Target = AUTO            |
|                           |                   | RS                | MODE_BLK.Target = AUTO            |
|                           |                   | DSP               | MODE_BLK.Target = AUTO            |
|                           |                   |                   | BLOCK_TAG_PARAM_1= FT101_AI       |
|                           |                   |                   | INDEX_RELATIVE_1 = 8              |
|                           |                   |                   | MNEMONIC_1 = VAZAO                |
|                           |                   |                   | ACCESS_1 = MONITORING             |
|                           |                   |                   | ALPHA_NUM_1 = MNEMONIC            |
|                           |                   |                   | DISPLAY_REFRESH = UPDATE DISPLAY  |
|                           |                   | AI_LD302          | MODE_BLK.Target = AUTO            |
|                           |                   |                   | XD_SCALE.EU_100 = 100             |
|                           |                   |                   | XD_SCALE.EU_0 = 0                 |
|                           |                   |                   | XD_SCALE.UNITS_INDEX = inH2O(4°C) |
|                           |                   |                   | OUT_SCALE.EU_100 = 100            |
|                           |                   |                   | OUT_SCALE.EU_0 = 0                |
|                           |                   |                   | OUT_SCALE.UNITS_INDEX = %         |
|                           |                   | CHANNEL = 1       |                                   |
|                           |                   | L_TYPE = INDIRECT |                                   |
|                           |                   | PID_LD302         | MODE_BLK.Target = AUTO            |
|                           |                   |                   | PV-SCALE.EU_100 = 100             |
|                           |                   |                   | PV-SCALE.EU_0 = 0                 |
| PV-SCALE.UNITS_INDEX = %  |                   |                   |                                   |
| OUT_SCALE.EU_100 = 100    |                   |                   |                                   |
| OUT_SCALE.EU_0 = 0        |                   |                   |                                   |
| OUT_SCALE.UNITS_INDEX = % |                   |                   |                                   |
| GAIN = 0.5                |                   |                   |                                   |
| RESET = 1                 |                   |                   |                                   |
| RATE = 0                  |                   |                   |                                   |

| DEVICE       | TAG                      | BLOCK             | PARAMETER                        |
|--------------|--------------------------|-------------------|----------------------------------|
| <b>TT302</b> | <b>TT302_DF62</b>        | TR                | MODE_BLK.Target = AUTO           |
|              |                          |                   | SENSOR_TYPE = PT100IEC           |
|              |                          |                   | SENSOR_CONNECTION = THREE WIRES  |
|              |                          |                   | SENSOR_TRANSDUCER_NUMBER = 1     |
|              |                          | RS                | MODE_BLK.Target = AUTO           |
|              |                          |                   | MODE_BLK.Target = AUTO           |
|              |                          | DSP               | BLOCK_TAG_PARAM_1 = TT100_AI     |
|              |                          |                   | INDEX_RELATIVE_1 = 8             |
|              |                          |                   | MNEMONIC_1 = TEMP                |
|              |                          |                   | ACCESS_1 = MONITORING            |
|              |                          |                   | ALPHA_NUM_1 = MNEMONIC           |
|              |                          |                   | DISPLAY_REFRESH = UPDATE DISPLAY |
|              |                          |                   | MODE_BLK.Target = AUTO           |
|              |                          | AI_TT302          | XD_SCALE.EU_100 = 500            |
|              |                          |                   | XD_SCALE.EU_0 = 0                |
|              |                          |                   | XD_SCALE.UNITS_INDEX = °C        |
|              |                          |                   | OUT_SCALE.EU_100 = 100           |
|              |                          |                   | OUT_SCALE.EU_0 = 0               |
|              |                          |                   | OUT_SCALE.UNITS_INDEX = %        |
|              |                          |                   | CHANNEL = 1                      |
|              |                          | L_TYPE = INDIRECT |                                  |
| PID_TT302    | MODE_BLK.Target = AUTO   |                   |                                  |
|              | PV_SCALE.EU_100 = 100    |                   |                                  |
|              | PV_SCALE.EU_0 = 0        |                   |                                  |
|              | PV_SCALE.UNITS_INDEX = % |                   |                                  |
|              | SP = 50                  |                   |                                  |
|              | GAIN = 0.5               |                   |                                  |
|              | RESET = 1                |                   |                                  |
| RATE = 0     |                          |                   |                                  |

| DEVICE                    | TAG        | BLOCK    | PARAMETER                        |
|---------------------------|------------|----------|----------------------------------|
| FI302                     | FI302_DF62 | TR       | MODE_BLK.Target = AUTO           |
|                           |            |          | TERMINAL_NUMBER = 1              |
|                           |            | RS       | MODE_BLK.Target = AUTO           |
|                           |            |          | MODE_BLK.Target = AUTO           |
|                           |            | DSP      | MODE_BLK.Target = AUTO           |
|                           |            |          | BLOCK_TAG_PARAM_1 = FCV102_AO    |
|                           |            |          | INDEX_RELATIVE_1 = 9             |
|                           |            |          | MNEMONIC_1 = VALVULA             |
|                           |            |          | ACCESS_1 = MONITORING            |
|                           |            |          | ALPHA_NUM_1 = MNEMONIC           |
|                           |            | AO_FI302 | DISPLAY_REFRESH = UPDATE DISPLAY |
|                           |            |          | MODE_BLK.Target = AUTO           |
|                           |            |          | PV_SCALE.EU_100 = 100            |
|                           |            |          | PV_SCALE.EU_0 = 0                |
|                           |            |          | PV_SCALE.UNITS_INDEX = %         |
| XD_SCALE.EU_100 = 20      |            |          |                                  |
| XD_SCALE.EU_0 = 4         |            |          |                                  |
| XD_SCALE.UNITS_INDEX = mA |            |          |                                  |

After the parameter setting, the user can start the device communication. It is necessary commissioning the devices to attribute the tags, IDs, and device addresses properly. If this procedure is not executed, the **Syscon** will detect the not commissioned device and the download for this device will be aborted. Finishing the device commissioning, the download process can start. The download process can be executed, for example, returning to the **Proj\_DF62** window, right-

clicking the **Fieldbus Networks** icon,  , and selecting the **Download** option. For further details about the available download types, refer to the **Syscon** manual.

## Macrocycle for the H1 Channel

The macrocycle for each channel depends on the configuration, but can be estimated by using data such as quantity of links, field devices and quantity of blocks. The following examples show this calculation.

Data for configuration 1, with high traffic:

- 50 object links in the H1 network H1 (30 ms per link)
- 8 field devices per channel
- 4 function blocks per device
- Supervision of one dynamic view per block

### Background time

For the “background traffic”, time related to the supervision and asynchronous messages, is necessary at least 960 ms ( $8 \times 4 = 32$  views, 30 ms for each one). For the “foreground traffic”, time related to links and control, is necessary at least 1500 ms (50 links and 30 ms for each one). So, the minimum macrocycle is 2460 ms. Therefore, a security extra time is added, about 20%, and the macrocycle will be equal to 3 s. The quantity of dynamic views per second is 10 (32 views/ 3s) and the publish/subscribe time is 3 s (equals to the macrocycle).

Data for configuration 2, with low traffic:

- 4 object links in the H1 network (30 ms per link)
- 8 field devices per channel
- 2 function blocks per device
- Supervision of one dynamic view per block

Calculating the limits:

- Background traffic: 480 ms ( $8 \times 2 = 16$  views, 30 ms for each one)
- Foreground traffic: 120 ms (4 links and 30 ms for each one)
- Macrocycle: 720ms (600 ms + 20% security extra time)
- Quantity of dynamic views per second: 22 (16 views/ 0.720 s)
- Publish/subscribe time: 720 ms (macrocycle)

So, the macrocycle can be estimated:

- Macrocycle = (Background traffic + Foreground traffic)\*1.2
- Background traffic = Quantity of views\*30 ms
- Foreground traffic = Quantity of links\*30 ms

The time equals to 30 ms is an average value estimated for the calculations above, and it is used for the most of situations.



# CREATING A PROFIBUS CONFIGURATION BY USING DF73, DF95 OR DF97

## Introduction

This section will show a strategy configuration using the DF73 controller. The architecture of the Profibus control loop can be seen in the following figure. It is possible to implement the same strategy using the DF95 or DF97 controllers.

The purpose of the process is to control the product output temperature using steam flow rate to heat it. The product temperature will be sent to the master controller, where it will be compared to the temperature set point.

The condensed steam is recovered by an intermediate tank, and the tank's level is kept through the control of a liquid pump which returns the condensed steam to the process.

### PROJ\_DF73

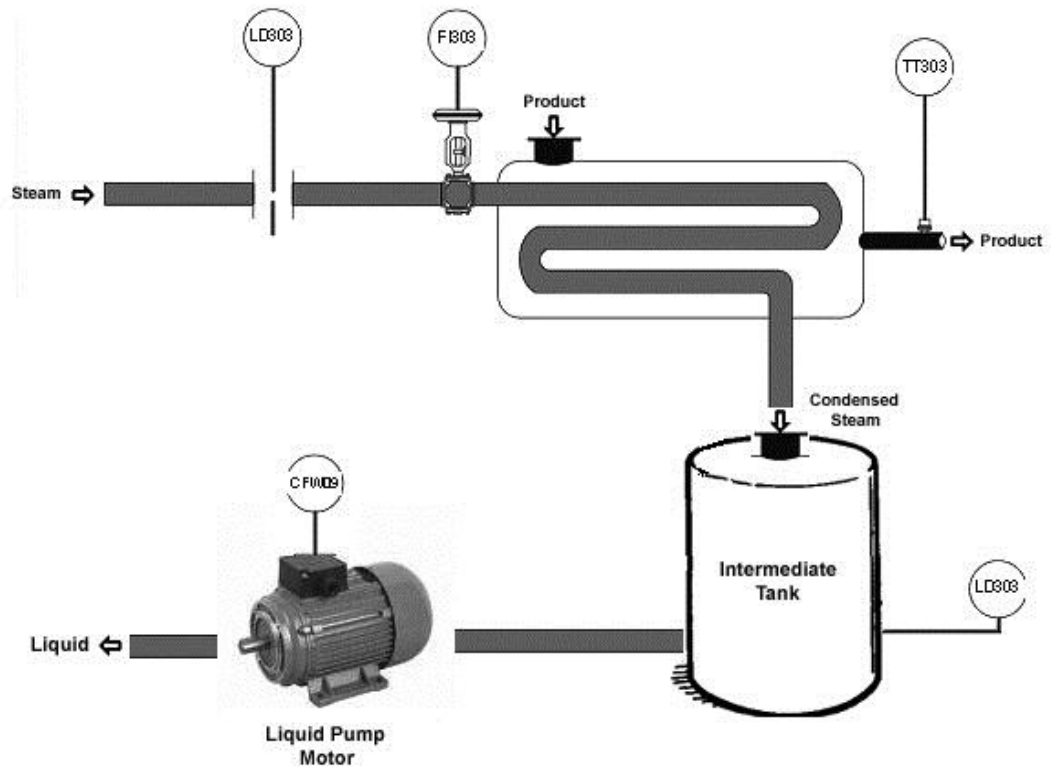


Figure 20. 1 – Example of Process

For the example above the following Profibus devices were used: an AC Drive (CFW09) to control the pump's motor, a LD303 for the steam flow rate measurement, a FI303 to control the steam flow rate, a TT303 for the product temperature measurement, and a LD303 for the tank level measurement.

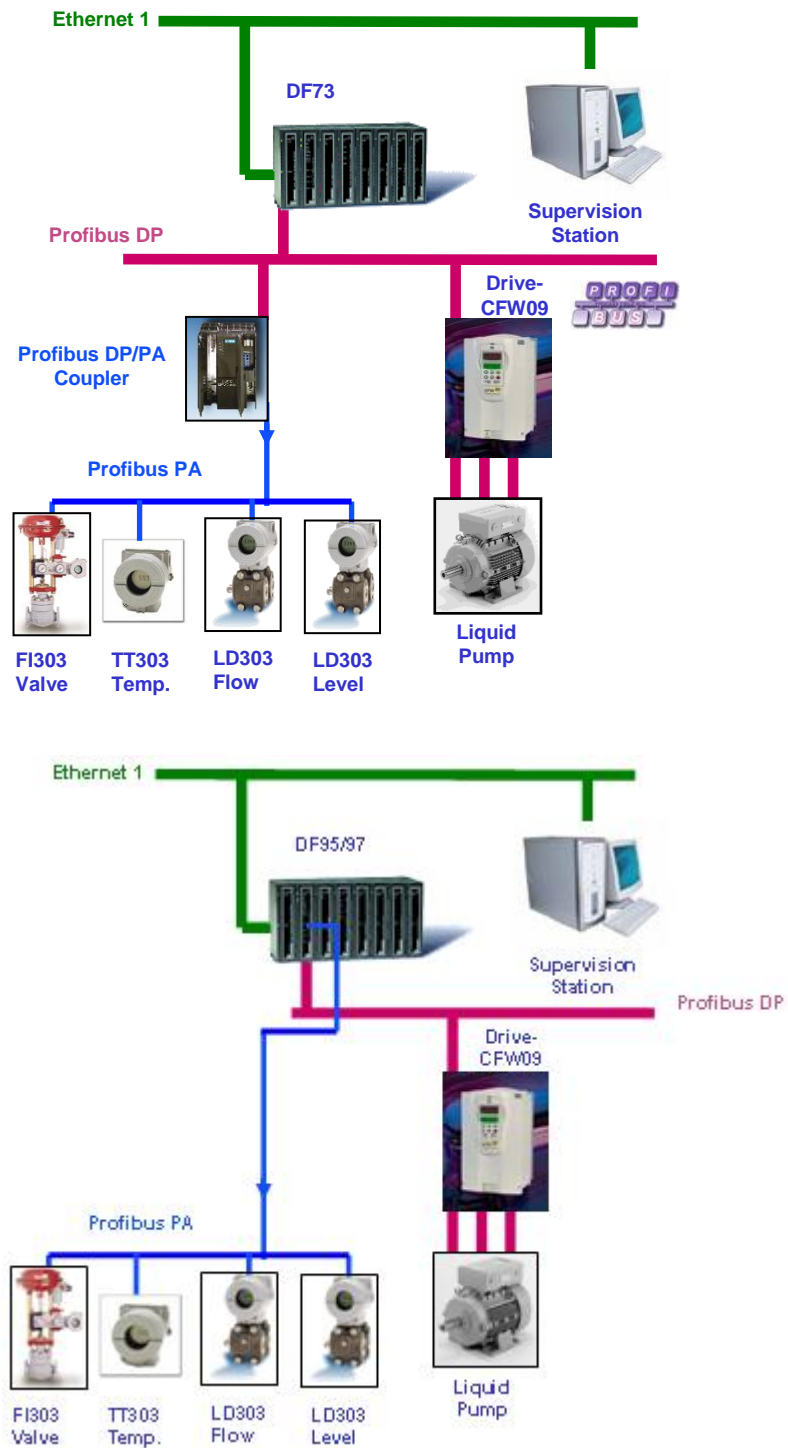


Figure 20. 2 – Profibus DP and PA control network architecture

The addresses, tags and modules which were attributed to the devices are as follows:

| Device | Device TAG    | Address | Modules  |
|--------|---------------|---------|--|
| FI303  | FI303_Vazao   | 3       | eSP+RB+RCASIN+RCASOUT+POS_D+CB<br>EMPTY_MODULE<br>EMPTY_MODULE |
| TT303  | TT303_Temp    | 4       | Analog Input (short)<br>EMPTY_MODULE                           |
| LD303  | LD303_Vazao   | 5       | Analog Input (short)<br>Total_Settot                           |
| LD303  | LD303_Nivel   | 6       | Analog Input (short)<br>EMPTY_MODULE                           |
| CFW09  | Bomba_Liquido | 7       | 6wIn/6wOut   |

In the next topics will show, step by step, how to configure the DF73 controller for the aimed example. At the **SYSTEM302** is possible to do control logic of two ways: ladder or function blocks. The steps 1 to 7 are necessary to configure the Profibus network. The step 8 shows how to do the configuration using ladder logic. From step 8' hereafter is shown how to do the logic using function blocks. Also is possible to mix the two configurations, i.e., part in ladder and part in function blocks.

**IMPORTANT**

Before starting the Profibus configuration in the **SYSTEM302** is necessary to obtain information about each slave device configuration (module address, baud rate, supported types of cyclic communication and mapping structure). Also is necessary the electronic identification file of the device GSD. This information is obtained with the respective Profibus device manufacturer.



## Starting the Area

### Step 1

It is possible to create, or edit, an area from the **Studio302**. In the **Studio302** interface select **Areas**. A window will appear listing all the areas of database.

To create a new area from the **Studio302**, left-click inside the **Areas** window, then choose **New Area**.

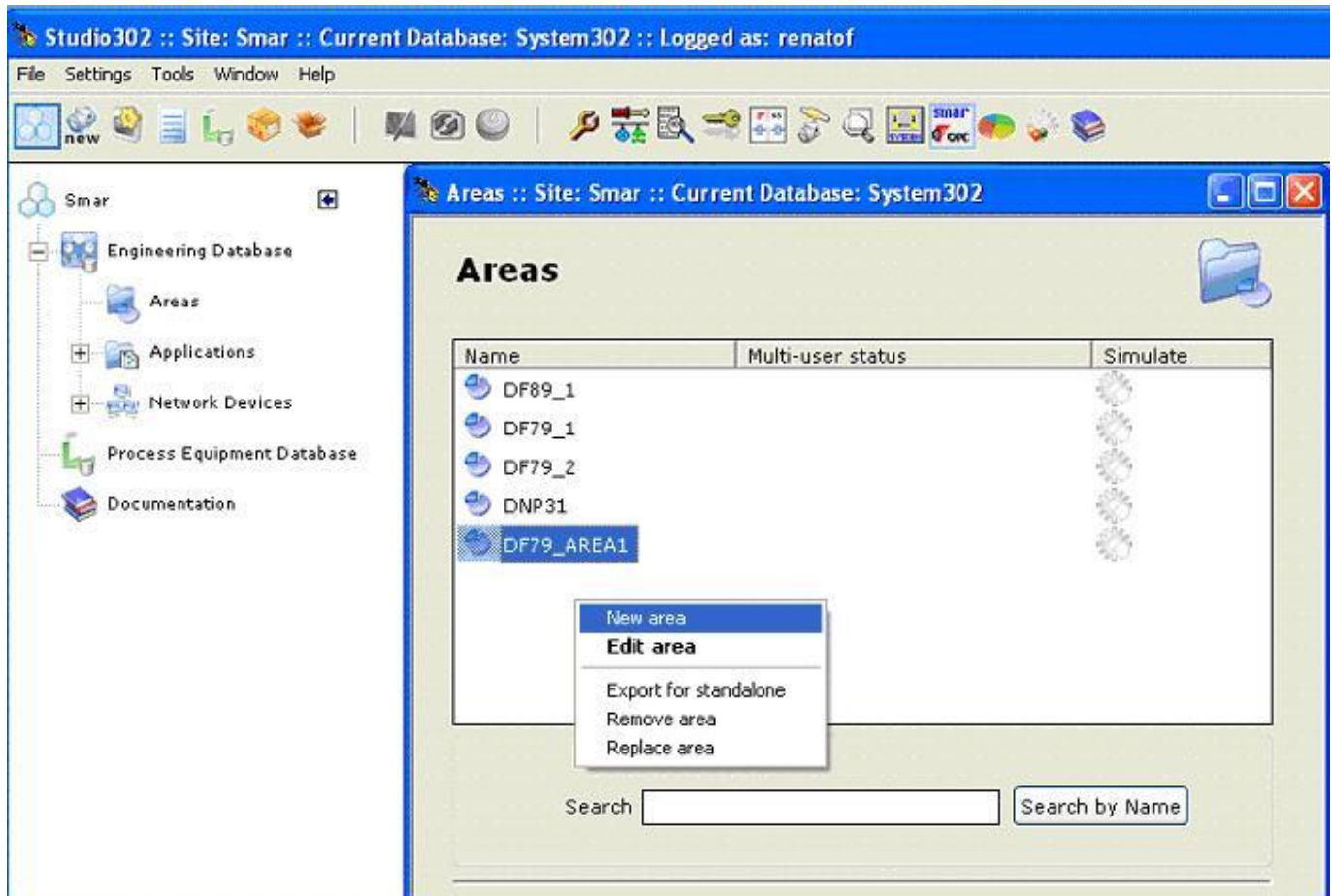



Figure 20. 3 - Creating a new area

Another way to create a new area is from **Syscon**. Click the icon  in the **Studio302** toolbar.

To create a new area on **Syscon**, choose **File → New**, or through the toolbar, choose **New** button . The dialog box shows the areas options. Select **HSE Area** as shown in the next figure:

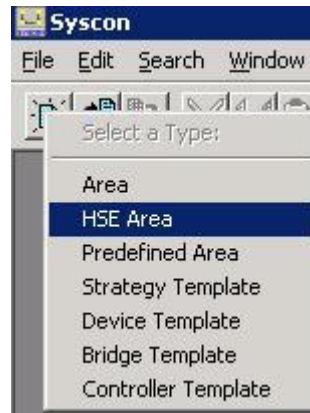


Figure 20. 4 - Options to create Syscon areas

After choosing the area type, it opens a window to the user give a name to the new area.



Figure 20. 5 – New area name

Type the name for the area in the **Area Name** box, and click **Ok**. For this example, it chooses **PROJ\_DF73** name.

A new window will appear. It shows:

- **Application** – Logical Plant. To insert the control strategies into this part.
- **Fieldbus Networks** – Physical Plant. To insert devices and function blocks used in the area.

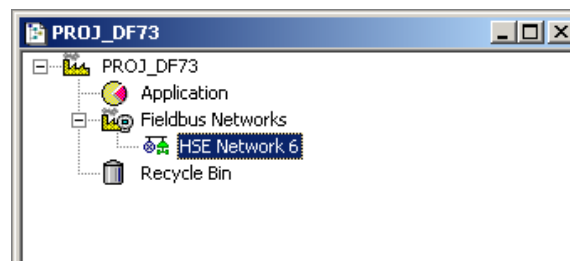


Figure 20. 6 - Area divisions

## Physical Plant Project

### Step 2


In the main window, **PROJ\_DF73**, right-click the **Fieldbus Networks** icon, , to select the Server. Choose **Communication Settings** option, or through the toolbar, choose **Communication→Settings**. The communication settings dialog box will open.



Figure 20. 7 – Choosing the Server

Confirm if the **Smar.HSEOLEServer.0** option has already been selected. Otherwise, the user must select it, and then click **OK**.

## Arranging the Fieldbus windows

### Step 3

After selecting the Server for the area, click the **+** sign placed at left of the **Fieldbus Networks**. The HSE network will appear with a tag, for example, *HSE Network 1\**. Right-click this item and choose the **Expand** option. The following figure shows the HSE network:

#### NOTE

\* This number changes if another area was created before. When a new HSE area is created, this number increases.



Figure 20. 8 – Creating the HSE network

To arrange the screen, click the area window. So, choose **Window** menu on the **Syscon** toolbar, and then choose **Tile** option.

## Inserting the Controller

### Step 4

Right-clicking the **HSE Network 1** icon, a dialog box to add new devices will appear. By clicking **New**, it is possible to select devices such as Bridges, Controllers and Devices for the area. For the aimed control, it selects the **Controller** option. Confirm this choice as shown in next figure.

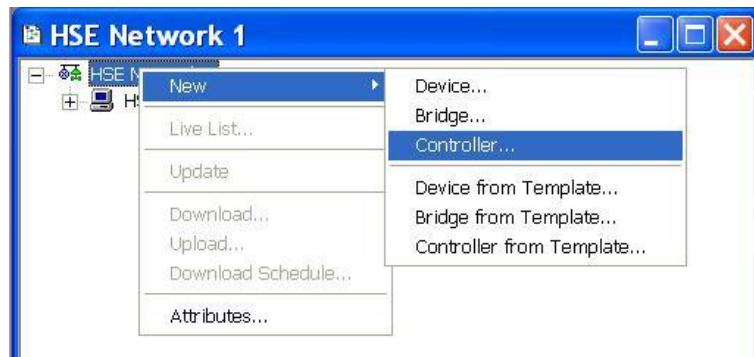


Figure 20. 9 – Choosing the controller for the area

After adding the new controller, it opens a window as shown in following figure.

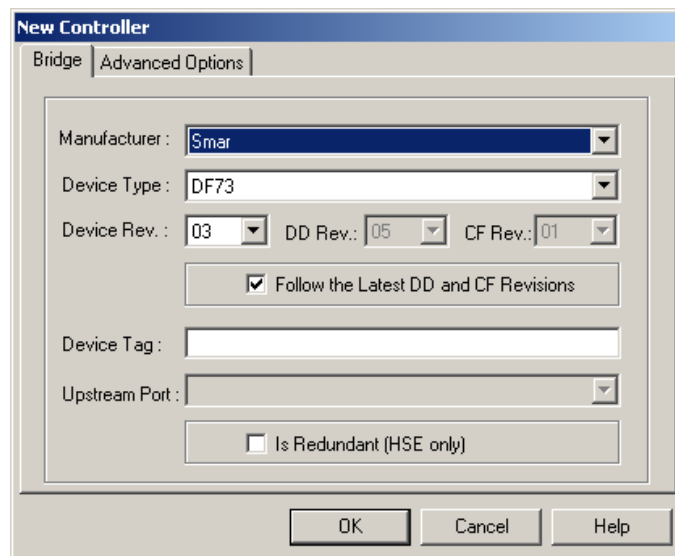


Figure 20. 10 – Setting the controller

Select **DF73** in the **Device Type** box. In the **Device Tag** box, type **DF73** or another tag, and click **OK** to conclude this task. As previously mentioned can be used DF95 or DF97 controllers in this area. The following steps are similar to those controllers.

| IMPORTANT  |
|--|
| <p>Not all characters are valid when naming the elements.<br/>                     The valid characters are:<br/>                     A-Z a-z 0-9 { } [ ] ( ) + -<br/>                     The invalid characters are:<br/>                     ~ ` ! @ # \$ % ^ &amp; * =   : ; , . &lt; &gt; ? / ' " \</p> |

| TIP  |
|--|
| <p>Is possible to create an initial HSE configuration in an easier way using templates. In this case a configuration exists with some common steps created previously. For example, the steps 1 to 4 can be replaced by a creation of template through main menu <b>File →New→Predefined Area</b> choosing <b>DF73 Profibus Controller HSE 1x Profibus DP</b> or <b>DF73 Profibus Controller HSE 1x Profibus DP with FFB-1131</b>.</p> |

## Adding Profibus Devices

### Step 5

After inserting the controller for the area, it is possible to insert Profibus devices. Before, return to the **PROJ\_DF73** window and right-click the controller, **DF73**. Then choose **New Network** option to configure the DF73 channels. See the Profibus bus creation in following figure.

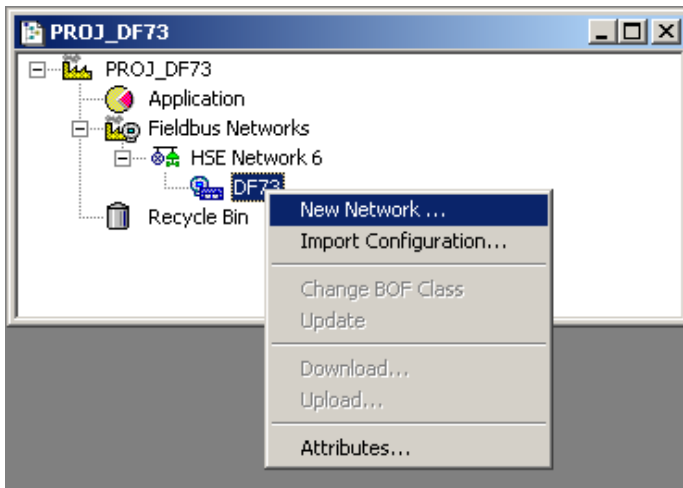


Figure 20. 11 – Creating the Profibus bus

When selecting **New Network**, the **Network Configurator** tool opens. The **Network Configurator** is the configuration tool for the Profibus network. Through it, the user has the structure of the Profibus network (devices, baud rate, and connection type). For further information about this tool, refer to its Help.

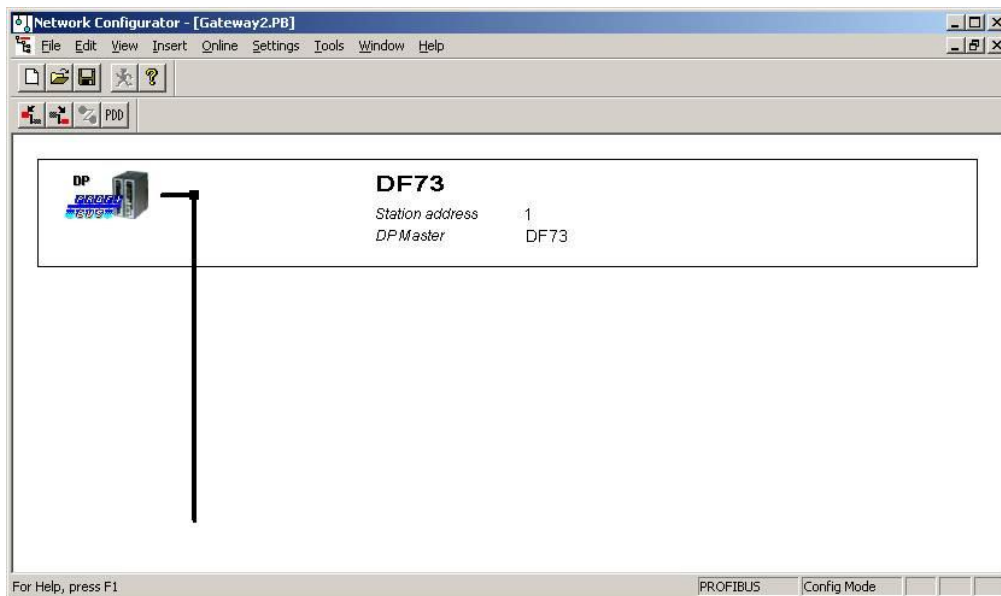



Figure 20. 12 – Network Configurator window

The controller DF73 has already been inserted to the configuration previously, so it is the Master device in the Profibus network. The Profibus devices that will be inserted to the network are named slaves.

### IMPORTANT

The address 1 in the Profibus network is the default address of the DF73. It is not recommended to use the address 125 for moving the devices in the Profibus network. The address 126 can be used for acyclic parameterization of the field devices.

To insert slave devices, click the button  (**Insert Device**) placed on the toolbar, or through the menu **Insert→Device....** Place the mouse cursor just below where the Master device is placed and left-click. See the next figure.

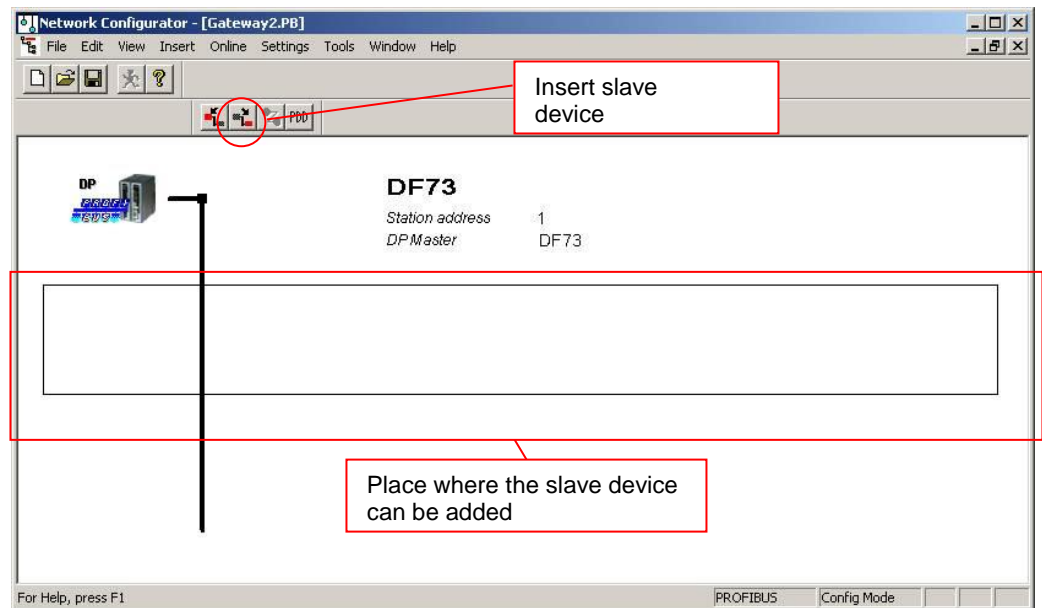


Figure 20. 13 – Placing the slave device in the Profibus network

The window for inserting slave devices will open, as shown below:

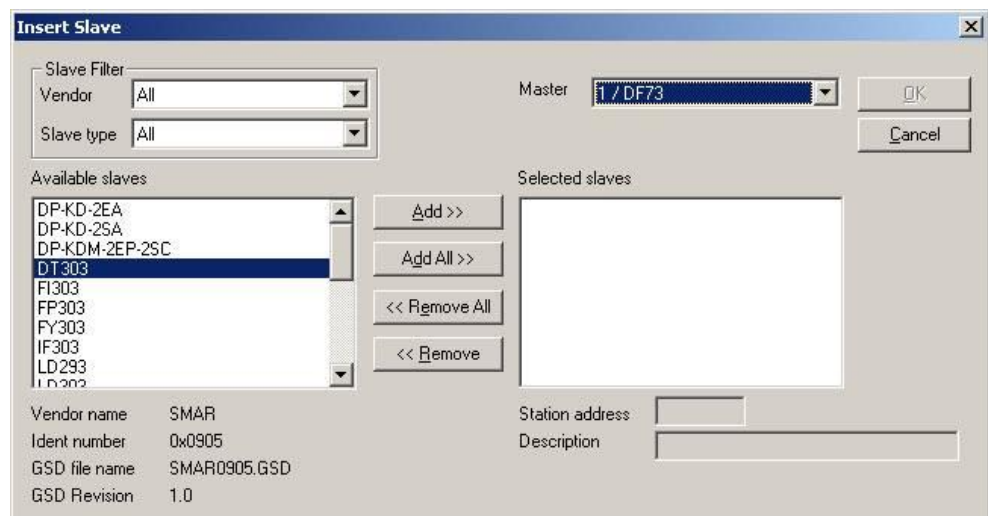


Figure 20. 14 – Inserting slave device

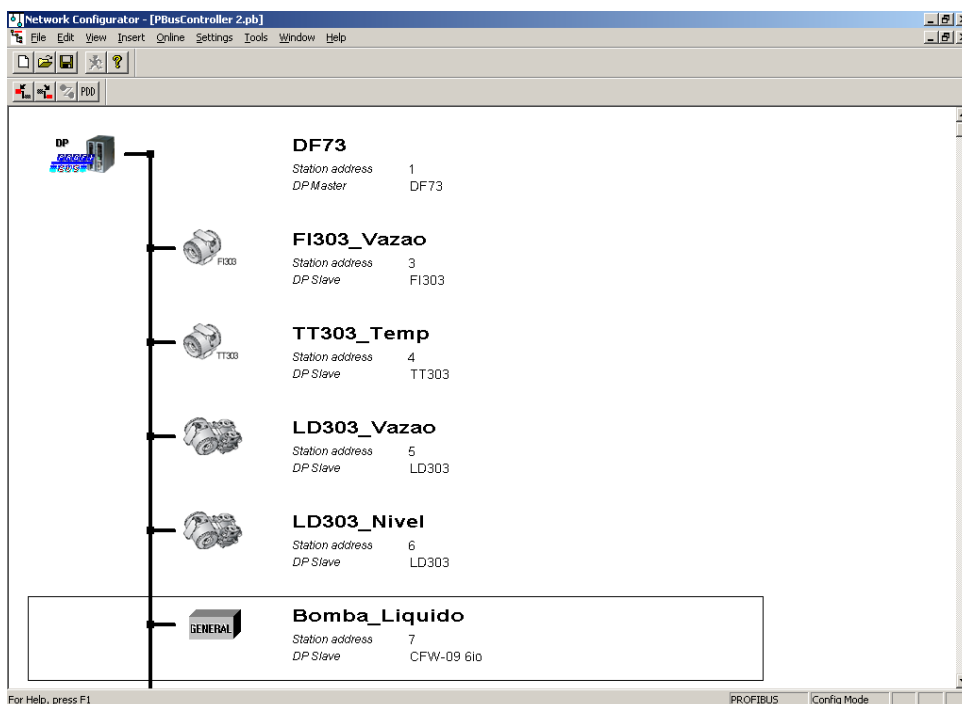
The user can select the slave device in this window. First the user has to obtain the configuration information of the Profibus slave device (refer to device’s manual). Follow these steps to insert slave devices:

- A. Select the device in the **Available slaves** box;
- B. Click **Add** button;
- C. Type the address for the device in the **Station Address** field (this address has to correspond to the physical configuration of the device in the Profibus network. Further details about how to configure the device’s address refer to device’s manual);
- D. Type the tag for the device in the **Description** field. If the user does not write any tag for the device, the default tag will be **Device1**.
- E. Click **OK**.

**NOTE**

The address as well as the tags of the devices must be unique in the Profibus network and also in the **Studio302** Database (Workspace). For further information refer to **Studio302** manual.

When these operations finish the Profibus network will be as the following figure.



**Figure 20. 15 – Profibus network created**

## Inserting Slave Devices that are no present in the “Available Slaves” list

The GSD files have the description of each Profibus device. They are provided by devices manufacturers. These files define the devices specific features in the Profibus network and their objects. The set of these files forms the devices database. The **SYSTEM302** already has a GSD database of the more common manufacturers, but is possible to add new devices in the **SYSTEM302** database.

If there is a device which will be in the Profibus network, but is not available in the devices list, the user has to contact the device manufacturer to take the GSD file, and also to take the \*.bmp file (with the device icon) if it exists.

The GSD and BMP files obtained from the manufacturers should be copied respectively to the folders below and follow the path of the installation:

```
\SMAR\ NetWork Configurator\Fieldbus\Profibus\GSD
\SMAR\ NetWork Configurator\Fieldbus\Profibus\BMP
```

## Setting Profibus Devices

### Step 6

After creating the Profibus network, the devices have to be configured. For example, right-click the device corresponding to the flow meter. Choose the **Slave Configuration** option to configure the slave device.

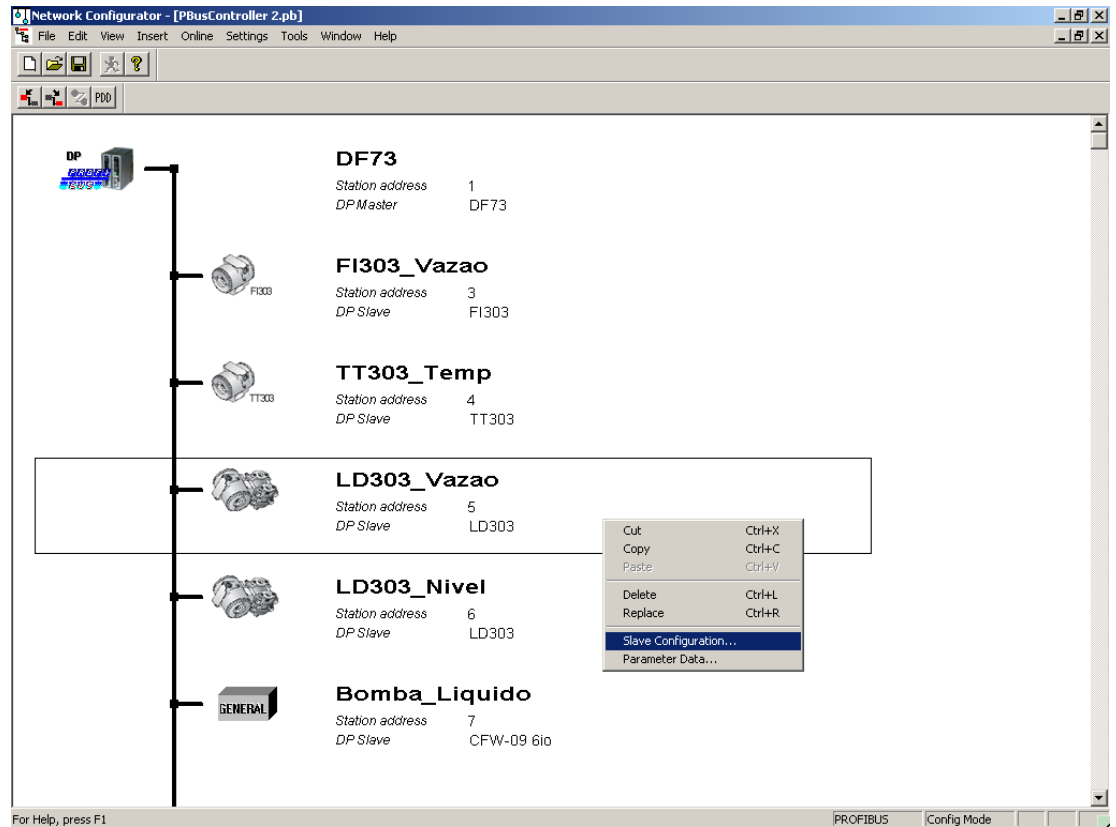


Figure 20. 16 – Setting the slave device

The configuration window also will open double-clicking the device.

The window for device configuration will open. See the figure below.

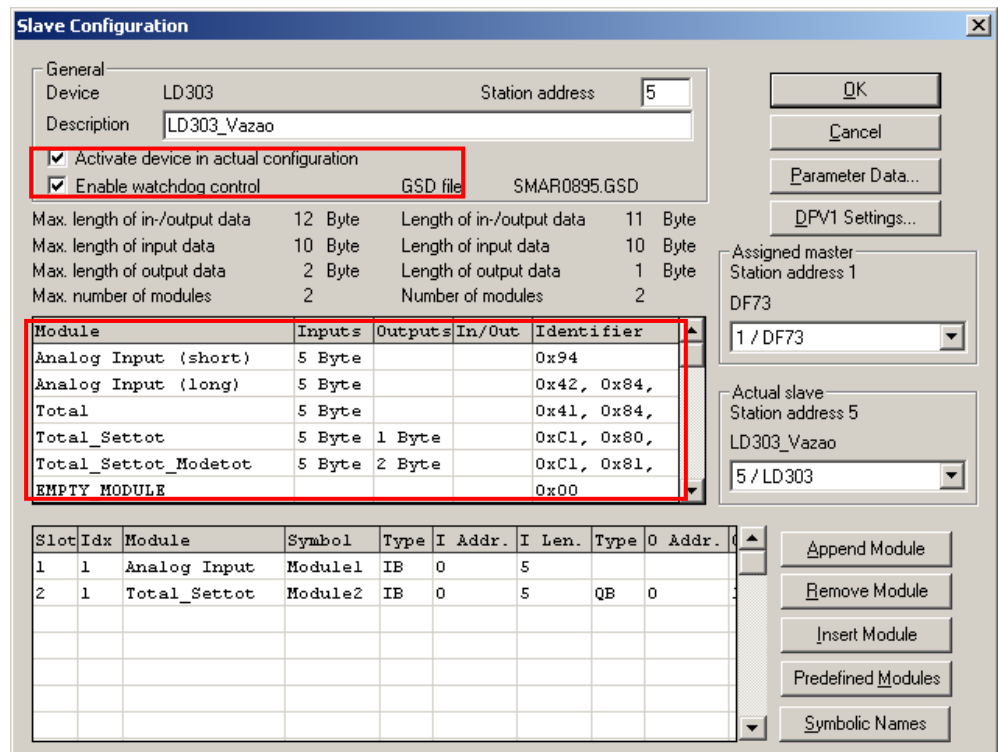


Figure 20. 17 – Setting the slave device



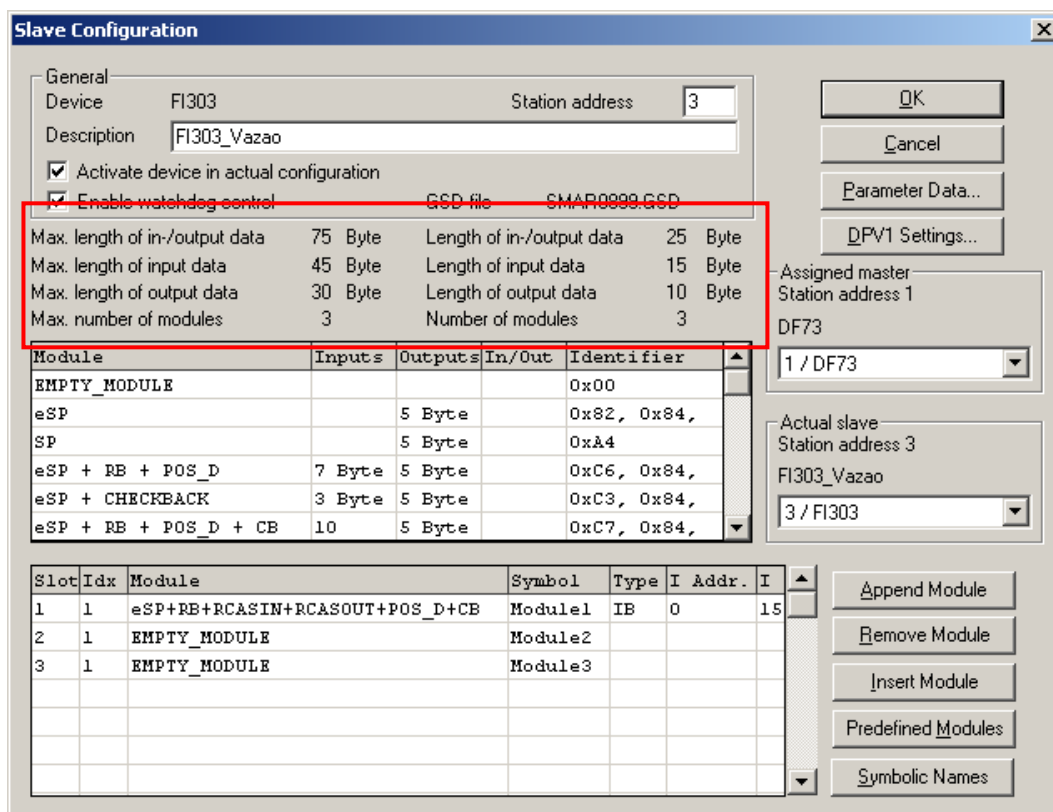
**IMPORTANT**

It is recommended that the *Enable watchdog control* option always is selected; therefore in the case of communication interruption the slaves, which were configured with this option, will attribute a safety value in them outputs after the configured watchdog time.

The data configuration is done by choosing the modules. This configuration can be fixed (if the device has a single module), or dependent of the modules selection and its quantity (if the device has more than one module).

The configurations for **PROJ\_DF73** will be as follows:

The **FI303** supports up to 3 outputs channels (see FI303 manual). When inserting the **FI303\_Vazao** is possible to see that it supports up to 3 modules. Since one valve will be controlled only one module will be used. For the others the **EMPTY\_MODULE** will be chosen indicating that these modules will not be used. The manufacturer provides in the device’s GSD file the available modules, the quantity and size of each module.



**Figure 20. 18 – Setting the FI303\_Vazao**

For the TT303 - **TT303\_Temp** – was chosen only one module, but it has capacity for two temperature inputs (but only one measurement is done). The **EMPTY\_MODULE** was added indicating that the second channel will not be used.

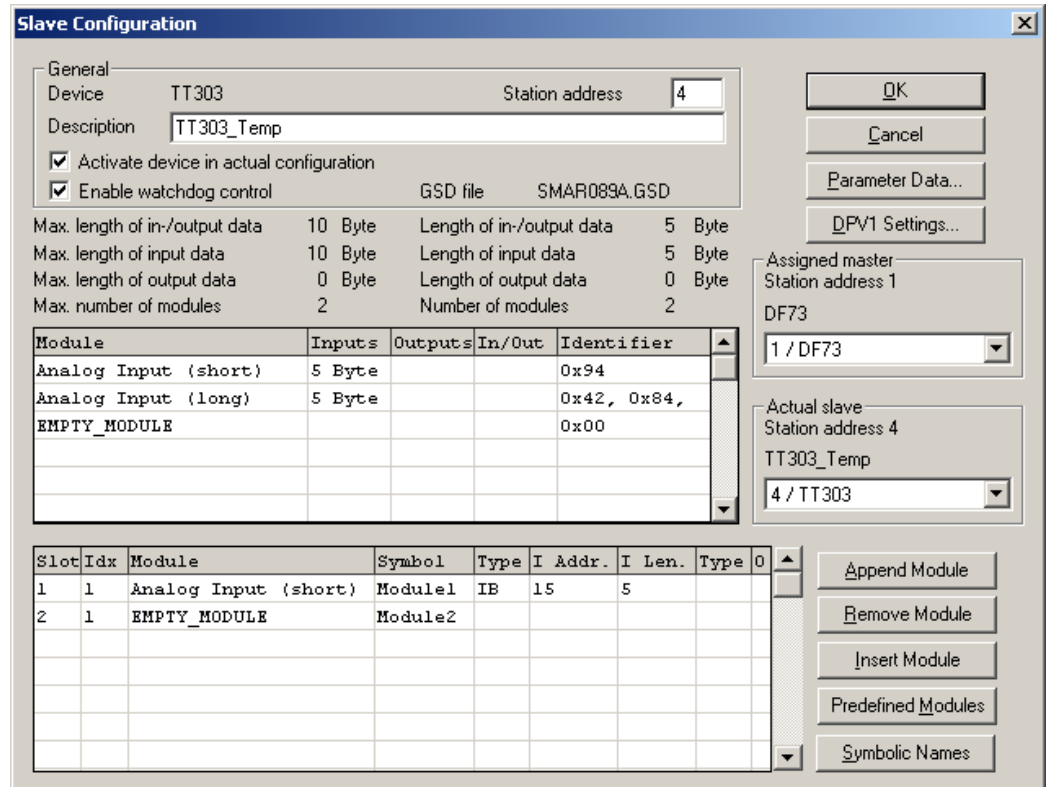


Figure 20. 19 – Setting the TT303\_Temp

For the LD303\_Vazao two modules were chosen. The first will read the flow rate, and the second will do the totalization. This feature is from the transmitter and it will avoid that this calculation is done by the controller.

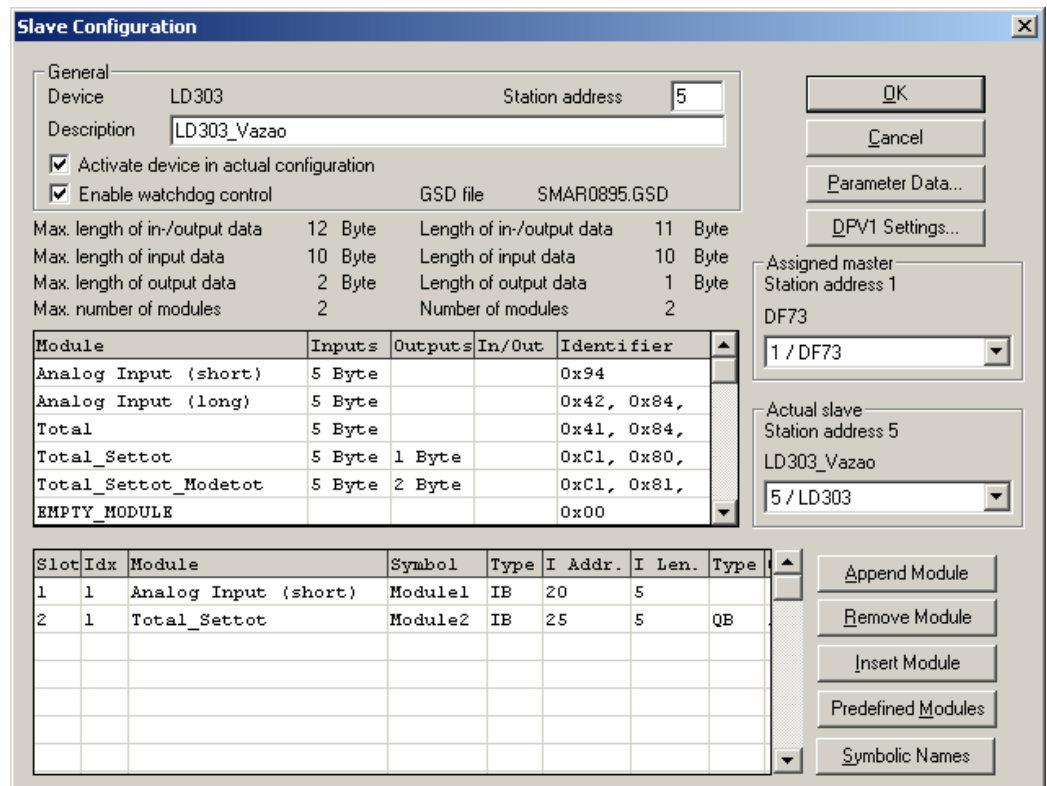


Figure 20. 20 – Setting the LD303\_Vazao

The configuration for the **LD303\_Nivel** is the same one for **TT303\_Temp**, because the added module will indicate the tank level, it is not necessary other measurements. After this, add the **EMPTY\_MODULE**.

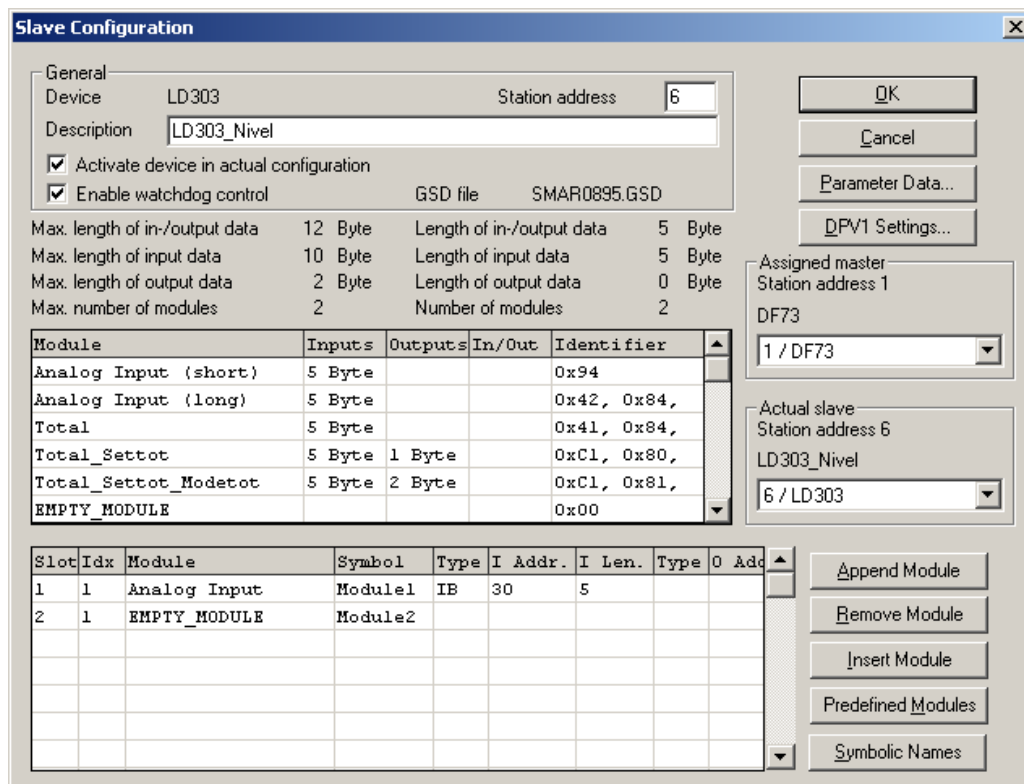


Figure 20. 21 – Setting the LD303\_Nivel

The **Bomba\_Liquido** device supports only one module type, thus add one module (see CFW09 manual), which will correspond to the 16 inverter status bits, 16 control bits, an integer used for set point, an integer used for speed reference, and other integers which vary according to the device’s model and device’s version.

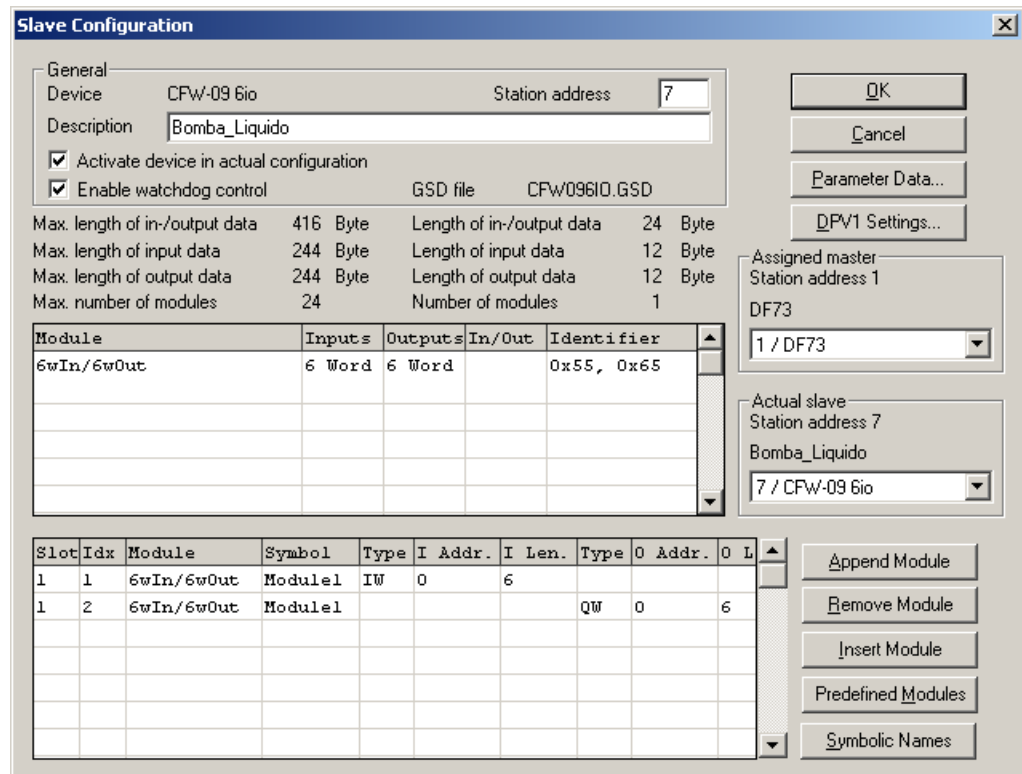


Figure 20. 22 – Setting the Bomba\_Liquido

When inserting devices finishes, the mapping must be done. It consists of mapping the values, bytes and data to be reading/written from the devices to the master memory. The procedure will be described in the following topic.

After selecting the inputs and outputs for the Profibus devices, set the baud rate for the Profibus network. Click the master device and choose **Settings→Bus Parameter** on the toolbar. The dialog box will open:

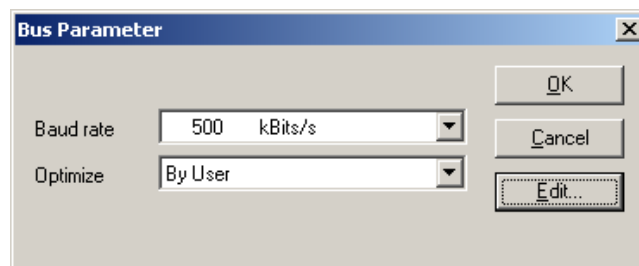


Figure 20. 23 – Selecting the baud rate for the Profibus network

Select the baud rate in the **Baud Rate** list, in the **Optimize** field select **By User**. Click **Edit...** if is necessary to configure the bus parameters. If is not necessary to configure the bus parameters select **Standard** and click **Ok**. The communication parameters will be described in the Profibus network time parameters topic, for further details, please consult it.

**NOTE**

The baud rate and communication parameters are dependent of the slaves in the network. The device's GSD file has the supported baud rates. The configuration tool will warning if some slave does not support the selected baud rate.



Save the configuration before exit from **Network Configurator**.

### Step 7

When the previous steps were finish, the Profibus network configuration can be saved, and then, exit from **Network Configurator**. The **Mapping Tool** launches automatically. With this tool is possible to map the points of Profibus network in available points which will be used in ladder logic or in function blocks logic. This tool configures all characteristics of Profibus points (user tags, data types, scales, etc). See the following figure.

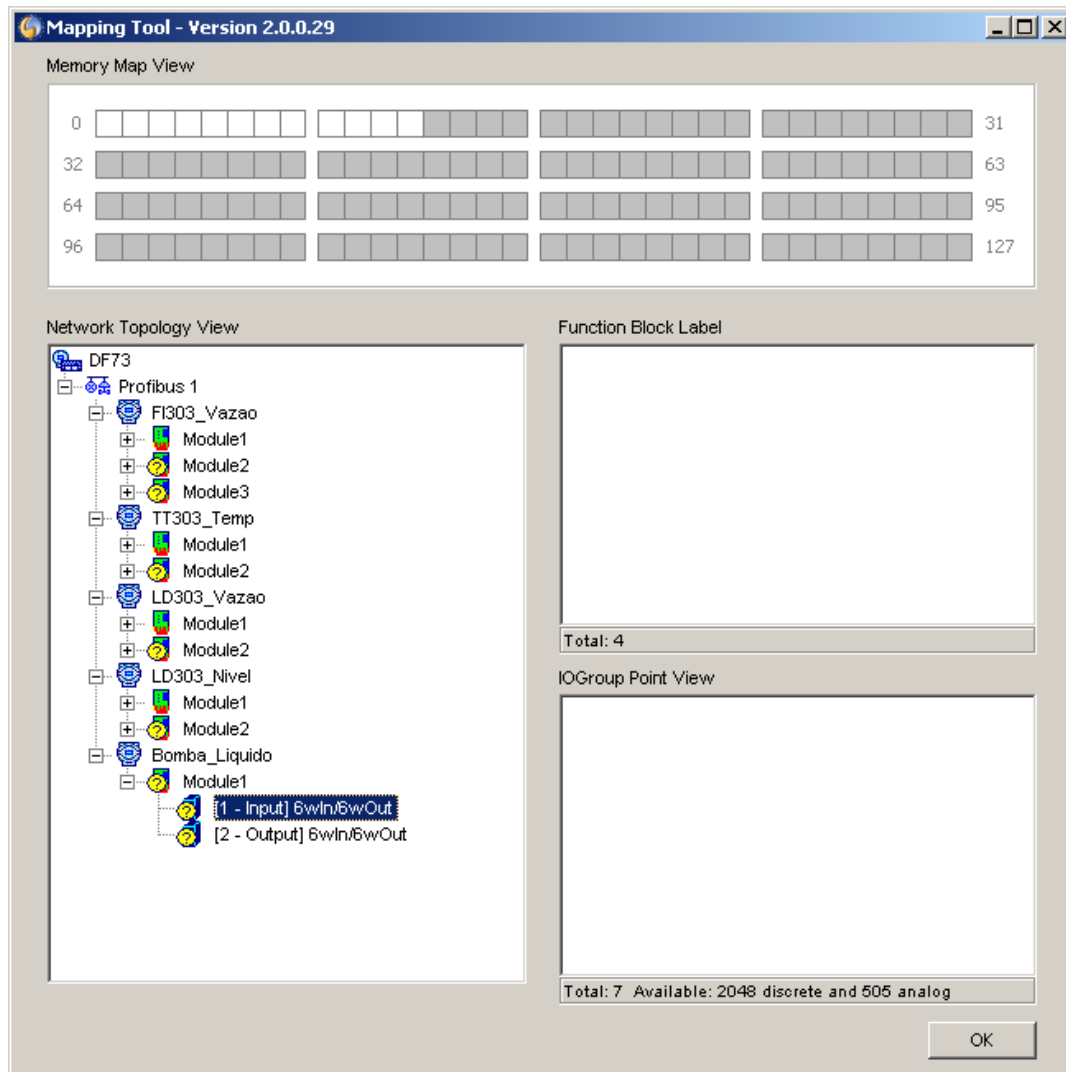



Figure 20. 24 – Mapping Tool window

In the last figure can be seen the **Network Topology View** window with the devices which were inserted in the Profibus network with their modules. In the **Function Block Label** window are the points which will be seen at **Syscon**, and the **IOGroup Point View** window are the points which will be seen at **LogicView for FFB**. The purpose is to configure each network “point” (or byte) in their respective data types.

The items with the symbol  have to be configured. The user has to refer to the Profibus DP devices manuals, such as CFW09 manual, to know each byte function of the Profibus module. The manual has the bytes’ meaning (if they are used as analog or digital).

According to the drive manual the inputs and outputs bytes have the following attributions:

| Digital Inputs |       |   | Digital Outputs |       |   |
|----------------|-------|---|-----------------|-------|---|
| Byte 0         | Bit 0 | ON Status<br>0=Stopped / 1=Rotating           | Byte 0          | Bit 0 | Mask for Rotate/Stop<br>1= Enabled / 0=Disable Rotate/Stop              |
| Byte 0         | Bit 1 | General Enable<br>0=Enabled / 1=Disabled.     | Byte 0          | Bit 1 | Mask for General Enable<br>1= Enabled / 0=Disable General Enable        |
| Byte 0         | Bit 4 | Local and Remote Status<br>0=Local / 1=Remote | Byte 0          | Bit 4 | Mask for Select Local and Remote<br>1= Enabled / 0=Disable Local/Remote |
| Byte 0         | Bit 5 | Power fault<br>0=Without power fault / 1=With | Byte 0          | Bit 7 | Mask for Reset<br>1= Enabled / 0=Disable Reset                          |
| Byte 0         | Bit 7 | Active Error<br>0=No / 1=Yes                  | Byte 1          | Bit 0 | Rotate/Stop Command<br>1=Rotate / 0=Stop                                |
|                |       |   | Byte 1          | Bit 1 | General Enable Command<br>1= Enabled / 0= General Disable               |
|                |       |   | Byte 1          | Bit 4 | Local and Remote Command<br>0=Local / 1=Remote                          |
|                |       |   | Byte 1          | Bit 7 | Reset Command<br>0=No Reset / 1=Reset                                   |

| Analog Inputs |                         | Analog Outputs |                             |
|---------------|-------------------------|----------------|-----------------------------|
| Byte 1        | Error Code<br>(0-255)   |                |                             |
| Bytes 2 and 3 | Motor Speed<br>(0-8192) | Bytes 2 and 3  | Speed Reference<br>(0-8192) |

Click the item which will be configured (for example **Bomba\_Liquido->Module1->[1 – Input] 6wIn/6wOut**) and in the window upper side will appear the available bytes. See the next figure.

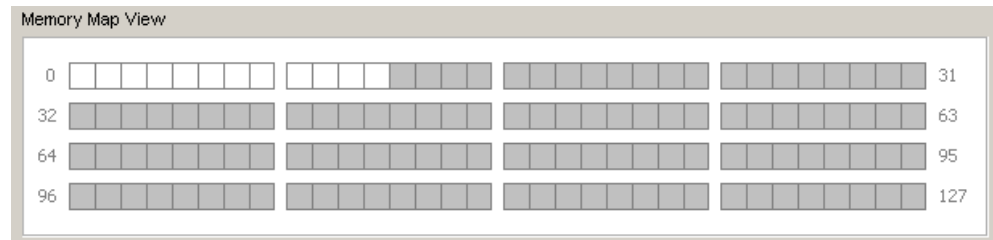


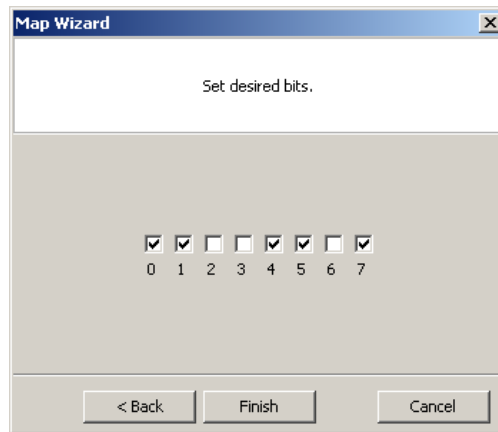
Figure 20. 25 – Available bytes

Click the byte, and the following window will appear.



Figure 20. 26 – Configuring the data type

Choose the variable data type of the slave device (**Data type**). The available types will depend on the chosen device. To **Bomba\_Liquido** the type is **Bit**.



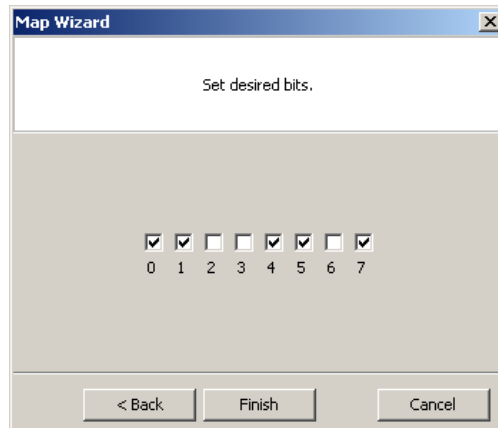
**Figure 20. 27 – Configuring the input discrete points**

The following steps have instructions about how to use the points, which were mapped in the **Network Configurator**, in the control logic. As above mentioned there are two ways to map inputs and outputs – ladder logic or function blocks.

## Mapping Profibus IO Points to be Used in Ladder

### Step 8

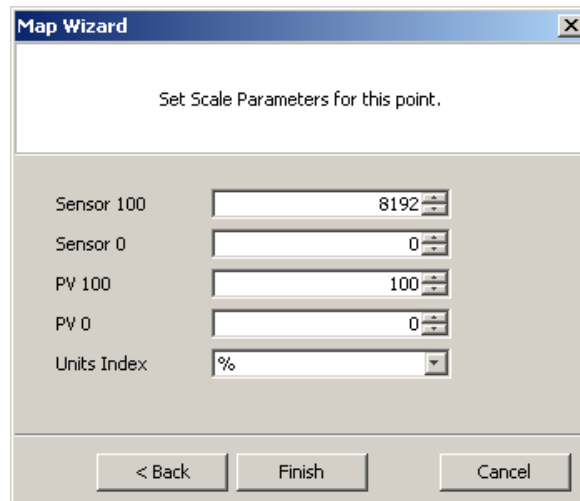
First the points will be mapped to be used in ladder, thus the **Block Type** (None) option will not be configured. The user can give a tag to group in **Group tag** option. If **Bit** option is selected the following window will appear.



**Figure 20. 28 – Configuring the bits**

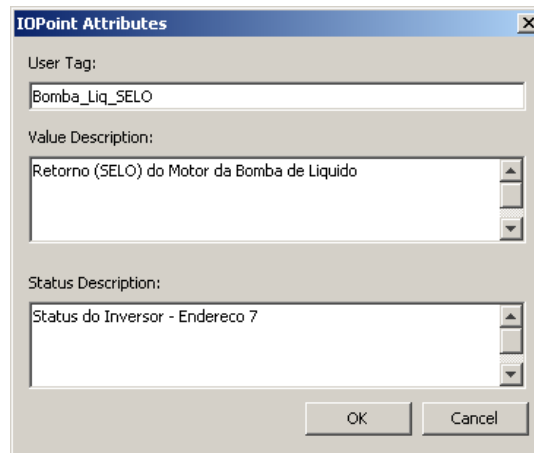
Select the bits which are necessary to the application, click **Finish** and the configured points will appear in the **Mapping Tool** window.

When analog data type was chosen the scale parameters for this point has to be configured. The speed and its reference for the drive have to be configured as **unsigned16** and the scale has to be 0-8192 for **sensor0-sensor100**. The error code has to be mapped as **unsigned8** and without scale (**PV0-PV100** equals to **sensor0-sensor100** within 0-255)



**Figure 20. 29 – Setting the scale parameters**

Right-clicking this point and choosing **Delete** it can be deleted, or some attributes can be defined for better identification through the **Attributes** option.



**Figure 20. 30 – Changing the point attributes**

Fill the necessary fields, and click **OK**.

After mapping and configuring all points, click **OK** to exit from **Mapping Tool**.

After finish the mapping, a FFB block has to be inserted in the configuration using the **Syscon**. This block is necessary to edit the ladder logic. For further details refer to Adding Function Blocks section or **Syscon** manual. Right-click FFB block, which was added, and then click **Define Parameters**.



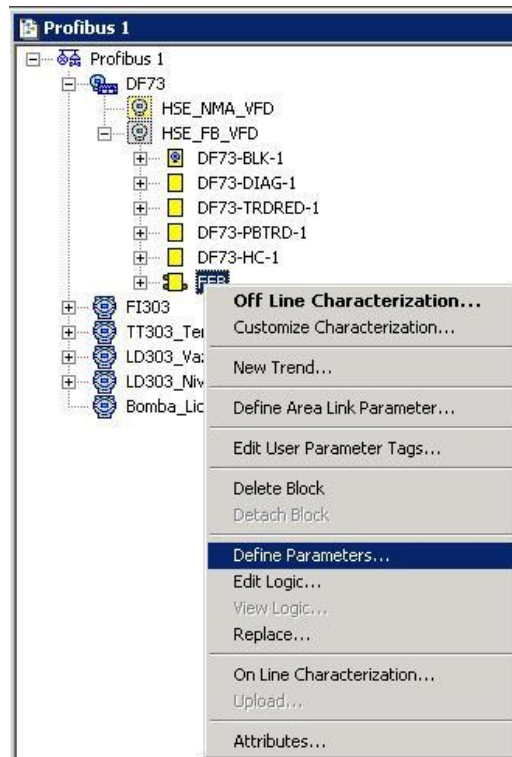


Figure 20. 31 – Defining FFB parameters (1)

The following window will appear.

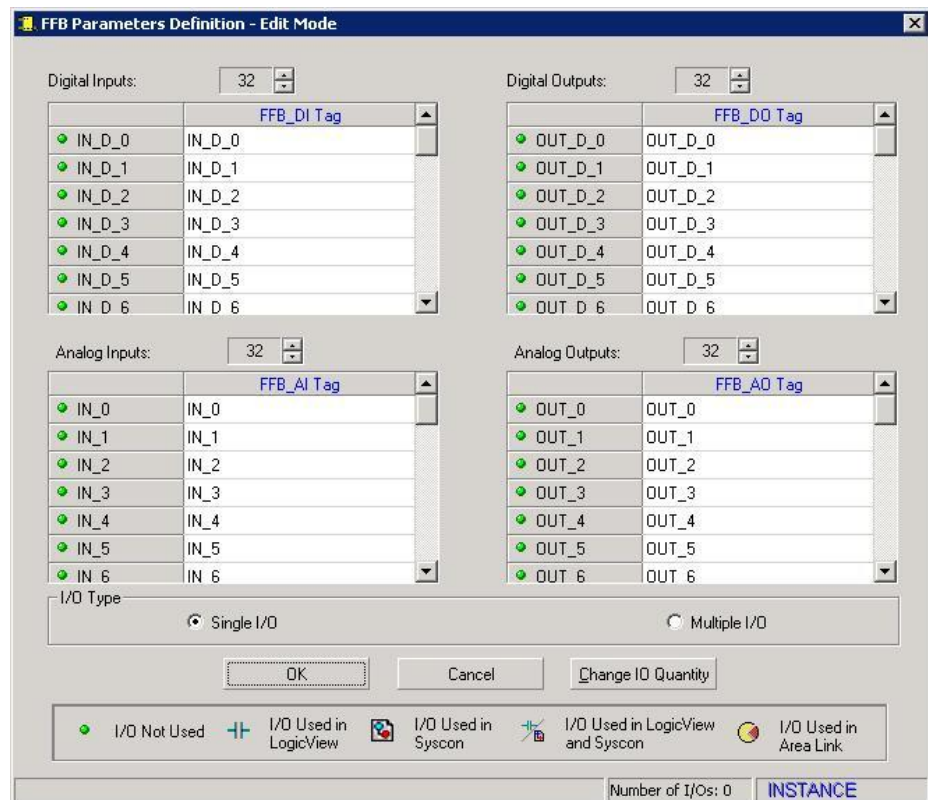


Figure 20. 32 – Defining FFB parameters (2)

If necessary define the inputs and outputs of FFB. Otherwise just click **OK**.



Return to **Syscon**, save the configuration, and do an **Export tags**.

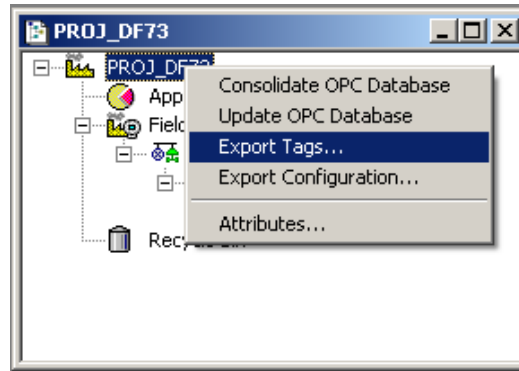


Figure 20. 33 – Export tags

After finish this operation, right-click the FFB block, and then select **Edit Logic**. The **LogicView for FFB** will launch, and the ladder logic can be edited.

For the first time the logic is edited the **Refresh Data** command has to be executed thus the IO points configured in **Mapping Tool** will be updated in the ladder. Right-click **Network I/O** in the **Hierarchy** window of the **LogicView for FFB**. See the next figure.

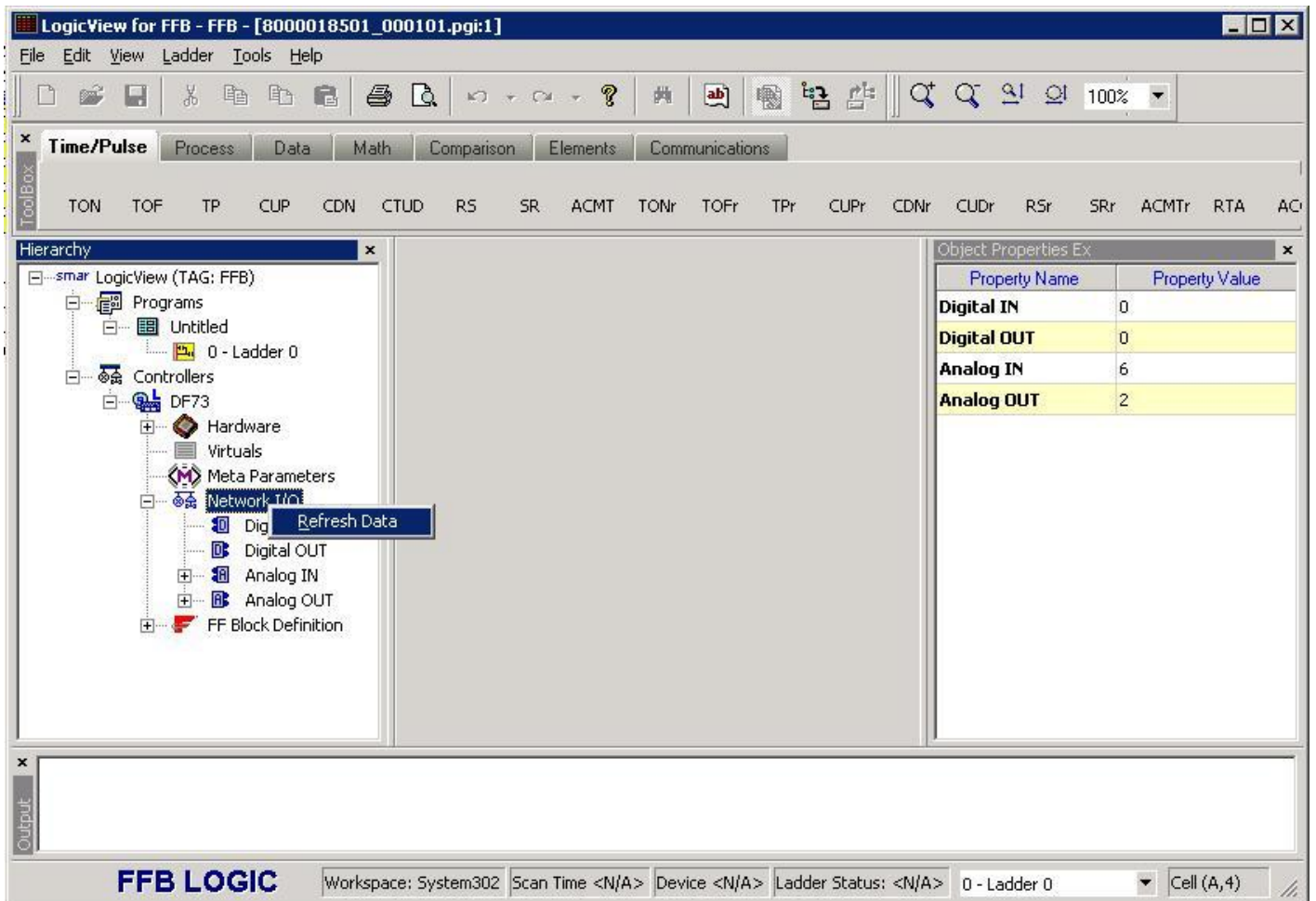


Figure 20. 34 – Refresh data

The NetIO points can be seen in the **Hierarchy** window. See the next figure.

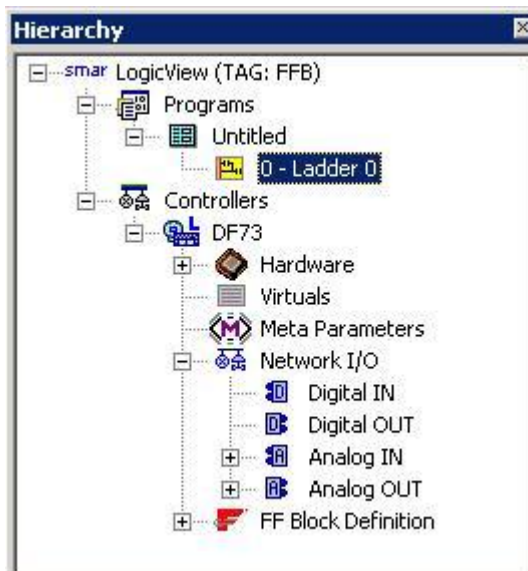



Figure 20. 35 – Network I/O at LogicView for FFB

After that procedure the IO point of the Profibus network are already available to be used in the logic. The user has a complete function library which can be used in the logic. For further details see the **LogicView for FFB** manual.

See in the following figure the EPID usage in the **LogicView for FFB** to implement the liquid pump control. All Profibus IO points appear with the symbol  in the ladder logic.

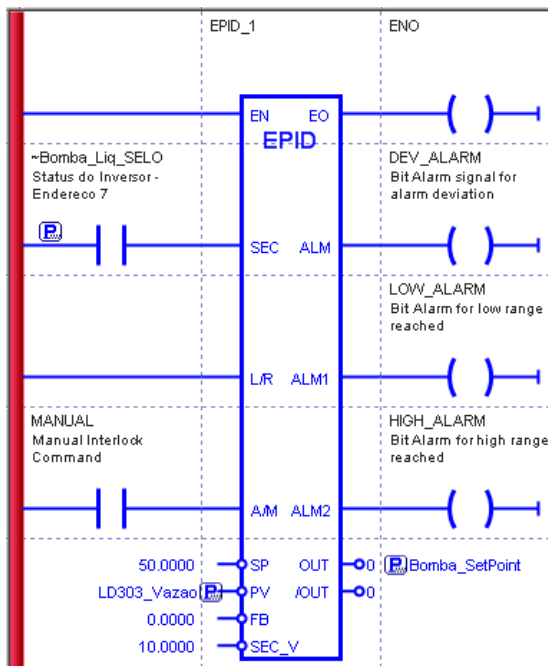



Figure 20. 36 – Editing logic

After ladder configuration the user can download the configuration to the device. Another option is to configure the function blocks at **Syscon**. If you also want to work with function blocks is necessary to follow the steps 9 to 12 to edit them. In this topic only the ladder was used to configure the ladder. Before downloading the configuration you have to save it in the **LogicView for FFB**. Exit from it, and return to **Syscon**.

To start a communication with the devices, first, is necessary to commission the controller. In this way the tags, IDs and addresses of each device will be assigned correctly. If this procedure was not done, the **Syscon** will detect the uncommissioned device and its download will be canceled. When the devices commissioning finishes the download process can start. The download process can be done, for example, returning to **Proj\_DF73** window, right-clicking **Fieldbus Networks** icon, , and then, select **Download** option. For further details about commissioning and possible download types refer to **Syscon** manual.

## Mapping Profibus IO Points to be Used in Function Blocks

In the same way of the configuration done through ladder, the configuration can be done with function blocks. In this topic the same Profibus IO points of the step 8 will be mapped, but now the function blocks will be used. As above mentioned, for the network creation and devices insertion the steps are common up to step 7.

### Step 8'

In the **Mapping Tool** window, to map the IO points in blocks, is necessary to configure the **Block Type** field as you can see in the following figure. When **None** is chosen, as in the step 8, the mapping will be done in ladder.

To map the **Bomba\_SetPoint** output, for example, choose the **Unsigned 15** data type. And then, in **Block type** choose **Multiple Digital Output**. Give a tag to the block in **Block Tag**.

**NOTE**

Every point of Profibus network is already configured automatically to work with ladder. To map in function blocks the user has to choose this option configuring the **Block Type** field of the **Map Wizard** window of **Mapping Tool** with the respective IO block.

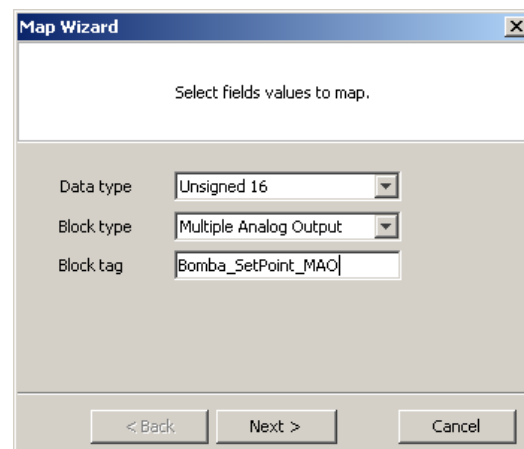


Figure 20. 37 – Configuring the data type

Click **Next**, and a window for bits configuration will open, select bit 1. Click **Finish**, and the configured point will appear in the **Mapping Tool** window.

**NOTE**

The **Mapping Tool** (MT) always tries to minimize the number of created blocks in the configuration. So, for a same slave device, if was not chosen any block tag the MT will allocate the point in an already existent block (the allocation availability will be verified, that is, the block has to be the same type and the block has to have empty points).

If the user informs an existent block tag, the MT will use this block to allocate the point. If the user informs a block tag that does not exist, the MT will create a new block.

Right-clicking this point and choosing **Delete** it can be deleted, or some attributes can be defined for better identification through the **Attributes** option.

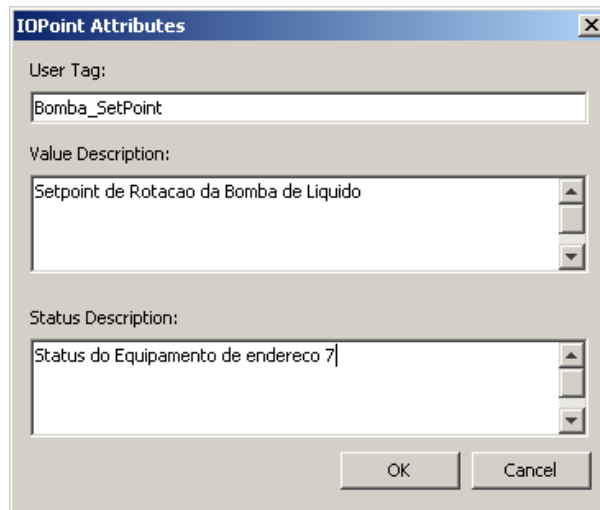


Figure 20. 38 – Changing the point attributes

Fill the necessary fields, and click **OK**.

After mapping and configuring all points, the **Mapping Tool** will be as in the following figure.

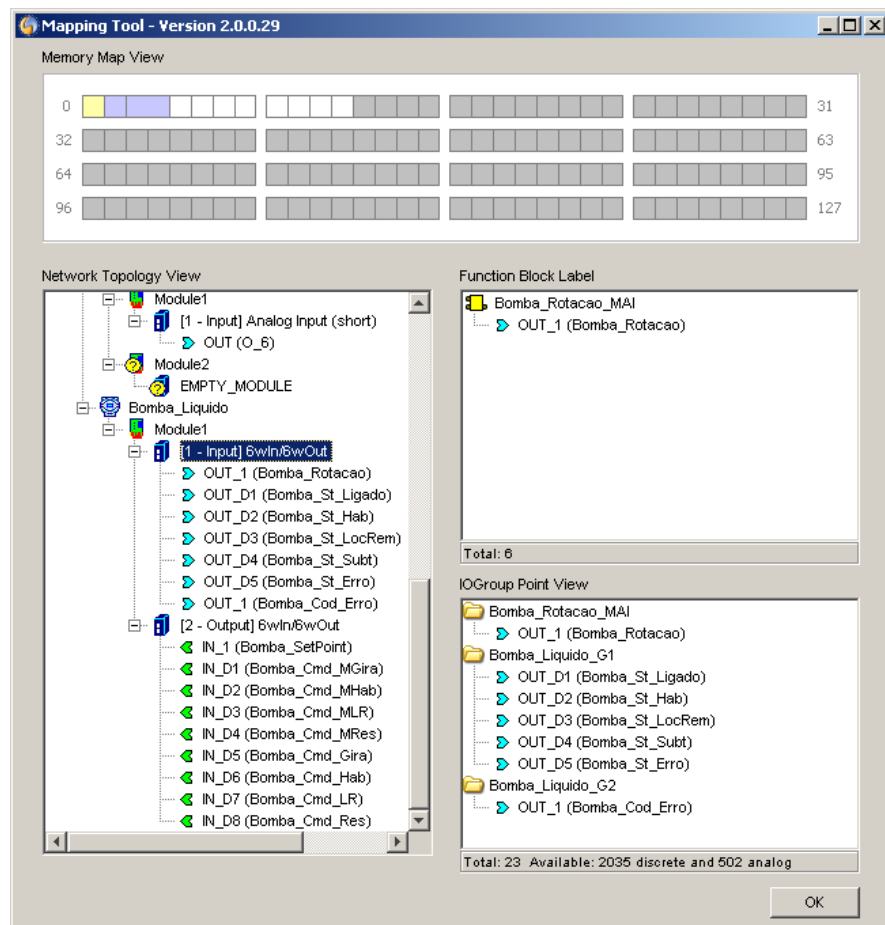


Figure 20. 39 – Mapped points in the Mapping tool

Click **Ok** to exit from **Mapping Tool**. Return to **Syscon**. The mapped blocks are already inserted in the area.

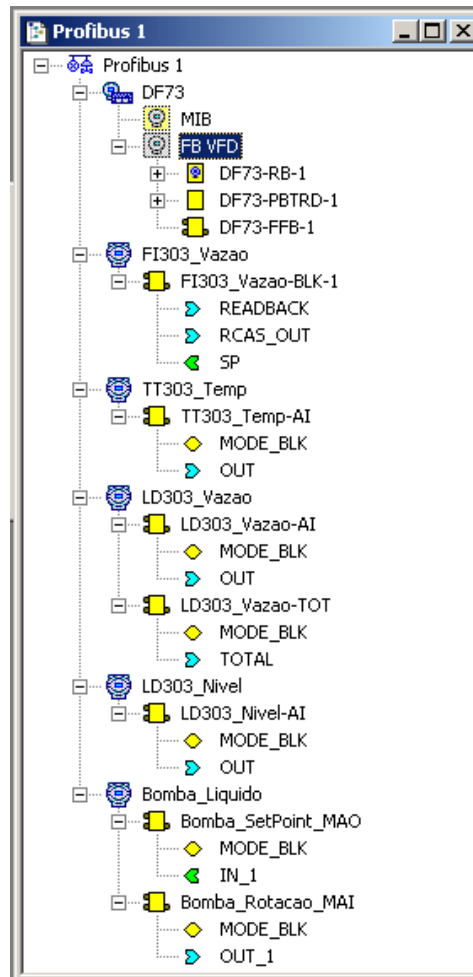


Figure 20. 40 – Mapped function blocks in the Syscon

The device's attributes can be verified right-clicking it. The following window will appear, and the information cannot be modified.

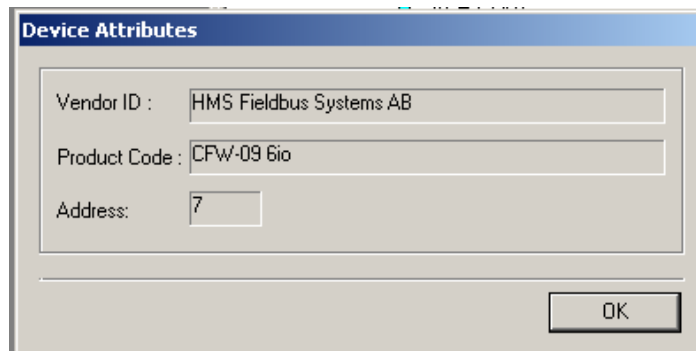


Figure 20. 41 – Verifying the device's attributes

The block's attributes can be verified right-clicking it. The following window will appear, and the information cannot be modified.

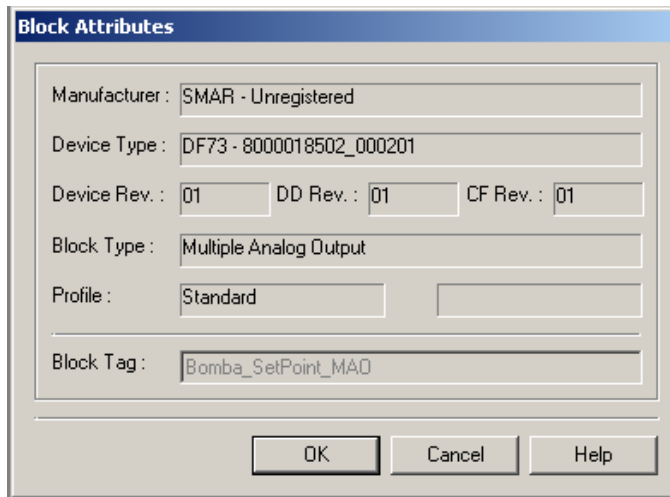


Figure 20. 42 – Verifying the block’s attributes

## Adding Other Function Blocks

### Step 9

Now the user can add Function Blocks that will be used in the strategy.

To insert a new FB (Function Block), click the sign , right-click the **FB VFD** (Virtual Field Device) icon and choose **New Block**. The FB VFD is responsible for the data management.

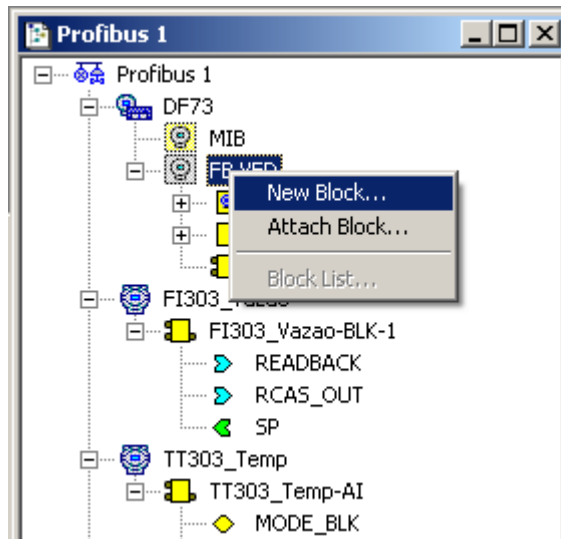


Figure 20. 43 – Inserting new function blocks

The **Function Block Characterization** dialog box will appear. The **Block Type** option has the available function blocks.

Select the block in the **Block Type** field and type its tag in the **Block Tag** field:

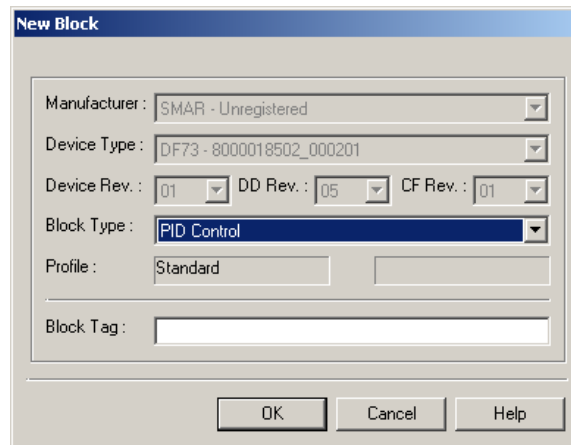


Figure 20. 44 – Selecting the function blocks that will be added to the devices

For this example, the PID block should be added to the DF73. The Profibus network can be seen in the next figure.

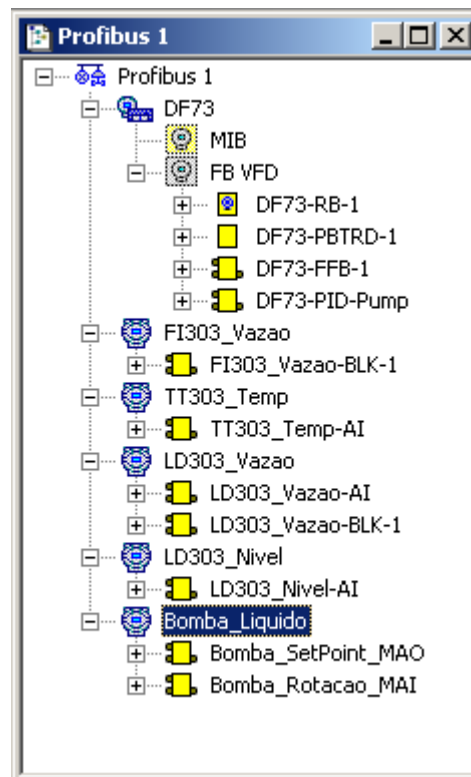


Figure 20. 45 – Profibus network with devices and function blocks inserted

## Creating New Process Cells

### Step 10

The user can create the strategy for the **Application (Logical Plant)**. First, it is necessary to create a new process cell.

The **Logical Plant** can be divided in several areas according to the area.

To create a new process cell, right-click the **Application** icon and choose **New Process Cell** item.



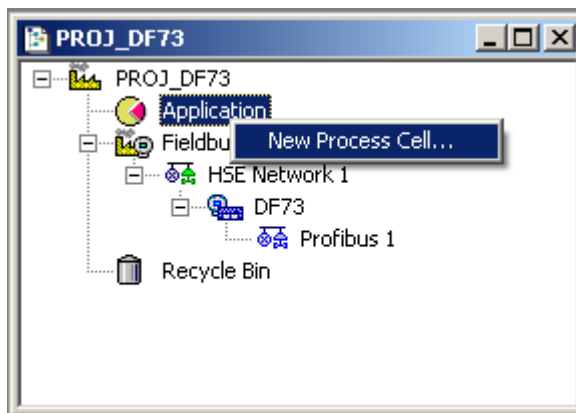


Figure 20. 46 – Inserting the Process Cell

The dialog box to name the **Process Cell** will open:

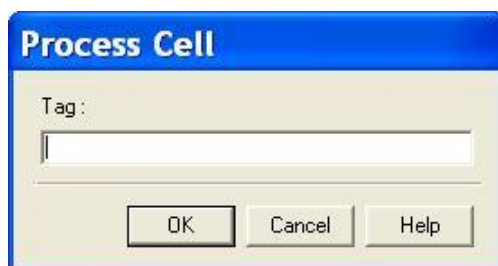


Figure 20. 47 – Naming the Process Cell

If the user needs to give a name for the Process Cell, enter the name in the tag box, and click **OK**. The default tag is **Process Cell 1**. This number will increase when new process cells are created. To create others, the user has to repeat the procedure.

After inserting a Process Cell, the **Proj\_DF73** window will be according to the following figure.

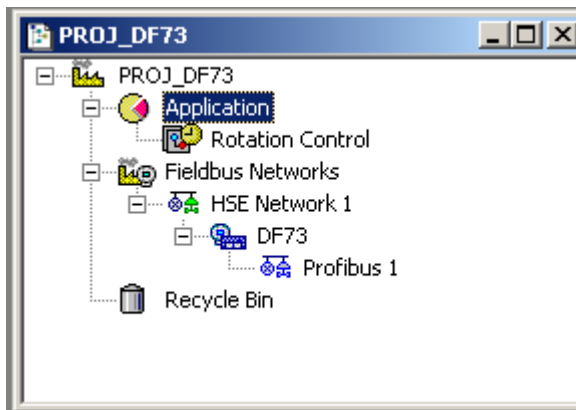


Figure 20. 48 – Area window with the Process Cell added

**NOTE**

The user must remember the **Application** is just a virtual division, and its purpose is to divide a large project.  
 For example: if the plant has 2 networks, they can be called **Process Cells** in the Syscon. One **Application** can have several **Process Cells**, but the **Process Cells** can not be in more than one **Application**.

## Creating a Control Module

### Step 11

Right-click the **Process Cell 1** icon, and choose **Expand** item.

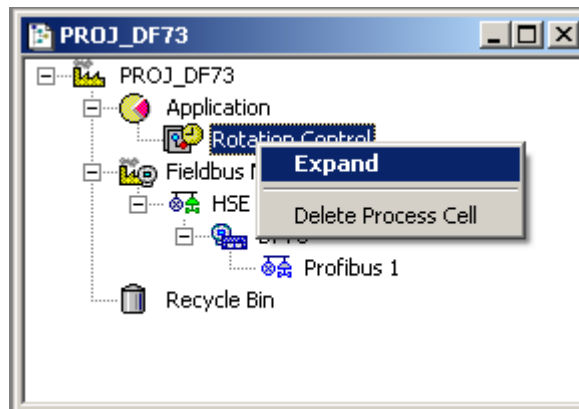


Figure 20. 49 –Creating a control module

To arrange the screen, click the **Process Cell 1** window. So, choose **Window** menu on the **Syscon** toolbar, and then **Tile** option.

As following, return to the **Process Cell 1** window. Right-click the **Process Cell 1** item, and choose **New Control Module**. The next figure shows creating the New Control Module.

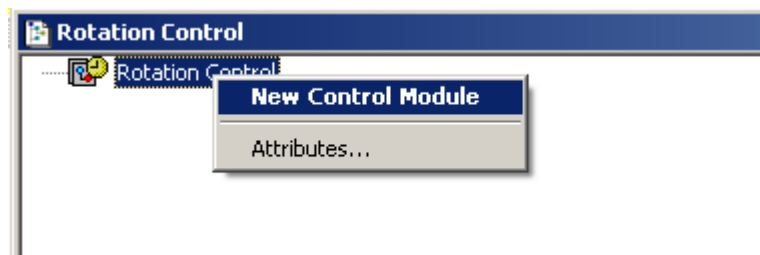


Figure 20. 50 – Creating a New Control Module

The **New Control Module** dialog box will appear. Name it with the tag related to the application. To conclude this task click **OK**.

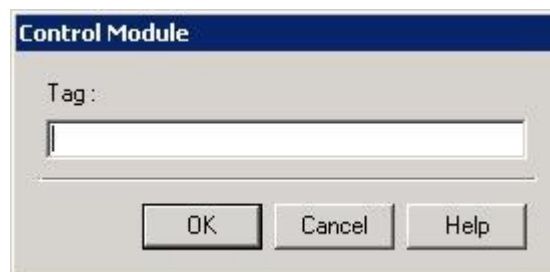


Figure 20. 51 – Naming the Control Module

### IMPORTANT

Remember that not all characters are valid when naming the elements with tags.

## Inserting Blocks to the Control Module

### Step 12

The user can insert (attaching) the blocks for the corresponding devices in the **Logical Plant**. Right-click the **Control Module 1** icon, and then select **Attach Block** option, as shown in the following figure.

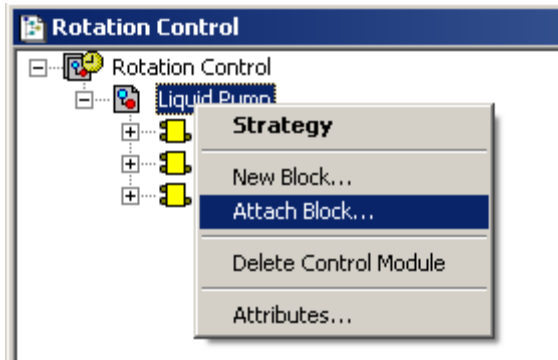


Figure 20. 52 – Attaching blocks to the Control Module

The **Attach Block** dialog box will open as shown in the following figure.

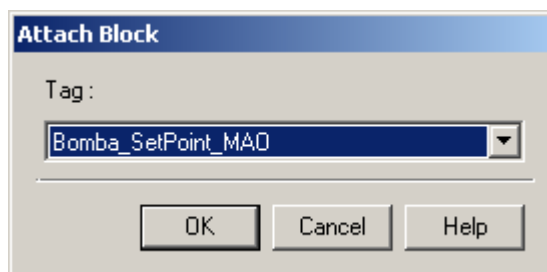


Figure 20. 53 – Inserting blocks to the Control Module

The available function blocks for the application are in the **Attach Block** box. For the aimed control, the function blocks that must be inserted will appear in this box. So, select them, one by one, and click **OK**.

For the example of valve opening control, at the end of Attach Block process, the **Control Module** will be as in the next figure.

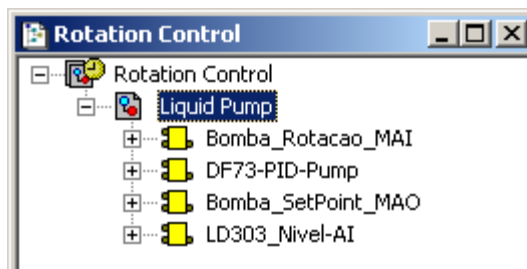


Figure 20. 54 – Blocks inserted in the Control Module

Another way to attach the blocks is left-clicking the element and dropping it to the window.

## Configuring the Control Strategy

### Step 13

Now the user is ready to develop the control strategy.

First, right-click the **Control Module 1** icon, and then select **Strategy** item. The **Strategy** window will appear as shown in the following figure.

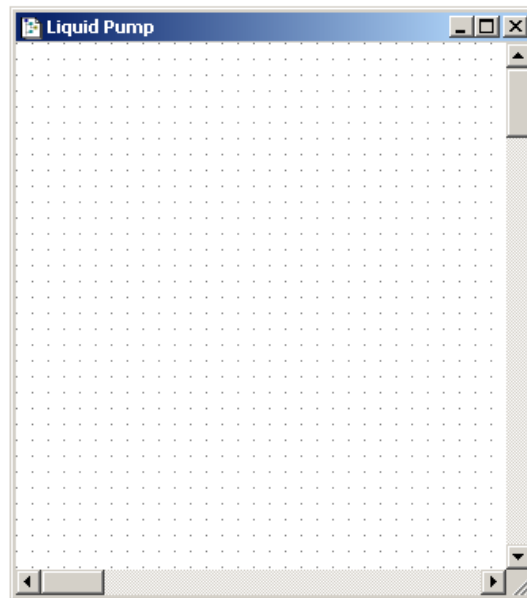


Figure 20. 55 – Strategy window

The Control Module attributes can be changed by right-clicking the **Control Module 1** icon, and then select **Attributes** option. Do the necessary changes, and click **OK**. For further information about Control Module refer to the **Syscon** manual.

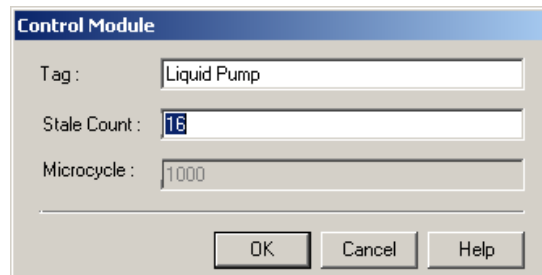


Figure 20. 56 – Changing the control module attributes

At this moment there are 3 or 4 windows opened in the **Syscon**. To arrange the screen, click the title of the **Proj\_DF73** window. On the toolbar, choose **Window → Tile**.


If the user does not have a monitor upper than 17", it is recommended to minimize the strategy window. Thus, it is possible to see the whole area.

The strategy window offers several tools for drawing. Refer to the **Syscon** manual for further details.

## Adding Blocks in the Strategy Window

### Step 14

Now the function blocks can be added to the **Liquid Pump** window.

In order, click the first block,  Bomba\_Rotacao\_MAI, and drop it into the strategy window. A function block will be created automatically.

The next figure shows the function block added to the strategy window:

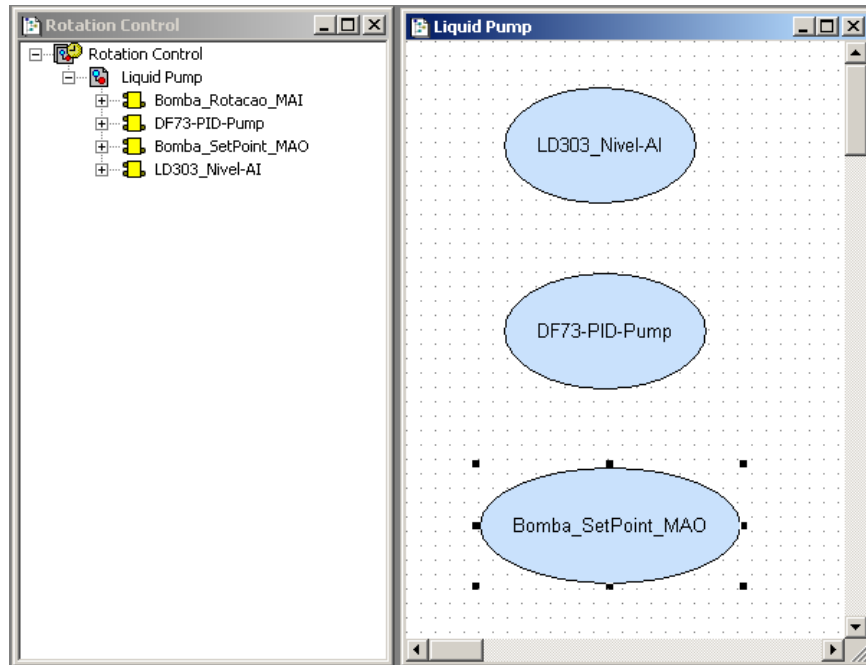



Figure 20.57 – Block inserted in the strategy window

The drag-and-drop procedure must be repeated for the other blocks.

## Linking the Blocks

### Step 15

There is a specific tool to link the blocks, the **Link** button, , on the **Strategy** toolbar. For the aimed control link the **OUT** output of the LD303\_NIVEL-AI (where the level measurement was mapped) to the **IN** input of the PID block.

Click this button on the toolbar, and then in the LD303\_NIVEL-AI function block. The dialog box for linking the input and output parameters will appear. Select **OUT** block output, and then click **OK** as shown in the following figure.

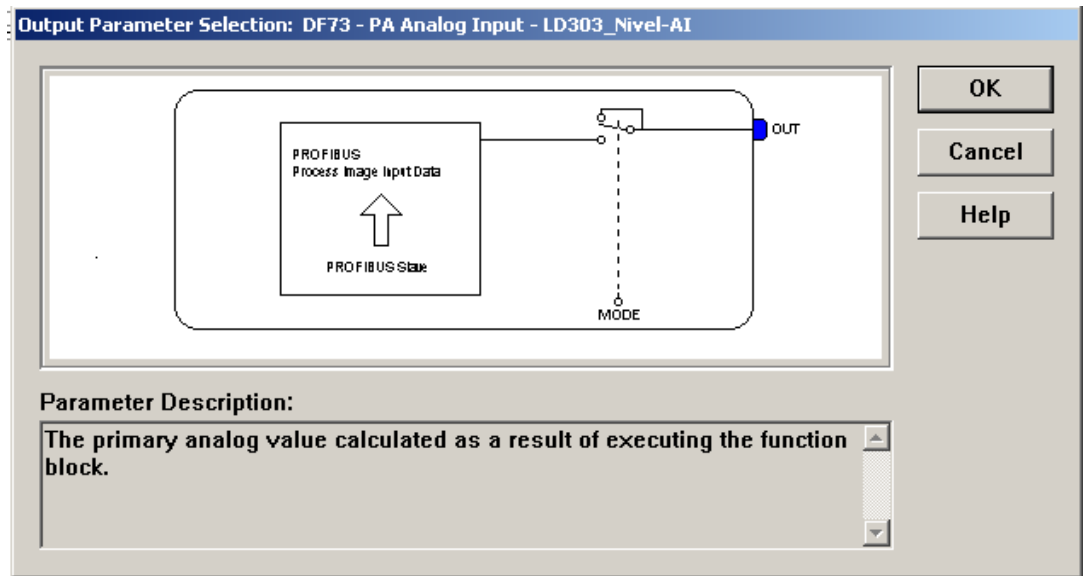


Figure 20. 58 – Linking the function blocks

The user also does the fast link procedure just right-clicking the function block, and does the necessary links.

After linking the specified parameters above, the strategy window will be as shown in the following figure.

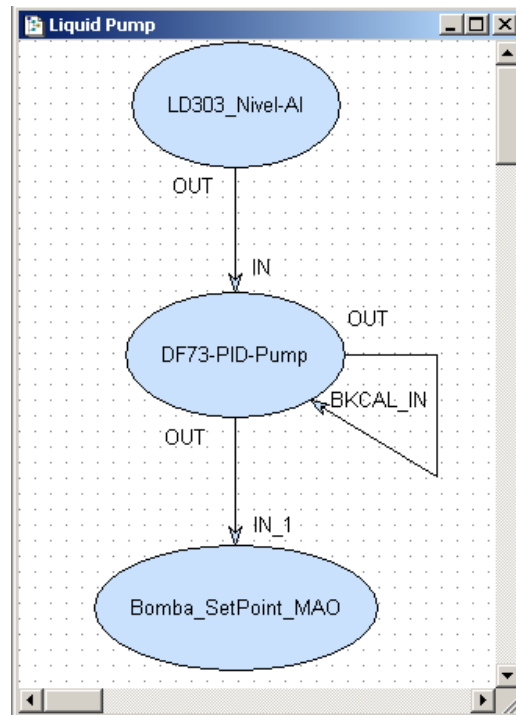


Figure 20. 59 – Linking the Blocks

## Block Characterization

### Step 16

The function blocks that are in the area must be set according to the application for them. So, it is necessary to do the block characterization.

The online and offline modes are possible for the block characterization. In the offline mode, the parameters are set before starting the communication among the devices. The online characterization is executed directly in the devices when the plant is already communicating, and the download to the devices was done.

To change the function block parameters, consider the following topics:

### 1. In the Strategy window

Select the block to characterize. Right-click it and select **Off Line Characterization**, or double-click it. The next figure shows the block offline characterization.

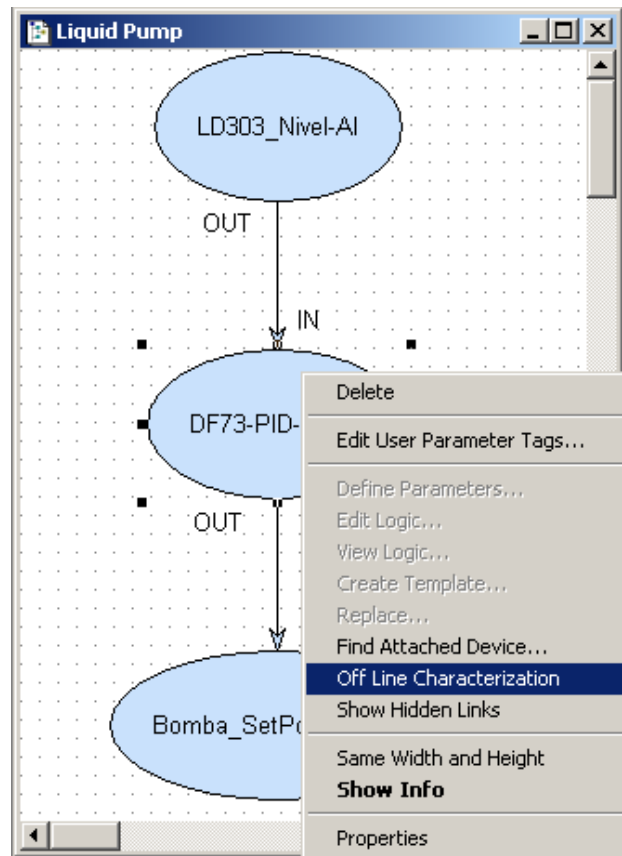


Figure 20. 60 - Offline characterization in the Strategy window

### 2. In the Profibus1 window

Another way to do the offline characterization is right-clicking the function block, and then selecting the **Off Line Characterization** option, as shown in the following figure.

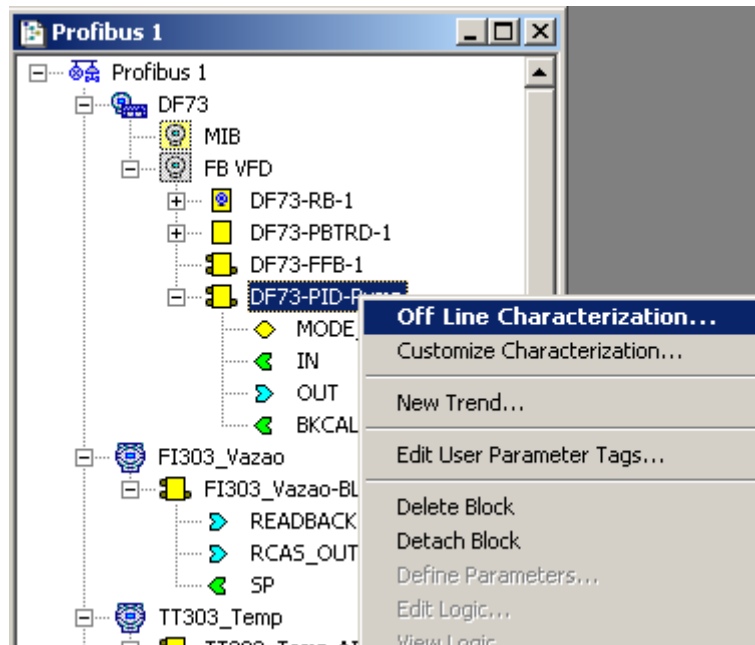


Figure 20. 61 - Offline characterization in the Profibus1 window

For both situations, the **Block Characterization** dialog box will appear:

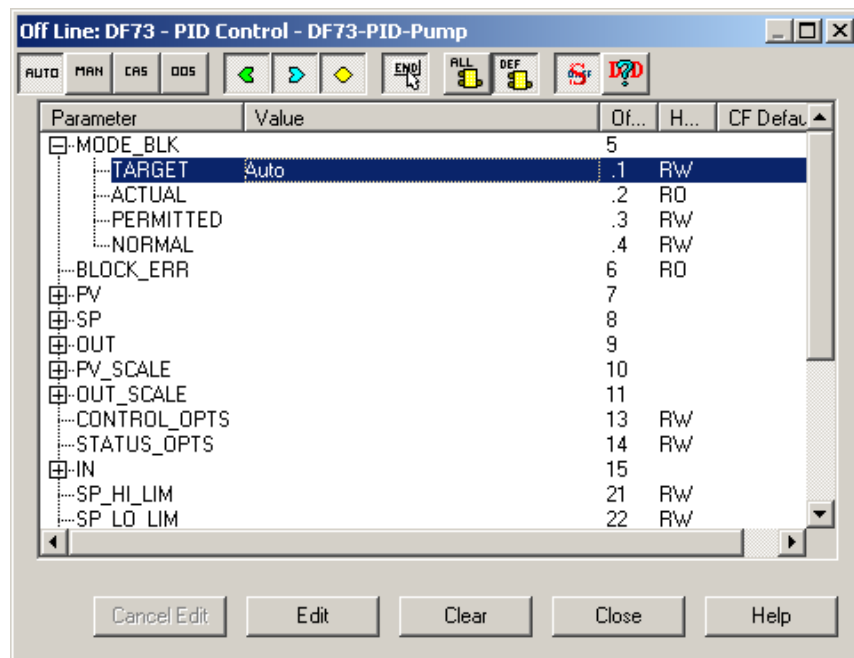


Figure 20. 62 - Function block characterization dialog box

Double-click at the right side of the parameter to change it. Another option is click once and then click **Edit** to start editing the parameter value. At the ending, click **End Edit**.



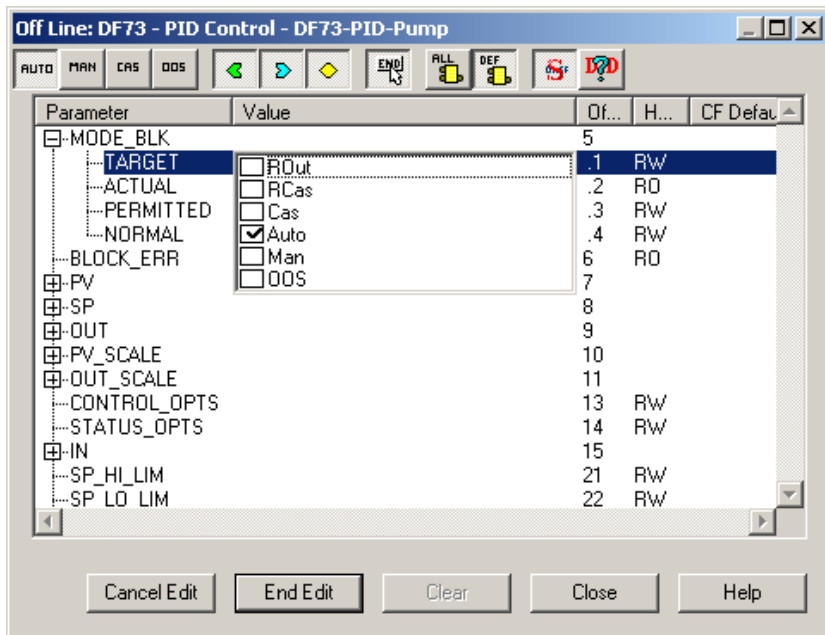


Figure 20. 63 - Editing the parameter in the Function Block Characterization box

An important parameter which has to be configured in all function blocks is **MODE\_BLK**. It determines the block operation – Out of Service (OOS), Manual (MAN) or Automatic (AUTO). All blocks for the aimed control have to be with **MODE\_BLK.TARGET** parameter in Auto.

Each block has a specific configuration parameter. For further information refer to Function Blocks manual.

**NOTE**

For the IO Profibus blocks is not necessary to configure the **CHANNEL** parameter. This parameter only will be used when IO blocks are used to map local IO points (IMB).

The flow control for heating the product can be done as follows:

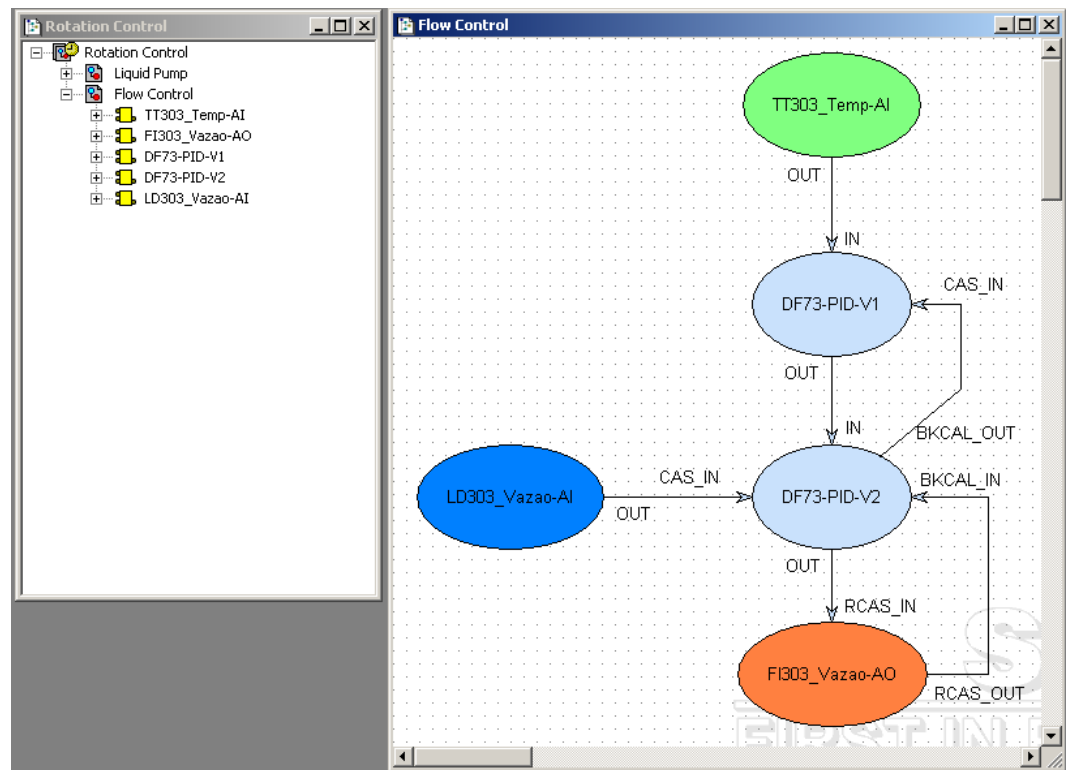


Figure 20. 64 - Function blocks links

## Commissioning and configuration download to the controller


After the parameters setting, the user can start the device communication. It is necessary commissioning the devices to attribute the tags, IDs and device addresses properly. If this procedure is not executed, the **Syscon** will detect the uncommissioned device and the download for this device will be canceled. Finishing the device commissioning, the download process can start.

The download process (**Syscon**) can be done in two main ways:

- Download of the plant – in this case will be downloaded all configurations of all controllers.
- Individual download in the controller – in this case will be downloaded all configurations of a single controller.

The controller configuration can be performed in several ways depending of the alteration. But the download performed by **Syscon** is the most recommended, because it controls the changes of all tools.

**Syscon** has two download types: total and incremental. The main difference is that the “total” cleans initially the configuration before downloading the new one while the “incremental” only downloads that has changed.

The download process can be executed, for example, returning to the **Proj\_DF73** window, right-clicking the **Fieldbus Networks** icon, , and then selecting the **Download** option

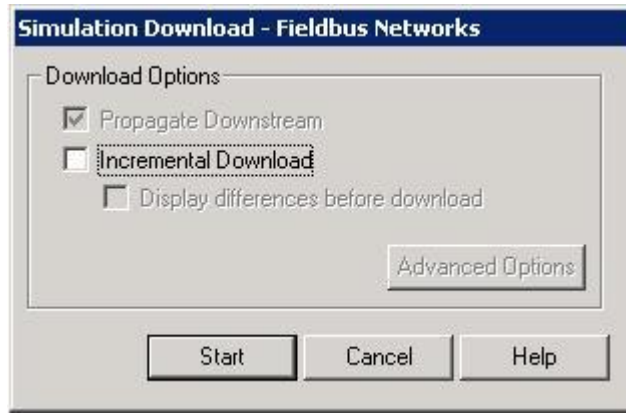


Figure 20. 65 - Download options

Selecting the incremental download, and then **Advanced Options** the user can select several items to be downloaded. See the figure below.

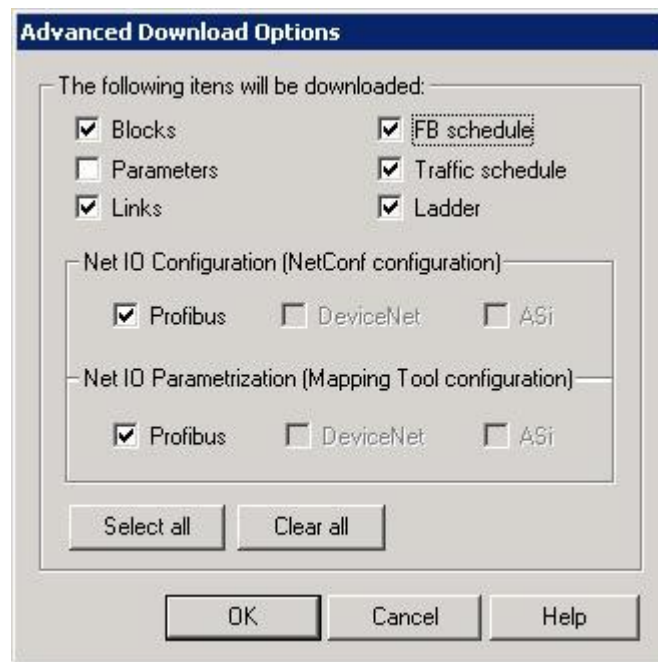


Figure 20. 66 - Advanced download options

The **NetIO Configuration** option refers to the network topology configuration edited by the **Network Configurator**, and if it is selected the incremental download will be done. This operation must be done carefully because it stops the Profibus network.

The **NetIO Parameterization** option refers to the points parameterization configuration of network devices (points' tags, scales, data types) and when it is selected the incremental download will be done.

The next topic is maintenance guide which informs the recommended download type depending on the operation performed.

For further details about the available download types and commissioning, refer to the **Syscon** manual.

## SYSTEM302 maintenance procedure

In this section is presented a summary of download procedures that are recommended in cases of configuration maintenance using **SYSTEM302**.

**SYSTEM302** has several download types and here is recommended a general type to meet the majority of cases. However other ways can be used. For further information refer to the **Syscon** manual.

In the **Recommended Download** column is the type of chosen download. At **Syscon** it can be incremental on the plant or in the controller. Refer to the **Syscon** manual for further information.

| MAINTENANCE EVENT  | SOFTWARE  | RECOMMENDED DOWNLOAD   |
|--|---|--|
| Do a new SYSTEM302 configuration using Profibus controller and ladder logic.   | Syscon, Network Configurator, Mapping Tool, LogicView for FFB | In Syscon do the plant incremental download*                 |
| Changing only the ladder logic.  | LogicView for FFB   | In LogicView for FFB do the download of the logic.           |
| Add FFB parameters and make HSE links or only add parameters to the FFB block that already has HSE link.                 | Syscon  | In Syscon do the plant incremental download*                 |
| Add or remove a FFB link to internal blocks within the same controller.  | Syscon  | In Syscon do the controller incremental download*            |
| Add a new device in the network or change its configuration (address, cyclic mapping, tag)                               | Network Configurator  | In Syscon do the controller incremental download*            |
| Change device configuration (address, cyclic mapping, tag)   | Network Configurator  | In Syscon do the controller incremental download*            |
| Change the interface parameters of the field device (scale, little/big endian, accessed bytes)                           | Mapping Tool  | In Syscon do the controller incremental download*            |
| Change media parameters (baud rate, communication configuration).  | Network Configurator  | In Network Configurator do the download of Profibus network* |
| Change configuration parameters of the field device hardware (acyclic configuration) or enable/disable the slave device. | Network Configurator  | In Network Configurator do the download of Profibus network* |

**Table 01 – Recommended download procedures**

Note: \* These operations will stop the Profibus channel.

## Profibus Network Time Parameters

The **Network Configurator** already has all time parameters of the Profibus network in TBit form, avoiding modifications when the baud rate value is changed. It is important to remember that the baud rate value is related to the slave which supports lower baud rate and the maximum distance of the Profibus DP network.

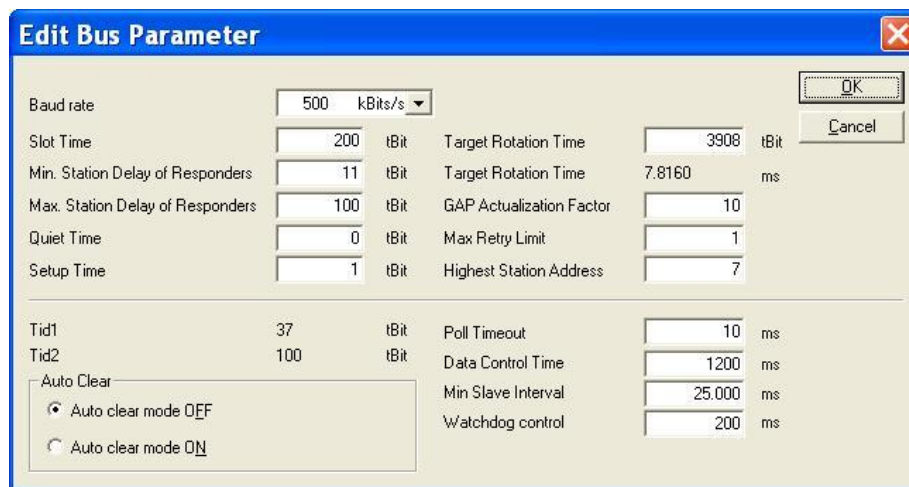


Figure 20. 67 - Editing the bus parameters

Each time parameter will be described separately:

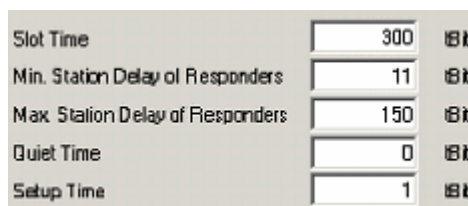


Figure 20. 68 - Time parameters

- **Slot Time (T<sub>SL</sub>)** – It is the maximum time that the master waits for a slave answer after it has done a request to the slave. If the master does not receive an answer after this time it will retry. This time is exactly the period between the last sent bit and the first bit received. It is also used in the token pass.
- **Min. Station Delay of Responders (min\_T<sub>SDR</sub>)** – It is the smaller time period between the last bit reception and the first bit sent of a station. There is a default period in the Profibus standard.
- **Max. Station Delay of Responders (max\_T<sub>SDR</sub>)** – It is the greater time period between the last bit reception and the first bit sent of a station. It is informed in the GSD file of each device.
- **Quiet Time (TQ)** – If a repeater is used or the media changes inducing a delay in the line, a time period is applied because the line has to be in silence. A consistent value needs to be **TQ < min\_T<sub>SDR</sub>**.

- **Setup Time (TSET)** – It is the minimum reaction time period between the answer reception and the sending of new request by the master. It is informed in the GSD file of each device.

|                          |                                     |      |
|--------------------------|-------------------------------------|------|
| Target Rotation Time     | <input type="text" value="4046"/>   | tBit |
| Target Rotation Time     | <input type="text" value="2.6973"/> | ms   |
| GAP Actualization Factor | <input type="text" value="10"/>     |      |
| Max Retry Limit          | <input type="text" value="1"/>      |      |
| Highest Station Address  | <input type="text" value="25"/>     |      |

Figure 20. 69 - Time parameters

- **Target Rotation Time (T<sub>TR</sub>)** – It is the designed time for a token cycle (between 2 token receptions) including high and low priority operations (cyclic and acyclic), errors and GAPL maintenance. The details will be shown later.
- **GAP Actualization Factor (GAP)** – It is used to define the **TGUD** (GAP Update Time). **TGUD = G.TTR** , **0 < G < 100**. The GAP is the addresses list's name between a detected station and other. At each GAP Update Time, the master verifies the status of a device from the GAP List (**GAPL**). This procedure is part of the network maintenance.
- **Max. Retry Limit (Retry)** – It is the maximum number of retries which has to be performed for data reading from a station.
- **Highest Station Address (HSA)** – It is the highest station address which was configured. Address within the HSA and 127 are not verified and they are eliminated from the GAP List.

|                    |                                    |    |
|--------------------|------------------------------------|----|
| Poll Timeout       | <input type="text" value="10"/>    | ms |
| Data Control Time  | <input type="text" value="1200"/>  | ms |
| Min Slave Interval | <input type="text" value="0.600"/> | ms |
| Watchdog control   | <input type="text" value="200"/>   | ms |

Figure 20. 70 - Time parameters

- **Poll Timeout** – It is important to master to master connection. This is the maximum time that a master has to answer a request from another master.
- **Data Control Time** – At each interval defined by Data Control Time, the master has to inform the slaves about its operation state. As a rule, the **Data Control Time** has to be greater or equals to **6.Tw**. The master can assume 4 states (OFFLINE, STOP, CLEAR, OPERATE).
- **Min Slave Interval** – The master has to assure that the time between two consecutive readings, in the same slave in two cycles, is not lesser than the slave can support. This parameter is specified in the slave's GSD file.
- **Watchdog control (T<sub>WD</sub>)** – In case of master failure, it is the time the slave waits before setting its outputs in **fail-safe**. As a rule **Twd > TTR**.

|  |                                  |      |
|--|----------------------------------|------|
| Tid1   | <input type="text" value="37"/>  | tBit |
| Tid2   | <input type="text" value="150"/> | tBit |
| Auto Clear   |                                  |      |
| <input checked="" type="radio"/> Auto clear mode OFF |                                  |      |
| <input type="radio"/> Auto clear mode ON             |                                  |      |

Figure 20. 71 - Time parameters

Depend on the message type we have:

- **Idle Time (TID)** is formed by 2 elements TID1 and TID2.
- **TID1** – Maximum time calculated after the master/ slave has received a confirmation, answer or token (only master), and before sending the next request/pass token.
- As some frames do not have confirmation (SDN – Send Data with no Acknowledge) – a broadcast for example, TID2 is calculated in a different way.
- **TID2** – Maximum time calculated after the master/ slave has sent a message which does not have confirmation, and the next request/pass token.
- **TID1** = max { **TQ** + 2.**TSET** + 2.Tbit + **TSYN**, **min\_TSDR** }.
- **TID2** = max { **TQ** + 2.**TSET** + 2.Tbit + **TSYN**, **max\_TSDR** }.
- **Safety margin: TSM** = 2 Tbit + 2.**TSET** + **TQ**
- **TSYN – Sync Time** – Minimum time interval that a station has to maintain in the idle state (idle = 1) in the media before starting a new request.
- **TSYN** is defined as 33 TBit. (**TSYN=33TBit**)
- **Auto Clear** – If a request is not answered by a device within the allowed retries number and the **Auto Clear** option is active, the master removes the device from the **data\_exchange** condition and clears its outputs (scan memory).

### Default Values of the Profibus Standard

| Baud rate in kbit/s      | 187.5 | 500 | 1500 | 3000            | 6000            | 12000           |
|--------------------------|-------|-----|------|-----------------|-----------------|-----------------|
| Cable Distance (m)       | 1000  | 400 | 200  | 100             | 100             | 100             |
| <b>Default-DP-Master</b> |       |     |      |                 |                 |                 |
| TSL (tBit)               | 100   | 200 | 300  | <del>1500</del> | <del>2000</del> | <del>2000</del> |
| Min TSDR (tBit)          | 11    | 11  | 11   | <del>11</del>   | <del>11</del>   | <del>11</del>   |
| Max TSDR (tBit)          | 60    | 100 | 150  | <del>45</del>   | <del>55</del>   | <del>75</del>   |
| TSET (tBit)              | 1     | 1   | 1    | <del>4</del>    | <del>8</del>    | <del>16</del>   |
| TQUI (tBit)              | 0     | 0   | 0    | <del>3</del>    | <del>6</del>    | <del>9</del>    |
| G                        | 10    | 10  | 10   | <del>10</del>   | <del>10</del>   | <del>10</del>   |
| HAS                      | 126   | 126 | 126  | <del>126</del>  | <del>126</del>  | <del>126</del>  |
| Max_retry_limit          | 1     | 1   | 1    | <del>2</del>    | <del>3</del>    | <del>4</del>    |

The strikethrough values, for example ~~2000~~, are recommendations from the manufacturers; they are not from the Profibus DP specification.

## Recommended Values

The values below attend the conditions for network good working for a great quantity of configurations:

|                            |            |
|----------------------------|------------|
| <b>Baud rate in kbit/s</b> | <b>500</b> |
| <b>Cable Distance (m)</b>  | <b>400</b> |
| <b>Default-DP-Master</b>   |            |
| TSL (tBit)                 | 200        |
| Min TSDR (tBit)            | 11         |
| Max TSDR (tBit)            | 100        |
| TSET (tBit)                | 1          |
| TQUI (tBit)                | 0          |
| GAP                        | 10         |
| HAS (High Station Address) | 126        |
| Max_retry_limit            | 4          |
| Twd (ms)                   | 5000       |
| TTR                        | 50000      |

These values are default to the Profibus configurations in the **SYSTEM302**.

The *Watchdog Time (Twd)* can be decreased, in case only Profibus DP devices are used, it is recommended  $\text{Min}(2,5 \times \text{TTR}, 1000\text{ms})$ .

If the configuration is being performed for the DF95 and DF97 to 12Mbps using the value of the **Slot Time (TSL)** should not be less than 6000 tbit.

## Required values when using third party devices

When there is a DP/PA coupler in the Profibus network, many times, the network parameters are conditioned to values specified on their manuals. In the next table are the more common devices which require special configurations.

| Parameter            | Reference from Manual or Standard | Siemens SIMATIC DP/PA Coupler | DP/PA Coupler Pepper+Fuchs Model: KFD2-BR-1.PA.93 |
|----------------------|-----------------------------------|-------------------------------|---|
| Baud Rate            | BaudRate                          | 45,45Kbps                     | 93,75Kbps   |
| Slot Time            | TSL                               | 640                           | 4095  |
| Min TSDR             | MinTSDR                           | 12                            | 22  |
| Max TSDR             | MaxTSDR                           | 400                           | 1000  |
| Setup Time           | TSET                              | 95                            | 150   |
| Quiet Time           | TQUI                              | 0                             | 0   |
| GAP Factor           | GAP                               | 10                            | 10  |
| High Station Address | HSA                               | 126                           | 126   |
| Max retry Limit      | Max Retry                         | 3                             | 3   |
| Watchdog Time        | TWD                               | 5000                          | 5000  |
| Target Rotation Time | TTR                               | 50000                         | 50000   |



## Network Diagnostics

There are many ways to identify communication failures in the Profibus network. Some options are: **Network Configurator**, Transducer block, **Syscon’s** Live List or module’s LEDs. Some ways will be explained on this topic.

### Network diagnostic using the Network Configurator

To do a network diagnostic through **Network Configurator** first is necessary to connect the **Network Configurator** to the controller. This can be done through serial communication (linking a serial cable of the computer to the controller RS-232 port) or through the Ethernet network as shown in the following figure.

First inform the master which will be used. Select the master device of the configuration, and then in the toolbar select **Settings**→**Device Assignment**. On the popup choose **CIF TCP/IP Driver** option, and click **OK**. A window will open to insert the master IP address.

**Device Assignment ODM TCP/IP Driver**

Driver Description  
Driver: ODMTcplp V2.032

Add IP Address  
IP Address: 10 . 0 . 0 . 14 Add

Board Selection

|                                     | IP Address | Type | Serial Number | MAC Address       | Address Switch |
|-------------------------------------|------------|------|---------------|-------------------|----------------|
| <input checked="" type="checkbox"/> | 10.0.0.14  | SMAR | 0             | 00-30-5C-08-00-0E | 0              |
| <input type="checkbox"/>            |            |      |               |                   |                |
| <input type="checkbox"/>            |            |      |               |                   |                |
| <input type="checkbox"/>            |            |      |               |                   |                |
| <input type="checkbox"/>            |            |      |               |                   |                |
| <input type="checkbox"/>            |            |      |               |                   |                |

Filtered Device(s)

|  | IP Address | Type | Serial Number | MAC Address | Address Switch |
|--|------------|------|---------------|-------------|----------------|
|  |            |      |               |             |                |
|  |            |      |               |             |                |
|  |            |      |               |             |                |
|  |            |      |               |             |                |

Select device

Buttons: OK, Cancel, Net/dent Rescan, Set IP Address

**Figure 20. 72 – Doing the master Device Assignment**

To do a network diagnostic just click the master device, and then **Online**→**Debug Mode**.

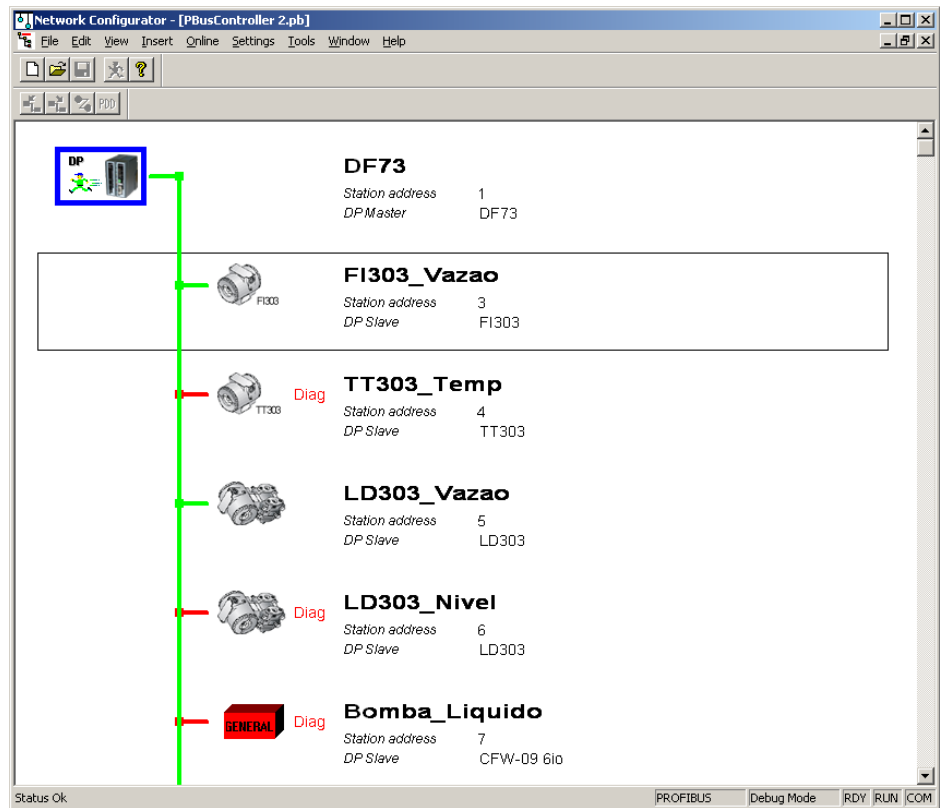


Figure 20. 73 – Doing the network diagnostic

The red spur indicates a device with some configuration failure. By clicking the device a description of the failure appear.

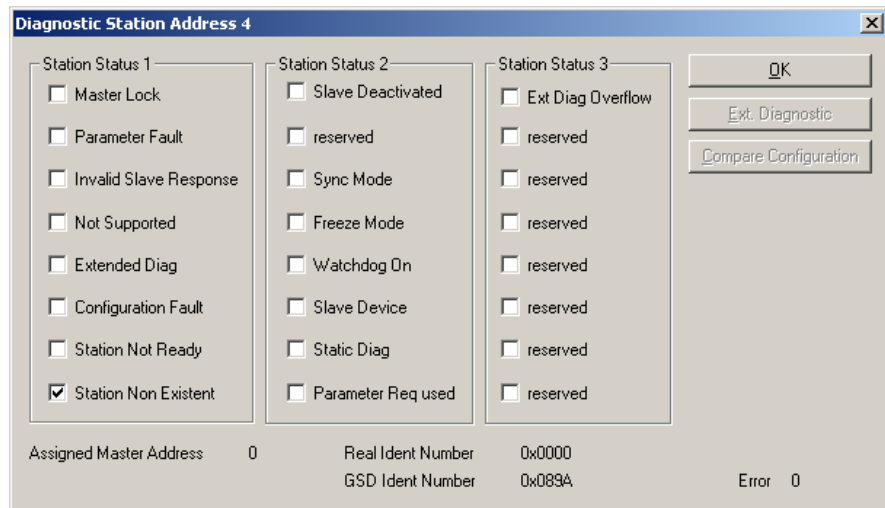


Figure 20. 74 – Device failure description

The example above shows an error due to some physical or address problem the master does not receive answers from the configured node.

**IMPORTANT**

The Ident Number is the device's model and it is used as a key allowing the configuration. If the device's Ident Number (physical) does not match with that is in the GSD file (configuration), the parameterization will not be concluded and the configuration will be canceled.

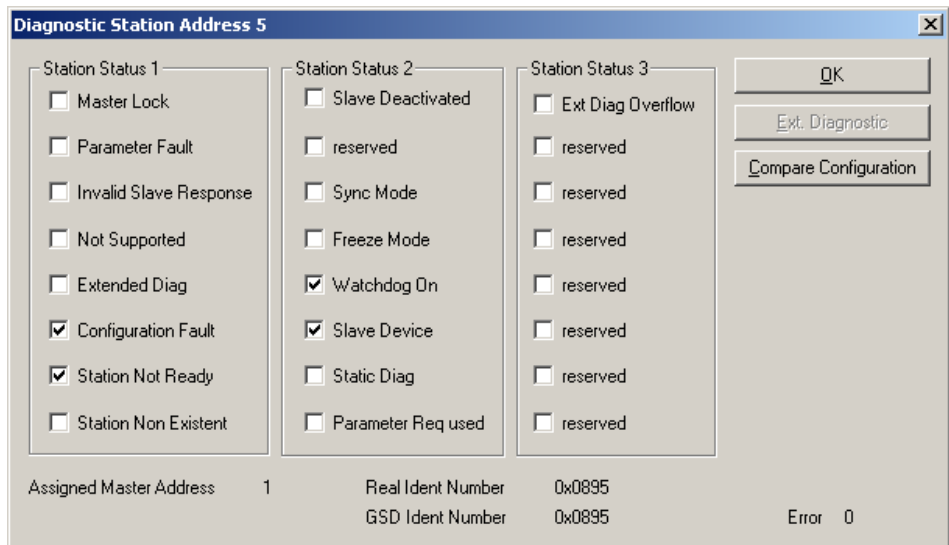


Figure 20. 75 – Device failure description

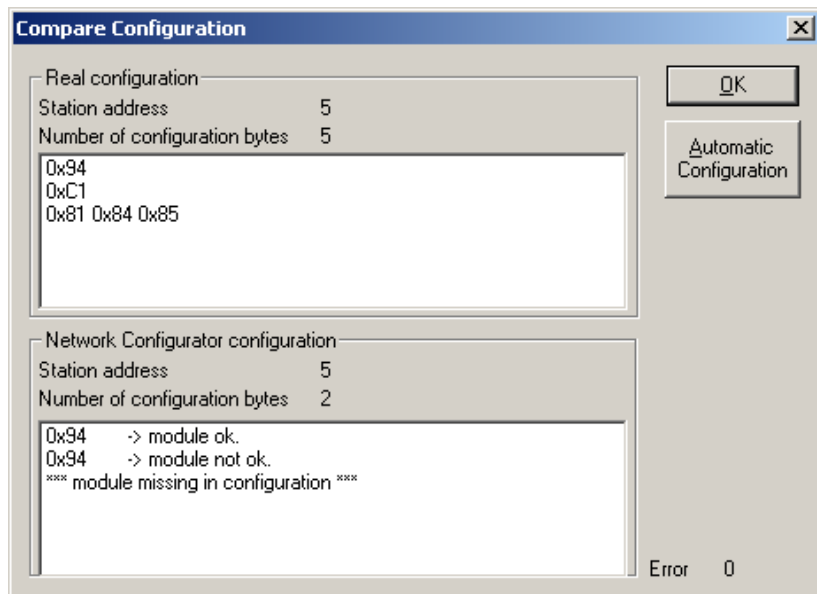


Figure 20. 76 – Device failure description

The example above shows a configuration error of Profibus device, because the LD303 was configured with two AI modules, and it would have to be configured with AI and Totalizer or AI and EMPTY\_MODULE, if the flow rate is not totalized.

**IMPORTANT**

If an address is repeated in the network, i.e., at least two nodes were configured with the same address, a conflict will happen and the master will consider the first answer as valid at each request. The work will be unstable for both addresses. In this case the master will cancel continuously the communication with both devices and it will notify with an error diagnostic.

## Extended Diagnostic in the Network Configurator

The DF73 as Profibus DP master has resources to show the communication status, disconnections status, communication errors and number of retries.

The access to the extended diagnostics is done by clicking the master and accessing the **Online** menu.

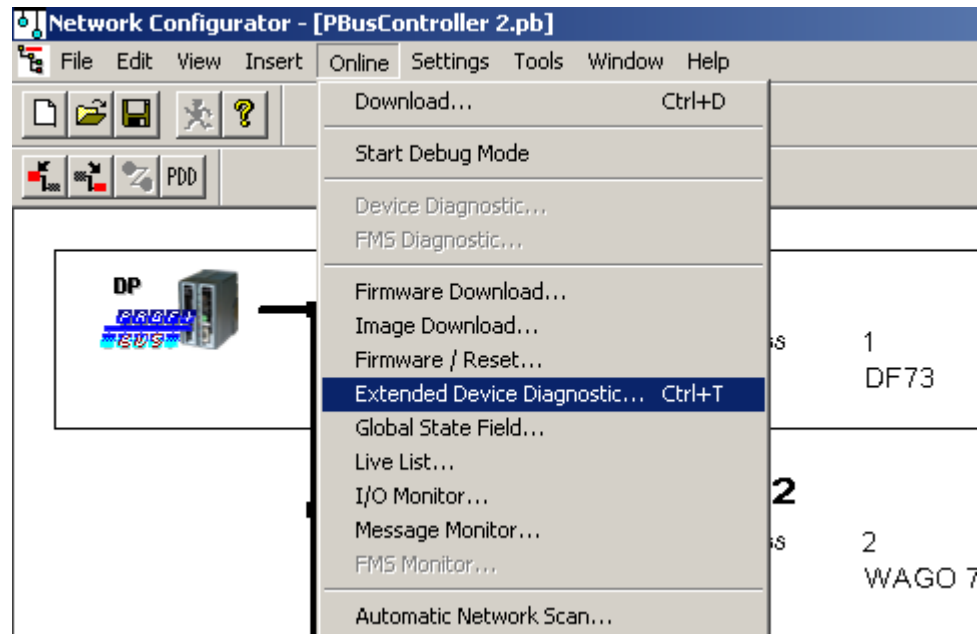


Figure 20. 77 – Extended diagnostic

The next window will appear:

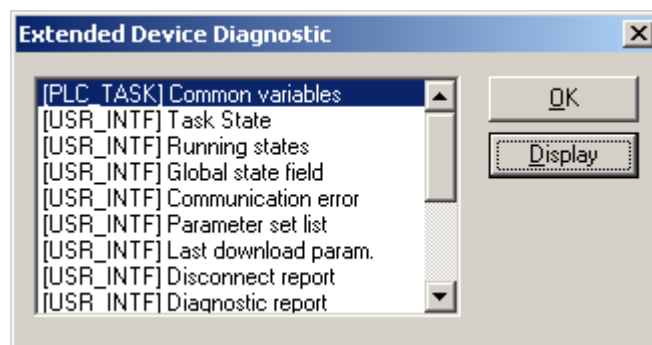


Figure 20. 78 – Extended diagnostic options

### Communication error

Through the **Communication error** item is possible to verify the error status of each slave. This error status is not increased (it does not record the errors); it only shows the error status at this moment.

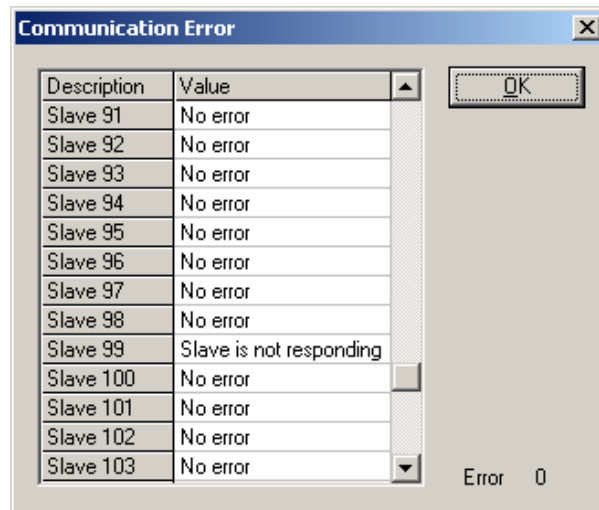


Figure 20. 79 – Status of slaves’ communication errors

**Disconnect Report**

It shows the number of communication disconnections due to communication errors. The counter increases only when the master is exchanging data with the slave and after finishing all retries (see **Max Retry Limit**).

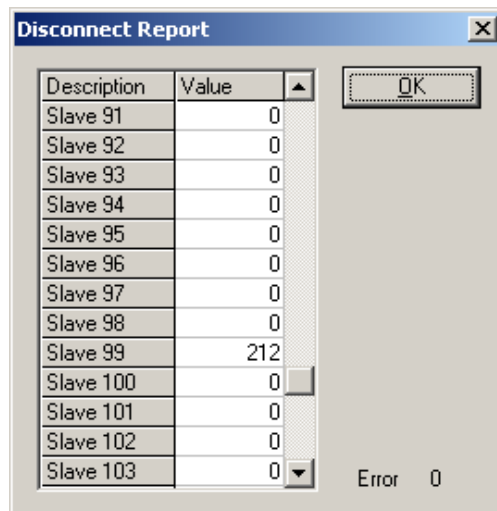


Figure 20. 80 – Disconnect report

**Diagnostic Report**

It shows the number of new diagnostics which the slaves make available. At each data exchange the bits, if they are configured by the slaves, are verified when inform that there is available a new diagnostic information, and the master has to do a new diagnostic request.

| Description | Value |
|-------------|-------|
| Slave 91    | 0     |
| Slave 92    | 0     |
| Slave 93    | 0     |
| Slave 94    | 0     |
| Slave 95    | 0     |
| Slave 96    | 0     |
| Slave 97    | 0     |
| Slave 98    | 0     |
| Slave 99    | 2     |
| Slave 100   | 0     |
| Slave 101   | 0     |
| Slave 102   | 0     |
| Slave 103   | 0     |

OK

Error 0

Figure 20. 81 – Diagnostic report

**Retry for Slave**

It shows the number of communication tries which were done by specific slave (see **Max Retry Limit**) when it does not answered.

| Description | Value |
|-------------|-------|
| Slave 91    | 0     |
| Slave 92    | 0     |
| Slave 93    | 0     |
| Slave 94    | 0     |
| Slave 95    | 0     |
| Slave 96    | 0     |
| Slave 97    | 0     |
| Slave 98    | 0     |
| Slave 99    | 1     |
| Slave 100   | 0     |
| Slave 101   | 0     |
| Slave 102   | 0     |
| Slave 103   | 0     |

OK

Error 0

Figure 20. 82 – Retry for slave



## CREATING A DEVICENET CONFIGURATION BY USING DF79

### Introduction

This section will show a strategy configuration using the DF79 controller. The next figures show an example of process used to control the conveyor movement for filling up bottles with some fluid. The conveyor moves until the sensor detects the bottle. At this moment the valve (ON/OFF) opens and fills up the bottle. The architecture of the DeviceNet control loop can be seen in the following figure.

### PROJ\_DF79

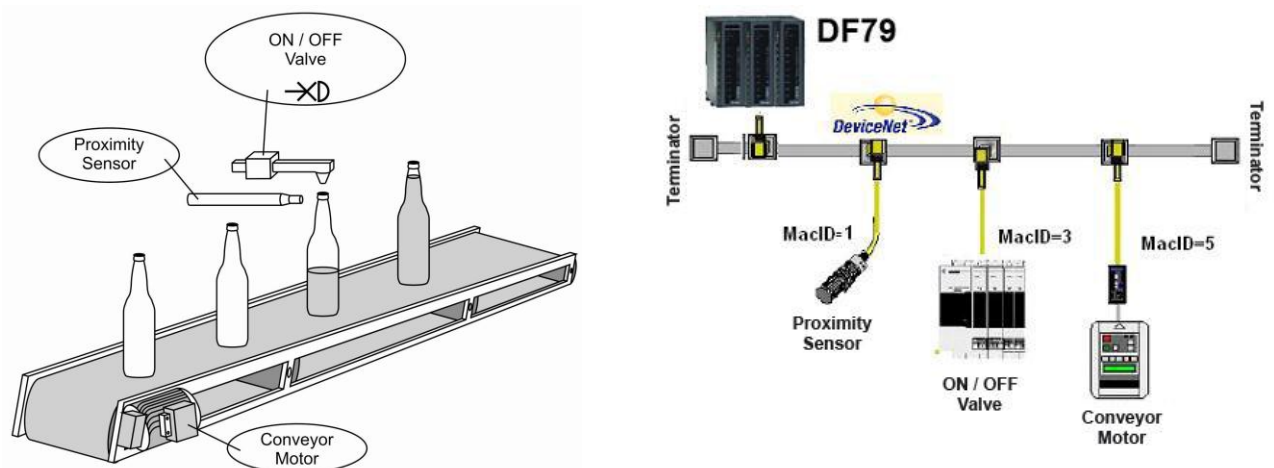


Figure 21. 1 – Example of Process

For the example above the following DeviceNet devices were used: an AC Drive to control the conveyor motor, a sensor to detect the bottle and a discrete I/O card to turn on and turn off the valve.

In the next topics will show, step by step, how to configure the DF79 controller for the aimed example. At the **SYSTEM302** is possible to do control logic of two ways: ladder or function blocks. The steps 1 to 7 are necessary to configure the DeviceNet network. The step 8 shows how to do the configuration using ladder logic. From step 8' hereafter is shown how to do the logic using function blocks. Also is possible to mix the two configurations, i.e., part in ladder and part in function blocks.

#### IMPORTANT

Before starting the DeviceNet configuration in the **SYSTEM302** is necessary to obtain information about each slave device configuration (module address, baud rate, supported types of cyclic communication and mapping structure). Also is necessary the electronic identification file of the device EDS. This information is obtained with the respective DeviceNet device manufacturer.



## Starting the Area

### Step 1

It is possible to create, or edit, an area from the **Studio302**. In the **Studio302** interface select **Areas**. A window will appear listing all the areas of database.

To create a new area from the **Studio302**, left-click inside the **Areas** window, then choose **New Area**.

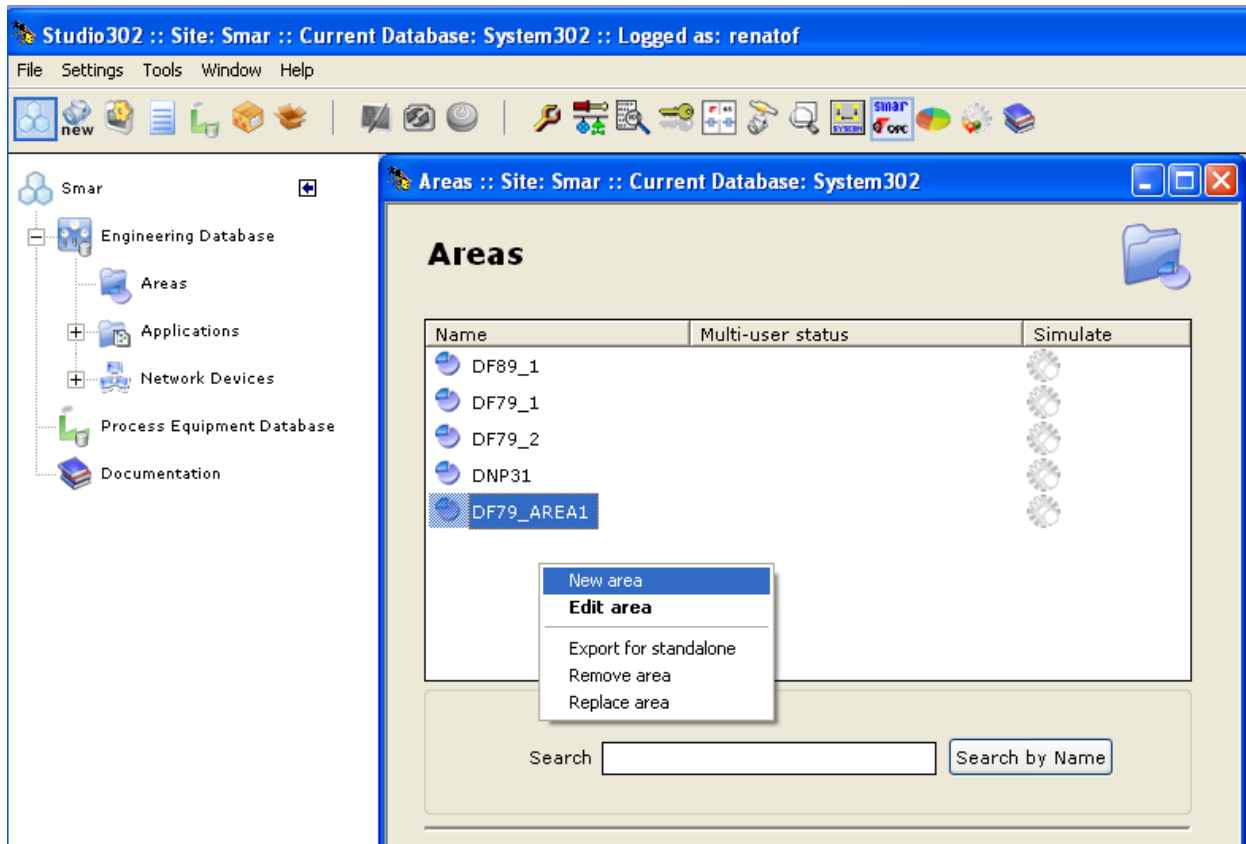


Figure 21. 2 – Creating a new area

Another way to create a new area is from **Syscon**. Click the icon  in the **Studio302** toolbar.

To create a new area on **Syscon**, choose **File → New**, or through the toolbar, choose **New** button



The dialog box shows the areas options. Select **HSE Area** as shown in next figure:



Figure 21. 3 - Options to create Syscon areas

After choosing the area type, it opens a window to the user give a name to the new area.

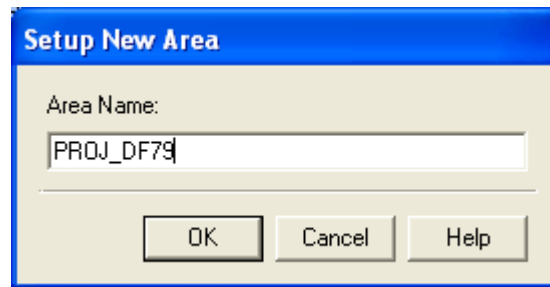


Figure 21. 4 – New area name

Type the name for the area in the **Area Name** box, and click **Ok**. For this example, it chooses **PROJ\_DF79** name.

A new window will appear. It shows:


- **Application** – Logical Plant. To insert the control strategies into this part.
- **Fieldbus Networks** – Physical Plant. To insert devices and function blocks used in the area.

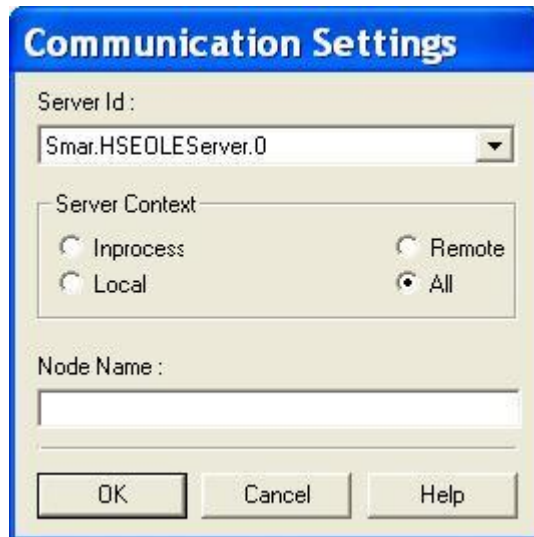


Figure 21. 5 - Area divisions

## Physical Plant Project

### Step 2

In the main window, **PROJ\_DF79**, right-click the **Fieldbus Networks** icon,  , to select the Server. Choose **Communication Settings** option, or through the toolbar, choose **Communication→Settings**. The communication settings dialog box will open.



**Figure 21. 6 – Choosing the Server**

Confirm if the **Smar.HSEOLEServer.0** option has already been selected. Otherwise, the user must select it, and then click **OK**.

## Arranging the Fieldbus windows

### Step 3

After selecting the Server for the area, click the  $\oplus$  sign placed at left of the **Fieldbus Networks**. The HSE network will appear with a tag, for example, *HSE Network 1\**. Right-click this item and choose the **Expand** option. The following figure shows the HSE network:



**Figure 21. 7 – Creating the HSE network**

To arrange the screen, click the area window. So, choose **Window** menu on the **Syscon** toolbar, and then choose **Tile** option.

\* This number changes if another area was created before. When a new HSE area is created, this number increases.

## Inserting the Controller

### Step 4

Right-clicking the **HSE Network 1** icon, a dialog box to add new devices will appear. By clicking **New**, it is possible to select devices such as Bridges, Controllers and Devices for the area. For the aimed control, it selects the **Controller** option. Confirm this choice as shown in next figure.

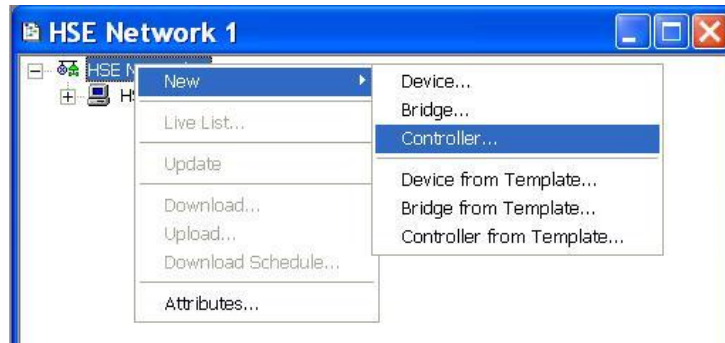


Figure 21. 8 – Choosing the controller

After adding the new controller, it opens a window as shown in following figure.

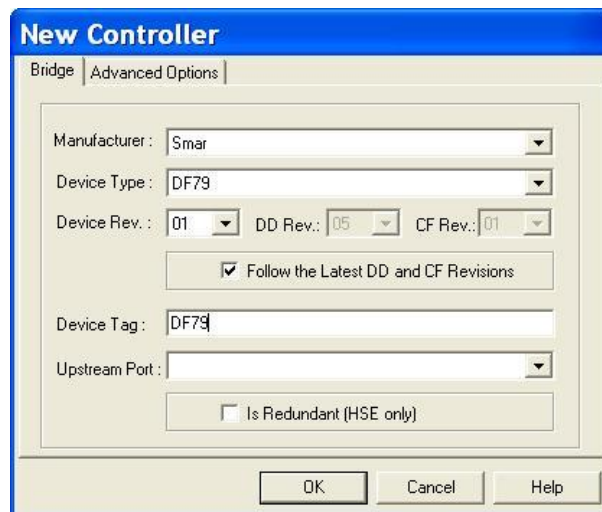


Figure 21. 9 – Setting the controller

Select **DF79** in the **Device Type** box. In the **Device Tag** box, type **DF79** or another tag, and click **OK** to conclude this task.

#### IMPORTANT

Not all characters are valid when naming the elements.

The valid characters are:

A-Z a-z 0-9 # { } [ ] ( ) + -

The invalid characters are:

~ ` ! @ # \$ % ^ & \* = | : ; , . < > ? / ' " \

#### TIP

Is possible to create an initial HSE configuration in an easier way using templates. In this case a configuration exists with some common steps created previously. For example, the steps 1 to 4 can be replaced by a creation of template through main menu **File → New → Predefined Area** choosing **DF79 DeviceNet HSE** or **DF79 DeviceNet HSE with FFB-1131**.

## Adding DeviceNet Devices

### IMPORTANT

Before launch the **Network Configurator** the user must save the configuration on **Syscon**, and then go to the next step.

#### Step 5

After inserting the controller, it is possible to insert DeviceNet devices. Before, return to the **PROJ\_DF79** window and right-click the controller, **DF79**. Then choose **New Network** option to configure the DF79 channels. See the DeviceNet bus creation in following figure.



Figure 21. 10 – Creating the DeviceNet bus

When selecting **New Network**, the **Network Configurator** tool opens. The **Network Configurator** is the configuration tool for the DeviceNet network. Through it, the user has the structure of the DeviceNet network (devices, baud rate, and connection type). For further information about this tool, refer to its Help.




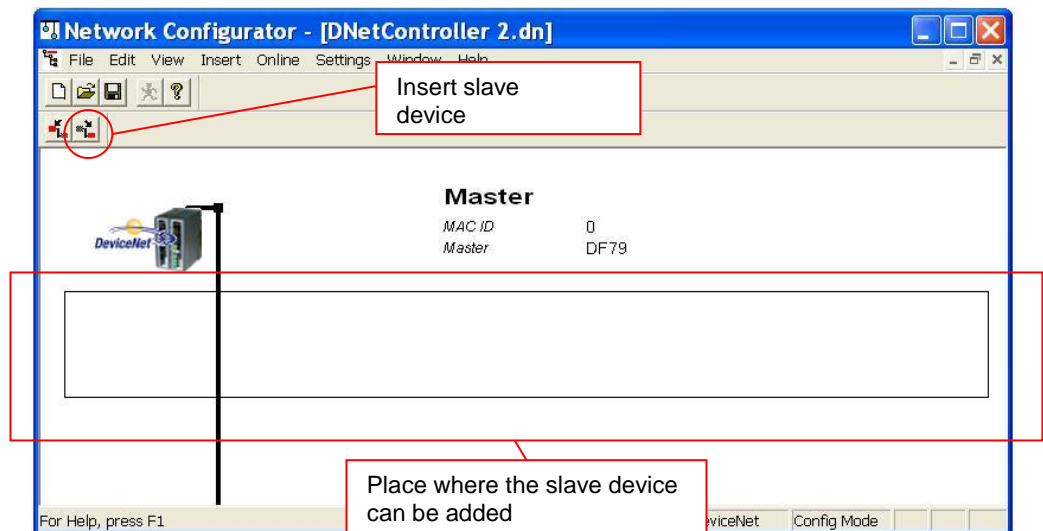
Figure 21. 11 – Network Configurator window

The controller DF79 has already been inserted to the configuration previously, so it is the Master device in the DeviceNet network. The DeviceNet devices that will be inserted to the network are named slaves.

### IMPORTANT

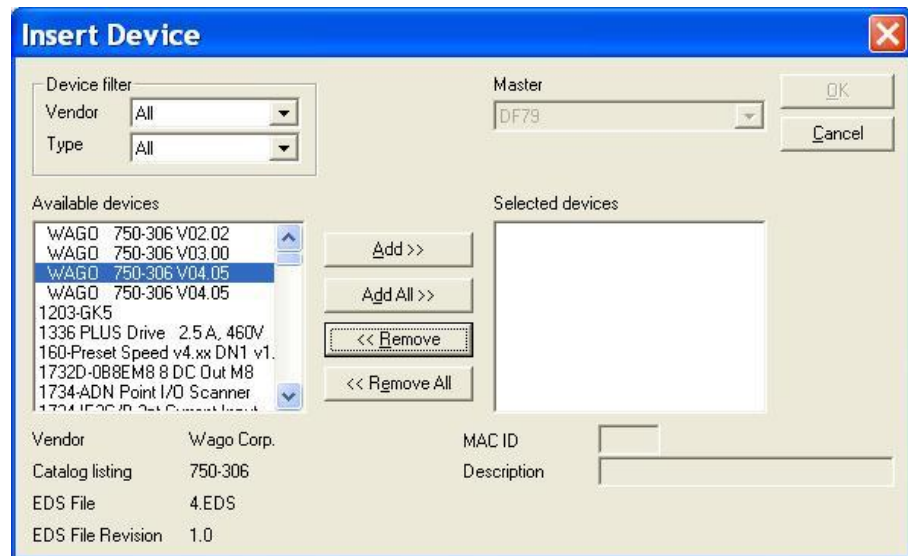
The address 0 in the DeviceNet network is the default address of the DF79 (MAC ID). It is recommended does not use the address 63 for moving the devices in the DeviceNet network.

To insert slave devices, click the button  (**Insert Device**) placed on the toolbar, or through the menu **Insert→Device....** Place the mouse cursor just below where the Master device is placed and left-click. See the next figure.



**Figure 21. 12 – Placing the slave device in the DeviceNet network**

The window for inserting slave devices will open, as shown below:



**Figure 21. 13 – Inserting slave device**

The user can select the slave device in this window. For the aimed control, the first device is the proximity sensor. First the user has to obtain the configuration information of the DeviceNet slave device (refer to device’s manual). Follow these steps to insert Slave devices:

- A. Select the device in the **Available slaves** box;
- B. Click **Add** button;
- C. Type the address for the device in the **MAC ID** field (this address has to correspond to the physical configuration of the device in the DeviceNet network. Further details about how to configure the device’s address refer to device’s manual);
- D. Type the tag for the device in the **Description** field. If the user does not write any tag for the device, the default tag will be **Device1**.
- E. Click **OK**.

**NOTE**

The address as well as the tags of the devices must be unique in the DeviceNet network and also in the **Studio302** Database (Workspace). For further information refer to **Studio302** manual.

The user also has to insert the devices corresponding to the ON/OFF valve and the conveyor motor. When these operations finish the DeviceNet network will be as the following figure.

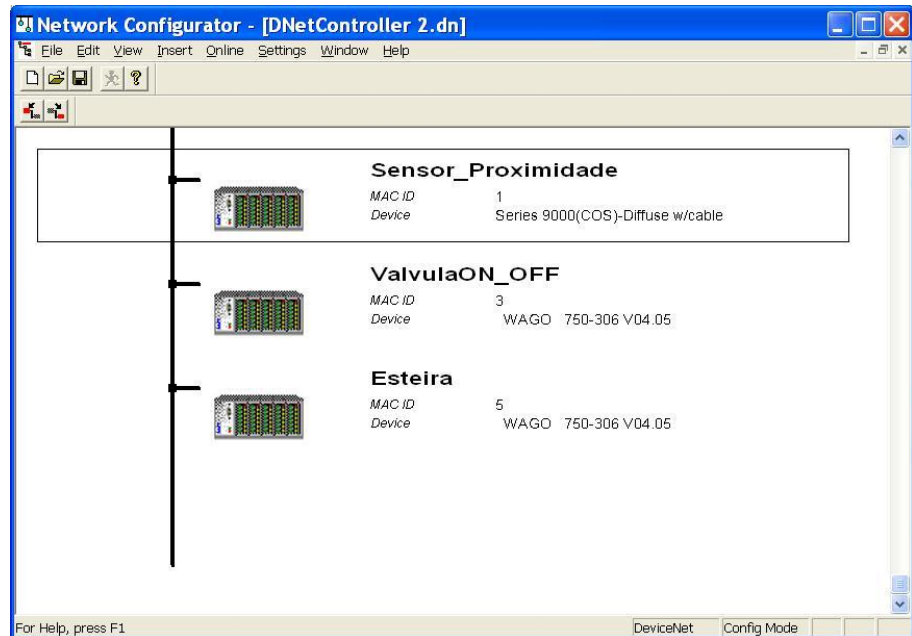


Figure 21. 14 – DeviceNet network created

## Inserting Slave Devices that are no present in the “Available Slaves” list

The EDS files have the description of each DeviceNet device. They are provided by devices’ manufacturers. These files define the devices’ specific features in the DeviceNet network and their objects. The set of these files forms the devices’ database. The **SYSTEM302** already has an EDS database of the more common manufacturers, but is possible to add new devices in the **SYSTEM302** database.

If there is a device which will be in the DeviceNet network, but is not available in the devices’ list, the user has to contact the device’s manufacturer to take the EDS file, and also to take the \*.ico file (with the device icon) if it exist. The new files must be placed in the following paths:

- EDS files: ...\\Smar\\Network Configurator\\Fieldbus\\DevNet\\EDS
- Drawings or bitmaps (\*.ICO): ...\\Smar\\Network Configurator\\Fieldbus\\DevNet\\BMP

**NOTE**

The module drawing (icon) only will be associated to the EDS file if it has the following line (that some manufactures does not include) inside the [Device] section:  
Icon = "filename.ico". For example:

```
[Device]
:
    Icon = "thumbnail4.ico";
```

To check if the drawing is associated to the EDS, create in the **Network Configurator** an EDS of the product and check if a correct icon is associated. Otherwise a **Network Configurator** default drawing will appear.

## Setting DeviceNet Devices

### Step 6

After creating the DeviceNet network, the devices have to be configured. For example, right-click the device corresponding to the ValvulaON\_OFF. Choose the **Device Configuration** option to configure the slave device.

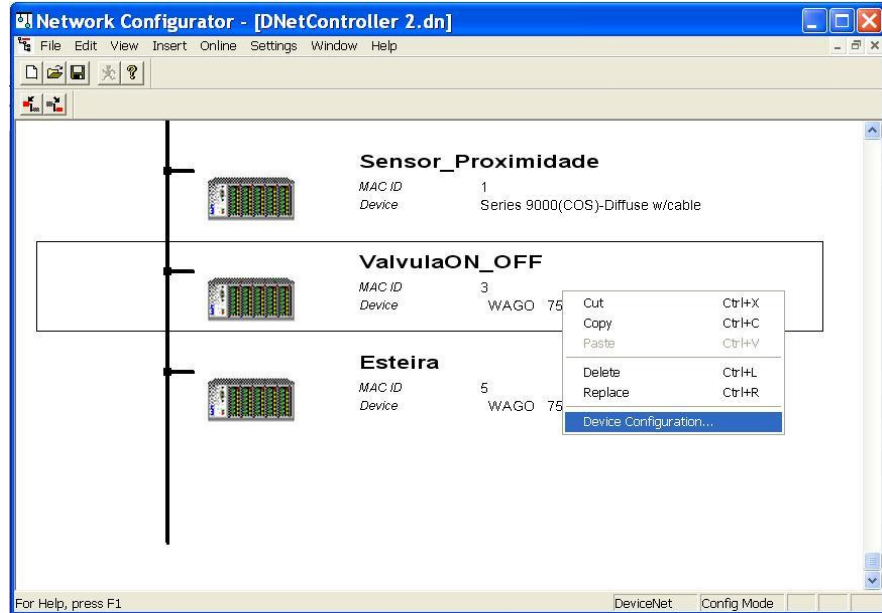


Figure 21. 15 – Setting the slave device

The configuration window also will open double-clicking the device.

The window for device configuration will open. See the figure below.

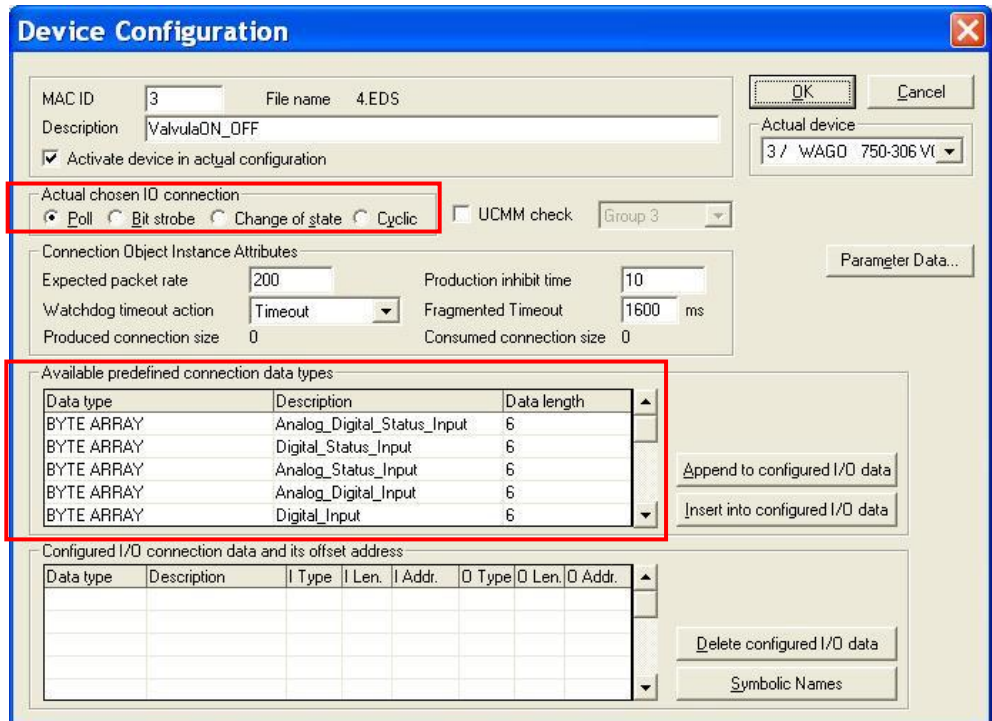


Figure 21. 16 – Setting the slave device

Are necessary to configure the IO connection type (IO Connection), and also the data order



(depending of slaves’ cards configuration). The DeviceNet supports 4 types of IO connections: Poll, Bit Strobe, Change of State and Cyclic. The devices can support different configurations. In the **DeviceNet Advanced Topics** section each one of the items above will be detailed. Refer to the DeviceNet slave devices’ manuals for further information.

The control parameters configuration (I/O message data exchanging) is done by choosing the data types and the size in the **Available predefined connection data types** box. This configuration can be fixed (if the device has a fixed number of IO points), or dependent of cards’ arrangement (if the slave has a variable number of IO points).

The configurations for **PROJ\_DF79** will be as follows:

The **Sensor\_Proximidade** device supports IO communication of the types Polling, Bit Strobe and Change of State. This last will be chosen for the aimed example. Usually the manufacturer provides in the device’s EDS only the supported types, in this case can be any of the available communications’ types. The device’s communication data is 1 bit of data, because it has only one digital input (**Sensor1** option was selected in the **Configured I/O Connection data and offset address** box). See the next figure.

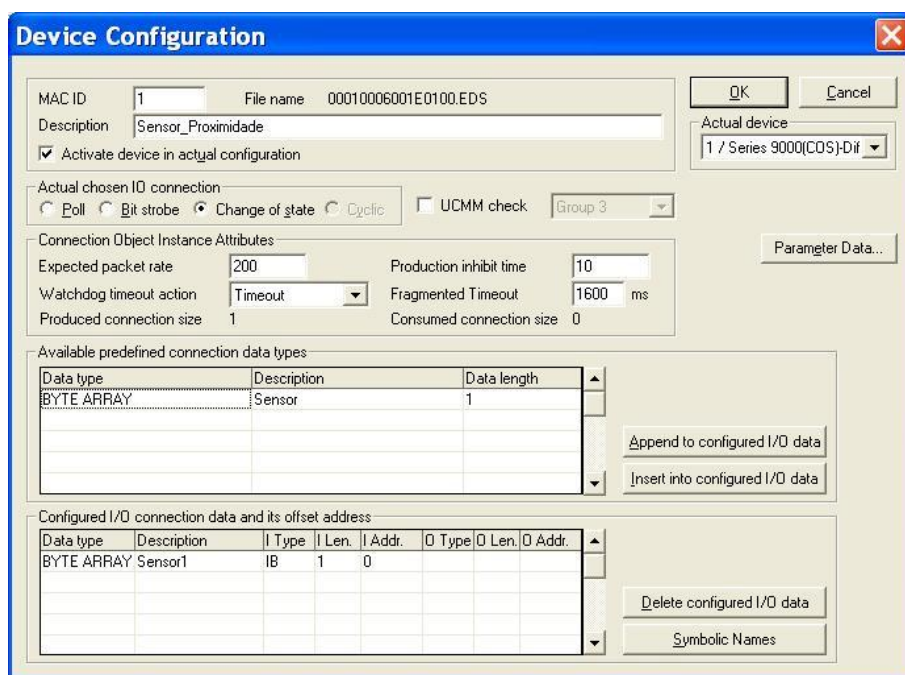


Figure 21. 17 – Setting the sensor

For the **ValvulaON\_OFF** was chosen a device with a variable number of IO, and the following cards were added: 4 discrete inputs and 4 discrete outputs. In this case the slave device supports the four types of IO communication. For the aimed example was chosen **Polling**. The IO cards configuration will be: Digital\_Input\_11 with 2 bytes, because the device has 4 digital inputs (1 byte) in addition to their status (1 byte), and Digital\_Output\_11 with 1 byte, because the device has 4 discrete outputs (1 byte). See the following figure.

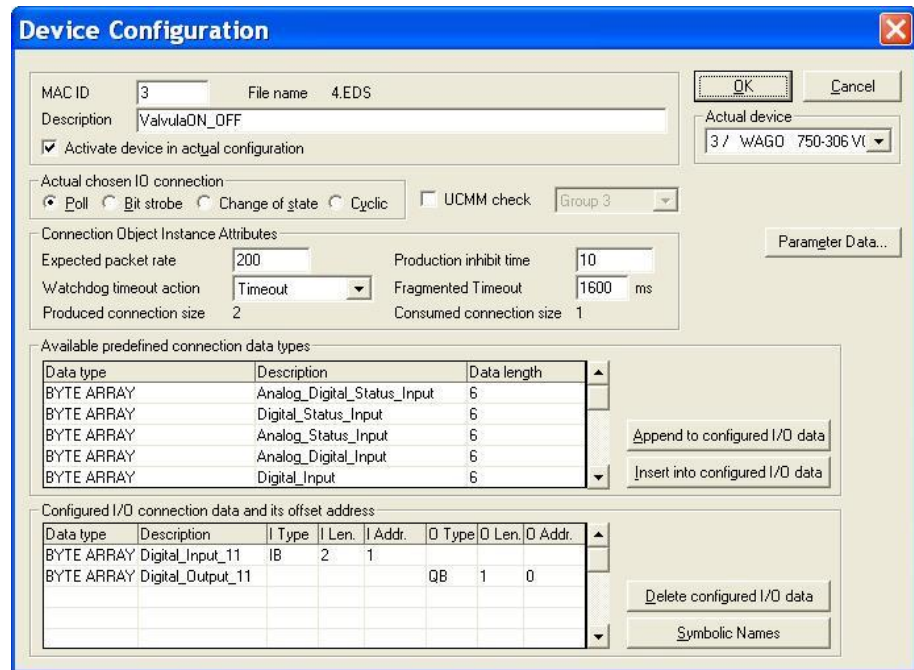


Figure 21. 18 – Setting the valve

For the conveyor (**Esteira**) was chosen a device with a variable number of IO points, and the following cards were added: 4 discrete inputs, 1 analog input and 4 discrete outputs. In this case the slave device supports the four types of IO communication. For the aimed example was chosen **Polling**. The IO cards configuration will be: Digital\_Input\_11 with 2 bytes, because the device has 4 digital inputs (1 byte) in addition to their status (1 byte), Analog\_Input\_11 with 2 bytes, because the analog variable has 12 bit-resolution accepting integer values from 0 to 4095, i.e., 2 bytes, and Digital\_Output\_11 with 1 byte, because the device has 4 discrete outputs (1 byte). See the following figure.

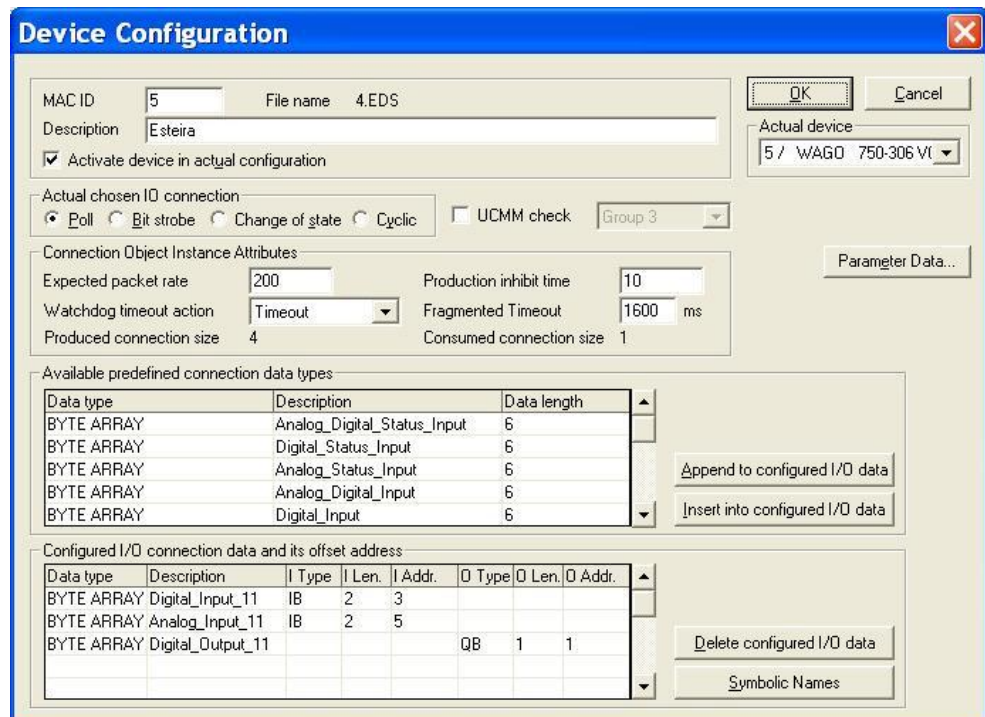
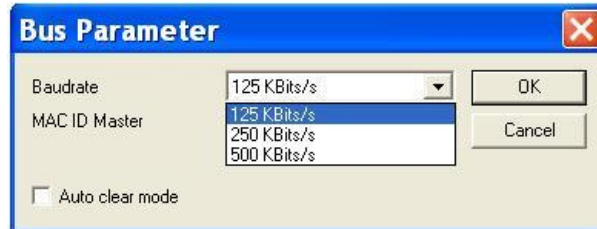


Figure 21. 19 – Setting the conveyor

When inserting devices finishes, the mapping must be done. It consists of mapping the values, bytes and data to be reading/written from the devices to the master memory. The procedure will be described in the following topic.

After selecting the inputs and outputs for the DeviceNet devices, set the baud rate for the DeviceNet network. Click the Master device and choose **Settings→Bus Parameter** on the toolbar. The dialog box will open:



**Figure 21. 20 – Selecting the baud rate for the DeviceNet network**

Select the baud rate in the **Baud Rate** list and click **OK**.

**NOTE**

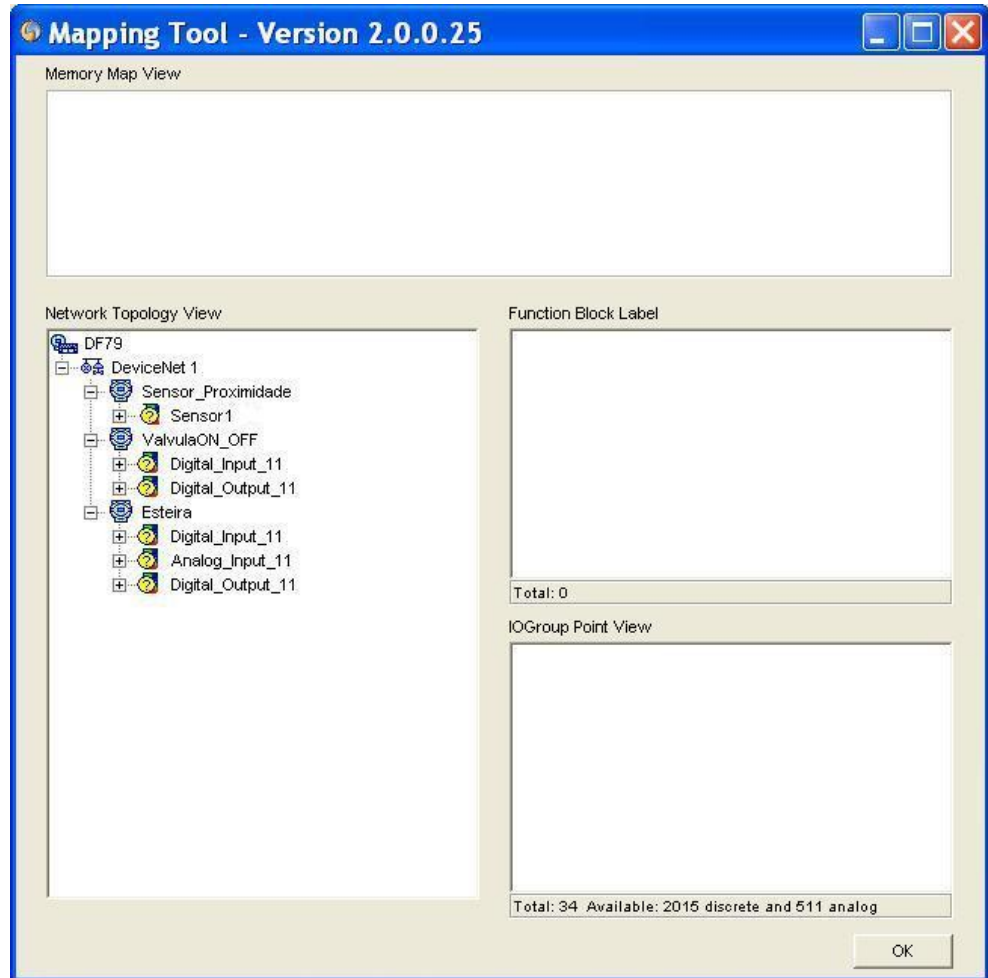
The baud rate of the DeviceNet network has to be configured according to the DeviceNet device which has the lowest baud rate, and all DeviceNet devices must be configured with the same baud rate.



Save the configuration before exit from **Network Configurator**


**Step 7**

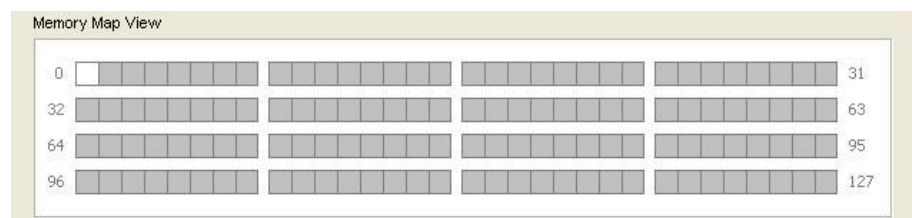
When the previous steps were finish, the DeviceNet network configuration can be saved, and then, exit from **Network Configurator**. The Mapping Tool launches automatically. With this tool is possible to map the points of DeviceNet mapping in available points which will be used in ladder logic or in function block logic. This tool configures all characteristics of DeviceNet points (user tags, data types, scales, etc). See the following figure.



**Figure 21. 21 – Mapping Tool window**

In the last figure can be seen the **Network Topology View** window with the devices which were inserted in the DeviceNet network with their modules. In the **Function Block Label** window are the points which will be seen at **Syscon**, and the **IOGroup Point View** window are the points which will be seen at **LogicView for FFB**. The purpose is to configure each network “point” (or byte) in their respective data types.

The items with the symbol  have to be configured. Click the item which will be configured (for example, **Sensor1**), and in the window upper side will appear the available bytes. To the sensor was configured 1 byte for data, and only the first bit has the sensor’s value. See the next figure.



**Figure 21. 22 – Available bytes**

Click the byte, and the following window will appear.



**Figure 21. 23 – Configuring the data type**

Choose the variable data type of the slave device (**Data type**). The available types will depend on the chosen device. To **Sensor1** the type is **Bit**. In this example was chosen bit, because only one data bit will be configured.

The following steps have instructions about how to use the points, which were created in the **Network Configurator** and mapped in the **Mapping Tool**, in the control logic. As above mentioned there are two ways to use inputs and outputs points – ladder logic or function blocks.

## Mapping DeviceNet IO Points to be Used in Ladder

### Step 8

First the points will be mapped to be used in ladder, thus the **Block Type** (None) option will not be configured. The user can give a tag to group in **Group tag** option. If **Bit** option is selected the following window will appear.



**Figure 21. 24 – Configuring the bits**

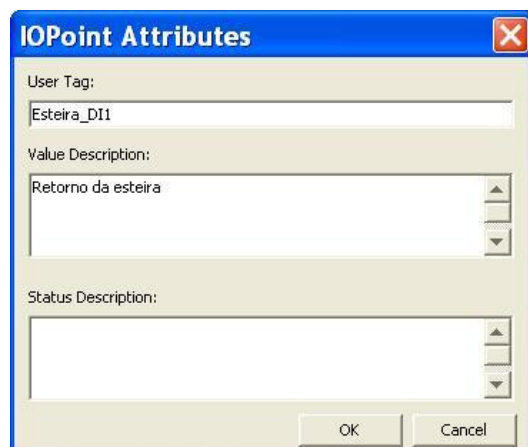
Select the bits which are necessary to the application, click **Finish** and the configured points will appear in the **Mapping Tool** window. It is important the user correctly select the bit of the desired information. For example, for the **Sensor\_Proximidade** that has only one data bit, the bit selected is the bit 0.

When analog data type was chosen the scale parameters for this point has to be configured. For example, for the **Esteira** that has one analog input of 12 bits the sensor scale must be from 0 to 4095.



**Figure 21. 25 – Setting the scale parameters**

Right-clicking this point and choosing **Delete** it can be deleted, or some attributes can be defined for better identification through the **Attributes** option.



**Figure 21. 26 – Changing the point attributes**

**NOTE**

For the analog points is important to know the bytes order (big endian or little endian). The greater number of DeviceNet devices has the little endian standard. To view or change the bytes order in the **Mapping Tool**, right-click the device and select **bit** or **little**.

Fill the necessary fields, and click **OK**.

After mapping and configuring all points, click **OK** to exit from **Mapping Tool**.

After finish the mapping, a FFB block has to be inserted in the configuration using the **Syscon**. This block is necessary to edit the ladder logic. For further details refer to Adding Function Blocks section or **Syscon** manual. Right-click FFB block, which was added, and then click **Define Parameters**.

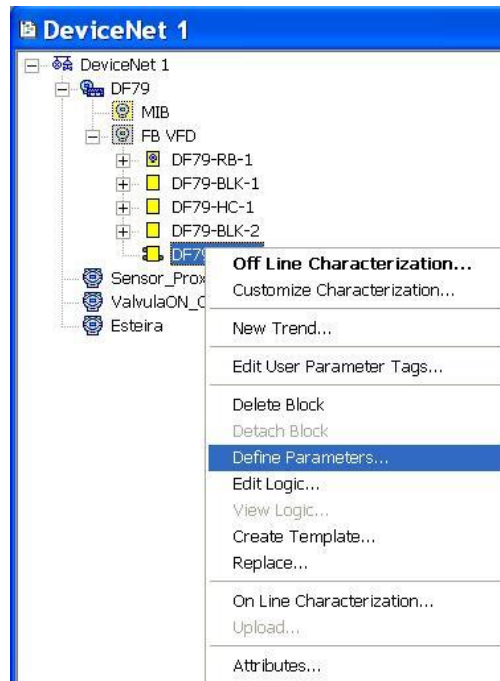


Figure 21. 27 – Defining FFB parameters (1)

The following window will appear.

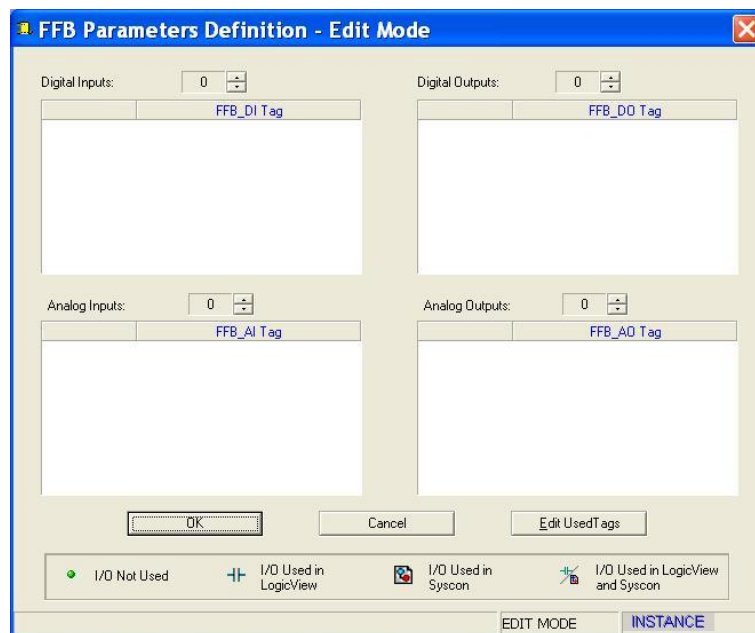


Figure 21. 28 – Defining FFB parameters (2)

If necessary define the inputs and outputs of FFB. Otherwise just click **OK**.



Return to **Syscon**, save the configuration, and do an **Export tags**.

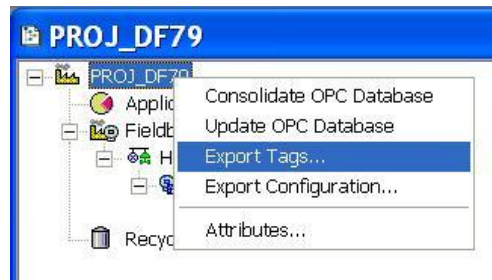


Figure 21. 29 – Export tags

After finish this operation, right-click the FFB block, and then select **Edit Logic**. The **LogicView for FFB** will launch, and the ladder logic can be edited.

For the first time the logic is edited the **Refresh Data** command has to be executed thus the IO points configured in **Mapping Tool** will be updated in the ladder. Right-click **Network I/O** in the **Hierarchy** window of the **LogicView for FFB**. See the next figure.

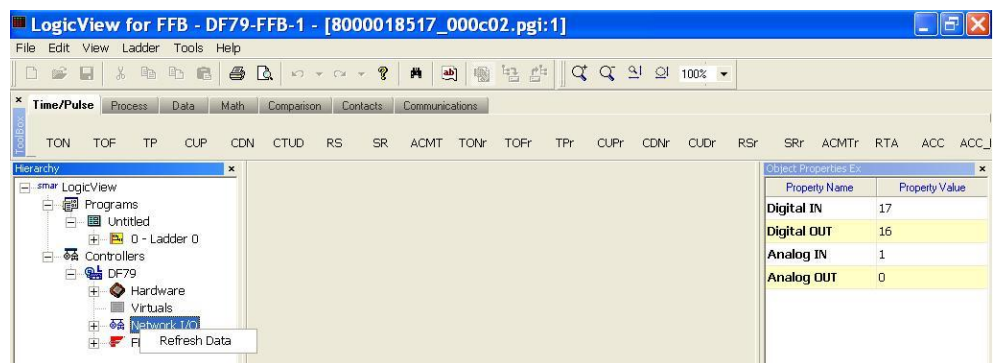


Figure 21. 30 – Refresh data

The NetIO points can be seen in the **Hierarchy** window. See the next figure.

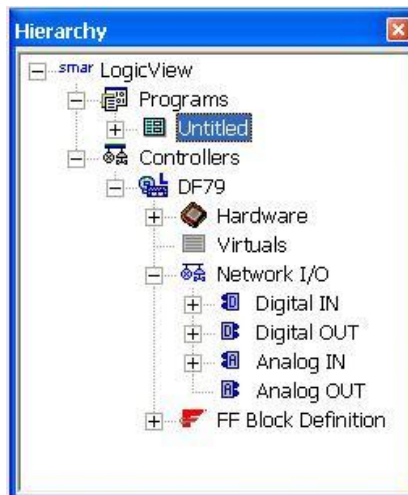


Figure 21. 31 – Network I/O at LogicView for FFB

After that procedure the IO point of the DeviceNet network are already available to be used in the logic. The user has a complete function library which can be used in the logic. For further details see the **LogicView for FFB** manual.

See in the following figure the proximity sensor's point linked to TON block (timer). All DeviceNet IO points appear with the symbol **D** in the ladder logic.



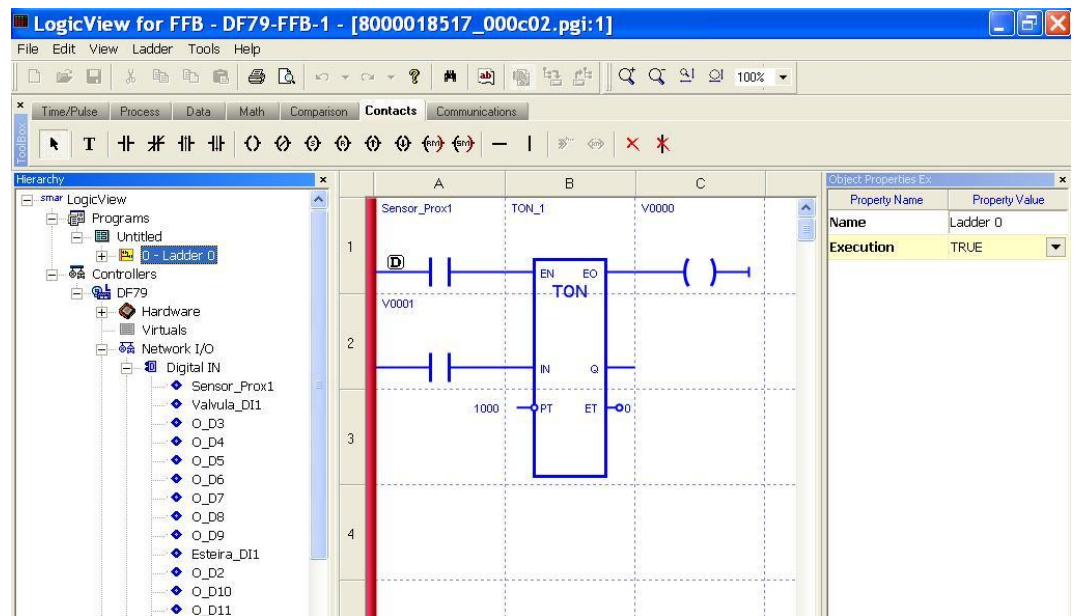



Figure 21. 32 – Editing logic

After ladder configuration the user can download the configuration to the device. Another option is to configure the function blocks at **Syscon**. If you also want to work with function blocks is necessary to follow the steps 9 to 12 to edit them. In this topic only the ladder was used to configure the ladder. Before downloading the configuration you have to save it in the **LogicView for FFB**. Exit from it, and return to **Syscon**.

To start a communication with the devices, first, is necessary to commission the controller. In this way the tags, IDs and addresses of each device will be assigned correctly. If this procedure was not done, the **Syscon** will detect the uncommissioned device and its download will be canceled. When the devices' commissioning finishes the download process can start. The download process can be

done, for example, returning to **Proj\_DF79** window, right-clicking **Fieldbus Networks** icon, , and then, select **Download** option. For further details about commissioning and possible download types refer to **Syscon** manual.

## Mapping DeviceNet IO Points to be Used in Function Blocks

In the same way of the configuration done through ladder, the configuration can be done with function blocks. In this topic the same DeviceNet IO points of the step 8 will be mapped, but now the function blocks will be used. As above mentioned, for the network creation and devices' insertion the steps are common up to step 7.

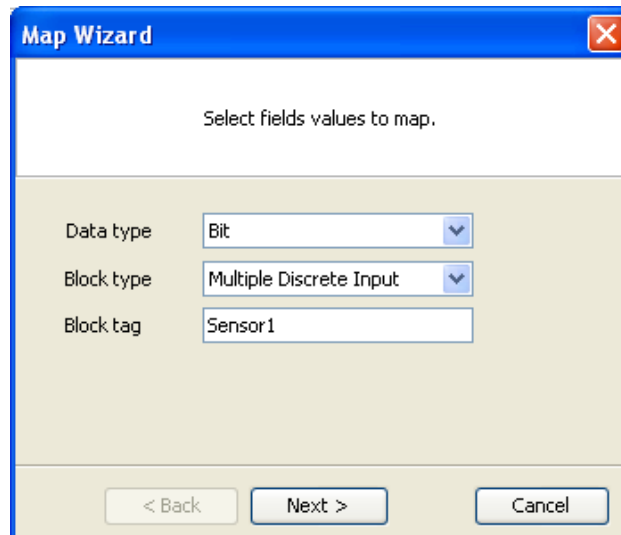
### Step 8'

In the Mapping Tool window, to map the IO points in blocks, is necessary to configure the **Block Type** field as you can see in the following figure. When **None** is chosen, as in the step 8, the mapping will be done in ladder.

To map the **Sensor\_Proximidade** input, for example, choose the **Bit** data type. And then, in **Block type** choose **Multiple Digital Input**. Give a tag to the block in **Block Tag**.

#### NOTE

Every point of DeviceNet network is already configured automatically to work with ladder. To map in function blocks the user has to choose this option configuring the **Block Type** field of the **Map Wizard** window of **Mapping Tool** with the respective IO block.



**Figure 21. 33 – Configuring the data type**

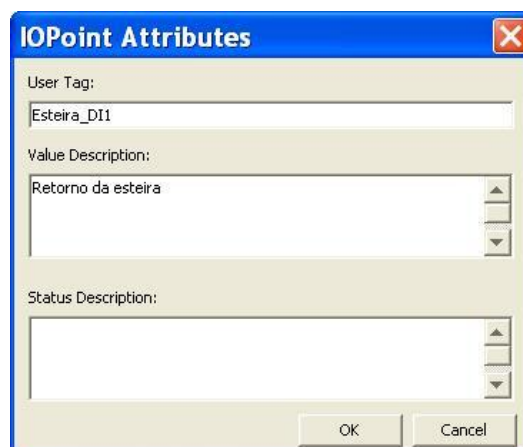
Click **Next**, and a window as the figure 21.24 will open, select bit 1. Click **Finish**, and the configured point will appear in the **Mapping Tool** window.

**NOTE**

The **Mapping Tool** (MT) always tries to minimize the number of created blocks in the configuration. So, for a same slave device, if was not chosen any block tag the MT will allocate the point in an already existent block (the allocation availability will be verified, that is, the block has to be the same type and the block has to have empty points).

If the user informs an existent block tag, the MT will use this block to allocate the point. If the user informs a block tag that does not exist, the MT will create a new block.

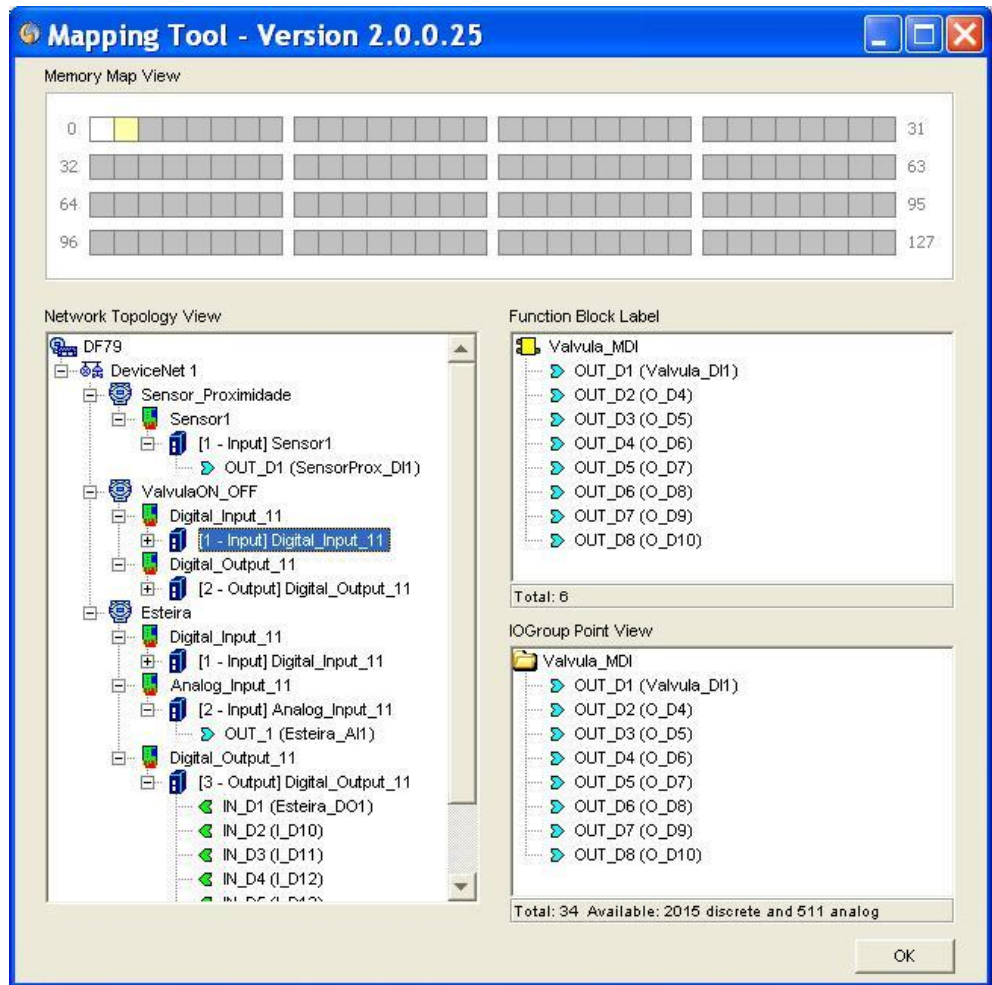
Right-clicking this point and choosing **Delete** it can be deleted, or some attributes can be defined for better identification through the **Attributes** option.



**Figure 21. 34 – Changing the point attributes**

Fill the necessary fields, and click **OK**.

After mapping and configuring all points, the **Mapping Tool** will be as in the following figure.



**Figure 21. 35 – Mapped points in the Mapping tool**

Click **Ok** to exit from **Mapping Tool**. Return to **Syscon**. The mapped blocks are already inserted in the area.

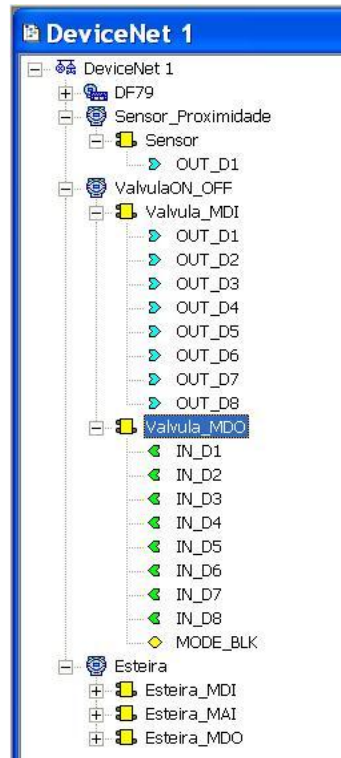


Figure 21. 36 – Mapped function blocks in the Syscon

The device's attributes can be verified right-clicking it. The following window will appear, and the information cannot be modified.

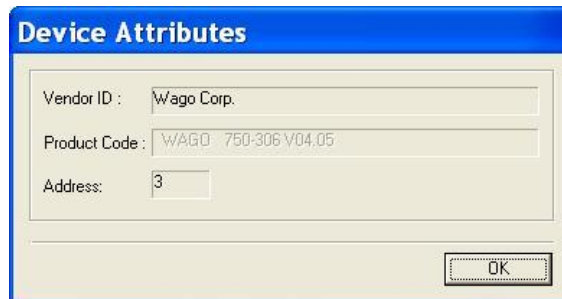


Figure 21. 37 – Verifying the device's attributes

The block's attributes can be verified right-clicking it. The following window will appear, and the information cannot be modified.

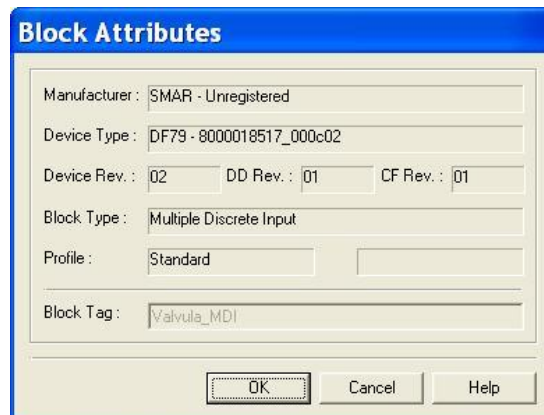


Figure 21. 38 – Verifying the block's attributes

## Adding Other Function Blocks

### Step 9

Now the user can add Function Blocks that will be used in the strategy.

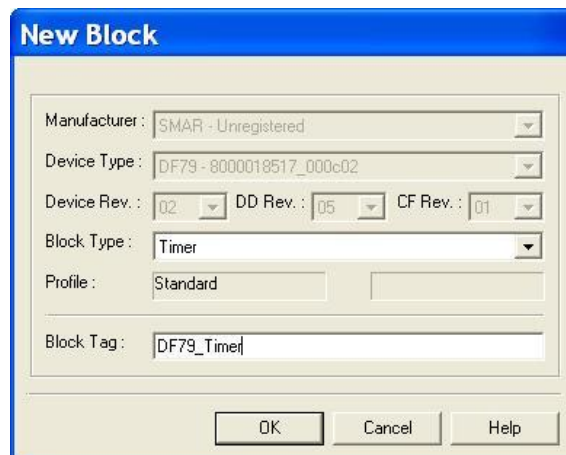
To insert a new FB (Function Block), click the sign , right-click the **FB VFD** (Virtual Field Device) icon and choose **New Block**. The FB VFD is responsible for the data management.



**Figure 21. 39 – Inserting new function blocks to the device**

The **Function Block Characterization** dialog box will appear. The **Block Type** option has the available function blocks.

Select the block in the **Block Type** box and type its tag in the **Block Tag** box:



**Figure 21. 40 – Selecting the function blocks that will be added to the device**

For this example, the Timer and Constant blocks should be added to the DF79. The DeviceNet network can be seen in the next figure.

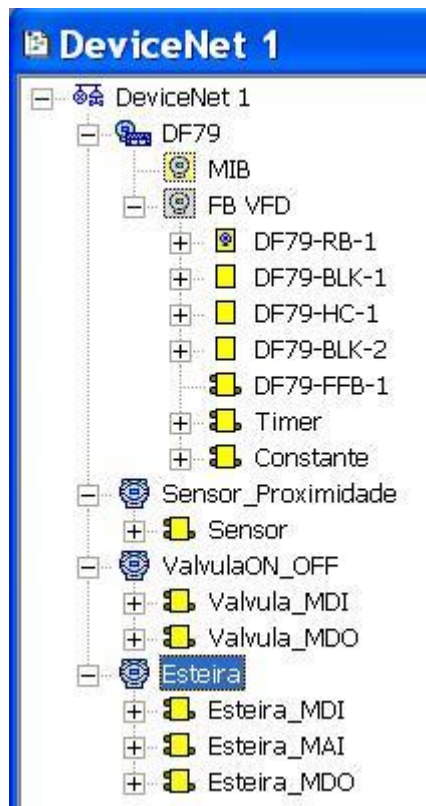


Figure 21. 41 – DeviceNet network with devices and function blocks inserted

## Creating New Areas

### Step 10

The user can create the strategy for the **Application (Logical Plant)**. First, it is necessary to create a new area.

The **Logical Plant** can be divided in several areas according to the area.

To create a new Process Cell, right-click the **Application** icon and choose **New Process Cell** item.

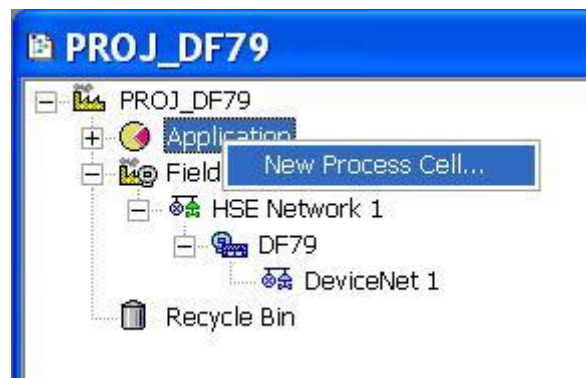
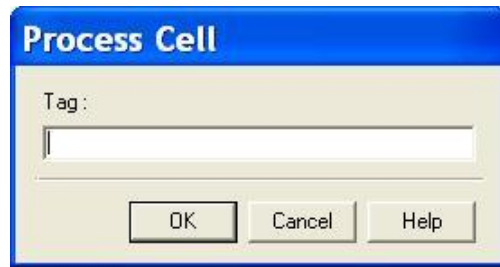


Figure 21. 42 – Inserting the Process Cell

The dialog box to name the **Process Cell** will open:



**Figure 21. 43 – Naming the Process Cell**

If the user needs to give a name for the Process Cell, enter the name in the tag box and click **OK**. The default tag is **Process Cell 1**. This number will increase when new areas are created. To create more areas, the user can repeat the last step.

After inserting a Process Cell, the **Proj\_DF79** window will be according to the following figure.



**Figure 21. 44 – Area window with the Process Cell added**

**NOTE**

The user must remember the **Application** is just a virtual division, and its purpose is to divide a large project.  
 For example: if the plant has 2 networks, they can be called **Process Cells** in the **Syscon**. One **Application** can have several **Process Cells**, but the **Process Cells** can not be in more than one **Application**.

## Creating a Control Module

### Step 11

Right-click the **Process Cell 1** icon and choose **Expand** item.



**Figure 21. 45 –Creating a control module**

To arrange the screen, click the **Process Cell 1** window. So, choose **Window** menu on the **Syscon** toolbar and then **Tile** option.

As following, return to the **Process Cell 1** window. Right-click the **Process Cell 1** item and choose **New Control Module**. The next figure shows creating the New Control Module.

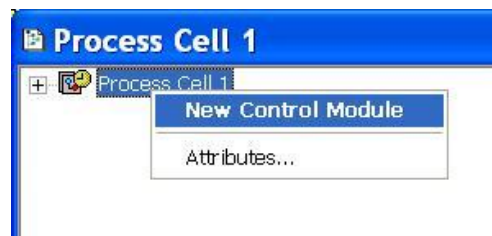


Figure 21. 46 – Creating a New Control Module

The **New Control Module** dialog box will appear. Name it with the tag related to the Application Area. To conclude this task click **OK**.

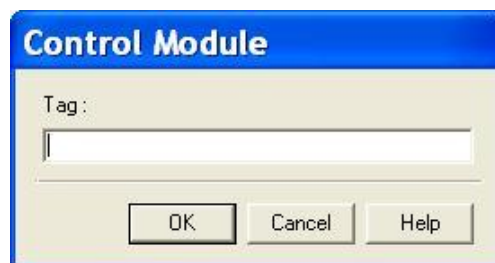


Figure 21. 47 – Naming the Control Module

**IMPORTANT**

Remember that not all characters are valid when naming the elements with tags.

## Inserting Blocks to the Control Module

### Step 12

The user can insert (attaching) the blocks for the corresponding devices in the **Logical Plant**. Right-click the **Control Module 1** icon, and then select **Attach Block** option, as shown in the following figure.

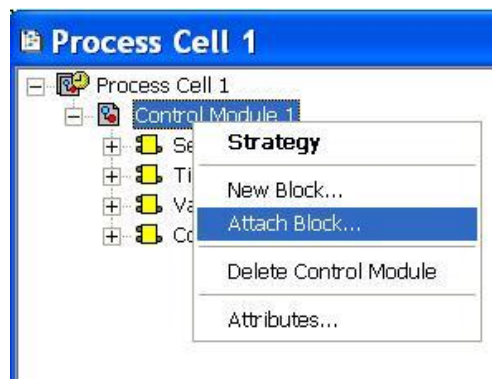


Figure 21. 48 – Attaching blocks to the Control Module

The **Attach Block** dialog box will open as shown in the following figure.

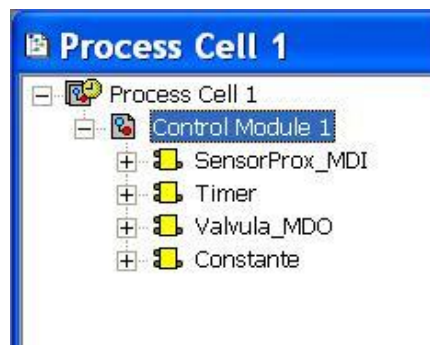




**Figure 21. 49 – Inserting blocks to the Control Module**

The available function blocks for the FB Application are in the **Attach Block** box. For the aimed control, the function blocks that must be inserted will appear in this box. So, select them, one by one, and click the **OK** button.

For the example of valve opening control, at the end of Attach Block process, the **Control Module** will be as in the next figure.



**Figure 21. 50 – Blocks inserted in the Control Module**

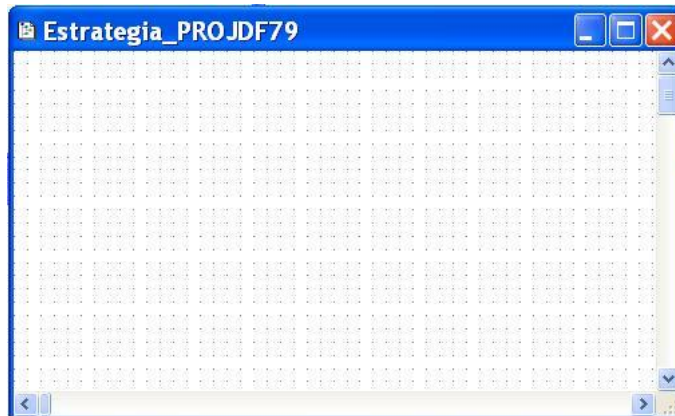
Another way to attach the blocks to the FB Application is left-clicking the element and dropping it to the window.

## Configuring the Control Strategy

### Step 13

Now the user is ready to develop the control strategy.

First, right-click the **Control Module 1** icon, and then select **Strategy** item. The Strategy window will appear as shown in the following figure.



**Figure 21. 51 – Strategy window**

The Control Module attributes can be changed by right-clicking the **Control Module 1** icon, and then select **Attributes** option. Do the necessary changes, and click **OK**. For further information about Control Module see **Syscon** manual.

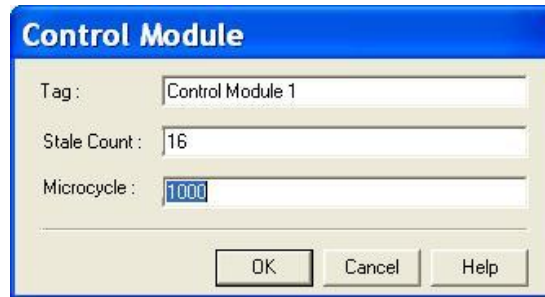


Figure 21. 52 – Changing the control module attributes

At this moment there are 3 or 4 windows opened in the **Syscon**. To arrange the screen, click the title of the **Proj\_DF79** window. On the toolbar, choose **Window → Tile**.


If the user does not have a monitor upper than 17", it is recommended to minimize the strategy window. Thus, it is possible to see the whole area.

The strategy window offers several tools for drawing. Refer to the **Syscon** manual for further details.

## Adding Blocks in the Strategy Window

### Step 14

Now the function blocks can be added to the **Estrategia\_PROJDF79** window.

In order, click the first block,  **SensorProx\_MDI**, and drop it into the strategy window. A function block will be created automatically.

The next figure shows the function block added to the strategy window:

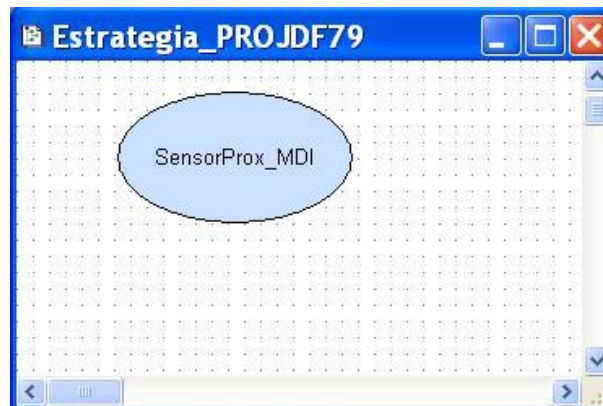


Figure 21. 53 – Block inserted in the strategy window

The drag-and-drop procedure must be repeated for the other blocks.

## Linking the Blocks

### Step 15

There is a specific tool to link the blocks, the **Link** button, , on the **Strategy** toolbar. For the aimed control link the **OUT\_D1** output of the SensorProx (where the proximity sensor was mapped) to the **IN\_D1** input of the TIMER block.

Click this button on the toolbar, and then in the SensorProx\_MDI function block. The dialog box for linking the input and output parameters will appear. Select **OUT\_D1** block output, and then click **OK** as shown in the following figure.

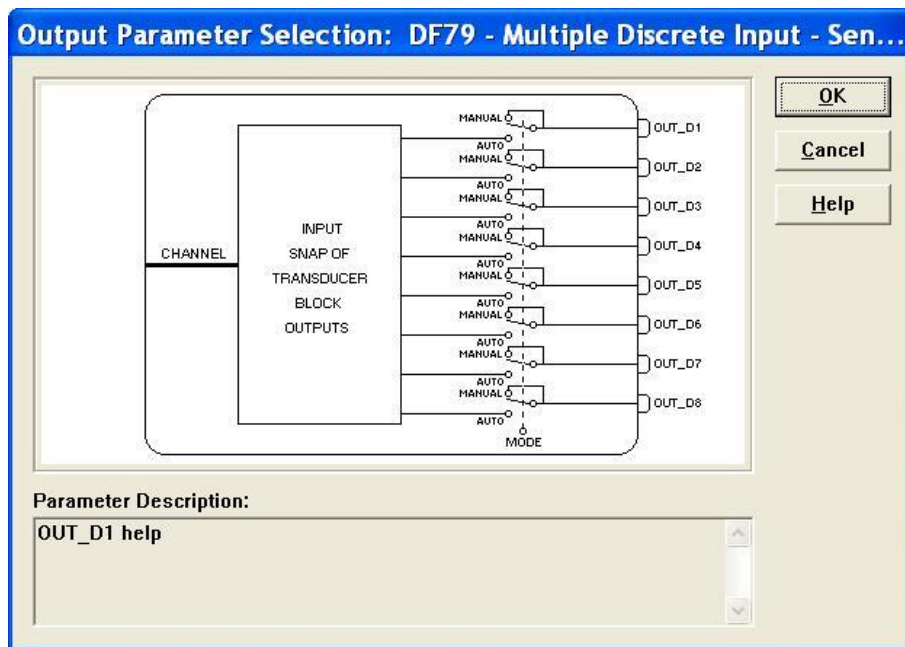


Figure 21. 54 – Linking the function blocks

The user also does the fast link procedure just right-clicking the function block, and does the necessary links.

After linking the specified parameters above, the strategy window will be as shown in the following figure.

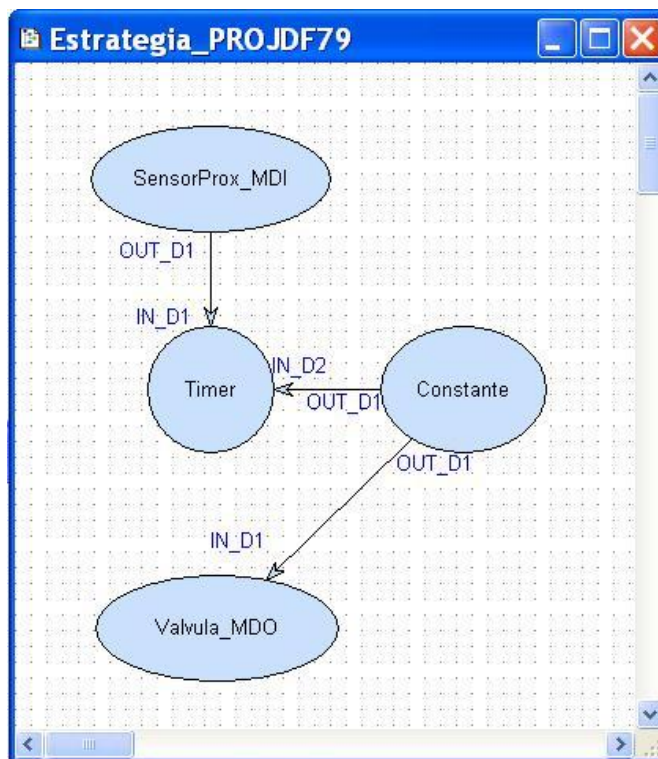


Figure 21. 55 – Linking the Blocks

## Block Characterization

### Step 16

The function blocks that are in the area must be set according to the application for them. So, it is necessary to do the block characterization.

The online and offline modes are possible for the block characterization. In the offline mode, the parameters are set before starting the communication among the devices. The online characterization is executed directly in the devices when the plant is already communicating, and the download to the devices was done.

To change the function block parameters, consider the following topics:

#### 1. In the Strategy window

Select the block to characterize. Right-click it, and select **Off Line Characterization** or double-left-click it. The next figure shows the block that is being done the offline characterization.

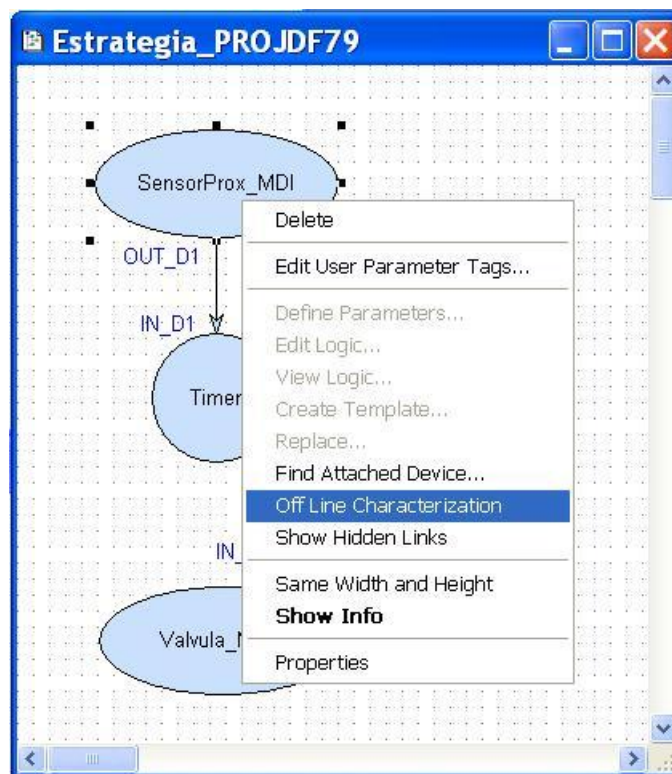


Figure 21. 56 - Offline characterization in the Strategy window

#### 2. In the DeviceNet1 window

Another way to do the offline characterization is right-clicking the function block, and then selecting the **Off Line Characterization** option, as shown in the following figure.

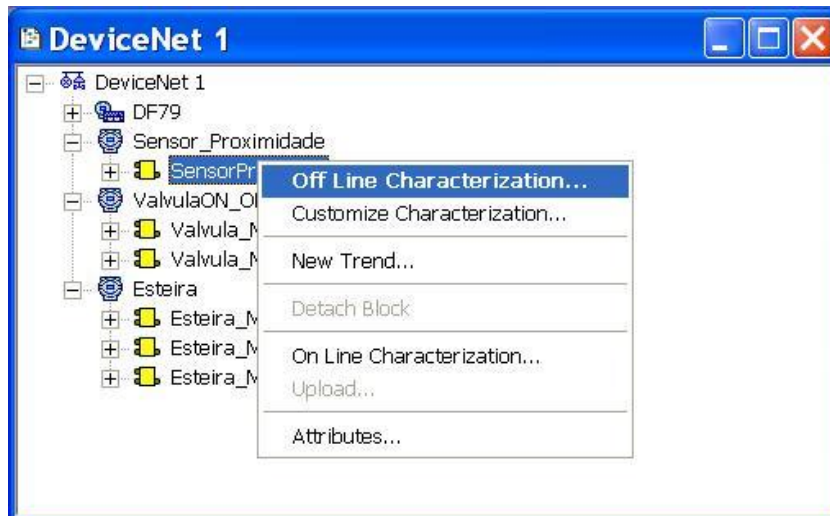


Figure 21. 57 - Offline characterization in the DeviceNet1 window

For both situations, the **Block Characterization** dialog box will appear:

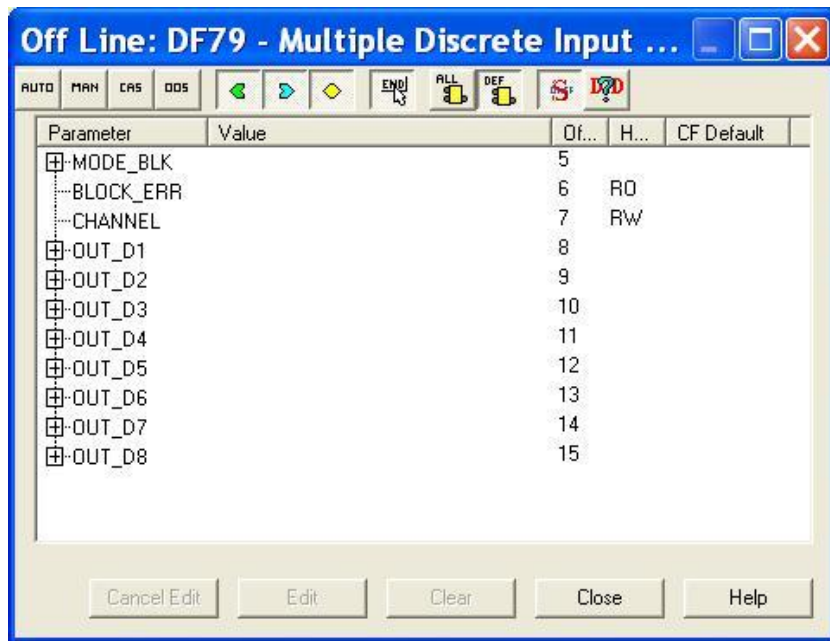


Figure 21. 58 - Function block characterization dialog box

Double-click at the right side of the parameter to change it. Another option is click once and then in the **Edit** button to start editing the parameter value. At the ending, click **End Edit** button.

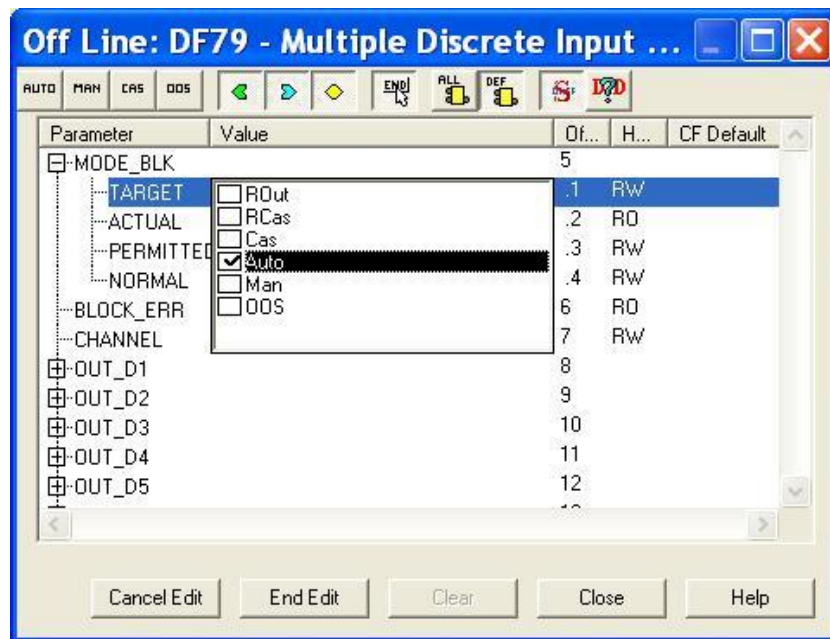


Figure 21. 59 - Editing the parameter in the Function Block Characterization box

An important parameter which has to be configured in all function blocks is **MODE\_BLK**. It determines the block operation – Out of Service (OOS), Manual (MAN) or Automatic (AUTO). All blocks for the aimed control have to be with **MODE\_BLK.TARGET** parameter in Auto.

Each block has a specific configuration parameter. For further information about each block refer to Function Blocks manual.

**NOTE**

For the IO DeviceNet blocks is not necessary to configure the **CHANNEL** parameter. This parameter only will be used when IO blocks are used to map local IO points (IMB).

## Commissioning and configuration download to the controller


After the parameter setting, the user can start the device communication. It is necessary commissioning the devices to attribute the tags, IDs and device addresses properly. If this procedure is not executed, the **Syscon** will detect the uncommissioned device and the download for this device will be canceled. Finishing the device commissioning, the download process can start.

The download process (**Syscon**) can be done in two main ways:

- Download of the plant – in this case will be downloaded all configurations of all controllers.
- Individual download in the controller – in this case will be downloaded all configurations of a single controller.

The controller configuration can be performed in several ways depending of the alteration. But the download performed by **Syscon** is the most recommended, because it controls the changes of all tools.

**Syscon** has two download types: total and incremental. The main difference is that the “total” cleans initially the configuration before downloading the new one while the “incremental” only downloads that has changed.

The download process can be executed, for example, returning to the **Proj\_DF79** window, right-clicking the **Fieldbus Networks** icon, , and then selecting the **Download** option

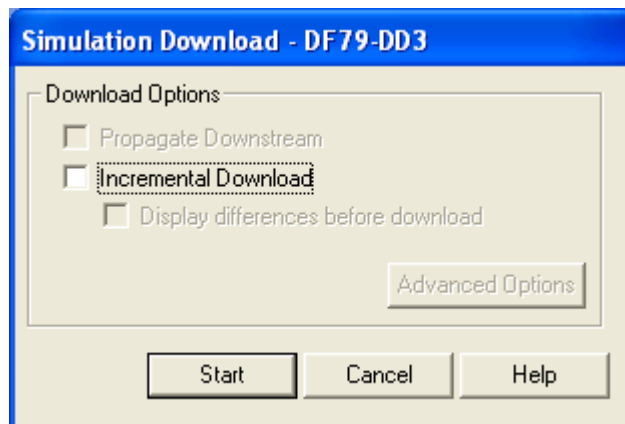


Figure 21. 60 – Download options

Selecting the incremental download, and then **Advanced Options** the user can select several items to be downloaded. See the figure below.

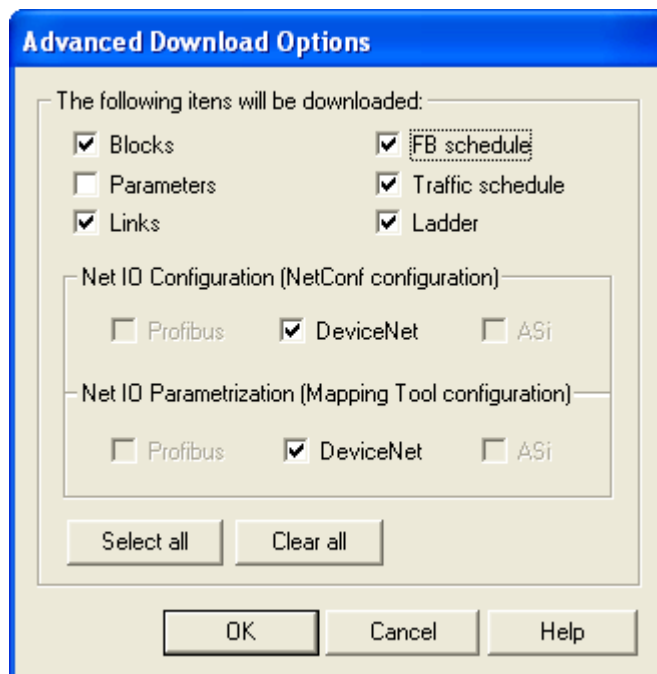


Figure 21. 61 – Advanced download options

The **NetIO Configuration** option refers to the network topology configuration edited by the **Network Configurator**, and if it is selected the incremental download will be done. This operation must be done carefully because it stops the DeviceNet network.

The **NetIO Parameterization** option refers to the points parameterization configuration of network devices (points' tags, scales, data types) and when it is selected the incremental download will be done.

The next topic is maintenance guide which informs the recommended download type depending on the operation performed.

For further details about the available download types and commissioning, refer to the **Syscon** manual.

## SYSTEM302 maintenance procedure

In this section is presented a summary of download procedures that are recommended in cases of configuration maintenance using **SYSTEM302**.

**SYSTEM302** has several download types and here is recommended a general type to meet the majority of cases. However other ways can be used. For further information refer to **Syscon's** manual.

In the column **Recommended Download** is the type of chosen download. At **Syscon** it can be incremental on the plant or in the controller. Refer to **Syscon's** manual for further information.

| MAINTENANCE EVENT  | SOFTWARE  | RECOMMENDED DOWNLOAD  |
|--|---|---|
| Do a new SYSTEM302 configuration using DeviceNet controller and ladder logic.  | Syscon, Network Configurator, Mapping Tool, LogicView for FFB | In Syscon do the plant incremental download*                  |
| Changing only the ladder logic.  | LogicView for FFB   | In LogicView for FFB do the download of the logic.            |
| Add FFB parameters and make HSE links or only add parameters to the FFB block that already has HSE link.                 | Syscon  | In Syscon do the plant incremental download*                  |
| Add or remove a FFB link to internal blocks within the same controller.  | Syscon  | In Syscon do the controller incremental download*             |
| Add a new device in the network or change its configuration (address, cyclic mapping, tag)                               | Network Configurator  | In Syscon do the controller incremental download*             |
| Change device configuration (address, cyclic mapping, tag)   | Network Configurator  | In Syscon do the controller incremental download*             |
| Change the interface parameters of the field device (scale, little/big endian, accessed bytes)                           | Mapping Tool  | In Syscon do the controller incremental download*             |
| Change media parameters (baud rate, communication configuration).  | Network Configurator  | In Network Configurator do the download of DeviceNet network* |
| Change configuration parameters of the field device hardware (acyclic configuration) or enable/disable the slave device. | Network Configurator  | In Network Configurator do the download of DeviceNet network* |

**Table 01 – Recommended download procedures**

Note: \* These operations will stop the DeviceNet channel.



## DeviceNet Advanced Topics

The DeviceNet protocol has two basic message types - IO messages or IO connections, and explicit messages. Each one is appropriate to the particular type of data, as described below:

**IO Messages:** type of synchronous telegram dedicated to move priority data between a producer and one or more consumers. Divided according to the data exchange method that are:

|                 |  |
|-----------------|--|
| Polled          | Communication method in which the master sends a command message to a specific slave (peer to peer) and the slave’s response is directly to the master.  |
| Change of state | Communication method in which data exchange between master and slave only occurs when there are changes in the monitored/controlled values up to certain time limit (heartbreaker). When this limit is reached the transmission and reception will occur even if no changes were done. |
| Bit-Strobed     | Communication method in which the master generates a multicast request in the network bus and all the slaves with bit-strobed communication response one after another.  |
| Cyclic          | Communication method in which the slave updates its data in the network master at pre-defined time intervals.  |

**Explicit message:** type of general use telegram and non-priority. It is mainly used in asynchronous tasks such as device’s parameterization and device’s configuration.

**UCMM (Unconnected Message Manager):** it is responsible to process the requests and responses of the unconnected explicit messages. These characteristics are supported by devices with peer to peer communication capability.

Devices which support UCMM must support group 3 messages. The devices which do not support UCMM support messages of group 2 Unconnected. Group 3 or group 2 Unconnected are acyclic message types to establish initially the connection between master and slaves or for acyclic information exchange among them.

The DeviceNet protocol requires a connection to a device must be previously established in order to exchange information with that device. To establish a connection each DeviceNet product may send an UCMM message group 3 or Group 2 Unconnected. After establishing communication, the connection is then used to exchange information from one node to another, or to connect additional I/O. Once the I/O connections have been established, I/O data can be transferred between the devices in the network.

### ATTENTION

To establish a communication with the device the master has to know if it supports UCMM or not. By default the DF79 assume that every slave device does not support UCMM. Information about support or not to UCMM are from the device’s manufacturer or can be discovered through self-detected device shown later in this section.

The words “produced” and “consumed” are used below. They have as reference the slave device. The “produced” word indicates that the slave produced reading data to the master (DI, AI), that are produced by slave, and the consumed word indicates writing data deriving from master (DO, AO) that are consumed by slave.

## I/O Messages Configuration in the Network Configurator

The configuration of I/O messages is done in the **Network Configurator** as in the step 6 previously shown. The figure below shows **IO connection** information.

Figure 21. 62 – Editing window of IO connection parameters

The information from **Actual chosen IO Connection** is dependent from the configured slave device. This information is obtained from manufacturer EDS file. Generally all devices support Polled type communication (Poll). It is possible to configure more than one communication type to the same slave since it supports it, for example, polled and bit-strobed.

The **UCMM check** (Group 1, 2, 3) option has to be selected when the slave supports UCMM messages.

The **Expected packet rate (EPR)** means:

- When **IO Connection** is **Cyclic** the EPR controls the time that the data will be produced.
- When **IO Connection** is **Change of state** the EPR indicates the watchdog time of the connection (heartbreaker).

The **Production inhibit time (PIT)** is the minimum delay time, in milliseconds, to produce new data. In this case the device suppresses new data production up to the PIT to expire.

The **Watchdog Timeout Action** field defines the watchdog function when the device's watchdog timer expires. In this case it may have the following actions:

- **Transition to Timeout:** The connection assumes the timeout status and remains in this state until it to be reset or deleted.
- **Auto Delete:** The connection is automatically deleted when there is inactivity or a watchdog timer occurs.
- **Auto Reset:** The connection is automatically reset when inactivity or watchdog timeout occurs.

The **Fragmented Timeout** field is the *timeout*, in milliseconds, when there are fragmented messages. Any messages larger than 8 bytes will be fragmented. For example, a device with more than 8 bytes produced or consumed creates a fragmented message.

## Network Configurator online communication with the controller

With the **Network Configurator** is possible to communicate directly with the DF79 controller. It is important to perform some functions such as configuration download to the DeviceNet slave, to check some network diagnostics, viewing and changing slave parameters, baud rate changes, and others.

This communication can done via serial port (connecting a serial cable to the computer and to the controller's RS-232 port) or through Ethernet network. To inform which serial port will be used, first select the configuration master device, and then in the **Network Configurator** toolbar select **Settings**→**Device Assignment**. The following figure will appear.

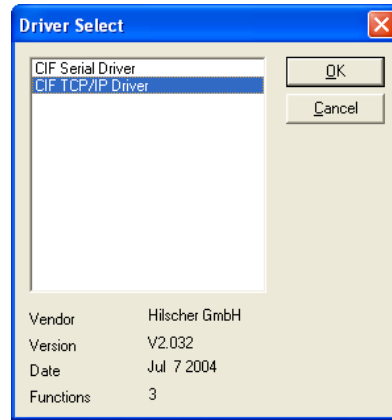


Figure 21. 63 – Choosing the communication driver

Select the **CIF TCP/IP Driver** option if the TCP/IP port will be used for communication; it is the typical case, and click **OK**. The following figure will appear. Then, enter the master’s IP, and click **Add**.

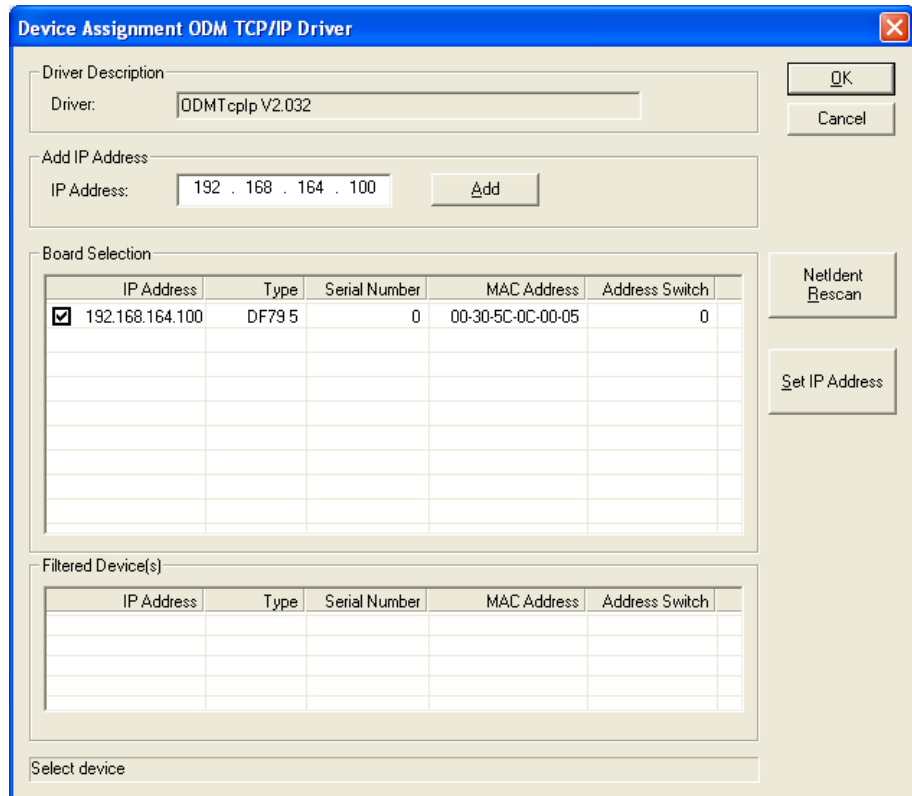


Figure 21. 64 – Device Assignment of the master device

In the **Board Selection** frame a line for a controller on the network should appear. Select this line, and click **OK**.

After these steps the **Network Configurator** already communicates online with the controller. In the following sections are detailed the main operations of online communication with the controller.

**ATTENTION**

After to establish the online communication the user can download the configuration by the **Network Configurator**. However this download is incomplete unlike that done by **Syscon**. The download by **Network Configurator** only deals with the communication with slaves, and does not deal of the control logic.

Therefore, every time that some equipment is included, the amount of IO message parameters or the devices' tags are changed the user has to do a download by **Syscon**.

**Explicit message configuration**

To configure the devices which have explicit message configuration is necessary to click **Parameter data** button in the device configuration window.

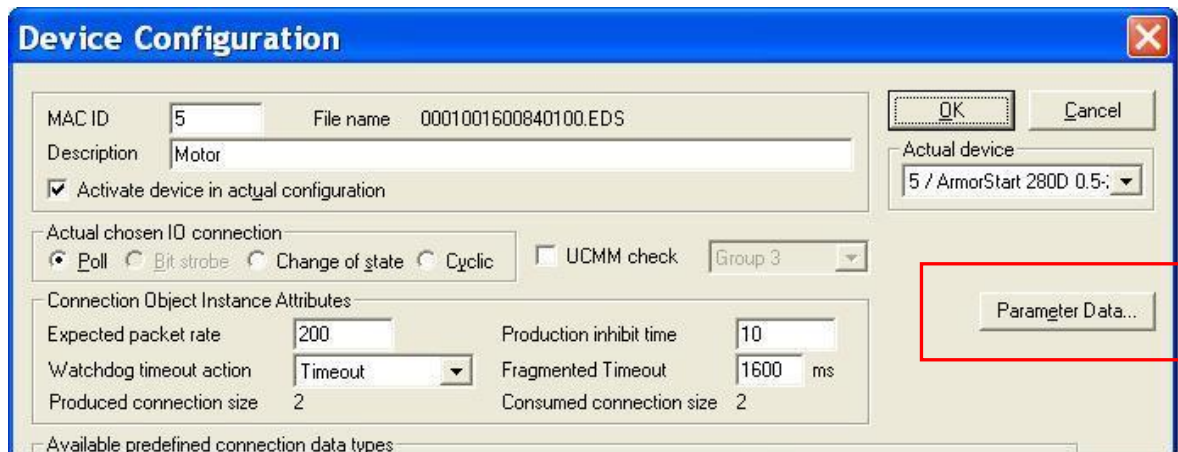


Figure 21. 65 – Parameter Data Option

All the slave's parameters will appear. See an example in the following figure. The parameter data window is divided in two parts: the supported parameters are in the upper part (in this case, the *ReadOnly* and *ReadWrite* are showed) and in the bottom part are the parameters configured by user.

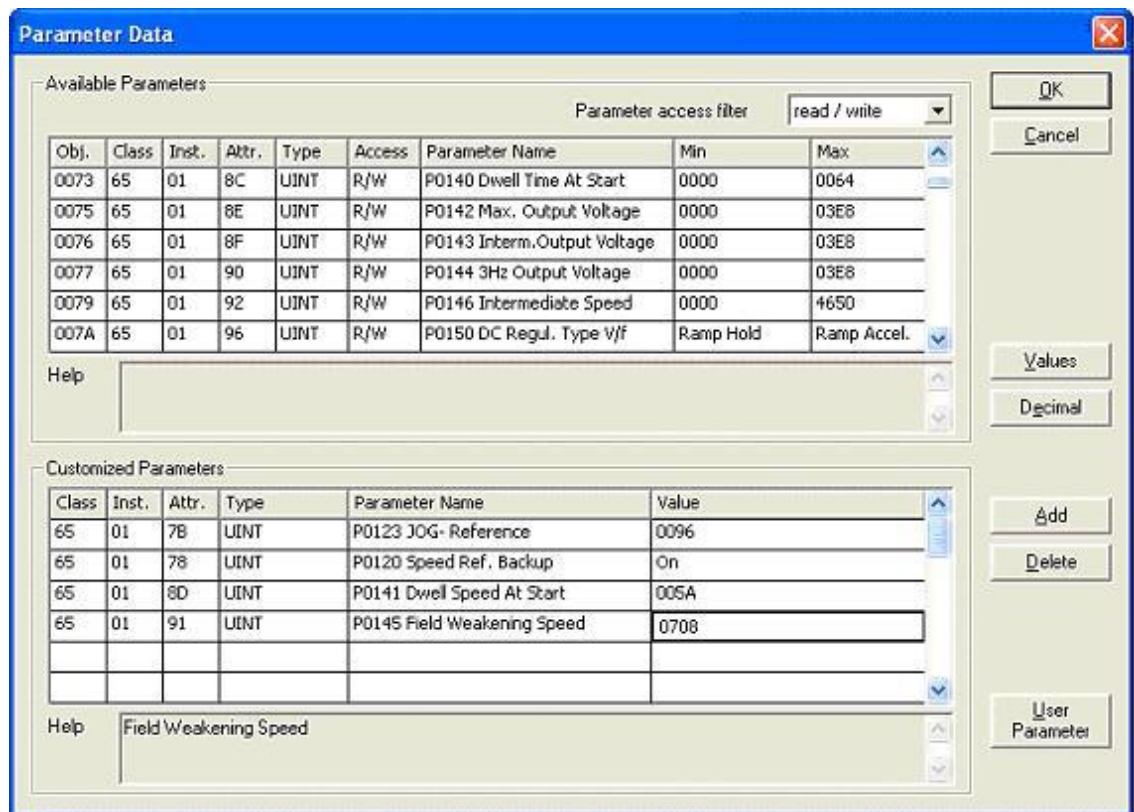


Figure 21. 66 – Editing window of the explicit message parameters

To configure a parameter the user has to select it in the **Available Parameters** section. Double-clicking the parameter, automatically it enters in the user-configured parameter list in **Customized Parameters**. In this section the user can change its value and save it to be downloaded with the configuration. The parameters which have “R/W” (ReadWrite) in the column **Access** can be configured by user.

#### ATTENTION

The change of configuration parameters is done offline and in order to change the new values in the slave devices is required to download (which can be used both by the **Network Configurator** or by **Syscon**). **But all download operation stops the DeviceNet channel.**

### Online Reading/Writing of slave’s parameters

The change of slave’s parameters may be done online through explicit messages. For example, is necessary to change the value of **P0145 Field Weakening Speed** parameter of the previous figure without stopping the slave communication.

The online change is done through the **Get device attribute / Set device attribute** command.

To change or read a parameter, first, the online communication between the **Network configurator** and controller must be established, as mentioned before in the **Network Configurator online communication with the controller** topic. Then, in the **Network configurator** main window click **Online** menu, and select **Get/Set device attribute**. See the following figure.

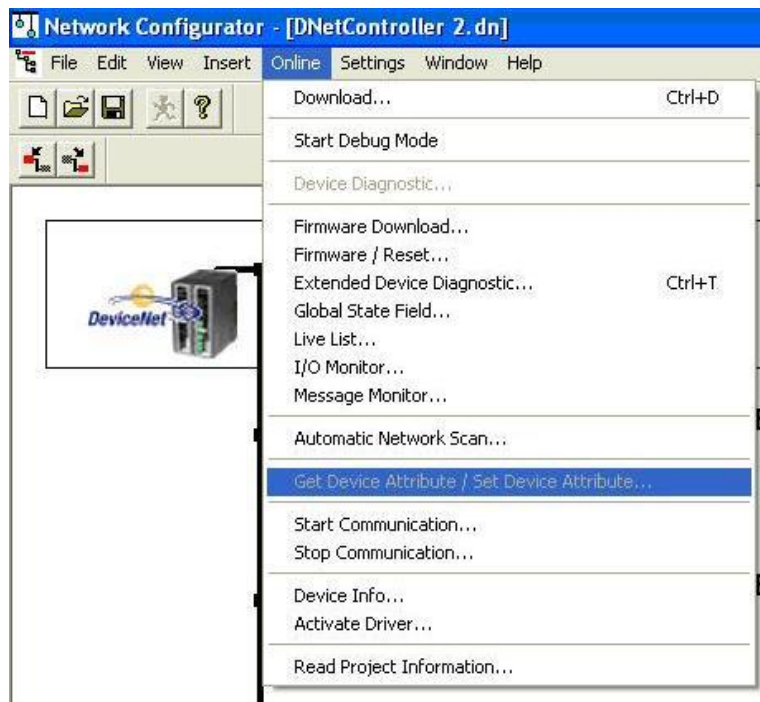


Figure 21. 67 - Online menu – Get/Set Device Attribute option

And then, inform the class, instance and attribute of the parameter. This information is in the **Parameter data** window in decimal values. Consider the example in Figure 21. 66, to change the **P0145 Field Weakening Speed** parameter is necessary to set class = 101 (0x65), instance = 1 (0x01) and attribute = 145 (0x91). Finally choose to read (**Get**) or to write (**Write**). The values always appear in hexadecimal. The next topic has an example of **get/set parameter**.

#### ATTENTION

Changing parameters online does not save them in the configuration. If a different value is set offline (as mentioned before) in the next download the parameters that were configured online may not have persistence.

## Changing the address via software

The address changing of some DeviceNet devices must to be done only via software. In these cases the user must first communicate with the slave on its current address and in the **Get device attribute / Set device attribute** window to inform class = 03, attribute = 01, instance = 01. This address is standard and common to all devices.

For example, to change the address of PSH5 from 52 to 53, first communicate online with the device (at the address 52). Then in the **Get attribute/set attribute** window just configure class = 03, attribute = 01, instance = 01, and value = 35h (53 in decimal). See an example in the following figure:

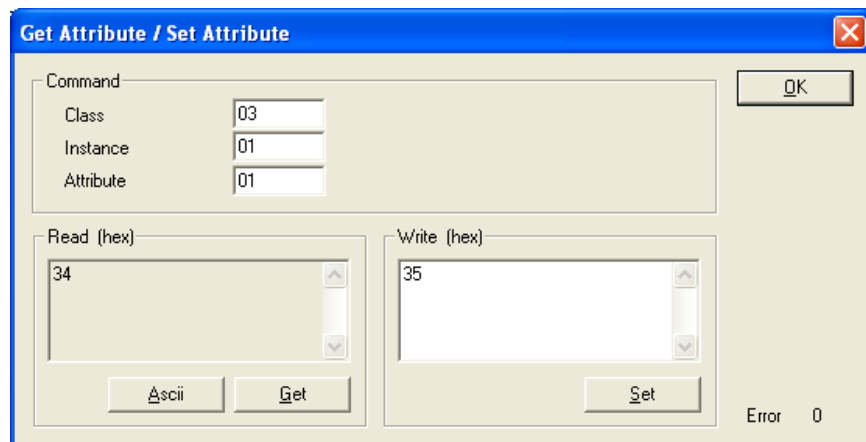


Figure 21. 68 – Get attribute/set attribute window

#### ATTENTION

The user can also change the slave address through the **Live list** option from the **Online** menu of **Network Configurator**. On DF79, this procedure may stop the DeviceNet channel, and the controller has to be restarted.

For further details refer to the **Troubleshooting** section of **SYSTEM302 Handbook**.

## Enabling and disabling a device in the configuration

Another interesting feature of the **Network Configurator** is the ability to enable or disable a slave device in the configuration without affecting any configuration mapping or logic. This operation is done in the device configuration window (Figure 21.16) selecting or not the **activate device in actual configuration** check box.

When the device is disabled an **X** appears in the main window of **Network configurator** indicating that the master is not scanning it. In this state despite the controller does not change the logic configuration and the device's mapping, it does not perform any operation with this device (cyclic and acyclic communication).

The controller will recognize this changing only after the configuration to be downloaded. This download can be done via Network Configuration or via **Syscon**. Remember that this operation stops the DeviceNet network.

To enable again the device proceed in the same way described above. In this case, the **X** disappears from the **Network Configurator** main window and the controller returns to update the device's data in the logic.

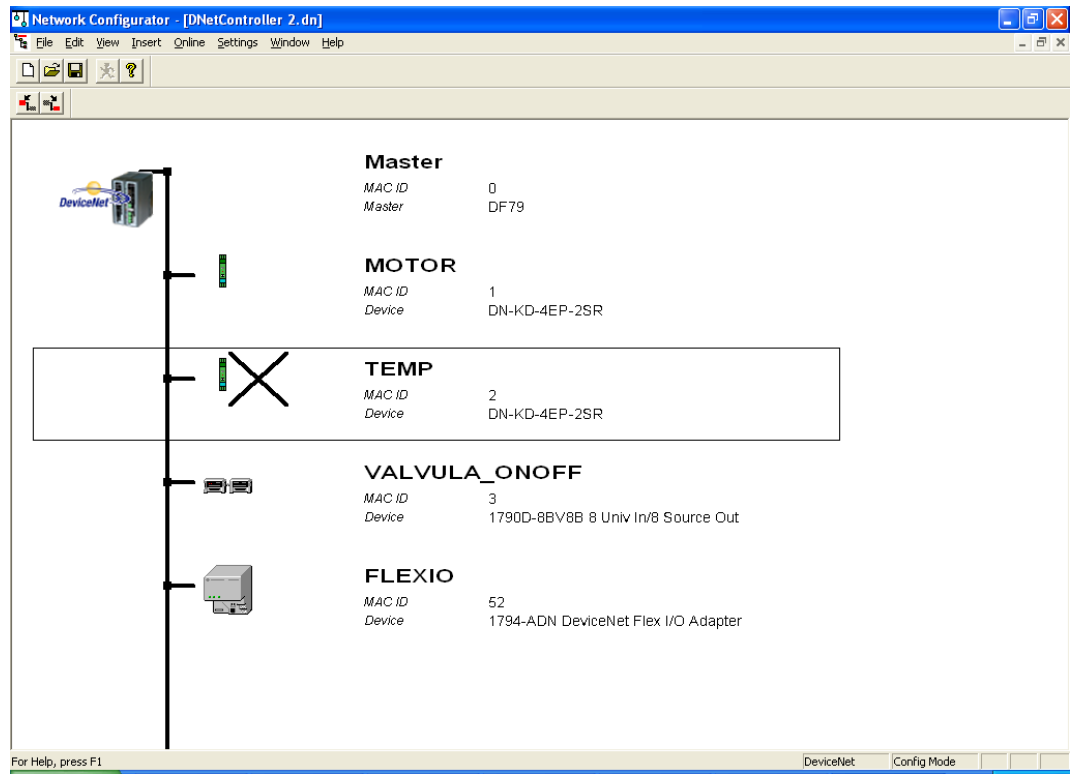


Figure 21. 69 – Example of disabled device (device with MAC-ID=2)



## Network Diagnostics

There are many ways to identify communication failures in the DeviceNet network. Some options are: Network Configurator, Transducer block, or module’s LEDs. These options will be explained in this topic.

### Network diagnostic using the Network Configurator

To do a network diagnostic through **Network Configurator** first is necessary to its connection to the controller (refer to **Network Configurator online communication with the controller** topic). Thus, some diagnostics are possible, such as Livelist, Start Debug Mode, IO Monitor, and others. They will be explained following.

#### Livelist

One of the first diagnostics that can be done is the **Livelist** of network devices. The DeviceNet **Livelist** is accessed through menu **Online → Livelist**. This Livelist shows the addresses of all active devices on the network, configured or not.

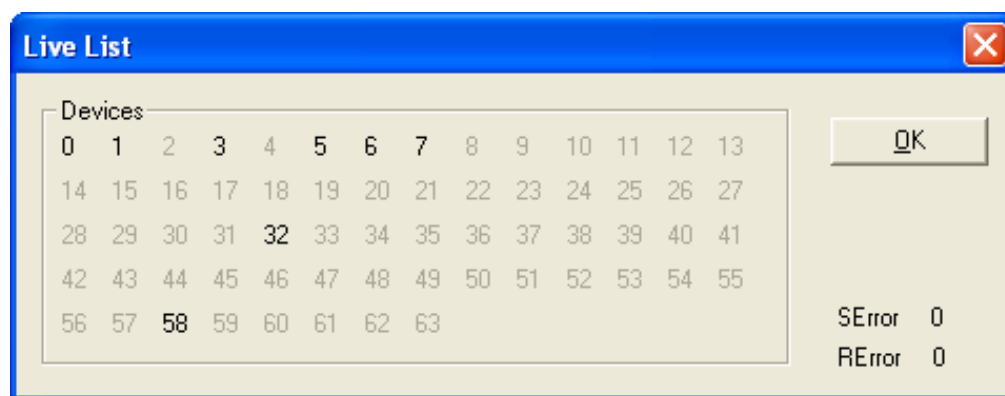


Figure 21. 70 – LiveList of the devices on the network

#### ATTENTION

Sometimes after trying to access a device that is not configured is necessary to download the configuration through the **Network Configurator** to restart the communication of DeviceNet network or with the controller. However, from the moment the configuration is valid the download operation is unnecessary. This is necessary when, for example, there is a network physically configured, but the Livelist shows nothing of the device.

Remember that every download operation stops the DeviceNet channel.

#### Global Diagnostic

Another available diagnostic in the **Network Configurator** is the **Global State Field**. This diagnostic provides an overview of the configured devices. It is used when there are many devices on the network, because it concentrates on a single window the diagnostic of the network master and the devices’ status. To access this diagnostic click **Online → Global State Field**.

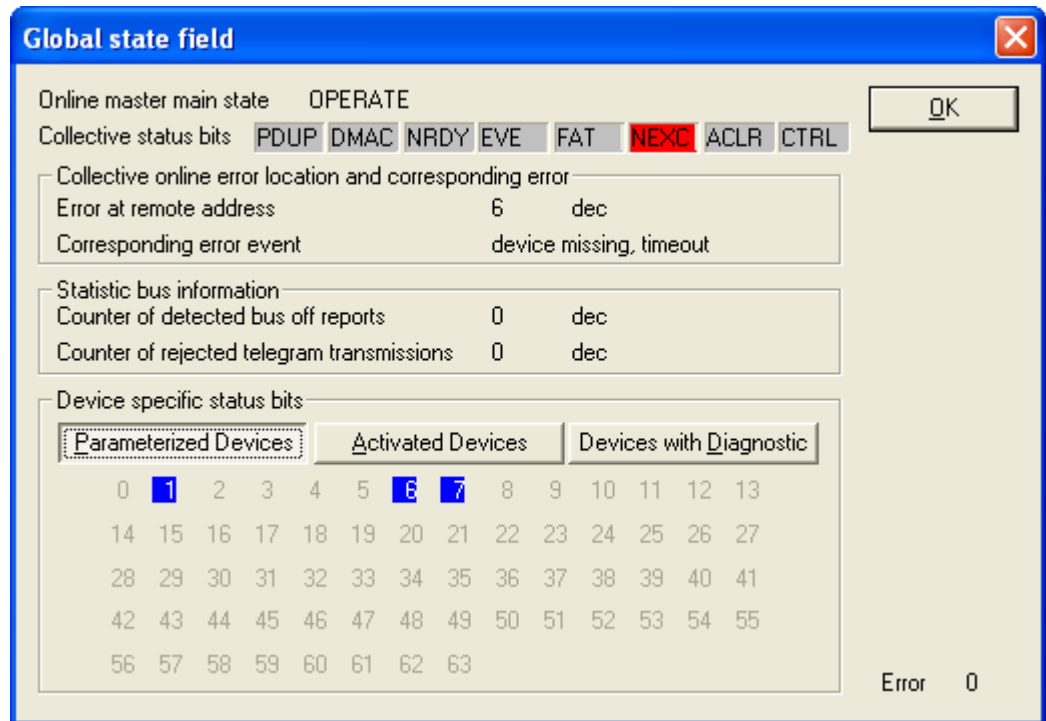


Figure 21. 71 – Global diagnostic of the network’s events

The figure above has an example of global diagnostic. Each parameter will be explained below:

**Online master main state:** indicates the current status of the DeviceNet network master. Possible status:

OFFLINE (00h), STOP (40h), CLEAR (80h), and OPERATE (C0h).

**Collective status bits:** these bits indicate an overview of the network global events, deriving from the master and the devices.

| BIT | MESSAGE | DESCRIPTION   |
|-----|---------|---|
| 0   | PDUP    | DUPLICATE-MAC-ID is performed – If this bit is activated the controller is checking the duplicate MAC_ID.                       |
| 1   | DMAC    | DUPLICATE-MAC-ID detected - Indicates that the controller found on the network equipment with the same MAC_ID.                  |
| 2   | NRDY    | HOST-NOT-READY-NOTIFICATION- If this bit is activated the controller is not available for communication.                        |
| 3   | EVE     | EVENT-ERROR The controller detected a short circuit in the bus. The number of detected events is in the bus_error_Cnt variable. |
| 4   | FAT     | FATAL-ERROR Due to information overload on the bus, the communication cannot continue, there is no available bandwidth.         |
| 5   | NEXC    | NON-EXCHANGE-ERROR Up this moment one or more devices do not perform the cyclic data exchange.                                  |
| 6   | ACLR    | AUTO-CLEAR-ERROR Controller stopped the communication with all devices and performed the auto-clear.                            |
| 7   | CTRL    | CONTROL-ERROR Parameterization error.   |

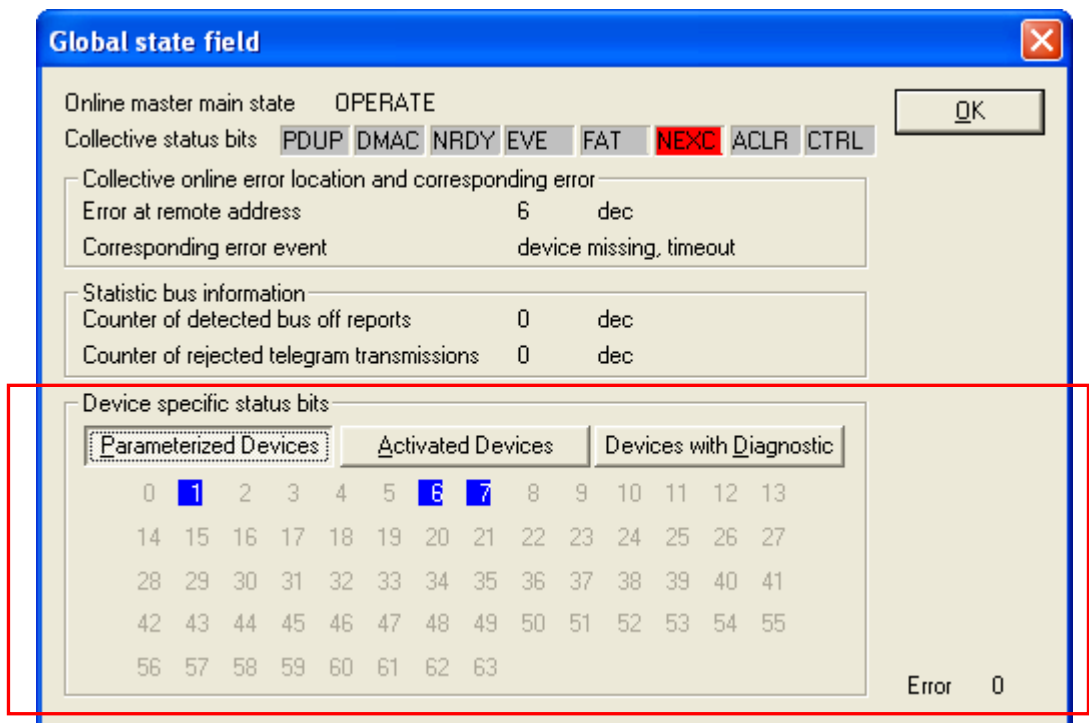
Table 02 – Description of GLOBAL\_ERROR parameter

**NOTE**

The bits shown on table 02 refer to **GLOBAL\_ERROR** parameter of the transducer block described following. However, the bits of **Collective status bit** are inverted compared to the **GLOBAL\_ERROR**, i.e., for the **Collective status bit** the flag **CTRL** corresponds to the bit 0 and **PDUP** corresponds to the bit 7.

**Collective online error location and corresponding error:** in this frame is specified in which network device the problem was detected, through the **Error at remote address** parameter, and in the **Corresponding error event** there is a brief description of it. If more than one device has an available diagnostic, on this frame the diagnostic that will appear is the one of the device with lesser MAC-ID.

**Statistic bus information:** in this frame appears the diagnostic of the physical network. Through the **Counter of detected bus off reports** parameter the low-quality transmission on the bus is counted (bus off) and the **Counter of rejected telegram transmissions** indicates the number of canceled transmissions and number of restarts of the CAN chip.



**Figure 21. 72 - View of Parameterized Devices status bits**

**Device specific status bits:** this frame presents a summary of the current status of all network devices.

- **Parameterized devices:** on this tab all included devices on the network and present on the last download are shown, even if they do not exist physically or have any kind of problem.
- **Activated devices:** on this tab all devices that reached the stage of data exchanging are shown. This indicates that master and slaves are exchanging cyclic I/O messages between them. Note that in the figure 21.72, compared to the previous figure, the device in the MAC-ID 6 is not present, because a **NEXC** event was reported to its address (*Error at remote address*)

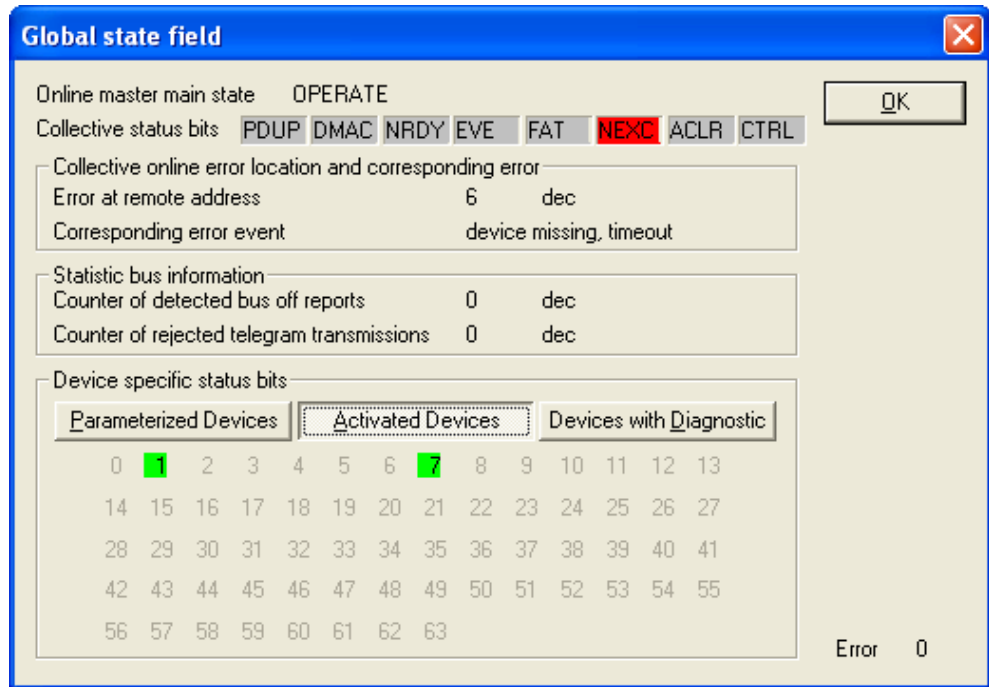


Figure 21. 73 – Activated Devices status bits

- **Devices with Diagnostic:** in the following figure is presented a list of devices with some diagnostic. Note that the devices with MAC-ID 6 and 7 are on the list, but only the diagnostic of the lower MAC-ID is on **Collective online error location and corresponding error** frame.

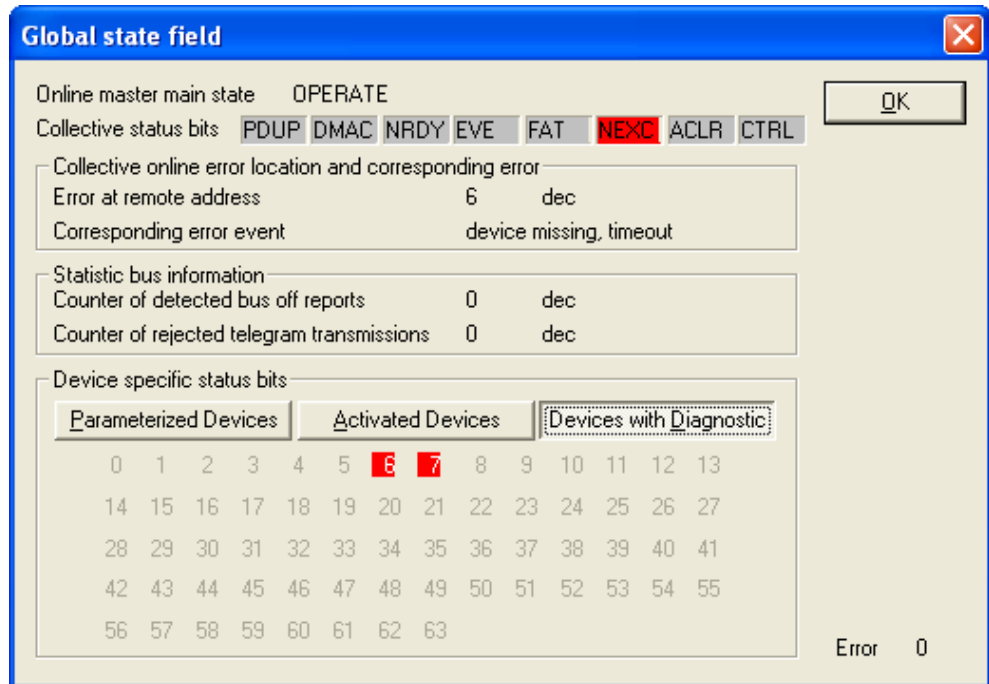


Figure 21. 74 – Devices with Diagnostic status bits

By clicking the missing devices, a detailed diagnostic of the error can be obtained, similar to that presented in the Start Debug Mode, which will be shown in the next item. Notice in the following figure that after clicking the diagnosis for the MAC-ID 7, its corresponding bit in the list devices with diagnostic ceases to be red, i.e., the diagnosis was read, and only return to be checked if there is one more instance to that address.

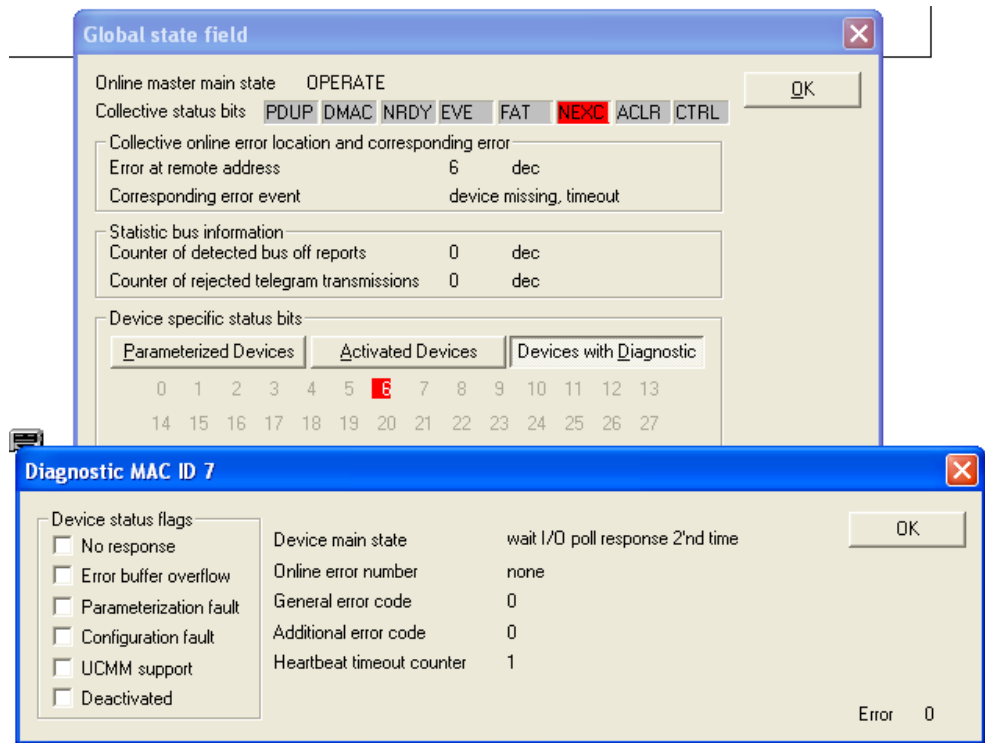


Figure 21. 75 – Detail of the error from the Devices with Diagnostic status bits list

### Start Debug Mode

Another available diagnostic in the **Network Configurator**, for the network device status, is the **Start Debug Mode**. To access this diagnosis, select the master device, and click **Online**→**Debug Mode**. See the following figure.

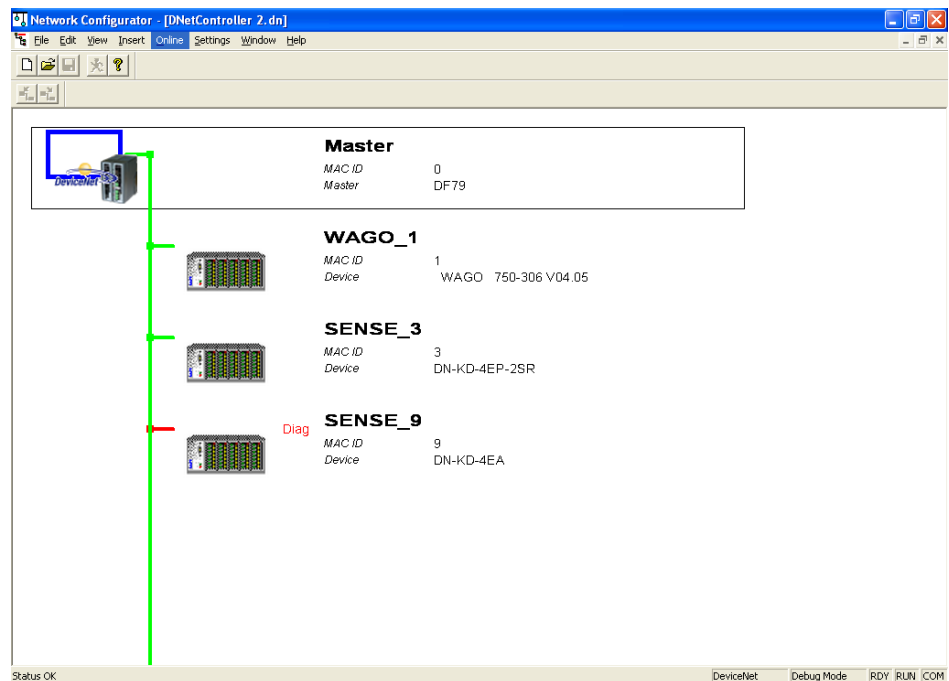


Figure 21. 76 – Doing the network diagnostic

In the previous figure there is a red-marked device with some available diagnosis. By clicking that device a window with diagnostic information will appear. See the next figure.

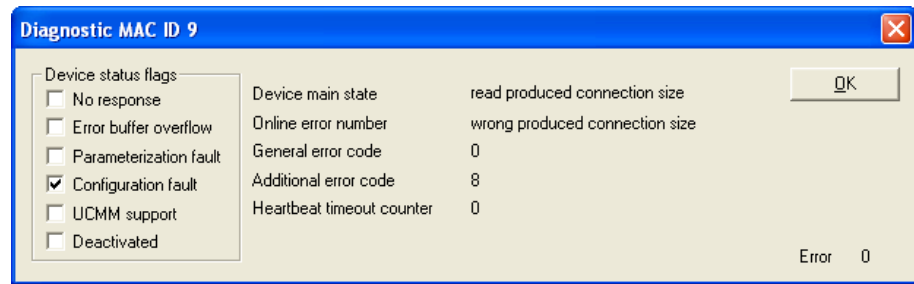


Figure 21. 77 – Description of device’s failure

The window is divided into several fields detailing the diagnosis:

- Device status flag
- Device main state
- Online error number
- General error code
- Additional error code
- Heartbeat timeout counter

Each one of this field can help solving the problem in question. They will be detailed following.

**Device status flag** shows the most general device’s diagnosis. In the table below there are its possible values.

| BIT | FLAG                          | DESCRIPTION  | POSSIBLE SOLUTION   |
|-----|-------------------------------|--|---|
| 0   | <i>No Response</i>            | Device does not respond to requests for communications.  | Check installations, cables and baud rate   |
| 1   | <i>Error Buffer overflow</i>  | Internal buffer of device is not consumed.   | Network with low time scan, device cannot send data produced.   |
| 2   | <i>Parameterization Fault</i> | Equipment was denied access to at least one attribute configured for writing.                              | <i>Host</i> trying to write in internal attribute in inadequate time. For example, an attempt to write in speed set point of a frequency inverter during operation. |
| 3   | <i>Configuration Fault</i>    | Configuration failure – difference between the configuration and the produced/consumed data by the device. | The quantity of produced/consumed configured is different from that available in the device.  |
| 4   | <i>UCMM Support</i>           | If this flag is selected the UCMM communication is supported.  | Device can establish direct connections to other devices which support UCMM.  |
| 7   | <i>Deactivate</i>             | Device is deactivated in the current configuration.  | Device was not commissioned and the configuration was not downloaded.   |

Table 03 – Description of Device status flags frame

Remember that “*produced*” indicates data which are produced by slaves and “*consumed*” indicates data which are consumed by slaves.

**Device main state** shows the device current status on the network, as follows.

| VALUE | MESSAGE  |
|-------|--|
| 0     | State machine enter  |
| 1     | Device inactive, not handled   |
| 2     | Own MAC ID, state waiting for all incoming duplicate MAC-ID requests |
| 3     | initialize internal predefined master slaves structures              |
| 4     | allocated predefined master slave connection set request             |
| 5     | wait for predefined master slave allocation connection response      |
| 6     | release predefined master slave connection set request               |
| 7     | wait for predefined master slave release connection response         |
| 8     | initialize internal I/O configured structures                        |
| 9     | allocate configured I/O connection request                           |
| 10    | wait for I/O allocation response                                     |
| 11    | release I/O connection request                                       |
| 12    | wait for I/O connection release response                             |
| 13    | read consumed connection size  |
| 14    | wait for read consumed connection size response                      |
| 15    | compare consumed connection size with internal configured one        |
| 16    | read produced connection size  |
| 17    | wait for read produced connection size response                      |
| 18    | compare produced connection size with internal configured one        |
| 19    | configure the I/O connection structures and register it              |
| 20    | set expected packet rate   |
| 21    | wait for set expected packet rate response                           |
| 22    | I/O poll request 1'st time   |
| 23    | wait for I/O poll response   |
| 24    | I/O poll request 2'nd time   |
| 25    | wait for I/O poll response   |
| 26    | I/O poll request 3'rd time   |
| 27    | wait for I/O poll response   |
| 28    | heart beat timeout to the device                                     |
| 30    | open unconnected explicit connection request 1'st time               |
| 31    | wait for unconnected explicit connection response                    |
| 32    | open unconnected explicit connection request 2'nd time               |
| 33    | wait for unconnected explicit connection response                    |
| 34    | close unconnected connection request                                 |
| 35    | wait for close unconnected connection response                       |
| 36    | release all established connections request                          |
| 37    | wait for connection release response                                 |
| 38    | open user unconnected explicit connection request                    |
| 39    | wait for user explicit connection response                           |
| 40    | user predefined master slave allocate connection request             |
| 41    | wait for user allocation response                                    |
| 42    | user close unconnected connection request                            |

|    |   |
|----|---|
| 43 | wit for user close unconnected response             |
| 44 | get or set user defined attribute request           |
| 45 | wait for user defined get or set attribute response |
| 46 | send or wait fragmented get or set attribute        |

**Table 04 – Description of device main state field**

**Online error number** indicates the current error related to the device, listed following.

| VALUE | MESSAGE   | ERROR SOURCE                 | DESCRIPTION/ POSSIBLE SOLUTION  |
|-------|---|------------------------------|---|
| 0     | no error  |                              |   |
| 1     | device guarding failed, after device was operational  | Slave device                 | check if device is still running  |
| 30    | device access timeout   | Slave device                 | device do not respond, check the baud rate and its MAC-ID                     |
| 32    | device rejects access with unknown error code   | Slave device                 | use single device diagnostic to get reject code                               |
| 35    | device response in allocation phase with connection error   | Slave device                 | use single device diagnostic to get additional reject code                    |
| 36    | produced connection ( process data input length in the view of the DEVICE) is different to the configured one       | Slave device / Configuration | use single device diagnostic to get real produced connection size             |
| 37    | consumed connection ( process data output length in the view of the DEVICE) size is different to the configured one | Slave device / Configuration | use single device diagnostic to get real consumed connection size             |
| 38    | device service response telegram unknown and not handled  | Slave device / Controller    | use single device diagnostic to get real consumed connection size             |
| 39    | connection already in request   | Slave device                 | connection will be automatically released                                     |
| 40    | number of CAN-message data bytes in read produced or consumed connection size response unequal 4                    | Slave device                 | device don't have operability with DEVICE and norm description                |
| 41    | predefined master slave connection already exists   | Slave device / Controller    | connection will be automatically released                                     |
| 43    | sequence error in device polling response   | Slave device                 | two first segments in multiplexed transfer were received                      |
| 44    | fragment error in device polling response   | Slave device                 | fragmentation counter while multiplexed transfer differs from the awaited one |
| 45    | sequence error in device polling response   | Slave device                 | middle or last segment was received before the first segment                  |
| 46    | length in bit strobe device response unequal produced connection size   | Slave device                 |   |
| 47    | sequence error in device COS or cyclic response   | Slave device                 | two first segments in multiplexed transfer were received                      |
| 48    | fragment error in device COS or cyclic response   | Slave device                 | fragmentation counter while multiplexed transfer differs from the awaited one |
| 49    | sequence error in device COS or cyclic response   | Slave device                 | middle or last segment was received before the first segment                  |
| 50    | length in COS or cyclic device response unequal produced connection size  | Slave device                 |   |
| 51    | UCMM group not supported  | Slave device                 | change the UCMM group   |
| 52    | Device Keying failed: Vendor ID mismatch  | Slave device / Configuration | check configured Vendor ID against devices Vendor ID                          |



|    |   |                              |   |
|----|---|------------------------------|---|
| 53 | Device Keying failed: Device Type mismatch  | Slave device / Configuration | check configured Device Type against devices Device Type  |
| 54 | Device Keying failed: Product Code mismatch   | Slave device / Configuration | check configured Product Code against devices Product Code  |
| 55 | Device Keying failed: Revision mismatch   | Slave device / Configuration | check configured Revision against devices Revision  |
|    |   |                              |   |
| 59 | double device address configured in actual configuration  | Configuration                | each device at DeviceNet must have its own MAC-ID   |
| 60 | whole size indicator of one device data set is corrupt  | Configuration                | download error in the current database, contact technical support   |
| 61 | size of the additional table for predefined master slave connections is corrupt                                     | Configuration                | download error in the current database, contact technical support   |
| 62 | size of predefined master slave I/O configuration table is corrupt  | Configuration                | download error in the current database, contact technical support   |
| 63 | predefined master slave I/O configuration does not correspond to the additional table                               | Configuration                | number of I/O modules and the number of configured offset addresses are different                           |
| 64 | size indicator of parameter data table corrupt  | Configuration                | value of size indicator too small   |
| 65 | number of inputs declared in the additional table does not correspond to the number in the I/O configuration table  | Configuration                | each entry in the I/O configuration must have only one entry in the additional table                        |
| 66 | number of outputs declared in the additional table does not correspond to the number in the I/O configuration table | Configuration                | each entry in the I/O configuration must have only one entry in the additional table                        |
| 67 | unknown data type in I/O configuration detected   | Configuration                | support BOOLEAN, BYTE, WORD, DWORD and STRING only  |
| 68 | data type of a defined I/O module in a connection does not correspond with the defined data size                    | Configuration                | following type and size are valid<br>BOOLEAN = 1 byte<br>UINT8 = 1 byte<br>UINT16 = 2byte<br>UINT32 = 4byte |
| 69 | configured output address of one module oversteps the possible address range of 3584 bytes                          | Configuration                | the process data image is limited to 3584 bytes   |
| 70 | configured input address of one module oversteps the possible address range of 3584 bytes                           | Configuration                | the process data image is limited to 3584 bytes   |
| 71 | one predefined connection type is unknown   | Configuration                | support of cyclic, polled, change of state, bit strobed only  |
| 72 | multiple connections defined in parallel  | Configuration                | supporting only one type of connection to one device  |
| 73 | the configured Exp_Packet_Rate value of one connection is less than the Prod_Inhibit_Time value                     | Configuration                | expected packet rate must be larger than the production inhibit time  |

**Table 05 – Description of Online error number field**

**General error code** provides further details about the error indicated by **Online error number**, such as type and error source. These values are defined in the DeviceNet specification and inserted into the list so that the error is detected. See an example for the error 35:

| ONLINE_ERROR | DESCRIPTION   | GENERAL_ERROR_CODES   |
|--------------|---|---|
| 35           | Device rejects requested command with an error message. | Error code containment of the response<br>2 = Resources unavailable<br>8 = Service not supported<br>9 = Invalid attribute value<br>11 = Already in request mode<br>12 = Object state conflict<br>14 = Attribute not settable<br>15 = Privilege violation<br>16 = Device state conflict<br>17 = Reply data too large<br>19 = Not enough data<br>20 = Attribute not supported<br>21 = Too much data<br>22 = Object does not exist |

**Additional error code** provides additional information about the error. This code is freely inserted by manufacturer and is only available when **General error code** is different from zero.

**Heartbeat timeout counter** counts the number of times the slave was not scanned on the network. This variable can indicate message transmission quality for this slave; since the **Expected packet rate** configuration parameter indicates the time that a data pack has to be detected. Double-click the device and the **Device Configuration** window will appear, thus is possible configure this parameter.

In the next topic are some more common errors in the DeviceNet device commissioning.

## Common errors of commissioning

### Device does not exist

In the error that appears in the figure above the **Device Status Flag** is indicating *No Response*. This error should indicate that the device is out of the network or it is not responding.

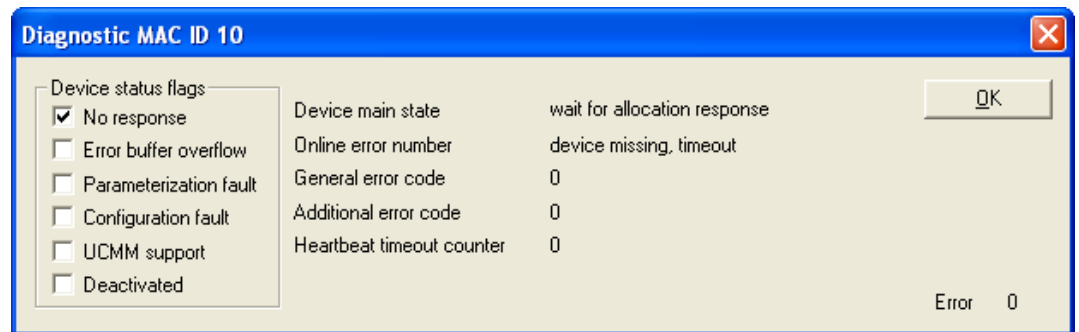


Figure 21. 78 –Error diagnostic window of a nonexistent device

If the device is on the network and is not responding, the following should be considered:

- Physically the device may not connected correctly (network LED is red);
- Device supports UCMM communication and this option is not selected in the configuration (refer to I/O Messages Configuration in the Network Configurator)
- The network is incorrectly configured (small time for EPR and PIT). In this case the master may not be scanning this device due to small time configured for PIT.

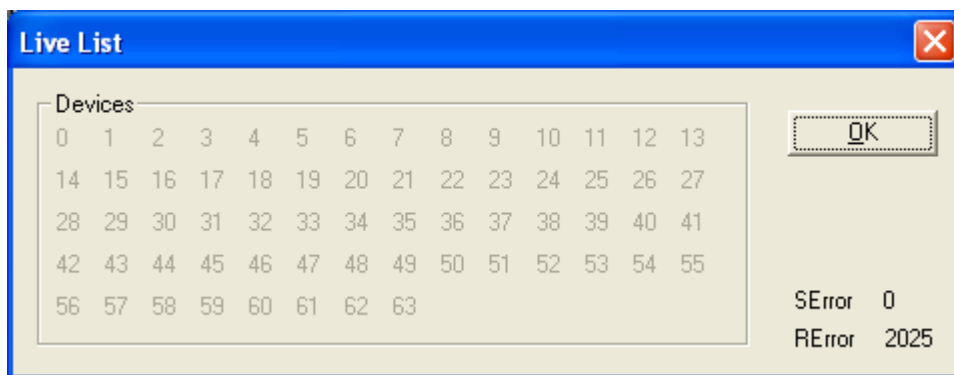
**Failure of device configuration**

The error of figure 21.77 means: The **Device Status Flag** is indicating **Configuration fault** because there is a problem in the device configuration. The **Device main state** and **Online error number** fields indicate that the device is “producing” a different number of bytes from the expected.

In the example above the number of I/O bytes configured is wrong. The correct number is 8 bytes – module with 4 analog inputs. But only 2 bytes were configured (as if it were using only the first input).

**Failure in the online communication between the Network Configurator and the controller**

The **Network Configurator** has two fields for errors that indicate the communication between the **Network Configurator** and the controller: **SError** and **RError**. These two fields are common for all online communication of the **Network Configurator** with the DF79 and are called **Online Data Manager**. The following figure shows an example of these errors.



**Figure 21. 79–Example of SError and RError**

The **SError** and **RError** fields can show a communication without errors when they are equal to zero. There most common error codes are listed below. Further information and other error codes are in the help of the **Network Configurator**.

| VALUE | DESCRIPTION       | POSSIBLE PROBLEM SOLUTION            |
|-------|-------------------|--------------------------------------|
| 0     | Communication OK. |                                      |
| 2025  | Message timeout   | Exit from software and launch again. |
| 8031  | Send error        | Exit from software and launch again. |

**Table 06 – Description of SError and RError codes**

## The auto detected devices

The **Network Configurator** can automatically recognize the device configuration (**Online** → **Automatic network scan** option). This is very useful when there is unknown device and is necessary to configure it for the first time. Below is an example of auto detection.

| Address   | Supported Functions   | Device Name  | Poll Size | Poll Size | BitStr. Size | BitStr. Size | Cyc/COS. Size | Cyc/COS. Size | Chosen Config. |
|-----------|-----------------------|--------------|-----------|-----------|--------------|--------------|---------------|---------------|----------------|
|           |                       |              | Produced  | Consumed  | Produced     | Consumed     | Produced      | Consumed      |                |
| MAC ID 0  | Not found             |              |           |           |              |              |               |               |                |
| MAC ID 1  | Not found             |              |           |           |              |              |               |               |                |
| MAC ID 2  | Cyc., COS, Bit        | WAGO 750-306 | 6         | 5         | 1            | 8            | 2             | 5             | Change of      |
| MAC ID 3  | Poll, Expl. Msg       |              | 1         | 0         | 0            | 0            | 0             | 0             | Polling        |
| MAC ID 4  | Not found             |              |           |           |              |              |               |               |                |
| MAC ID 5  | Not found             |              |           |           |              |              |               |               |                |
| MAC ID 6  | Not found             |              |           |           |              |              |               |               |                |
| MAC ID 7  | Not found             |              |           |           |              |              |               |               |                |
| MAC ID 8  | Not found             |              |           |           |              |              |               |               |                |
| MAC ID 9  | Not found             |              |           |           |              |              |               |               |                |
| MAC ID 10 | Not found             |              |           |           |              |              |               |               |                |
| MAC ID 11 | Not found             |              |           |           |              |              |               |               |                |
| MAC ID 12 | Not found             |              |           |           |              |              |               |               |                |
| MAC ID 13 | Not found             |              |           |           |              |              |               |               |                |
| MAC ID 14 | Not found             |              |           |           |              |              |               |               |                |
| MAC ID 15 | Poll, Expl. Msg       |              | 8         | 2         | 0            | 0            | 0             | 0             | Polling        |
| MAC ID 16 | Not found             |              |           |           |              |              |               |               |                |
| MAC ID 17 | Bit Str., Poll, Expl. |              | 1         | 1         | 1            | 8            | 0             | 0             | Polling        |

Figure 21. 80 – Example of autodetection

In the example above the device 2 supports **Cyclic**, **COS (Change of state)** and **BitStrobe** communication types, but the suggestion was “COS”. If the chosen option was COS the input bytes would be 2 (for DF79 would be *produced* for the slave) and the output bytes would be 5 (*consumed* for the slave).

Likewise for the device 15 which supports only **Polling** and **Explicit message** (acyclic data) communication types, the suggestion was **Polling**. It has 8 input bytes (produced) and 2 output bytes (consumed).

To effect the proposed configuration just click **Automatic Configuration** (but remember that it will erase the previous configuration). In the **Chosen config** column is suggested that cyclic communication is configured, but this choice can be changed.

### NOTE

In the **Device name** column, sometimes, devices from some manufacturers are not recognized (that for some devices that do not have all information inside them). For example, The devices’ names with MAC ID 15 and 17 were not recognized. When the device supports UCMM this information appear in the **Supported functions** column of the previous figure.

### ATTENTION

- After the auto detection the user can accept or reject the new configuration. If the new configuration is accepted all previous configurations will be deleted and a generic EDS file will be used. It has only cyclic communication characteristics (I/O connection). If were necessary use acyclic parameters (explicit message) the user has to choose the correct EDS.
- The **Automatic configuration** only identifies the number of bytes; it does not specify the data types of the slaves. Thus a discrete device and an analog device (with Word, Dword or Byte) always will be their configuration mapped on “bytes” type.
- After perform an auto detection is necessary to restart the communication of all network devices. So, this function will stop the DeviceNet channel.

## Devices diagnostic through their LEDs

Another diagnostic way is through the devices and DeviceNet master LEDs. These LEDs have standard network functions that will be common to any device. The table below shows names, colors, descriptions and behavior of the frontal LEDs of the DF79 controller.

| LED  | COLOR | DESCRIPTION   | BEHAVIOR  |
|------|-------|---|---|
| DN   | Blue  | It indicates DeviceNet channel activity.                            | <p><b>On:</b> The DeviceNet communication was activated and all active devices in the configuration are working normally.</p> <p><b>Off:</b> DeviceNet network was not configured, or inversion of the power cables or the data cables.</p> <p><b>Blinking:</b> Some active device in the configuration is missing or has a problem. Verify the device or deactivate it in the configuration (a download is necessary).</p> |
| ERR  | Red   | It indicates it there is an error related to the DeviceNet network. | <p><b>On:</b> Error in the DeviceNet network (short circuit, noise, terminator is missing). The 24V is missing, some node is missing or with error.</p> <p><b>Off:</b> The DeviceNet network is configured and all active devices are working normally.</p> <p><b>Blinking:</b> The DeviceNet communication was deactivated.</p>  |
| LINE | Green | It indicates that the bus is powered with 24V.                      | <p><b>On:</b> Powered bus.</p> <p><b>Off:</b> Bus is not powered</p> <p><b>Blinking:</b> NA*</p>  |

**Table 07 – Description of the DeviceNet network LEDs for the DF79 controller**

\*NA – Not applicable

The table below shows the description of the DeviceNet network LEDs in the slave devices.

| LED | COLOR | DIAGNOSTIC   | ACTION  |
|-----|-------|--|---|
| Net | Green | <b>On:</b> The communication on the bus is ok.   | <b>On:</b> No action  |
|     |       | <b>Off:</b> Bus is not powered.  | <b>Off:</b> Power the bus with 24V.   |
|     |       | <b>Blinking:</b> Master is not scanning the slave.   | <p><b>Blinking:</b> Check if there is a master un the line, if yes repeats the download.</p> <ul style="list-style-type: none"> <li>In DF79 if the point is mapped on the Network Configurator and was not mapped on Mapping Tool the controller will not configure any I/O message to that device.</li> <li>Check if the network time scan is small.</li> </ul>  |
|     | Red   | <p><b>On:</b> There is a physical failure on the line (a short circuit was detected). Address conflict.</p> <p><b>Off:</b> Physical communication is ok.</p> | <p><b>On:</b> Check DeviceNet network problems:</p> <ul style="list-style-type: none"> <li>Power off the device or the network (reset the device).</li> <li>Check if the network impedance is 60 ohms (2 resistors of 120 ohms at each end).</li> <li>Check if the device is the unique at that address (after changing the address you must reset the slave).</li> </ul> <p><b>Off:</b> No action.</p> |

**Table 08 – Description of DeviceNet network LEDs for the slaves**

## Diagnostic through Transducer block

### Location of Global Diagnostic in the Communication Transducer

The communication transducer is a block of DF79 and serves only to diagnose the operation conditions of the DeviceNet network and its devices, providing online the operating status of connection, configuration and communication.

The global diagnostic is on the **DN\_COMM\_TRD** block, from the offset 9, below the **DN\_BAUD\_RATE** parameter up to slaves' list with I/O connection in operation, **DN\_IO\_LIST**.

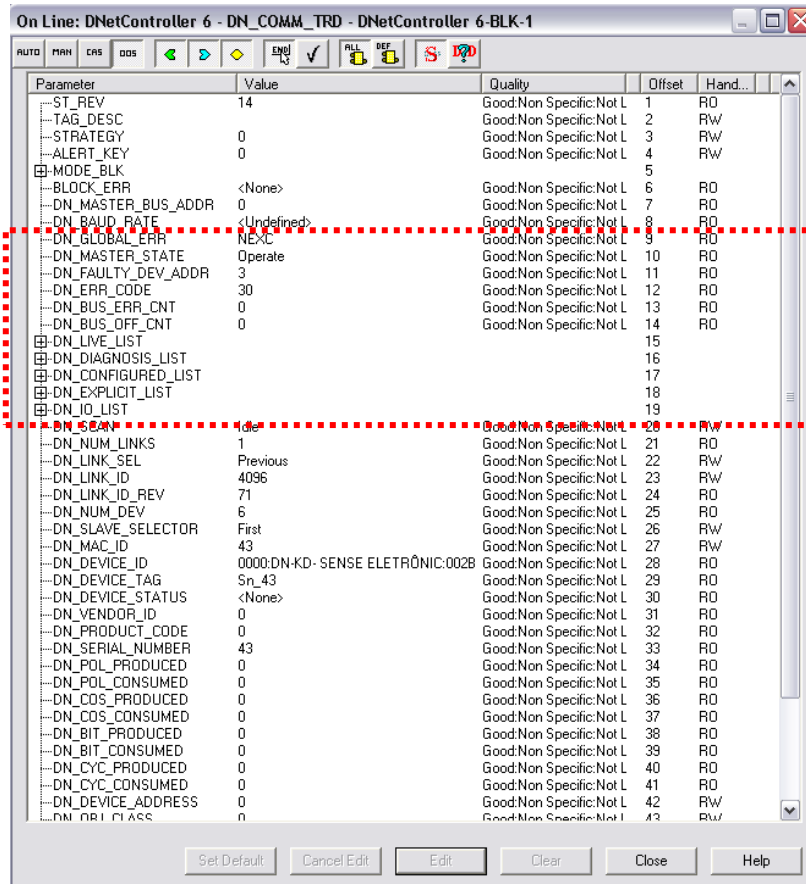


Figure 21. 81 – Global diagnostic parameters in the DN\_COMM\_TRD block

In the following table is listed the link between the information on the global diagnostic area of the **Network Configurator** and its respective presentation at the communication transducer block **DN\_COMM\_TRD**.

| NETWORK CONFIGURATOR<br>GLOBAL STATE FIELD  | TRANSDUCER BLOCK<br>DN_COMM_TRD |
|---|---------------------------------|
| Collective status bits                      | DN_GLOBAL_ERR                   |
| Online master state                         | DN_MASTER_STATE                 |
| Error at remote address                     | DN_FAULTY_DEV_ADDR              |
| Corresponding error event                   | DN_ERR_CODE                     |
| Counter of rejected telegrams transmissions | DN_BUS_ERR_CNT                  |
| Counter of detected bus off report          | DN_BUS_OFF_CNT                  |
| Parameterized Devices                       | DN_CONFIGURED_LIST              |
| Activated Devices <sup>1</sup>              | DN_EXPLICIT_LIST                |
|   | DN_IO_LIST                      |
| Devices with diagnostic                     | DN_DIAGNOSIS_LIST               |

Table 09 – Mapping of global diagnostic information in the DN\_COMM\_TRD block

<sup>1</sup> In DN\_COMM\_TRD is possible to check which devices are with *explicit messages* (used to configure the device) activated. The Network Configurator only watches if there are data exchange, serving for this communication by I/O scan or configuration messages.

The maps of bits for status information are listed, consisting of slave address and its respective status. It should be emphasized that the addressing starts in one (1) even to 64, so the master is on address 1 and all the slaves have their address shifted by one.

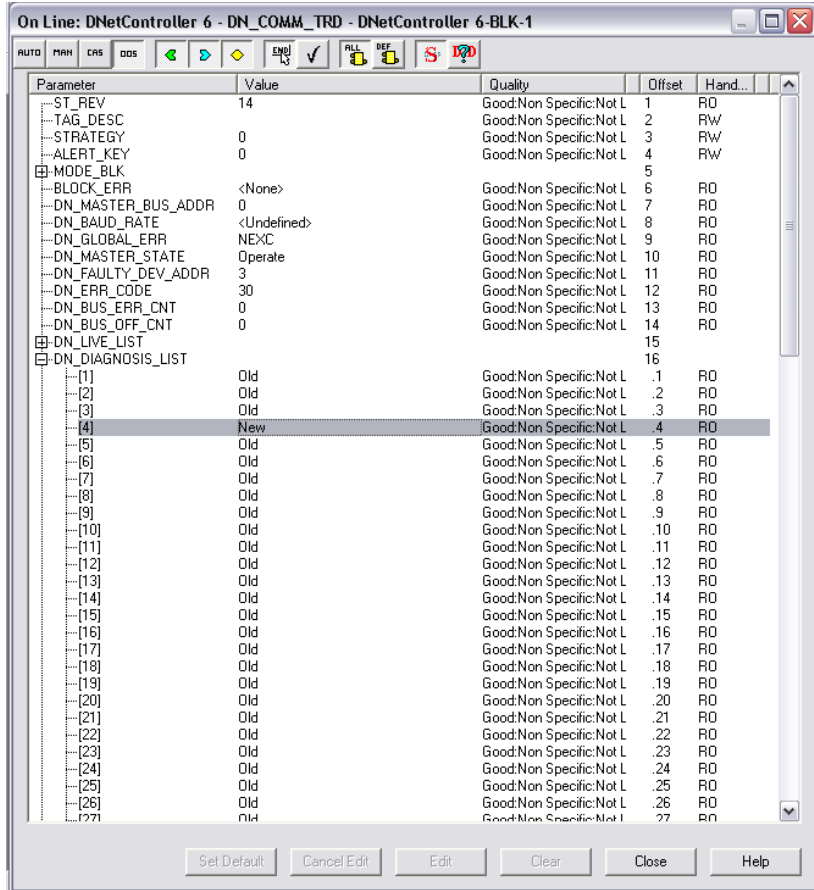


Figure 21. 82 – Example of the expanded status list

In the table below are the names used to indicate the status on each status list in order to adapt to the nature of the information returned.

| STATUS LIST               | TRUE       | FALSE         |
|---------------------------|------------|---------------|
| DN_LIVE_LIST <sup>2</sup> | Online     | Offline       |
| DN_CONFIGURED_LIST        | Configured | Pending       |
| DN_EXPLICIT_LIST          | Connected  | No Connection |
| DN_IO_LIST                | Connected  | No Connection |
| DN_DIAGNOSIS_LIST         | New        | Old           |

Table 10 – Names used in the status list

<sup>2</sup> The first position in the *Livelist* list shows the name “Master”, indicating that the controller is on this position by default.

Location of Individual Diagnostic in the Communication Transducer

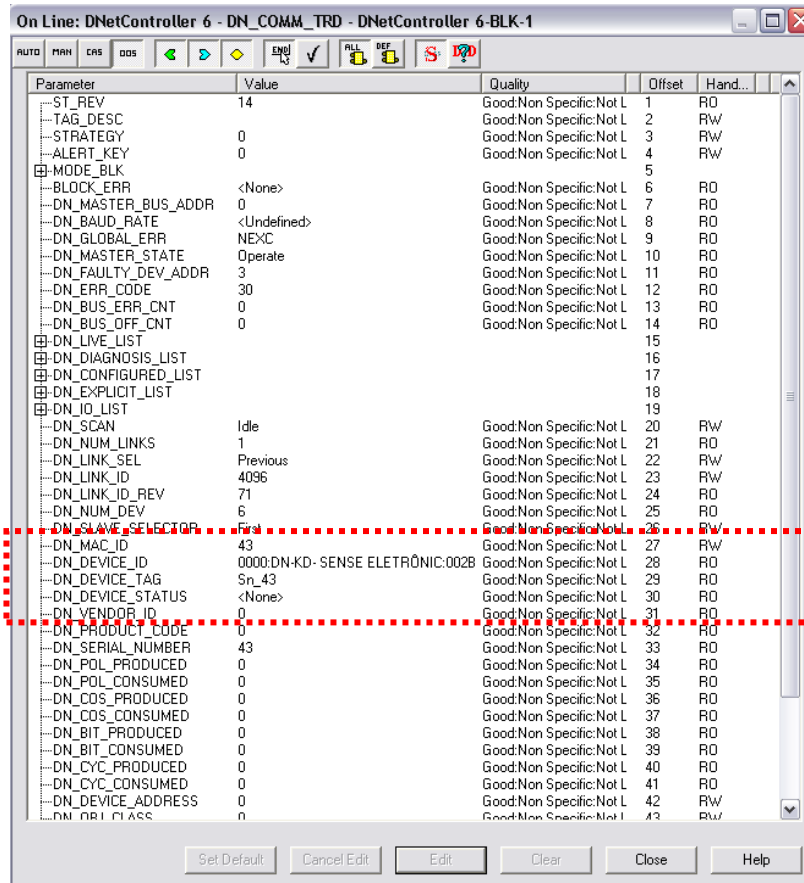


Figure 21. 83 – Detail of the browsing methods on the Transducer DN\_COMM\_TRD

In order to facilitate the acquisition of diagnostic information, the DN\_COMM\_TRD block has the DN\_SLAVE\_SELECTOR parameter, with the following browsing commands among the slaves:

| OPTION   | ACTION  |
|----------|---|
| First    | Goes to the first slave of the Live list      |
| Next     | Shift to the next slave of the Live list      |
| Previous | Return to the previous slave of the Live list |
| Last     | Goes to the last slave of the Live list       |

Table 11 – Browsing commands

Or the user can choose the slave directly, through the DN\_MAC\_ID parameter. The information about Device ID, Device Tag and Status are obtained through the DN\_DEVICE\_ID, DN\_DEVICE\_TAG and DN\_DEVICE\_STATUS parameters, respectively.

The DN\_DEVICE\_STATUS item returns the status byte presented in the previous figure. The possible messages that can be recovered on this field are listed below.

| MESSAGE   | SIGNIFICATION   |
|-----------|---|
| <None>    | Slave operates normally   |
| NoResp    | Slave does not respond  |
| Prm_Fault | Slave does not allow writing at least one attribute                         |
| Cfg_Fault | Number of bytes consumed or produced does not match to the value configured |
| Deact     | Slave deactivated in the current configuration                              |

Table 12 – Status byte recover in the transducer DN\_COMM\_TRD



## DeviceNet controller specific blocks

### DeviceNet Communication Transducer

This block provides the following characteristics:

- Live list of the slaves devices;
- Slaves devices diagnostic;
- Online configuration of slaves' configuration parameters.

See in the following table the parameters description.

| Idx | Parameter           | Data Type  | Valid Range   | Initial Value | Unit | Storage/ Mode | Views      | Description  |
|-----|---------------------|------------|---|---------------|------|---------------|------------|--|
| 1   | ST_REV              | Uns6       | 0 ... 65535   | 0             | None | S/RO          | 1, 2, 3, 4 |  |
| 2   | TAG_DESC            | VisStr(32) |   | Space         | Na   | S/---         | ---        |  |
| 3   | STRATEGY            | Uns16      | 0 ... 65535   | 0             | None | S/---         | 4          |  |
| 4   | ALERT_KEY           | Uns8       | 0 to 255  | 0             | None | S/---         | 4          |  |
| 5   | MODE_BLK            | DS-69      | Auto;OOS  | OOS           | Na   | S/---         | 1, 3       |  |
| 6   | BLOCK_ERR           | Bitstr(2)  |   | 0, 0          | E    | D/RO          | 1, 3       |  |
| 7   | MASTER_BUS_A<br>DDR | Unsig8     | 0...63  | 0             | None | S/RO          | 2          | DeviceNet master bus address.                                    |
| 8   | BAUD_RATE           | Unsig8     | 3: 125 kbps<br>2: 250 kbps<br>1: 500 kbps                   | 0             | None | S/RO          | 2          | DeviceNet bus baud rate.   |
| 9   | GLOBAL_ERR          | Bitstr(2)  | See Table 2   | 0             |      | D/RO          | 1, 3       | See Table 2  |
| 10  | MASTER_STATE        | Uns8       | 0x00: Offline<br>0x40: Stop<br>0x80: Clear<br>0xC0: Operate | 0             |      | D/RO          | 3          | This parameter represents the main state of the master.          |
| 11  | FAULTY_DEV_AD<br>DR | Uns8       | 0...63  | 0             |      | D/RO          | 1, 3       | Faulty device address.   |
| 12  | ERR_CODE            | Uns8       |   | 0             |      | D/RO          | 1, 3       | Error code of the faulty device. See user manual.                |
| 13  | BUS_ERR_CNT         | Uns16      |   | 0             |      | D/RO          | 1, 3       | Number of detected low transmission qualities.                   |
| 14  | BUS_OFF_CNT         | Uns16      |   | 0             |      | D/RO          | 1, 3       | Number of canceled transmissions and CAN-chip reinitializations. |
| 15  | LIVE_LIST           | Uns8[64]   | 0: Online<br>1: Master<br>255: Offline                      | 0             |      | D/RO          | 1, 3       | List of connected devices on the network.                        |
| 16  | DIAGNOSIS_<br>LIST  | Uns8[64]   | 0: Old<br>1: New  | 0             |      | D/RO          |            | List of devices with new diagnostic information available.       |
| 17  | CONFIGURED_<br>LIST | Uns8[64]   | 0: Pending<br>1: Configured                                 | 0             |      | D/RO          |            | List of configured devices.                                      |
| 18  | EXPLICIT_LIST       | Uns8[64]   | 0: No Connect<br>1: Connected                               | 0             |      | D/RO          |            | List of devices with established explicit connection.            |
| 19  | IO_LIST             | Uns8[64]   | 0: No connect<br>1: Connected                               | 0             |      | D/RO          |            | List of devices with established I/O connection.                 |
| 20  | DN_SCAN             | Uns8       | 0: Idle<br>1: Scan<br>2: Scanning<br>3: Error               | 0             |      | D/RW          |            | Performs automatic scan of the DeviceNet network.                |
| 21  | NUM_LINKS           | Uns8       |   | 1             |      | S/RO          | 2          | It defines the supported number of buses.                        |
| 22  | LINK_SEL            | Uns8       | 0: First<br>1: Next<br>2: Previous<br>3: Last               | 0: First      |      | D/RW          |            | Select which bus will have the displayed information.            |
| 23  | LINK_ID             | Uns16      |   | 0             |      | S/RW          | 2          | It identifies the bus currently selected.                        |
| 24  | LINK_ID_REV         | Uns32      |   | 0             |      | S/RO          | 2          | It contains the live list revision of the current bus.           |

| Idx | Parameter         | Data Type  | Valid Range                                   | Initial Value | Unit | Storage/ Mode | Views | Description   |
|-----|-------------------|------------|---|---------------|------|---------------|-------|---|
| 25  | NUM_DEV           | Uns16      |   | 0             |      | D/RO          | 1, 3  | It identifies the number of devices on the current bus.                           |
| 26  | SLAVE_SELECTOR    | Uns8       | 0: First<br>1: Previous<br>2: Next<br>3: Last | 0             |      | D/RW          |       | Slave address selector to read scan information.                                  |
| 27  | MAC_ID            | Uns8       | 1...63 and 255                                | 255           |      | D/RW          | 1, 3  | Slave address selector to read scan information.                                  |
| 28  | DEVICE_ID         | VisStr(32) |   | Spaces        |      | D/RO          | 2     | It identifies the device ID of the selected device in the Slave Selector/MAC_ID.  |
| 29  | DEVICE_TAG        | VisStr(32) |   | Spaces        |      | S/RO          | 2     | It identifies the device Tag of the selected device in the Slave Selector/MAC_ID. |
| 30  | DEVICE_STATUS     | BitsTr(2)  |   | 0             |      | D/RO          | 1, 3  | See Table 3   |
| 31  | VENDOR_ID         | Uns16      | 0   | 0             |      | D/RO          | 1, 3  | Vendor ID code according to ODVA.   |
| 32  | PRODUCT_CODE      | Uns16      | 0   | 0             |      | D/RO          | 1, 3  | Manufacturer specific device type code.   |
| 33  | SERIAL_NUMBER     | Uns32      | 0   |               |      | D/RO          | 1, 3  | Manufacturer specific device serial number.                                       |
| 34  | POL_PRODUCED      | Uns8       | 0   | 0             |      | D/RO          |       | Produced size in polling connection.  |
| 35  | POL_CONSUMED      | Uns8       | 0   | 0             |      | D/RO          |       | Consumed size in polling connection.  |
| 36  | COS_PRODUCED      | Uns8       | 0   | 0             |      | D/RO          |       | Produced size in Change of State connection.                                      |
| 37  | COS_CONSUMED      | Uns8       | 0   | 0             |      | D/RO          |       | Consumed size in Change Of State connection.                                      |
| 38  | BIT_PRODUCED      | Uns8       | 0   | 0             |      | D/RO          |       | Produced size in bit strobe connection.   |
| 39  | BIT_CONSUMED      | Uns8       | 0   | 0             |      | D/RO          |       | Consumed size in bit strobe connection.   |
| 40  | CYC_PRODUCED      | Uns8       | 0   | 0             |      | D/RO          |       | Produced size in cyclic connection.   |
| 41  | CYC_CONSUMED      | Uns8       | 0   | 0             |      | D/RO          |       | Consumed size in cyclic connection.   |
| 42  | DEVICE_ADDRESS    | Uns8       | 0...63  | 0             |      | D/RW          |       | Slave address to establish an explicit connection.                                |
| 43  | OBJ_CLASS         | Uns16      | -   | 0             |      | D/RW          |       | Object class to establish an explicit connection.                                 |
| 44  | OBJ_INSTANCE      | Uns16      | -   | 0             |      | D/RW          |       | Object instance to establish an explicit connection.                              |
| 45  | INST_ATTRIBUTE    | Uns16      | -   | 0             |      | D/RW          |       | Attribute number to establish an explicit connection.                             |
| 46  | ATTR_VALUE        | OctSt(32)  | -   | 0             |      | D/RW          |       | Attribute value read/written from/to the device.                                  |
| 47  | GET_SET_ATTRIBUTE | Uns8       | 0: Idle<br>1: Get<br>2: Set<br>3: Error       | 0             |      | D/RW          |       | Control and status of the Get/Set operation.                                      |
| 48  | DNM_CFG_STATUS    | Uns8       | 0: Invalid<br>1: Updating<br>2: Using         | 0             |      | S/RO          |       | Informs the user if the DNM has been configured.                                  |
| 49  | IO_MAP_CFG_STATUS | Uns8       | 0: Invalid<br>1: Updating<br>2: Using         | 0             |      | S/RO          |       | Informs the user if the I/O mapping has been done.                                |

Legend: E – Enumerated parameter; Na – Dimensionless parameter; RO – Read only; D – dynamic; N – non-volatile; S – Static  
 Gray Background Line: Default Parameters of Syscon

**Table 13 – Parameters description of DeviceNet Communication Transducer block**



## CREATING AN AS-I CONFIGURATION BY USING DF81

### Introduction

This section will show a strategy configuration using the DF81 controller. The next figures show an example of process used to control the conveyor movement for filling up bottles with some fluid. The conveyor moves until the sensor detects the bottle. At this moment the valve (ON/OFF) opens and fills up the bottle. The architecture of the AS-i control loop can be seen in the following figure.

### PROJ\_DF81

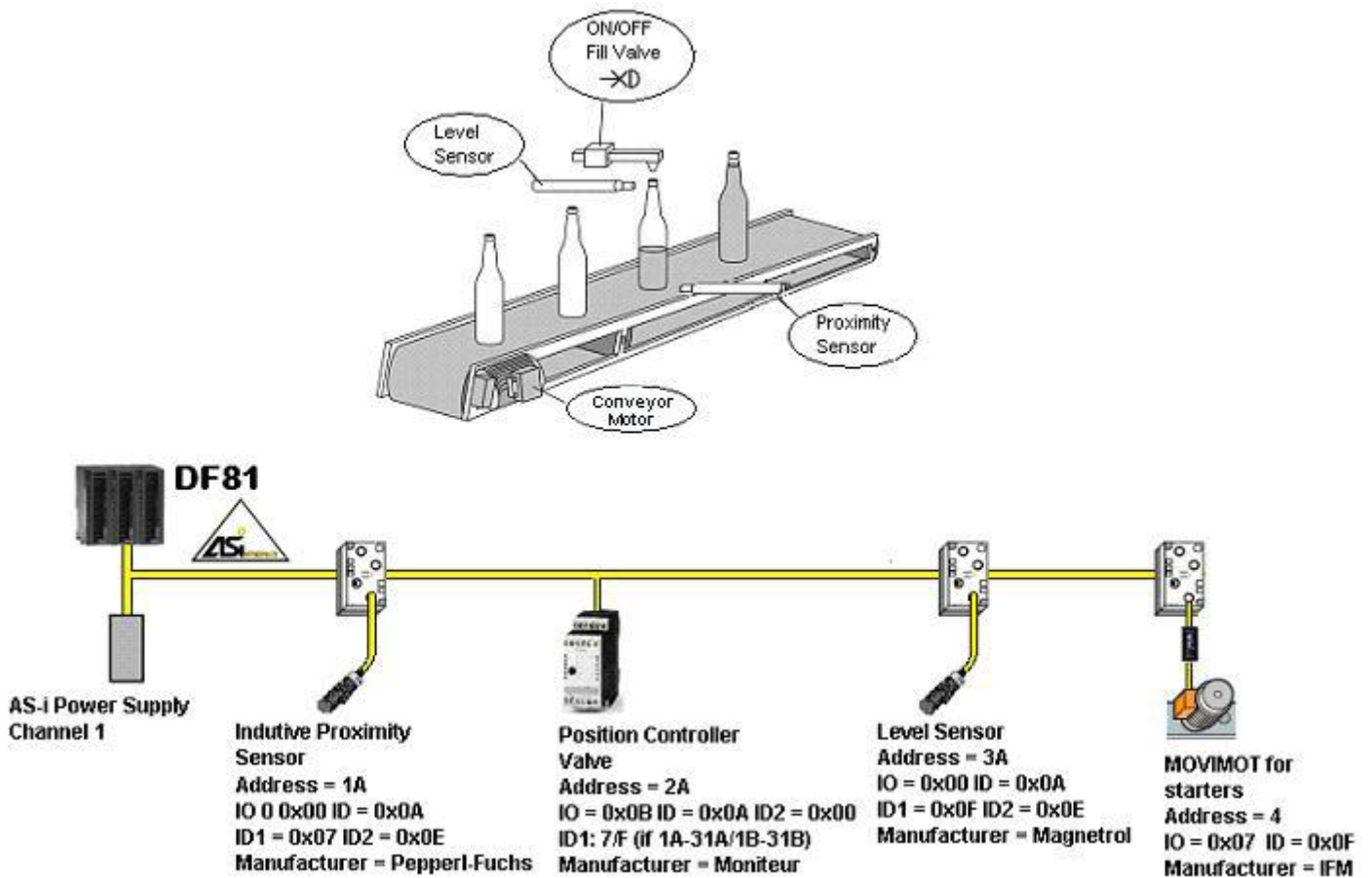


Figure 22. 1 – Example of Process with AS-i Network

For the example above the following devices were used: a power supply for the controller, a power supply for AS-i bus, a DF81 controller, a sensor to detect the bottle, a position controller to turn on and turn off the valve, a level sensor and an IFM Electronic Movimot module for a conveyor motor control.

Often a single application requires more modules of sensors. Inductive and capacitive proximity sensors offer the best solutions, as there are in various formats, have integrated LED display, are easy to assemble and safe in operation.

Besides the known modules input/output with IDC technology (connection by "vampires") and yellow flat cable, the AS-i network has increased the number of slaves integrated in actuators. The compact module Movimot is directly mounted on the drive frequency set on the engine. Two rotational speeds and two directions of rotation can be controlled.

In the next topics will show, step by step, how to configure the DF81 controller for the aimed example. For the DF81 can only make control logic via ladder. The AS-i points are not mapping MDI, MDO blocks etc. Step 8 shows how to setup using Ladder.

## Starting the Area

### Step 1

It is possible to create, or edit, an area from the **Studio302**. In the **Studio302** interface select **Areas**. A window will appear listing all the areas of database.

To create a new area from the **Studio302**, left-click inside the **Areas** window, then choose **New Area**.

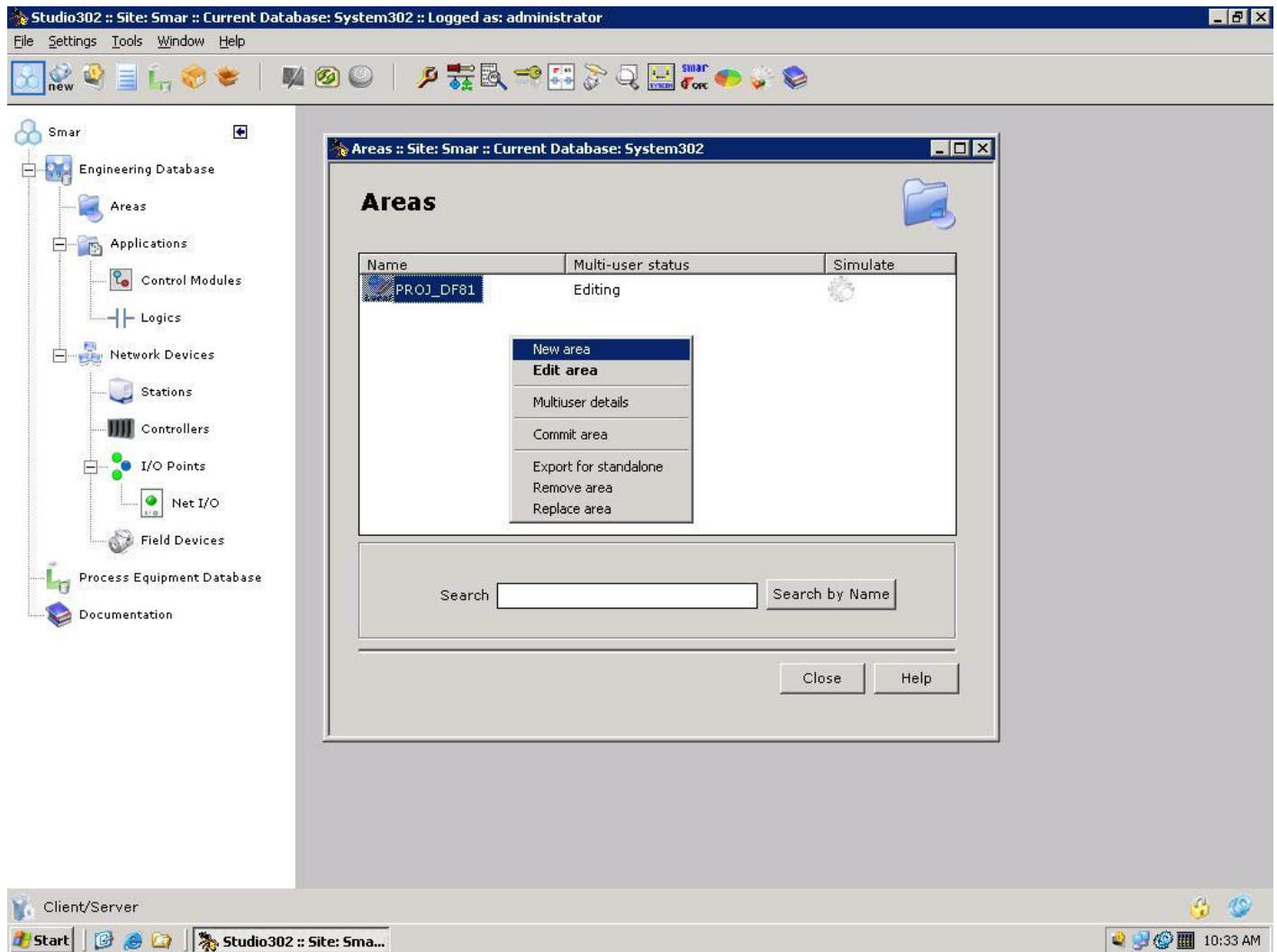



Figure 22.2 - Creating a new area

Another way to create a new area is from **Syscon**. Click the icon  in the **Studio302** toolbar.

To create a new area on **Syscon**, choose **File → New**, or through the toolbar, choose **New** button . The dialog box shows the areas options. Select **HSE Area** as shown in next figure:

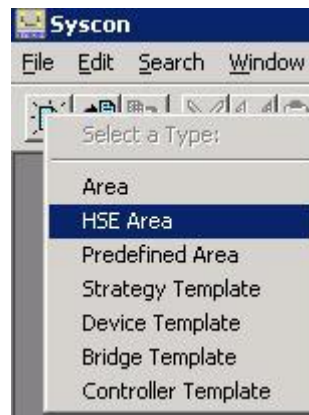


Figure 22.3- Options to create Syscon areas

After choosing the area type, it opens a window to the user give a name to the new area.



Figure 22.4- New area name

Type the name for the area in the **Area Name** box, and click **Ok**. For this example, it chooses **PROJ\_DF81** name.

A new window will appear. It shows:

- **Application** – Logical Plant. To insert the control strategies into this part.
- **Fieldbus Networks** – Physical Plant. To insert devices and function blocks used in the area.

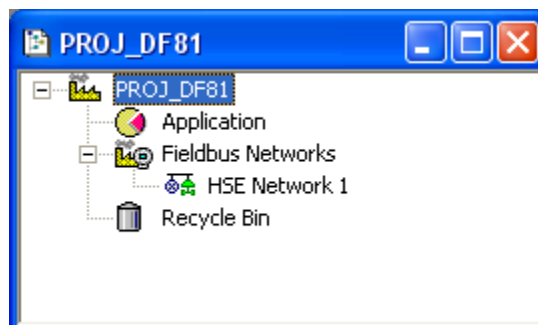


Figure 22.5 – Area Division

## Physical Plant Project

### Step 2


In the main window, PROJ\_DF81, right-click the **Fieldbus Networks** icon, , to select the Server. Choose **Communication Settings** option, or through the toolbar, choose **Communication→Settings**. The communication settings dialog box will open.



Figure 22.6 – Choosing the Server

Confirm if the **Smar.HSEOLEServer.0** option has already been selected. Otherwise, the user must select it, and then click **OK**.

## Arranging the Fieldbus windows

### Step 3

After selecting the Server for the area, click the  $\oplus$  sign placed at left of the **Fieldbus Networks**. The HSE network will appear with a tag, for example, *HSE Network 1\**. Right-click this item and choose the **Expand** option. The following figure shows the HSE network:

#### NOTE

\* This number changes if another area was created before. When a new HSE area is created, this number increases.



Figure 22.7 – Creating the HSE network

To arrange the screen, click the area window. So, choose **Window** menu on the **Syscon** toolbar, and then choose **Tile** option.

## Inserting the Controller

### Step 4

Right-clicking the **HSE Network 1** icon, a dialog box to add new devices will appear. By clicking **New**, it is possible to select devices such as Bridges, Controllers and Devices for the area. For the aimed control, it selects the **Controller** option. Confirm this choice as shown in the next figure.

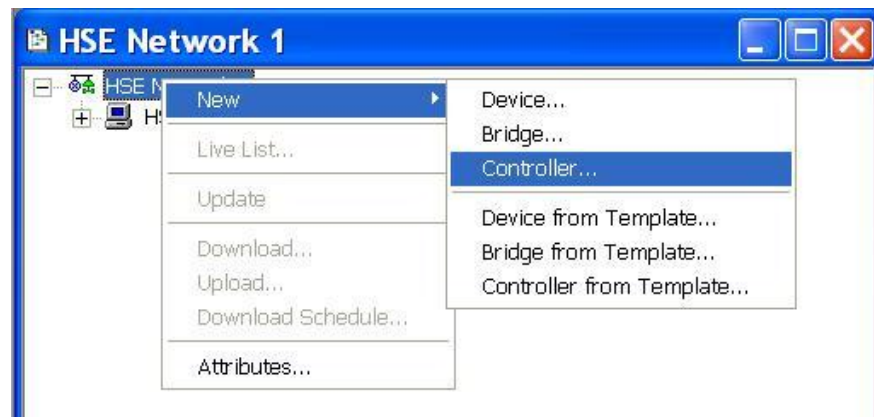


Figure 22.8 – Choosing the controller for the area

After adding the new controller, it opens a window as shown in following figure.

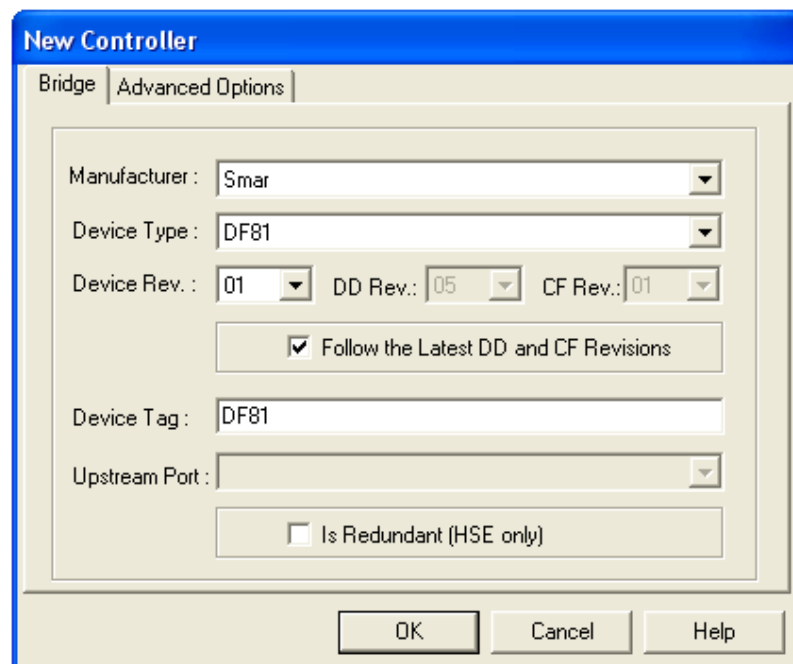


Figure 22.9 – Setting the controller

Select **DF81** in the **Device Type** box. In the **Device Tag** box, type **DF81** or another tag, and click **OK** to conclude this task.

**IMPORTANT**

Not all characters are valid when naming the elements.

The valid characters are:

A-Z a-z 0-9 { } [ ] ( ) + -

The invalid characters are:

~ ` ! @ # \$ % ^ & \* = | : ; , . < > ? / ' " \

**TIP**

Is possible to create an initial HSE configuration in an easier way using templates. In this case a configuration exists with some common steps created previously. For example, the steps 1 to 4 can be replaced by a creation of template through main menu **File → New → Predefined Area** choosing **DF81 AS-i Controller HSE 2xAsi HSE** or **DF81 AS-i Controller HSE 2xAsi with FFB-1131**.



## Adding AS-i Devices

### IMPORTANT

After to open **Network Configuration Tool** (environment for setting a specific network) the user must save the configuration in **Syscon**, to commission the DF81 controller and after to go to the next step.

#### Step 5

After inserting the controller for the area, it is possible to insert AS-i devices. Before, return to the **PROJ\_DF81** window and right-click the controller, **DF81**. Then choose **New Network** option to configure the DF81 channel. DF81 controller has 2 channels that can be configured, but only one at a time. See the AS-i bus creation in the following figure.

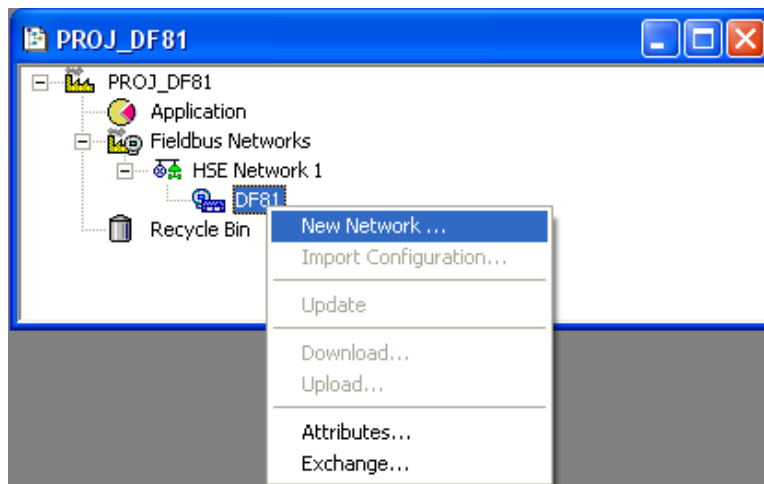


Figure 22.10 – Creating the AS-i bus

When selecting **New Network**, the window to select the channel opens. In this case, you must define a tag for the channel, as well as choose which channels want to create through the **Port** box (1 or 2).

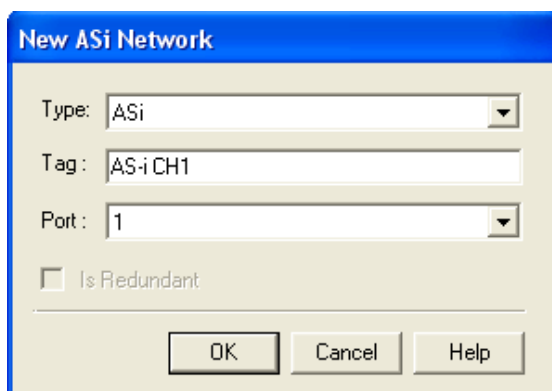


Figure 22.11 – Selecting the channel to be created

By clicking **OK**, the **Network Configuration tool** opens. It is the configuration tool for the AS-i network. Through it, the user has the structure of the AS-i bus (configuration of the DF81 master flags, devices, settings code IO, ID, ID1 e ID2). For further information about this tool, refer to its help.

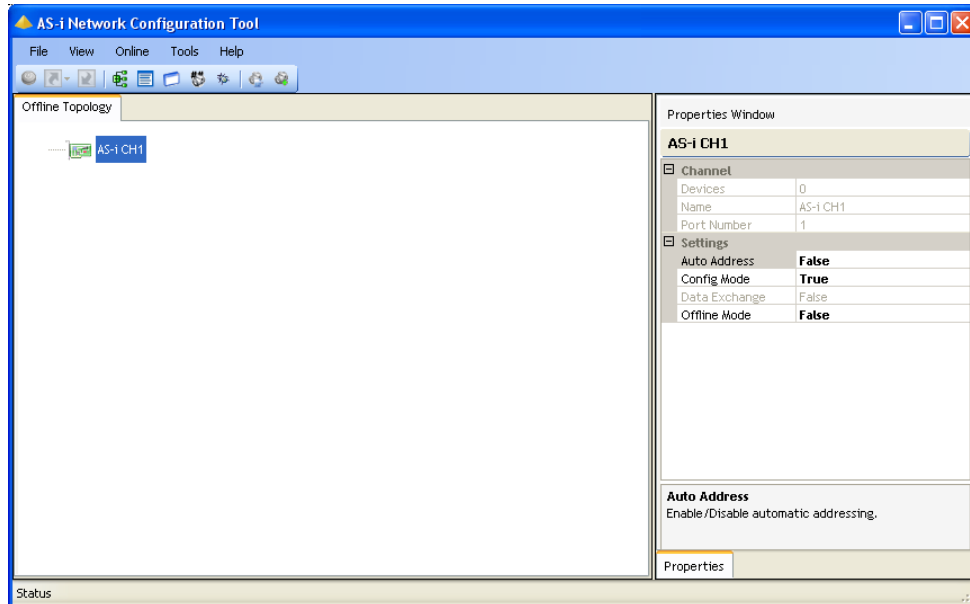
As the controller DF81 has already been inserted to the configuration previously, and the configured channel was set to Channel 1 and did not have equipment in its configuration, it will appear empty in the network AS-i with only the instantiated channel. This channel is a master in the AS-i network which must be unique. Since the AS-i devices would be inserted are called devices slaves.

**IMPORTANT**

1) The AS-i network supports only one master per bus and its addresses are defined at the time of the channel creation (1 or 2). These addresses are used for **SYSTEM302** architecture and not for AS-i network itself.

2) Is allowed to issue only one channel at a time in the **Network Configuration Tool**.

3) Is it right to have the bus only a slave with address zero. It must obtain a valid address, so that after it is inserted by a slave factory default comes with address zero.



**Figure 22.12 – Network Configuration Window**

These slaves may be present in one or more lists described below.

**List of Detected Devices (LDS):** Each slave corresponds to a bit of that list, which is activated when the slave was detected correctly.

**List of Activated Devices (LAS):** In this list the corresponding bit to the slave is activated when it was activated properly.

**List of Projected Devices (LPS):** This list is in non-volatile memory and represents the slaves that were expected to be connected to the AS-i network when it is turned on.

**List of Peripheral Fault (LPF):** In this list the corresponding bit in the slave is activated when a high signal is detected in FID pin of the slave.


In the execution control phase of AS-i network the masters states are reported to the host through some flags described below.

| Flag                           | Meaning   |
|--------------------------------|---|
| ASI_ECF_NORMAL_OPERATION       | It indicates that the master is cyclically transiting between phases of normal operation.   |
| ASI_ECF_CONFIG_OK              | This flag is activated when setting nominal and real detected are in according. This is a simple way to obtain information about the configuration. |
| ASI_ECF_PERIPHERAL_OK          | It indicates that List of Periphery Fault is empty.   |
| ASI_ECF_ZERO_ADDR_DEV_DETECTED | It indicates the presence of a slave with address "0" - which is not allowed in normal operation.   |
| ASI_ECF_AUTO_ADDRESS_ASSIGNED  | Allows the master to assign a new address for a slave.  |
| ASI_ECF_OFFLINE_READY          | Activated when the offline phase is complete.   |
| ASI_ECF_AUTO_ADDRESS_AVAILABLE | It indicates that there are conditions to occur the automatic addressing*.  |
| ASI_ECF_CONFIG_MODE_ACTIVE     | It indicates if the master is in the Configuration Mode (True) or Protected (False).  |
| ASI_ECF_ASI_POWER_FAILURE      | It indicates bus voltage below the lower limit.   |
| ASI_MHF_OFFLINE                | When activated by the User, the master goes to the offline phase.   |

|                             |  |
|-----------------------------|--|
| ASI_MHF_AUTO_ADDRESS_ENABLE | It indicates that automatic addressing is activated.   |
| ASI_MHF_DATA_EXCHANGE       | Enables the exchange of data between master and slave. |

Thus, it is necessary that the user "designs" the AS-i network that is or will be present in the field. This projection can be given in two ways: the user can manually enter each slave (it is not necessary that it is physically in the field). Another way is to perform the upload of the detected slaves and then to send this information to the AS-i master, i.e. to perform the download procedure. These procedures are described as follows.

## Inserting Devices in the Topology

To insert the slave device, click the  (**Insert Devices**) in the toolbox, or through **Tools→Insert Devices** menu. Place the mouse cursor over the channel and click **Insert Devices**.

The window for insertion of the slave device will open, as shown in the following figure.

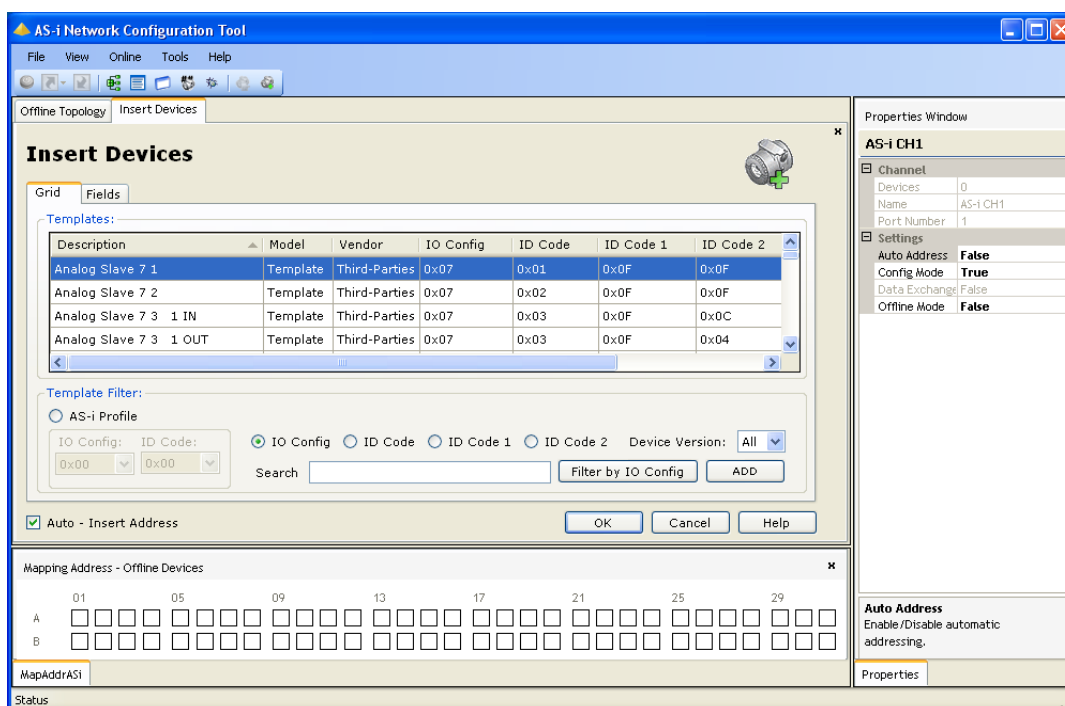


Figure 22.13 – Inserting the Slave Devices

In this window, should be selected slave device that will be inserted. For the aimed example, the first chosen equipment is the proximity sensor. First, the information of AS-i configuration from slave device (IO, ID, ID1, ID2 codes) must be obtained. Follow the next steps to insert the slave device:

- A. Select the device in the option box **Templates**. Use filters to find the desired device;
- B. Click **Add**;
- C. In the **Address** field, assign an address for this device (this address must match the physical configuration of device in the AS-i network);
- D. In the **Device Tag** field, give a tag for this device. If the user does not assign a tag to the equipment, the tag will be the default - Device 1,
- E. Click **OK**.

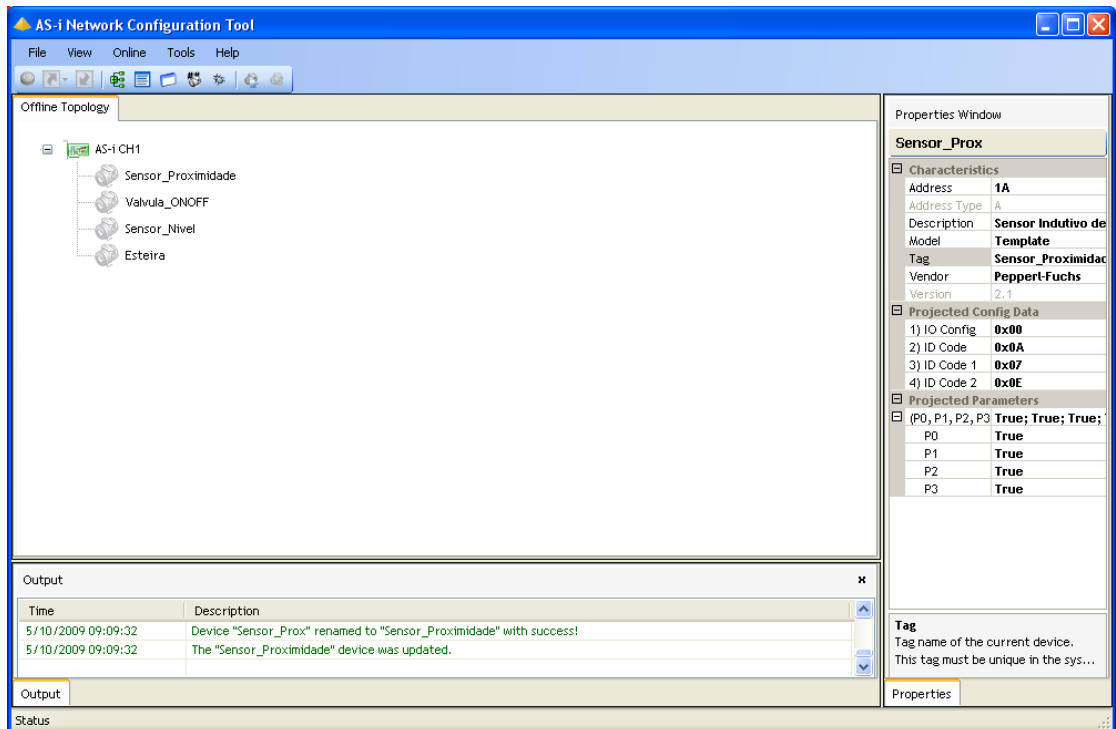


Figure 22.14 – AS-i Network Created

**NOTE**

The addresses assigned as well as the device tags should be unique on the AS-i network and also in the **Studio302** Database (Workspace). For further details refer to **Studio302** manual.

Enter also the equipment related to the ON/OFF valve, level sensor and conveyor motor. Finally, the AS-i network will be the figure 22.14.

Since the equipment properties are equal to the equipment that is or will be installed, the next step is to perform the Download of the configuration designed. However, it is necessary that the master is in configuration mode, as shown in the next figure. If the flag is off (**False**) just change this condition and perform a **Download** only of the channel (AS-i CH1) via **Online** menu, with the **Download-> AS-i Channel** option.

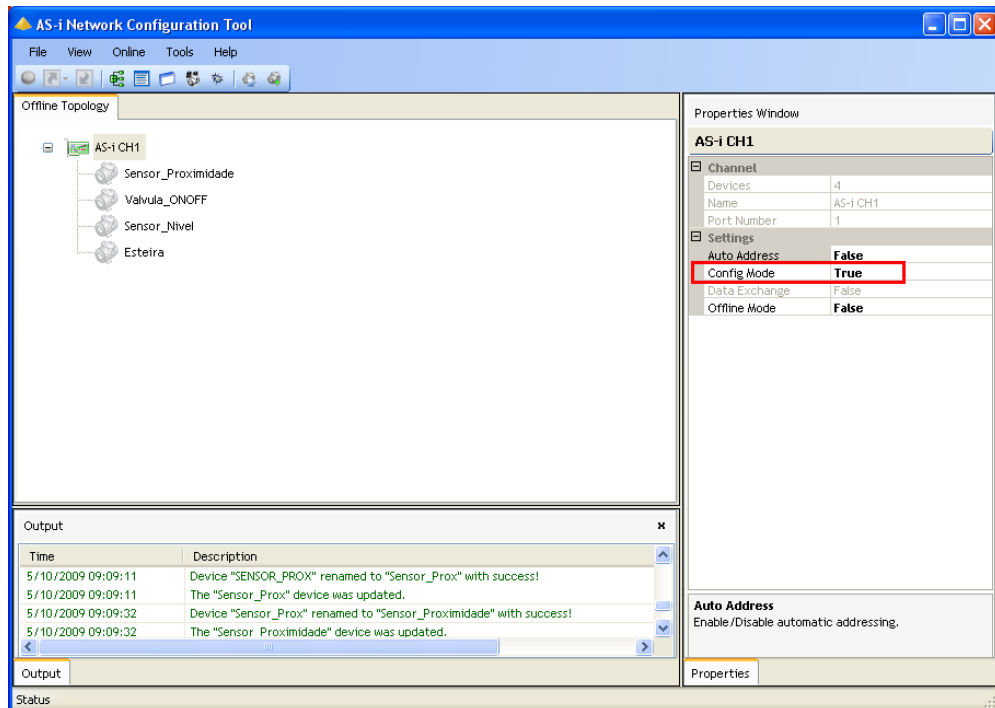



Figure 22.15 – Enable Flag Config Mode

## Performing the Upload of Detected Device

The second way of designing an AS-i network is to perform the upload of detected devices, i.e., physically installed in the field, because in this way all parameters already pre-configured by the manufacturer are automatically loaded into Offline Topology. The following are the steps to perform the **Upload** procedure of the detected devices.

- A. Click the  button (*Toggle Start/Stop Communication*) to start the communication;
- B. Select the channel (**AS-i CH1**) right-click it and select **Upload Channel**→**Detected Devices**. This procedure also can be done through **Online** menu and **Upload**→**Detected Devices** option.
- C. At this moment will appear a new window (see below) comparing the configuration of Offline topology with the configuration on the field;
- D. Click **Confirm Upload**;

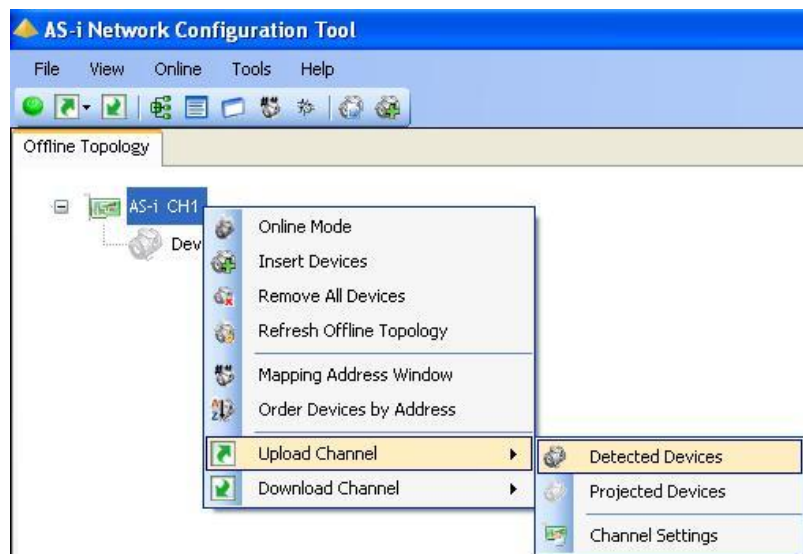
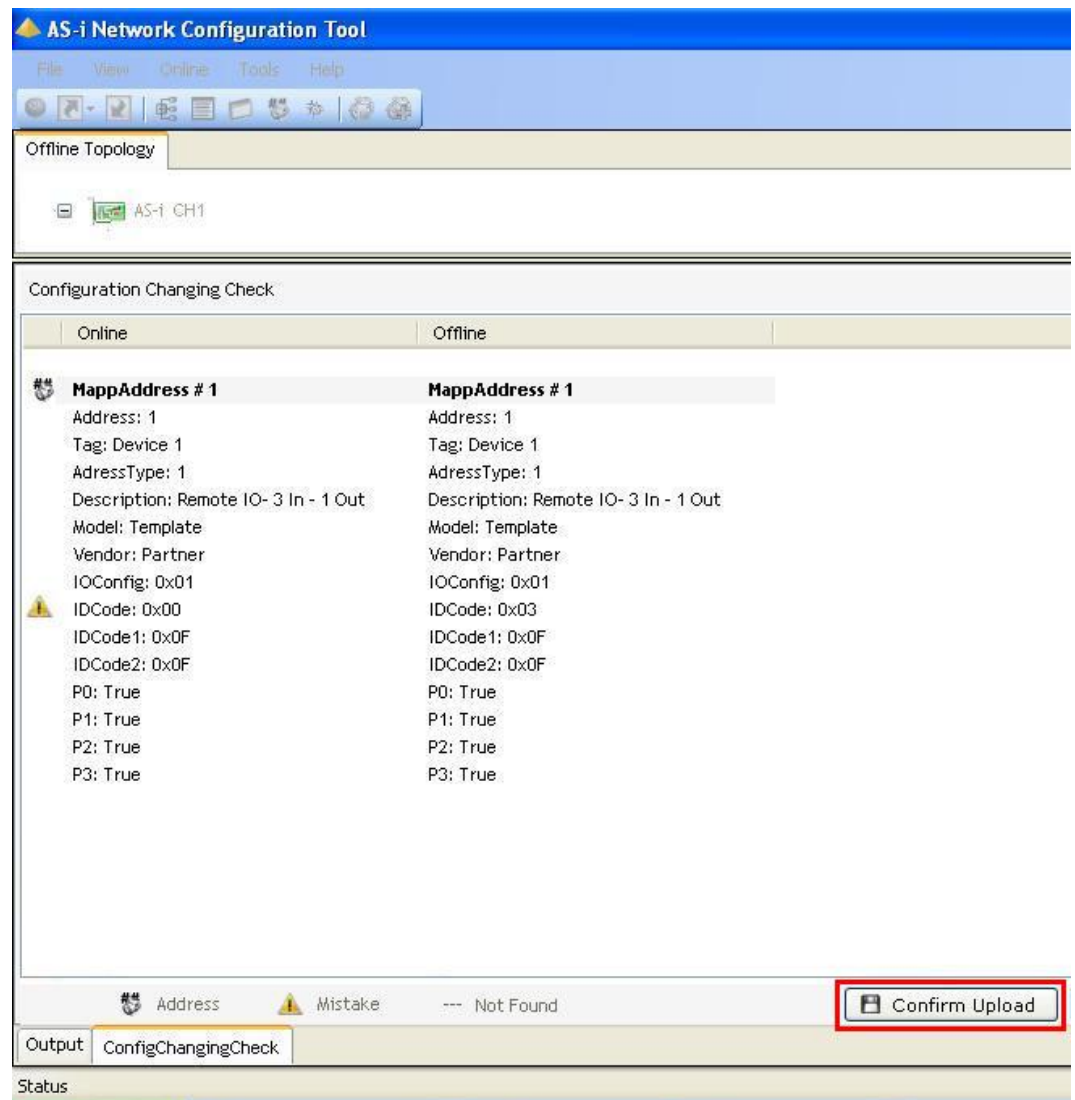



Figure 22.16 – Upload Detected Devices




**Figure 22.17 –Comparing between Devices Offline Topology and the Detected**

Finally it needs to **Download** the configuration to put the devices in the AS-i master memory. To do this, just select the button  (**Propagate DownStream**). There are other **Download** options: selecting the channel or via **Online** menu. For further information about the differences between these options, please consult the tool help.

## Inserting New AS-i Devices in Standard List

**SYSTEM302** already has a database of more common AS-i devices in the market. If there is any device that requires a specific parameter and is not on the available device list you can use the **Device Profile Editor** to create new equipment **Template**.

To create a new device, click the  button (**Device Profile Editor**) in the toolbar, or through **Tools→Device Profile Editor** menu. The window to create the slave device will open, as shown in the next figure.

Select the **Customize** tab and enter the specific parameterization of slave device. Click **Save** to add this device to the standard list. Click **Close** to close the **Device Profile Editor** and the device will be already available for use in the list of **Insert Devices** window.

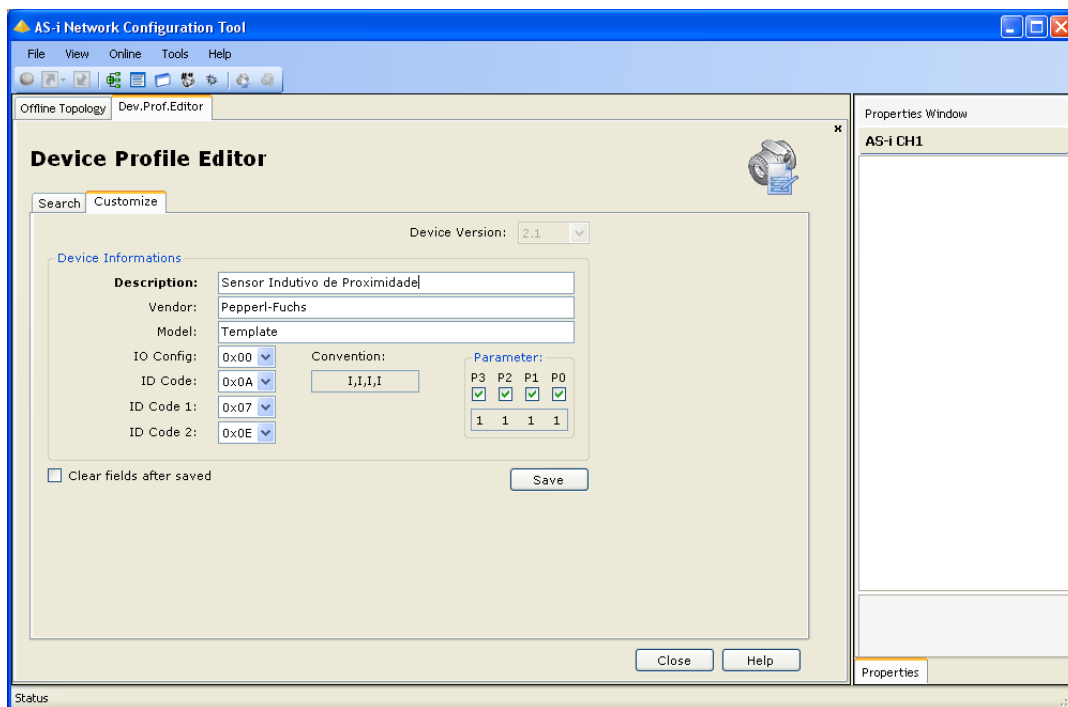


Figure 22.18 – Creation of New Slave Devices

## Configuring the AS-i Devices

### Step 6

After creating the AS-i network, the devices have to be configured. For example, click the device corresponding to the ONOFF\_Valve. The right side of the Topology Offline window will present the device properties.

Basically, it has the information necessary for the **SYSTEM302** architecture (**Tag, Description, Model and Vendor**) and the AS-i network configurations (**Address, IO Config, ID Code, ID Code 1 and ID Code 2 and Projected Parameters**). All this information is available in device manual and must be configured correctly.

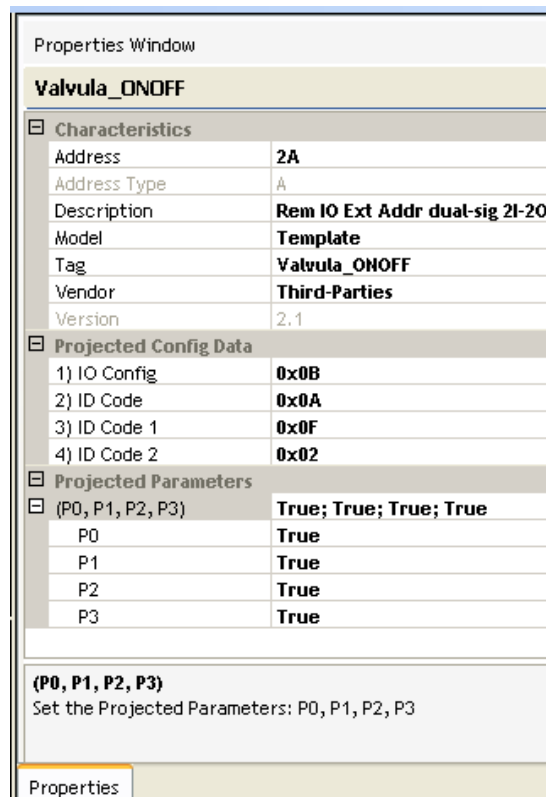


Figure 22.19 – Setting the Slave Device

**NOTE**

In the AS-i network configuration tool there is not **Save** option to save the configuration. All configurations created or changed is automatically stored in the **Studio302** Database (Workspace).

**Step 7**

When the previous steps were finish, the AS-i network configuration can be saved, and then, exit from **Network Configuration tool**. The **Mapping Tool** launches automatically. With this tool is possible to map the points of AS-i network in available points which will be used in ladder logic. This tool configures all characteristics of AS-i points (user tags, data types, scales, etc). See the following figure.

**NOTE**

In the case of AS-i network its points are not mapped in function blocks, because of the particular characteristics of AS-i network that is linked to the discrete points used in the Ladder.



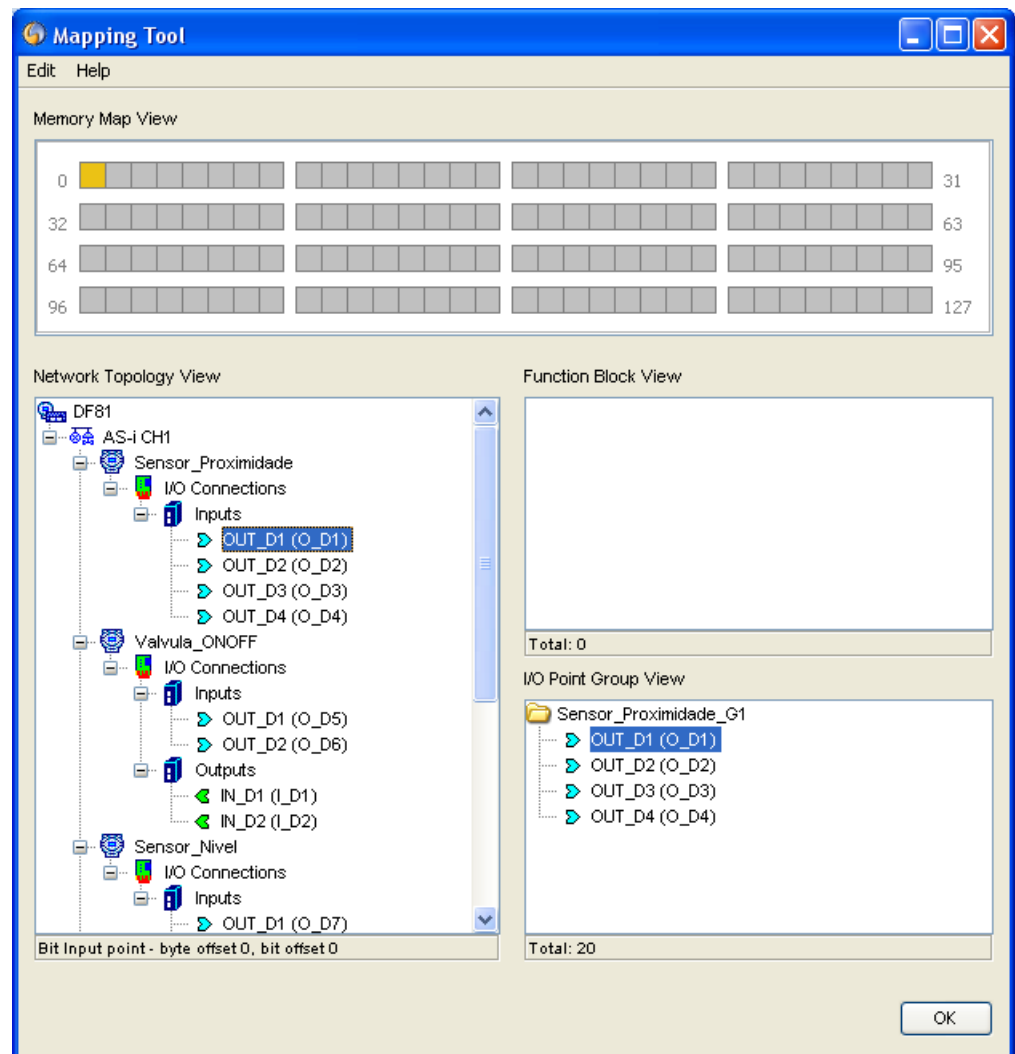


Figure 22. 20 – Mapping Tool Window

In the previous figure the devices which were inserted in the AS-i network with their modules can be seen in the **Network Topology View** window. In the **Function Block Label** window are the points which will be seen at **Syscon**, and the **I/O Group Point View** window are the points which will be seen at **LogicView for FFB**. The purpose is to configure each network “point” (or byte) in their respective data types.

#### NOTE

All points of AS-i network are automatically configured and have only the **Data type** bit type.

The next steps show how to use the points mapped in the **Network Configuration Tool** in the control logic. As mentioned earlier in the AS-i network there is only one way to map the inputs and outputs – ladder logic.

## Mapping AS-i I/O points to be used in Ladder

### Step 8

The points are automatically mapped in the AS-i network and will be available for use in the ladder. See the next figure that the bits have been automatically selected by the tool. By default all inputs and outputs of the equipment will be mapped.



Figure 22. 21 – Configuring the bits

Click **Cancel** to go to the initial screen or **OK** to exit from **Mapping Tool**.

After the operation is carried out successfully, insert a FFB block in the configuration using **Syscon**. This block is required to edit any ladder. For further details refer to the section Adding Function Blocks or **Syscon** manual. Right-click the FFB block, and then select **Define Parameters**.

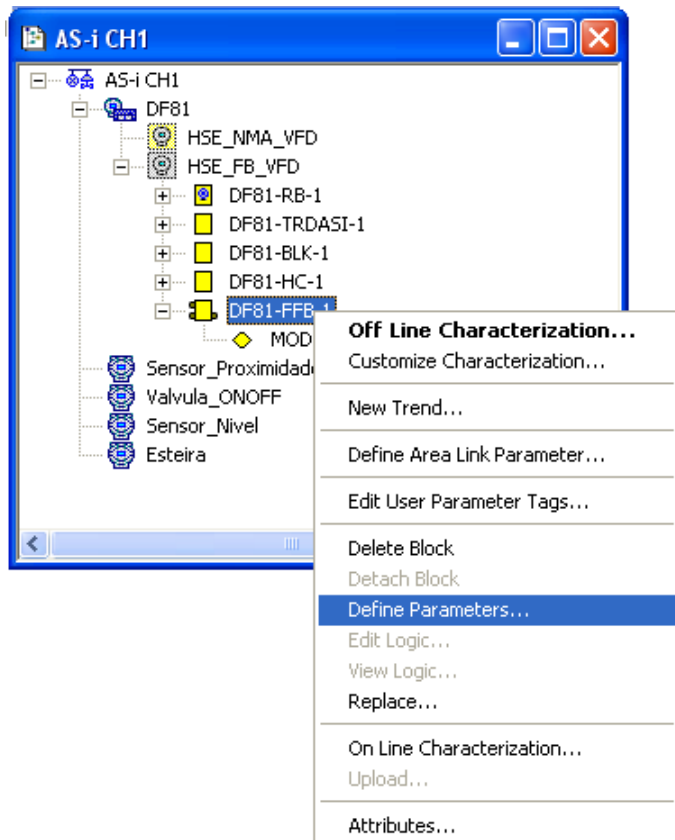


Figure 22. 22 – Defining FFB parameters (1)

The follow window will open:

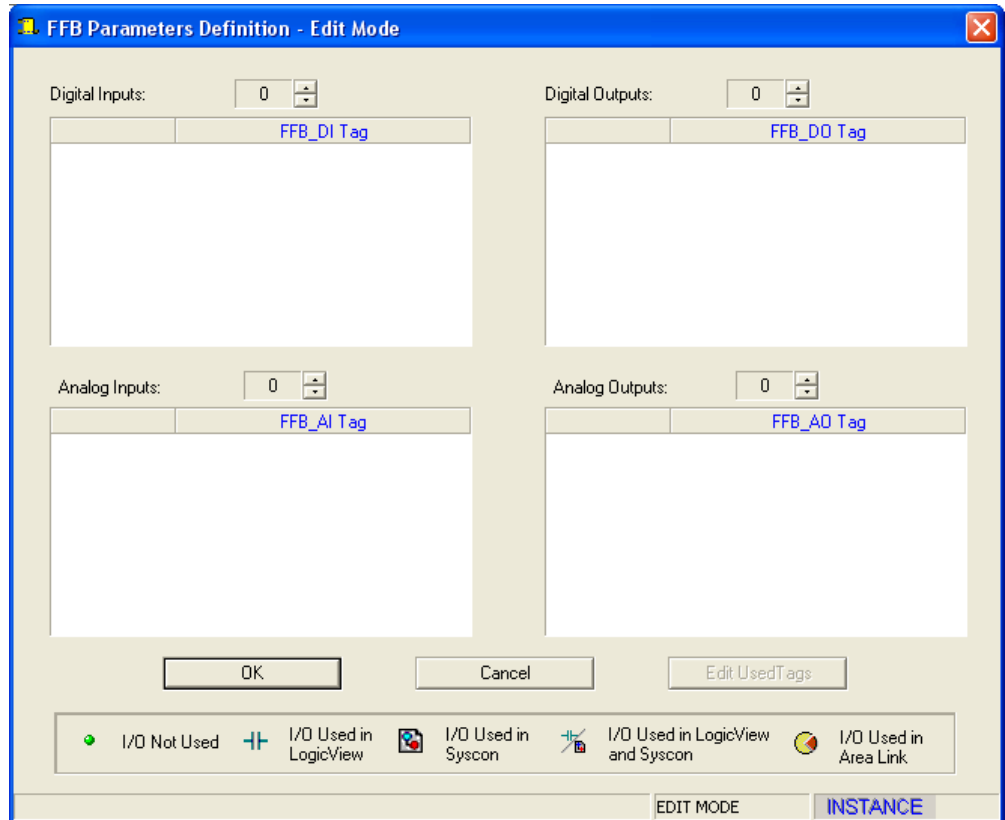


Figure 22. 23 – Defining FFB parameters (2)

If necessary define the inputs and outputs of FFB. Otherwise just click **OK**.



Return to **Syscon**, save the configuration, and do an **Export tags**.

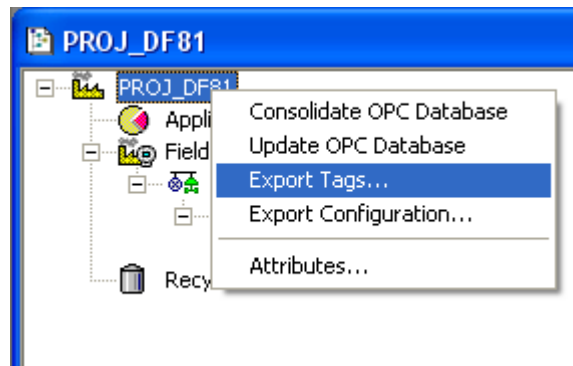


Figure 22. 24 – Export tags

After finish this operation, right-click the FFB block, and then select **Edit Logic**. The **LogicView for FFB** will be launched, and the ladder logic can be edited.

For the first time the logic is edited the **Refresh Data** command has to be executed thus the IO points configured in **Mapping Tool** will be updated in the ladder. Right-click **Network I/O** in the **Hierarchy** window of the **LogicView for FFB**. See the next figure.

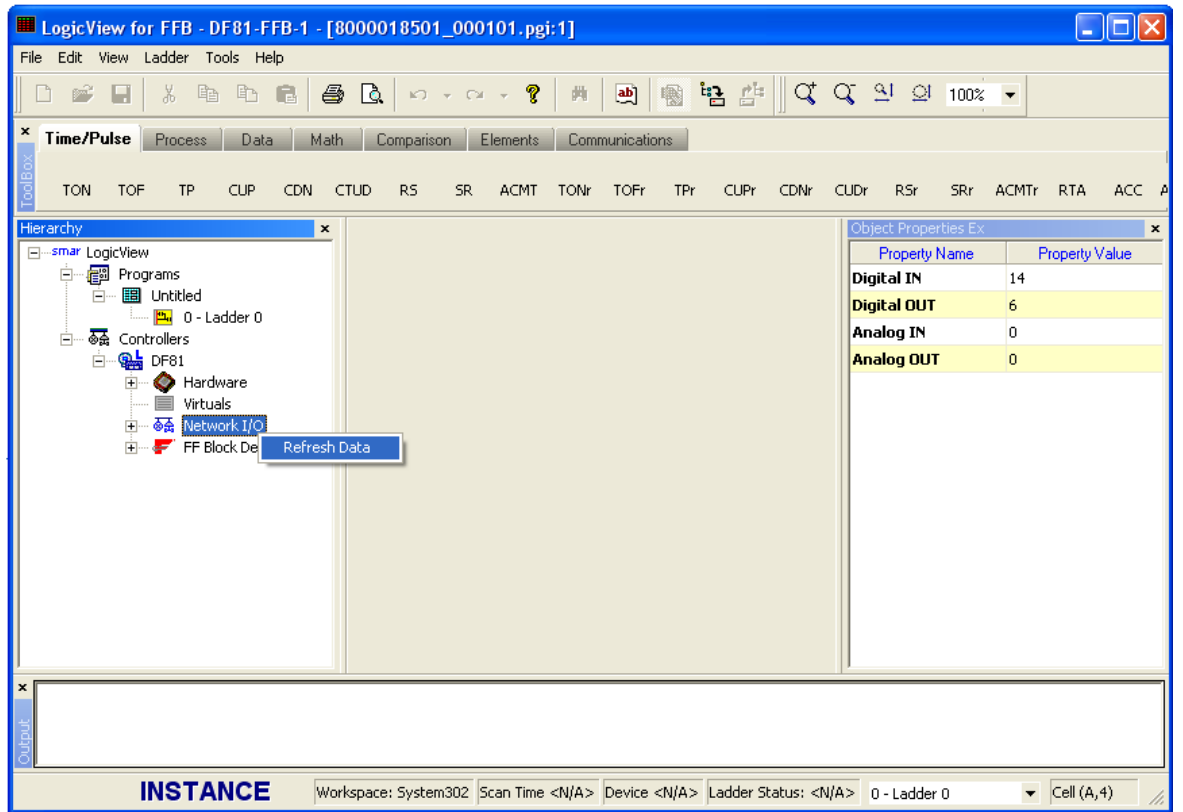


Figure 22. 25 – Refresh data

The NetIO points can be seen in the **Hierarchy** window. See the next figure.

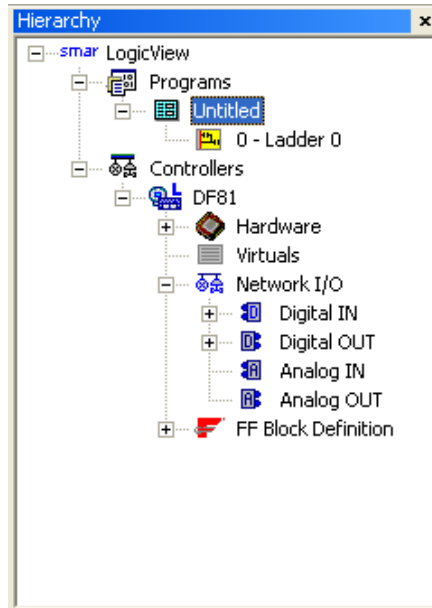



Figure 22. 26 – Network I/O at LogicView for FFB

After that procedure the IO point of the AS-i network are already available to be used in the logic. The user has a complete function library which can be used in the logic. For further details see the **LogicView for FFB** manual.

In the following figure is shown the logic with respect to such proposed. The point of the proximity sensor connected in a TON block (Timer). All the AS-i IO points appear with the symbol  in the ladder logic.

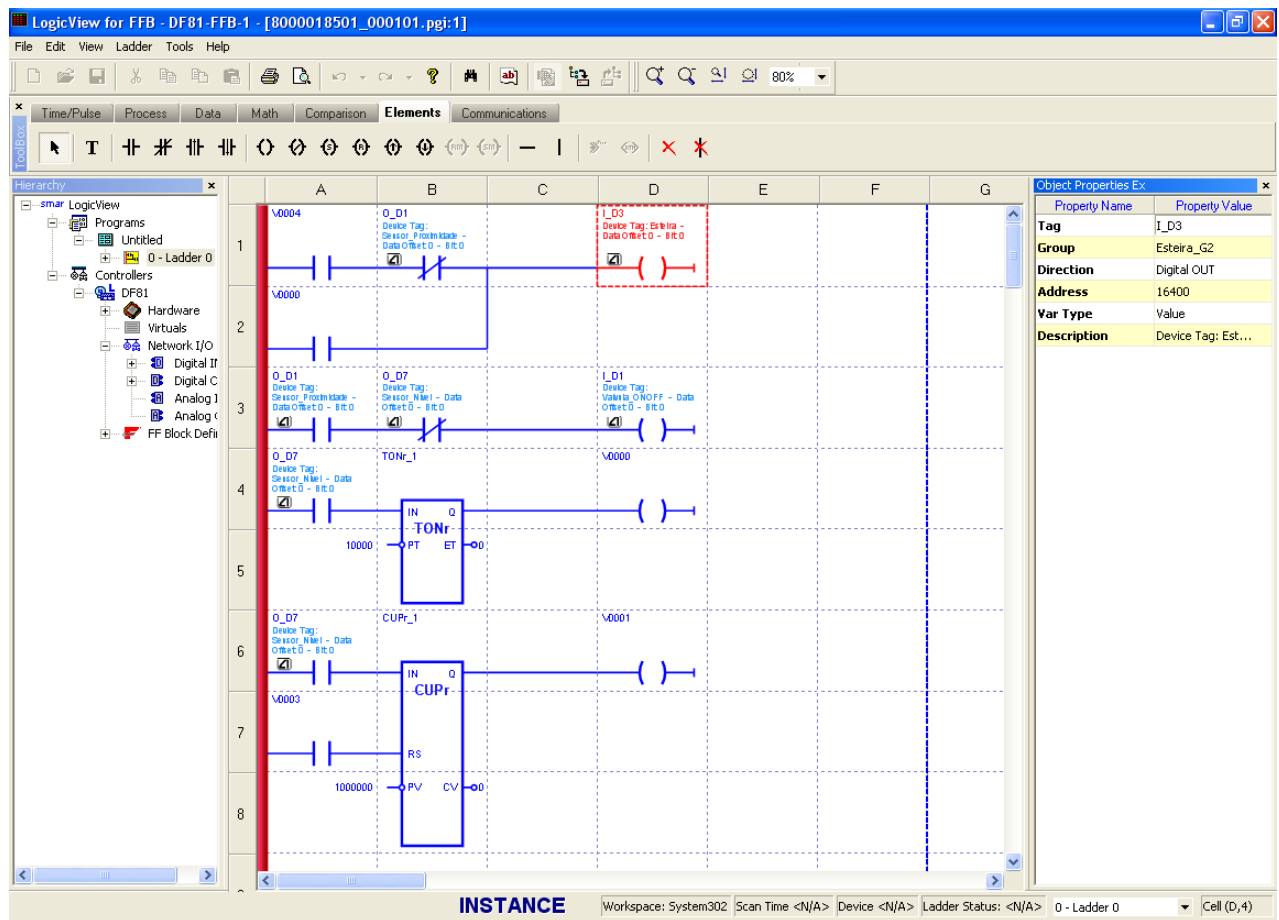



Figure 22. 27 – Editing Logic

After ladder configuration the user can download the configuration to the device. Another option is to configure the function blocks at **Syscon**. In this topic only the ladder was used to configure the ladder. Before downloading the configuration you have to save it in the **LogicView for FFB**. Exit from it, and return to **Syscon**.


To start a communication with the devices, first, is necessary to commission the controller. In this way the tags, IDs and addresses of each device will be assigned correctly. If this procedure was not done, the **Syscon** will detect the uncommissioned device and its download will be canceled. When the devices' commissioning finishes the download process can start. The download process can be

done, for example, returning to **Proj\_DF81** window, right-clicking **Fieldbus Networks** icon, , and then, select **Download** option. For further details about commissioning and possible download types refer to **Syscon** manual.

## Network Diagnostics

There are many ways to identify communication failures in the AS-i network. Some options are: Network Configurator, Transducer block, **Syscon** Live List or module's LEDs. Some ways will be explained in this topic.

### Network diagnostic using the Network Configurator

To do a network diagnostic through **Network Configuration Tool** first is necessary to connect it to the controller. This can be done by  button (**Toggle Start/Stop Communication**). After, right-click the channel, and select **Online Mode** option as shown in the following figure.

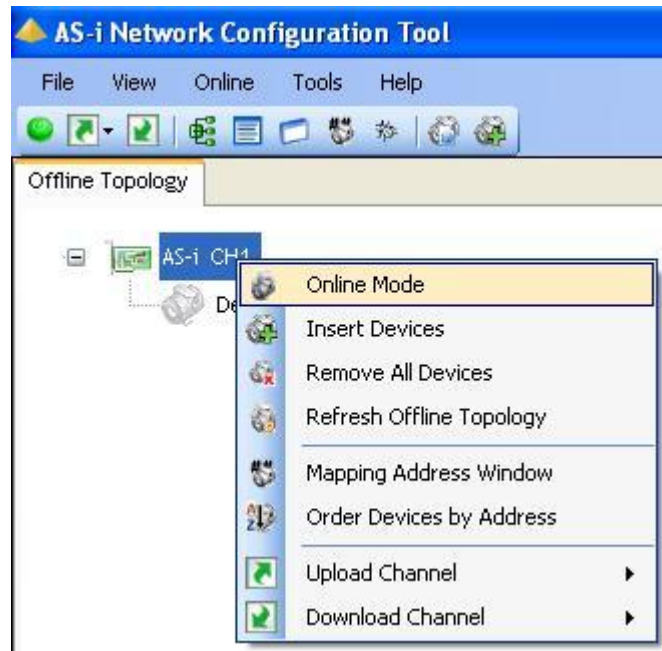


Figure 22. 28 – Selecting the Visualization in the Online Mode

After this procedure is performed the **Online Mode** window will open (see figure below). This view will bring the most of the necessary information on the installed AS-i network.

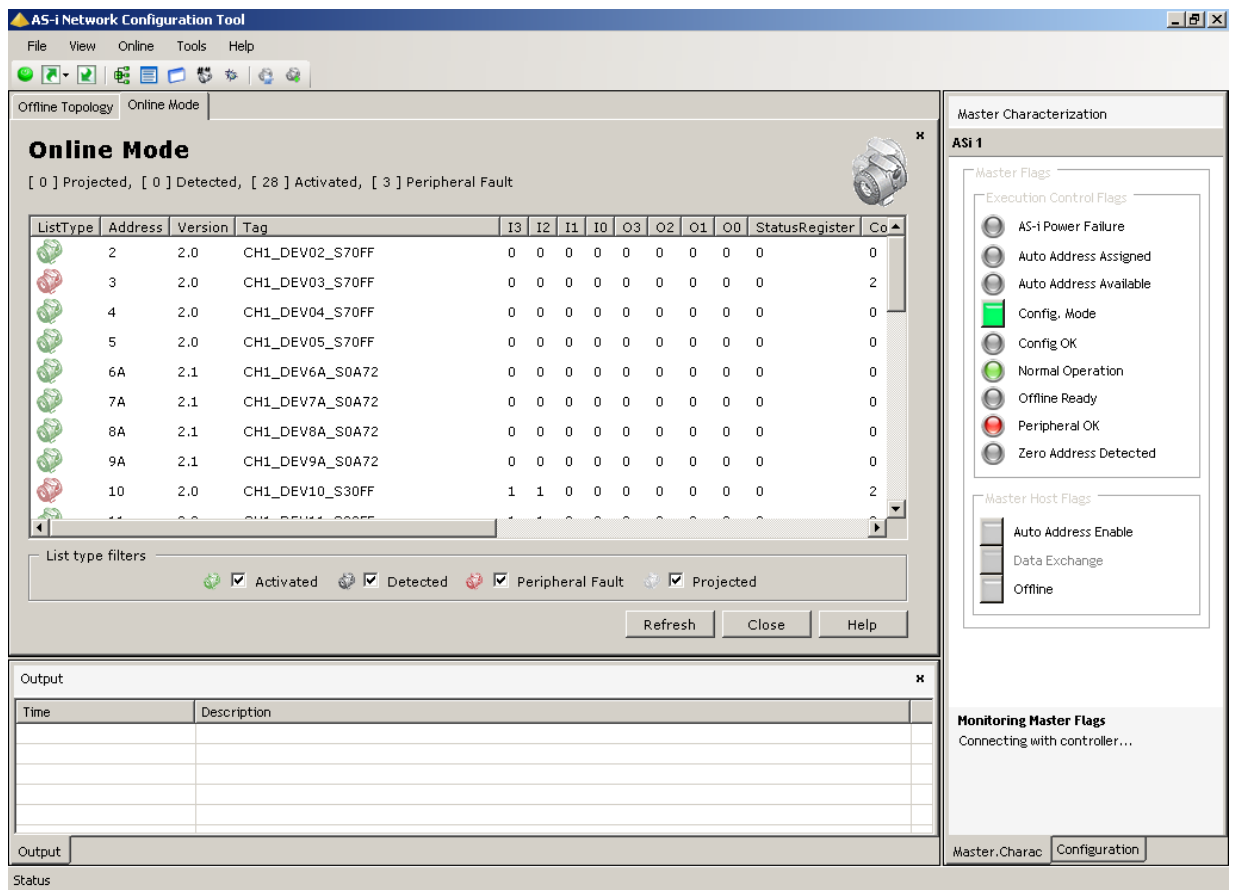


Figure 22. 29 –AS-i Network Diagnostic

The previous figure shows problems with equipment 3 and 10 that went to the LPF and on the other side; there was a red sign in **Peripheral OK** flag of the AS-i Master indicating that there are problems with devices on the network. In addition, there are parameters as **StatusRegister** and **CommErrors**.

**StatusRegister** indicates the information recorded in nonvolatile memory of the slave (for further information see "Specific blocks of AS-i controller").

**CommErrors** represents the number of communication failures that occurred between the master and a specific slave. For this case there is an increase of 3, it is the maximum number of attempted communications of the master with the slave in each communication cycle.

### Network diagnostic using the Communication Transducer Block

The figure below represents the AS-i Communication Transducer Block. In this block have been mapped the main parameters of the AS-i network that can also be seen in **Network Configuration Tool**. The difference is that the writings in certain parameters are limited to the user. The treatment is done by the configuration tool of the network.

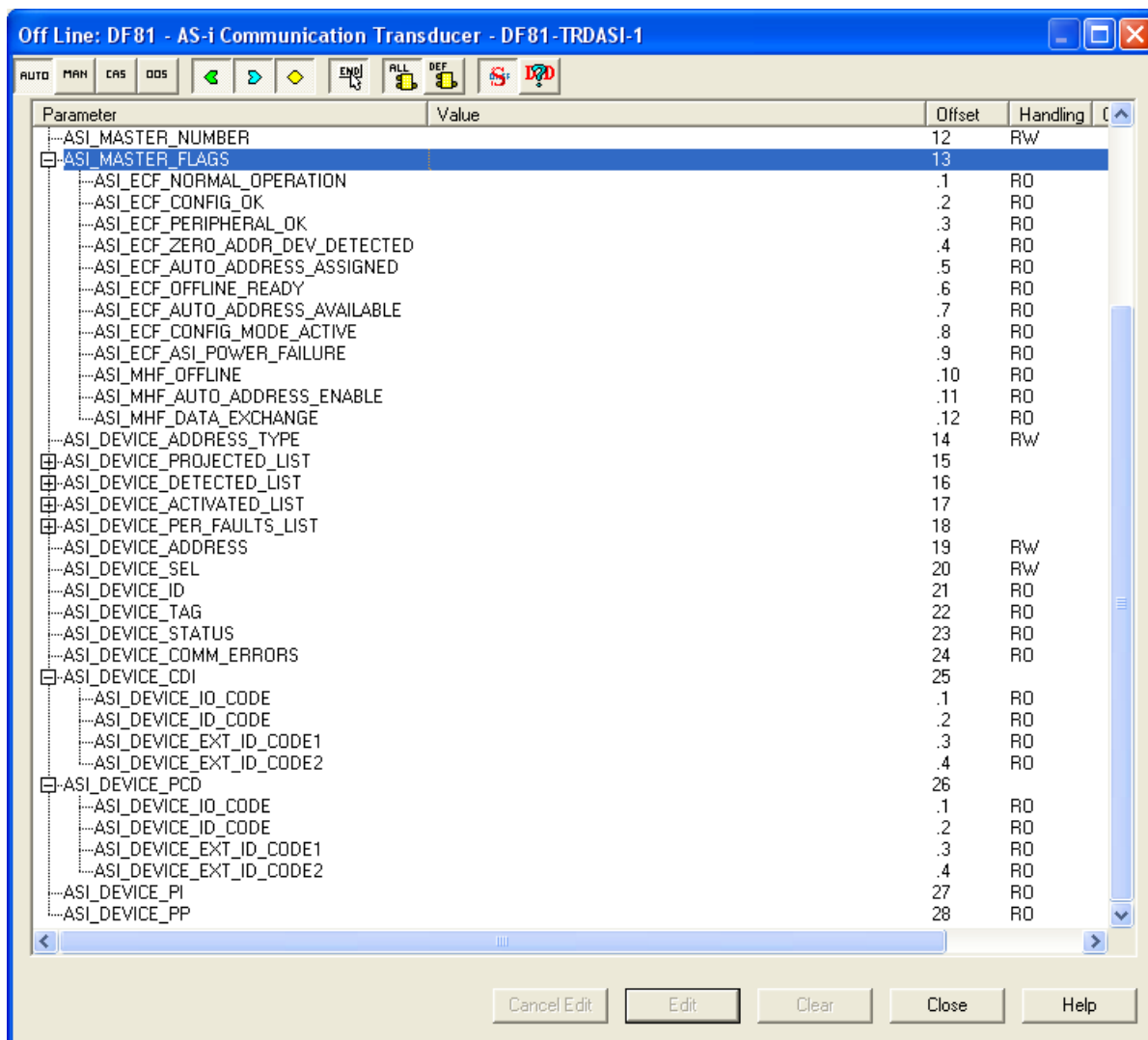


Figure 22. 30 – Transducer Block AS-i Communications

## Network diagnostic using the LEDs' Controller

The following table has the indication of the AS-i bus status via the LEDs' controller.

| LED                    | COLOR/STATE      |                  | DESCRIPTION   | BEHAVIOR  |
|------------------------|------------------|------------------|---|---|
|                        | Red              | Green            |   |   |
| AS-i PWR1<br>AS-i CFG1 | On               | Off              | It indicates supply failure ( <i>Power Fail</i> ) on the channel.   | LED: red on and green off   |
|                        | Blinking Quickly | Off              | Channel powered ( <i>Power On</i> ) and master is not running ( <i>Not ready</i> )  | Blinking quickly and pre-set intervals of the red LED and green LED off |
| AS-i PWR2<br>AS-i CFG2 | Off              | Blinking Quickly | Channel powered ( <i>Power On</i> ), there is not power failure, but the master is Offline.                                   | Red LED off and green LED blinking quickly on pre-set intervals.        |
|                        | Off              | Blinking Slowly  | It indicates when the NORMAL_OPERATION flag is off OR its CONFIG_OK flag is not active OR the master is in configuration mode | Red LED off and green LED blinking slowly                               |
|                        | Off              | On               | It indicates normal operation, CONFIG_OK flag is active and the master is on protected mode.                                  | Red LED off and green on  |

Table 22.1 – Description of the state of LEDs Controller

## Specific Blocks of AS-i Controller

### AS-i Communication Transducer

This block provides the following characteristics:

- Live list of the slaves devices;
- Devices list (LPS, LDS, LAS, LPF);
- Slaves devices diagnostic;
- Online configuration of slaves' configuration parameters.

See in the following table the parameters description.

| Idx | Parameter         | Data Type     | Valid Range  | Initial Value | Unit | Storage/ Mode | Views  |
|-----|-------------------|---------------|--|---------------|------|---------------|--|
| 1   | ST_REV            | Unsigned16    |  | 0             | Na   | S             |  |
| 2   | TAG_DESC          | OctString(32) |  | Spaces        | Na   | S             |  |
| 3   | STRATEGY          | Unsigned16    |  | 0             | Na   | S             |  |
| 4   | ALERT_KEY         | Unsigned8     | 1 - 255  | 0             | Na   | S             |  |
| 5   | MODE_BLK          | DS-69         |  | O/S           | Na   | S             | See Parameter Mode.  |
| 6   | BLOCK_ERR         | Bitstring(2)  |  |               | E    | D / RO        |  |
| 7   | ASI_NUM_LINKS     | Unsigned8     | 1 - 2  | 2             | Na   | S / RO        | This parameter defines the number of buses/channels supported for the DF81   |
| 8   | ASI_LINK_SEL      | Unsigned8     | 0: First<br>1: Next<br>2: Previous<br>3: Last<br>255: Host | 0             | E    | S/RW          | Select which buses will have the information available in items 11 to 17   |
| 9   | ASI_LINK_ID       | Unsigned16    |  | 4096          | Na   | D / RW        | This parameter identifies the bus DF81 currently selected in the Chooser Links   |
| 10  | ASI_LINK_ID_REV   | Unsigned8     |  | 0             | Na   | D / RO        | Contains the revision of the live list of current DF81 bus   |
| 11  | ASI_NUM_DEV       | Unsigned16    | 1-63   | 1             | Na   | D / RO        | Identifies the number of equipment in the AS-i bus current DF81. That's up to 62 slaves, more 1 that identifies the master |
| 12  | ASI_MASTER_NUMBER | Unsigned8     | 1 - 2  | 1             | Na   | D / RW        | This parameter selects the master/channel to be monitored  |
| 13  | ASI_MASTER_FLAGS  | DS-293        |  | O/S           | E    | D / RO        | Structure that contains execution flags and control of AS-i master   |



| Idx | Parameter                  | Data Type         | Valid Range  | Initial Value  | Unit | Storage/ Mode | Views  |
|-----|----------------------------|-------------------|--|----------------|------|---------------|--|
| 14  | ASI_DEVICE_ADDRESS_TYPE    | Unsigned8         | 0: Not applicable.<br>1: Original version: from 1 to 31.<br>2: Extended version: from 1A to 31A.<br>3: Extended version: from 1B to 31B.<br>4: Version not supported.  | Not applicable | E    | D/RW          | Identifies the type of equipment to address the list of AS-i master  |
| 15  | ASI_DEVICE_PROJECTED_LIST  | Unsigned8(32)     | 0: Not Projected<br>1: Projected<br>2: Used by an old version device   | 0              | Na   | D / RO        | Device list designed for AS-i network  |
| 16  | ASI_DEVICE_DETECTED_LIST   | Unsigned8(32)     | 0: Not Detected<br>1: Detected<br>2: Used by an old version device   | 0              | Na   | D / RO        | Device list detected in the AS-i network   |
| 17  | ASI_DEVICE_ACTIVATED_LIST  | Unsigned8(32)     | 0: Not Activated<br>1: Activated<br>2: Used by an old version device   | 0              | Na   | D / RO        | Device list activated in the AS-i network  |
| 18  | ASI_DEVICE_PER_FAULTS_LIST | Unsigned8(32)     | 0: Peripheral_OK<br>1: Peripheral Fault<br>2: Used by an old version device  | 0              | Na   | D / RO        | Device list failed in the AS-i.  |
| 19  | ASI_DEVICE_ADDRESS         | Unsigned8         | 1-63   | 63             | Na   | D / RW        | It identifies the address of the device. Address 63 is used to identify the network master and the address 0 is not valid                |
| 20  | ASI_DEVICE_SEL             | Unsigned16        | 0:First<br>1:Next<br>2:Previous<br>3>Last<br>255: Host   | 0              | E    | S/RW          | Select which device in the current DF81 bus will have the information shown in items 19 to 29  |
| 21  | ASI_DEVICE_ID              | VisibleString(32) |  | Spaces         | Na   | D / RO        | It identifies the ID of the device selected in the Chooser Equipment   |
| 22  | ASI_DEVICE_TAG             | VisibleString(32) |  | Spaces         | Na   | D / RO        | Identifies the tag of the equipment of the device selected in the Chooser Equipment. This tag comes from the network configuration tool. |
| 23  | ASI_DEVICE_STATUS          | Unsigned8         | 0: Good. No status register is set.<br>1: Flag S0: Address Volatile Fault.<br>2: Flag S1: Peripheral Error.<br>3: Flag S2: Reserved.<br>4: Flag S3: Read Error Non-Volatile Memory.<br>5: Bad. Could not evaluate status register flags.<br>6: Not Applicable. | 6              | E    | D/RO          | It identifies the communication status of the AS-i master with the equipment selected in the Chooser Equipment                           |
| 24  | ASI_COMM_ERRORS            | Unsigned8         | 0-255  | 0              | Na   | D/RO          | It identifies the communication errors between AS-i master with the equipment selected in the Chooser Equipment                          |
| 25  | ASI_DEVICE_CDI             | DS-297            |  | O/S            | Na   | S/RO          | It identifies the current configuration of the equipment selected in the Chooser Equipment   |
| 26  | ASI_DEVICE_PCD             | DS-297            |  | O/S            | Na   | S/RO          | It identifies the configuration designed the equipment selected in the Chooser Equipment   |
| 27  | ASI_DEVICE_PI              | Unsigned8         | 0: 0000<br>1: 0001<br>...<br>15: 1111<br>16: Not applicable.   | 0              | E    | S/RO          | It identifies the current parameters of the equipment selected in the Chooser Equipment  |
| 28  | ASI_DEVICE_PP              | Unsigned8         | 0: 0000<br>1: 0001<br>...<br>15: 1111<br>16: Not applicable.   | 0              | E    | S/RO          | It identifies the parameters of the designed equipment selected in the Chooser Equipment   |

Legend: E – Parameter List; Na – Dimensionless parameter; RO – Read Only; D – Dynamic; N – nonvolatile; S - Static  
Fill line with Gray Background: Default Parameters of Syscon

**Table 22.2 – Description of the parameters of AS-i Communication Transducer block**

The AS-i transducer block has two special structures: DS-293 and DS-297. Its parameters are presented below.

**Description of the DS-293 Structure (AS-i Master Flags)**

| Flag                           | Meaning  |
|--------------------------------|--|
| ASI_ECF_NORMAL_OPERATION       | It indicates that the master is cyclically transiting between phases of normal operation   |
| ASI_ECF_CONFIG_OK              | This flag is enabled when nominal configuration matches with the real configuration detected. This is a simple way to obtain information about the configuration |
| ASI_ECF_PERIPHERAL_OK          | It indicates that List of Periphery Fault is empty   |
| ASI_ECF_ZERO_ADDR_DEV_DETECTED | It indicates the presence of a slave with address "0" - is not permitted in normal operation   |
| ASI_ECF_AUTO_ADDRESS_ASSIGNED  | Allows the master to assign a new address for a slave  |
| ASI_ECF_OFFLINE_READY          | Activated when the offline phase is complete   |
| ASI_ECF_AUTO_ADDRESS_AVAILABLE | It indicates that there are conditions to occur the automatic addressing*  |
| ASI_ECF_CONFIG_MODE_ACTIVE     | Indicates the master is in the "Configuration" mode (True) or "Protected" (False)  |
| ASI_ECF_ASI_POWER_FAILURE      | It indicates bus voltage below the lower limit   |
| ASI_MHF_OFFLINE                | When activated by the user, the master takes to the offline phase  |
| ASI_MHF_AUTO_ADDRESS_ENABLE    | Indicates that the automatic addressing is enabled   |
| ASI_MHF_DATA_EXCHANGE          | Enables the data exchange between master and slave   |

\*As a matter of terminology, confusion may occur between this flag and **Auto\_Address\_Enable**. Note that the first is user-defined, allowing the self address if the conditions are met, which is indicated by the flag **Auto\_Address\_Available**.

It is important to note that four of these flags are enabled by user – host – and affect the behavior of the master: last two on the list, **Auto\_Address\_Available** flag and the **Config Mode** flag. All others cannot be changed by user and are controlled by the master.

**Description of the DS-297 Structure (AS-i Slaves Configuration)**

| Parameter               | Meaning  |
|-------------------------|--|
| ASI_DEVICE_IO_CODE      | Through this request the master receives a response to configuration input / output (IO configuration) of a slave. Along with the ID code of the slave (ID code) configuration of IO uniquely identifies a type of slave   |
| ASI_DEVICE_ID_CODE      | The ID code of the slaves in compliance with version 2.1 of the specification are in addition to the unique ID code, read by the master by request "Read ID Code", two other codes - "Extended ID Code 1" and "Extended ID Code 2". Together they serve to identify different slaves. Slaves complying with the new specification, for example, have ID code "A" in hexadecimal, as an ID code "B" indicates a slave "safety at work". All slaves with the same ID code "A" also have the other two ID codes |
| ASI_DEVICE_EXT_ID_CODE1 | It is used to read the code extended 1 slave, when it exists. This code, unlike the original, can be modified by the user.   |
| ASI_DEVICE_EXT_ID_CODE2 | This code extends the possibilities for configuring the slaves, and as the unique ID code cannot be modified by the user, is defined in a nonvolatile way by the manufacturer.   |



## CREATING A MODBUS CONFIGURATION USING THE DF89

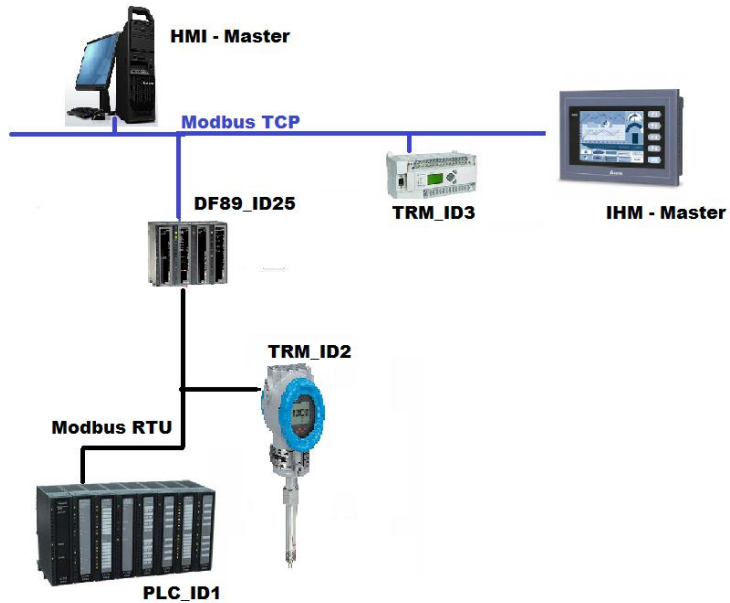
### Introduction

This section will present how to configure a strategy using the DF89 as controller. The DF89 controller can operate in several Modbus scenarios. Therefore different application approaches will be shown throughout the topics of this section.

| NOTE |  |
|------|--|
| •    | The characteristics of the DF89 described in this section are only available from the firmware version 4 (V4.xx) with Device Description 4.xx. |
| •    | The Modbus configuration characteristics of firmware versions prior to 4 are the same as described in section “Adding Modbus” of this manual.  |
| •    | The DF89 only has RS-485 port from the serial number SN623.  |
| •    | Modules with serial number less than SN623 support firmware version 4 and features described in this section only for RS-232 serial port.      |

To illustrate the configuration, consider as example a process has two transmitters, one slave, one IHM and one supervision station (HMI). The network architecture is shown on the figure below. The scenarios used as examples are:

- 1) The DF89 stands for the RTU Modbus master of the slave PLC (PLC\_ID1) and the slave transmitter (TRM\_ID2) on the RS-485 serial port.
- 2) The DF89 stands for the TCP Modbus master of the slave transmitter (TRM\_ID3) on the Ethernet.
- 3) The DF89 is the TCP Modbus slave for the IHM (IHM Master).
- 4) The supervision station (HMI Master) can read the DF89 data (concentrator) or the data directly from the slaves on the DF89 serial port (Bypass).



**Figure 23. 1 – Example of process using several Modbus scenarios with the DF89**

The configuration for each one of these scenarios is explained step by step on the next topics. At the beginning, the steps 1 to 4 are the same for all scenarios. Beyond step 5 there will be differences according to the scenario.

SYSTEM302 enables to execute the control logic by two ways: ladder or function blocks. Steps 5 to 8 are necessary to configure the Modbus network. Step 9 shows how to map the Modbus network points in available points for use in Ladder or Function Block logic. Step 10 shows how to make the configuration using ladder logic and the step 10' using function blocks. It also possible to combine both configurations, i.e., part in ladder and part in function blocks.

#### IMPORTANT

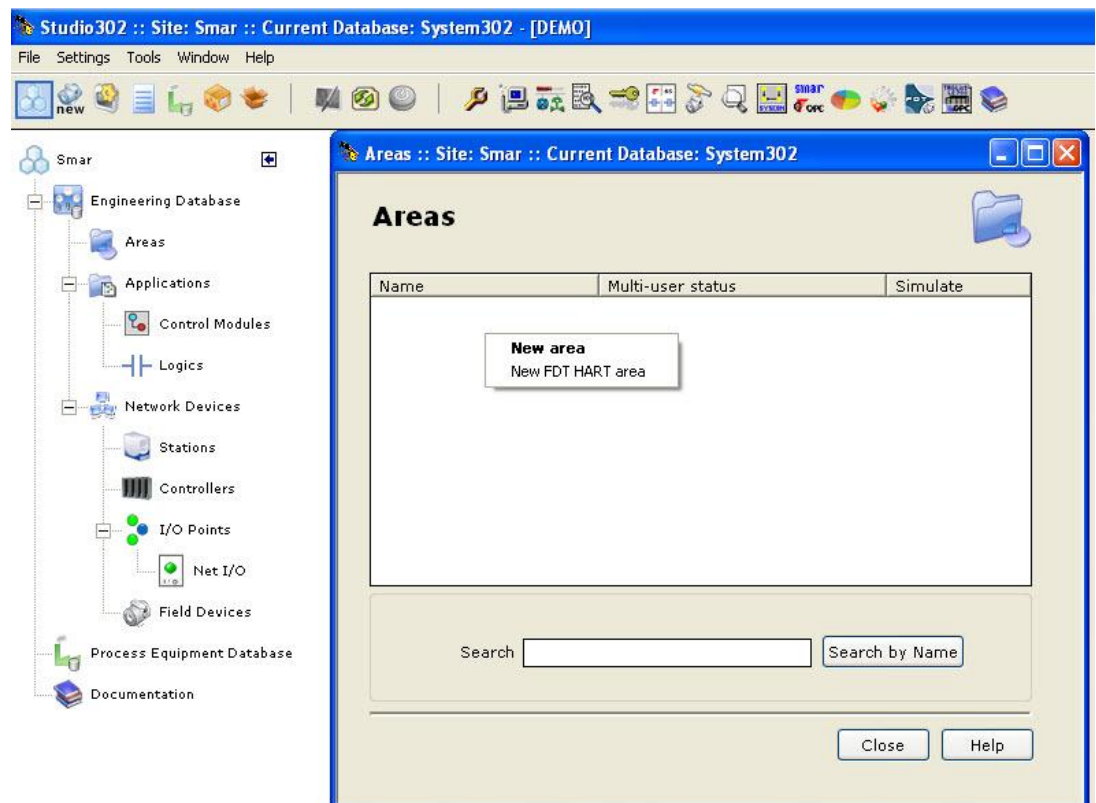
Before configuring the Modbus network it is necessary to previously seek information on each slave device configuration such as communication rate, data type, point address and functions supported. This information is supplied by the respective Modbus device manufacturer

## Creating a Basic Area

This topic will show how to create a basic DF89 area to be used on any of the above scenarios.

### Step 1

To create a new area (on the SYSTEM302 language), right-click inside the **Studio302 Areas** window and choose **New Area** as on the next figure.



**Figure 23. 2 - Options to create a new area on the Studio302**

Next, a window will be shown for the user to choose the type of configuration. As the DF89 controller is HSE device, you may choose **HSE Area** or **Predefined** by using a template.

The next window will show the types of existing templates. For every controller there are options with the FFB1131 block or without it. Here, a DF89 template will be used with the FFB1131.

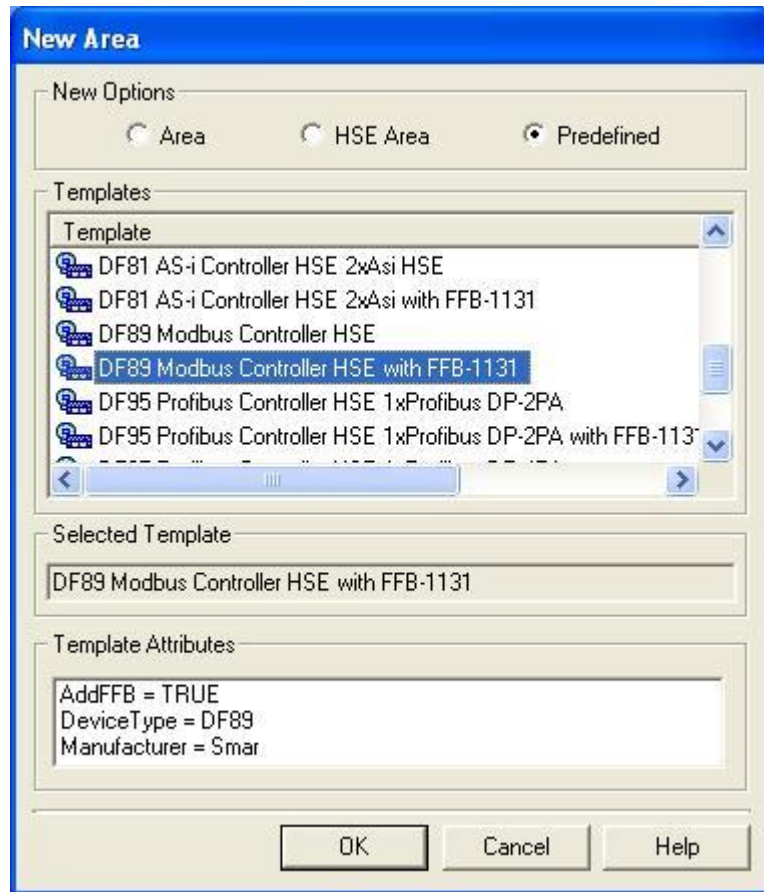


Figure 23. 3 - Pre-defined configuration window

Choose the template and click **OK**.

**Step 2**

The user must enter the area name as shown on the figure below.



Figure 23. 4 – New area name

Type the name **PROJ\_DF89** in the **Area Name** field and click **OK**. Thus, the new area will be created with the DF89 controller. See the following figure.

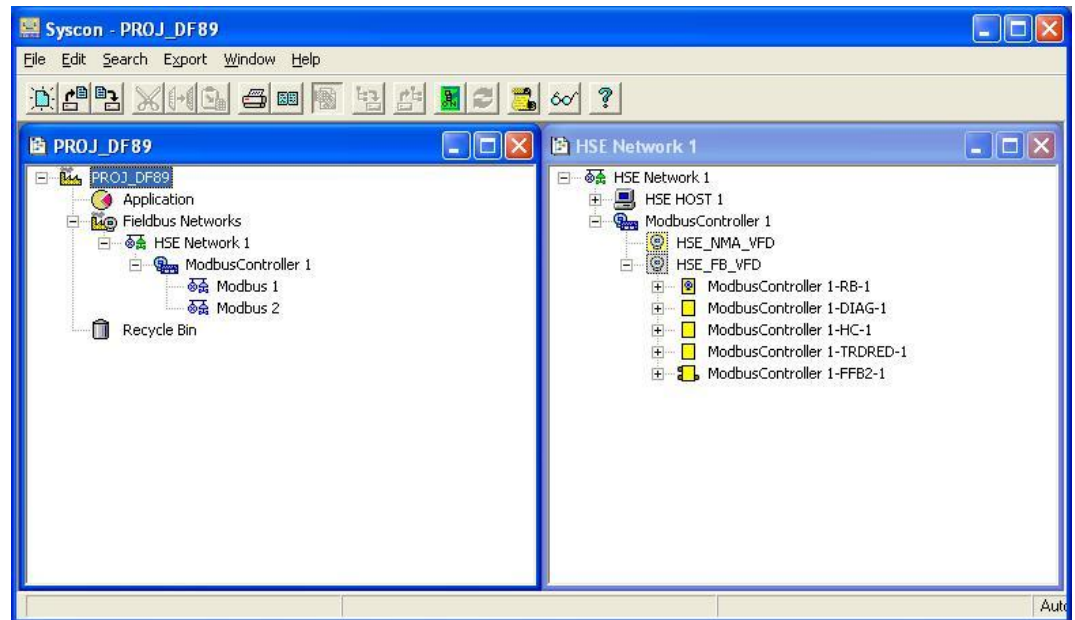


Figure 23. 5 – Syscon with the area and HSE channel windows

The figure above shows the **Syscon** window, with the HSE fieldbus network on the left (**HSE Network 1**); below it, there is only one DF89 controller with default tag (**ModbusController 1**). Below the DF89 controller, two channels were created supported by this device: the **Modbus 1**, which corresponds to the serial channel, and the **Modbus 2**, which corresponds to the TCP channel.

The second window on the right represents the expansion (or view) of the HSE channel, which has only the **ModbusController 1**. The other HSE controllers can be added by simply clicking the channel and ask for adding new devices.

### Step 3


These default tags can be altered simply by right-clicking the corresponding tag on the main window and choose **Attributes**. The figure below shows the DF89 tag altered to **Area1\_DF89**.

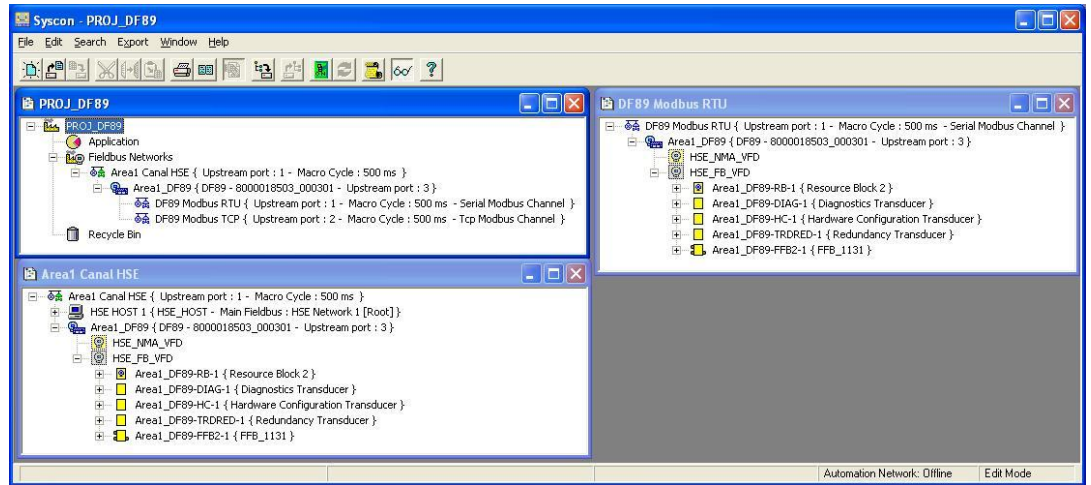


Figure 23. 6 – Controller attribute window

To alter the channel tag, on the main window, click the channel (for example, Modbus 1) and command window expansion. A new window will open. At the window edge, right-click the channel tag and choose **Attributes**. The figure below shows the configurations for the controller and the channels with the new tags. The tags were changed as follows:

- HSE – from **HSE Network 1 to Area 1 Canal HSE**
- DF89 Modbus Serial – from **Modbus 1 to DF89 Modbus RTU**
- DF89 Modbus TCP – from **Modbus 2 to DF89 Modbus TCP**

To ease the visualization, the **Details** button  on the toolbar shows the type of object between brackets { }: channel, controller, and block. The figure below shows the new tags with the respective types.



**Figure 23. 7 – Syscon with the area windows (above left), for the HSE channel (below left) and for the serial channel (above right).**

**IMPORTANT**

Not all characters are valid when naming the elements.

The valid characters are:

A-Z a-z 0-9 # { } [ ] ( ) + -

The invalid characters are:

~ ` ! @ # \$ % ^ & \* = | : ; , . < > ? / ' " \

**ATTENTION**

The easier method to create a configuration was used here, based on template. In this case, the configuration is created with all of the necessary channels. If the user does not want a specific channel, it can be excluded.

There is another way of creating the configuration, when the controller and the channel are created manually. In this case, in the step 1 in the figure 23.3, the type of area to be chosen must be the **HSE Area** option, and only an empty HSE configuration will be created. Step 4 described below shows how to create a configurator starting from HSE window. For more details refer to the **Syscon** manual.

The option to create from a template will only be available for new areas.

**Step 4**

This step will only serve to add a new controller or when the configuration is created only with the HSE Host. In the example of this chapter is not even necessary step.

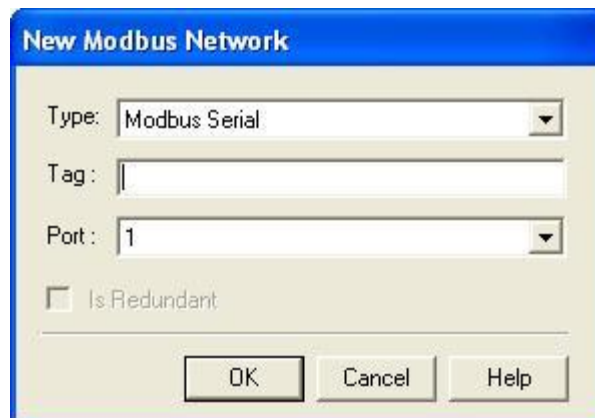
To add the DF89 controller, at the HSE channel window, right-click the **Area1 Canal HSE**, choose **New Controller** and then **D89**, as shown on the next figure.





**Figure 23. 8 – Creating the DF89 Controller manually**

The new controller will be added. Then, still on the area window right-click and choose **New Network**. The window shown on the figure below will appear. Fill out the channel type and tag. Click **OK** and **SmarNetCont** will open automatically.



**Figure 23. 9 – Creating the Modbus channel**

## **DF89 configuration as Modbus Serial Master**

This section will detail every step to make the following configuration:

- Add devices on the DF89 serial channel
- Add Modbus points on the devices
- Map the Modbus points for the **SYSTEM302** logic

For the example of the process on figure 23.1 are used one PLC slave (PLC\_ID1) and one transmitter (TRM-ID2) connected to the RS-485 of the DF89 using Modbus RTU.

### **IMPORTANT**

On the Modbus serial scenario the DF89 has two physical means, RS-232 and RS-485, although only the DF89 has a serial port. In other words, it will work only with the configuration (baud rate, stop, parity and timeout) for both means. The DF89 supports up to 32 devices on the serial channel.

Step 5

**Modbus network configuration**

**SmarNetConf** or **Network Configurator** is the Modbus network configuration tool. On it, the user will define the network parameters, all slaves that compose them and all parameters necessary for Modbus communication. The **SmarNetConf** has only the vision of the respective channel (Serial or TCP), meaning that on the serial channel vision only the device corresponding to the chosen channel will be shown.

Whenever the user needs to configure the DF89 channel as **Modbus Master** he should use **SmarNetConf**. This will be possible on the following cases:

- The DF89 is master of Modbus RTU slaves on the serial channel (RS-232/RS-485);
- The DF89 is bypass of devices on the serial port;
- The DF89 is master of Modbus RTU slaves on the TCP channel (ETH1);

More details will be provided on the respective scenario section. For other information on the **SmarNetConf** consult the tool help.

To launch the **SmarNetConf** first expand the channel window, which in this example is **DF89 Modbus RTU** serial channel. Select and right-click it. Choose the **Modify Configuration** option. See the next figure.

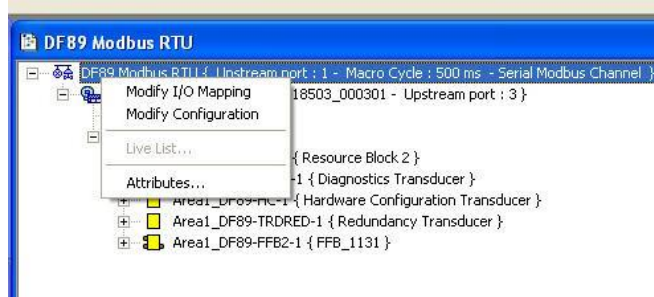


Figure 23. 10 – Launching SmarNetConf to configure a Modbus Serial device

The figure below shows the main **SmarNetConf** serial channel window.

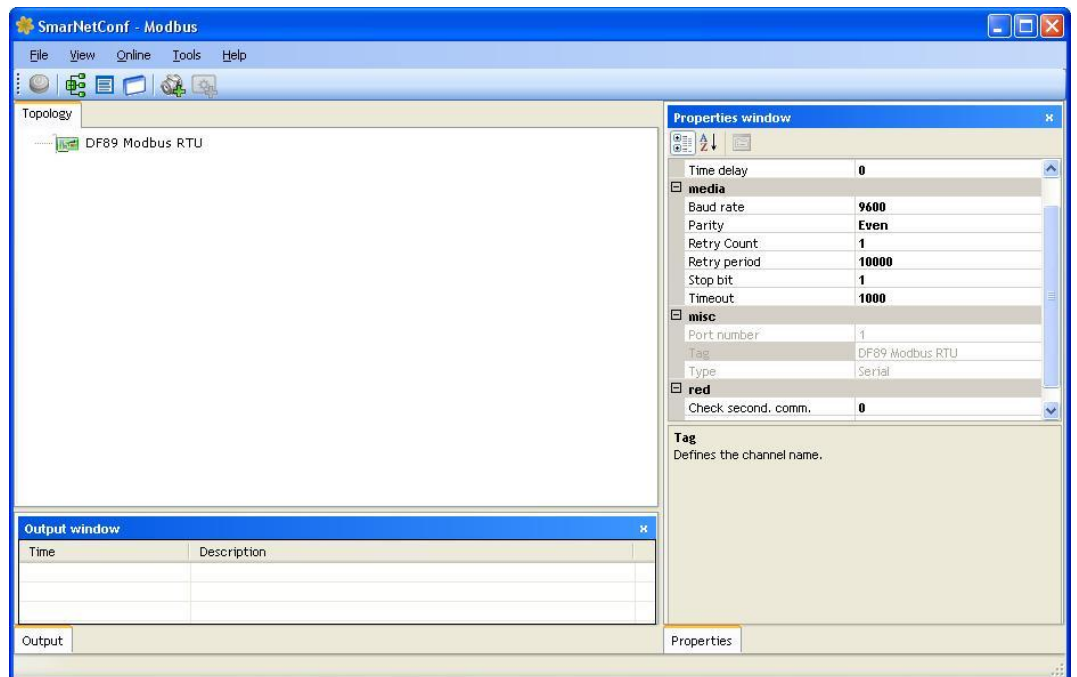


Figure 23. 11 – Main window of the SmarNetConf Modbus configurator

The configurator has three main windows as shown on the previous figure: the **Topology** window, at left, which shows a tree structure for the network device at a given channel, the **Properties** window, at right, which shows all the properties of the item selected on the topology window and, finally, the **Output** window (for events and error logs) at the bottom part of the window.

The properties channel window must have the channel parameters filled out: Baud rate, stop bit, parity, timeout, etc. Each one of these parameters is detailed on the **SmarNetConf** parameterization section.

#### NOTE

All devices must have the same media parameterization (*Baud rate, Stop Bit and parity*). The DF89 always considers the data bits parameter equals to 8.

### Step 6

## Configuring Modbus devices

After creating the Modbus network, the device should be configured. To insert a slave device, click on the **Insert Device** button located on the toolbar, or through the **Insert→Device** menu. The next figure shows the window to insert the slave devices, where the user can add one of several devices of the same type.

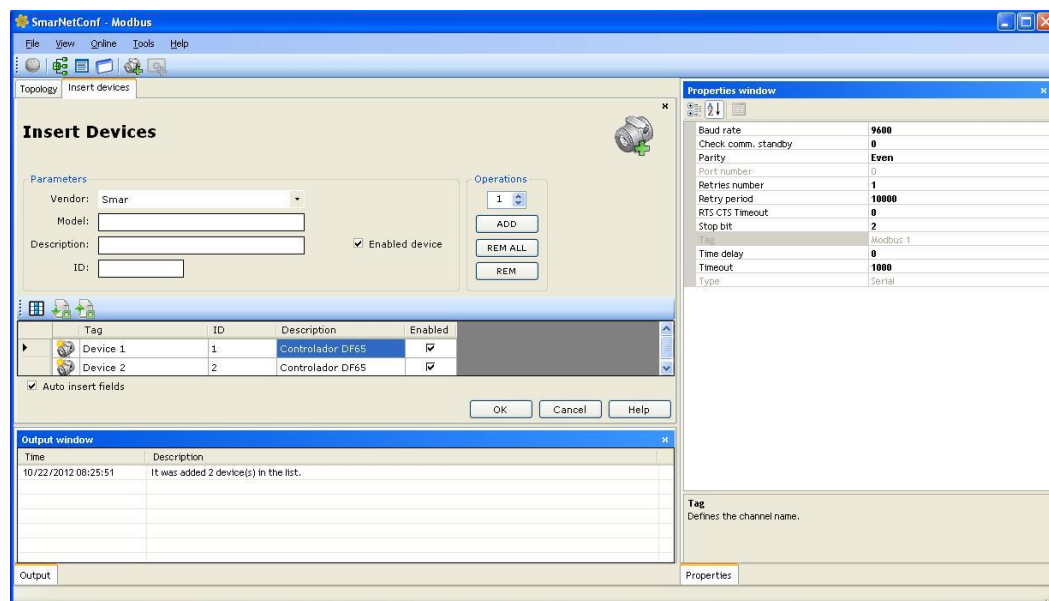


Figure 23. 12 – Adding device on the Modbus network

In this window, select the slave device to be inserted. For the present example, two serial channels will be included. First, get the information for configuring the slave device (see its manual). Follow the steps below to insert the slave device:

- A. Fill out the device **Model**, **Description** and **ID** fields;
- B. Select the quantity of device of a given type;
- C. Click **Add**. A table will be shown with amount of selected device;
- D. On the **ID** field, attribute an address for the device;
- E. On the **Tag** field, the device tag is attributed. In case the user does not attribute a tag to the device, a default tag will be attributed;
- F. Click **OK**. The added devices will be included on the main window.

#### NOTE

The attributed device addresses and tags must be the only ones in the Modbus network and also in the **Sudio302** (Workspace) database. For more details refer to the **Studio302** manual.

Both devices on the proposed example (PLC\_ID1 e TRM\_ID2), on the serial channel, will be shown on **SmarNetconf**. See the next figure.

**Step 7**

**How to edit the devices properties**

After adding the device, its properties can be changed. The main ones are tag, ID and if the device is or is not enabled. Other properties can be changed in this window. An explanation for each property is shown on the **SmarNetConf** parameters section.

For example, to edit the PLC\_ID1 properties, right-click the corresponding Modbus device. At the open pop up, choose the **Edit Device Properties** option to configure the slave device parameters.

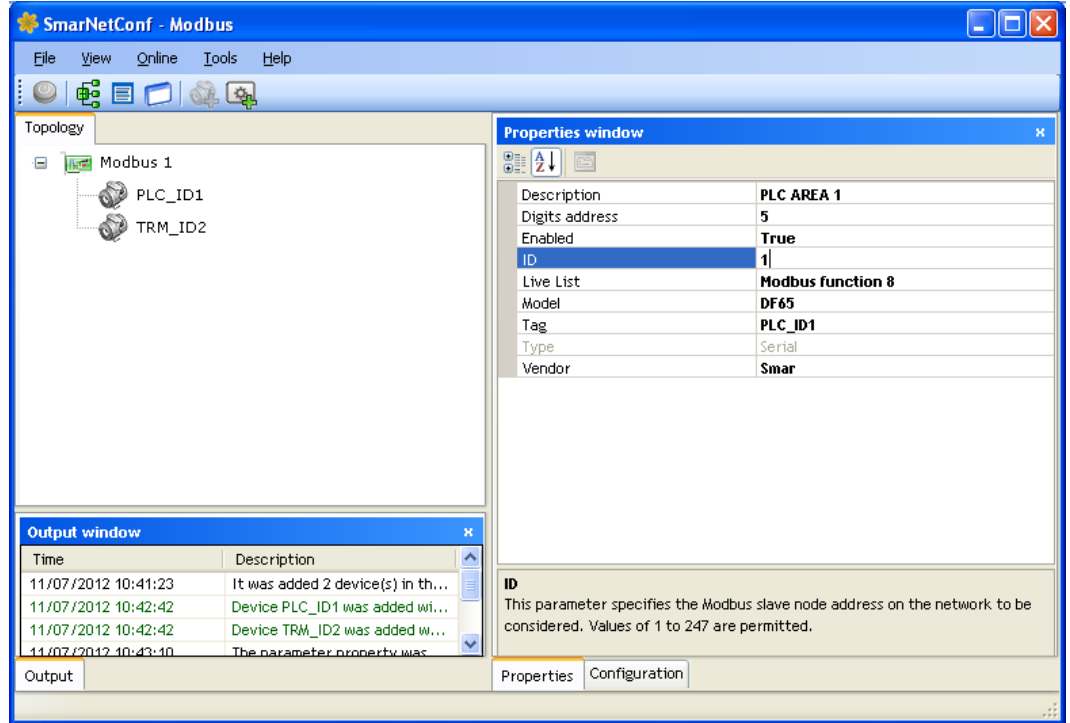


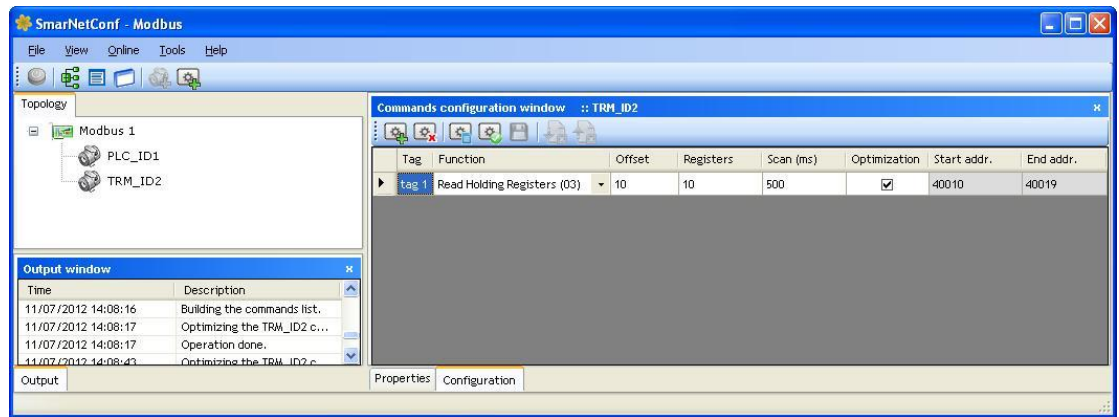
Figure 23. 13 – Editing the device properties

**Step 8**

**Adding commands to the device**

The slave variables to be supervised or written are mapped by commands, which can be individual or multiple ones. For example, if the analog points should be supervised on addresses 40001 and 40010. This supervision can be performed through the two individual commands (cmd1 for 40001 reading and cmd2 for 40010 reading) or a multiple command (cmd1 –reading beyond 40001 reading with 10 registers). This last form is most common and most optimized.

The command configuration window is accessed right-clicking the corresponding Modbus device, for example, the PLC\_ID1. On the open pop up, choose the **Insert Commands** option to configure the device Modbus commands. The following figure shows the example of a command addition window.



**Figure 23. 14 – Configuring the Modbus device commands**

The commands configuration window on the above figure shows a toolbar in which it is possible to add, delete, check if the configuration is correct, save the configuration, import and export to a xls format spreadsheet. More information about these features refers to the **SmarNetConf** help.



For each new command, it is created a table line up to the limit of 30 commands per device. On the Modbus protocol the addressing takes into account the functions, the offset and number of registers. Hence, for each command, the user should pay attention to the mapping of these three parameters. The detailed command description is shown on the next **SmarNetConf** parameter section.

The DF89, when working as master, admits the Modbus functions shown on the table below. At the “data type” column RW means that it supports reading and writing and RO supports only reading.

| Modbus Function | Description                   | Data Type           |
|-----------------|-------------------------------|---------------------|
| 1               | Read Coils (0x)               | Discrete Input (RW) |
| 2               | Read Discrete Inputs (1x)     | Discrete Input (RO) |
| 3               | Read Holding registers (4x)   | Analog Input (RW)   |
| 4               | Read Input registers (3x)     | Analog Input (RO)   |
| 5               | Write Single Coil (0x)        | Discrete Output     |
| 6               | Write Single Register (4x)    | Analog Output       |
| 15              | Write Multiple Coils (0x)     | Discrete Output     |
| 16              | Write Multiple Registers (4x) | Analog Output       |

**Table 23. 1 – Modbus Functions Supported**

After including the command check the configuration and save it. This saving indicates that every device configuration command made on the SYSTEM302 database will be effective. In order for this to happen there can be no inconsistencies on the commands mounted (like the inclusion of repeated points on the commands or a command bigger than the limit. This is done by the **Check**

 and **Save**  buttons in the **SmarNetConf** toolbar.

The **Scan** and **Optimization** fields are advanced parameters that can remain as **Default**. The **Scan** field indicates the minimum time desired between the scan on the respective command. The **Optimization** field indicates that the Modbus command is to be optimized or not. The latter, if the user chooses not to optimize it, will be activated the same way it was configured.

Finally, the **Start Address** and **End Address** fields are ways to visualize the Modbus points. The **Start Address** represents the beginning of the Modbus range addressed, while the **End Address** represents the end of that command. This type of visualization can be of 5 digits (under the Modbus Modcon specification) or 6 digits (under a Modbus 2.0 spec). The device **Digits Address** property indicates if the visualization will be with 5 or 6 digits.

For example, on figure 23.13 a visualization of 5 digits was used. The first command was mapped as follows: analog reading “03” function, offset equal to 10 and number of registers equal to 10. This represents the addressing of the Modbus 40010 to 40019 registers. Should the chosen visualization be that of 6 digits, so the corresponding Modbus **StartAddress** addresses would be 400010 and the **EndAddress** would be 400019.

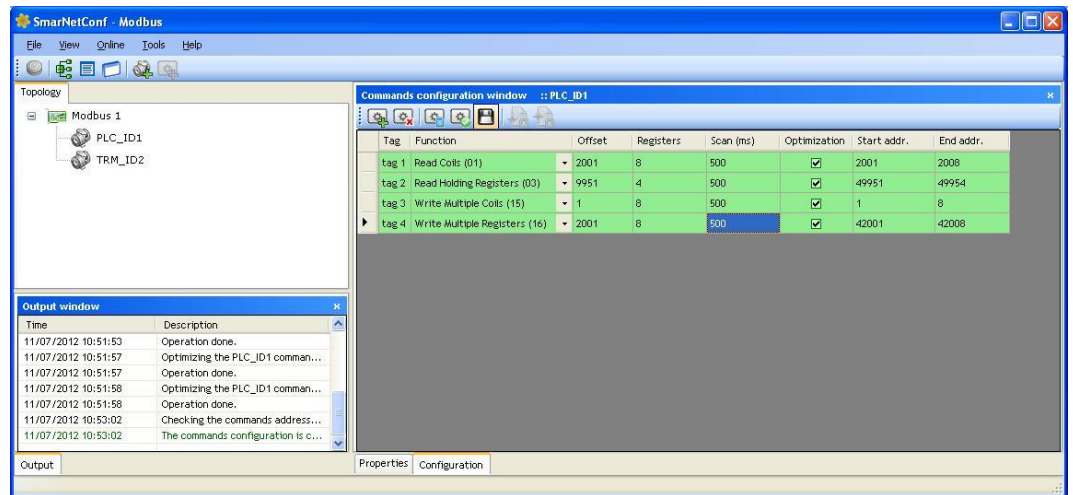


Figure 23. 15 – Configuring the PLC\_ID1 commands

When the previous steps are finished, the Modbus channel configuration can be saved and the **Smar Network Configurator** can be closed. Automatically the **Mapping Tool** launches.

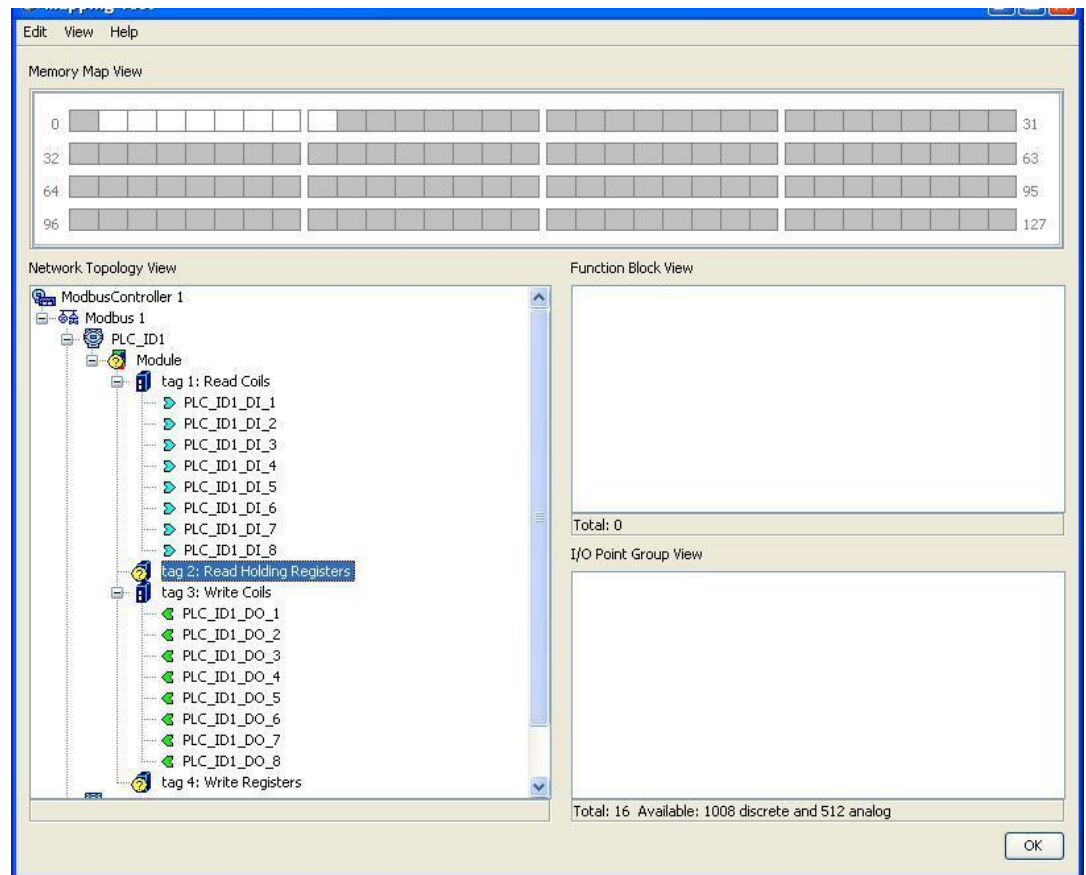


Do not forget to save the commands configuration before exiting the **Smar Network Configurator**. This is the only point to be saved manually. The changes of the properties on the channel or the device are saved automatically.

### Step 09


## Mapping the Modbus points for the SYSTEM302 logic

The **Mapping tool** is responsible for mapping the Modbus network points on points available for use in Ladder Logic or Function Blocks logic. This tool also configures all the features of the Modbus network points (user tags, data types, scales, etc.). Observe the next figure:



**Figure 23. 16 – Mapping Tool window**

As seen on the previous figure, the device was inserted on the Modbus network with their respective commands. The **Function Block Label** shows the points that will be visualized on the **Syscon** and on the **IO Point Group View** window are shown the points to be seen on the **LogicView for FFB**. The purpose here is to configure each network point (or byte) at their respective data type.

A **Mapping Tool** maps automatically by default all registers created on the **SmarNetConf** with discrete functions (Modbus 1, 2, 5, 15 functions) as Boolean type. The user can only alter the point tags. The analog points that appear with the  symbol must be configured.

To configure the point, click the command to be configured; on the next figure, for example, the command will be **Tag2**. Remember that on the **SmarNetConf**, **Tag2** was mapped on the Modbus from 49941 to 49954 register range.

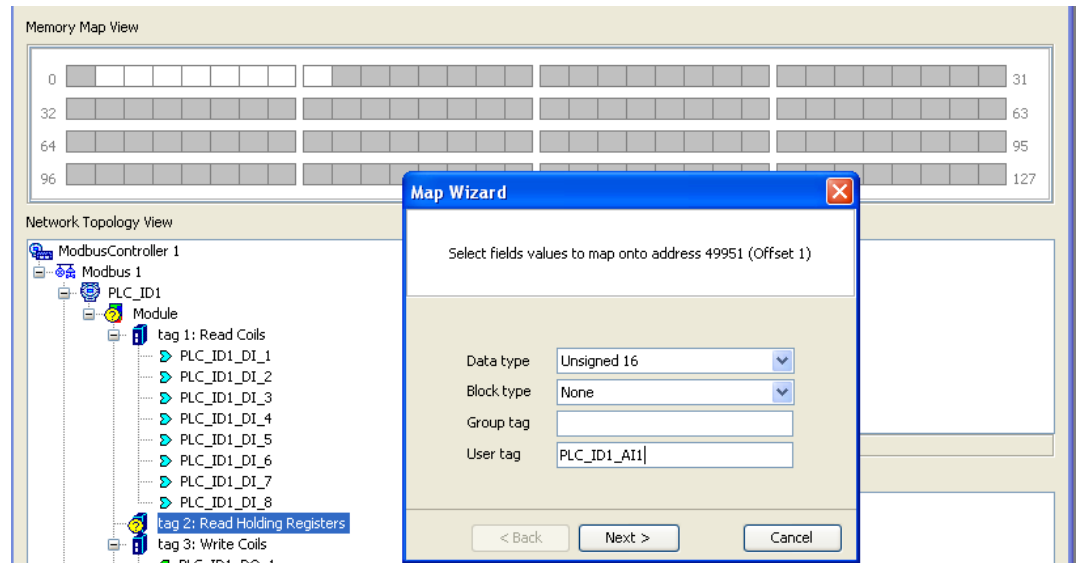


Figure 23. 17 – Mapping the analog points on Mapping Tool

On the window upper part, the available bytes will be shown in white. Click the byte and a window to configure the point will appear. For our example on **Tag2** the first available byte was clicked. According to the mapping window it corresponds to the 49951 address (Byte Offset 1).

Choose the data type (**Data type**) of the slave device variable. The available types depend on the chosen device and must be obtained in the slave device manual. For our example of the data type of the point 49951 is **Unsigned16**. For analog points can also be set for each scale point. More information about Data type will be shown in the Advanced Topics section. The figure below shows the configuration of the point scale.

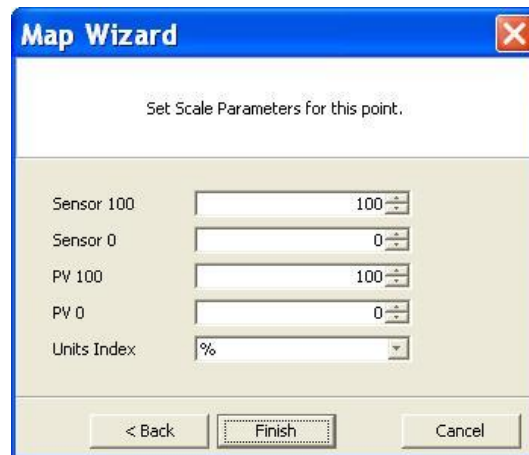
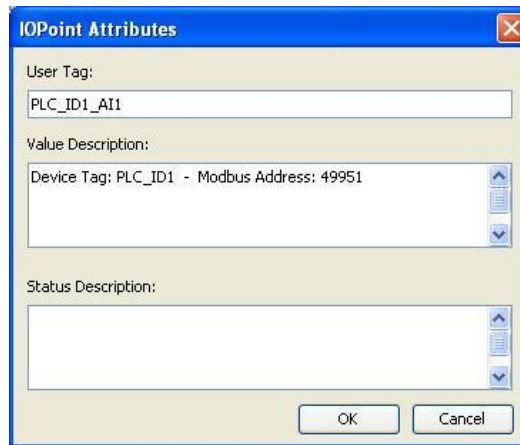


Figure 23. 18 – Configuring the scale parameters

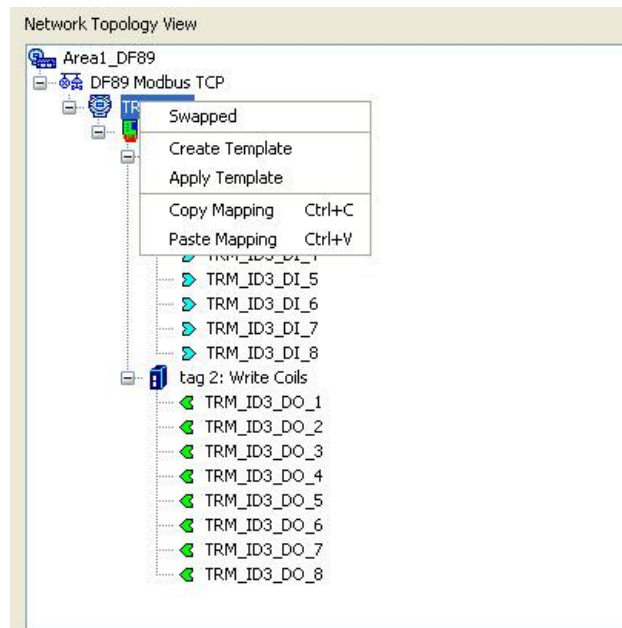
By right-clicking the point you can remove it with the **Delete** option, or define some attributes that identify it better, with the **Attributes** option. The **Mapping tool** automatically creates the description with the Modbus address. This is useful to identify the point through the Modbus address in the ladder logic. Fill out the necessary fields and click **OK**.





**Figure 23. 19 – Altering the attributes of the mapped points**

It is still possible to choose between the data on the direct or swapped format for analog types with 4 bytes (float, uns32 and signed32). This device information tells if it uses data with the swapped format or not. To configure the swapped format, right-click the device on **Mapping tool** and choose **Swapped**, as shown on the figure below. The Advance Topics section explains in detail the type of swapped data.



**Figure 23. 20 – Example of configuration**

After mapping and configuring all points, click **OK** to close the **Mapping Tool**.



Save the configuration after returning to the **Syscon**.

## DF89 Configuration as Modbus TCP Master

This section will detail all steps to make the following configuration:

- a. Add devices on the DF89 TCP channel
- b. Add Modbus points on the slaves
- c. Map all Modbus points for the **SYSTEM302**

As an example of the figure 23.1 process, the Modbus TCP Master configuration uses the PLC\_ID3 slave transmitter.

To configure the Modbus TCP channel, the procedure is the same used on the serial channel from step 5, where the Modbus TCP also is the **SmarNetConf**. To that effect, choose the Modbus TCP as channel type on the figure 23.7 window and expand the TCP channel. From the area window expand the TCP channel (DF89 Modbus TCP). Select the channel on the window top and right-click it. Choose the **Modify Configuration** option.

The figure below shows the TCP channel main **SmarNetConf** window.

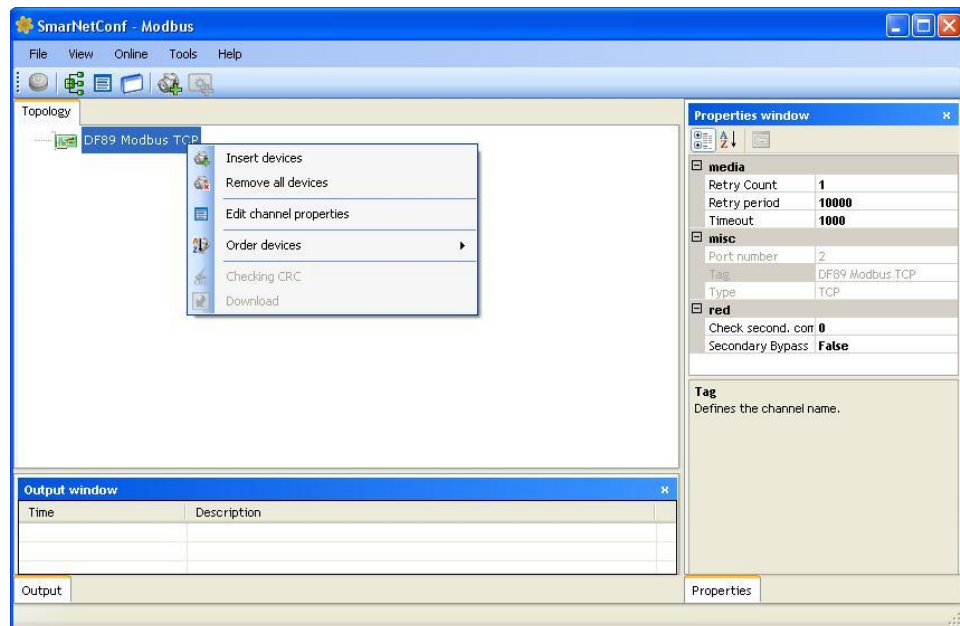
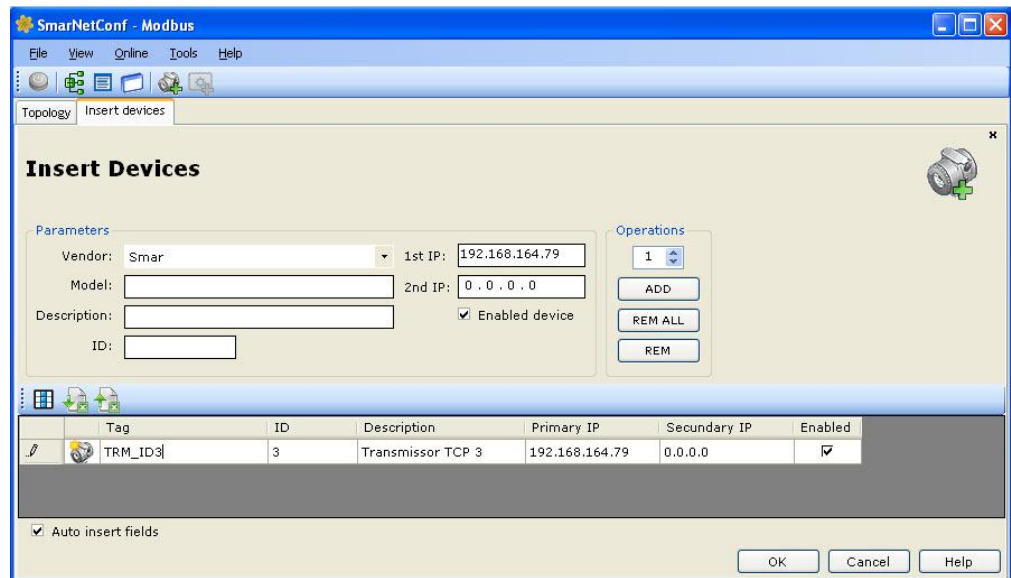


Figure 23. 21 – SmarNetConf Modbus Configurator main window

The CHECK SECOND. COMM. parameter has similar functionality of CHECK\_COMM\_STANDBY parameter of MBCF block that is used by other DF1302 controllers. So the secondary DF89 (standby) will perform a communication test with the slave devices in the period configured in this parameter.

### Configuring the Modbus devices

To insert a slave device, click the **Insert Device** button located on the toolbar, or through the **Insert→Device** menu, or still right-clicking the TCP channel as shown on the next figure. The window shown on the next figure is the window for slave device insertion where the user can add one or several devices of the same type.



**Figure 23. 22 – Adding device on the Modbus network**

Select on this window the slave device to be inserted. One device only will be included on the proposed example. First, get the slave device Modbus configuration on its manual. Follow the steps below to insert the slave device:

- A. Fill out the **Model**, **Description** and **ID** of the device;
- B. Fill out the device IP address on the **1st IP** field. If the device is redundant, the **2nd IP** will be chosen as redundant path. For more details see the Redundancy section;
- C. Select the device quantity of a determined type. In this case it will be only one.
- D. Click **ADD**. A table will be shown with the quantity of selected device.
- E. On the **ID** field, attribute an address for this device.
- F. On the **Tag** field is attributed the device tag. If the user does not attribute a tag, a default tag is attributed.
- G. Click **OK**. The added device will be included on main window.

#### NOTE

The addresses attributed, as well as the device tags must be the only ones on the Modbus network and also on the **Studio302** Workspace database. Refer to the **Studio302** manual.

## Editing the devices properties and commands

After adding the device, its properties can be changed. To alter the device properties, add and delete commands, follow the same procedures described for the serial channel. The device properties and commands are described in detail on the SmarNetConf Parameters section.

For the TCP channel example there is a TRM\_ID3 device. The following figure shows the **SmarNetConf** screen with the **TRM\_ID3** device of the proposed example.

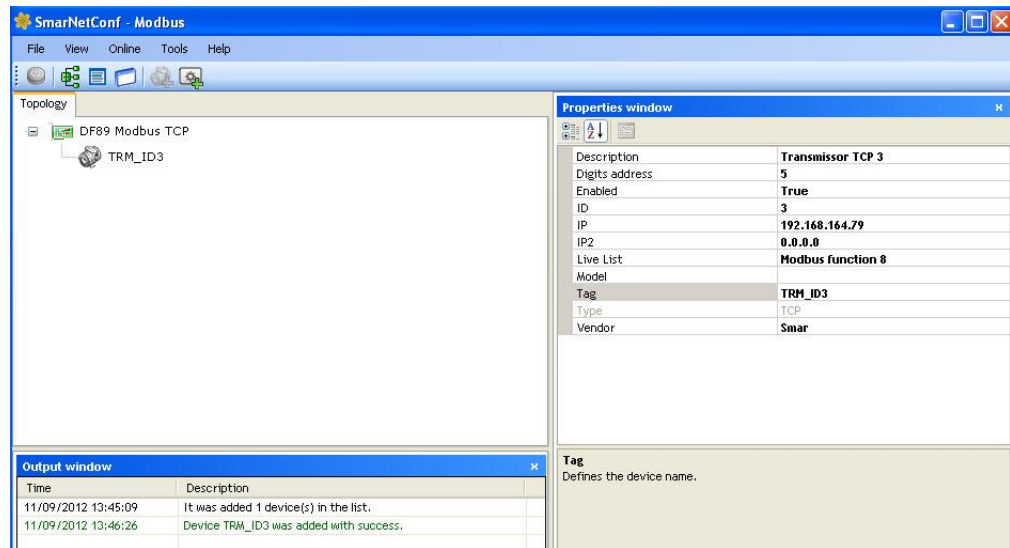


Figure 23. 23 – Example of the TCP channel properties

## Making logic with the Modbus I/O Points

This section will detail all steps to make the following configurations:

- a. Make a logic in blocks or ladder with the slave Modbus points
- b. Download the configuration.

Until now the Modbus TCP and Serial slaves were created and their points were mapped. The next steps will show how to use the points mapped on the **Network Configurator** for the control logic. As mentioned previously, there are two ways to map inputs and outputs on ladder logic or function blocks. Each tool has its specific block library. It is possible to blend both logics through the FFB 1131 block.

Initially the steps will be shown to use only the Ladder logic. After that, it will be explained how to mount the logic using function blocks. Which tool to use will be user’s choice.

### Mapping the Modbus points to be used on Ladder

#### Step 10

As the points will be mapped to be used on ladder, by returning to the figure 23.17, it is not necessary to use the **Block Type** option (None). A tag can be attributed to the group on the **Group Tag** option or leave the default tag (**Group Tag** is important for use in blocks). Finally the **User Tag** to be shown on the ladder logic will be chosen. In our example the 49951 point will be **PLC\_ID1\_AI1** as seen on figure 23.25.

Sometimes, especially when the **LogicView for FFB** is already open, the points mapped on the **Mapping Tool** do not appear on **LogicView for FFB**. If so, execute the **Refresh Data** command to update the I/O points configured on the **Mapping Tool** on the ladder logic by right-clicking **Network I/O** at the **Hierarchy** window of the **LogicView for FFB**. See the next figure.

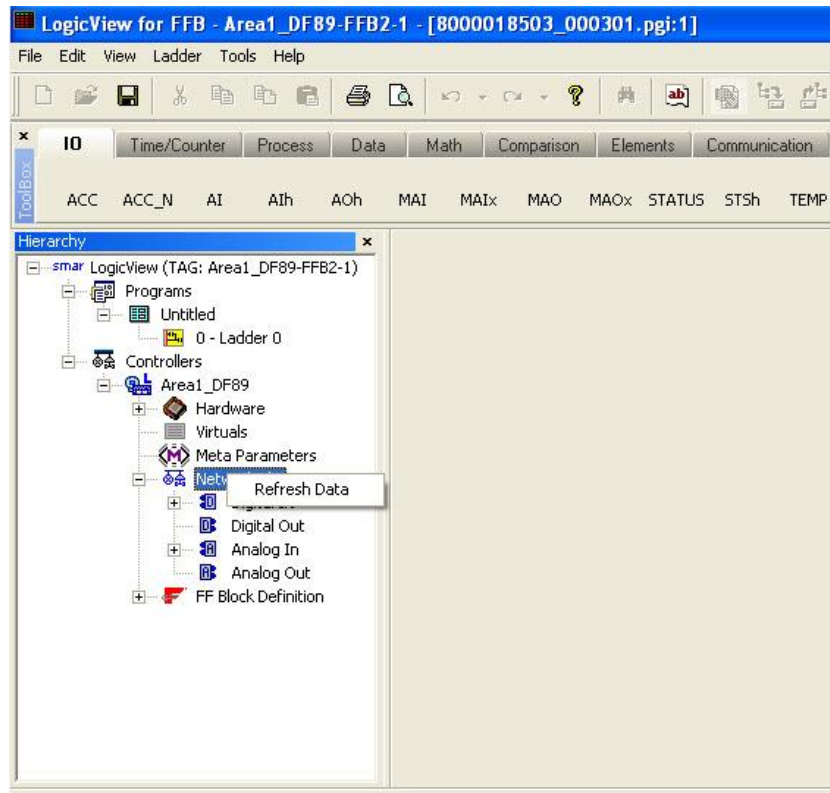


Figure 23. 24 – Executing the Refresh Data

The **NetIO** points can be seen on the **LogicView for FFB Hierarchy** window. On the **Object Properties** window is generated initially a description of the Modbus address variable. On the figure below, **Hierarchy** is on the left side window with all the Modbus points mapped on the **Mapping tool**. On the **LogicView for FFB** all points of both channels are shown. On the right side of the figure is shown the **Object properties** window of the **PLC\_ID1\_AI\_1** selected point that was configured on the Modbus 49951 address.

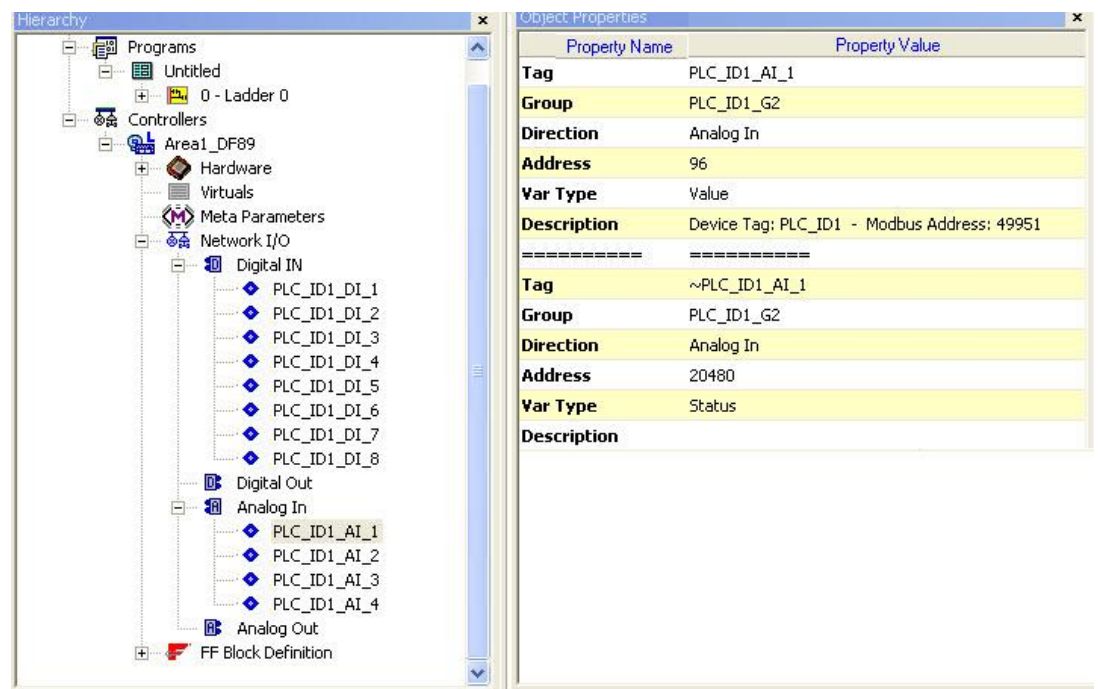


Figure 23. 25 – Network I/O on LogicView for FFB

After this procedure, the Modbus network I/O points are available to be used on the ladder logic,

counting on a complete function library to be utilized by the user. For more details see the **LogicView for FFB** manual.

The figure below shows two Modbus points used on ladder logic. The discrete **PLC\_ID1\_DI\_1** point and the analog **PLC\_ID1\_AI\_1** point. All of the Modbus I/O points appear as the **(MB)** symbol on ladder logic.

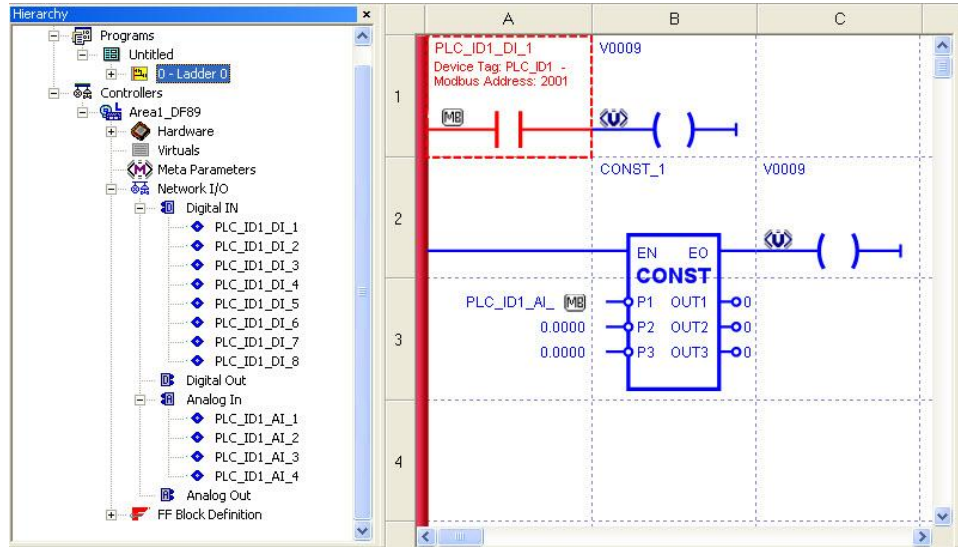


Figure 23. 26 – Editing the logic

The configuration of the serial channel using ladder logic only ends here. Save the **LogicView for FFB** and return to the **Syscon**.

After configuring the ladder, the user can download the configuration on the device, or instead choose to configure function blocks on the **Syscon**. Should the user wants to work also with function blocks, it is necessary to follow the steps 9 to 12 for the function blocks edition.

To follow the same example, it is still necessary to configure also the TCP channel. To configure the TCP channel without using function blocks go to the **Configuring TCP Channel** step. To download only the configuration up to this point, go to the **Configuration Download** step.

### Step 11

## Mapping the Modbus points to be used in Function Blocks

Similarly to the configuration was done through the ladder, the configuration can be done using function blocks. This section will show the mapping of the same Modbus I/O point of step 10, but now using function blocks.

As stated previously, for the creation and insertion of network devices the steps are common up to step 8. That is, we must follow the complete procedure for the area creation of **Syscon** and set the controller, as done in steps 1-4 and the devices should also be inserted in the same way as done for the ladder.

To map the I/O points in function blocks in the **Mapping Tool** window of as shown in the figure 23:17, it is necessary to fill the **BlockType** field. When is chosen **None**, as shown in step 10, indicates that the point only is mapped in the ladder.

The user can only choose to map the I/O points in function blocks of type multiple inputs (analog or discrete - MAI and MDI) or multiple outputs (analog or discrete - MDO and MAO).

At this point the user is ready to develop the control strategy. In this case the user may use other function blocks to make the desired control strategy. To interconnect the blocks the user needs to make links between them. To open a control strategy in **Syscon** is necessary to create a control module, and then, the strategies. For details on these procedures, it is recommended to check the **Syscon** manual.

An important parameter that must be configured in all function blocks is the MODE\_BLK parameter that determines the Out of Service (OOS), Manual (MAN) or Automatic (AUTO) block operations. All blocks in this area must have the MODE\_BLK.TARGET in AUTO. Each block has a specific parameter configuration. For more information about each block see the Function Blocks manual.

**NOTE**

The Modbus I/O blocks do not need to configure the CHANNEL parameter. This parameter will only work when using the I/O blocks to map the local I/O (IMB).

## Commissioning and configuration download to the controller

After configuring the parameters, the user can begin communicating with the devices. It is necessary to perform the device commissioning so that each device tags, IDs and addresses be attributed adequately. If this procedure is not observed, the **Syscon** will detect the non-commissioned device and the download will be aborted. The commissioning consists in combining a network DF89 controller and the configurator used on the configuration. The same configuration tag will be attributed to the controller.

To commission, simply enable the online communication with the network equipment through the ON button on the **Syscon** toolbar shown below.



**Figure 23.27 – Enabling Online mode**

Then, click the controller or the channel and choose **Commission**. More information on how to commission refer to the **Syscon** manual.

After finishing the devices commissioning, the download process may begin. Download can be done in several **Syscon** points and depends on the purpose: on all controllers, on only one controller, etc. However, the **Syscon** download is recommended for being the most complete, as it controls the alterations performed on all tools.

The **Syscon** has two download procedures: conventional mode (non-incremental) and the incremental download.

- On conventional or non-incremental download the entire configuration is downloaded on the device.
- Incremental download includes a phase that compares the configuration stored on the plant physical device with the **Syscon** configuration, stored on the **Studio302** database. Only the differences are downloaded to avoid that unnecessary information are sent to the device. On this option, the download scope can be limited by the user.

The figure below shows the device download with the option for performing the incremental download or not (which, in this case would be the total download).



**Figure 23.28 – Performing the download**

The download operation can affect a network of devices (when selecting a Fieldbus network, an HSE network or a Linking Device channel) or a particular device, possibly a HSE device (Bridge, Linking Device, Controller), or a H1 device. In the latter case, the operation is also called **partial download**.

The download operation will be available only when the **Syscon** is on online mode, communicating with the plant and with the device already commissioned.

**NOTE**

If the user has finished the commissioning, the **Syscon** suggests a download. Sometimes, after the commissioning is performed, it is necessary to click on the **Refresh** button at the right side of the online button on the Windows toolbar.

If the user chooses the incremental download, this option must be selected in the previous window. A window will appear with the incremental download configuration options. If there are some of the selected options, it means that **Syscon** will compare initially that option with the controller and will only download if there are differences. Before downloading, the **Syscon** still will show the user a window with the differences. Only when the user verifies the differences the new configuration will be really downloaded.

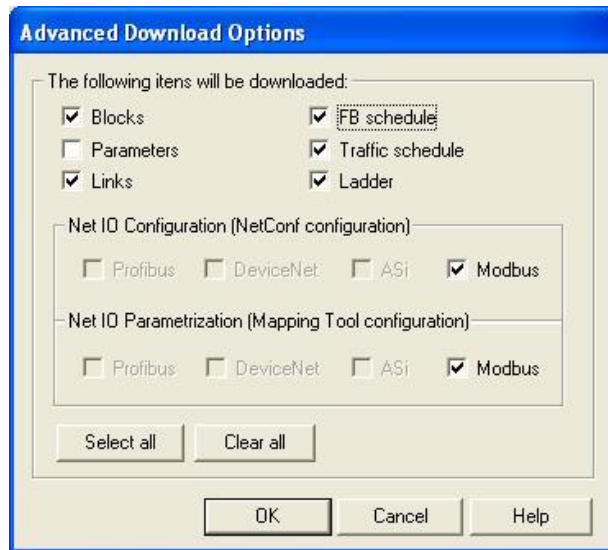


Figure 23. 29 – Selecting download options

On the present example, only **PROJ DF89** is to be downloaded. So, right-click the controller and select the **Download** option. On the download window, select **Start**.

After performing the download, the user can check the logic parameters supervision on the device. To supervise the parameters, both of ladder and blocks, the user must perform **Export Tags**. This procedure indicates that the database will be updated with the desired supervision information. **Export tags** is done on the area window by right-clicking its name.



Figure 23. 30 – Performing the Export Tags



After this operation the user can supervise the configuration parameters. New ladder logic or block alterations may be applied. The **Export Tags** procedure must be repeated only if new ladder logic or block alterations are included.

## DF89 Configuration as Modbus Slave

DF89 can work as Modbus Serial slave or TCP. In this case, any Modbus Master equipment can read the points on the DF89 controller, be them conventional I/O, Modbus I/O points of slaves scanned by the DF89 or other DF89 internal points. On the figure 23.1 example, the DF89 is the Modbus slave of an IHM Modbus TCP.

To configure the DF89 as Modbus slave, a block must be first created on **Syscon - Modbus Slave Configuration**. To that effect, right-click the **HSE\_FB\_VFB** of DF89 controller, as shown on the next figure.

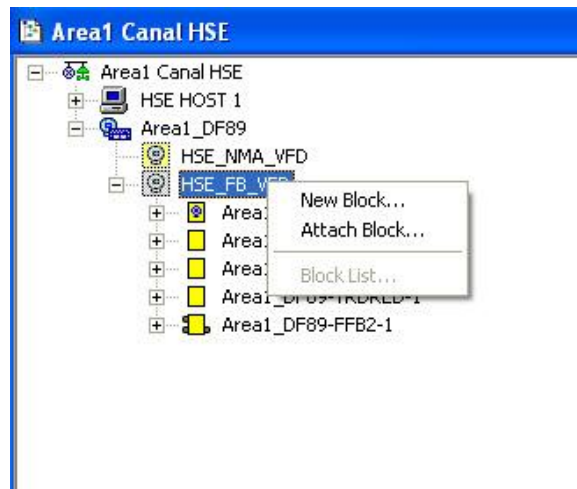


Figure 23. 31 – Including a new block on the controller

Then, a **Modbus Slave Configuration** block must be created. This block represents the entire DF89 configuration as Modbus slave (Serial or TCP).

After creating the block, the user may configure the parameters. As Modbus TCP slave the main parameters are **MODE\_BLK** and **DEVICE\_ADDRESS**. On figure 23.1, the DF89 has the Modbus address 25.

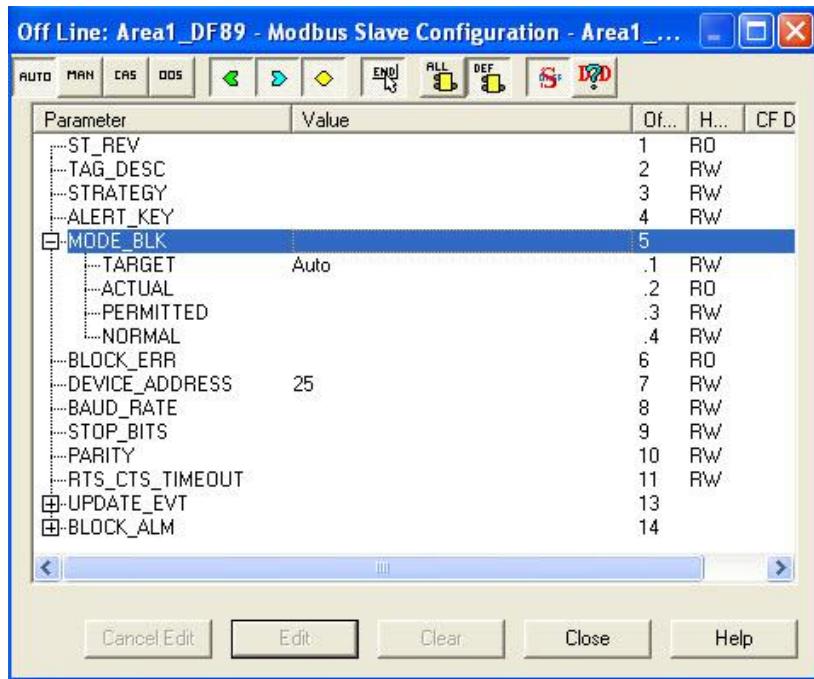


Figure 23. 32 – Modbus Slave configuration parameters

The Modbus Serial slave configuration requires the following procedure:

- 1) No serial channel can be created on the **Syscon**, because the DF89 has only one serial channel. The serial channel as master has priority over the slave function.
- 2) **MODE\_BLK** and **DEVICE\_ADDRESS** parameters must be configured on the **MBSCF** block.
- 3) Serial media parameters must be configured on the **MBSCF** block: Baud rate, Stop Bits and Parity.
- 4) The serial can be checked if it is enabled as slave or master on the **Modbus Transducer** block **SERIAL\_CHANNEL**.

Only the points mapped on ladder logic can be mapped as Modbus slaves. Each Modbus point on ladder has a respective Modbus address. To get information about the point, click it and check the **Object Properties** window, as shown on the next figure.

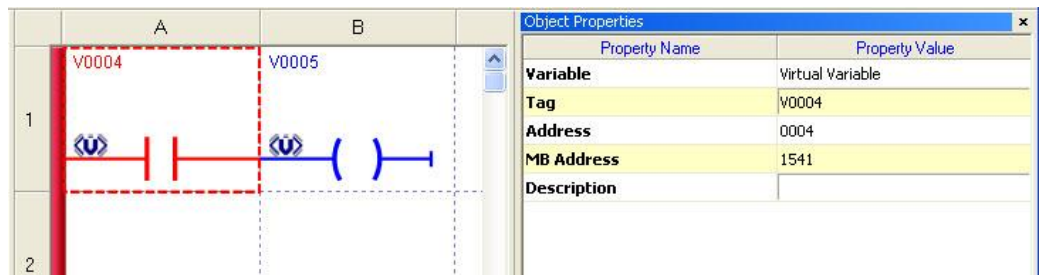


Figure 23. 33 – Example of how to get the Ladder point Modbus address

On the example of the figure above, the V0004 contact has **1541** as Modbus MB address.

| NOTES |  |
|-------|--|
| 1)    | All analog points are floating type.   |
| 2)    | Only Modbus multiple writing functions are admitted, namely, functions 15 and 16.                      |
| 3)    | The DF89 is already produced as Modbus TCP and Serial slave on address 247 with baud rate 9600/1/Even. |

## DF89 Configuration as Bypass Modbus only

Another DF89 feature is to work as **Bypass Modbus**, i.e. Modbus TCP master equipment can access a slave Modbus serial equipment situated below the DF89.

The DF89 configuration as bypass is done by creating a serial channel. If the user wishes to work only as bypass, simply create a serial channel on the **SmarNetConf** and configure the serial media.

On figure 23.1 example, the serial channel with devices has already been created, so it is already supporting the bypass automatically. Take as example the IDM Master TCP accessing any point of the **TRM\_ID2** or **PCL\_ID1** slaves simply by attributing the **ID** of the respective device (**ID 1** or **ID 2**) and the DF89 IP.

| NOTES  |
|--|
| <ul style="list-style-type: none"> <li>To work as bypass, the Modbus slave address cannot be the same as the <b>MBSCF</b> block <b>DEVICE_ADDRESS</b>.</li> <li>The media configuration is done only on <b>SmarNetConf</b>. On the bypass case, the same download can be used on the modification of any media parameter.</li> <li>The bypass is supported by the two DF89 Ethernet ports: ETH1 and ETH2.</li> <li>On the redundancy case, it is also possible to access the secondary port as bypass, simply by configuring the parameter of the <b>BYPASS_SECONDARY</b> device on <b>SmarNetConf</b>.</li> </ul> |

## Advanced Modbus topics

There are two main Modbus specifications: an old one, created by Modcon company – the predecessor of Modbus, which follows the Modcon **PI-MBUS-300** 1996 reference book. The current Modbus version follows the Modbus Organization specification – Application Protocol Specification – since 2002. Both specs are totally compatible, with only one difference of visualization and size on the addressing band.

The Modbus register is a 2-byte number (Word) that indicates a given parameter on the slave device. For example, address 1 indicates an I/O point, while address 2 indicates another I/O point. This Modbus Modcon addressing has specific ranges depending on the function shown below, taking into consideration that the Modbus protocol function indicates if it is desired working with register reading or writing. The functions supported and the description for each function are on table 23.3.

- Functions 1, 5, 15 – addressing range Modbus Modcon 0xxxx (0001 – 10000)
- Functions 2 – addressing range Modbus Modcon 1xxxx (10001 – 20000)
- Functions 3, 6, 16 – addressing range Modbus Modcon 4xxxx (40001 – 50000)
- Function 4 – addressing range Modbus Modcon 3xxxx (30001 – 40000)

For the current version, also called *extended Modbus*, this range no longer exists, since the frame format already ignore it. This kept the addressing range from being restricted to the 10000 range registers.

A favorite format to use these ranges as reference is the quantity of bytes on the Modbus address, i.e., if it uses 5 or 6 digits. The table below compares old and new addressing as address examples.

| EXAMPLE OF USER INPUT |               | VIEW 5 DIGITS  | VIEW 6 DIGITS | MODBUS IN THE BUS |               |
|-----------------------|---------------|----------------|---------------|-------------------|---------------|
| Function              | Start Address | Start Address  | Start Address | Function          | Start Address |
| 1                     | 2000          | 2000           | 2000          | 1                 | 1999          |
| 3                     | 10            | 40010          | 400010        | 3                 | 9             |
| 2                     | 2500          | 12500          | 102500        | 2                 | 2499          |
| 4                     | 1533          | 31533          | 301533        | 4                 | 1532          |
| 3                     | 15200         | Cannot be seen | 115200        | 3                 | 15199         |

**Table 23.2 – Example of Modbus address on the old protocol (5 digits) or the current protocol (6 digits) and how the protocol stays internally (Modbus online)**

The table above shows examples of Modbus addressing using both specifications: Modcon (with 5 digits) and the current one (with 6 digits).

The user input columns show an example of a given Modbus function and register.

The Modbus column on the bus shows a would-be Modbus protocol. Usually, the user does not see it, because it is inside the protocol for communication between devices. In this case, the initial bus

address is always a relative address, i.e., they generate the same command on the bus. In this case, the initial bus address is always a relative address discounted from the function base and it is unique for both representations.

Table 23.2 shows that both protocol views do not have any difference for communication, i.e., they generate the same bus command. The user then chooses which way he wants to work with, the old or the current one. The only difference will be when the device will have a very large address range (over 10000 registers) and so only the 6-digit format will be feasible.

| NOTE   |
|--|
| The DF89 supports the Modbus TCP and the Modbus RTU serial protocols. For both protocols the standard is the same under the old or current specs, and they are totally supported by the controller. The DF89 default is the 5-digit visualization, which is the most used. |
| There are other non-standard Modbus protocol extensions, like Enron and Daniel, which are not supported by the DF89.   |

### Types of data supported

On the Modbus, the points are mapped in registers. These registers differ, depending on the type of variable. For discrete types (functions 1, 2, 5, or 15), each register occupies a 2-byte word. Besides this information it is necessary to know which type of data corresponds to these registers. The information on the data types supported by the DF89 Modbus are the following:

| Modbus Function | Data types Supported | Size in Bytes | Nr of Modbus Registers Necessary |
|-----------------|----------------------|---------------|----------------------------------|
| 1, 2, 5 or 15   | BIT                  | 1/8           | 1                                |
| 3, 4, 6 or 16   | UNSIGNED 8           | 1             | 1                                |
| 3, 4, 6 or 16   | UNSIGNED 16          | 2             | 1                                |
| 3, 4, 6 or 16   | UNSIGNED 32          | 4             | 2                                |
| 3, 4, 6 or 16   | FLOAT_SINGLE         | 4             | 2                                |
| 3, 4, 6 or 16   | SIGNED 8             | 1             | 1                                |
| 3, 4, 6 or 16   | SIGNED 16            | 2             | 1                                |
| 3, 4, 6 or 16   | SIGNED 32            | 4             | 2                                |

**Table 23. 3 – Data types supported**

Besides these data types, the analog data of 4 bytes size can be swapped or not. In this case, the type of swapped data has a little-endian data inversion relative to the big-endian non-swapped data type. This information is selected in the device inside the **Mapping Tool** and it is valid for the whole device.

For example, considering the number of 4 bytes 12345678 allocated on the Modbus 40001 and 40002 addresses:

| Datatype           | Register 40001 | Register 40002 |
|--------------------|----------------|----------------|
| Unsigned32         | 5678           | 1234           |
| Swapped Unsigned32 | 1234           | 5678           |

## Supervision and Control using DF89

The Modbus variables in the slave device can be mapped in DF89 by user in the following usage scenarios: supervision or control. As supervision, the variables are read cyclically via Modbus from the slave device and stored in the memory of DF89 and can be written on demand. As control, the variables are read cyclically (and do not allow writing) or written cyclically (and are never read).

| Characteristic   | Usage scenario: Supervision   | Usage Scenario: Control  |
|--|---|--|
| Modbus command configuration on SmarNetConf                                      | Only Modbus commands for reading:<br>- Read Coil (command 1)<br>- Read Holding Register (command 3)   | Modbus command to read or write:<br>- Read Discrete Input (command 2)<br>- Read Input Register (command 4)<br>- Read Coil (command 1)<br>- Read Holding Register (command 3)<br>- Write Single Coil (command 5)<br>- Write Single Register (command 6)<br>- Write Multiple Coil (command 15)<br>- Write Multiple Register (command 16) |
| Type of Modbus variable in the slave device and type of possible Modbus command. | Coil (address 0x.xxx or 0xx.xxx) and Holding Register (address 4x.xxx or 4xx.xxx) : Modbus command for reading  | Discrete Input (address 1x.xxx or 1xx.xxx) and Input Register (address 3x.xxx or 3xx.xxx): Modbus command for reading<br><br>Coil (address 0x.xxx or 0xx.xxx) and Holding Register (address 4x.xxx or 4xx.xxx): Modbus command for reading or written  |
| Modbus variable on DF89 (cache)  | Discrete Input (address 1x.xxx or 1xx.xxx) or Input Register (address 3x.xxx or 3xx.xxx) with float data type.  | If Modbus command for reading:<br>Discrete Input (address 1x.xxx or 1xx.xxx) or Input Register (address 3x.xxx or 3xx.xxx) with float data type.<br><br>If Modbus command for written:<br>Coil (address 0x.xxx or 0xx.xxx) or Holding Register (address 4x.xxx or 4xx.xxx)   |
| Frequency of sending Modbus command for reading                                  | Cyclic according to SmarNetConf configuration.  | Cyclic according to SmarNetConf configuration.   |
| Frequency of sending Modbus command for written                                  | User demand. When writing occurs via Smar.DfiOleServer.   | Cyclic according to SmarNetConf configuration.   |
| Application  | DF89 works as <b>concentrator for an OPC Server/Client</b> (it scans the slave devices and stores in the DF89 memory for host access).<br><br>Despite the Modbus variable on DF89 is Discrete Input or Input Register, the written via Smar.DfiOleServer will be converted to written Modbus command to the slave device. | DF89 transfers cyclically a variable:<br>- from a Modbus device to another one<br>- from a Modbus device to a FF device<br>- from a FF device to a Modbus device   |

### Supervision

For example, in the HMI of example of figure 23.1 it is desired to map the point 40020 , which was a PID set point, and a contact 2001 that would be an on/off of a pump. The point will be created in **SmarNetConf** and **Mapping tool** as shown in steps 5 to 9 and would be as follows.

| Modbus Function (SmarNetConf) | Start Address (SmarNetConf) | Point Tag (Mapping Tool) | Description |
|-------------------------------|-----------------------------|--------------------------|-------------|
| Read Coils (01)               | 2001                        | PLC_ID1_DI_1             | On/Off Pump |
| Read Holding Registers (03)   | 40020                       | PLC_ID1_AI_1             | SP of PID   |

These points were used in the ladder in a particular control strategy, and could also be mapped in supervisory via Smar.DfiOleServer. In supervisory, the value of points **PLC\_ID1\_DI\_1** and **PLC\_ID1\_AI\_1** can be changed by the user where the change will be mapped into a Modbus command of writing (function 5,6,15 or 16) and will be sent to the slave. The value of the next reading will already be the value really affected on the slave. If the point continues with the previous value means that the writing was not recognized by the slave.

On ladder it is not possible to alter the set point value, as the online ladder alteration does not admit writing on input parameters like this.

### Peer-to-Peer of I/O point

A point mapped as peer-to-peer must be read on some slave device and written on other slave device.

For example, if the user wants to read the **PLC\_ID1** set point value and write the **TRM\_ID2** set point. In this case, the **PLC\_ID1** set point must be mapped with any reading function (n.1, 2, 3 or 4), and the TRM\_ID2 mapped with any writing function (n. 5, 6, 15 or 16). So, both ladder or function block logic can be used so that the point mapped as **PLC\_ID1.PID1\_SP** be written on **TRM\_ID2.PID2\_SP**.

### Scan time between commands

The DF89 has the additional characteristic of choosing the scan time by command. By default, this parameter is 500 ms and must suit most applications. This value can be adjusted from 0 to 65500 ms (65.5 s).

The Modbus scan time allows the user setting different times for each command as multiples of 100 ms. For variable requiring a smaller periodicity, as analog variables, the Modbus time can be slower, for example, in relation to discrete points.

Scan time is also useful to prioritize the bypass. It refers only to the commands determined for the D89 to execute as a Modbus master and does not influence the Modbus bypass at all. So, if using a 1000 ms scan time and there is only one command, the DF89 will execute the scan command at each second. The rest of the time it can serve the bypass. That is, this makes bypass supervision much faster, as the bypass range is bigger in this case.

This is time is the time the user. However, as the scan depends on other commands to be executed, sometimes this time cannot be effected if the scan is much bigger than necessary. For example, imagine if the user has 5 commands to execute a device data (5 commands, including the optimization). And suppose that the user set the time of 100 ms for all commands. If the time for each command is 100 ms, then the time to do all the scan would be 500 ms. As the user configured 200 ms (desired time) the time had never been able to be done because the scan occurs at least every 500ms. If the user changes the time to 1000ms then will exist a gap between the scan of 500ms.

### Optimization of commands

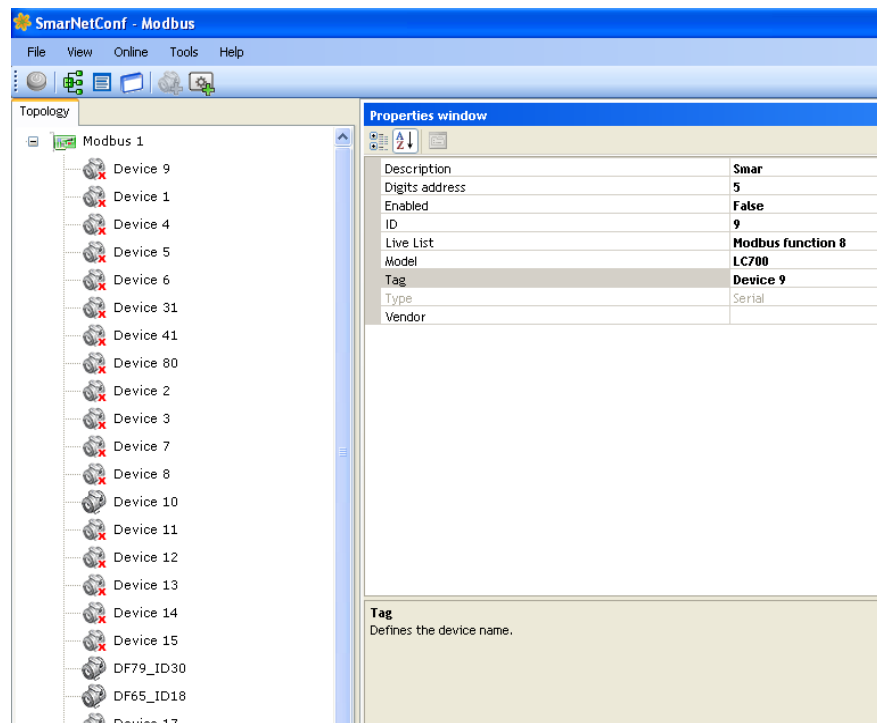
The DF89 has an additional command optimization feature. It consists on reducing the number of commands sent online and optimizes the Modbus communication. Use only the non-selected option when the Modbus slave really does not support the optimized commands.

### Enabling and disabling a device in the configuration

Another interesting **Network Configurator** feature is the possibility of enabling and disabling a slave device on the configuration without affecting the device properties window where the user executes the device scan.

When the device is disabled, although the logic configuration and device mapping are not altered, the controller does not perform any other operation with this device, not sending any command to the slave.

The figure below shows a sample configuration with disabled devices. When the device is turned off it appears with a red (x) in the device drawing. In the figure below only the devices 10, 18 and 30 are enabled. This option is very useful when there are devices for maintenance.



**Figure 23. 34 – Example of configuration with enabled and disabled devices**

This enabling change needs a download to the controller to recognize it. This download operation can be performed from the **Smar Network Configuration** or from **Syscon**.

To enable again the device, return to device’s properties window and execute a new download.

## Network Configurator online communication with the controller

Direct communication with the DF89 is possible through the **SmarNetConf**. It can facilitate some functions like slave channel parameter download, among others. This communication is carried out through the Ethernet network.

To enable Modbus communication through **SmarNetConf**, first enable communication with the OPC server.

## SYSTEM302 Maintenance Procedure

This section presents a summary of download procedures recommended for cases of maintenance of a **SYSTEM302** configuration.

As the **SYSTEM302** has several download modes, there must be a general way that meets most cases. However, there are other procedures for the same alteration (consult the **Syscon** manual).

On the **Download Recommended** column the reference is the **Syscon** incremental download on the plant or on the controller. These operations are explained in detail in the **Syscon** manual.

| MAINTENANCE EVENT  | ALTERATION TOOL   | RECOMMENDED DOWNLOAD   |
|--|---|--|
| Make a new SYSTEM302 configuration with the Modbus controller and ladder logic. FFB block has no HSE links to other controllers. | Syscon, Network Configurator, Mapping Tool, LogicView for FFB | On Syscon make an incremental plant download with all selected options or a download on the controller (*).  |
| Include a new device or a new command on the Modbus network  | Network Configurator, Mapping Tool                            | On Syscon make an incremental plant download with all selected options.                                      |
| Alter the device configuration on the Modbus network (device address, Modbus points addressing)                                  | Network Configurator  | Make an incremental plant download on the controller on Syscon(*).   |
| Change specific parameters on the Modbus channel ( <i>baud rate, timeout</i> or other parameter).                                | Network Configurator  | Download the Modbus network on the Network Configurator (*)  |
| Enable or disable Modbus device keeping the entire Modbus configuration  | Network Configurator  | Download the Modbus network on the Network Configurator (*)  |
| Add parameters on the FFB block and make HSE links or only add FFB parameters to a FFB block that already has HSE link.          | Syscon  | On Syscon make an incremental plant download (*).  |
| Include or remove FFB link for internal blocks inside the same controller.   | Syscon  | Make an incremental download on the controller without the enabled NetIO options (*).                        |
| Change of mapping parameters I/O points (scale, point tags, alteration of accessed or swapped bytes).                            | Mapping Tool  | On Syscon make an incremental download on the controller with the NetIO Parameterization enabled option (*). |
| Change slave device configuration parameters (tag, model or number of visualization digits) or enable/disable the slave device.  | Network Configurator  | Download the Modbus network on the Network Configurator (*).   |
| Alteration only of ladder logic.   | LogicView for FFB   | Download the logic on the LogicView for FFB.   |

**Table 23.4 – Recommended download procedures**

(\*) These operations will stop the Modbus network channel



## Smar Network Configurator Parameters

### Serial Channel Parameters

| Category   | Parameter         | Valid Range   | Default | Unit | Description  |
|------------|-------------------|---|---------|------|--|
| Advanced   |                   |   |         |      |  |
|            | RTS CTS Timeout   | 0-65535   | 0       | ms   | Specifies the maximum waiting time for the CTS become active after sending RTS on the serial ports.  |
|            | Time delay        | 0-65535   | 0       | ms   | Waiting time between Rx reception and the next Tx transmission.  |
| Media      |                   |   |         |      |  |
|            | Baud rate         | 0:110, 1:300,<br>2:600, 3:1200,<br>4:2400, 5:4800,<br>6:9600, 7:19200,<br>8:38400,<br>9:57600,<br>10:115200 | 9600    | E    | Define the baud rate of serial ports.  |
|            | Parity            | 0:Even, 1:Odd,<br>2:None.   | Even    | E    | Defines the serial ports parity  |
|            | Retry Count       | 0-5   | 1       |      | Number of retransmissions in case the master does not receive a response from the slave.   |
|            | Retry period      | 0-65536   | 10000   |      | Time spent on a new live list check for the devices that failed on the scan.   |
|            | Stop bit          | 0:1, 1:2  | 1       | E    | Defines the number of stop bits for the serial ports.  |
|            | Timeout           | 0-65536   | 1000    | ms   | Waiting time for a slave response after sending a command to the serial ports.   |
| Misc       |                   |   |         |      |  |
|            | Port number       |   |         |      | 1  |
|            | Tag               |   |         |      | Channel tag  |
|            | Type              |   |         |      | Serial   |
| Redundancy |                   |   |         |      |  |
|            | CHECK SECOND COMM | 0 – Disable test<br>1 – 65535 Interval<br>between each test   | 0       | ms   | Parameter configured for the secondary redundant port if user wants the communication test between slave devices.                                      |
|            | SECONDARY BYPASS  | True/False  | False   |      | Parameter configured for the secondary redundant port if wanting to use the path as bypass for a TCP master to access the serial slave below the DF89. |

### TCP Channel Parameters

| Category   | Parameter         | Valid Range   | Default | Unit        | Description   |
|------------|-------------------|---|---------|-------------|---|
| Media      |                   |   |         |             |   |
|            | RETRY COUNT       | 0-5   | 1       |             | Number of retransmissions if the master does not receive a response from the slave.   |
|            | RETRY PERIOD      | 0-65536   | 0       | ms          | Time of retransmission if the master does not get a response from the slave.  |
|            | TIMEOUT           | 0-65536   | 1000    | ms          | Waiting time for a slave response after sending a command for the TCP ports.  |
| Misc       |                   |   |         |             |   |
|            | PORT NUMBER       |   |         | (read only) | 2   |
|            | TAG               |   |         | (read only) | Channel Tag   |
|            | TYPE              |   |         | (read only) | TCP   |
| Redundancy |                   |   |         |             |   |
|            | CHECK SECOND COMM | 0 – Disable test<br>1 – 65535 Interval<br>between each test | 0       | ms          | Parameter configured for the secondary DF89. If the user wants to perform the periodic communication test with the slaves to check the communication. |
|            | Secondary Bypass  | 0 – False<br>1 – True                                       | False   |             |   |

### Serial Device Parameters

| Category | Parameter      | Valid Range   | Default | Unit | Description  |
|----------|----------------|---|---------|------|--|
| Advanced |                |   |         |      |  |
|          | Digits address | 5 or 6  | 5       |      | Indicates if the "Modbus Address" will show the number with 5 or 6 digits, indicating if it is the old Modbus Modicon standard or a new one.   |
|          | Live List      | 1 – Use Modbus function 8.<br>2 – Use the First command | 1       |      | This parameter indicates which command will be used by the master and check if the device is alive. By default the loop back command (function 8) is used, though the device may not support this command. In this case, the user may choose option 2 and the first configured command will be sent. |
| Main     |                |   |         |      |  |
|          | Enabled        | 0 – False<br>1 – True                                   | 1       |      | This Field defines if, and on what conditions, the command must be executed.<br>If the parameter is configured as 0, the command is disabled and won't be executed in the normal polling sequence.<br>If the parameter is configured as 1, the command will be executed on each command list scan.   |
|          | Slave address  | 1-247   |         |      | This parameter specifies the node address, on the network, of the Modbus slave that will be considered. Values 1 to 247 are allowed.   |
| Misc     |                |   |         |      |  |
|          | Description    |   |         |      |  |
|          | Model          |   |         |      |  |
|          | Tag            |   |         |      | Device tag   |
|          | Type           |   |         |      | Serial   |
|          | Vendor         |   |         |      |  |

### TCP Device Parameters

| Category | Parameter      | Valid Range   | Default | Unit | Description  |
|----------|----------------|---|---------|------|--|
| Advanced |                |   |         |      |  |
|          | Digits address | 5 or 6  | 5       |      | Indicates if the "Modbus Address" will show the number with 5 or 6 digits, indicating if it is the old Modbus Modicon standard or a new one.   |
|          | Live List      | 1 – Use Modbus function 8.<br>2 – Use the First command | 1       |      | This parameter indicates which command will be used by the master to check if the equipment is alive (livelist). By default the loop back command (function 8) is used, though the equipment may not support this command. In this case, the user may choose option 2 and the first configured command will be sent. |
| Main     |                |   |         |      |  |
|          | Enabled        | 0 – False<br>1 – True                                   | 1       |      | This field defines if the command must be executed and under which conditions.<br>If the parameter is configured as 0, the command is disabled and will not be executed on the normal polling sequence.<br>If the parameter is configured as 1, the command is executed at each command list scan.                   |
|          | Slave address  | 1-247   |         |      | This parameter specifies the node address, on the network, of the slave device that will be considered. Values 1 to 247 are allowed.   |
|          | IP             |   | Spaces  |      | Device main IP address   |
|          | IP2            |   | Spaces  |      | Redundant device IP address. See redundancy cases.   |
| Misc     |                |   |         |      |  |
|          | Description    |   |         |      |  |
|          | Model          |   |         |      |  |
|          | Tag            |   |         |      | Device tag   |
|          | Type           |   |         |      | TCP  |
|          | Vendor         |   |         |      |  |

## Parameters of device commands (serial or TCP)

| Parameter    | Valid Range  | Default | Unit | Description   |
|--------------|--|---------|------|---|
| TAG          |  |         |      | Device Tag  |
| FUNCTION     | The options are in according to Modbus supported functions table | 1       |      | This parameter specifies the Modbus function that will be executed by the command. These function codes are defined by the Modbus protocol. The next table defines the purpose of each action supported by the module.  |
| OFFSET       | 0 to 65535   | 0       |      | This parameter specifies the initial Modbus register or the digital point address to be considered by Modbus slave equipment command. Refer to each slave device documentation on the network to attribute their registers and digital point address.   |
| REGISTERS    | 0 to 65535   | 0       |      | This parameter specifies the number of registers and digital points to be associated to the command. Functions 5 and 6 ignore this field and their only apply to a single data point.<br>For functions 1, 2 and 15, configure the number of digital registers to be associated to the command. For functions 3, 4 and 16 configure the number of analog registers to be associated to the command. Note: the register that may be associated to a point depends on the data type. See more about association of register and point in the item data type supported described in this section. |
| SCAN         | 0 to 65500<br>(multiple of 100)                                  | 500     | ms   | This parameter specifies the minimum interval to execute continuous commands periodically. This parameter must be multiple of 100. So, if the scan time is 500 the command will be executed at each 500 ms minimum.   |
| OPTIMIZATION | 0 – False<br>1 – True  | 1       |      | When the parameter is true (checked on), indicates that it will be used to optimize the Modbus command where the algorithm tries to group multiple internal points of the same type and the same device in the same command.  |
| START ADDR   |  |         |      | This Field is a composition of function and Relative Address, which will be the Modbus address in the user language. It will depend also of the Nr_digits_addr parameter. See the Modbus Address mounting.  |

### Modbus Functions Supported

The table below lists all Modbus functions supported by DF89 and their description. This function code follows the current Modbus specification Modbus Organization – Application Protocol Specification.

| Modbus Function | MODBUS_FUNCTION Parameter     | Class     | Description                                      |
|-----------------|-------------------------------|-----------|--|
| 1               | Read Coils (0x)               | <b>RW</b> | Reading of Input/Output Discrete Points.         |
| 2               | Read Discrete Inputs (1x)     | <b>RO</b> | Reading of Input Discrete Points                 |
| 3               | Read Holding registers (4x)   | <b>RW</b> | Reading of Input/Output Analog Points            |
| 4               | Read Input registers (3x)     | <b>RO</b> | Reading of Input Analog Points                   |
| 5               | Write Single Coil (0x)        | <b>W</b>  | Writing of Discrete Point (only 1 register)      |
| 6               | Write Single Register (4x)    | <b>W</b>  | Writing of Analog Point (only 1 register)        |
| 15              | Write Multiple Coils (0x)     | <b>W</b>  | Writing of Discrete Points (1 or more registers) |
| 16              | Write Multiple Registers (4x) | <b>W</b>  | Writing of Analog Points (1 or more registers)   |

RW - Read and Write, RO - Read Only, W - Write Only

Besides these functions is also supported the function of checking the device function (8 - check). This function is used when starting the device to know if is alive or not (LiveList). In the LiveList parameter of the device the user may choose to use this function or the first function defined in the command table.

## Specific blocks of DF89 controller

### Modbus Communication Transducer

This block provides the following functionalities:

- Slave device live list;
- Slave device diagnostics;
- Parameter online configuration of slave configuration.

See in the table below the parameters description.

| Idx | Parameter           | Data type | Valid Range  | Default | Memory | Mode | Unit | Description   |
|-----|---------------------|-----------|--|---------|--------|------|------|---|
| 1   | ST_REV              | Uns16     |  |         | S      | RO   |      |   |
| 2   | TAG_DESC            | Octet     |  |         | S      | RW   |      |   |
| 3   | STRATEGY            | Uns16     |  |         | S      | RW   |      |   |
| 4   | ALERT_KEY           | UNS8      |  |         | S      | RW   |      |   |
| 5   | MODE_BLK            | DS_69     |  |         | S      | RW   |      |   |
| 6   | BLOCK_ERR           | Bitstr    |  |         | D      | RO   |      |   |
| 7   | SERIAL_CHANNEL      | Uns8      | 0 : Slave<br>1 : Master  | 0       | S      | RO   |      | Shows if the serial port is being used as Modbus master or slave.   |
| 8   | BAUD_RATE           | uns8      | 3:1200,<br>4:2400, 5:4800,<br>6:9600, 7:19200,<br>8:38400, 9:57600,<br>10:115200 | 9600    | S      | RO   |      | Shows the current baud rate used on master or slave on the serial port.   |
| 9   | STOP_BITS           | uns8      | 0:1; 1:2   | 1       | S      | RO   |      | Shows the current stop bit used on master or slave serial port.   |
| 10  | PARITY              | uns8      | 0:Even<br>1:Odd<br>2:None  | Even    | S      | RO   |      | Shows the current parity used on master or slave serial port.   |
| 11  | SERIAL_TIMEOUT      | Uns16     | Positive   | 1000    | S      | RO   | ms   | Waiting time for the slave response using the serial port.  |
| 12  | SERIAL_NR_RETRIES   | Uns8      | Positive   | 2       | S      | RO   |      | Number of attempts of re-sending the failing serial port command.   |
| 13  | SERIAL_RETRY_PERIOD | Uns16     | Positive   | 5000    | S      | RO   | ms   | Time spent to re-send the command to the slave that does not respond.   |
| 14  | RTS_CTS_TIMEOUT     | uns16     | Positive   | 0       | S      | RO   | ms   | Specifies the maximum waiting time for the CTS to be activated after the RTS is configured on the serial ports. |
| 15  | TIME_DELAY          | uns16     | Positive   |         | S      | RO   | ms   | Waiting time between Rx reception and the next Tx transmission.   |
| 16  | SERIAL_CHK_COM_SEC  | uns16     | Positive   |         | S      | RO   | sec  | Indicates to redundancy if the information that the check will be made on the secondary path was configured.    |
| 17  | BYPASS_SECONDARY    | uns8      | 0=False;<br>1=True   |         | S      | RO   |      | Indicates to redundancy if the user can use or not the secondary path as bypass                                 |
| 18  | SERIAL_ENABLE_DEVS  | Uns8      |  |         | D      | RO   |      | List of devices enabled on the serial network. The number represents the slave device_address.                  |
| 19  | SERIAL_LIVE_LIST    | Uns8      |  |         | D      | RO   |      | List of devices connected to the serial network. The number represents the slave device_address.                |

|    |                  |       |  |       |   |    |   |   |
|----|------------------|-------|--|-------|---|----|---|---|
| 20 | SERIAL_ERR_CNT   | Uns32 |  | 0     | D | RO |   | Serial errors number counter. Use the RESET_COUNTERS to restart the counter.              |
| 21 | SERIAL_SCAN_TIME | Uns32 |  | 0     | D | RO |   | Time spent by the serial port to scan the Modbus variables.                               |
| 22 | TCP_TIMEOUT      | uns16 | Positive                                   |       | S | RO |   | Waiting time for a slave response after sending a command on the TCP port.                |
| 23 | TCP_NR_RETRIES   | uns8  | Positive                                   |       | S | RO |   | Number of retransmissions if no the slave response is received.                           |
| 24 | TCP_RETRY_PERIOD | uns16 | Positive                                   |       | S | RO |   | Time to re-send the command to slave that is not responding.                              |
| 25 | TCP_CHK_COM_SEC  | uns16 | Positive                                   |       | S | RO | s | Indicates to redundancy if the check on the secondary path will be configured             |
| 26 | TCP_ENABLE_DEVS  | Uns8  |  |       | D | RO |   | List of device enabled on the TCP network. The number represents the slave device_address |
| 27 | TCP_LIVE_LIST    | Uns8  |  |       | D | RO |   | List of device connected to the TCP network.  |
| 28 | TCP_ERR_CNT      | Uns32 |  | 0     | D | RO |   | TCP error number counter. Use RESET_COUNTERS to restart this counter.                     |
| 29 | TCP_SCAN_TIME    | Uns32 |  | 0     | D | RO |   | Time spent by the TCP port to scan the Modbus variables.                                  |
| 30 | RESET_COUNTERS   | Uns8  |  |       | D | RW |   | Restart the TCP and Serial error counters.  |
| 31 | NUM_LINKS        | Uns8  |  | 1     | S | RO |   | Defines the number of buses supported.  |
| 32 | LINK_SEL         | Uns8  | 0: First ; 1: Next ; 2: Previous ; 3: Last | First | D | RW |   | Selects which bus will show its information. Internal LiveList use.                       |
| 33 | LINK_ID          | uns16 |  | 0     | D | RW |   | Identifies the currently selected bus. Internal LiveList use.                             |
| 34 | LINK_ID_REV      | Uns32 |  | 0     | S | RO |   | Current bus LiveList revision. Internal use.  |
| 35 | NUM_DEV          | Uns16 |  | 0     | D | RO |   | Number of devices on current bus for use on the LiveList.                                 |
| 36 | SLAVE_SELECTOR   | Uns8  | 0: First ; 1: Next ; 2: Previous ; 3: Last | First | D | RW |   | Slave address selector to read LiveList information. Internal use.                        |
| 37 | SLAVE_ADDR       | uns8  | 1 to 247                                   | 0     | D | RW |   | Slave parameter address for LiveList. Internal use.                                       |
| 38 | UPDATE_EVT       | DS-73 |  |       | D |    |   |   |
| 39 | BLOCK_ALM        | DS-72 |  |       | D |    |   |   |

## Modbus Slave Configuration

See in the table below the parameters description.

| Idx | Parameter          | Data type | Valid Range   | Default          | Memory | Mode | Unit | Description   |
|-----|--------------------|-----------|---|------------------|--------|------|------|---|
| 1   | ST_REV             | UNS16     |   | 0                | S      | RO   |      |   |
| 2   | TAG_DESC           | OCT(32)   |   | Spaces           | S      | RW   |      |   |
| 3   | STRATEGY           | UNS16     |   | 0                | S      | RW   |      |   |
| 4   | ALERT_KEY          | UNS8      | 1 to 255  | 0                | S      | RW   |      |   |
| 5   | MODE_BLK           | DS_69     | OOS , AUTO  | OOS              | S      | RW   |      |   |
| 6   | BLOCK_ERR          | Bitstr(2) |   |                  | D      | RO   |      |   |
| 7   | DEVICE_ADDRESS     | uns8      | 1 to 247  | 1                | S      | RW   |      | Defines the DFI302 Modbus address when working as Modbus slave.   |
| 8   | BAUD_RATE          | uns8      | 0:110, 1:300, 2:600, 3:1200, 4:2400, 5:4800, 6:9600, 7:19200, 8:38400, 9:57600, 10:115200 | 9600             | S      | RW   |      | Defines the DFI302 serial port baud rate when working as Modbus slave. Defines the DFI302 Modbus address when working as Modbus slave.                                    |
| 9   | STOP_BITS          | uns8      | 0:1, 1:2  | 1                | S      | RW   |      | Defines the DFI302 serial port stop bit when working as Modbus slave.   |
| 10  | PARITY             | uns8      | 0:Even, 1:Odd, 2:None   | Even             | S      | RW   |      | Defines the DFI302 serial port parity when working as Modbus slave.   |
| 11  | RTS_CTS_TIMEOUT    | uns16     |   | 0                | S      | RW   | ms   | When the value is other than zero, it indicates that the RTX_CTS function is enabled and the value is the connection timeout. Used when the DFI302 works as Modbus slave. |
| 12  | ENABLE_CHK_COM_SEC | Uns8      |   | 0-False ; 1-True | S      | RW   |      | When the DFI302 works as Modbus slave, this flag enables the redundancy, checks the communication on the secondary.   |
| 13  | UPDATE_EVT         | DS-73     |   |                  | D      |      |      |   |
| 14  | BLOCK_ALM          | DS-72     |   |                  | D      |      |      |   |

## Redundancy and Modbus

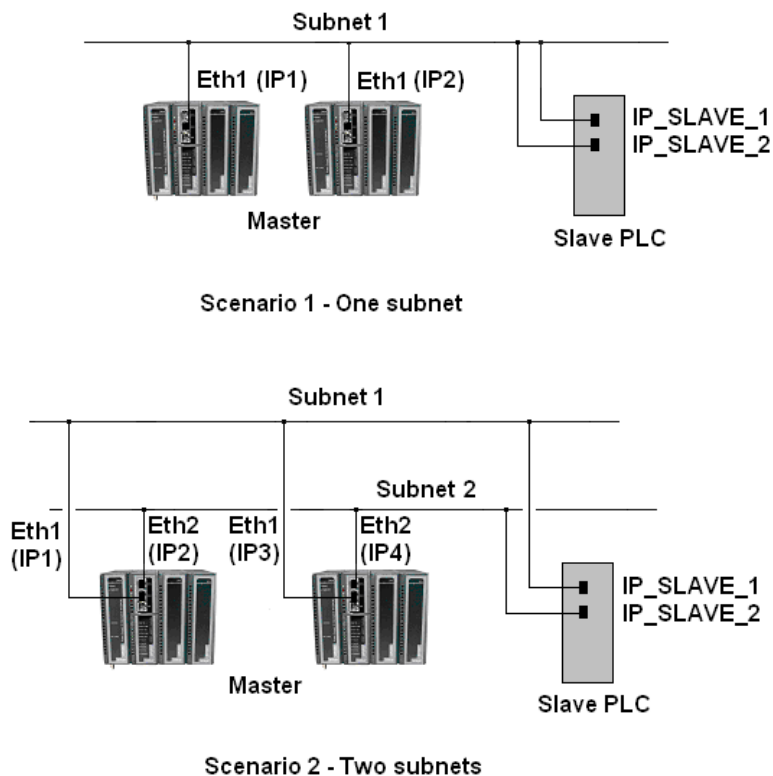
The redundancy in Modbus communication may be mapped to many possible scenarios. Some of them are supported by the controllers. The restrictions which should be considered are described below:

1. The Modbus TCP in the DF89 will be established in both Ethernet ports (ETH1 and ETH2). It is recommended to use both ports only in the scenarios where the DF89 is slave. When running as Modbus Master, the DF89 should not be configured to use ETH2 to avoid duplication in the bandwidth and it may damage the communication performance.
2. The both Ethernet ports (ETH1 and ETH2) are available to answer the Modbus requests when the DF89 is slave.
3. Switch over conditions are related to bad conditions in the Primary controller (see description of these bad conditions in another section of this manual “Adding Redundancy to DFI302 HSE Controllers”). As slave Modbus, the controllers will not generate a switch over condition because of communication failures. It is always the master who should switch over in such conditions. When using TCP and all IPs are in the same subnet, the master should to decide when switch the request to other slave Ethernet connection.
4. As Modbus Master, DF89 (either TCP or Serial RTU) only switch over if the Primary does not have any answer from all slave modules.

### Redundant DF89 as master and PLC, with two Ethernet ports, as slave, using Modbus TCP

There are two possible scenarios, in the first only one subnet is used and all IPs of equipment are on the same subnet.

In the second scenario, two subnets are used, and each device has an Ethernet port connected to one of them, see the following figure. The second scenario is the most recommended if the availability of the Modbus communication is an important factor, because in this case if there is some failure in one switch the another network/subnet will cover this failure.



**Figure 23.35 – Example of configuration with enabled and disabled devices  
Network topologies for DF89 redundant master and slave PLC with two Ethernet ports**

The redundant PLC can either use two Ethernet cards or one card with two Ethernet ports.

Once the Primary DF89 executes the requests, it is assumed that any of the slave connections may receive and process the request. If one connection is not running properly, the primary DF89 will use another available connection (connection switching).

If the Primary DF89 did not receive response to any of the connections and the Secondary DF89 has response to at least one of the connections, the DF89 pair will switch over (scenario Bad Condition/ controller switching).

**Redundant DF89 as master and redundant PLC as slave, using Modbus RTU**

In this scenario, the DF89 is redundant, using RS-485 serial port, and it is connected via multidrop to redundant PLC (both ports). Once the active DF89 executes the requests (see R1 in the following figure), it is assumed that only one slave will process the request. In case of any “bad condition” the DF89 will switch over (see R2 in the following figure).

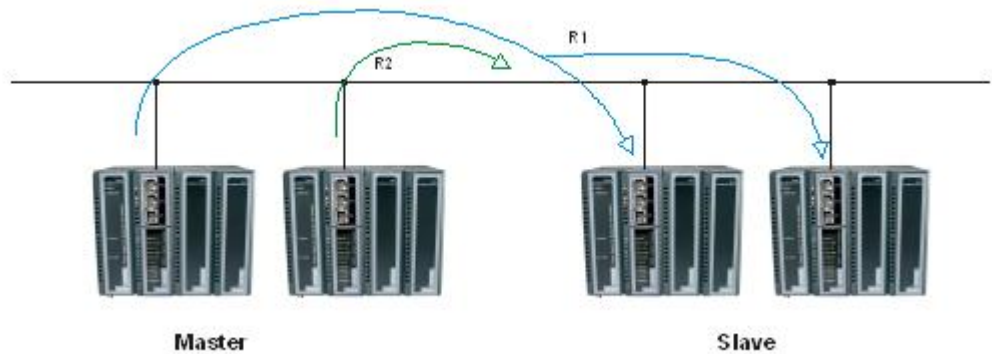


Figure 23. 36 – DF89 redundant master and PLC redundant slave, using Modbus RTU

**Redundant DF89 as slave and redundant PLC as Master, using Modbus TCP**

In this scenario, the Primary and the Secondary DF89 answer the reads requested by the Master PLC. The writes will be executed only by the Primary DF89. If for any reason the Secondary DF89 receives writing, so this request will be forwarded via redundancy path from Secondary DF89 to Primary DF89.

**Redundant DF89 as slave and redundant PLC as Master, using Modbus RTU**

In this scenario, only the Primary DF89 will answer the readings and writings requested by the Master PLC.



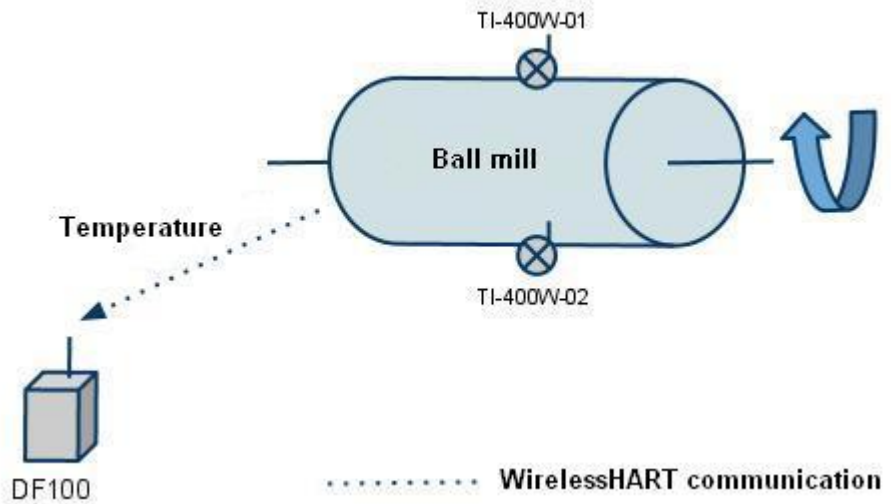


## CREATING A FOUNDATION FIELDBUS STRATEGY BY USING THE DF100

### Introduction

This section describes the fieldbus strategy configuration by using the DF100 controller. The figure below shows a ball mill (rotary) whose product temperature must be monitored.

### PROJ\_DF100



**Figure 24. 1 - Example of temperature monitoring in a ball mill**

The purpose is to monitor the product temperature at the center of the ball mill. The product temperature is measured by two wireless temperature transmitters installed in the hull of the mill, in its central part, in diametrically opposite positions. Measured temperatures will be transmitted from each of the temperature transmitters to the DF100 (*WirelessHART Gateway*) via *WirelessHART* communication. In the DF100, positioned near the ball mill and connected to the HSE network control, there will be special transducer blocks that will map the temperatures received from the transmitters. In addition to the transducers, the DF100 has function blocks that are used to calculate the average temperature of the mill from the two measured temperatures.

## Starting an Area

### Step 1

It is possible to create, or edit, an area from the **Studio302**. In the **Studio302** interface select **Areas**. A window will appear listing all areas of database.

To create a new area from the **Studio302**, right-click inside the **Areas** window, then choose **New Area**.

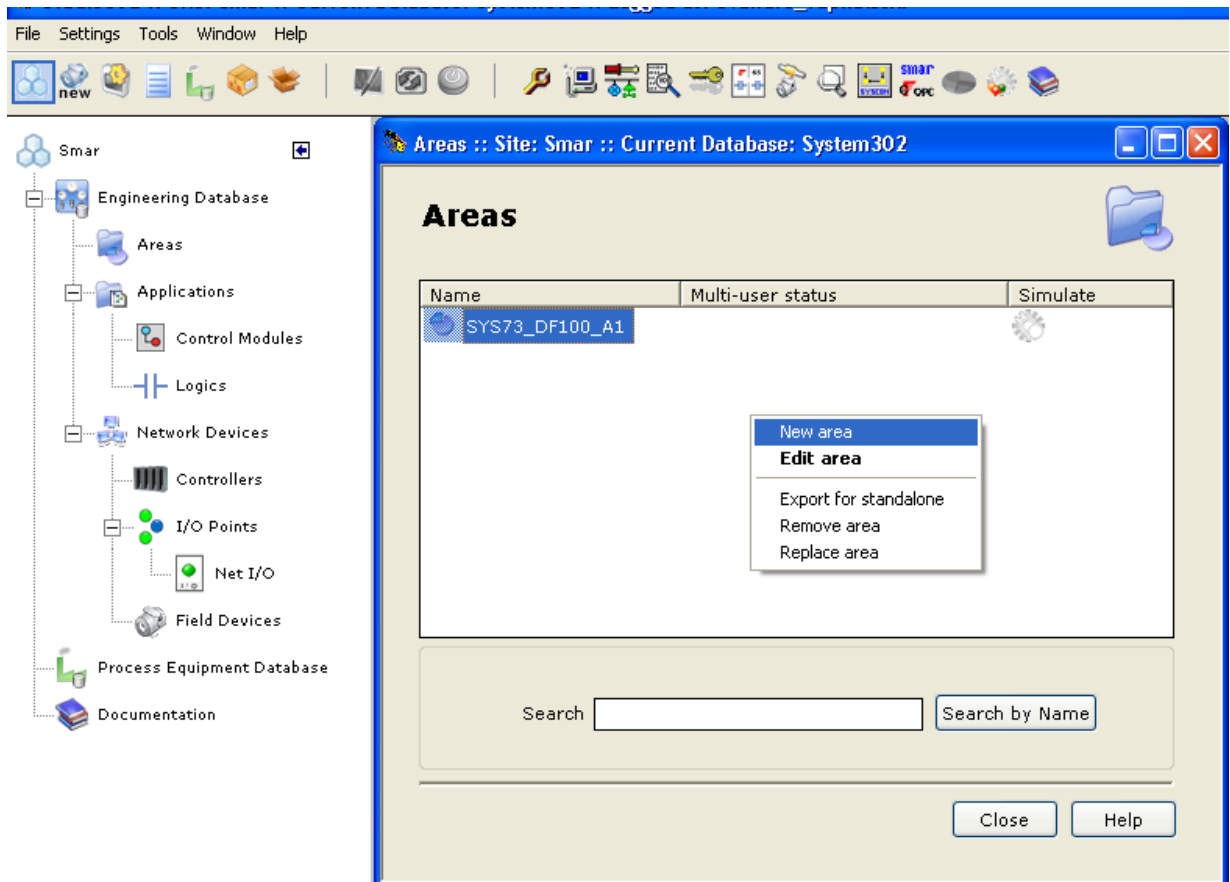



Figure 24. 2 - Creating a new area

Another way to create a new area is from **Syscon**. Click the icon  in the **Studio302** toolbar.

To create a new area on **Syscon**, choose **File → New**, or through the toolbar, choose **New** button . The dialog box shows the areas options. Select **HSE Area** as shown in next figure:

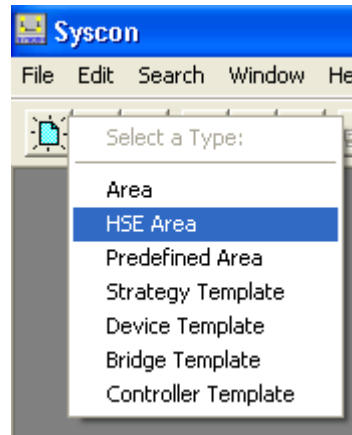


Figure 24. 3 - Options to create Syscon areas

After choosing the area type, it opens a window to the user give a name to the new area.

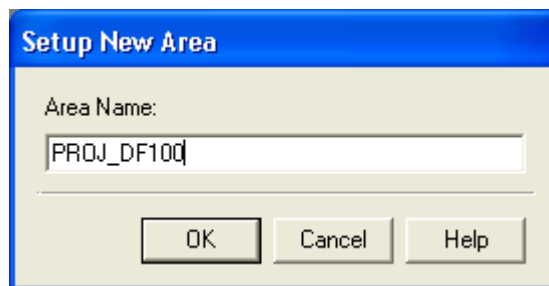


Figure 24. 4 - New area name

Type the name for the area in the **Area Name** box, and click **Ok**. For this example, it chooses **PROJ\_DF100** name.

A new window will appear. This window has:

- **Application** – Logical Plant. To insert control and/or monitoring strategies into this part.
- **Fieldbus Networks** – Physical Plant. To add devices and blocks (resources, transducers and function blocks) to the area into this part.

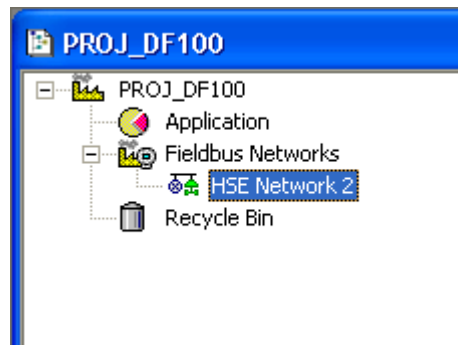



Figure 24. 5 - Area divisions

## Physical Plant Project

### Step 2

In the main window, **PROJ\_DF100**, right-click the **Fieldbus Networks** icon, , and choose **Communication Settings** option, or through the toolbar, choose **Communication**→**Settings**. The communication settings dialog box will open.

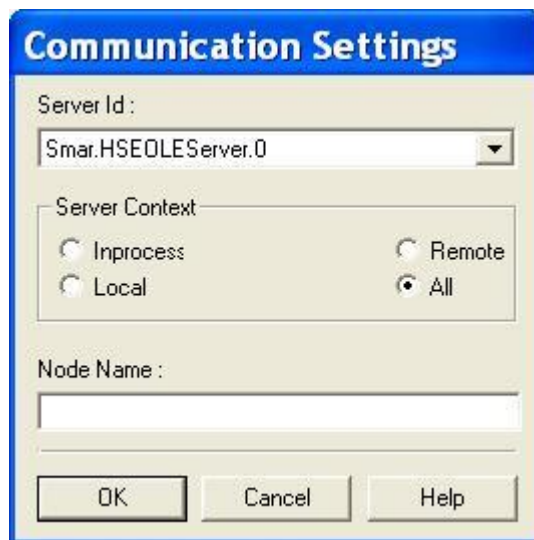


Figure 24. 6 - Choosing the Server

Confirm if the **Smar.HSEOLEServer.0** option has already been selected. Otherwise, the user must select it, and then click **OK**.

## Arranging the Fieldbus windows

### Step 3

After selecting the Server for the area, click the  $\oplus$  sign placed at left of the **New Fieldbus**. The HSE network will appear with a tag, for example, **HSE Network 1\***. Right-click this item and choose **Expand** option. The figure below shows the HSE network:

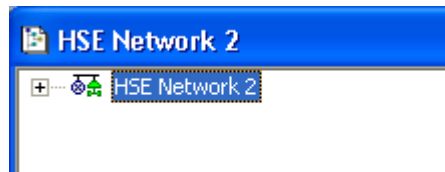


Figure 24. 7 - Creating an HSE network

To arrange the screen, click the area window. So, choose **Window** menu on the **Syscon** toolbar, and then **Tile** option.

## Adding the Controller

### Step 4

Right-clicking the **HSE Network 2**, it opens a dialog box to add new devices. Choosing **New** option, it is possible to select devices such as **Bridges**, **Controllers** and **Devices** for the area. For the aimed strategy, choose **Controller** option. Confirm this choice observing the following figure.

\* This number changes if another area was created before. When a new HSE area is created, this number increases.

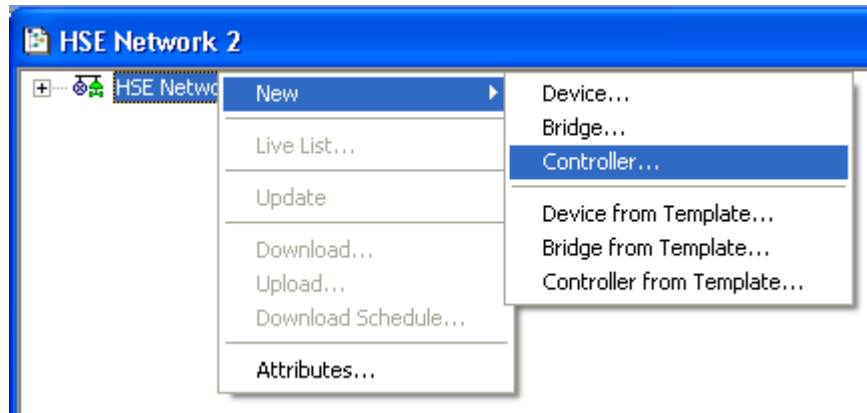


Figure 24. 8 - Choosing the Controller

After selecting that option, it opens a window as shown in the next figure.

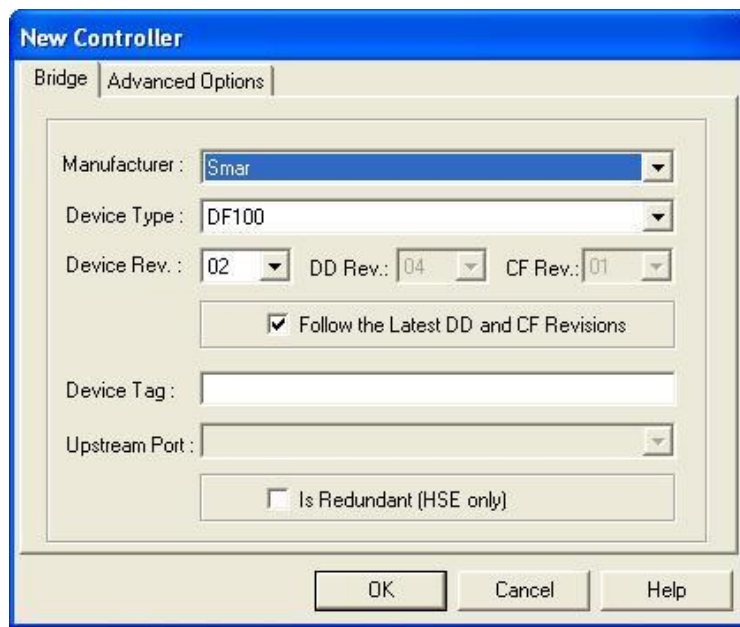


Figure 24. 9 - Setting the Controller

Select the **DF100** device in the **Device Type** box. In the **Device Tag** box, enter **DF100** or another tag, and click **OK**.

| IMPORTANT  |
|--|
| <p>Not all characters are valid when naming the elements, so pay attention;<br/>                     The valid characters are:<br/>                     A-Z a-z 0-9 # { } [ ] ( ) + -</p> <p>The invalid characters are:<br/>                     ~ ` ! @ # \$ % ^ &amp; * =   : ; , . &lt; &gt; ? / ' " \</p> |

At this moment, the following blocks will be created in the configuration:

- Resource block;
- Diagnostic transducer block;
- Transducer block for HART Gateway (Transducer Block for HART Gateway - TBHG);
- One transducer block for the first HART or *WirelessHART* field device (Transducer Block for *WirelessHART* - TBWH).

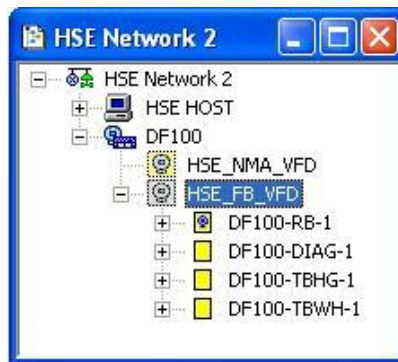


Figure 24. 10 – Blocks created after adding the controller

Quite simply, we understand that the DF100 (*WirelessHART* Gateway) and the *WirelessHART* and HART<sup>1</sup> field devices will be mapped on SYSTEM302 by the transducer blocks. This is possible due to the HSE WIO technology, embedded in the DF100.

The DF100 will be mapped by the transducer block (single and mandatory) called Transducer Block for HART Gateway (TBHG). Furthermore, each HART and *WirelessHART* field device will be mapped by transducer blocks called Transducer Blocks for *WirelessHART* (TBWH). There will be as many TBWH blocks as there are HART and *WirelessHART* field devices needed in the configuration.

## Adding HSE WIO Transducer and Function Blocks

### Step 5

The first HSE WIO transducer block, **TBHG**, is automatically created when the DF100 controller was added to the Physical Plant. Make sure that its **MODE\_BLK** parameter is configured to Auto (Automatic) before downloading the configuration on the DF100. This block, as monitored in Online mode, shows the list of HART and/or *WirelessHART* field devices currently connected to the DF100. Thus, we can understand that the **TBHG** provides to the system and to the user the Live List of field devices connected to the DF100 via *WirelessHART* network. See Library B Function Blocks Instruction Manual for additional information on the **TBHG** block.

The next step is to associate the **TBWH** block to the first wireless temperature transmitter of this example. This **TBWH** was also automatically created (with the **DF100-TBWH-1** tag) when the DF100 controller was added. The transmitter Long Tag has to be attributed (suppose **TI-400W-01**<sup>2</sup>) to the **Block Tag** of **TBWH** block. The following figures show the association between **TBWH** and the transmitter.

<sup>1</sup> The DF100 integrates HART, 4 to 20 mA conventional field devices, via *WirelessHART* adapters.

<sup>2</sup> In online mode, the Long Tags of transmitters connected to DF100 can be found in the **LIVE\_LIST\_TAG\_x** parameters of TBHG block.

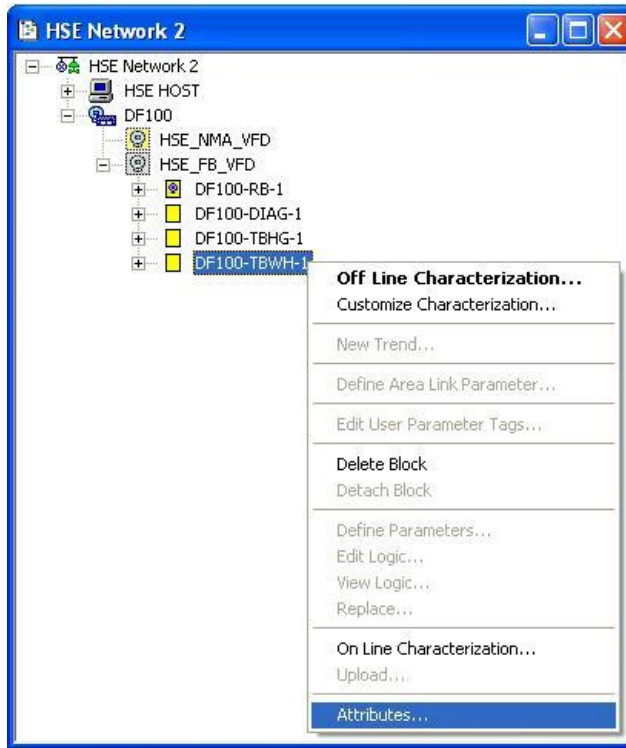


Figure 24. 11 – Changing the attributes of TBWH block

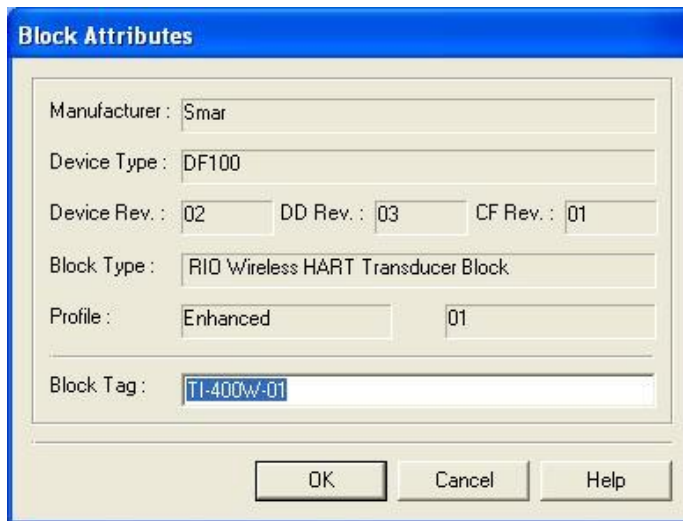



Figure 24. 12 – Changing the attributes of TBWH block

Depending on the strategy, you can add as many **TBWH** blocks as there are HART and *Wireless*HART field devices supported by the DF100 (see section Technical Specifications). For the purposed example, just add another **TBWH** block, which will map the second temperature transmitter. Its Long Tag will be **TI-400W-02**.

To add a new Function Block (FB), click the  sign, near to the DF100 controller, and right-click the **Virtual Field Device** (HSE\_FB\_VFD) icon. Choose **New Block** option.



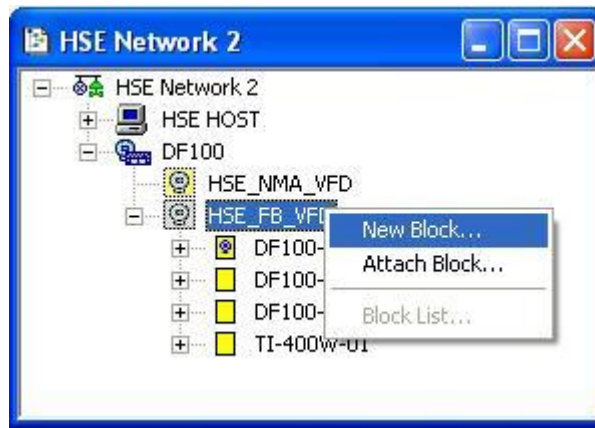


Figure 24. 13 – Adding New Blocks

The **New Block** dialog box will appear. In the **Block Type** option the blocks designed to the controller can be selected.

Select the block in the **Block Type** box, and name it in the **Block Tag** box. Click **OK**. The following figure shows adding the second **TBWH** block that will map the transmitter whose Long Tag is **TI-400W-02**

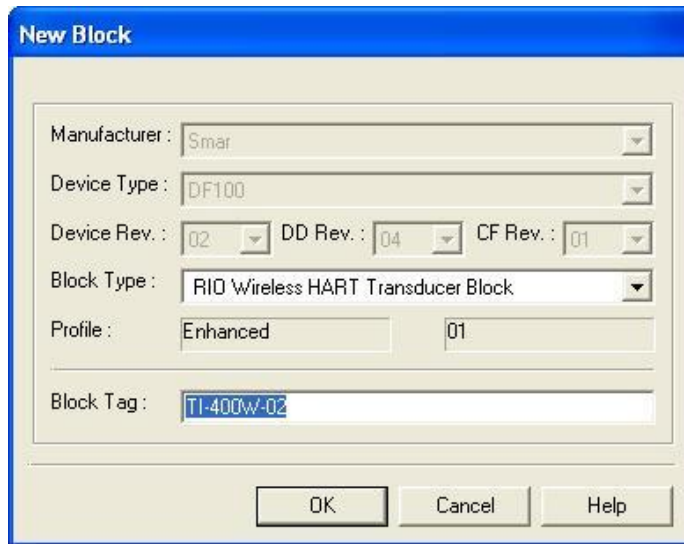


Figure 24. 14 – Adding TBWH block

As a general rule, for each **TBWH** block added, it is recommended:

- Assign the Long Tag of the HART or *WirelessHART* field device to the block tag attribute of **TBWH**.
- Configure the **MODE\_BLK** parameter to Auto (Automatic) before downloading the configuration on the DF100.

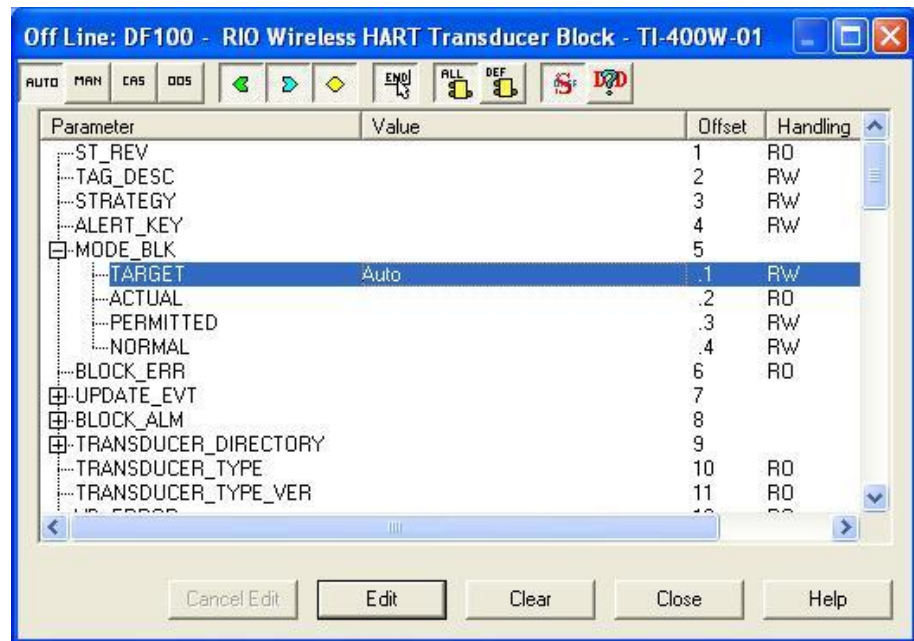


Figure 24. 15 – Configuring the MODE\_BLK parameter

- Configure the **HART\_EXPD\_DEV\_INFO** parameter with the attributes of the field device that will be mapped by **TBWH**. Refer to Library B Function Blocks Instruction Manual as well as the HART or *WirelessHART* field device manual<sup>3</sup> to configure correctly this parameter.

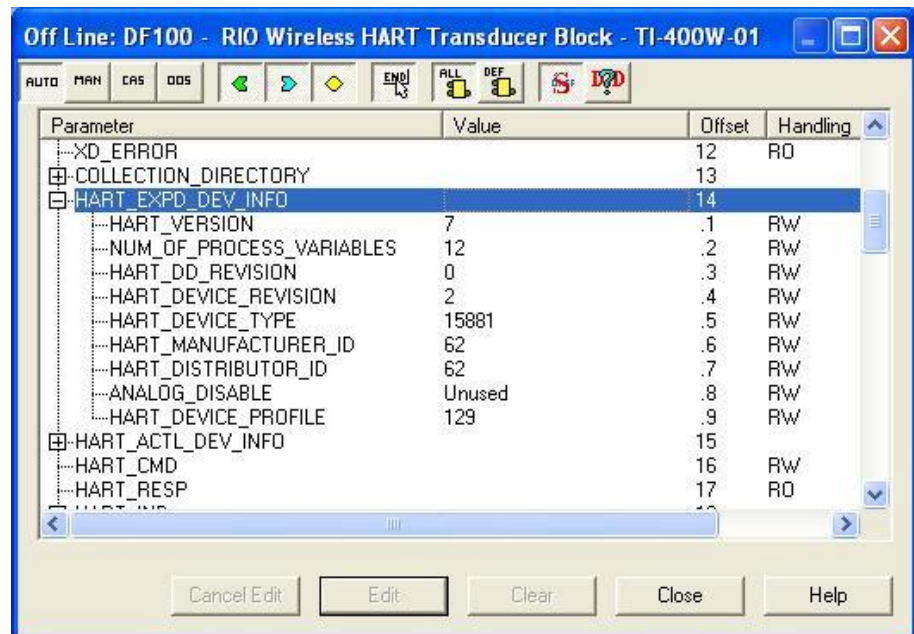


Figure 24. 16 – Configuring the HART\_EXPD\_DEV\_INFO parameter

<sup>3</sup> In online mode, if the desired field device is connected to DF100 and commissioned, it is recommended to configure the attributes of **HART\_EXPD\_DEV\_INFO** parameter with the values of the respective attributes of **HART\_ACTL\_DEV\_INFO** parameter.

**NOTE - HART\_EXPD\_DEV\_INFO**

The above parameterized attributes are specific to the considered field device - in this example the TT400 Smar WirelessHART was used. Therefore, important to note that the values assigned to the attributes of **HART\_EXPD\_DEV\_INFO** parameter depend on the type of device (pressure, temperature, density, etc.) and its firmware version.

The table below summarizes the attributes values of the **HART\_EXPD\_DEV\_INFO** parameter for some Smar WirelessHART field devices:

| Attribute                | LD400WH<br>Firmware 3.0.1 | DT400WH<br>Firmware 1.0.0 | TT400WH<br>Firmware 2.0.1 | TT481WH<br>Firmware 1.0.0 |
|--------------------------|---------------------------|---------------------------|---------------------------|---------------------------|
| HART_VERSION             | 7                         | 7                         | 7                         | 7                         |
| NUM_OF_PROCESS_VARIABLES | 11                        | 4                         | 12                        | 18                        |
| HART_DD_REVISION         | 1                         | 1                         | 1                         | 1                         |
| HART_DEVICE_REVISION     | 3                         | 1                         | 2                         | 1                         |
| HART_DEVICE_TYPE         | 15882                     | 15888                     | 15881                     | 15890                     |
| HART_MANUFACTURER_ID     | 62                        | 62                        | 62                        | 62                        |
| HART_DISTRIBUTOR_ID      | 62                        | 62                        | 62                        | 62                        |
| ANALOG_DISABLE           | Unused                    | Unused                    | Unused                    | Unused                    |
| HART_DEVICE_PROFILE      | 129                       | 129                       | 129                       | 129                       |

- Knowing that the second temperature transmitter used in this example, whose tag is **TI- 400W-02**, it is also a TT400 Smar WirelessHART with identical firmware to the **TI-400W-01** transmitter, configure the **HART\_EXPD\_DEV\_INFO** parameter exactly as was done for the TBWH of **TI- 01-400W**.
- Configure the parameters HART\_VAR\_CODES8 and VAR\_NAMES9.
- The codes for HART\_VAR\_CODES8 can be found in the “Note - HART\_VAR\_CODES8” field.
- The names used in each VAR\_NAMES9 will uniquely identify (in the scope of the DF100 that contains TBWH) the variables **HART\_PV**, **HART\_SV**, **HART\_TV**, **HART\_QV**, **HART\_5V**, **HART\_6V**, **HART\_7V**, **HART\_8V** AND **ANALOG\_VALUE**, respectively. This procedure is necessary, as the input HSE WIO function blocks will use these names to address the values of the **HART** variables that must be configured in the parameter. The figure below shows the parameterization of **VAR\_NAME** that will identify the **HART\_PV** variable of the TI-400W-01 transmitter. It is important to note that only one **VAR\_NAME** has been parameterized and that, depending on the strategy adopted, not all **VAR\_NAME** will need to be parameterized. See the Library B Function Block Instruction Manual for additional information on the **TBWH** transducer block, its parameters and required parameterizations.

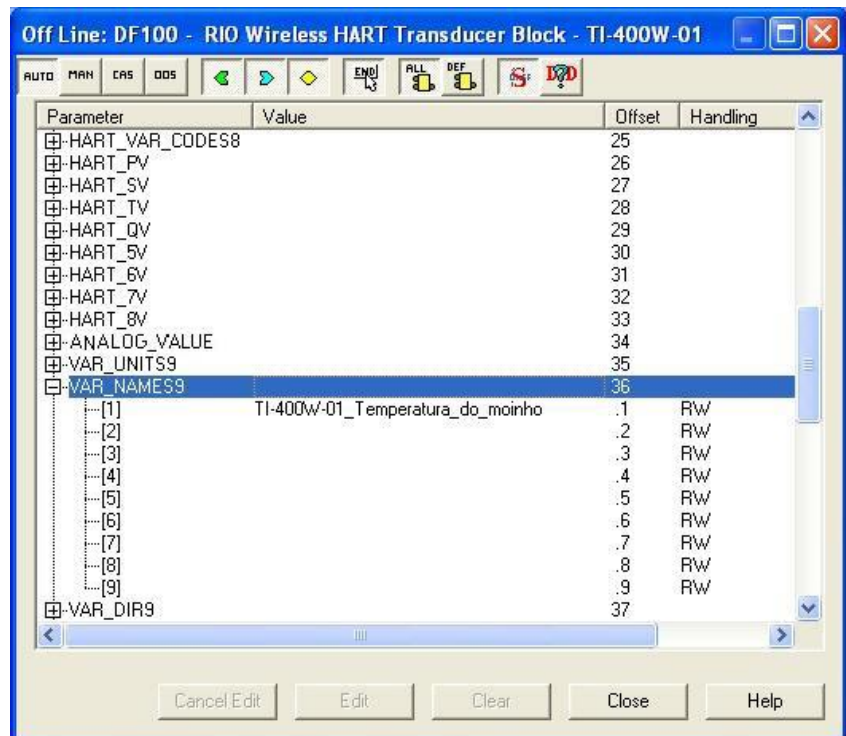


Figure 24. 17 – Configuring the VAR\_NAMES9 parameter of TBWH tagged TI-400W-01

Similarly for the TBWH block tagged as TI-400W-02, the VAR\_NAMES9 parameter will be configured with the TI-400W-02\_Temperatura\_do\_moinho value.

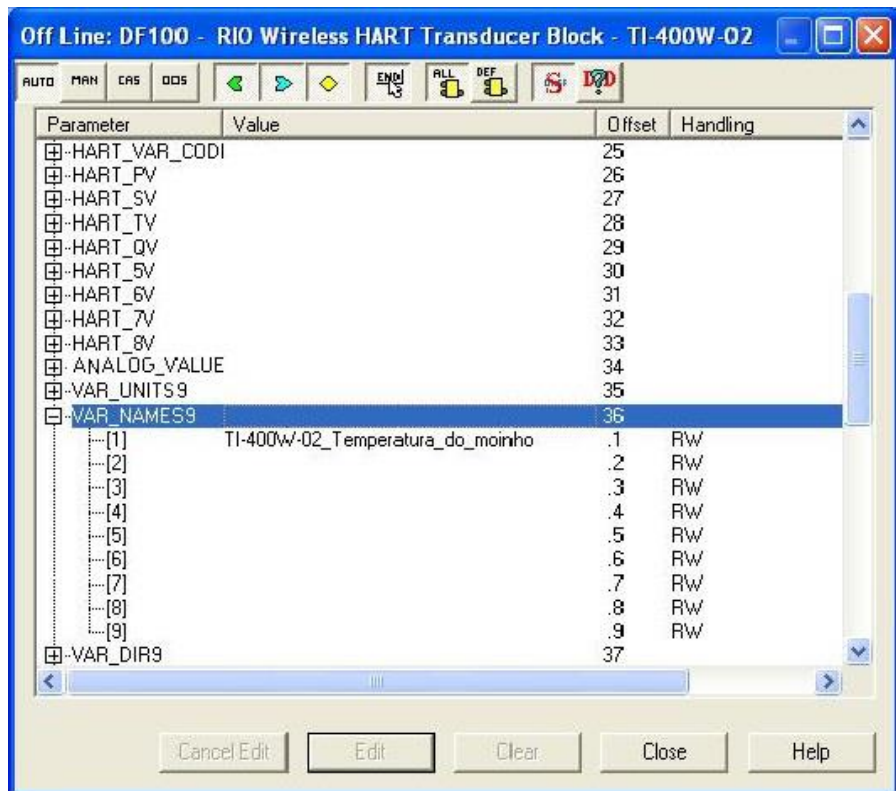


Figure 24. 18 – Configuring the VAR\_NAMES9 parameter of TBWH tagged TI-400W-02

**NOTE - HART\_VAR\_CODES**

HART\_VAR\_CODES8 parameters for some Smar WirelessHart equipment. For other equipment not documented here, please consult the manufacturer.

## LD400WH

| Variable |          | Description                                      | Units                                 |
|----------|----------|--|---------------------------------------|
| Number   | Mnemonic |  |                                       |
| 0        | OUT      | Output Variable related to analog output         | Milliamperes (fixed)                  |
| 1        | OUT%     | Ranged Output Variable related to analog output  | Percentage (fixed)                    |
| 2        | PRES     | Primary Variable related to measured pressure    | PV Units (configurable)               |
| 3        | PV%      | Ranged Process Variable                          | Percentage (fixed)                    |
| 4        | PV       | Process Variable in engineering units            | PV Units or User Units (configurable) |
| 5        | TEMP     | Secondary Variable related to sensor temperature | Degrees Celsius (fixed)               |
| 6        | TOT      | Totalization                                     | Total units                           |
| 7        | SP%      | Ranged Setpoint                                  | Percentage (fixed)                    |
| 8        | SP       | Setpoint in engineering units                    | PV Units or User Units (configurable) |
| 9        | ERR%     | Deviation (PV% - SP%)                            | Percentage                            |
| 10       | BAT      | Battery Voltage                                  | Volts (fixed)                         |

## TT400WH

| Variable Number | Mnemonic | Description                              | Units               |
|-----------------|----------|--|---------------------|
| 0               | OUT      | Output Variable related to analog output | Milliampere (fixed) |
| 1               | PV%      | Process Variable in percentage units     | Percent (fixed)     |
| 2               | PV       | Process Variable in engineering units    | PV Unit             |
| 3               | TEMP     | Environment temperature                  | PV Unit             |
| 4               | BACK     | Backup Sensor Value                      | PV Unit             |
| 5               | -        | Not Used                                 | -                   |
| 6               | -        | Not Used                                 | -                   |
| 7               | ADTMP    | Environment Temperature ADC value        | None                |
| 8               | AD23     | Channel 23 ADC value                     | None                |
| 9               | AD34     | Channel 34 ADC value                     | None                |
| 10              | AD24     | Channel 24 ADC value                     | None                |
| 11              | BAT      | Battery Voltage                          | Volt (fixed)        |

## DT400WH

| Variable |          | Description                                      | Units                   |
|----------|----------|--|-------------------------|
| Number   | Mnemonic |  |                         |
| 0        | PV       | Primary Variable related to measured density     | PV Units (configurable) |
| 1        | PV%      | Ranged Process Variable                          | Percentage (fixed)      |
| 2        | SV       | Secondary Variable related to sensor temperature | SV Units (configurable) |
| 3        | BAT      | Battery Voltage                                  | Volts (fixed)           |

TT481WH

| Variable Number | Mnemonic | Description                          | Units          |
|-----------------|----------|--------------------------------------|----------------|
| 0               | SNS1     | Sensor 1 Process Variable            | Sensor PV Unit |
| 1               | SNS2     | Sensor 2 Process Variable            | Sensor PV Unit |
| 2               | SNS3     | Sensor 3 Process Variable            | Sensor PV Unit |
| 3               | SNS4     | Sensor 4 Process Variable            | Sensor PV Unit |
| 4               | SNS5     | Sensor 5 Process Variable            | Sensor PV Unit |
| 5               | SNS6     | Sensor 6 Process Variable            | Sensor PV Unit |
| 6               | SNS7     | Sensor 7 Process Variable            | Sensor PV Unit |
| 7               | SNS8     | Sensor 8 Process Variable            | Sensor PV Unit |
| 8               | ENV      | Environment temperature              | °C (fixed)     |
| 9               | BAT      | Battery Voltage                      | Volt (fixed)   |
| 10              | PERC1    | Sensor 1 Process Variable Percentage | %              |
| 11              | PERC2    | Sensor 2 Process Variable Percentage | %              |
| 12              | PERC3    | Sensor 3 Process Variable Percentage | %              |
| 13              | PERC4    | Sensor 4 Process Variable Percentage | %              |
| 14              | PERC5    | Sensor 5 Process Variable Percentage | %              |
| 15              | PERC6    | Sensor 6 Process Variable Percentage | %              |
| 16              | PERC7    | Sensor 7 Process Variable Percentage | %              |
| 17              | PERC8    | Sensor 8 Process Variable Percentage | %              |

- Configure the **LOCAL\_MOD\_MAP** parameter with the value that the **TBWH** block should have to be used with Modbus. The first **TBWH** has to be configured with **LOCAL\_MOD\_MAP** equals to 0, the second one with 1 and so on up to 99. Refer to Modbus Protocol Support section for further information about Modbus mapping and addressing.

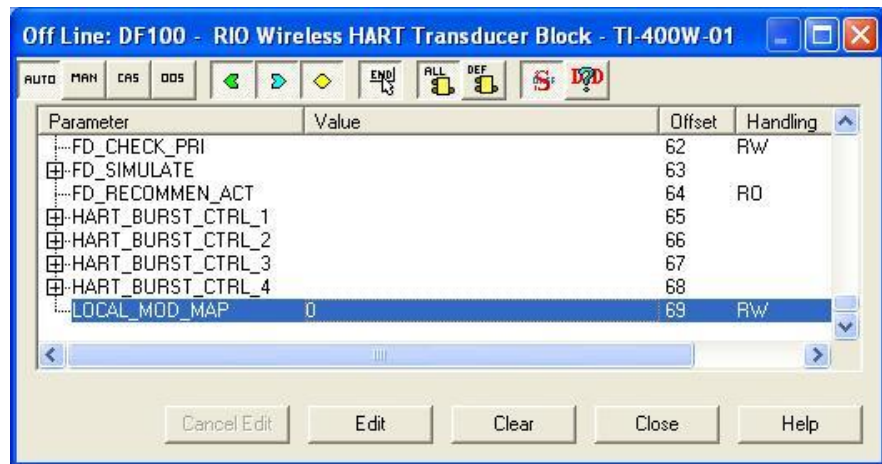


Figure 24. 19 – Configuring the LOCAL\_MOD\_MAP parameter

From now on, we will add to the configuration HSE WIO input function blocks. In the DF100 the **WIO Analog Input (WAI)** and **Multiple Analog Input 16 (MAI16)** blocks are available. These blocks are variations of the HSE WIO for conventional **Analog Input (AI)** and **Multiple Analog Input (MAI)** blocks, respectively. Despite having similar algorithms, the HSE WIO input function blocks have, besides data types specifically designed for the HSE WIO technology, parameters named **CHANNEL\_TAG**. A HSE WIO input function block (such as **WAI** or **MAI16**) uses the **CHANNEL\_TAG** parameter instead of **CHANNEL** parameter to correctly address a HART variable, from a **TBWH** transducer block. Knowing that, besides the already known parameterization steps for the conventional input function blocks, it is necessary to parameterize the **CHANNEL\_TAG** parameters with HART variable names. In other words, the names parameterized for the **CHANNEL\_TAG** can be any names among those parameters parameterized in the **VAR\_NAMES9** parameters of the **TBWH** transducer blocks. Refer to the Function Blocks Manual for additional information on the HSE WIO function blocks, its parameters and parameterization.

For the configuration of this example, add two **WAI** blocks. The addition of the **WAI** blocks is similar to addition of **TBWH** block just described above. Each **WAI** block will address a wireless temperature transmitter (and its data) via **TBWH** transducer block. For each **WAI** of the purposed example, the **CHANNEL\_TAG** is configured with the **VAR\_NAME** assigned to the **HART\_PV** variable (see **TBWH** block parameterization above) of the addressed wireless temperature transmitter. The two following figures demonstrate the **CHANNEL\_TAG** configuration of the **WAI** blocks that will address the temperature transmitters **TI-400W-01** and **TI-400W-02**, respectively.

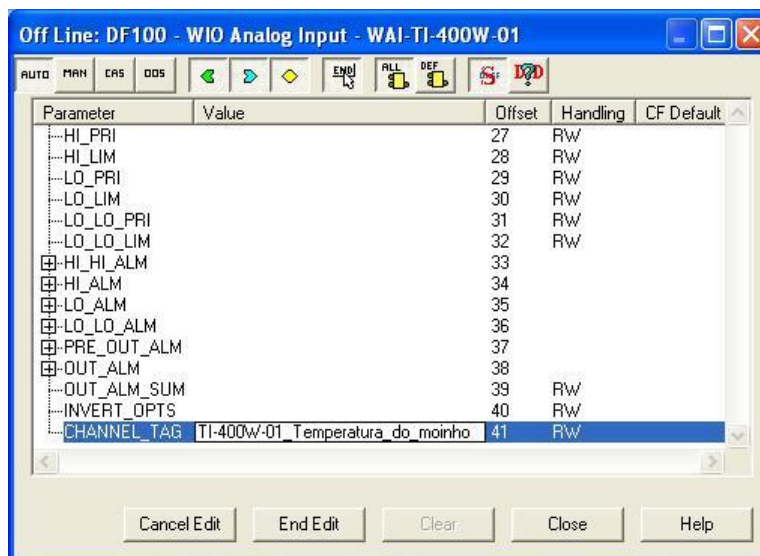


Figure 24. 20 – Configuring the **CHANNEL\_TAG** that addresses the **HART\_PV** of **TI-400W-01**

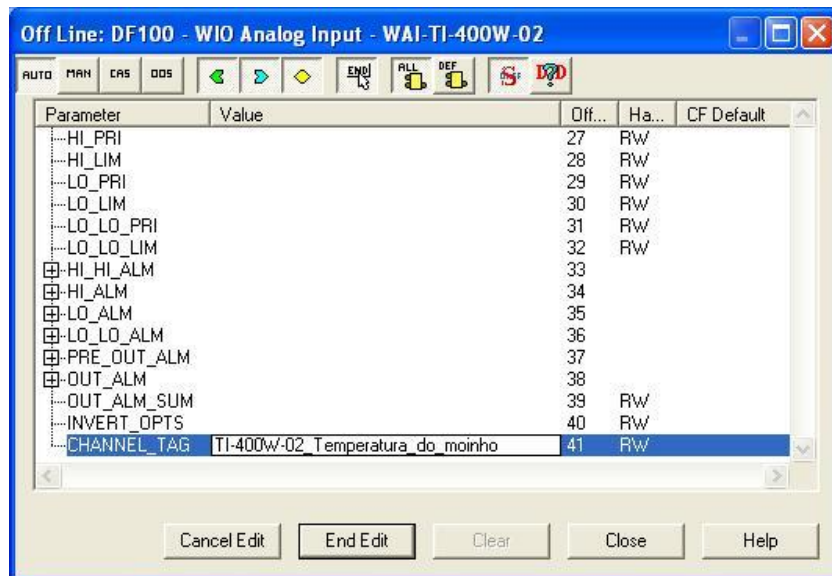


Figure 24. 21 – Configuring the CHANNEL\_TAG that addresses the HART\_PV of TI-400W-02

With the addition of the **WAI** blocks we have finished adding the HSE WIO transducers and function blocks. See the figure below for having a general idea of HSE WIO blocks configured so far.

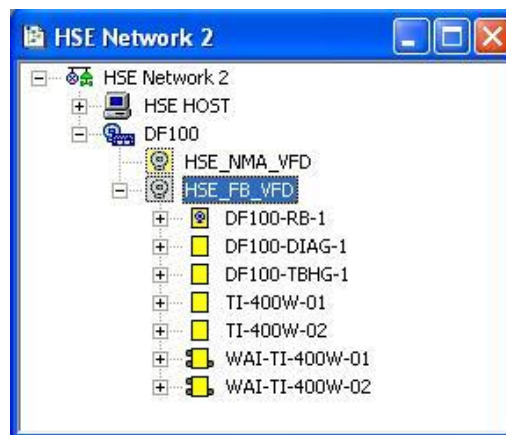


Figure 24. 22 – HSE WIO transducers and function blocks

## Adding Conventional Function Blocks

### Step 6

The user can also add others conventional function blocks, i.e., non-specific HSE WIO ones. For that, in the **New Block** dialog box, select the desired function block in the **Block Type** box, and then, in the **Block Tag** box, give a tag to the block. Click **OK**. The next figure shows the addition of the **ARTH** function block (AR Block).



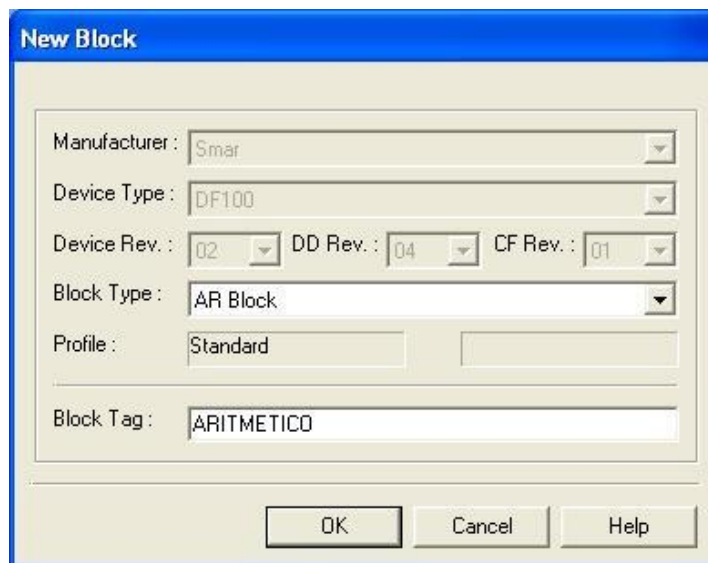


Figure 24. 23 –Adding a conventional function block

For this example, the **ARTH** block complements the strategy and it will be used in the DF100 to calculate the average temperature in the ball mill.

**NOTE**

Only transducer and function blocks were added in the DF100 (*WirelessHART* Gateway). The HART and *WirelessHART* field devices not support function blocks. They are only mapped in the DF100 through **TBWH** transducer blocks.

The configuration with all the function and transducers blocks, conventional or not, is presented in the following figure.

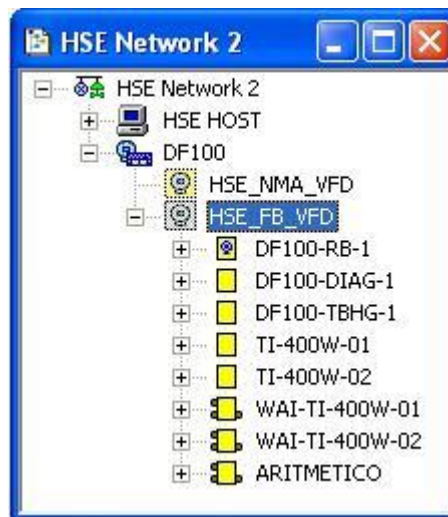


Figure 24. 24 – Complete wireless configuration

Now, the strategy area can be developed (**Application, Logic Plant**). First is necessary to create a new Process Cell.

## Creating New Process Cells

### Step 7

The **Logical Plant** can be divided in several process cells, according to the plant.

To create a new process cell, right-click the **Application** icon, and select **New Process Cell** item.

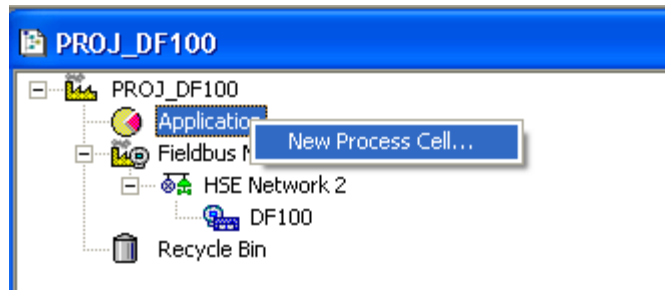


Figure 24. 25 – Inserting a Process Cell

The dialog box to name the **Process Cell** will open:

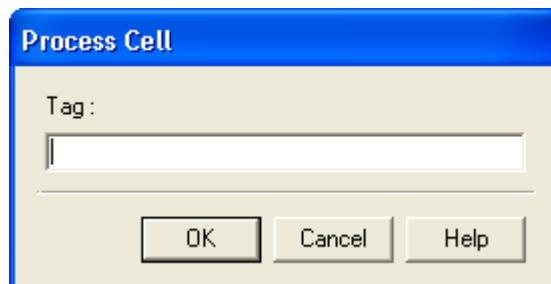


Figure 24. 26 – Attributing tag to the Process Cell

If the user needs name the Process Cell with a specific tag. Enter it in the **Tag** box, and click **OK**. To create more process cells, the procedure above can be repeated.

After inserting the Process Cell, the **PROJ\_DF100** window will be according to the next figure:

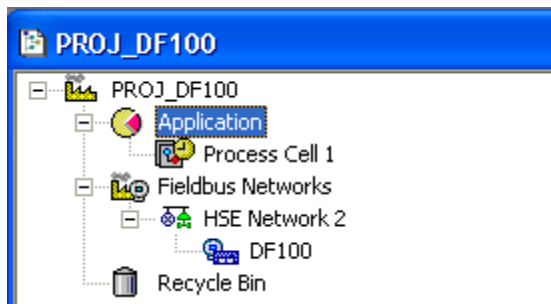


Figure 24. 27 – Area window after inserting the Process Cell

**NOTE**

The user must remember that **Application** is a virtual division. It only divides a large plant. For example: if the plant has two networks, they can be **Process Cells** in the **Syscon**. One **Application** can have several **Process Cells**, but a **Process Cell** cannot be in more than one **Application**.

## Creating a Control Module

### Step 8

Now the user can create a Control Module in the Application section.

Right-click the **Process Cell1** icon, and choose **Expand** item.

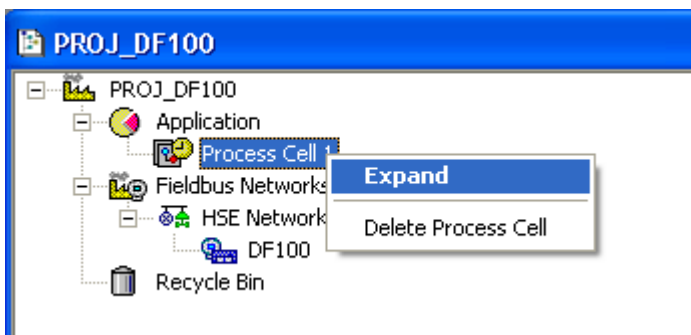


Figure 24. 28 – Creating the Control Module

To arrange the screen, click the **Process Cell 1** window. So, choose **Window** menu on the **Syscon** toolbar, and then **Tile** option.

As following, return to the **Process Cell1** window. Right-click the **Process Cell1** item, and choose **New Control Module**. The figure below shows creating the New Control Module.

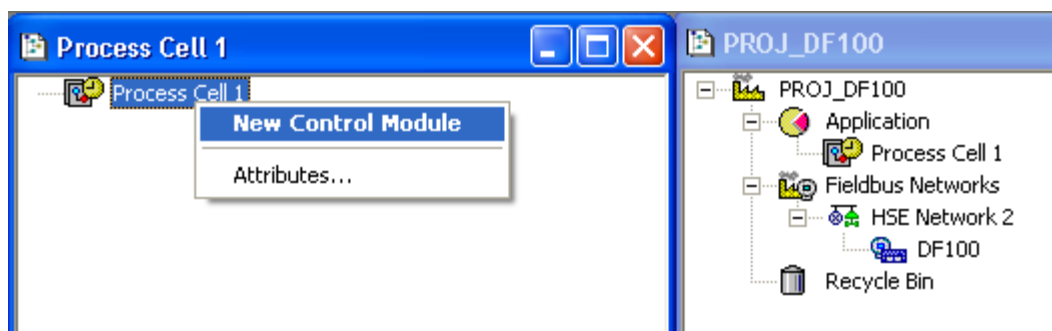


Figure 24. 29 – Creating the New Control Module

The **New Control Module** dialog box will appear. Name it with the tag related to the application. To continue, click **OK**.

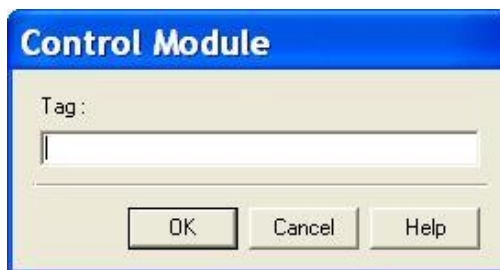


Figure 24. 30 – Attributing tag to the Control Module

**IMPORTANT**

Remember that not all characters are valid when naming the elements with tags.

## Inserting Blocks in the Control Module

### Step 9

Now the user can add function blocks which will participate in the strategy of the mill temperature monitoring in the **Logical Plant**. Right-click the **Control Module 2** item, and choose **Attach Block** option, as shown in the next figure:

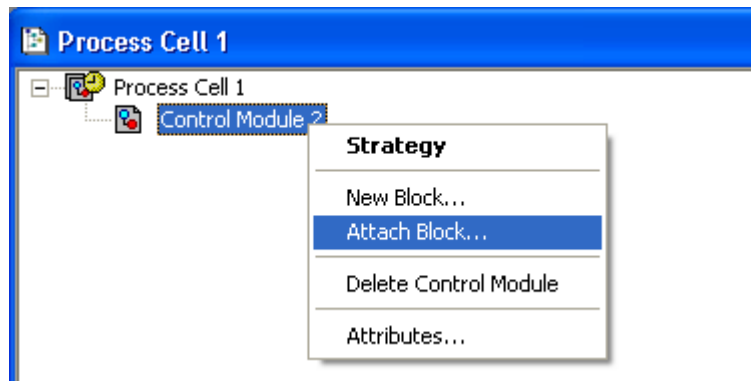


Figure 24. 31 –Adding new functions blocks to the FBAP

The **Attach Block** dialog box will open as shown below:



Figure 24. 32 –Attaching blocks to the Control Module

The available function blocks for the application are shown in the **Attach Block** box. For the aimed strategy, the function blocks that must be inserted will appear in the box. So, select them one by one, and click the **OK** button.

When the **Attach Block** process ends, the application will be as shown in the following figure:

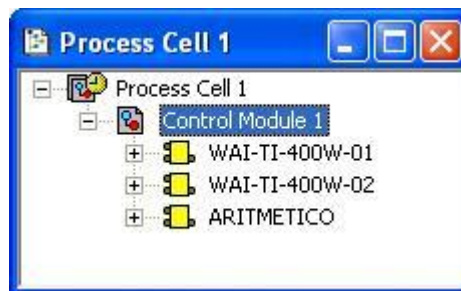


Figure 24. 33 –Blocks added to the Control Module

Another way to attach the blocks is left-clicking the element and drop it to the window.

A new tag can be done to the **Control Module** right-clicking it, and selecting **Attributes**. For the aimed example will be attributed **Temperatura Moinho de Bolas**

## Configuring the Control Strategy

### Step 10

Now the user is ready to develop the control strategy.

First, right-click the **Temperatura Moinho de Bolas** icon, and select **Strategy**. The **Strategy** window will appear as shown in the following figure.



**Figure 24. 34 –Strategy window**

It is recommended to minimize the strategy window. Thus, it is possible to see the whole area.

The strategy window offers several tools for drawing. Refer to the **Syscon** manual for further details.

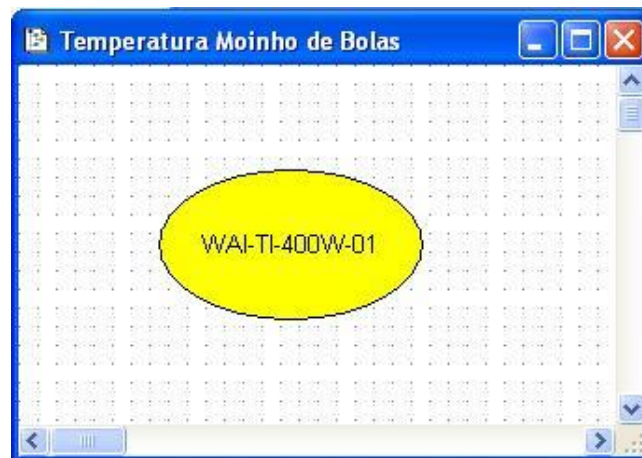
## Adding Blocks to the Strategy window

### Step 11

Now the function blocks can be added to the **Temperatura Moinho de Bolas** window.

In order to get this, click the first block, **WAI-TI-400W-01**, and drop it into the strategy window. A function block will be automatically created.

The next figure shows the function block added to the strategy window:



**Figure 24. 35 –Block inserted into the strategy window**

Repeat the drag-and-drop procedure for the other blocks **WAI-TI-400W-02** and **ARITMETICO**.

## Linking the Blocks

### Step 12

There is a specific tool to link the blocks, the **Link** button, , on the **Strategy** toolbar.

Click this button on the toolbar, and then in the **WAI-TI-400W-01** function block. The dialog box for linking the input and output parameters will appear. Select **OUT**, and then click the **OK** button as shown in the following figure.

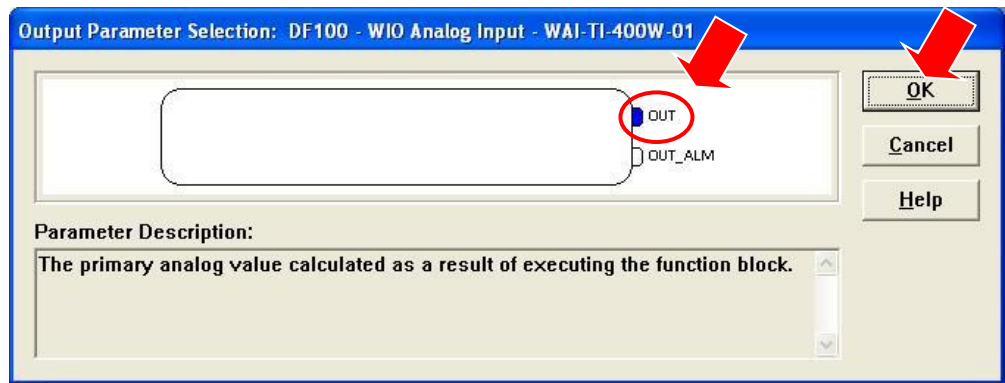


Figure 24. 36 –Linking the Function Blocks

Move the mouse cursor up to the block that will be linked.

The user also does the fast link procedure just right-clicking the function block. The links necessary for this strategy are:

**Direct Links:**

- OUT(WAI-TI-400W-01) → IN\_1(ARITMETICO)
- OUT(WAI-TI-400W-02) → IN\_2(ARITMETICO)

After linking the parameters specified above, the strategy window will be as shown in the following figure:

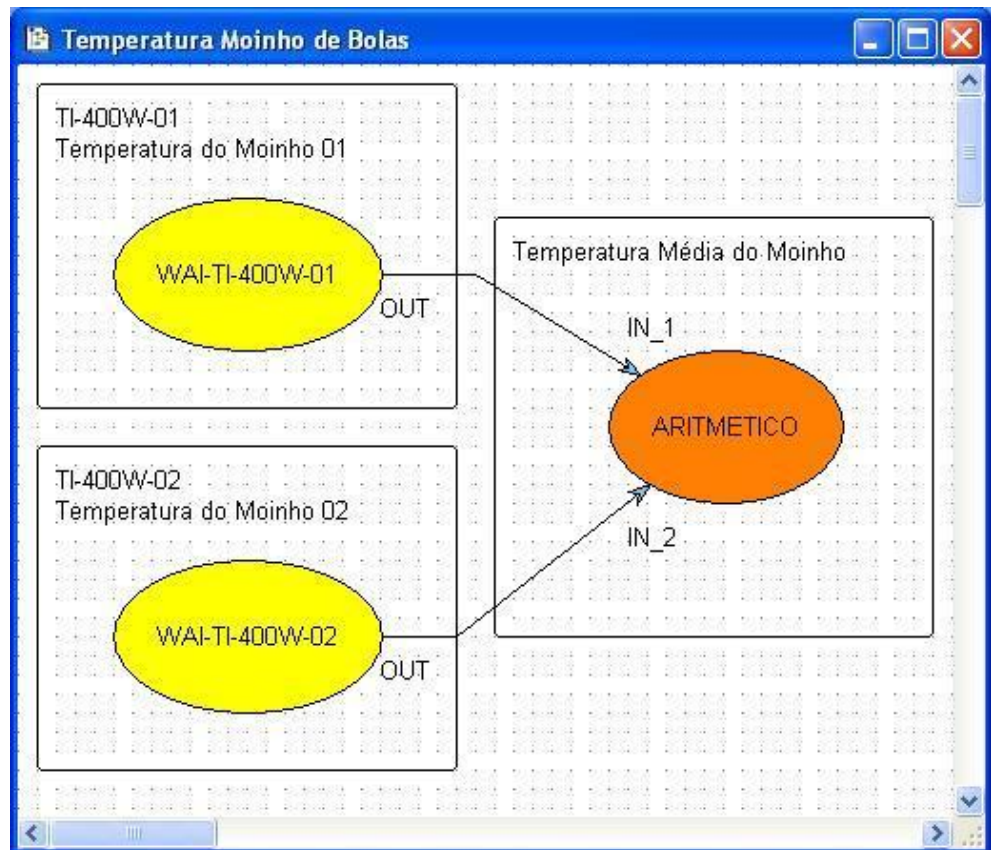


Figure 24. 37 –Links between the Function Blocks

## Function Block Characterization

### Step 13

The function blocks that are in the strategy must be set according to the application for them. So, it is necessary to do the block characterization.

The online and offline modes are possible for the block characterization. In the offline mode, the parameters are set before starting the communication between the devices. The online characterization is executed directly in the devices when the plant is already communicating.

To change the function block parameters, consider the following steps:

Select the block to characterize. Right-click it, and select the **Off Line Characterization** option, or double-click it. The following figure shows the block that is being done the offline characterization:

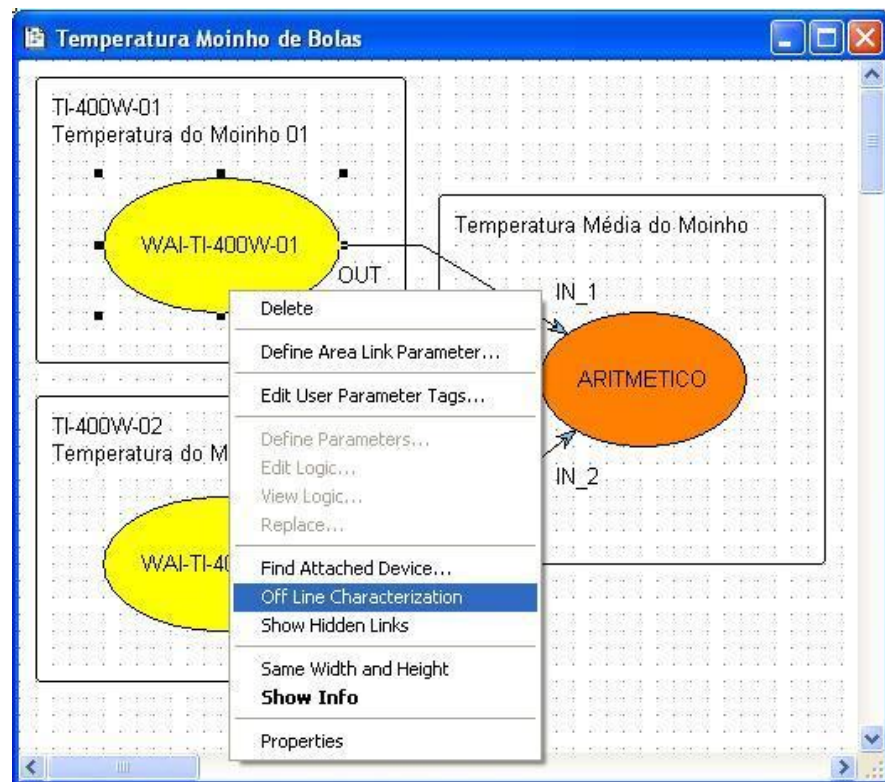


Figure 24. 38 –Offline characterization in the Strategy window

The **Off Line Characterization** dialog box will appear:

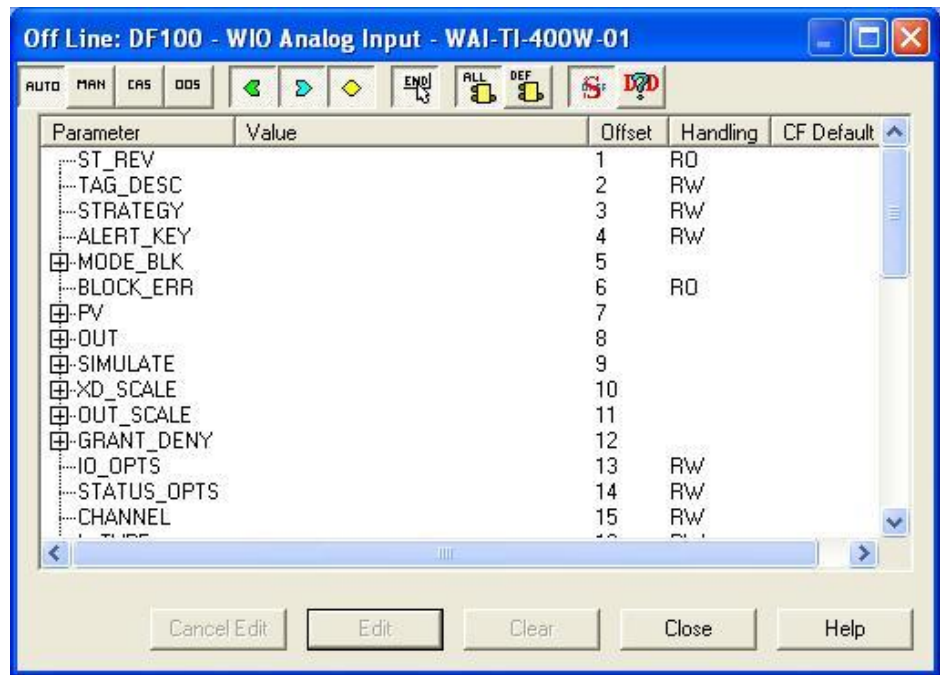


Figure 24. 39 –Offline characterization in the function block

Double-click at the right side of the parameter to change it. Another option is click it once, and then in **Edit** to start editing the parameter value. At the ending, click **End Edit**.

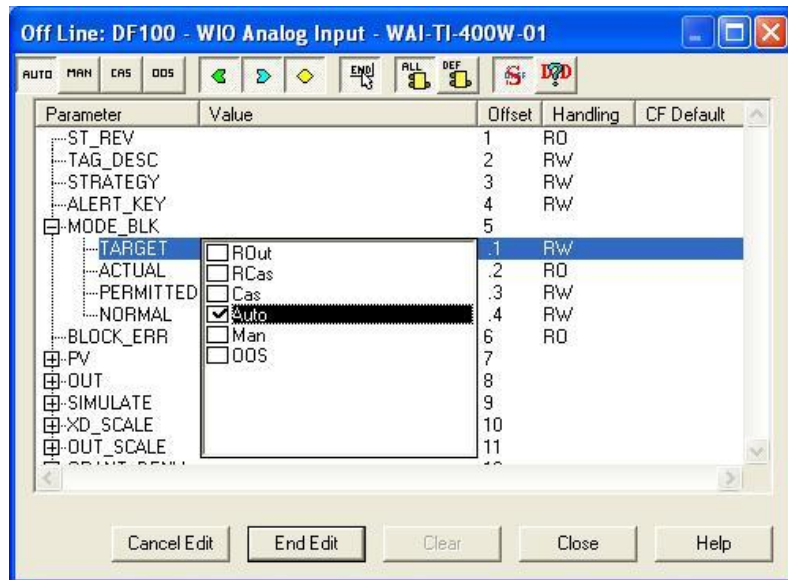



Figure 24. 40 –Editing the parameter in the Function Block Characterization box

The following list shows the parameters that must be set for this area:



| DEVICE               | TAG   | BLOCK          | PARAMETER  |
|----------------------|-------|----------------|--|
| DF100                | DF100 | DF100-RB-1     | MODE_BLK.Target = AUTO   |
|                      |       | DF100-DIAG-1   | MODE_BLK.Target = AUTO   |
|                      |       | DF100-TBHG-1   | MODE_BLK.Target = AUTO   |
|                      |       | TI-400W-01     | MODE_BLK.Target = AUTO   |
|                      |       |                | HART_EXPD_DEV_INFO.<br>HART_VERSION = 7<br>NUM_OF_PROCESS_VARIABLES = 12<br>HART_DD_REVISION = 0<br>HART_DEVICE_REVISION = 2<br>HART_DEVICE_TYPE = 15881<br>MANUFACTURER_ID = 62<br>DISTRIBUTOR_ID = 62<br>ANALOG_DISABLE = Unused<br>DEVICE_PROFILE = 129 |
|                      |       |                | VAR_NAMES9[1] = TI-400W-01_Temperatura_do_moinho   |
|                      |       |                | LOCAL_MOD_MAP = 0  |
|                      |       | TI-400W-02     | MODE_BLK.Target = AUTO   |
|                      |       |                | HART_EXPD_DEV_INFO.<br>HART_VERSION = 7<br>NUM_OF_PROCESS_VARIABLES = 12<br>HART_DD_REVISION = 0<br>HART_DEVICE_REVISION = 2<br>HART_DEVICE_TYPE = 15881<br>MANUFACTURER_ID = 62<br>DISTRIBUTOR_ID = 62<br>ANALOG_DISABLE = Unused<br>DEVICE_PROFILE = 129 |
|                      |       |                | VAR_NAMES9[1] = TI-400W-02_Temperatura_do_moinho   |
|                      |       |                | LOCAL_MOD_MAP = 1  |
|                      |       | WAI-TI-400W-01 | MODE_BLK.Target = AUTO   |
|                      |       |                | CHANNEL_TAG = TI-400W-01_Temperatura_do_moinho   |
|                      |       | WAI-TI-400W-02 | MODE_BLK.Target = AUTO   |
|                      |       |                | CHANNEL_TAG = TI-400W-02_Temperatura_do_moinho   |
|                      |       | ARITMETICO     | MODE_BLK.Target = AUTO   |
| ARITH_TYPE = Average |       |                |  |

After the parameter setting, the user can start the device communication. It is necessary commissioning the DF100. If this procedure is not executed, the **Syscon** will detect the not commissioned controller and the download for this device will be aborted. Finishing the commissioning, the download process can start. The download process can be executed, for

example, returning to the **PROJ\_DF100** window, right-clicking the **Fieldbus Networks** icon, , and selecting the **Download** option. For further details about the available download types, refer to the **Syscon** manual.

## DF100 conventional function blocks

- Resource (RS2)
- Diagnostic transducer block (DIAG)

### Control and calculation function blocks

- PID Control (PID)
- Enhanced PID control (EPID)
- Advanced PID control (APID)
- Arithmetic (ARTH)
- Splitter (SPLT)
- Enhanced signal characterizer (ECHAR)
- Integrator (INTG)
- Enhanced analog alarm (EAALM)
- Input selector (ISEL)
- Setpoint ramp generator (SPG)

- Enhanced setpoint ramp generator (ESPG)
- Timer and logic (TIME)
- Lead lag (LLAG)
- Output signal selector and dynamic limiter (OSDL)
- Constant and contained RW (CTRW)
- Flip-flop and edge trigger (FFET)
- Analog data transfer (ADT)
- Discrete data transfer (DDT)

### ***DF100 specific blocks***

Listed below are the blocks defined specifically for DF100. For additional information about them see Library B Function Blocks Instruction Manual.

- Transducer Block for HART Gateway (TBHG)
- Transducer Block for WirelessHART (TBWH)
- ROM Analog Input (ROMAI)
- 16 Multiple Analog Input (MAI16)

## Modbus Protocol Support

### Supported Characteristics

- RS-485 port: physical level EIA-485, Modbus RTU, characteristics configured in the **MBCF** block
  - BAUD\_RATE: up to 19.2 Kbps
  - STOP\_BITS: 1 or 2
  - PARITY: Even, odd or none
  - MASTER\_SLAVE: Master or Slave
- ETH1 and ETH2 ports: physical level Ethernet TCP/IP, Modbus TCP/IP
  - Modbus TCP/IP : multimaster protocol
  - ETH1: DF100 can perform simultaneously the role of master and slave, and it is not necessary configuration
  - ETH2: DF100 performs only slave role
- Bypass: bridge functionality, conversion of the physical level. When the RS-485 port is configured as Master, Modbus commands sent via TCP / IP to the IP Address of a given controller, but whose ID is different from of this DF100, the command is retransmitted on the RS-485 port and the response that comes to this port will be retransmitted to the Ethernet port.
- The DF100 address on the Modbus network is configured in the **MBCF** block, **DEVICE\_ADDRESS** parameter. This device identifier (ID) is the same of the three ports (RS-485, ETH1 and ETH2).
- It is possible to configure the registers swap through **MBCF** block, **RTS\_CTS** parameter, and it is applicable to all ports (RS-485, ETH1 and ETH2).  
Exemplifying the functionality of the registers swap, the order of bytes in the Modbus message is the following if the swap was not configured (**RTS\_CTS** = False)  
101.325 = 0x42 (MSB) 0xCA 0xA6 0x66 (LSB)  
Register 402.601 = 0xA6 0x66  
Register 402.602 = 0x42 0xCA  
In the response message in which the two registers were requested we have:  
0xA6 0x66 0x42 0xCA  
  
If configured to perform swap of registers (**RTS\_CTS** = True) we have:  
Register 402.601 = 0x42 0xCA  
Register 402.602 = 0xA6 0x66  
In the response message in which the two registers were requested we have:  
0x42 0xCA 0xA6 0x66
- Types of standard commands supported as master and slave:

| FUNCTION CODE | DESCRIPTION  |
|---------------|--|
| 03            | Reading of a Holding Registers range (reading and writing variables) |
| 04            | Reading of an Input Registers range (reading variables)              |
| 06            | Writing in a single Holding Register                                 |
| 16            | Writing in a Multiple Registers range                                |

- Native mapping: Variables mapped to Modbus regardless of configuration. Field devices variables are mapped to Modbus variables in Input Register (read only) or Holding Register (reading and writing). See the item "Native Mapping" for details.
- Configured mapping: By configuring the MBCS Modbus block, you could map some block parameters of the DF100 (aiming at an addresses sequence, and so use the reading or writing commands in registers range) as Holding Register.

### Native mapping

#### Mapped variables

Several **TBWH** block parameters of the DF100 are mapped to Modbus. In other words, as the **TBWH** maps field devices, a variable set of each field device is mapped to Modbus. For each instantiated **TBWH** block whose **LOCAL\_MOD\_MAP** parameter is properly parameterized<sup>4</sup>, the following parameters / variables are available to Modbus:

<sup>4</sup> The valid values interval for the **LOCAL\_MOD\_MAP** parameter is defined in the Parameters description of the **TBWH** block.

- **TBWH** block tag
- FD\_SIMULATE;
- LIVE\_LIST\_ST;
- HART\_PV;
- HART\_SV;
- HART\_TV;
- HART\_QV;
- HART\_5V;
- HART\_6V;
- HART\_7V;
- HART\_8V;
- PRIMARY\_VALUE
- VAR\_UNITS9;
- HART\_VAR\_CODES8.

| NOTES  |
|--|
| 1. All bits of Field Diagnostics are mapped. See definition of Field Diagnostics for DF100.              |
| 2. For <b>HART_PV</b> to <b>HART_8V</b> and <b>PRIMARY_VALUE</b> variables, Status and Value are mapped. |

**Discrete Inputs Variables**

The Modbus address for any discrete input variable can be calculated by the following equation.

$$EndereçoModbusDI = 104.001 + LOCAL\_MOD\_MAP * 50 + Offset$$

Where:

- **EndereçoModbusDI**: Modbus address of the discrete input variable.
- **LOCAL\_MOD\_MAP**: value of the same name parameter that was configured by user in the **TBWH** block.
- **Offset**: displacement of the variable with respect to the base address

The following table presents the DF100 discrete input variables that are mapped to Modbus, as well as its respective offsets, lengths (in bits), and Modbus addresses.

|  |  | NOTE  |  |  |  |  |  |  |  |  |  |  |  |  |
|--|--|---|--|--|--|--|--|--|--|--|--|--|--|--|
|  |  | The Modbus addresses were calculated for few <b>LOCAL_MOD_MAP</b> values. If you need the Modbus address of any other discrete input variable whose <b>LOCAL_MOD_MAP</b> is not on the table, use the above equation to calculate it. |  |  |  |  |  |  |  |  |  |  |  |  |

| Discrete Input Variable | Number of Bits | Offset | LOCAL_MOD_MAP |        |        |        |        |        |        |        |        |        |        |        |  |
|-------------------------|----------------|--------|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--|
|                         |                |        | 0             | 1      | 2      | 3      | 4      | 5      | 10     | 20     | 30     | 40     | 50     | 99     |  |
| FD_SIMULATE             | 32             | 0      | 104001        | 104051 | 104101 | 104151 | 104201 | 104251 | 104501 | 105001 | 105501 | 106001 | 106501 | 108951 |  |
| LIVE_LIST_ST            | 1              | 32     | 104033        | 104083 | 104133 | 104183 | 104233 | 104283 | 104533 | 105033 | 105533 | 106033 | 106533 | 108983 |  |

### Input Register Variables

The Modbus address for any input register variable can be calculated by the following equation.

$$\text{EndereçoModbusIR} = 300.001 + \text{LOCAL\_MOD\_MAP} * 80 + \text{Offset}$$

Where:

- **EndereçoModbusIR:** Modbus address of the input register variable.
- **LOCAL\_MOD\_MAP:** value of the same name parameter that was configured by user in the TBWH block.
- **Offset:** displacement of the variable with respect to the base address

The following table presents the DF100 input register variables that are mapped to Modbus, as well as its respective offsets, lengths (in bits), and Modbus addresses.

**NOTE**

The Modbus addresses were calculated for few **LOCAL\_MOD\_MAP** values. If you need the Modbus address of any other input register variable whose **LOCAL\_MOD\_MAP** is not on the table, use the above equation to calculate it.

| Input Register Variable | Number of Registers | Offset | LOCAL_MOD_MAP |        |        |        |        |        |        |        |        |        |        |        |
|-------------------------|---------------------|--------|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
|                         |                     |        | 0             | 1      | 2      | 3      | 4      | 5      | 10     | 20     | 30     | 40     | 50     | 99     |
| HART_PV.Status          | 1                   | 0      | 300001        | 300081 | 300161 | 300241 | 300321 | 300401 | 300801 | 301601 | 302401 | 303201 | 304001 | 307921 |
| HART_PV.Value           | 2                   | 1      | 300002        | 300082 | 300162 | 300242 | 300322 | 300402 | 300802 | 301602 | 302402 | 303202 | 304002 | 307922 |
| HART_SV.Status          | 1                   | 3      | 300004        | 300084 | 300164 | 300244 | 300324 | 300404 | 300804 | 301604 | 302404 | 303204 | 304004 | 307924 |
| HART_SV.Value           | 2                   | 4      | 300005        | 300085 | 300165 | 300245 | 300325 | 300405 | 300805 | 301605 | 302405 | 303205 | 304005 | 307925 |
| HART_TV.Status          | 1                   | 6      | 300007        | 300087 | 300167 | 300247 | 300327 | 300407 | 300807 | 301607 | 302407 | 303207 | 304007 | 307927 |
| HART_TV.Value           | 2                   | 7      | 300008        | 300088 | 300168 | 300248 | 300328 | 300408 | 300808 | 301608 | 302408 | 303208 | 304008 | 307928 |
| HART_QV.Status          | 1                   | 9      | 300010        | 300090 | 300170 | 300250 | 300330 | 300410 | 300810 | 301610 | 302410 | 303210 | 304010 | 307930 |
| HART_QV.Value           | 2                   | 10     | 300011        | 300091 | 300171 | 300251 | 300331 | 300411 | 300811 | 301611 | 302411 | 303211 | 304011 | 307931 |
| HART_5V.Status          | 1                   | 12     | 300013        | 300093 | 300173 | 300253 | 300333 | 300413 | 300813 | 301613 | 302413 | 303213 | 304013 | 307933 |
| HART_5V.Value           | 2                   | 13     | 300014        | 300094 | 300174 | 300254 | 300334 | 300414 | 300814 | 301614 | 302414 | 303214 | 304014 | 307934 |
| HART_6V.Status          | 1                   | 15     | 300016        | 300096 | 300176 | 300256 | 300336 | 300416 | 300816 | 301616 | 302416 | 303216 | 304016 | 307936 |
| HART_6V.Value           | 2                   | 16     | 300017        | 300097 | 300177 | 300257 | 300337 | 300417 | 300817 | 301617 | 302417 | 303217 | 304017 | 307937 |
| HART_7V.Status          | 1                   | 18     | 300019        | 300099 | 300179 | 300259 | 300339 | 300419 | 300819 | 301619 | 302419 | 303219 | 304019 | 307939 |
| HART_7V.Value           | 2                   | 19     | 300020        | 300100 | 300180 | 300260 | 300340 | 300420 | 300820 | 301620 | 302420 | 303220 | 304020 | 307940 |
| HART_8V.Status          | 1                   | 21     | 300022        | 300102 | 300182 | 300262 | 300342 | 300422 | 300822 | 301622 | 302422 | 303222 | 304022 | 307942 |
| HART_8V.Value           | 2                   | 22     | 300023        | 300103 | 300183 | 300263 | 300343 | 300423 | 300823 | 301623 | 302423 | 303223 | 304023 | 307943 |
| PRIMARY_VALUE.Status    | 1                   | 24     | 300025        | 300105 | 300185 | 300265 | 300345 | 300425 | 300825 | 301625 | 302425 | 303225 | 304025 | 307945 |
| PRIMARY_VALUE.Value     | 2                   | 25     | 300026        | 300106 | 300186 | 300266 | 300346 | 300426 | 300826 | 301626 | 302426 | 303226 | 304026 | 307946 |
| BLOCK_TAG               | 16                  | 27     | 300028        | 300108 | 300188 | 300268 | 300348 | 300428 | 300828 | 301628 | 302428 | 303228 | 304028 | 307948 |
| VAR_UNITS9              | 9                   | 43     | 300044        | 300124 | 300204 | 300284 | 300364 | 300444 | 300844 | 301644 | 302444 | 303244 | 304044 | 307964 |

### Holding Register Variables

The Modbus address for any holding register variable can be calculated by the following equation.

$$\text{EndereçoModbusHR} = 404.001 + \text{LOCAL\_MOD\_MAP} * 20 + \text{Offset}$$

Where:

- **EndereçoModbusHR**: Modbus address of the holding register variable.
- **LOCAL\_MOD\_MAP**: value of the same name parameter that was configured by user in the **TBWH** block.
- **Offset**: displacement of the variable with respect to the **TBWH** base address

The following table presents the DF100 holding register variables that are mapped to Modbus, as well as its respective offsets, lengths (in bits) and Modbus addresses.

| NOTE  |  |
|---|--|
| The Modbus addresses were calculated for few <b>LOCAL_MOD_MAP</b> values. If you need the Modbus address of any other holding register variable whose <b>LOCAL_MOD_MAP</b> is not on the table, use the above equation to calculate it. |  |

| Holding Register Variable | Number of Registers | Offset | LOCAL_MOD_MAP |        |        |        |        |        |        |        |        |        |        |        |  |
|---------------------------|---------------------|--------|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--|
|                           |                     |        | 0             | 1      | 2      | 3      | 4      | 5      | 10     | 20     | 30     | 40     | 50     | 99     |  |
| HART_VAR_CODE S8          | 8                   | 0      | 404001        | 404021 | 404041 | 404061 | 404081 | 404101 | 404201 | 404401 | 404601 | 404801 | 405001 | 405981 |  |

### General notes about Native Addressing

- If the requested register in Modbus commands involves (exclusively or not) reserve address, the DF100 will respond with a zero value for such register.
- The Modbus of DF100 is based on version known as **Combined Scenario**. Thus, the DF100 allows enabling / disabling the swap of variable registers of float type through the **RTS\_CTS** parameter of Modbus **MBCF** block.
- The Modbus addresses, of any available Modbus point at DF100, may also be consulted through the information page of the DF100 Web Server - see next figure. After launching it, if necessary, use the arrows of decreasing or increasing advancement to determine the desired value for the **LOCAL\_MOD\_MAP**. Once you determine the value of **LOCAL\_MOD\_MAP**, Modbus addresses will be automatically updated.

Welcome to DF100 Webserver TAG: DF100\_WHG Serial number: 8

SMAR LOCAL\_MOD\_MAP (Informative)

SMAR Information Setup Device Info WirelessHART Network Manager Modbus **Addresses**

<< < 0 > >>

**Input Register**

| Variable             | Num. of Regs. | Offset | Modbus Address |
|----------------------|---------------|--------|----------------|
| HART_PV.Status       | 1             | 0      | 300001         |
| HART_PV.Value        | 2             | 1      | 300002         |
| HART_SV.Status       | 1             | 3      | 300004         |
| HART_SV.Value        | 2             | 4      | 300005         |
| HART_TV.Status       | 1             | 6      | 300007         |
| HART_TV.Value        | 2             | 7      | 300008         |
| HART_QV.Status       | 1             | 9      | 300010         |
| HART_QV.Value        | 2             | 10     | 300011         |
| HART_SV.Status       | 1             | 12     | 300013         |
| HART_SV.Value        | 2             | 13     | 300014         |
| HART_6V.Status       | 1             | 15     | 300016         |
| HART_6V.Value        | 2             | 16     | 300017         |
| HART_7V.Status       | 1             | 18     | 300019         |
| HART_7V.Value        | 2             | 19     | 300020         |
| HART_8V.Status       | 1             | 21     | 300022         |
| HART_8V.Value        | 2             | 22     | 300023         |
| PRIMARY_VALUE.Status | 1             | 24     | 300025         |
| PRIMARY_VALUE.Value  | 2             | 25     | 300026         |
| BLOCK_TAG            | 16            | 27     | 300028         |
| VAR_UNITS9           | 9             | 43     | 300044         |

**Discrete Input**

| Variable     | Num. of Bits | Offset | Modbus Address |
|--------------|--------------|--------|----------------|
| FD_SIMULATE  | 32           | 0      | 104001         |
| LIVE_LIST_ST | 1            | 32     | 104033         |

**Holding Register**

| Variable        | Num. of Regs. | Offset | Modbus Address |
|-----------------|---------------|--------|----------------|
| HART_VAR_CODES8 | 8             | 0      | 404001         |

Figure 24. 41 – Web page with Modbus addresses for LOCAL\_MOD\_MAP equals to zero

## Modbus Combined Scenario

The DF100 supports the **Modbus Combined Scenario**, in which it is able to perform the role as master and slave simultaneously via Modbus TCP / IP regardless of any configuration.

The selection between master and slave would only apply to the RS-485 port, which could be communicating simultaneously to the Modbus TCP / IP on ETH1 and ETH2 ports.

# ADDING REDUNDANCY TO THE DFI302 HSE CONTROLLERS

## Introduction

To meet the requirements for fault tolerance, system availability and safety of the industrial process, the following DFI302 HSE controllers support redundancy: DF62, DF63, DF73, DF75, DF89, DF95 and DF97.

The Hot Standby redundancy strategy is used when the Primary controller executes all tasks, and the Secondary controller is the one that, continuously synchronized with the Primary, keeps ready to assume the process in case the Primary controller fails. This event, where the Secondary assumes the process by changing its function to Primary, is also called switch over, and occurs in a bumpless and autonomous way.

In those controllers the redundancy is Device D-3 type, in compliance with the specification “High Speed Ethernet (HSE) Redundancy Specification FF-593” of Fieldbus Foundation. By this capacity (Device D-3), during the entire operation time, the controller pair is seen as a single device by the configurator. Thus, actions as commissioning, decommissioning, configuration download, and parameterizations affect both controllers (Primary and Secondary).

The different failures types, such as failures in the communication ports, are indicated even if occur in the Secondary, this allows proactive maintenance and thus ensure the redundancy availability.

This new generation of Hot Standby redundancy of the DFI302 HSE controllers brings better diagnostic and failure detection capacities, autonomy during startup and transparency for the configuration tools.

### IMPORTANT

The characteristics described in this section are valid for DF62, DF63, DF73, DF75, DF89, DF95, and DF97 controllers, except the information related to the FOUNDATION™ fieldbus H1 channels which are only applied to the DF62 and DF63 controllers.

It is assumed that the user is familiar with **Studio302** and **Syscon**. For further information, refer to the respective manuals.

## Hot Standby Redundancy

With the Hot Standby redundancy full redundancy is achieved, heavily improving the fault tolerance, plant availability and safety. All the controller functionalities and databases have redundancy:

1. Device redundancy (Hardware redundancy);
2. Network redundancy (or LAN redundancy, for controllers with two Ethernet ports – DF63, DF73, DF75, DF89, DF95, and DF97);
3. Ethernet Gateway ↔ 4 FOUNDATION fieldbus H1 ports;
4. Link Active Scheduler (LAS) in the FOUNDATION fieldbus H1 channels;
5. Controller (running function blocks, including FFB/ Ladder logic);
6. Supervision;
7. Modbus Gateway ↔ 4 FOUNDATION fieldbus H1 ports;
8. Synchronism channel redundancy.

The procedures for configuration and maintenance are as simple as for a non-redundant system, saving time to get the system running. Only one configuration download is necessary to configure the redundant pair. And in case of replacement of a failed controller none configuration download or user intervention is necessary. The new module inserted is automatically recognized, receiving the whole configuration from the controller in operation.



## Preparing a Redundant System

In order to have a true redundant system, not just all the devices must be redundant but also the entire system architecture must be designed as redundant. The more elements with redundancy ability the system have, better reliability and availability can be achieved. A typical redundant architecture based on DFI302 controllers can be seen in the next figure.

### Ethernet network architectures

In the following topics are presented the Ethernet network architectures required for the controllers with two Ethernet ports (DF63, DF73, DF75, DF89, DF95, and DF97), and also for the DF62 which have one Ethernet port and requires a different network architecture.

In both cases the IP address of the controllers and network cards must follow the Class C (subnet mask 255.255.255.0), which means that all IP addresses on the same subnet must have the first three bytes equal.

For reference purpose, in each pair of controllers, we designate one of them as **A** and another one as **B**. It may be associated with the controllers’ position in the panel. For example, the controllers on the left side are “A”, and the controllers on the right side are “B”. This designation (A and B) is an important reference for some of the procedures in this section, as well as for documentation of the controllers IP list. This is a static identification, different from the controllers function (Primary / Secondary) which is a dynamic state of the pair and can take any sequence depending on the failures that may cause a switch over.

#### IMPORTANT

It is highly recommended that the automation Ethernet networks are physically separated from other networks such as the corporate network, of common use. This is necessary to guarantee the safety and good operation of the automation Ethernet network.

### Network architecture for controllers with two Ethernet ports

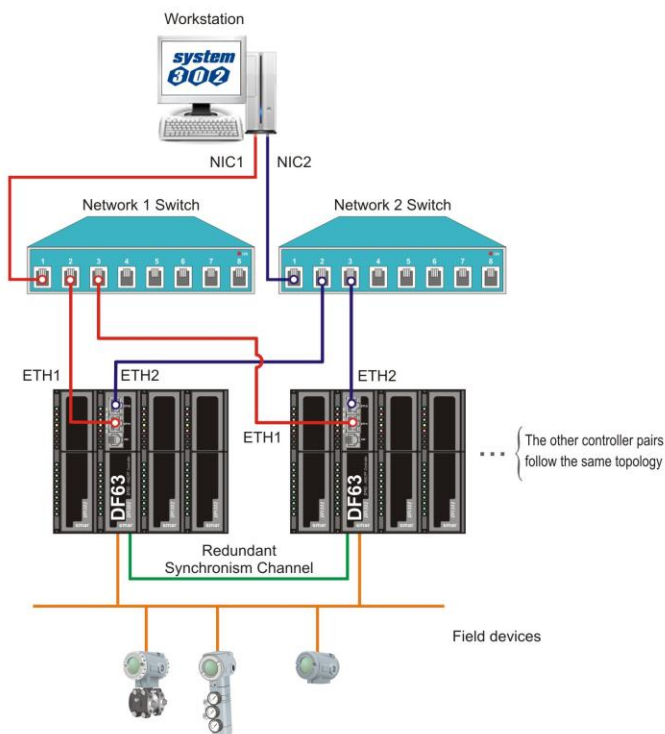


Figure 25. 1 – Network architecture for controllers with two Ethernet ports

In the Figure 25.1 are presented the network requirements, detailed as follows:

- For controllers with two Ethernet ports, the networks' nodes have to be equal (the last byte of IP addresses must be equals). For the ETH1 port must be used one subnet, and for the ETH2 port must be used another subnet.  
Example: the first DF63 port (ETH1) = 192.168.164.34, the second DF63 port (ETH2) = 192.168.165.34.  
This way, there will be two subnets: 192.168.164.X (red network) and 192.168.165.X (blue network), the first serves all ETH1 ports, and the second serves all ETH2 ports of all the controllers. These two subnets must be designed to be physically separated, using different network elements.
- The workstations must have two network cards (NIC1 and NIC2) and each one must have the IP configured in one of the subnets as explained previously. Example: NIC1 = 192.168.164.250 and NIC2 = 192.168.165.250.

This way, for controllers with two Ethernet ports, using the network architecture described the network redundancy is obtained. Thus, a failure that affects one of the network segments will be covered by the network redundancy, adopting the other network path which was not affected by the failure.

### Network architecture for the DF62 controller

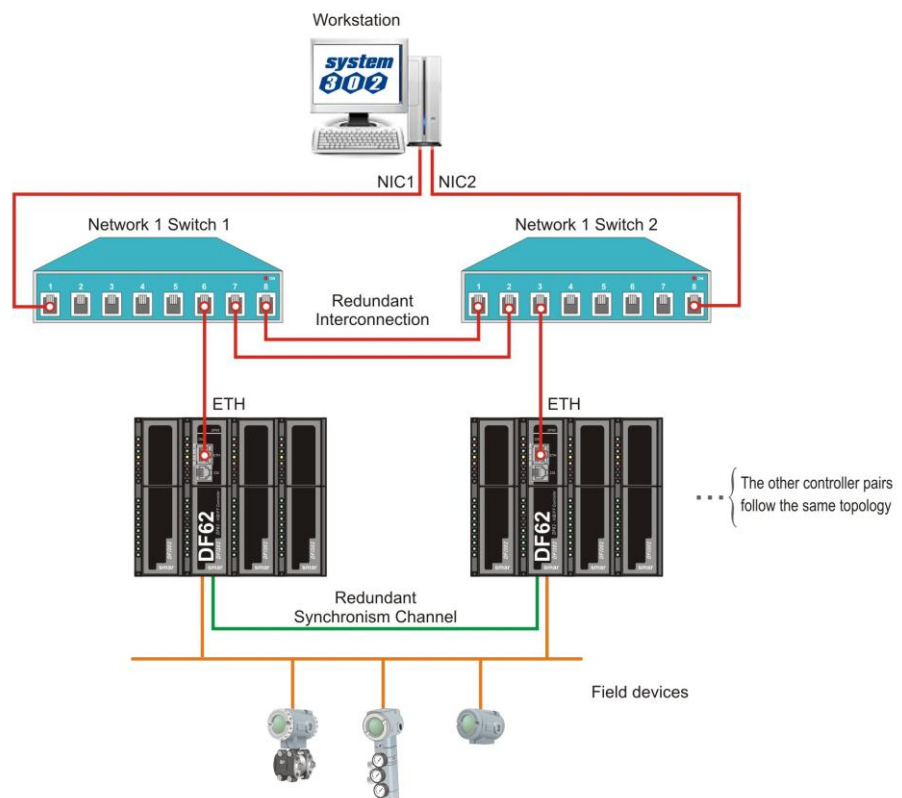


Figure 25. 2 – Network architecture for the DF62 controller

In the Figure 25.2 are presented the network requirements when using the DF62, detailed as follows:

- Just one subnet must be used (in the figure above the red network represents only one subnet). Example: all IP addresses in the range 192.168.164.X (only the last byte changes). But two switches and two network cards must be used (NIC1 and NIC2), because this way we still have redundancy on the network segments between workstations and switches.

- The network cards may have any IP addresses, but necessarily in the same subnet.  
E.g.: NIC1 = 192.168.164.250 and NIC2 = 192.168.164.251.
- The controllers A must be connected to the *switch* 1 and the controllers B must be connected to the *switch* 2 (see Figure 25.2). That is, for each controller pair, one of the DF62 will be connected to a switch and the other DF62 of the same pair will be connected to the other switch.

| IMPORTANT  |  |
|--|--|
| <p>It is mandatory that the <b>switches are connected by two paths</b>. This is necessary to guarantee that a single failure in the interconnection cable between the switches does not affect the HSE control links which may exist between different pairs of controllers. Necessarily the switches must support RSTP (Rapid Spanning Tree Protocol) and have this feature enabled. Preferably the switches should have ports <i>auto sensing</i> type to avoid preoccupations with types of cable and ports that will be used for these interconnections.</p> <p>To increase the project safety, the interconnections should be performed with the analysis of a network administrator or IT professional. Using switches with no RSTP support may cause an interruption on the Ethernet network.</p> |  |

This way, for a system with pairs of DF62 controllers, using the previous network architecture, the network redundancy is achieved between the workstations and switches. A failure that occurs on a segment between the workstations and switches will be covered by the network redundancy adopting the other network path which was not affected by the failure.

For a failure that occurs in a segment between switches and controllers, and affects the current Primary controller, it will be covered by the controllers’ redundancy through the switch over of them.

In the tables 25.1 and 25.2 is presented an example of the IPs’ configuration for the two architectures described in this section, both for the workstations and the controllers involved.

|           |      | Controllers with one Ethernet port | Controllers with two Ethernet ports |
|-----------|------|------------------------------------|-------------------------------------|
| Station 1 | NIC1 | 192.168.164.250                    | 192.168.164.250                     |
|           | NIC2 | 192.168.164.251                    | 192.168.165.250                     |
| Station 2 | NIC1 | 192.168.164.252                    | 192.168.164.251                     |
|           | NIC2 | 192.168.164.253                    | 192.168.165.251                     |

**Table 25.1 – Example of the IPs’ addresses list for the workstations, considering the two types of network architecture**

|        |             | Controllers with one Ethernet port | Controllers with two Ethernet ports |                |
|--------|-------------|------------------------------------|-------------------------------------|----------------|
| Pairs  | Controllers | ETH port IPs                       | ETH1 port IPs                       | ETH2 port IPs  |
| PAIR 1 | DF A        | 192.168.164.10                     | 192.168.164.10                      | 192.168.165.10 |
|        | DF B        | 192.168.164.11                     | 192.168.164.11                      | 192.168.165.11 |
| PAIR 2 | DF A        | 192.168.164.12                     | 192.168.164.12                      | 192.168.165.12 |
|        | DF B        | 192.168.164.13                     | 192.168.164.13                      | 192.168.165.13 |
| PAIR 3 | DF A        | 192.168.164.14                     | 192.168.164.14                      | 192.168.165.14 |
|        | DF B        | 192.168.164.15                     | 192.168.164.15                      | 192.168.165.15 |

**Table 25.2 – Example of the IPs’ addresses list for the controllers, considering the two types of network architecture**

## Configuring the Server Manager and Syscon

At the **Studio302** toolbar, click the button  and the **Server Manager** dialog box will open.



Figure 25. 3 – Server Manager

Click the **Network** option and the next window will open.

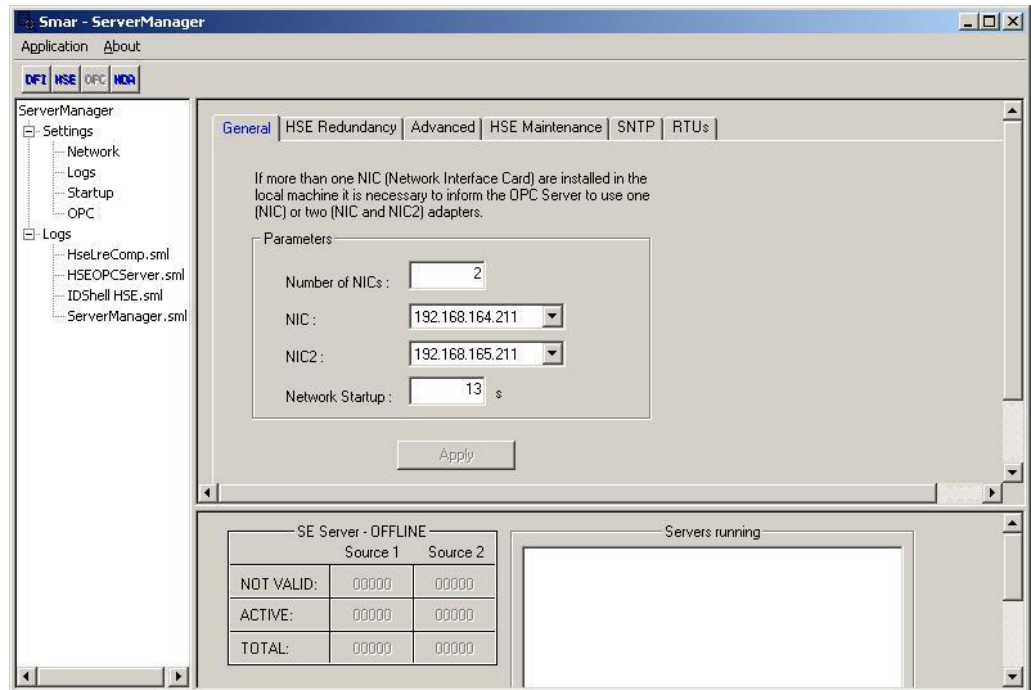
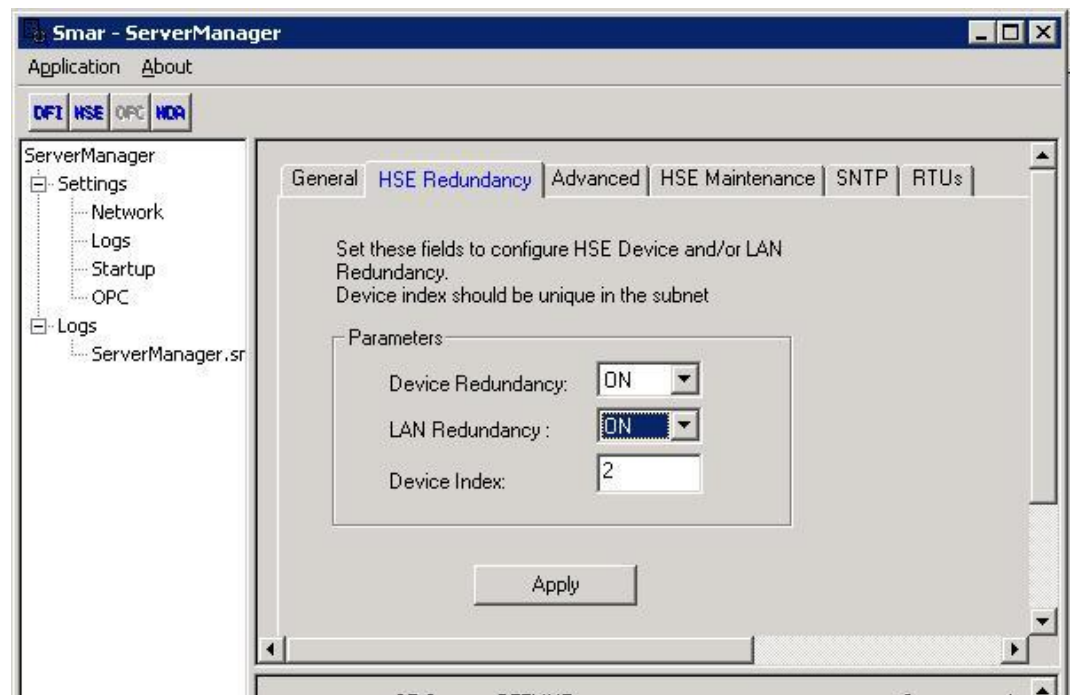


Figure 25. 4 – Server Manager: General tab

At the **General** tab type the number of NICs (network cards) used in the machine, in this case is **2** (redundant system). Select the IP address of the NICs used by the **Server Manager**.

At the **HSE Redundancy** tab, configure the fields as in the following figure.



**Figure 25. 5 – Server Manager: HSE Redundancy tab**

Select **ON** for **Device Redundancy**. If there are two network cards the network will be redundant. In this way select **ON** for **LAN Redundancy** (even using the DF62 controller).

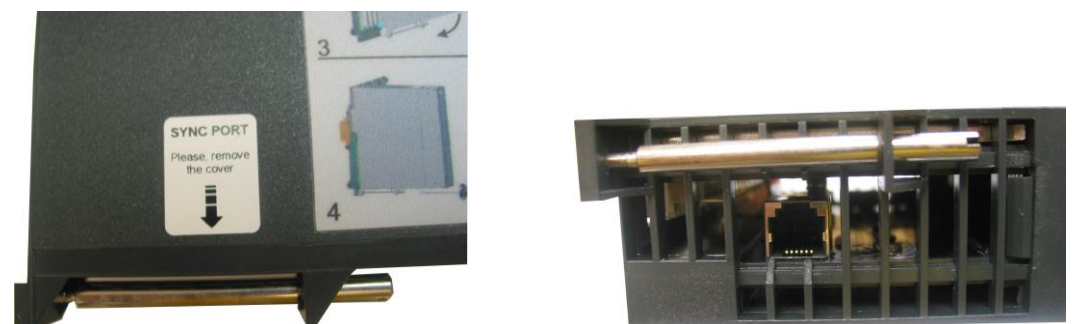
At the **Device Index** text box, type a value between **1** and **9** for each machine, and every machine must have a unique number. In the HSE network, the **Device Index** represents the network address for each device for routing purposes, because of this it needs to be unique.

At the **Syscon**, the only care to be taken in the control strategy configuration related to redundancy is:

- Right-click each controller which will be redundant and choose **Attributes** option;
- Configure the item "**Is Redundant (HSE Only)**" as enabled.

## Synchronism channel

A RS232 serial port is dedicated to synchronism between the Primary and Secondary controllers using the DF82 (0.5 m) or DF83 (1.8 m) cables. See the next figures.



**Figure 25. 6 - Label to identify the serial synchronism port (Left) and the serial synchronism port in the bottom part of the module (Right)**

Thus, the distance between controllers is limited to 1.8 m. Therefore they have to be installed preferentially in the same panel, but with different power supplies and independent no-breaks.

**DIFFERENTIAL**

The DFI302 HSE controllers have redundancy of synchronism channel as a differential, with up to three possible paths: between ETH1 ports, between ETH2 ports and through serial port. Thus is ensured a greater availability of the own device's redundancy.

**IMPORTANT**

- The synchronism between the controllers is done through the serial port mainly during the startup. After controllers' startup, the synchronism is done through the Ethernet ports, ensuring a greater transfer rate for synchronism. If there is a communication failure in an Ethernet port, the synchronism is reestablished by another one. If there is a communication failure in both Ethernet ports, the synchronism will be done through the serial synchronism port.
- Exception: If a ladder application is used the synchronism has to be done through the Ethernet ports because demands a greater transfer rate. If there is a communication failure in both Ethernet ports, the controller pair will lost the synchronism of the ladder application, thus, the redundancy is not fully available, because the Secondary will not be updated to assume if the Primary fails. It is important that failures are repaired in order to have the redundancy available again.
- It is mandatory that the synchronism serial cable (DF82/DF83) remain connected all the time. This peer-to-peer connection is what determines the formation of a redundant controller pair during the plant startup, and also during restart up, after scheduled stops.

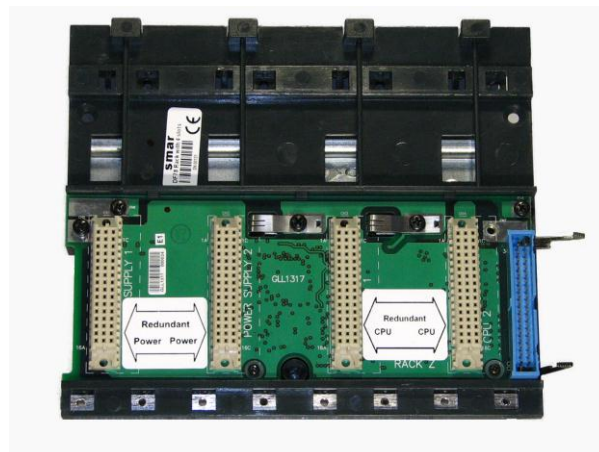
**FOUNDATION fieldbus H1 channels**

**FOUNDATION fieldbus H1 redundant segments:** For each FOUNDATION fieldbus H1 channel, from a common point in the panel, a segment can be ramified up to the Primary controller, and another one up to the Secondary controller offering failure tolerance in these segments.

**Accessing the I/O bus**

To allow the access to the I/O modules in a redundant way, a proper hardware topology must be used. Thus, it is necessary to use the DF78 or DF92 rack, where in the first two slots (Power Supply 1 and Power Supply 2) the power supplies DF50 (AC/DC) or DF56 (DC/DC) must be inserted, thus the power supply redundancy is provided. The controllers must be installed side by side in the CPU 1 and CPU 2 slots. The next two figures demonstrate the use of DF78 rack.

DF78 and DF92 racks allow direct access to the I/O modules in a safe and transparent way when redundant controllers are used. Also is possible hot swap (insertion/extraction) of the controllers for maintenance purposes.



**Figure 25. 7 –DF78 Rack**



Figure 25. 8 – Example of modules arrangement in the DF78 rack (DF50-DF50-CPU1-CPU2)

## Hot Standby Redundancy Working

### Starting up the redundancy

The controller which starts up first becomes the Primary. In case of both controllers which form a pair are started up at the same time, both will assume the same role that they were operating previously (nonvolatile information).

In the absence of nonvolatile information (startup immediately after firmware updating or Factory Init mode) and in case of both controllers are started up at the same time, the controller which has a bigger serial number will be elected as Primary, and its partner will be the Secondary.

#### IMPORTANT

The controllers have conditions to define their role (Primary or Secondary) autonomously during the startup and no user action is necessary.

Besides the information above mentioned, during the entire operating time of the controller pair and in conditions free of failures, we have the following:

- There is not physical difference between Primary and Secondary controllers;
- There is not preference for a controller rather than another, or for a rack position rather than another, to determine which controller will be the Primary.

### Operational Transparency

In **Syscon** and **LogicView for FFB** the redundancy is seen in a transparent manner to the user, i.e., the redundant pair is seen as a single device. This concept is known as “operational transparency of redundancy”.

In practice, the configurator will always be connected to the controller that is the current Primary. Thus, all download or configuration actions performed in the configurator will be destined to the current Primary. The synchronism implemented in the controllers’ firmware is responsible for updating constantly the Secondary. If there is a switch over, the new Primary is automatically recognized by the configurator, so that at no time the user has to take extra care due to redundancy in the actions of the operation or maintenance of the plant.

## Switch over conditions

The different failures that may occur in such system, lead it to a switch over, when the Secondary becomes Primary, and vice-versa in a bumpless way. The possible reasons for a switch over, divided in two types, are as follows:

### General Failures

When the whole controller fails, this comprises:

- Hardware failure;
- Power off;
- Removal of the controller from the rack.

### Bad Condition Failures

When one of the Primary controller's ports fails:

- Failure in all Ethernet cables directly connected to the Primary;
- Failure in an H1 channel (hardware or cables) of the Primary;
- Failure in the Modbus communication (hardware or cables; in case of operating as master).

The system is capable of checking which controller has the best conditions, electing it as the Primary. It is assured the recovery of one failure at a time. That is, once a failure has occurred, a second failure will be recovered by redundancy only if the first failure has been fixed. While the failure is not fixed, the system has the redundancy not fully available (in case of **Bad Condition Failures**) or even not available (in case of **General Failures**).

For the case of **General Failures**, as soon as the failed controller recovers a healthy state or is replaced, the controllers automatically become a redundant pair again. That is, the system automatically recognizes a new inserted controller. After a failure, the maximum switch over time may alter depending on the specific failure, but typically takes 2 seconds or less.

In order to monitoring the redundancy state, some parameters available in the Redundancy Transducer function block (TRDRED) should be used. See the following table. For further details see the Function Blocks manual.



| Parameter                           | Valid Range/<br>Options   | Description   |
|-------------------------------------|---|---|
| <b>RED_PRIMARY_SN</b>               | 0 ~ 65535   | Indicates the Serial Number of the Primary controller.  |
| <b>RED_SECONDARY_SN</b>             | 0 ~ 65535   | Indicates the Serial Number of the Secondary controller.  |
| <b>RED_SYNC_STATUS</b>              | 0: Not defined<br>1: Stand Alone<br>2: Synchronizing<br>3: Updating Secondary<br>4: Synchronized<br>5: WARNING: Role Conflict<br>6: WARNING: Sync Cable Fail<br>7: WARNING: Updating Secondary Fail | Indicates the Synchronism status of the controller pair.<br>0: Default value just after start up.<br>1: Stand alone operation (no redundancy).<br>2: Checking configuration for synchronization.<br>3: Primary transferring configuration to the Secondary.<br>4: The Primary continuously updates the Secondary dynamic databases.<br>5: It was not possible to solve autonomously the Role. (Primary / Secondary).<br>6: Fail on all the synchronism channels (redundancy unavailable).<br>7: Primary fails before synchronism is completed (redundancy unavailable). |
| <b>RED_PRIMARY_BAD_CONDITIONS</b>   | Bit<br>0: Modbus<br>1: H1-1<br>2: H1-2<br>3: H1-3<br>4: H1-4  | Bad conditions for the Primary / Secondary controllers.   |
| <b>RED_SECONDARY_BAD_CONDITIONS</b> | 5: LiveList<br>6: ETH1<br>7: Reserved<br>8: ETH2<br>9: Serial Sync Cable<br>10: Unable to Sync  |   |

**Table 25.3 – Description of main parameters of Redundancy Transducer function block**

| Bit | Variable          | Description  |
|-----|-------------------|--|
| 0   | Modbus            | When working as master and if no Modbus slave device answers, it means that Modbus communication is in bad conditions. Failures on the communication path or even a failure on the slave can cause it. |
| 1   | H1-1              | Failure on an H1 channel, specifying each channel had the failure.   |
| 2   | H1-2              |  |
| 3   | H1-3              |  |
| 4   | H1-4              |  |
| 5   | LiveList          | H1 Live List was not completed on Secondary controller.  |
| 6   | ETH1              | Synchronism failure on ETH1 port.  |
| 7   | Reserved          | -  |
| 8   | ETH2              | Synchronism failure on ETH2 port.  |
| 9   | Serial Sync Cable | Failure on serial synchronism cable.   |
| 10  | Unable to Sync    | Firmware versions with incompatible synchronism.   |

**Table 25.4 – Description of RED\_PRIMARY\_BAD\_CONDITIONS and RED\_SECONDARY\_BAD\_CONDITIONS parameters bits**

**IMPORTANT**

To know how to proceed when warnings appear in **RED\_SYNC\_STATUS** parameter and the indications of **BAD\_CONDITIONS** parameters refer to Troubleshooting topic.

### Standby LED Behavior

The available blinking patterns for the Standby LED are summarized below. The next figure shows a graphic representation for these patterns.

- a) PRIMARY IN STAND ALONE: Standby LED turned off all the time. It indicates that there is no partner connected.
- b) SECONDARY SYNCHRONIZED: Standby LED turned on all the time. It indicates that the Secondary controller is totally synchronized with the Primary controller and the redundancy is available.
- c) PRIMARY WITH PARTNER: Each three seconds, Primary's Standby LED blinks briefly. It indicates that the Primary controller has a partner.
- d) SECONDARY SYNCHRONIZING: Standby LED blinking slowly turned off about one second and turned on about one second. It indicates that the configuration synchronism is on progress.
- e) ROLE CONFLICT: Standby LED blinking fast. It indicates the controller did not define its role during the startup. The Primary will pause for two seconds the blinking each ten times. The Secondary will blink permanently.
- f) PRIMARY - CABLE FAILURE: Standby LED blinking twice in the Primary, quickly at each two seconds. It indicates failure in the synchronism serial cable.
- g) SECONDARY – CABLE FAILURE: Standby LED blinking four times in the Secondary, quickly, at each two seconds. It indicates failure in the synchronism serial cable.
- h) PRIMARY FAILS DURING SECONDARY UPDATING: Standby LED blinking three times in the Secondary, quickly, at each two seconds. It indicates that there has been a general failure on Primary before reaching the **Synchronized** status.

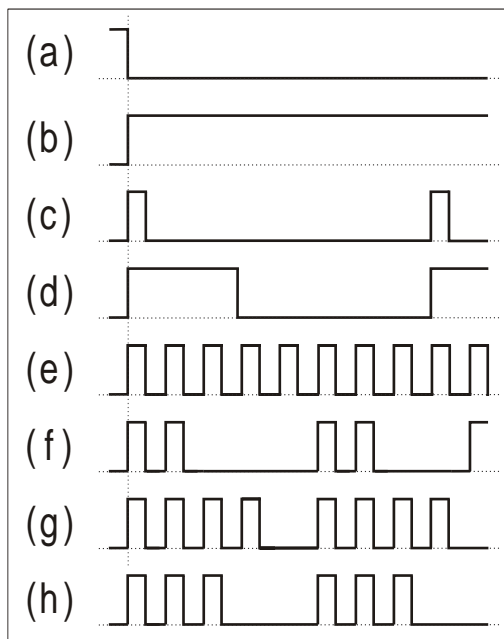


Figure 25. 9 – LED Standby behavior

## Procedures for Hot Standby Redundancy

The next steps are for configuration and maintenance when using the Hot Standby redundancy. It is recommended that the steps be all read and understood before they are executed.

### IMPORTANT

Before executing any of the following procedures, make sure you have followed the guidelines of the topic Preparing a redundant system.




At this section, the following expressions and their respective definitions are used:

- Hold Mode: stops the firmware execution in the controller as well as all tasks in the process.
- Run Mode: executes the firmware again.
- Factory Init Mode: restores the factory configuration, erasing the user’s configuration.

For further information about those expressions and how to update the firmware refer to sections Setting Up or Troubleshooting in this manual.

### Configuring for the first time a redundant system

This is the procedure to configure the system with Hot Standby redundancy for the first time, at the plant startup.

- 1 – With the rack not powered, connect the synchronism serial cable to each controller.
- 2 –Connect both controllers through the H1 channels (1 to 4), in case of DF62/DF63. Connect the Ethernet cables to the corresponding controllers’ ports.
- 3 – Power the rack where the controllers are installed. The controllers will decide autonomously which one will be Primary and Secondary. Wait until the Standby LED of one controller turns on permanently, what means the roles have been defined and the controller pair is synchronized.
- 4 - At the **Studio302** click **Areas** , choose the desired configuration. It will be open at **Syscon**, and then click **On-line Mode** option . Execute the commissioning of controllers and field devices. Download the configuration right-clicking **Fieldbus Networks** . For further information refer to **Syscon** manual, specially the section Creating a FOUNDATION fieldbus configuration.

5 – The controller pair will synchronize the configuration (Standby LED will blink). When the controller pair is synchronized (Standby LED turned on permanently in Secondary), the Primary will constantly update the Secondary with the process dynamic variables.

As soon the controller pair get the **Synchronized** status and **<none>** in the **BAD\_CONDITIONS** parameters, the redundancy will be fully available and failure simulations can be performed.

## Changing the configuration

Download the new configuration to the device commissioned in the **Syscon**. The controller pair will re-synchronize automatically.

## Replacing a controller with failure

To ensure a high safety process when replacing a controller, make sure of following the steps below:

1 – With the new controller disconnected from the rack, turn off the battery switch, at least, for 30 seconds. Set the **BATTERY** position to **OFF**, wait for 30 seconds and return to the **ON** position.

2 – You must connect the synchronism cable (DF82/DF83) just before inserting the new controller. This will avoid role conflict between controllers.

3 - If possible, connect all cables: besides the synchronism cable, H1 channels (1 to 4) in case of DF62/DF63 and the Ethernet ports.

4 – Insert the new controller in the rack.

5 – In case all cables have been connected before the insertion of new controller, the synchronism will automatically start (the Standby LED should blink in the new controller). When the system is synchronized (Standby LED turned on permanently), the Primary controller will constantly update the Secondary with the process dynamic variables.

6 – In case only the synchronism cable have been connected before the insertion, a hot insertion of the H1 cables (in DF62/DF63) may be necessary. In this case, set the new controller to **Hold** (none executing), connect the H1 cables, and also the Ethernet cables. Then, return the controller to **Run** mode (execution).

7 - As soon the system get the **Synchronized** status and **<none>** in the **BAD \_CONDITIONS** parameters, the redundancy will be fully available and failure simulations can be performed.

8 – For any situation different from **Synchronized** status, refer to section Standby LED Behavior to make a better diagnosis.

## Adding redundant controllers in a non-redundant system

Even a non-redundant controller supports redundant operation, working as Primary in Stand Alone state.

Thus, a non-redundant system, in operation, may have redundant controllers added later without process interruption. Only is necessary that the non-redundant system has foreseen some cares according to the section Preparing a Redundant System. The procedure is the same of the previous section (Replacing a controller with failure).

## Firmware update without process interruption

It is possible updating the controllers' firmware to new versions, which have new features or improvements, without process interruption.

For reference purpose in the following procedure, we designate one of the controllers as **A** and another as **B**. Suppose the controller A is the one which was Primary at the beginning of the procedure execution. That is, the references A and B are static, and the user can even associate the controller A as the one in the rack's left side and controller B as the one in the rack's right side.

Follow the steps below:

1. Be sure the system is in the **Synchronized** status and it has <none> in the **BAD\_CONDITIONS** parameters. So, using **FBTools** update the firmware of the controller A (current Primary). At this moment, the other controller (B) will take over becoming the current Primary.
2. After finishing the firmware’s update of controller A, the controller pair will synchronize with the current Primary (B) transferring the entire configuration to the other one (A). Wait for the system get the **Synchronized** status and it has <none> in the **BAD\_CONDITIONS** parameters.
3. Using **FBTools** update the firmware of the current Primary controller (B). At this moment, the other controller (A) will take over becoming the current Primary.
4. After finishing the firmware’s update, the controller pair will synchronize with the current Primary (A) transferring the entire configuration to the other one (B). As soon the system get the **Synchronized** status and it has <none> in the **BAD\_CONDITIONS** parameters, the redundancy is fully available again and failure simulations can be performed.

After finishing this procedure both controllers will have updated firmware and the original configuration will be preserved without need of process interruption.

## Troubleshooting

### Role Conflict

This exceptional situation occurs when some procedure was not followed. It is signaled by the **RED\_SYNC\_STATUS** parameter (value **5: WARNING: Role Conflict**) and by the Standby LED (see Standby LED behavior topic).

There is a chance to occur role conflict only when a controller has already had a partner operating in redundancy when one of the controllers is exchanged without doing a Factory Init in the new controller inserted. In such situation the redundancy does not define the function of the new controller because of security reasons. The user is responsible to decide which controller has the right configuration.

**Solution:** the user has to do a Factory Init in the controller which will be the Secondary (the entire configuration of this controller will be erased and it will receive the configuration from another controller).

### Correction of synchronism cables failure

Once there is a failure in some of the synchronism media (Serial, ETH1, ETH2) it is signaled by the **BAD\_CONDITIONS** parameters, respectively with: **Serial Sync Cable**, **ETH1** and **ETH2** (see Table 25.4). Even the synchronism channel is redundant (with up to three paths); it is recommended that as soon as a failure is signaled in some of the paths, it has to be fixed.

Indications of bad condition on ETH1 and ETH2 will be signaled on both the Primary controller and the Secondary controller. This indication advises that the controllers are unable to perform synchronization for a given path (ETH1/ETH2). The individual diagnosis for each of the Ethernet ports can be accomplished through **ethLinkStatus** parameters available via SNMP.

### **Typical example of failure scenario**

The indication of zero in **ethLinkStatus** for both ports indicates that the Ethernet cables are connected (Media presence). This condition of *LinkStatus* is also signaled via ETH1 LNK and ETH2 LNK LEDs in the controllers’ frontal. If in this condition the indication of bad condition for both ports (ETH1 and ETH2) appears, it may be an indication that in some of the controllers the cables were inversely connected (ETH1 cable on ETH2 port, and ETH2 cable on ETH1 port).

### **Solution:**

- Check if the connectors are properly fitted;
- Check the synchronism cables with failure indication as well as the network elements in case of a failure in the Ethernet ports.
- Check if the ports are connected to their networks (ETH1 port to network 1, ETH2 port to the network 2).

### **Primary fails before completing the synchronism.**

This exceptional situation occurs when some procedure was not followed. It is signaled by the **RED\_SYNC\_STATUS** parameter (value 7: **WARNING: Updating Secondary Fail**) and by the Standby LED (see Standby LED behavior topic).

There is a chance to occur this failure only when a redundant pair is not yet with **Synchronized** in the **RED\_SYNC\_STATUS** parameter and then the current Primary is turned off. In such situation, when the redundancy is not available yet, the Secondary does not have conditions to take over the plant in a safe way. In this situation the Secondary keeps the same function and indicates this state as a safety condition.

#### **Solution:**

- In case the user knows that the Primary, which was turned off recently, has the complete configuration, set the Secondary to Hold, and then, turn on the Primary. Some seconds after that, remove the Secondary from Hold. The controller pair will synchronize, and only after they get **Synchronized** status and **<none>** in the **BAD CONDITIONS** parameters, failure simulations can be performed.

- In case the user does not trust the Primary configuration, follow the same procedure above mentioned, however download the configuration again.

### **Correction of an H1 cable failure**

Cables failures in H1 segments which affect only one controller (Primary or Secondary) are signaled in the **BAD CONDITIONS** parameters allowing an immediate maintenance.

In case the failure occurs in an H1 cable segment which affects only the Primary controller, the redundancy will cover this failure, performing a switch over. In case the failure affects only the Secondary, it will not affect the process but even so it will be signaled by the **RED\_SECONDARY\_BAD\_CONDITIONS** parameter allowing proactive maintenance.

During the maintenance, in case the H1 cable is reconnected at once, the noise inserted in the line will cause communication problems for some time, what is undesirable. To avoid this, the next procedure has to be followed.

- 1 – Set the controller, which was affected by the H1 cable failure, to Hold mode.
- 2 – Fix the H1 cable connection.
- 3 – Remove the controller from Hold mode. The controller will be automatically recognized by the Primary controller. As soon as the controller pair has **Synchronized** status and **<none>** in the **BAD\_CONDITIONS** parameters, the redundancy will be fully available again.

### **Correction of bad conditions – Modbus**

Check:

- If there are any cables failures in the paths related to the Modbus communication topology.
- The parameterization of the Modbus function blocks.
- If the converters/devices used in the Modbus communication topology are working properly.
- If the Modbus slave device is correctly configured and working.

### **Correction of bad conditions – Live List**

Check:

- If the H1 cables have some connection problem or noise;
- Problems with line terminators (BT302): bad contact, missing or excess of BT302;
- Poor grounding;
- Water in the junction boxes or inside the devices;
- Transmitters with poor isolation;
- Transmitter digital card with some problem;

In case a deeper investigation is necessary, it is recommended to use the **FBView** software which is integral part of **SYSTEM302**. The **FBView** manual, in the Signal Quality and Live List topics, brings the necessary procedures.

**Correction of bad conditions – Synchronism incompatibility**

When executing the procedure Firmware update without process interruption in general will occur momentarily a situation where a controller has a firmware version and the other controller has another one. The following momentary situations may happen:

a) Secondary has a newer firmware version than the Primary (Upgrade): the synchronism is compatible and the controller pair synchronizes normally. That is, this scenario is perfectly supported. An exception may happen if the firmware versions are not compatible where the controller pair does not synchronize indicating this situation as “**Unable to Sync**” in the **BAD\_CONDITIONS** parameters.

DF62/DF63/DF73/DF75: firmware version 1.x is not compatible with 2.x.

b) Secondary with an older firmware version than the Primary (Downgrade): the synchronism is not compatible and the controller pair does not synchronize indicating this situation as “**Unable to Sync**” in the **BAD\_CONDITIONS** parameters. That is, this scenario is not supported in the redundancy context.

**Solution for case b:**

This scenario (downgrade) must be avoided. Once a plant is operating with a firmware version in the controllers, and for some reason the user desires to operate the plant with a previous firmware version the option is: with the plant stopped, change the firmware of all controllers (Primaries and Secondaries), and then follow the procedure of the Configuring for the first time a redundant system topic.

## ADDING REDUNDANCY WITH REDUNDANT I/O MODULES

### Introduction

To meet the requirements for fault tolerance, system availability and safety in the industrial process, the DFI302 controllers work with a Hot Standby redundancy strategy, where all the levels, including conventional Input and Outputs signals, may be configured and installed in a redundant manner.

In this strategy, the Primary and the Secondary controllers are connected to a set of redundant I/O scanners, which are dedicated to read and write the redundant I/O modules. The complete path from sensor until operation station is totally redundant. In case of one fault, an event will alarm the user, and the availability will be granted in a bumpless way.

| IMPORTANT  |  |
|--|--|
| The characteristics described in this section are supported by the DF62, DF63, DF73, DF75, DF89, DF95, and DF97 controllers at this time. Ask to check availability to other DFI302 controllers. |  |

### R-Series Ordering Codes

The following components are necessary to built R-Series I/O Redundancy in DFI302.

| RACKS AND ACCESSORIES |  |
|-----------------------|--|
| DF106                 | Master Rack - 6 slots for I/O redundancy                     |
| DF110 -1              | Slave Rack - 10 slots for I/O redundancy - Terminal blocks   |
| DF110 -2              | Slave Rack - 10 slots for I/O redundancy – Interface cabling |
| DF109                 | Thin stub cable (0,40m)                                      |
| DF119                 | Thick cable (1,0m) for DF106-DF109 or DF106-DF110            |
| SCANNERS              |  |
| DF107                 | Master Scanner for I/O Redundancy                            |
| DF108                 | Slave Scanner for I/O Redundancy                             |
| I/O MODULES           |  |
| DF111                 | 1 Group of 16 Redundant Digital Inputs 24 Vdc - Source       |
| DF112                 | 1 Group of 16 Redundant Digital Outputs 24 Vdc - Sink        |
| DF113                 | 1 Group of 8 Redundant Current Analog Inputs                 |
| DF114                 | 1 Group of 8 Redundant Current Analog Outputs                |

The following components may complement R-Series IO Redundancy in DFI302.

| CODE  | DESCRIPTION   |
|---|---|
| DF87  | Power Supply for Backplane 20-30VDC (5A, Advanced Diagnostic) |
| DF0-R   | Box Used In Empty Slots                                       |
| ITF-CR-10<br>ITF-CR-15<br>ITF-CR-20<br>ITF-CR-25<br>ITF-CR-30<br>ITF-CR-35<br>ITF-CR-40<br>ITF-CR-45<br>ITF-CR-50 | Interface cabling ( 1 m to 5 m)                               |



|            |   |
|------------|---|
| ITF-DIG    | Passive Interface Panel for 16 Digital Input and/or Output Module - DC<br>Obs. The active components must be external connected |
| ITF-AN-IOR | Interface Panel for 8 Analog Input and/or Output Module<br>Obs. Exclusive for R-Series  |

## R-Series IO Redundant System Overview

In order to have a true Conventional I/O redundant system, all the parts and paths must be redundant. The hardware topology for Input and Output Redundant segments based on DFI302 controllers can be seen in the following figure. The system supports up to 16 pairs of R-Series I/O modules. This means 128 analog or 256 discrete I/O values, or a mix of them.

The R-series, redundant I/O module system, consists of 1 master rack and up to 4 slave racks; they are addressed as 0, 1, 2 and 3. It is possible for each slave rack add up to 4 pairs of I/O modules, addressed as pair 0, 1, 2 and 3. See the following figure.

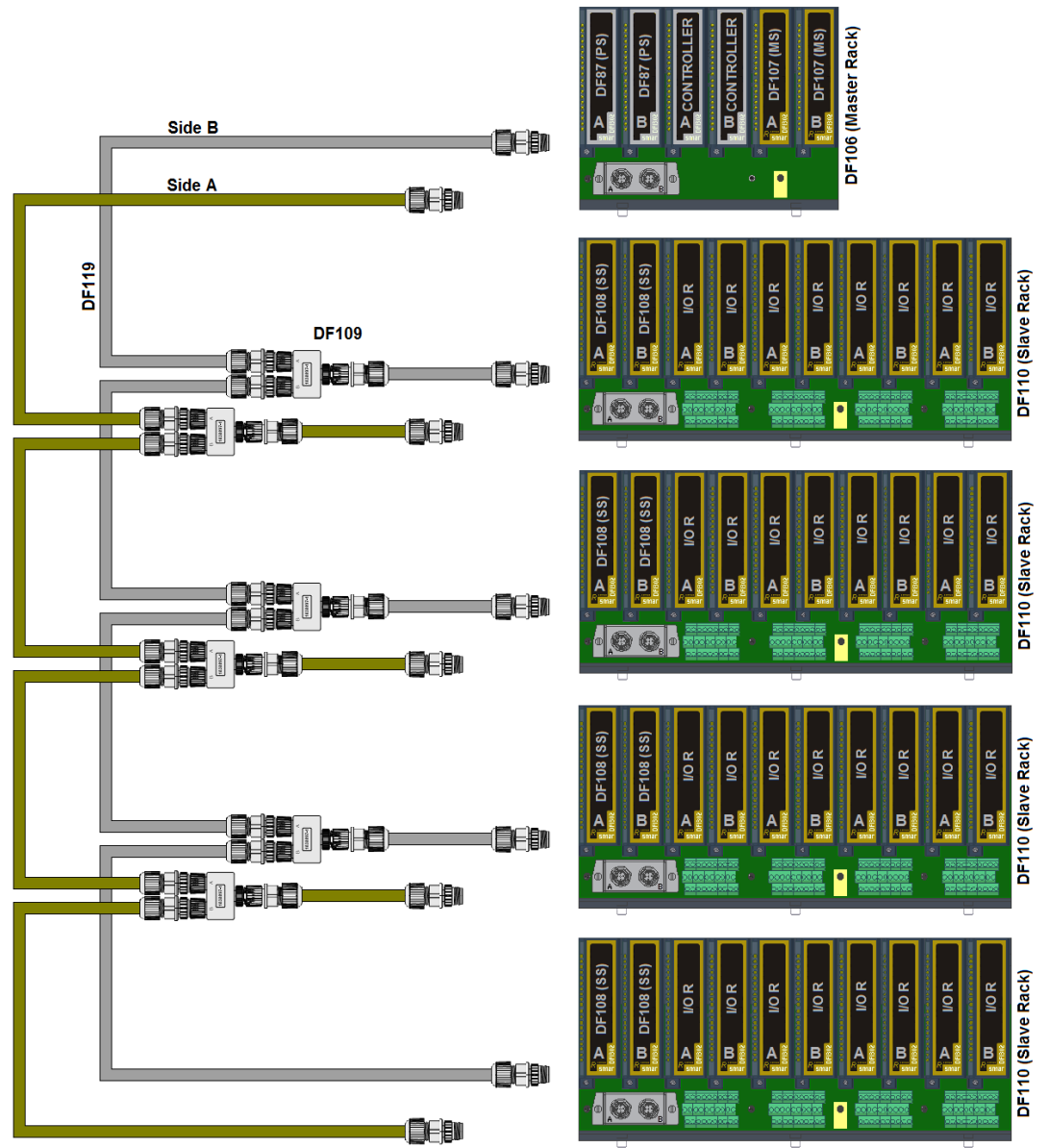


Figure 26. 1 - Conventional I/O Redundant Overview

**IMPORTANT**

For a better understanding, for each pair of modules - power supply, controller, scanner or I/O module, consider the left module (front view) as module A and the right module as module B. See the figure 26.1.

The controller A only has access to scanners A. The controller B only has access to scanners B.

The set controller A, master scanner A, DF109/DF119 cables and slave scanners A is conventionally called "Side A".

The set controller B, master scanner B, DF109/DF119 cables and slave scanners B is conventionally called "Side B".

The side whose controller is the current primary will be the Primary side.

The slave scanners (A and B) have access to all I/O modules (A and B) of the same rack, making the redundancy of I/O modules independent from redundancy of controllers.

See the Switchover Scenarios section for a complete understanding of redundancy in the "R-Series" system.

This architecture supports until one failure in any element of the system, which means that any hardware failure is covered by a second hardware working in a hot standby way.

**NOTE**

It is recommended that each identified fault has corrective action to make the system redundancy available again to cover new faults.

All I/O modules have the self-diagnostic feature to all points.

Scanners continually measure the health of each I/O modules to update the main controllers. The main controllers may use the status of the I/O modules in the control logic as safety interlock and provide the same rich information to HMI Stations. For further information about SNMP diagnostic items refer to Appendix B on this manual.

The diagnostic status for the whole system is available, as OPC and Simple Network Management Protocol (SNMP) parameters, available to HMI stations through its respective servers.

When maintenance is needed, the system permits hot swap of the modules, including power supplies, controllers, scanners and I/O modules.

The racks were built to avoid any kind of maintenance. No active component is mounted in this rack.

For further information about technical characteristics of R-Series modules, racks, cables and scanners refer to the Digital and Analog Input/Output Modules of DFI302 manual.

**Switchover scenarios**

The switchover of controllers/scanners (side) is independent from switchover of I/O modules, i.e., one do not interfere with the other.

**Switchover of I/O modules**

It occurs when there is a failure in the hardware of module A or a failure in the 24V external power supply of that module, when the module B becomes the primary. Once the failure in the module A is repaired, it becomes the primary again. That is, different from the behavior of the controller redundancy, for the redundant I/O modules, in the absence of faults in the module A, it will always be the preferred primary.

Each pair of redundant I/O modules checks the conditions from each other, working autonomously, regardless of the controller scan and ensures the switch in less than 100 microseconds. In case of failure of the primary I/O module, the secondary module takes over ensuring that the digital field devices remain powered, and the process remains undisturbed.

### **Switchover of controller/scanner**

The controller switchover will occur when there is a failure in any part of the Primary side:

- Controller failure;
- Master scanner failure;
- Failure of DF109/DF119 cables;
- Slave scanner failure.

In this case when there is controller switchover, the side of the new primary controller will become the primary side. Once the faulty element is repaired, the current primary side will remain as primary, because for controllers redundancy there is no preferred primary.

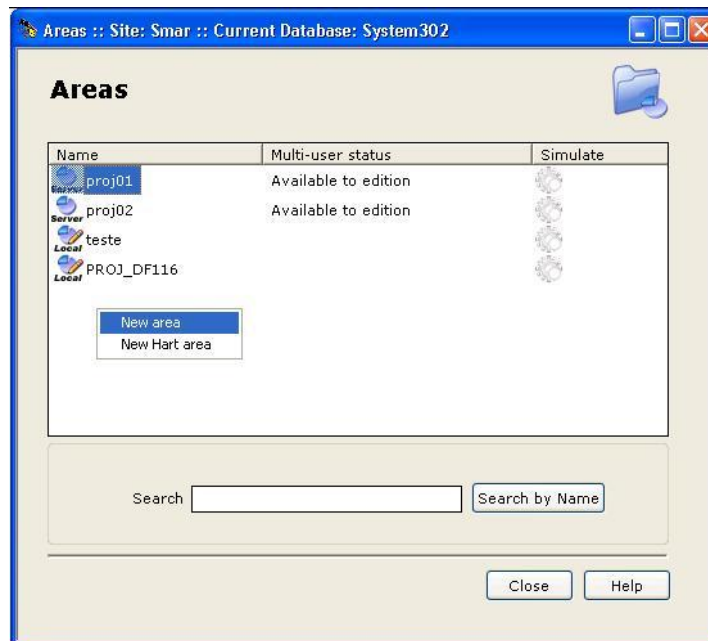
## **Adding the R-Series I/O modules to a redundant system**

The information of this section are only complementary, it does not intend to explain how the function blocks are instantiated, neither how the controllers and devices are configured. For further information on configuring control strategies refer to the user manual of **Syscon**. On developing logics for discrete control and configuration of redundant I/O modules refer to the **LogicView for FFB** manual.

### **Starting the Area**

It is possible to create, or edit, an area from the **Studio302**. In the **Studio302** interface select **Areas**. A window will appear listing all areas of database.

To create a new area from the **Studio302**, left-click inside the **Areas** window, then choose **New Area**.



**Figure 26. 2 - Creating a new area on Studio302**

Another way to create a new area is from **Syscon**. Click the icon  in the **Studio302** toolbar.

To create a new area on **Syscon**, choose **File → New**, or through the toolbar, choose **New** button . The dialog box shows the **Area** options. Select **Predefined Area** as shown in next figure:

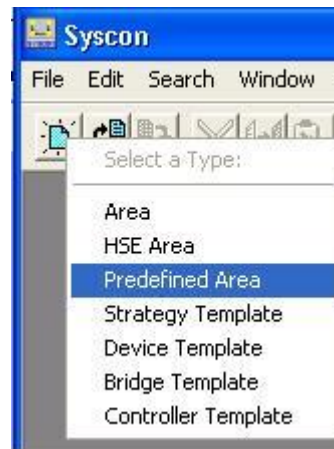


Figure 26. 3 - Options to create Syscon areas

After choosing the area name, a window will appear and the user has to choose the template type that will be used. In this case, the DF75 controller with FFB function block was chosen.

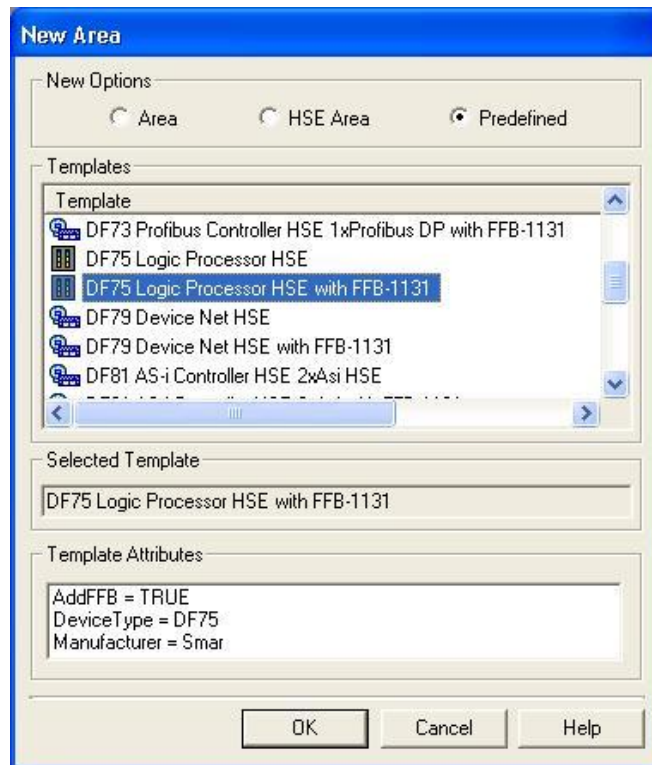


Figure 26. 4 – Template options on Syscon

Type the name for the area in the **Area Name** box, and click **Ok**. For this example, it chooses **PROJ\_RSERIES**.



Figure 26. 5 – New area name

A new window will appear. This window has:

- **Application** – Logical Plant. To insert control strategies into this part.
- **Fieldbus Networks** – Physical Plant. To add devices and function blocks to the area into this part.

The area shall be as follows:

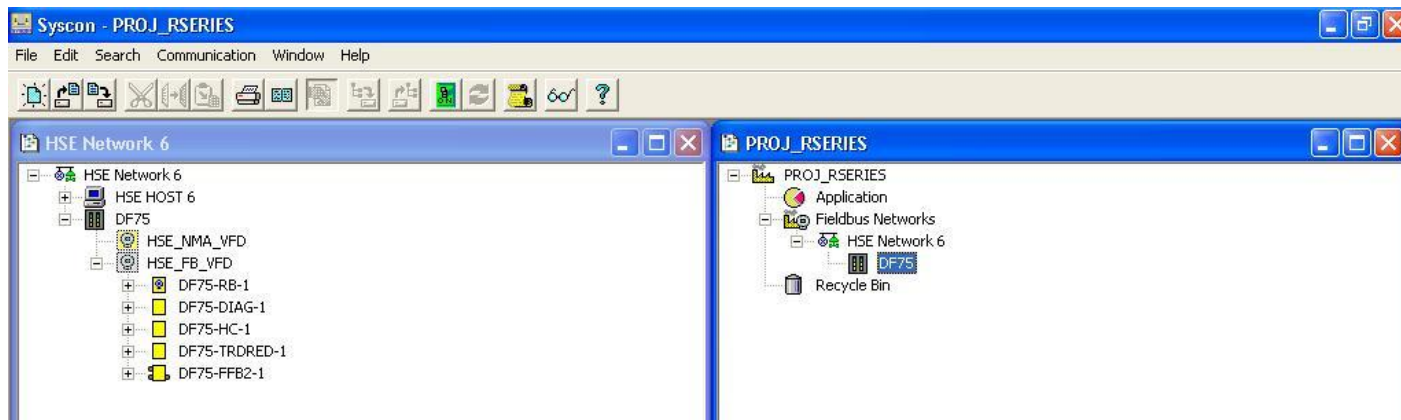


Figure 26. 6 – PROJ\_RSERIES area created on Syscon

**IMPORTANT**

The R-Series modules cannot be configured through the HCT function block on **Syscon**. The configuration of modules parameters must be done through the **LogicView for FFB**. For further information refer to its manual.

**Creating a logic from the FFB function block**

Right-click the **DF75-FFB2-1** block and choose **Edit Logic** option.

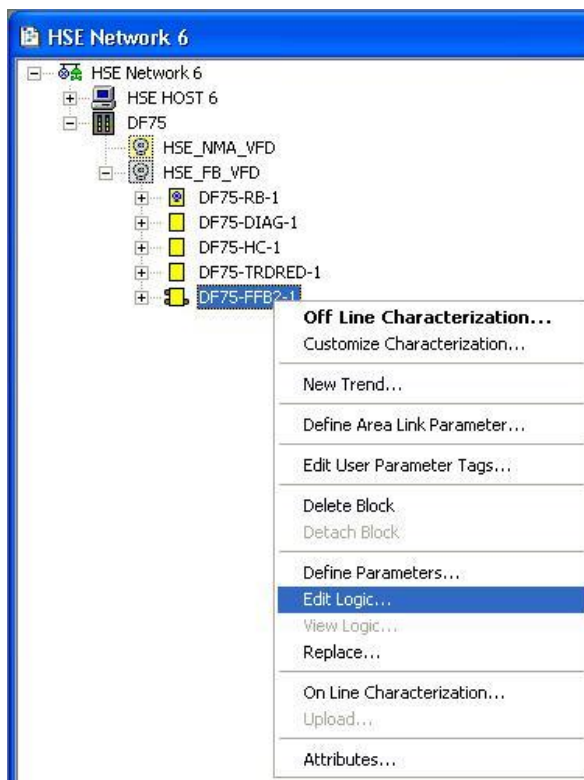


Figure 26. 7 – Edit Logic option

The LogicView for FFB shall be as follows:

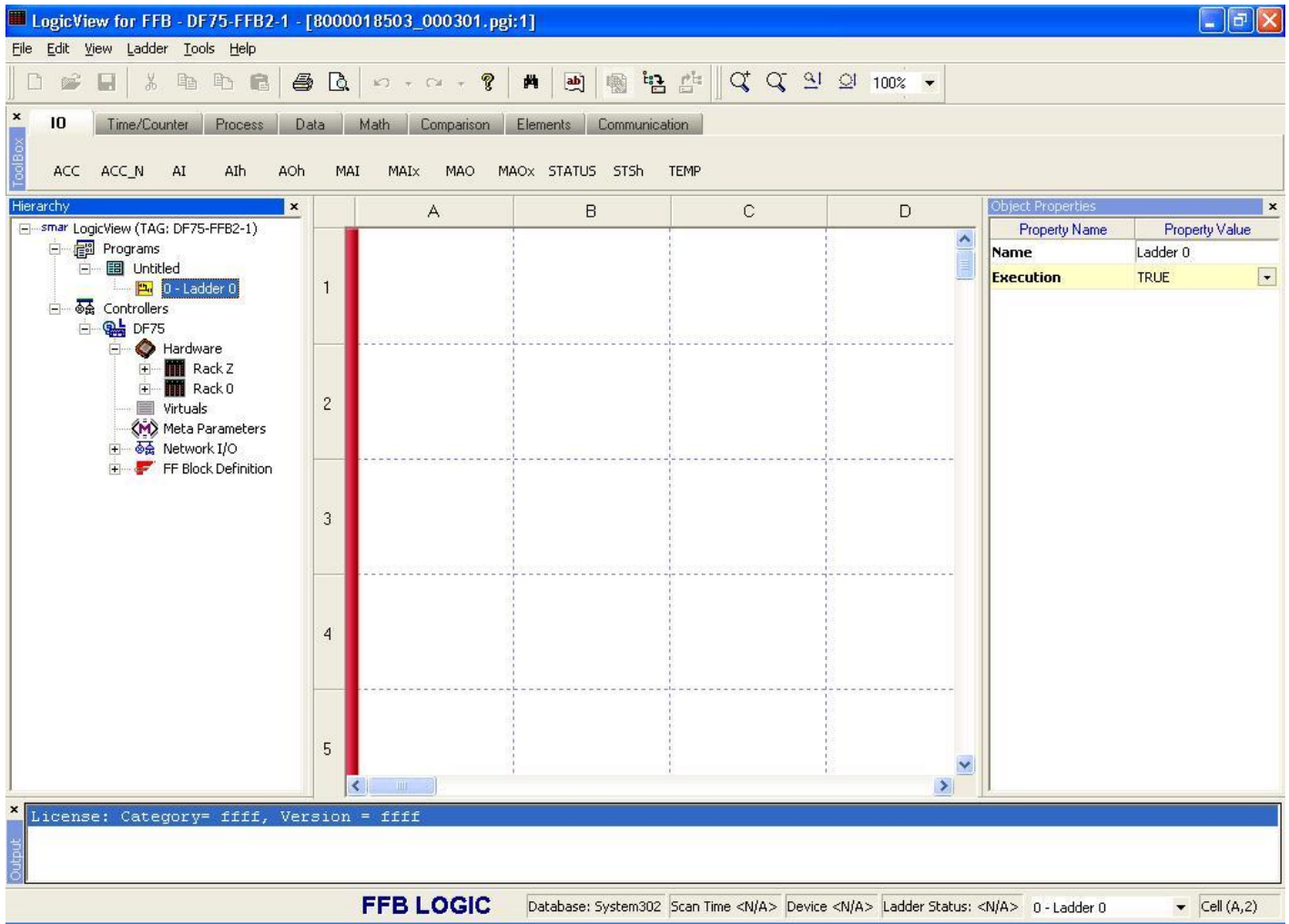


Figure 26. 8 – Editing the configuration on LogicView for FFB

## Configuring the hardware on LogicView for FFB

In the Hierarchy window right-click **Hardware** and choose **Hardware Configuration** option.

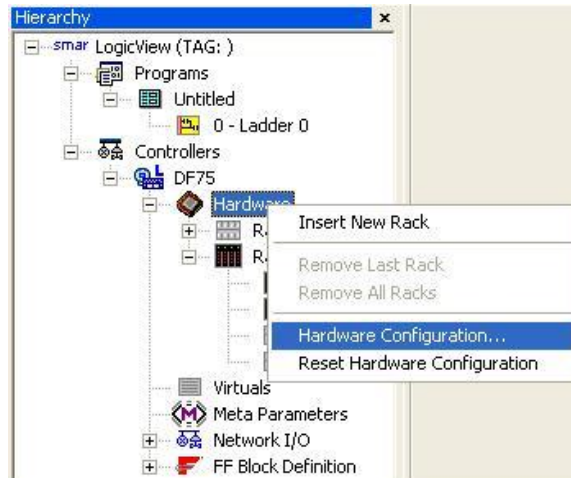


Figure 26. 9 – Configuring the hardware on LogicView for FFB

The following window will appear:

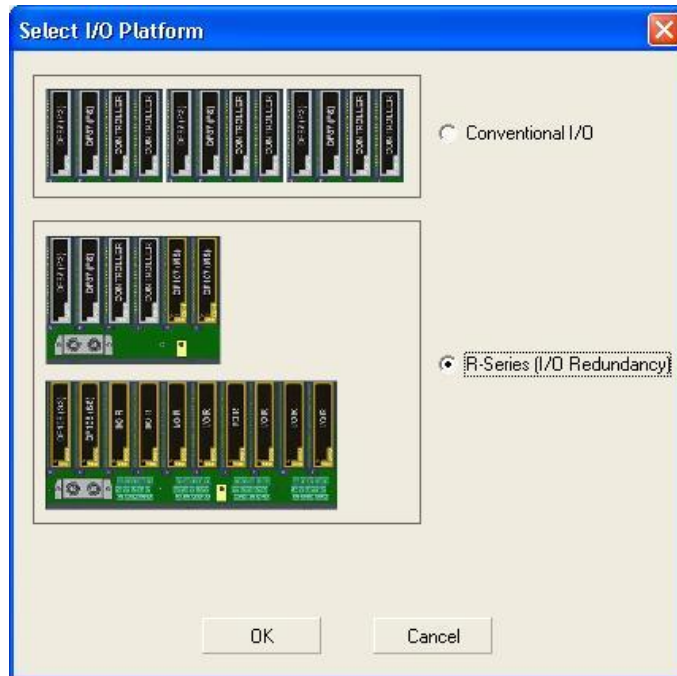


Figure 26. 10 – Selecting the I/O platform

Choose the **R-Series (I/O Redundancy)** option and click **Ok**. The following window will appear to choose the modules that form the system.

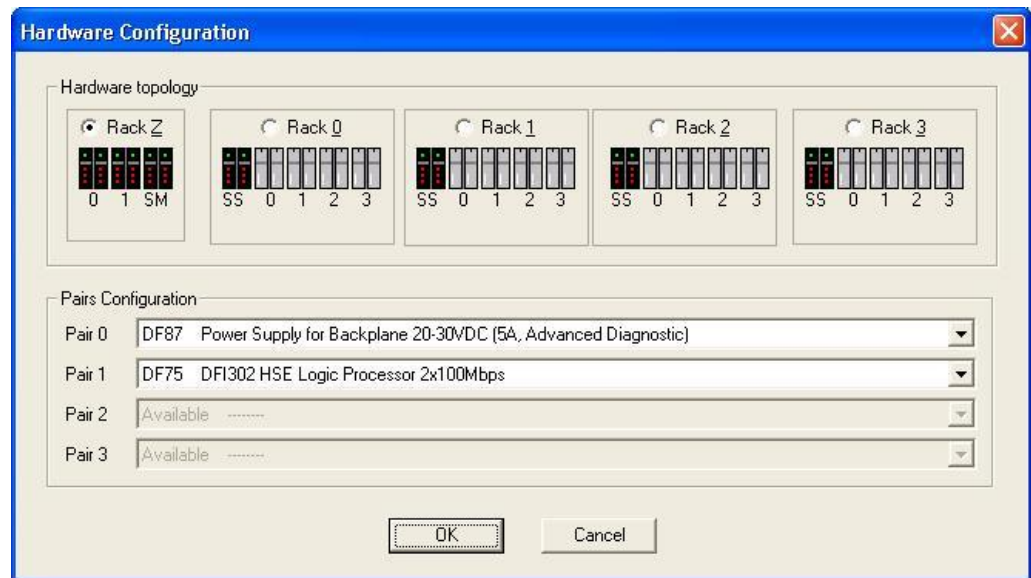


Figure 26. 11 – Configuring the hardware

The controller and the power supply are preconfigured. To choose the redundant I/O modules click the desired rack and the pairs can be defined. See the next figure:

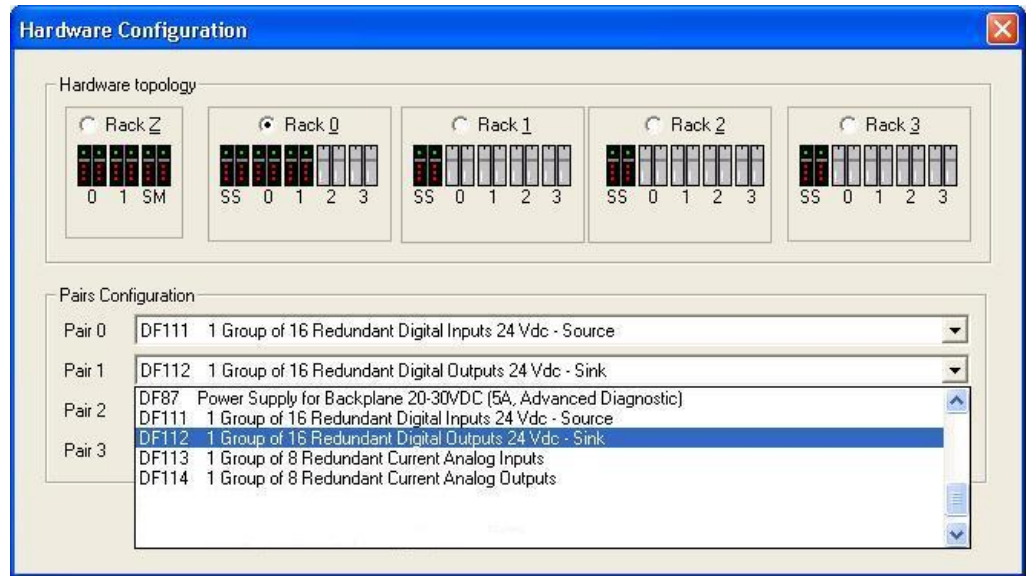


Figure 26. 12 – Choosing the redundant pairs

After choosing the redundant pairs click **OK**. The next step is to configure the logic in the ladder drawing area of **LogicView for FFB**.

### Diagnostics via SNMP

The diagnostic information of the redundant I/O system is available through the Smar SNMP OPC Server for DFI302. For further information, please, refer to Appendix B on this manual.





# Appendix A

|   |                                    |                      |
|---|------------------------------------|----------------------|
| <b>smar</b>   | <b>SRF – Service Request Form</b>  |                      |
|   | DFI302 – Fieldbus Universal Bridge | Proposal N°: _____   |
| <b>COMPANY INFORMATION</b>  |                                    |                      |
| Company: _____  |                                    |                      |
| Unit: _____   |                                    |                      |
| Invoice: _____  |                                    |                      |
| <b>COMMERCIAL CONTACT</b>   |                                    |                      |
| Full Name: _____  |                                    |                      |
| Phone: _____  |                                    | Fax: _____           |
| E-mail: _____   |                                    |                      |
| <b>TECHNICAL CONTACT</b>  |                                    |                      |
| Full Name: _____  |                                    |                      |
| Phone: _____  |                                    | Extension: _____     |
| E-mail: _____   |                                    |                      |
| <b>EQUIPMENT DATA</b>   |                                    |                      |
| Model: _____  |                                    |                      |
| Serial Number: _____  |                                    |                      |
| <b>PROCESS DATA</b>   |                                    |                      |
| Process Type (Ex. boiler control): _____  |                                    |                      |
| Operation Time: _____   |                                    |                      |
| Failure Date: _____   |                                    |                      |
| <b>FAILURE DESCRIPTION</b>  |                                    |                      |
| (Please, describe the failure. Can the error be reproduced? Is it repetitive?)  |                                    |                      |
| _____   |                                    |                      |
| _____   |                                    |                      |
| _____   |                                    |                      |
| _____   |                                    |                      |
| <b>OBSERVATIONS</b>   |                                    |                      |
| _____   |                                    |                      |
| _____   |                                    |                      |
| _____   |                                    |                      |
| _____   |                                    |                      |
| <b>USER INFORMATION</b>   |                                    |                      |
| Company: _____  |                                    |                      |
| Contact: _____  |                                    |                      |
| Section: _____  |                                    |                      |
| Title: _____  |                                    | Signature: _____     |
| Phone: _____  |                                    | Extension: _____     |
| E-mail: _____   |                                    | Date: ____/____/____ |
| For warranty or non-warranty repair, please contact your representative.<br>Further information about address and contacts can be found on <a href="http://www.smar.com/contactus.asp">www.smar.com/contactus.asp</a> |                                    |                      |



## SNMP DIAGNOSTICS

### Introduction

The SNMP (Simple Network Management Protocol) is a protocol that is part of the TCP/IP protocols and is available in most computers and in all manageable Ethernet network equipment.

The HSE DFI302 controllers of Smar (DF62, DF63, DF73, DF75, DF79, DF81, DF95, DF97 and DF100) bring embedded the SNMP protocol as an alternative for diagnosis.

The main benefits of using SNMP for diagnostic are:

- Lower cost to the controller CPU performance compared to the supervision of function blocks;
- In redundant controllers, possibility to separately access Primary and Secondary, providing what the Fieldbus Foundation normalization for redundancy calls "Diagnostic Visibility";
- Possibility of integration of controllers' SNMP items directly to information systems that support SNMP managers. In this way, is possible to treat the SNMP items of controllers and network equipment, e.g. routers, in an integrated way.

#### DIFFERENTIAL

Providing individual access to Primary and Secondary controllers, the SNMP enables proactive maintenance, as even physical faults or bad conditions on Secondary Controller can be identified or alarmed. Thus, it is easier to maintain the availability of the own redundancy of the controller pair.

### Working principle

SNMP is based on MIBs (Management Information Base) that are manageable databases. These MIBs are implemented in the equipment and overall map their important items in a standardized way (read/write).

The SNMP protocol defines agents and managers. In **SYSTEM302**, each DFI302 controller module is an agent and the **SNMP OPC Server** is the manager. Thus, the **SNMP OPC Server** performs the reading/writing interface of the SNMP protocol for the OPC standard, widely used as an interface between the applications of supervision/maintenance/asset management and equipment.

In DFI302 controllers, SNMP can be used for the following purposes:

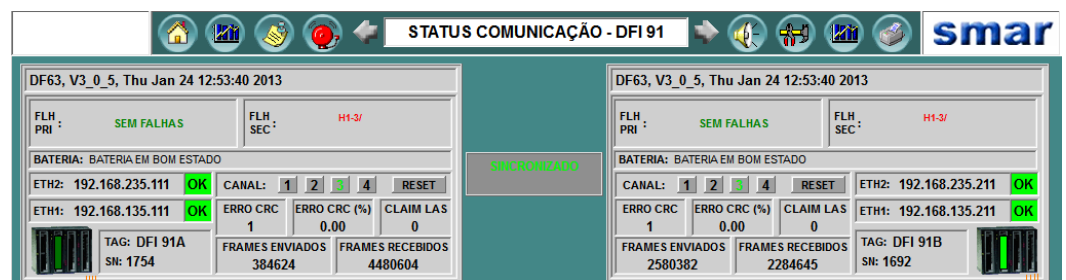
- Diagnostic of failures and bad conditions;
- Alarms and events monitoring.

The steps for **SNMP OPC Server** configuration are in the user manual of **Studio302**, **Appendix A**, section **Configuring the SNMP OPC Server**.

After the **SNMP OPC Server** configuration, by any OPC client, such as **ProcessView** and **TagView**, it is possible to perform a search on the items available for that particular type of controller. With this you can choose the items you want to use the OPC client.

For the diagnostic information in this section, the OPC Server component that must be active is the **SNMP OPC Server for Smar DFI302** (smar.snmpopcserver.0).

See the following examples of supervisory screens (HMI) using SNMP items:



The screenshot displays the 'CONTROLLERS DFI' interface. At the top, it shows 'GR-CONTROLLER-A.GDF' and navigation icons. The main area contains four controller status cards: A-DFI-04 (STANDALONE), A-DFI-05 (STANDALONE), A-DFI-11 (STANDALONE), and A-DFI-12 (SYNCHRONIZED). Each card includes 'General fail A' and 'General fail B' indicators and synchronization links. To the right, two detailed configuration panels are shown for 'UNIT 38'. The top panel is for 'A-FCS-107-F-SYS / A-DFI-12A' (Serial: 2067, Role: PRIMARY, Status: SYNCHRONIZED) and the bottom panel is for 'A-FCS-107-F-SYS / A-DFI-12B' (Serial: 2068, Role: SECONDARY, Status: SYNCHRONIZED). Both panels list network interfaces (Eth1, Eth2, H1-1 to H1-4), communication protocols (Sync. Cable, Modbus, HSE Link, Sync), and battery status (GOOD).

## Integration and Network Security

For better security automation network, is a requirement that it is physically separated from the corporate LAN and the Internet.

If it is necessary to integrate a third-party SNMP network manager to external network elements, for example send alarms from the SNMP to pagers or SMS, you may need to have the automation network integrated to the corporate network. Therefore, it is recommended to use specialized firewalls to guarantee the automation network security. In this case it is recommended that the project be monitored by **Smar**.

Using network management tools via SNMP it is also possible access the diagnostic items of controllers directly by this protocol without using **SNMP OPC Server** in this case. It is thus possible that the management of network equipment, for example switches, and DFI302 controllers are integrated in the same environment.

## Overview of diagnostic features for DFI302 controllers

Below are presented which diagnostic groups are available for each controller.

| Controller | DeviceInfo | Ethernet | Fieldbus | iored | pwr | redundancy | serial | profibus | devicenet | asibus | whbus |
|------------|------------|----------|----------|-------|-----|------------|--------|----------|-----------|--------|-------|
| DF62       | X          | X        | X        | X     | X   | X          | X      |          |           |        |       |
| DF63       | X          | X        | X        | X     | X   | X          | X      |          |           |        |       |
| DF75       | X          | X        |          | X     | X   | X          | X      |          |           |        |       |
| DF73       | X          | X        |          |       |     | X          | X      | X        |           |        |       |
| DF95       | X          | X        |          |       |     | X          | X      | X        |           |        |       |
| DF97       | X          | X        |          |       |     | X          | X      | X        |           |        |       |
| DF79       | X          | X        |          |       |     |            | X      |          | X         |        |       |
| DF81       | X          | X        |          |       |     |            | X      |          |           | X      |       |
| DF89       | X          | X        |          |       |     | X          | X      |          |           |        |       |
| DF100      | X          | X        |          |       |     |            | X      |          |           |        | X     |

X: Feature available

## Diagnostic groups common to all controllers

The following tables show the items available in DFI302 controllers. After these tables additional information for some items will be presented. For all tables the abbreviations have the following meaning: RO - Read-only and RW - Read/Write.

### NOTE

For a better understanding of the items listed in the following tables, refer to the corresponding section prior to the feature. E.g.: section for controller redundancy.

## General information of the controllers

| ITEM                         | DESCRIPTION                                | VALID RANGE                               | SNMP SYNTAX                  | ACCESS |
|------------------------------|--|---|------------------------------|--------|
| deviceInfo.deviceDescription | Device type, date and version of firmware. |   | DisplayString (SIZE(0..255)) | RO     |
| deviceInfo.serialNumber      | Device serial number                       |   | INTEGER (0..65535)           | RO     |
| deviceInfo.upTime            | Current up time in seconds                 |   | Counter32                    | RO     |
| deviceInfo.numRestarts       | Number of restarts                         |   | INTEGER (0..65535)           | RO     |
| deviceInfo.batteryStatus     | Battery status                             | 0: noBattery<br>1: maintenance<br>2: good | INTEGER                      | RO     |
| deviceInfo.cpuLoad           | CPU load in percentage                     |   | INTEGER(0..100)              | RO     |

Table 1 – Diagnostic items available by SNMP in DFI302 controllers

## Diagnostic/status of Ethernet ports

For all controllers n = 2 (two Ethernet ports), except for the DF62 controller wherein n = 1 (Ethernet port).

| ITEM  | DESCRIPTION  | VALID RANGE | SNMP SYNTAX        | ACCESS |
|---|--|-------------|--------------------|--------|
| ethernet.defaultGateway                     | Default gateway IP address   |             | IpAddress          | RO     |
| ethernet.ethPort[n].ipAddress[n]            | Current IP address for port [n]  |             | IpAddress          | RO     |
| ethernet.ethPort[n].netmask[n]              | Current netmask for port [n]   |             | IpAddress          | RO     |
| ethernet.ethPort[n].ethResetStats[n]        | This value controls when port [n] statistics should be reset. To reset the statistics, write a value greater than zero. The statistics will be reset and the item value will return to zero. |             | INTEGER (0..65535) | RW     |
| ethernet.ethPort[n].numPacketsSent[n]       | Number of packets sent by port [n]   |             | Counter32          | RO     |
| ethernet.ethPort[n].numPacketsReceived[n]   | Number of packets received by port [n]   |             | Counter32          | RO     |
| ethernet.ethPort[n].numMulticastSent[n]     | Number of multicast packets sent by port [n]   |             | Counter32          | RO     |
| ethernet.ethPort[n].numMulticastReceived[n] | Number of multicast packets received by port [n]   |             | Counter32          | RO     |
| ethernet.ethPort[n].numNoStackBuffers1      | Number of times that a packet is   |             | Counter32          | RO     |

| ITEM                                 | DESCRIPTION   | VALID RANGE                           | SNMP SYNTAX           | ACCESS |
|--------------------------------------|---|---------------------------------------|-----------------------|--------|
|                                      | received by port [n] but the driver does not have a buffer for copying it |                                       |                       |        |
| ethernet.ethPort[n].numCRCErrors[n]  | Number of packets received by port [n] with CRC error                     |                                       | Counter32             | RO     |
| ethernet.ethPort[n].numCollisions[n] | Number of collisions at port [n]  |                                       | Counter32             | RO     |
| ethernet.ethPort[n].ethLinkStatus[n] | Link status for Ethernet port [n]   | 0: Unavailable<br>1: Link established | INTEGER<br>(0..65535) | RO     |

Table 2 – Diagnostic items available by SNMP for Ethernet ports

### Diagnostic/status of serial port

| ITEM                       | DESCRIPTION   | SNMP SYNTAX        | ACCESS |
|----------------------------|---|--------------------|--------|
| serial.serResetStats       | This values controls when serial statistics should be reset. To reset the statistics, write a value greater than zero. The statistics will be reset and the item value will return to zero. | INTEGER (0..65535) | RW     |
| serial.numSerBytesSent     | Number of bytes sent by serial port.  | Counter32          | RO     |
| serial.numSerBytesReceived | Number of bytes received by serial port.  | Counter32          | RO     |
| serial.numSerFCSErrors     | Number of serial frames received with FCS error.  | Counter32          | RO     |

Table 3 – Diagnostic items available by SNMP for serial port

### Specific diagnostic groups

For all tables the abbreviations have the following meaning: RO - Read-only and RW - Read/Write.

### Diagnostic/status of the controller redundancy (DF62, DF63, DF73, DF75, DF89, DF95 and DF97)

| ITEM                        | DESCRIPTION   | VALID RANGE   | SNMP SYNTAX           | ACCESS |
|-----------------------------|---|---|-----------------------|--------|
| redundancy.role             | Current role in redundancy  | 0: undefined<br>1: primary<br>2: secondary  | INTEGER               | RO     |
| redundancy.status           | Current redundancy synchronism status   | 0: undefined<br>1: standAlone<br>2: synchronizing<br>3: updatingSecondary<br>4: synchronized<br>5: roleConflict<br>6: SyncCableFail<br>7: updatingSecFail<br>8: reserved1<br>9: reserved2<br>10: reserved3<br>11: reserved4   | INTEGER               | RO     |
| redundancy.primaryIP        | IP address of the primary device  |   | IpAddress             | RO     |
| redundancy.secondaryIP      | IP address of the secondary device  |   | IpAddress             | RO     |
| redundancy.primarySN        | Serial number of the primary device   |   | INTEGER<br>(0..65535) | RO     |
| redundancy.secondarySN      | Serial number of the secondary device   |   | INTEGER<br>(0..65535) | RO     |
| redundancy.primaryBadCond   | Bad condition indications for primary device. Bit-string type. See beside the bits meaning. | 0: Modbus<br>1: H1-1 (only DF62/DF63)<br>2: H1-2 (only DF62/DF63)<br>3: H1-3 (only DF62/DF63)<br>4: H1-4 (only DF62/DF63)<br>5: LiveList (only DF62/DF63)<br>6: Eth1<br>7: Reserved<br>8: Eth2 (not applicable to DF62)<br>9: Serial Sync Cable<br>10: Unable to Sync | INTEGER<br>(0..10)    | RO     |
| redundancy.secondaryBadCond | Bad condition indications for   | 0: Modbus   | INTEGER               | RO     |

| ITEM                             | DESCRIPTION  | VALID RANGE   | SNMP SYNTAX                     | ACCESS |
|----------------------------------|--|---|---------------------------------|--------|
|                                  | secondary device. Bit-string type. See beside the bits meaning.  | 1: H1-1 (only DF62/DF63)<br>2: H1-2 (only DF62/DF63)<br>3: H1-3 (only DF62/DF63)<br>4: H1-4 (only DF62/DF63)<br>5: LiveList (only DF62/DF63)<br>6: Eth1<br>7: Reserved<br>8: Eth2 (not applicable to DF62)<br>9: Serial Sync Cable<br>10: Unable to Sync              | (0..10)                         |        |
| <b>redundancy.numSwitchOvers</b> | Number of switchovers performed  |   | Counter32                       | RO     |
| <b>redundancy.numStandAlones</b> | Number of StandAlone occurrences   |   | Counter32                       | RO     |
| <b>redundancy.redResetStats</b>  | This value controls when redundancy statistics should be reset. To reset the statistics, write a value greater than zero. The statistics will be reset and the item value will return to zero. |   | INTEGER<br>(0..65535)           | RW     |
| <b>redundancy.statsSince</b>     | Date and time redundancy statistics were reset.  |   | DisplayString<br>(SIZE(0..255)) | RO     |
| <b>redundancy.localBadCond</b>   | Bad condition indications for specified device. Bit-string type. See beside the bits meaning.  | 0: Modbus<br>1: H1-1 (only DF62/DF63)<br>2: H1-2 (only DF62/DF63)<br>3: H1-3 (only DF62/DF63)<br>4: H1-4 (only DF62/DF63)<br>5: LiveList (only DF62/DF63)<br>6: Eth1<br>7: Reserved<br>8: Eth2 (not applicable to DF62)<br>9: Serial Sync Cable<br>10: Unable to Sync | INTEGER<br>(0..10)              | RO     |

Table 4 – Diagnostic items available by SNMP for redundant controllers

### Diagnostic/status of the Foundation H1 ports (DF62 and DF63)

For the following items of H1 Fieldbus ports, DF62 and DF63 have n ranging from 1 to 4 (4 H1 ports).

| ITEM  | DESCRIPTION  | SNMP SYNTAX                            | ACCESS |
|---|--|--|--------|
| <b>fieldbus.applicationTimer</b>            | Current time of application in 1/32 ms since Jan, 1 <sup>st</sup> 1972   | INTEGER64<br>(0..18446744073709551615) |        |
| <b>fieldbus.fbPort[n].portID[n]</b>         | Fieldbus port [n] identification   | INTEGER (0..65535)                     | RO     |
| <b>fieldbus.fbPort[n].fbResetStats[n]</b>   | This value controls when port [n] statistics should be reset. To reset the statistics, write a value greater than zero. The statistics will be reset and the item value will return to zero. | INTEGER (0..65535)                     | RW     |
| <b>fieldbus.fbPort[n].numPDUSent[n]</b>     | Number of fieldbus frames sent by port [n]   | Counter32                              | RO     |
| <b>fieldbus.fbPort[n].numPDUReceived[n]</b> | Number of fieldbus frames received by port[n]  | Counter32                              | RO     |
| <b>fieldbus.fbPort[n].numFCSErrors[n]</b>   | Number of fieldbus frames received with FCS error by port [n]  | Counter32                              | RO     |
| <b>fieldbus.fbPort[n].numClaimLAS[n]</b>    | Number of claim LAS at port [n]  | Counter32                              | RO     |

Table 5 – Diagnostic items available by SNMP for H1 ports

### Diagnostic of redundant I/O modules system (DF62, DF63 and DF75)

The redundant I/O module system, **R-series**, consists of 1 master rack and up to 4 slave racks, addressed as 0, 1, 2 and 3, it being possible for each slave rack add up to 4 pairs of I/O modules addressed as 0, 1, 2 and 3. Refer to the section **Adding Redundancy with Redundant I/O Modules** for further information, such as conditions for switching of controller or I/O modules.



For a better understanding, for each pair of modules (power supply, controller, scanner and I/O module), consider the left module (front view) as module A, and the right module as module B.

| ITEM                                | DESCRIPTION   | VALID RANGE          | SNMP SYNTAX | ACCESS |
|-------------------------------------|---|----------------------|-------------|--------|
| <b>iored.msStatus</b>               | Detailed status for master scanner module. See note 1.  | See table 8          | INTEGER     | RO     |
| <b>iored.ss0Status</b>              | Detailed status for slave scanner module with address 0. See note 1.  | See table 9          | INTEGER     | RO     |
| <b>iored.ss1Status</b>              | Detailed status for slave scanner module with address 1. See note 1.  |                      |             | RO     |
| <b>iored.ss2Status</b>              | Detailed status for slave scanner module with address 2. See note 1.  |                      |             | RO     |
| <b>iored.ss3Status</b>              | Detailed status for slave scanner module with address 3. See note 1.  |                      |             | RO     |
| <b>iored.module00Astatus</b>        | Detailed status for I/O module 00A. See note 2.<br><b>00A</b> → <b>0</b> : Rack 0, <b>0</b> : Pair 0, <b>A</b> : left module.   | See table 10         | INTEGER     | RO     |
| ...                                 |   |                      |             |        |
| Same rule up to the last I/O module |   |                      |             |        |
| <b>iored.module33Bstatus</b>        | Detailed status for I/O module 33B. See note 2.<br><b>33B</b> → <b>3</b> : Rack 3, <b>3</b> : Pair 3, <b>B</b> : right module.  |                      |             | RO     |
| <b>iored.pair00.point000</b>        | Detailed status for point 0 – pair 00. See note 3.<br><b>000</b> → <b>0</b> : Rack 0, <b>0</b> : Pair 0, <b>0</b> : Point 0     | See tables 11 and 12 | INTEGER     | RO     |
| ...                                 |   |                      |             |        |
| <b>iored.pair00.point0015</b>       | Detailed status for point 15 – pair 00. See note 3.<br><b>0015</b> → <b>0</b> : Rack 0, <b>0</b> : Pair 0, <b>15</b> : Point 15 |                      |             | RO     |
| ...                                 |   |                      |             |        |
| Same rule up to the last pair       |   |                      |             |        |
| <b>iored.pair33.point330</b>        | Detailed status for point 0 – pair 33. See note 3.<br><b>330</b> → <b>3</b> : Rack 3, <b>3</b> : Pair 3, <b>0</b> : Point 0     |                      |             | RO     |
| ...                                 |   |                      |             |        |
| <b>iored.pair33.point3315</b>       | Detailed status for point 15 – pair 33. See note 3.<br><b>3315</b> → <b>3</b> : Rack 3, <b>3</b> : Pair 3, <b>15</b> : Point 15 | RO                   |             |        |

**Table 6 – Diagnostic items available by SNMP for redundant I/O modules**

| NOTES   |
|---|
| 1 - When this value is provided by module A, only the controller A will have access. The same is valid for module B and controller B. |
| 2 - Unlike the scanners status, for I/O modules, any controller (A or B) can get the status of the modules (A and B) simultaneously.  |
| 3 - For modules containing only 8 points, should be considered only the first eight point status.                                     |

## Details of status bits for I/O redundant modules

All status items of the I/O redundant system are based on self-diagnosis embedded in all modules. If you need to evaluate details of the modules status, it is possible to interpret each bit for the diagnosis of specific fault conditions.

For tables Master Scanner Status, Slave Scanner Status and I/O Module Status, the bit 7 is the most significant (MSB). This bit is a consolidation of the status of all lower bits, reflecting the overall status of the module. Being this bit the most significant; it is possible to have the overall status module just checking the ranges as shown below. Thus, it is not necessary to use bit masks.

| VALUE      | STATUS  | DESCRIPTION                                     |
|------------|---------|---|
| 0 to 127   | BAD     | Module with failure.                            |
| 128 to 254 | WARNING | Module without failure, but with some warning*. |
| 255        | GOOD    | Module without failure and without warning*.    |

**Table 7 – Range of Status Values**

**NOTE**

\* An alert (warning) does not interfere immediately in the module's functionality, but in the occurrence of other faults the redundant system can be compromised. It is recommended that each warning is identified, reading each bit of the item, and that corrective action is taken.

| <i>iored.msStatus - Detailed status for Master Scanner module</i> |                  |   |                           |                                     |
|---|------------------|---|---------------------------|-------------------------------------|
| BIT   | Identification   | Description   | Value                     |                                     |
|   |                  |   | 1                         | 0                                   |
| 0   | Current in PWR_0 | Overcurrent indication in the first + 5V power input from the power supply A (master rack)    | Current OK                | Current higher than normal          |
| 1   | Current in PWR_1 | Overcurrent indication in the second + 5V power input from the power supply B (master rack)   | Current OK                | Current higher than normal          |
| 2   | Voltage in PWR_0 | Voltage level indication in the first + 5V power input from the power supply A (master rack)  | Normal voltage            | Low voltage                         |
| 3   | Voltage in PWR_1 | Voltage level indication in the second + 5V power input from the power supply B (master rack) | Normal voltage            | Low voltage                         |
| 4   | Partner MS       | Indication of redundant partner status  | Partner master scanner OK | Partner master scanner with failure |
| 5   | Controller MS    | Indication of controller status   | Controller OK             | Controller with failure             |
| 6   | Reserved         | Reserved  | Always 1                  | The value never goes to 0           |
| 7   | Module Status    | Bit that consolidates the module status   | Module Ok                 | Module with failure                 |

**Table 8 – Master Scanner Status**

| <i>iored.ss[n]Status - Detailed status for Slave Scanner module</i> |                  |   |                          |                                    |
|---|------------------|---|--------------------------|------------------------------------|
| BIT   | Identification   | Description   | Value                    |                                    |
|   |                  |   | 1                        | 0                                  |
| 0   | Current in PWR_0 | Overcurrent indication in the first + 5V power input from the power supply A (master rack)    | Current OK               | Current higher than normal         |
| 1   | Current in PWR_1 | Overcurrent indication in the second + 5V power input from the power supply B (master rack)   | Current OK               | Current higher than normal         |
| 2   | Voltage in PWR_0 | Voltage level indication in the first + 5V power input from the power supply A (master rack)  | Normal voltage           | Low voltage                        |
| 3   | Voltage in PWR_1 | Voltage level indication in the second + 5V power input from the power supply B (master rack) | Normal voltage           | Low voltage                        |
| 4   | Partner SS       | Indication of redundant partner status  | Partner slave scanner OK | Partner slave scanner with failure |
| 5   | Reserved         | Reserved  | Always 1                 | The value never goes to 0          |
| 6   | Reserved         | Reserved  | Always 1                 | The value never goes to 0          |
| 7   | Module Status    | Bit that consolidates the module status   | Module Ok                | Module with failure                |

**Table 9 – Slave Scanner Status**

| <i>iored.moduleXYstatus - Detailed status for I/O module</i> |                |  |                     |                           |
|--|----------------|--|---------------------|---------------------------|
| BIT  | Identification | Description  | Value               |                           |
|  |                |  | 1                   | 0                         |
| 0  | HS_PWR_0_5V    | Voltage level indication in the first + 5V power input from the power supply A (master rack)                   | Normal voltage      | Low voltage               |
| 1  | HS_PWR_1_5V    | Voltage level indication in the first + 5V power input from the power supply B (master rack)                   | Normal voltage      | Low voltage               |
| 2  | LS_INT_VCC     | Voltage level indication of the I/O module internal power supply provided by the external power supply (VEXT). | Normal voltage      | Low/High voltage          |
| 3  | LS_EXT_VCC     | Voltage level indication of the external power supply (VEXT).  | Normal voltage      | Low/High voltage          |
| 4  | Reserved       | Reserved   | Always 1            | The value never goes to 0 |
| 5  | Reserved       | Reserved   | Always 1            | The value never goes to 0 |
| 6  | IO_STATUS      | Bit that consolidates the status of the I/O module points (AND logic of all module points).                    | Points with failure | Points with failure       |
| 7  | Module Status  | Bit that consolidates the module status  | Module Ok           | Module with failure       |

**Table 10 – I/O module status**

| <i>iored.pairXX.pointYY - Detailed status of point for digital I/O module</i> |  |       |
|---|--|-------|
| Status  | Description                                  | Value |
| GOOD  | Point Ok                                     | 255   |
| BAD   | Error in self-diagnosis. Point with failure. | 3     |
|   | Unavailable I/O module                       | 0     |

Table 11 – Point status (Digital I/O module)

| <i>iored.pairXX.pointYY - Detailed status of point for analog I/O module</i> |  |       |
|--|--|-------|
| Status   | Description  | Value |
| GOOD   | Point Ok   | 255   |
| BAD  | Error in self-diagnosis. It was not possible to assess the point.                | 3     |
|  | Error in self-diagnosis. Reading the point value is below the allowed tolerance. | 2     |
|  | Error in self-diagnosis. Reading the point value is above the allowed tolerance. | 1     |
|  | Unavailable I/O module   | 0     |

Table 12 - Point status (Analog I/O module)

### Diagnostic/status of the DF87 power supply and DF93 racks (DF62, DF63 and DF75)

| ITEM                                | DESCRIPTION                            | VALID RANGE   | SNMP SYNTAX | ACCESS |
|-------------------------------------|--|---|-------------|--------|
| <b>pwr.rackZ</b>                    | Voltage status of rack Z (rack 16)     | 0: Voltage Ok<br>1: Low voltage<br>2: Unavailable status  | INTEGER     | RO     |
| <b>pwr.rack0</b>                    | Voltage status of rack 0               |   |             | RO     |
| ...                                 |  |   |             | RO     |
| <b>pwr.rack15</b>                   | Voltage status of rack 15              |   |             | RO     |
| <b>pwr.pwrsupply[n].rackPS[n]</b>   | Power Supply Location [n] - rack       | 0 to 3<br>17 – power supply does not configured   | INTEGER     | RO     |
| <b>pwr.pwrsupply[n].slotPS[n]</b>   | Power Supply Location [n] - slot       | 0 to 3<br>4 – power supply does not configured  | INTEGER     | RO     |
| <b>pwr.pwrsupply[n].statusPS[n]</b> | Overall status of the power supply     | <128: Failure (bad)<br>128 to 254: Ok (good), with some alert (warning)<br>255: OK, without failure or alerts (warnings)                            | INTEGER     | RO     |
| <b>pwr.pwrsupply[n].vinPS[n]</b>    | Input voltage status                   | 255 – Ok (good)<br>130 – Warning Hi<br>129 – Warning Low<br>124 – Fail Low<br>120 – Fail Hi<br>0 – Power supply is unavailable or it is not powered | INTEGER     | RO     |
| <b>pwr.pwrsupply[n].voutPS[n]</b>   | Output voltage status                  |   |             | RO     |
| <b>pwr.pwrsupply[n].ioutPS[n]</b>   | Input current status                   |   |             | RO     |
| <b>pwr.pwrsupply[n].ripplePS[n]</b> | Ripple voltage status                  |   |             | RO     |
| <b>pwr.pwrsupply[n].tempPS[n]</b>   | Status of the power supply temperature |   |             | RO     |
|                                     |  |   |             |        |

Table 13 – Diagnostic items available by SNMP for DF87 power supplies and DF93 racks

| IMPORTANT  |
|--|
| <p>For diagnostic information of DF87 power supply there are some restrictions:</p> <ul style="list-style-type: none"> <li>- Only two power supplies can be diagnosed (n = 1 or n = 2). To 3≤n≤6 - future use.</li> <li>- For DF92 and DF106 racks the default positions are: Rack16Slot0 and Rack16Slot1</li> <li>- For DF93 racks, the default position of the power supply is Rack0Slot0.</li> <li>- For DF1A racks, the default position of the power supply is Rack0Slot0.</li> </ul> <p>If there are more than two DF87 power supplies in the system, the diagnostic is only possible through the DIAG1, DIAG2 and DIAG3 LEDs in the module front. Refer to the section Adding power supplies for further information.</p> |

## SNMP items - Additional Information

Some SNMP items require a better understanding as to the valid range values and possible user actions. For these items here additional information is presented.

## Battery status

### deviceInfo.batteryStatus

- 0: noBattery: DIP switch number 1, on the back of the module, in OFF position (check) or discharged battery (required replacement as soon as possible);
- 1: maintenance: Battery end of life (required replacement as soon as possible);
- 2: good: battery in good condition.

## Redundancy

Most redundancy items follow the same principles of the redundancy transducer block (**TRDRED**) parameters. For details, refer to the section **Adding Redundancy to DFI302 HSE Controllers** of this manual.

The items started in "num" are counters and represent statistical information. There are also items to perform the restart or reset of the counters listed at the moment that the user wants. Below are detailed some counters not available in **TRDRED** block.

### redundancy.numSwitchOvers

Indicates the number of times the controller pair exchanged its function (Primary ⇔ Secondary) due to some failure in any of the interfaces (H1, Ethernet, Modbus or R-Series Scanners/Cable).

### redundancy.numStandAlones

Indicates the number of times the controller was in StandAlone state (without redundancy). It can also be understood as the number of times that the controller has taken the primary function due to overall failure of the partner controller (shutdown or general hardware failure).

## Fieldbus

### fieldbus.fbPort[n].numFCSErrors[n]

Indicates the number of FCS errors (Frame Check Sequence) at the reception of port [n].

If this item is increasing in a short period of time, refer to the **FBView** manual, section 3.4.1 **Signal Quality**, to assess the possible problems on the bus.

### fieldbus.fbPort[n].numClaimLAS[n]

Indicates the number of frames "Claim LAS" type on the bus of port [n]. It is expected that these commands occur only at equipment startup and when occur failure/shutdown of the current master LAS. The intermittent increase of this item the system regime condition can also indicate master LAS hardware failure or installation problems on the bus. For details refer to **FBView** manual, section 3.4.3 **Link Master - LAS**.

