MANUAL

INSTALLATION | OPERATION | MAINTENANCE

USER'S GUIDE
LC800

JAN/25

smar
Technology Company

LC800

User's Guide

Consult our subsidiary

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Chapter 1

OVERVIEW

Introduction

LC800 system is the eighth generation of Smar Controllers. It includes communication port and capacity for block execution and IEC-61131-3 Ladder. In addition, the CPU800 controller has two Ethernet ports to ensure high availability of control and supervision, and supports redundancy at all levels, providing the process with a high level of security.

Features and Limits for the CPU800 Module
- 2 Ethernet 10/100 Mbps ports;
- Flexible Functional Block (FFB) support;
- 128 parameters can be linked externally via HSE links;
- Webserver;
- Modbus Gateway;
- Redundant operation;
- Real Time Clock (RTC) and watchdog;
- It has supervision for up to 2000 points per second;

Hardware
In order to preserve customers' investment, the CPU800 module accesses the same I/O cards used in the LC700 system. Through the IMB (Inter-Module Bus), present in the rack where the CPU module is mounted, up to 16 racks R-700-4A or DF93 can be interconnected, each containing up to 4 cards. In case you have a redundant controller, the DF92 rack should be used. If DF92 is used, another 16 DF93 racks can be used. Additionally, there may be a need for other power supplies depending on the number of cards.

The architecture of the LC800 System is integrated into SYSTEM302. Various system software concepts and components have a detailed description in specific manuals, which are:
- Syscon Manual
- LogicView for FFB Manual

SYSTEM302 Architecture

The LC800 is an integral part of Smar's SYSTEM302, as illustrated in Figure 1.1.

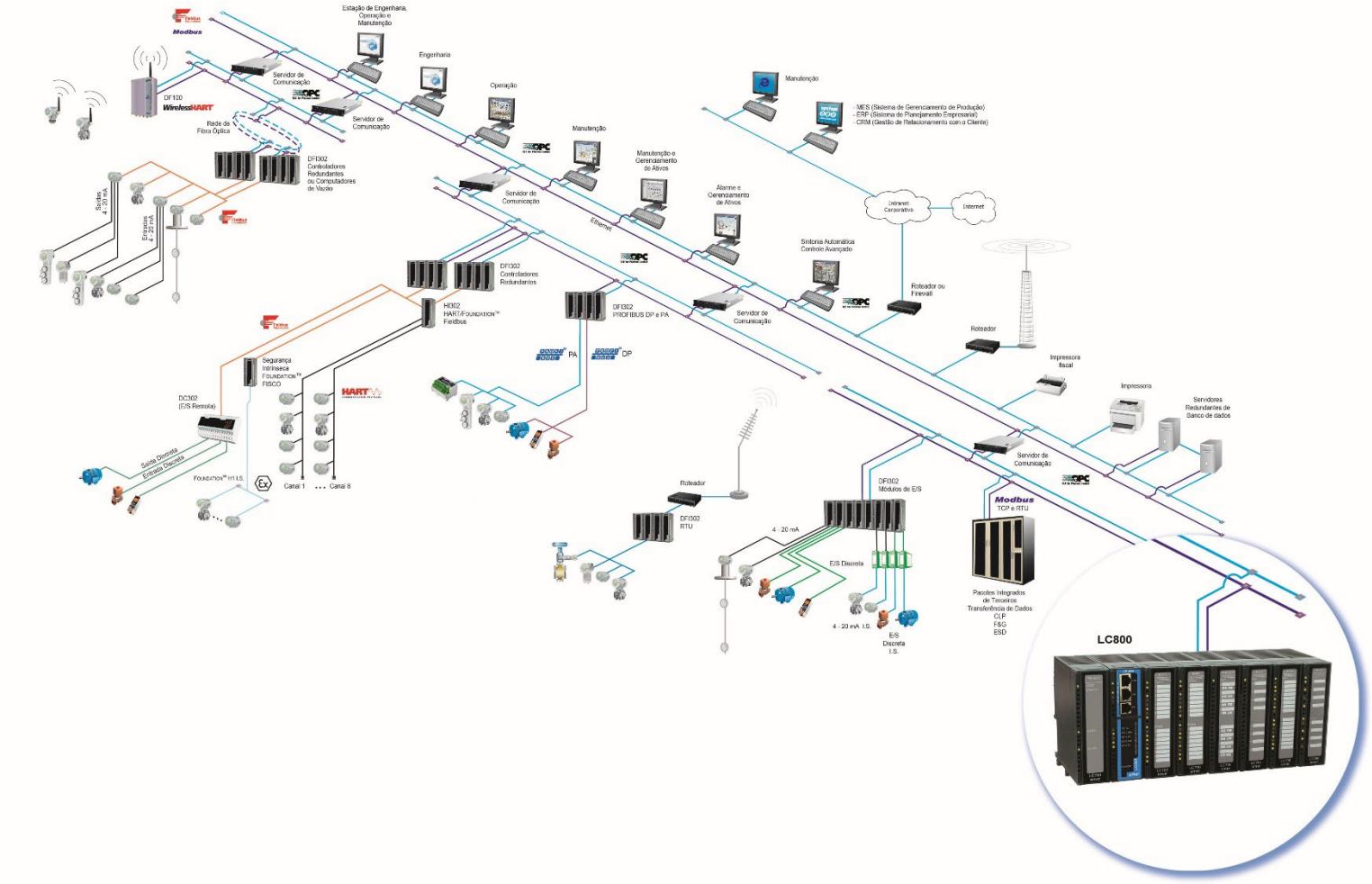


Figure 1.1 - LC800 System in System302 architecture

Among the characteristics of SYSTEM302 we highlight:

Distributed architecture: All system configuration and maintenance can be performed with high efficiency and interoperability.
The system supports:
- *Gateway* Modbus
- *Gateway* Ethernet;
- *Gateway* Profibus;
- H1 Power Supply;
- H1 Barrier;
- Conventional I/O.

High reliability: Distributed architecture ensures high reliability even in harsh industrial environments: no hard disks, no moving mechanical parts. At the software execution level, internal tasks (communication, functional blocks, supervision, etc.) are controlled by a multitasking system, thus guaranteeing real-time and deterministic operation.

Configuration: The system is completely configured through the functional blocks available in the FOUNDATION Fieldbus standard. This allows the whole system (any H1 fieldbus equipment or HSE bridge/gateway from Smar or another manufacturer) to be completely configured by a single application, the Syscon tool.

Supervision: OPC server allows connection to any supervision package. The only requirement is the existence of an OPC client for the package.

Redundancy: the system supports *hot-standby* redundancy in several levels:

- OLE server
- LAS (*Link Active Scheduler*)
- Ethernet
- Functional Blocks"
- H1 *links*
- *Gateway* Modbus

Chapter 2

LC800 ARCHITECTURE

Racks and Modules

Most important elements of LC800 system are the racks and modules. To build a LC800 system, you basically need a CPU module, one or more power supply modules and a set of I/O modules to interact with the field signals.

Modules are plugged into the slots that are part of the racks. Slots connect the modules through a common bus called Inter-Module-Bus (IMB) used by the CPU to communicate with each other.

Racks can be interconnected for system expansion. Each rack has 4 slots. This means that each rack added creates a space for 4 extra modules (See Fig. 2.1).

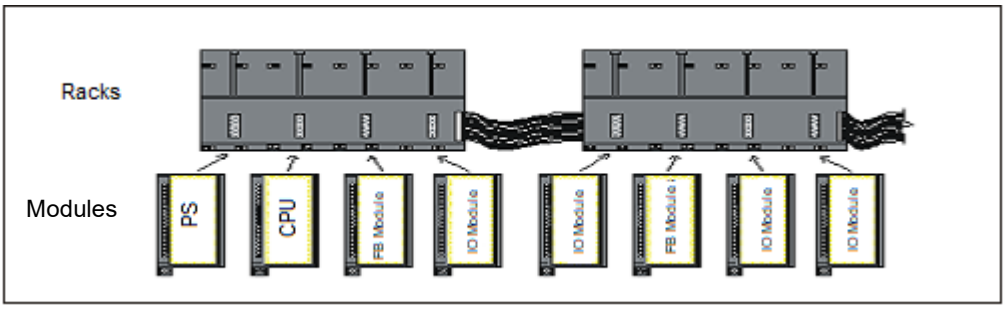


Figure 2.1 - Racks and Modules

LC800 system can have up to 16 racks. This implies a maximum of 64 modules per system.

This section provides instructions on how to assemble an LC800 system. The next topic will describe the basic components of an LC800 system and how to install them.

Basic Components

Rack - A rack is basically a plastic support for the Inter-Module-Bus (IMB) that has connectors where the modules are connected. These connectors, which fit the modules, are called Slots.

Notes:

a) The rack has a rotary key where we select an address. The possible addresses are: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F

b) The main function of IMB is to transport the signals between the modules and the CPU

Module - Plastic box with a labeled lid explaining the terminal connections. There are many types of modules offered for the applications (See section Modules and Accessories). Main module is the CPU module that is responsible for executing the user configuration during the operation time. There are other modules such as: power supply, discrete inputs/outputs, analog inputs/outputs, pulse inputs, motor controllers, fieldbus scanners, remote inputs/outputs, etc.

Racks, Cables and Accessories of LC800 System

Code	Description
M-000	Blind Module to fill empty slots
R-700-4A	Rack with 4 slots - Supports shielded flat cable
T-700	Rack terminator - right side
FC-700-0	Flat cable to connect two racks - length 6.5 cm
FC-700-1A	Flat cable to connect two racks - length 65 cm
FC-700-2A	Flat cable to connect two racks - length 81.5 cm
FC-700-3A	Flat cable to connect two racks - length 98 cm
FC-700-4A	Flat cable to connect two racks - length 110 cm
DF9	Individual module support
DF84	IMB Soft Starter
DF90	IMB Power Cable
DF91	Side adapter
DF93	Rack with 4 slots, with diagnosis
DF96	Terminator for racks - left side
DF101	Flat cable for left side rack connection - length 70 cm
DF102	Flat cable for right side rack connection - length 65 cm
DF103	Flat cable for right side rack connection - length 81 cm
DF104	Flat cable for right side rack connection - length 98 cm
DF105	Flat cable for right side rack connection - length 115 cm

Installing the system base with DF93 racks

In the figure below is the DF93 rack with its components identified.

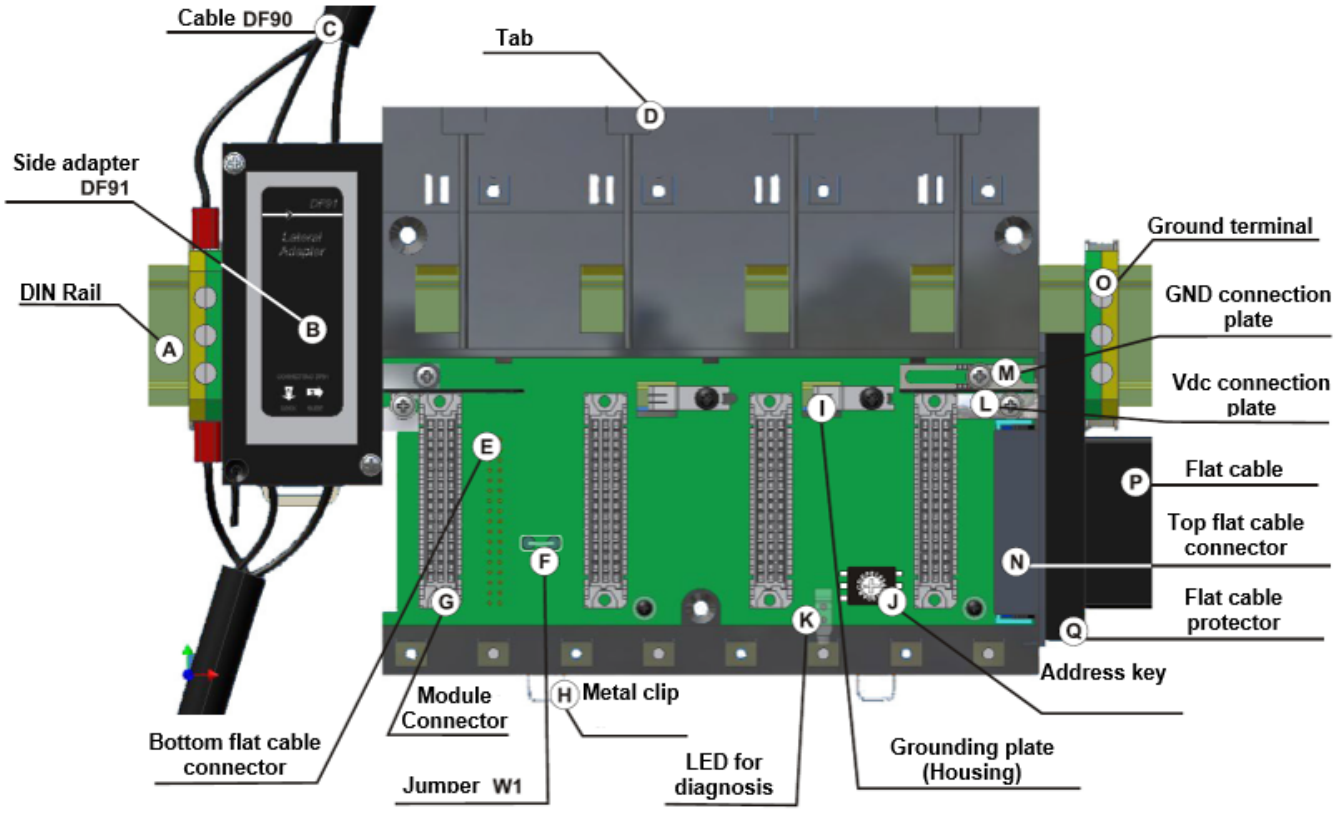


Figure 2.2 –DF93 Rack

A – DIN Rail - Base for fixing the rack. Must be firmly attached to the mounting location of the rack.

B – DF91 side adapter – Allows connection of DF90 cables to the rack.

C – DF90 cable – IMB power transmission cable. In this cable is the Vdc and GND of IMB and must be connected to the left side of the rack.

D – **Tab -** Located on the top of the *rack*. It is used to fix the top of the modules.

E – **Lower Connector for Flat cable** - Allows two racks to be connected through the *Flat cable* (P). When there is more than one rack on the same DIN rail, you should proceed as described later in the topic "Connection between adjacent racks".

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

G – **Module connector** – Connector to fit the bottom of the module to the rack.

H – **Metal Clips** - Metal clips, located on the bottom of the rack, allow it to be attached to the DIN rail. They must be pulled before the rack is snapped onto the DIN rail and then pushed to secure the parts.

I – Grounding plate (housing)

J – Addressing Key – When there is more than one rack in a data bus, the addressing keys allow a separate address to be assigned to each rack.

K – Diagnostic LED – Used for diagnosing sufficient or insufficient voltage in the rack.

L – Vdc connection plate – Vdc terminal (for power transmission).

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

N – Top Connector for Flat cable – Allows two racks to be interconnected through the Flat cable (P). When there is more than one rack on the same DIN rail, you should proceed as described later in the topic "Connection between adjacent racks".

O – Ground terminal – Used to ground the shielding of flat cables.

P –Flat cable - Used to connect the data bus between the racks.

Q – Flat cable Protector - To meet EMC requirements, the ESD protector must be installed on the right Flat cable connection.

Installing the DF93 Racks

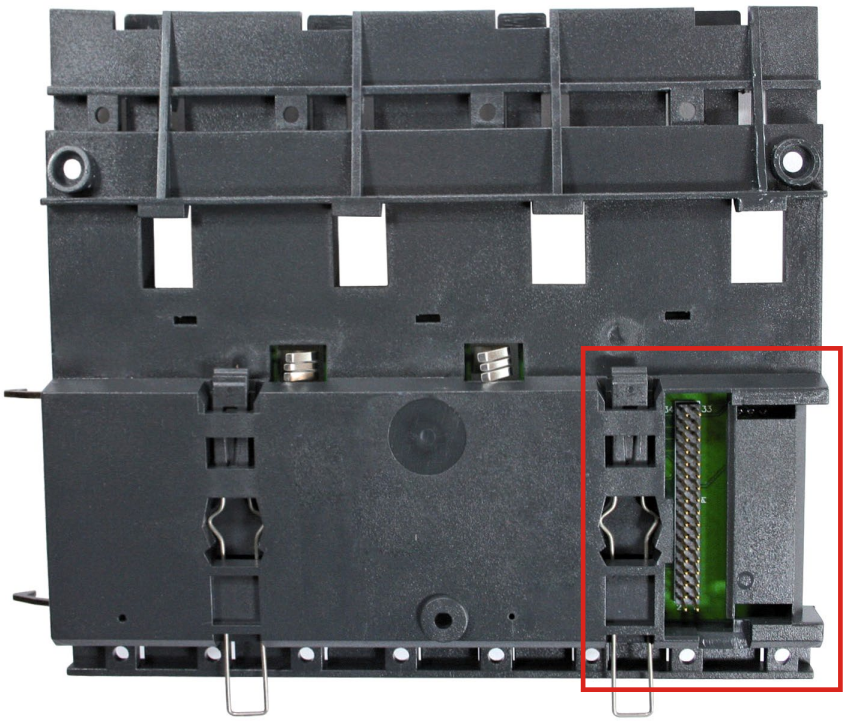


Figure 2.3 – Rear Connector of DF93 Rack

IMPORTANT
Remember to leave space on the DIN rail to install the DF91 and the grounding terminal on the left side of the rack

Installing racks on the DIN rail

IMPORTANT
Before installing the rack on the DIN rail, connect the Flat cable to the rear connector (E) if you will connect this rack to another one from the left. Because once connected to the rail it is not possible to place the flat cable on the back without removing the rack.

1. Use a wrench, or your fingers, to pull down the fixing clips.
2. Attach the rear of the rack to the top edge of the DIN rail.
3. Accommodate the rack on the rail and push the fixing clips up. You will hear a "click" sound when the clips are locked correctly.
4. DF93 rack address must be set using the selection key called *rack number* (J) on the front of the rack.

Connection between adjacent racks

1. The cards adjacent to the junction between the two racks need to be removed to allow access to this operation (slot 3 of the rack on the left and slot 0 of the rack on the right).
2. Connect the two racks with the FC-700-0 flat cable. Flat cable must already be connected to the connector at the rear of the rack on the right. Connect it now to the top connector (N) of the rack on the left.
3. Connect both racks with the metal power connectors (L and M), moving them with the aid of a wrench and fixing them with the screws. Loosen the screws just enough to prevent them from falling out when you make the connection. See next figure.

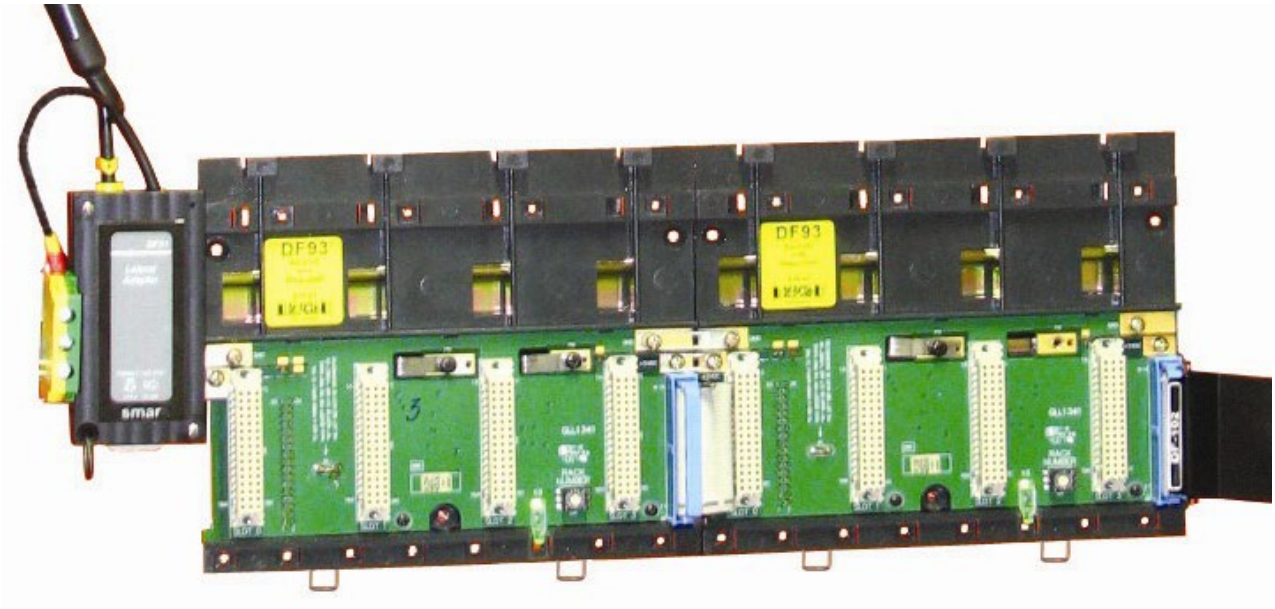


Figure 2.4 – Connection between adjacent racks

Use of DF91
It is important to remember that DF91 must be installed on the left side of each row of racks, for compatibility with EMC standards even if there is no power expansion.

For more details on installing DF91, see the topic "Expanding the System Power - DF90 and DF91".

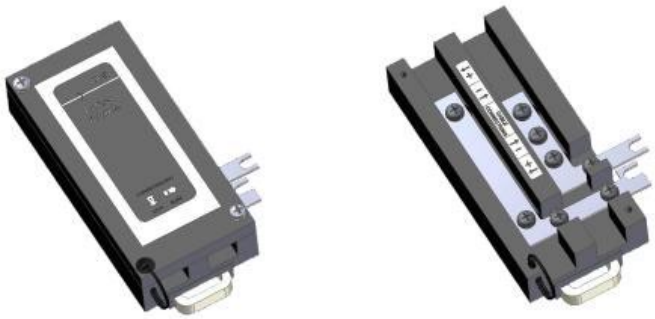


Figure 2.5 –DF91 Details

Rack disconnection
1. The cards adjacent to the junction between the racks involved need to be removed to allow access to this operation.
2. Remove the flat cable from the top connector (N) of the adjacent rack on the left.
3. Remove the power connections (L and M) on both sides of the rack to be uninstalled. To do this, using a screwdriver, loosen the screws (only enough) and move the connection plates to the left until they are completely retracted, leaving the rack free to be removed.
4. If the DF91 (B) is connected to the rack to be removed, move it away until the rack is free to be removed.
5. Remove the bottom connector (E) after removing the rack from the DIN rail.

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

These Flat cables are used when the LC800 is expanded into more than one row of racks, i.e., into different DIN rail segments, one below the other.

DF101 - Flat cable for left side rack connection
It is installed in the rear connectors E of the left end of each row of racks, interconnecting rows 2-3, 4-5 and 6-7 (if any).

To ground the shielding of these flat cables, use a grounding (O) terminal near the flat cables connection. The terminal available next to each DF91 (B) can be used.

DF102, DF103, DF104 and DF105 - *Flat cables* for right side rack connection
It is installed on the top connectors N of the right end of each row of racks, interconnecting rows 1-2, 3-4 and 5-6 (if any).

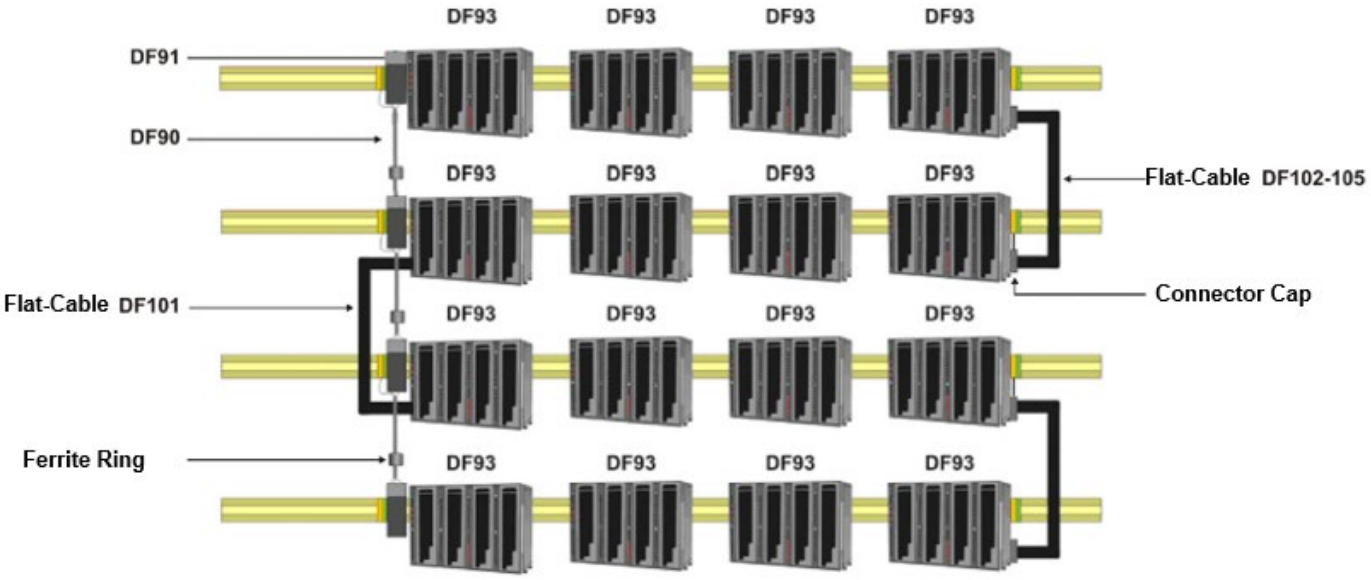


Figure 2.6 – Illustrative drawing – Flat cables DF101 and DF102-105

To ground the shielding of these flat cables, use grounding terminals near the connection of the flat cables to the racks.

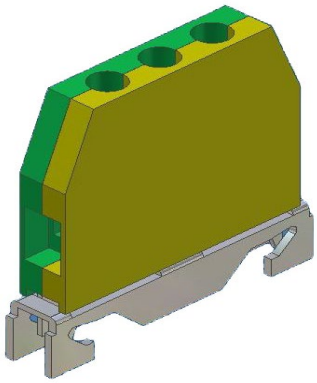


Figure 2.7 – Grounding terminal

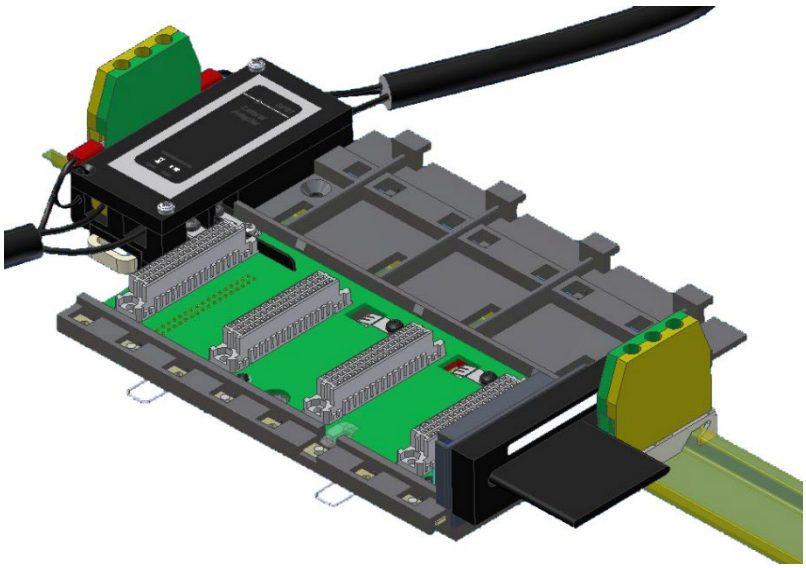


Figure 2.8 –Ground Terminal Installed

Flat cables protector

To meet EMC requirements, the ESD shield must be installed on the right flat cable connection. Figure below shows the flat cable protector being fitted to the cable connector.

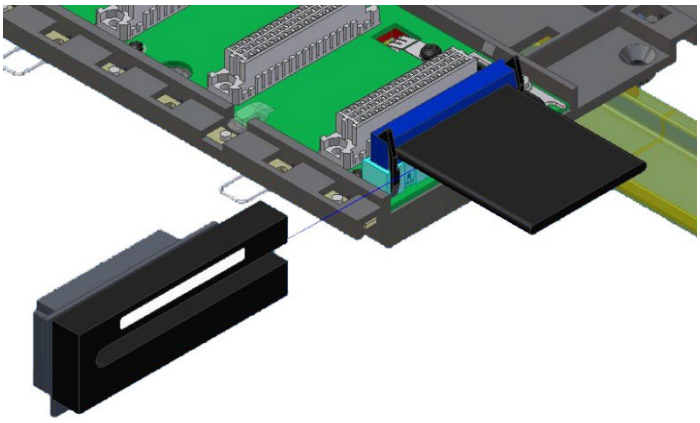


Figure 2.9 – Fitting the flat cable protector

Figure below shows the protector fitted to the connector.

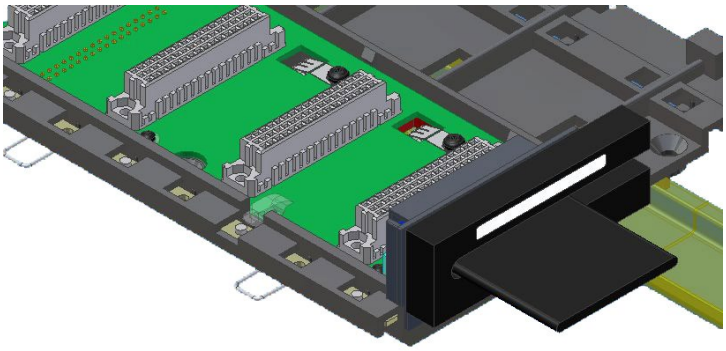


Figure 2.10 – Installed flat cable protector

Installing the terminator at IMB - T-700 or DF96

Only one of these two types of terminators (T-700 or DF96) should be installed at the end of an IMB bus, depending on which side the last rack is connected to the rest of the system.

T-700 – IMB Terminator to the right
It is connected to the N connector on the last rack when it is connected to the other racks by its left. See figure below.

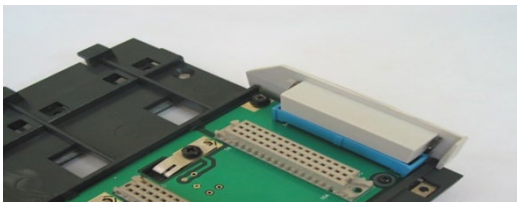


Figure 2.11 – T-700 Terminator installed

Installation
See the pictures below to correctly install the T-700.

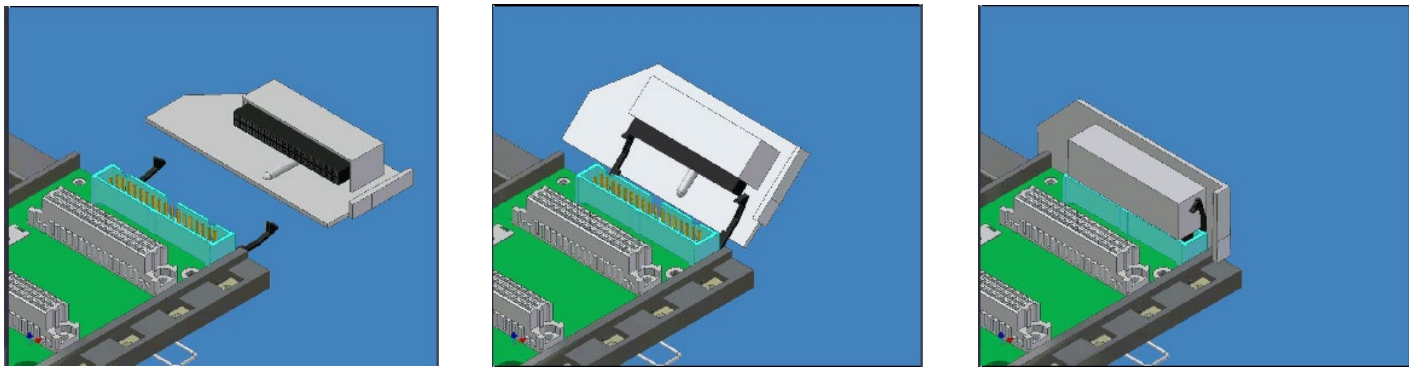


Figure 2.12 – Installing the T-700 Terminator

DF96 – IMB Terminator to the Left
It is connected to the E connector of the last rack when it is connected to the other racks by its right. See figure below.

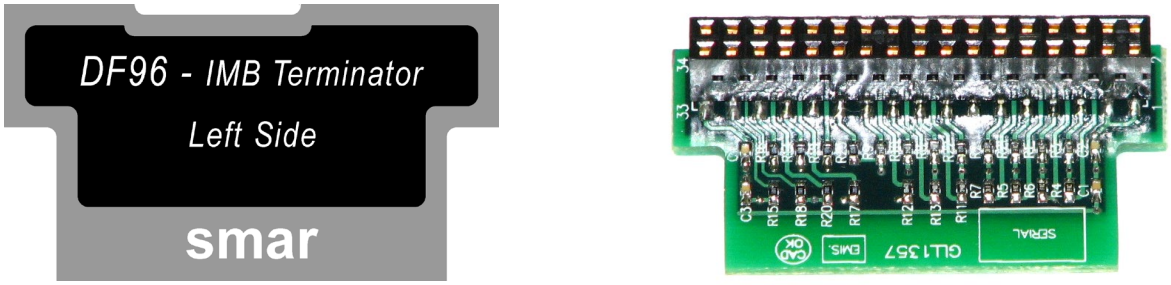


Figure 2.13 –DF96 Terminator

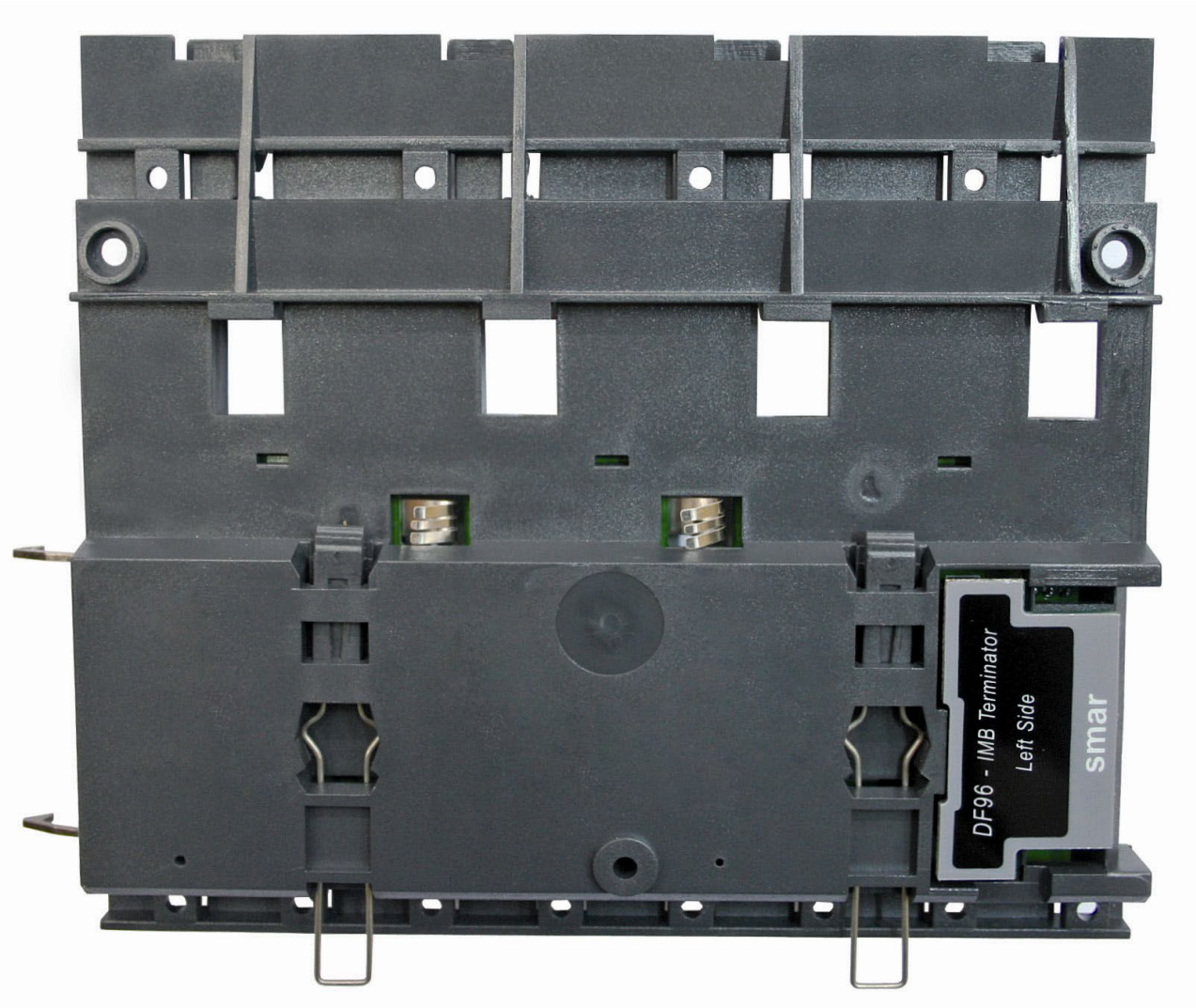


Figure 2.14 – DF96 Terminator installed in DF93 Rack

In short, if the last rack of the panel has the flat cable connected to its left, the T-700 terminator is used. If the last rack has the flat cable connected from its right, the DF96 terminator is used. These two cases depend on the number of rows of racks, whether it is even or odd.

Expanding the power system - DF90 and DF91

This power expansion should be used when the LC800 System is expanded into more than one row of racks, i.e., into different DIN rail segments, one below the other.

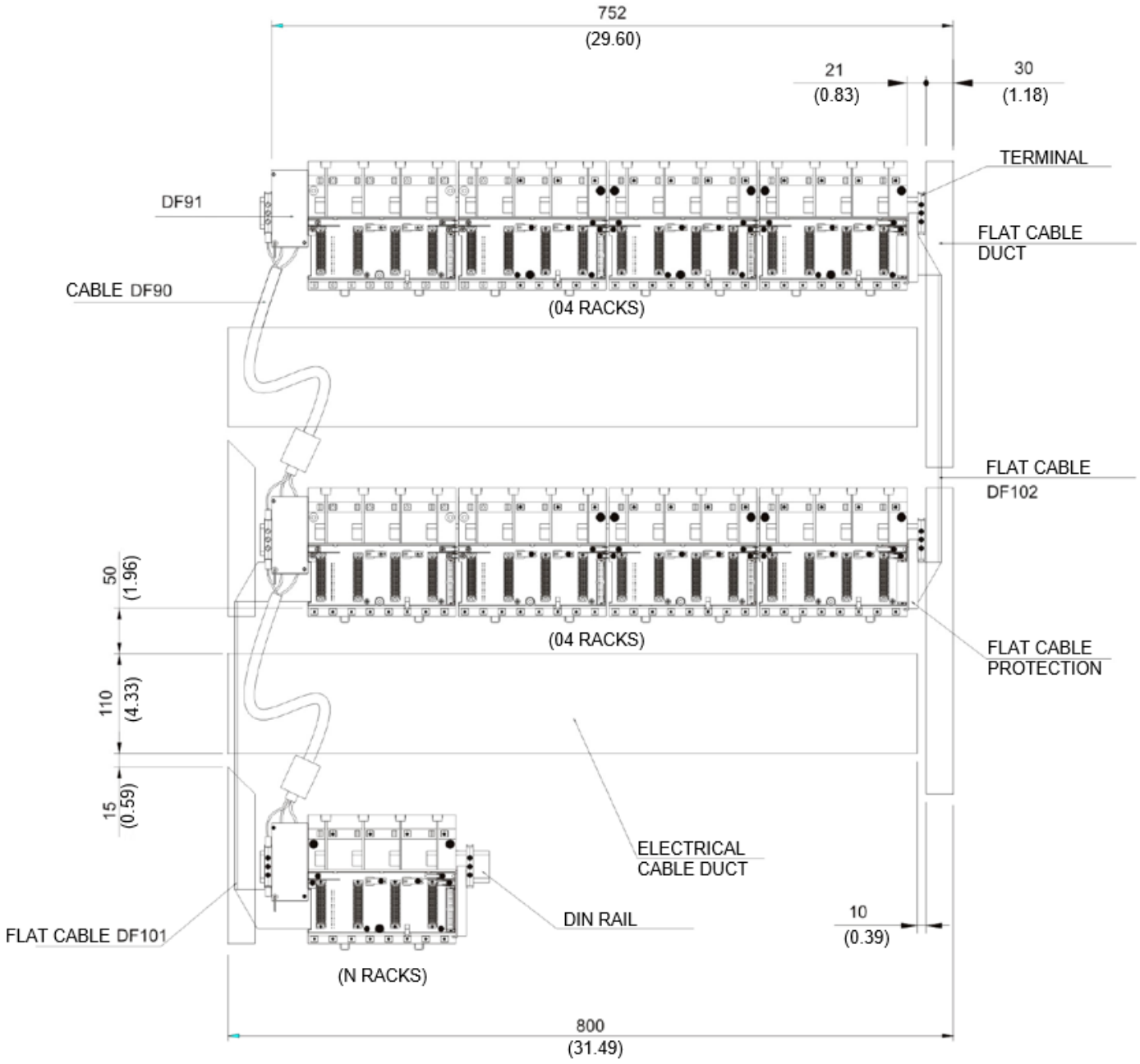


Figure 2.15 – Example of expanded system

IMPORTANT
DF91 must be installed on the left side of each row of racks for compatibility with EMC standards, even if there is no power expansion.

Installing DF91 on the DIN rail
DF91 is installed on the left side of the rack most left of each row of racks.

To connect the DF91 to the DIN rail, snap the back of the DF91 onto the top edge of the DIN rail and then snap the DF91 onto the rail, pushing it until you hear the "click" of the lock.

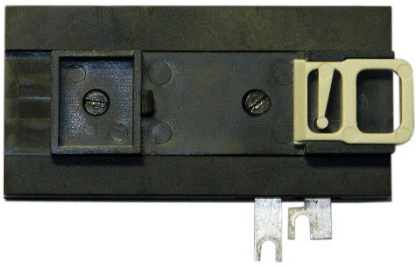


Figure 2.16 – Back of DF91

Connecting DF91 to the rack
The first slot of the rack to be connected must be empty to allow access to this operation.

1. Loosen (only enough) the screws on the rack power connector. See figure below.

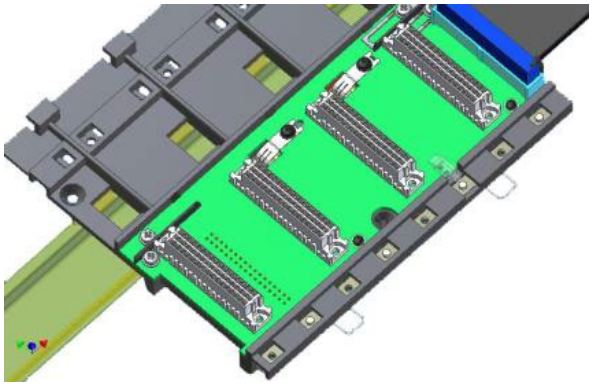


Figure 2.17 – Detail of Rack Power Connector Screws

2. Move the DF91 to the right until it fits the screws.
3. Tighten the screws.
4. After connecting the DF91 to the rack, install the grounding terminal on the left side of the DF91 to keep the DF91 firmly next to the rack. This terminal will also serve to ground the shield of DF90.

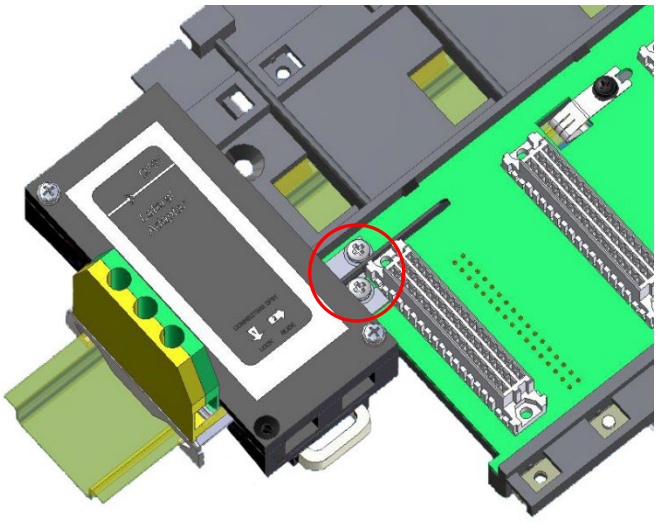


***Figure 2.18 – DF91 connected to the* rack**

Installing the DF90

Figure 2.19 – IMB power cable (DF90)

DF90 links two DF91. To execute such procedure, follow the steps below.

1. With the DF91 already connected to the rack, loosen the screws of its cover and open it;
2. On DF91, loosen the screws indicated with (+) and (-);

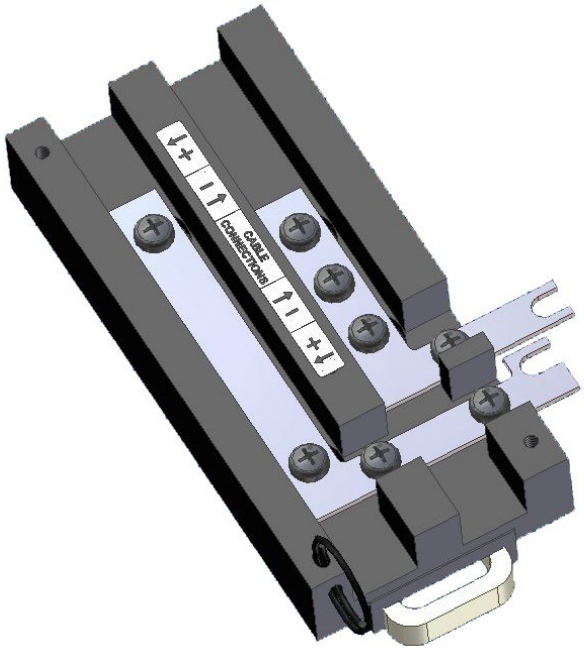


Figure 2.20 – Detail of DF91

3. Fasten the DF90 cable terminals with the DF91 screws, following the polarity indications;
4. Connect the DF90.

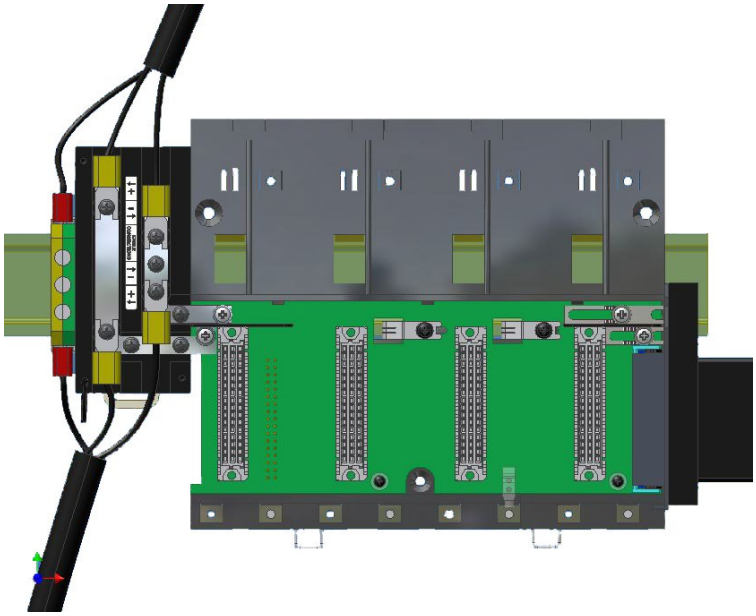


Figure 2.21 – DF91 installed in the rack

5. Close the DF91 cover and tighten the screws.

Disconnection between DF91 and rack

1. The first card in the rack to be disconnected must be removed to allow access to this operation;
2. Loosen (only enough) the screws of the rack power connector, where DF91 is connected;
3. Move DF91 to the left (without moving it away from the rail) until the connection plates of the DF91 are outside the limits of the rack;
4. Tighten the screws on the rack again if you are not going to connect them again;
5. To remove DF91, using a screwdriver, unlock it from the DIN rail by pulling down the latch on its bottom and moving that part of the rail away.

Diagnostic Features

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

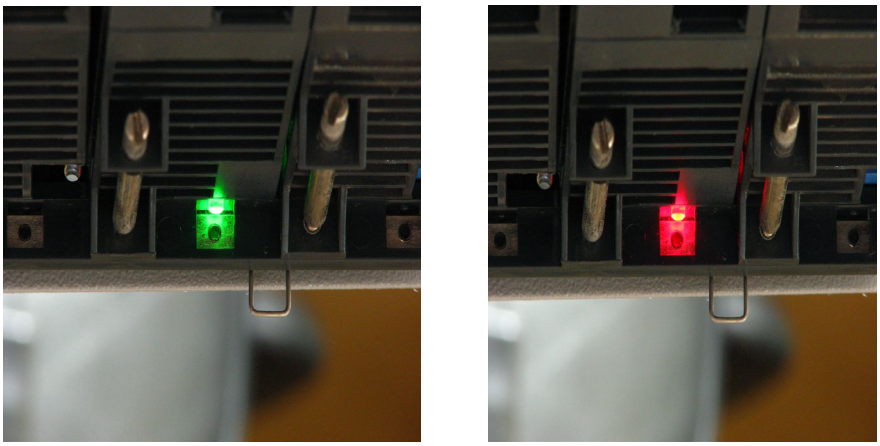


Figure 2.22 – LEDs for diagnostics in the DF93 Rack

Installing the system base with the R-700-4A rack

Look at the pictures of the module and the rack and proceed as instructed:

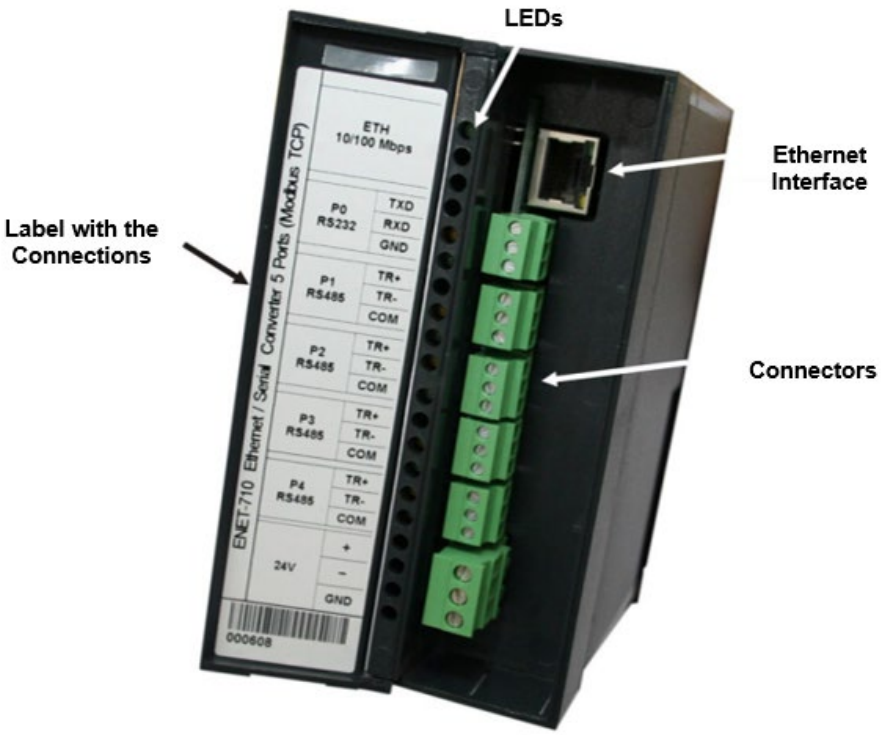


Figure 2.23 - Module

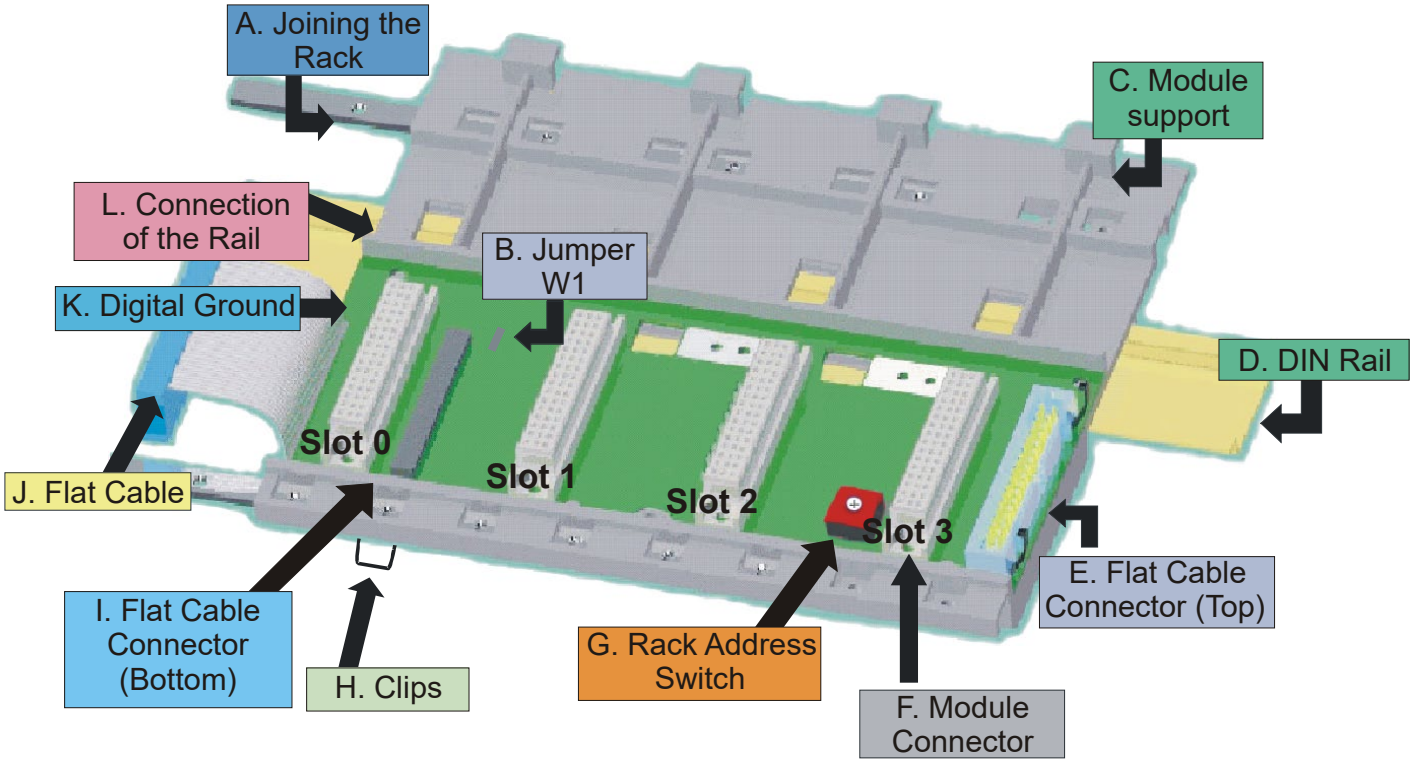


Figure 2.24 - Rack - R-700-4

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).

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.

NOTES
1. Although any application using R-700 as the first rack can use DF84 (IMB soft starter), it is only necessary when the CPU800 executes local logic with discrete output modules. This rule applies only for racks where the controller is installed. 2. When using DF92 rack, DF84 is not necessary, the stabilization feature is already built into the rack's board.

Improving the LC800 Ground Signal (R-700-4A)

Although the R-700-4A rack of the **LC800** system is connected by flat cables for signal transport and power, it is possible that degradation of the ground signal level occurs for applications that use several modules. One solution to keep the ground signal stable and the system more immune to electrical noise is the addition of an extra cable between the racks. These cables should follow the flat cable path to avoid ground loops. The wires should be reinforced and have a gauge of at least 18 AWG.

For adjacent racks use the rack extension connector located on the left side. Clearly, it is possible to have a system with adjacent and non-adjacent racks.

NOTES
1 - The rack containing the CPU module must always be set to zero address. 2 - All other racks can have any address from 1 to 14. 3 - The addresses cannot be repeated in the same LC800 system.

NOTE: Always use the terminator board, T-700, on the last rack.

The Rack

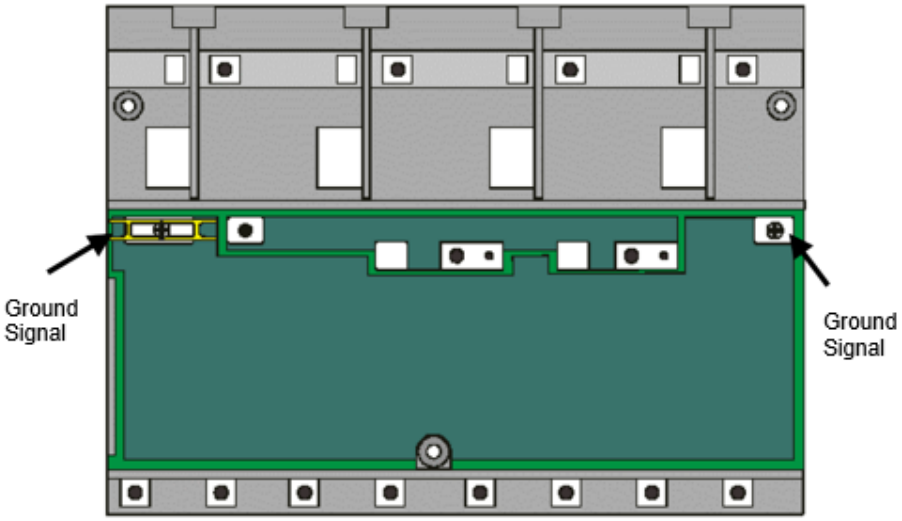


Figure 2.25 - A rack showing all the points where the ground signal cable should be connected

Non-Adjacent Racks

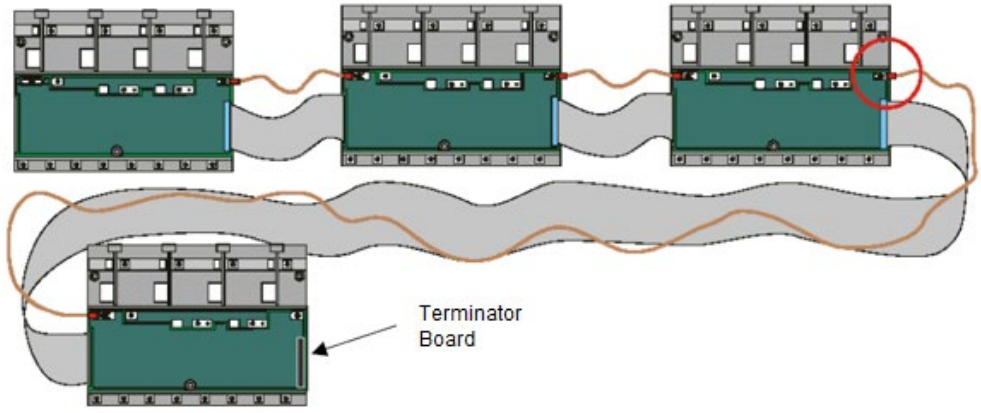


Figure 2.26 - Shows how the ground signal is connected between the Racks.

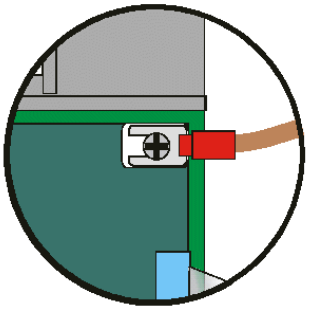


Figure 2.27 - Ground cable connection detail

Adjacent Racks

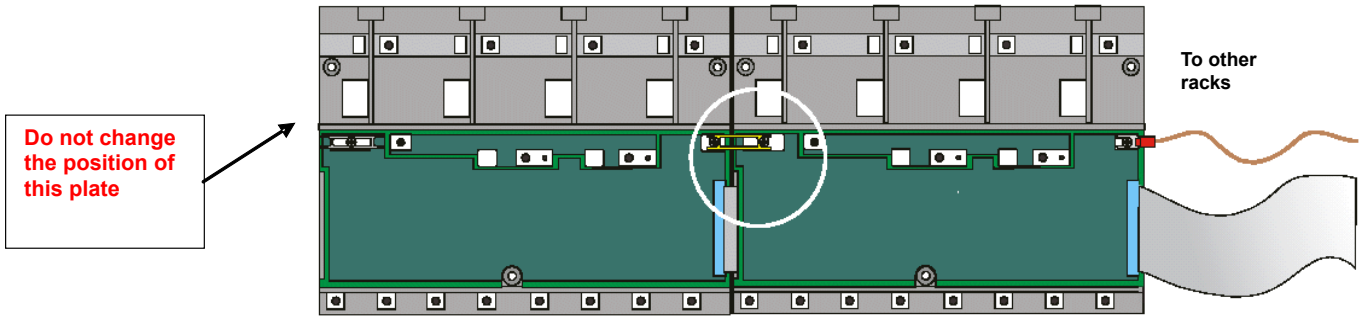


Figure 2.28 - Connecting adjacent racks

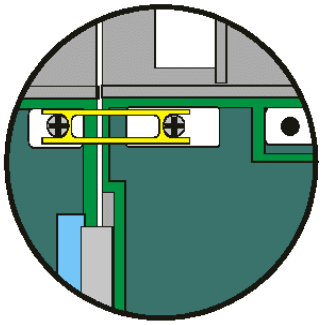


Figure 2.29 - Adjacent Rack Detail

IMPORTANT
It is not advisable to connect the digital ground to the housing ground.

How to Install a Module

It is possible to mix various types of input and output modules at any backplane position despite their voltage levels. However, for best performance, it is recommended that FB700 and M-402 modules be placed as close as possible to the power supply module.

Be sure to write a description of each input and output channel for easy identification. Some modules require a 24 VDC auxiliary source. This can be provided through a PS-AC-R module or an external power supply. These modules can also be used to power external sensors, transmitters, and others.

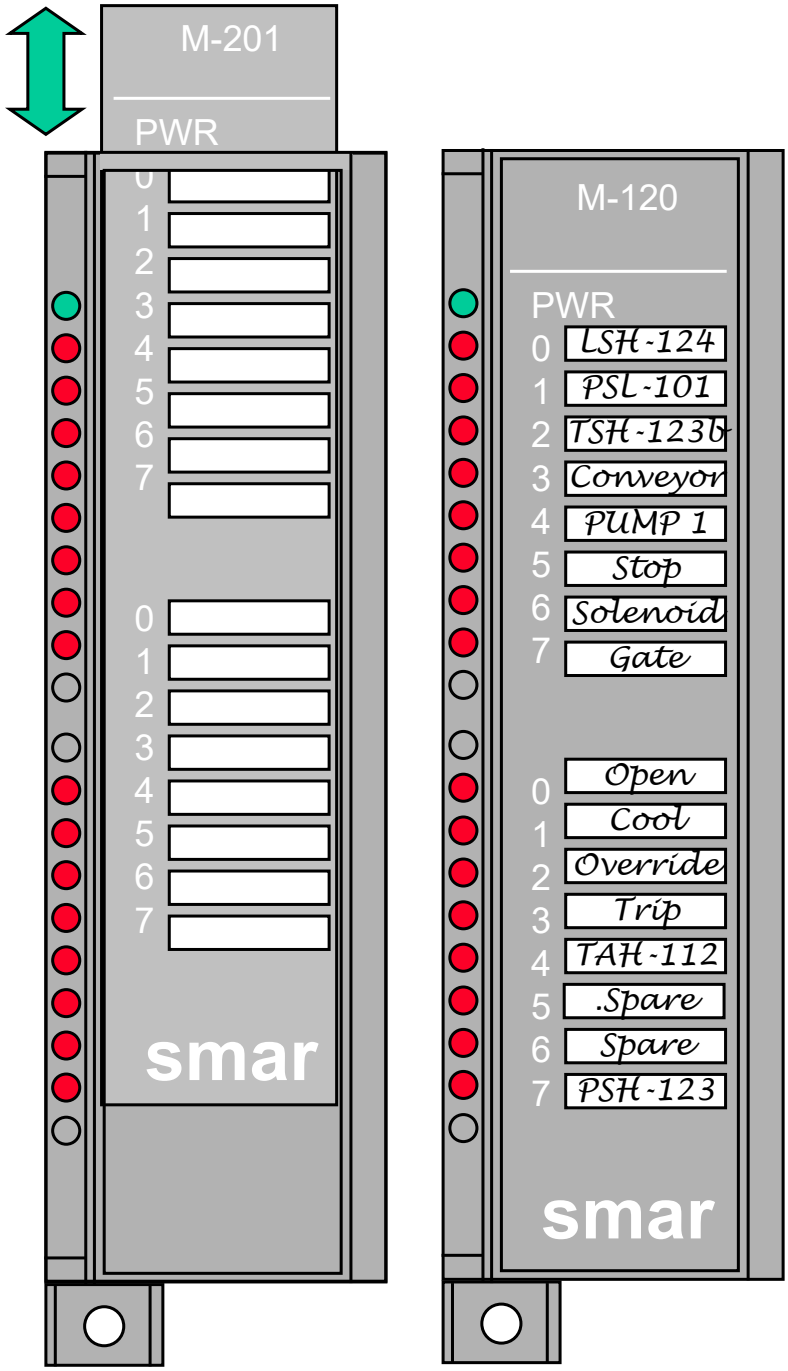
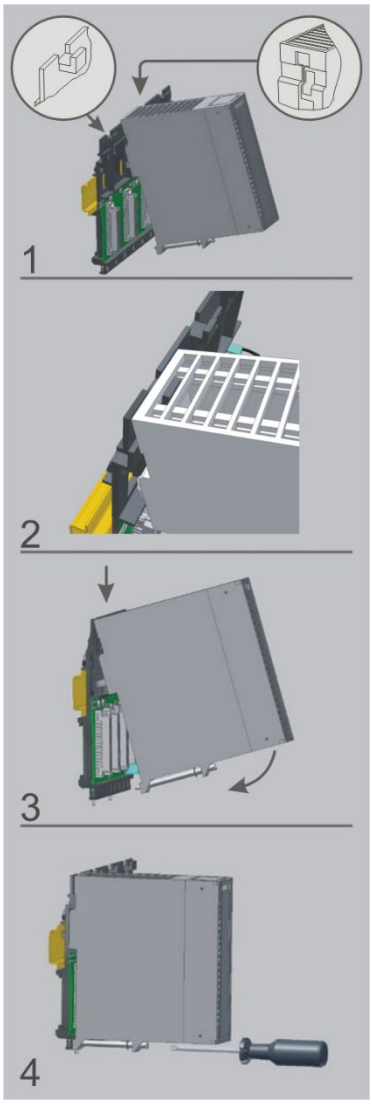


Figure 2.30- Writing down the Description of each channel of the Module

Installing a module

<table>
<tr><td rowspan="4"> 
</td><td>Inserting a module in the rack:
○ Locate the "flap" on the rack that is on top of a free slot.
○ Fit the hole, located at the top and back of the module, into the "flap".</td></tr>
<tr><td>Detail of the fitting.</td></tr>
<tr><td>Lock the module into the IMB connector (slot) by pressing it against the rack.</td></tr>
<tr><td>Finally, secure the module in the rack by using a screwdriver to tighten the locking screw located on the bottom of the module case.</td></tr>
</table>

How to open the module

See the photo below, in which is shown how to open a module.

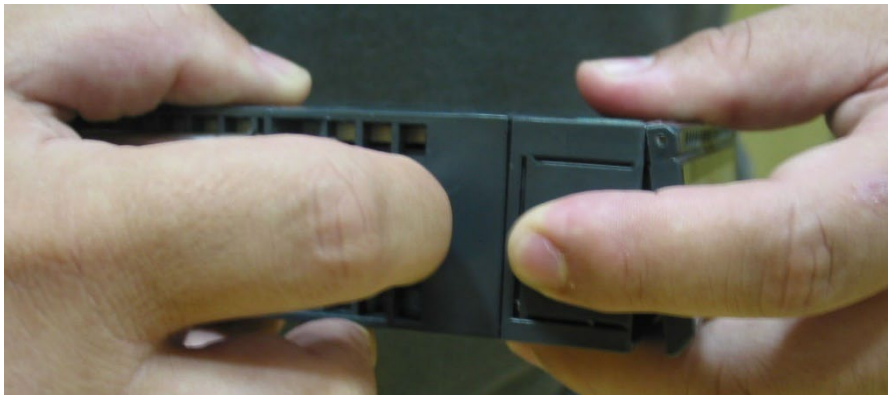


Figure 2.31 – Opening the Module

Basic steps for specifying a LC800 system

1- Know the LC800 family.
A wide variety of components from the LC800 family are available in the **Modules & Accessories** Chapter.

2- Specify Communication Requirements
LC800's CPU already has 2 ethernet communication ports and 1 serial port.

3- Check the available I/O modules
LC800 system has different types of I/O modules. Check the **Modules and Accessories** Chapter and write down the ones you intend to use.

4- Choose and check the type of power supply and the quantity.
There are 2 types of power supply available. For more details, see the Power Supply module types:
- PS-AC-R: AC Power Supply Module
- PS-DC-R: DC Power Supply Module

It is important to calculate the power consumption of the modules to determine how many power supplies will be needed.

NOTE
In the case of the use of long flat cables, the DC voltage of the IMB should be measured to check the need for the addition of another supply module. If the measured voltage is less than 4.95 V a new source must be added. DC voltage is measured between pins 16A and 16C of any of the connectors in the last rack.

Dimensional Drawing of R-700-4 Racks and Modules

Dimensions in mm

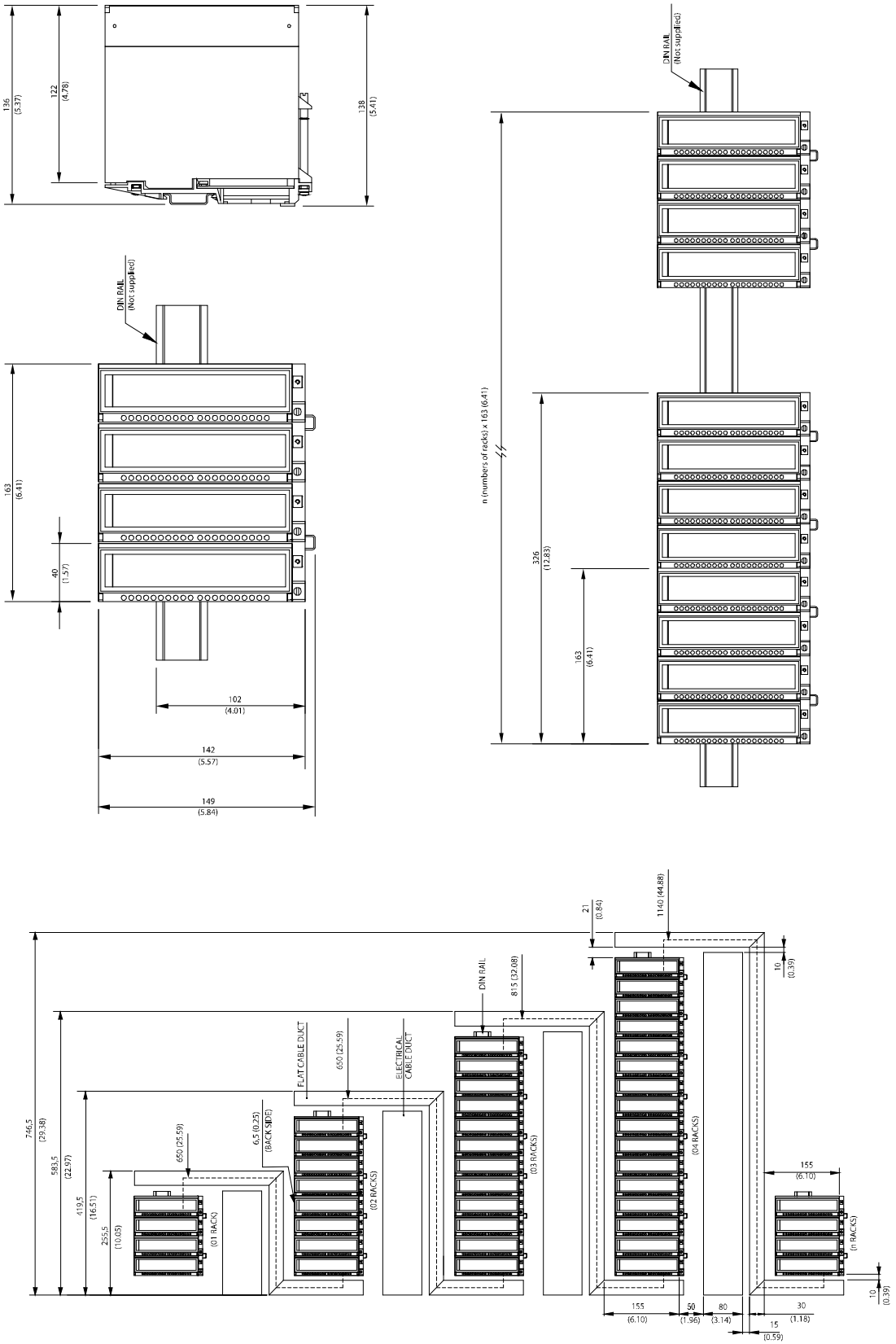
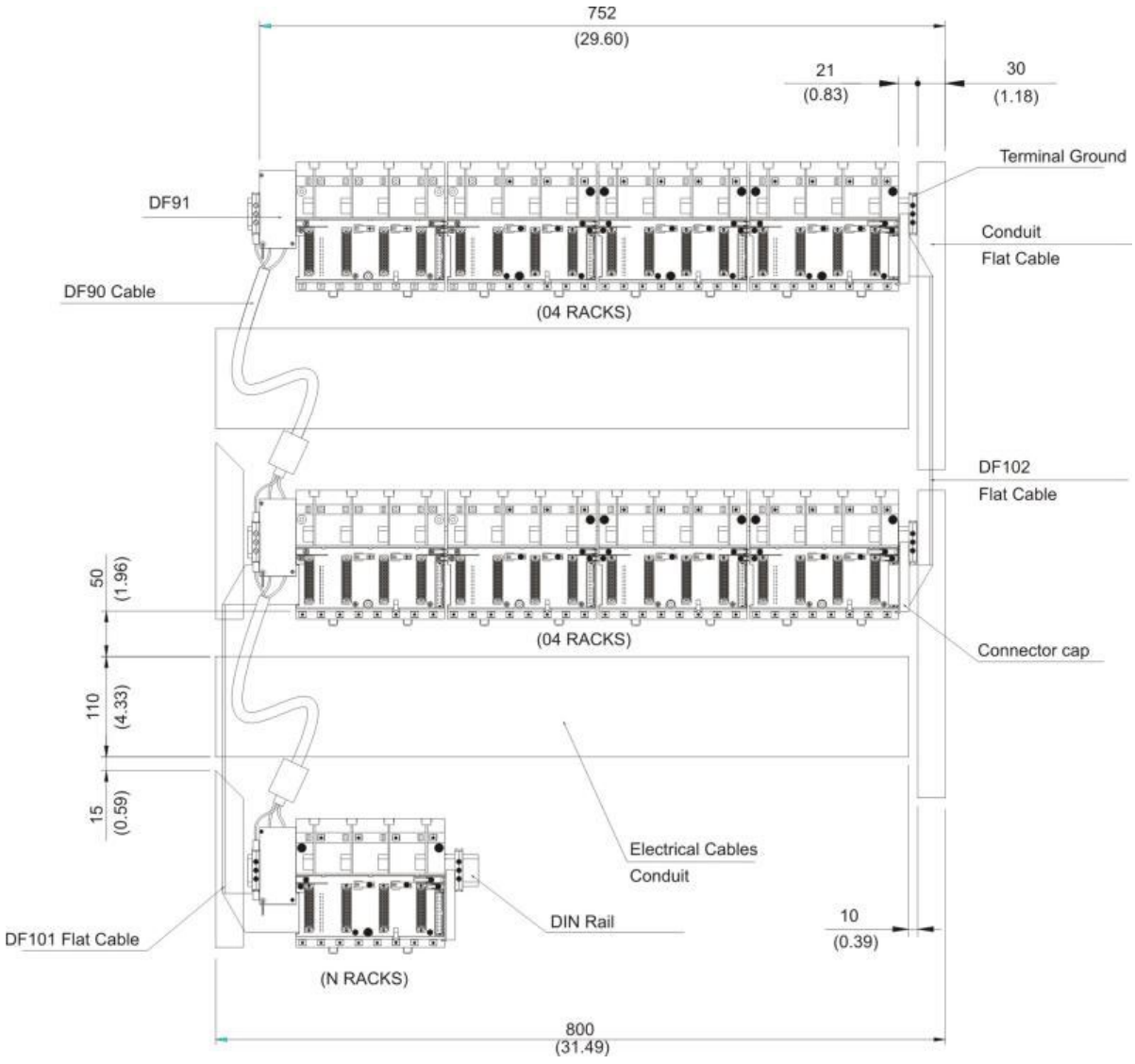
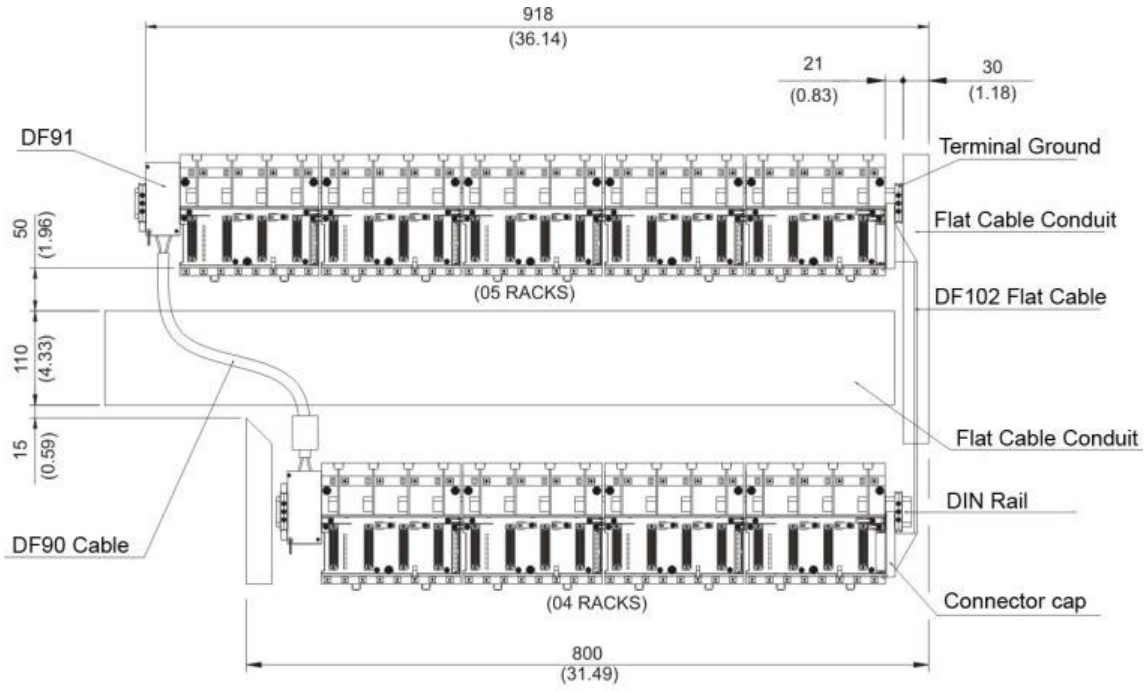


Figure 2.32 – Dimensional Drawing of Racks and Modules

Dimensional Drawing of DF93 Racks and Modules

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





LC800 installation and shipping requirements

Initial Checks

When receiving the LC800, check if:
- Model corresponds to your purchase order;
- Externally, the device has not been damaged during shipping;
- User manual, configuration manual and **SYSTEM302** installation media are in accordance with the requested order;
- The DF84 comes with the product.

Local Conditions for Installation

Power Supply
For the LC800 to operate stably and to maintain system reliability, it is very important that the power supply is of high quality. Requirements below must be followed:

AC Power Supply	Voltage Variation	90 -264 Vac
	Frequency Variation	45-65 Hz
DC Power Supply	Voltage Variation	20-30 Vdc

Environmental Conditions
The temperature and moisture in the control room must meet the limits specified below:
- Room Temperature: 0ºC to 60ºC
- Environment Moisture: 20 to 90% (without condensation)
- Storage Temperature: -20ºC to 80ºC

Air Purity
It is desirable that the environment atmosphere is without corrosive gases or accumulation of dust.

Mechanical Operating Conditions
The limits below must be respected for the LC800 to operate properly.

- Vibration Immunity: 5Hz to 2KHz, 0.4 mm pp/2.5g panel mounted, 1 hr per axis
- Shock Immunity: 10 g, 2 times.
- Noise Immunity: 1.000Vpp, 1 µs.

Tolerable Pollution Degree
LC800 is intended for use in industrial environments with Grade 2 pollution.

Altitude
This equipment can operate in up to 2000m of altitude.

Conditions for Shipping

Temperature for Shipping
Temperature range allowed for this type of equipment is -25 ºC to 70 ºC.

Shipping Precautions
- Ship the controllers in the packages supplied by Smar and in the position indicated on the box;
- Use a shipping method that protects the load from vibration and shock;
- If the boxes are opened and repacked for storage or shipping, be sure to follow the same packing procedure done by Smar;
- During shipping, protect the load from water and direct sunlight, using a canvas or similar.

Hot Swap

Several modules have a new Hardware feature which allows them to be hot swapped without causing CPU control issues. With this feature it is possible to add or remove a module with the IMB bus powered.

NOTE
M-000 module should always be used when there is an empty slot in the rack.

Chapter 3

MODULES AND ACCESSORIES

NOTE
Modules come from the factory with an adhesive plastic protective label that must be removed after installation of the modules.

List of Modules

CPU	
CPU800	Controller with redundant ethernet ports.

POWER SUPPLIES	
PS-AC-R	AC Power Supply for IMB and for output: 90 to 264 Vac or 127 to 135 Vdc. With redundancy capacity.
PS-DC-R	DC Power Supply for IMB and for output: 20 to 30 Vdc. With redundancy capability.
PS302P AC	AC Power Supply 90 to 264 Vac or 127 to 135 Vdc.
PS302P DC	DC Power Supply 20 to 30Vdc.

INPUTS	
M-001	2 groups of 8 inputs of 24 Vdc (optically isolated)
M-002	2 groups of 8 inputs of 48 Vdc (optically isolated)
M-003	2 groups of 8 inputs of 60 Vdc (optically isolated)
M-004	2 groups of 8 inputs of 125 Vdc (optically isolated)
M-005	2 groups of 8 inputs of 24 Vdc (optically isolated)
M-010	2 groups of 4 inputs of 120 Vac (optically isolated)
M-011	2 groups of 4 inputs of 240 Vac (optically isolated)
M-012	2 groups of 8 inputs of 120 Vac (optically isolated)
M-013	2 groups of 8 inputs of 240 Vac (optically isolated)
M-020	1 group of 8 push-button On/Off
M-302	2 groups of 8 pulse inputs of 0-100 Hz-24 Vdc
M-303	2 groups of 8 pulse inputs of 0-10 KHz -24 Vdc
M-304	2 groups of 8 pulse inputs of 0-10 KHz -AC
M-401-R	8 analog current/Voltage inputs with internal shunt resistor (optically isolated)
M-401-DR	8 analog current/Voltage inputs with internal shunt resistor (optically isolated)
M-402	8 low level signal inputs (TC, RTD, mV, Ω) (optically isolated)

OUTPUTS	
M-101	1 group of 16 outputs with open collector (optically isolated)
M-102	2 groups of 8 outputs by transistor (source)
M-110	2 groups of 4 outputs of 120/240 Vac (optically isolated)
M-111	2 groups of 8 outputs of 120/240 Vac (optically isolated)
M-120	2 groups of 4 NO relay outputs with internal RC (optically isolated)
M-121	2 groups of 4 NC relay outputs (optically isolated)
M-122	1 group of 4 NO relay outputs and 4 NC relay outputs (optically isolated)
M-123	2 groups of 8 NO relay outputs (optically isolated)
M-124	2 groups of 4 NO relay outputs (optically isolated)
M-125	2 groups of 4 NC relay outputs (optically isolated)
M-126	1 group of 4 NO relay outputs and 1 group of 4 NC relay outputs (optically isolated)
M-127	2 groups of 8 NO relay outputs with internal RC (optically isolated)
M-501	1 group of 4 analog outputs in current and 1 group of 4 analog outputs in voltage (optically isolated)

INPUTS/OUTPUTS	
M-201	1 group of 8 inputs of 24 Vdc and 1 group of 4 NO relay outputs (optically isolated)
M-202	1 group of 8 inputs of 48 Vdc and 1 group of 4 NO relay outputs (optically isolated)
M-203	1 group of 8 inputs of 60 Vdc and 1 group of 4 NO relay outputs (optically isolated)
M-204	1 group of 8 inputs of 24 Vdc and 1 group of 4 NC relay outputs (optically isolated)
M-205	1 group of 8 inputs of 48 Vdc and 1 group of 4 NC relay outputs (optically isolated)
M-206	1 group of 8 inputs of 60 Vdc and 1 group of 4 NC relay outputs (optically isolated)
M-207	1 group of 8 inputs of 24 Vdc and 1 group with 2 NO relay outputs and 2 NC relay outputs (optically isolated)
M-208	1 group of 8 inputs of 48 Vdc and 1 group with 2 NO relay outputs and 2 NC relay outputs (optically isolated)
M-209	1 group of 8 inputs of 60 Vdc and 1 group with 2 NO relay outputs and 2 NC relay outputs (optically isolated)

CABLES AND ACCESSORIES	
R-700-4A	Rack with 4 slots - Supports shielded flat cable
DF93	Rack with 4 slots, with diagnosis
DF90	IMB Power Cable
FC-700-0	Flat cable to connect 2 racks (6.5 cm)
FC-700-1A	Shielded flat cable to connect 2 racks (65.0 cm)
FC-700-2A	Shielded flat cable to connect 2 racks (81.5 cm)
FC-700-3A	Shielded flat cable to connect 2 racks (98.0 cm)
FC-700-4A	Shielded flat cable to connect 2 racks (114.0 cm)
M-000	Blind Module to fill empty slots
T-700	Rack terminator - right side
DF9	Individual module support
DF84	IMB soft starter
DF91	Side adapter
DF96	Terminator for racks - left side
DF101	Flat cable for left side rack connection - length 70 cm
DF102	Flat cable for right side rack connection - length 65 cm
DF103	Flat cable for right side rack connection - length 81 cm
DF104	Flat cable for right side rack connection - length 98 cm
DF105	Flat cable for right side rack connection - length 115 cm

GENERAL SPECIFICATIONS	
Supply voltage	PS-AC-R: 90 to 264 Vac (47-63 Hz)
	PS-DC-R: 20 to 30 Vdc
Consumption by Power Supply	PS-AC-R: 72 VA
	PS-DC-R: 42 W
Operating Temperature	0 °C to 60 °C
Cooling Method	Air Convection
Storage Temperature	-20°C to 80°C
Environment Moisture	20 to 90% (without condensation)
Vibration Immunity Shock Immunity	5 Hz to 2 kHz, 0.4 mm pp/ 2.5 g panel mounted, 1hr per axis 10 g, 2 times
Noise Immunity	1.000Vpp, 1µs
Environmental Atmosphere	No corrosive gases or dust accumulation

NOTE
For aggressive environments, consult the factory about tropicalized modules.

Module Specification Format

Module specification is shown in a format similar to the example in Figure 3.1. Module specifications explain functionality, field connection, electrical characteristics and show a simplified layout of the interface circuit for better understanding.

DC INPUT MODULE M-005
(SUPPORTS HOTSWAP E DEVICE ID)

Module Name

Part Number

M-005 (2 groups of 8 inputs 24 Vdc isolated)

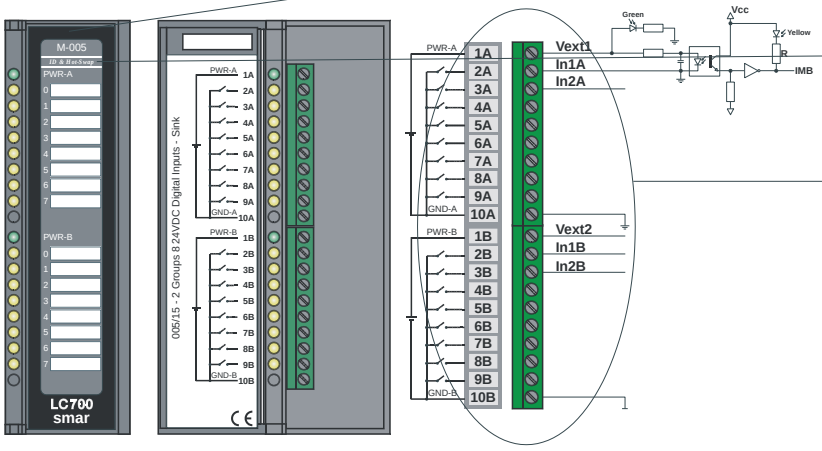
Part Number

Description

The module senses the DC input voltage and coverts it into a True (ON) or False (OFF) logic signal. It has 2 optically isolated Groups of 8 inputs.

Brief Description of the Module

Frontal Panel with labels Of the Channel Tags



Indicates if the module supports Hot Swap and Device ID

External Connections Diagram and Simplified Internal Circuit Diagram

Architecture	
Inputs	**16**
Groups	**2**
Points per Group	**8**

Technical Specification

Figure 3.1 - Module Specification Format

CPU800 - Hardware Specifications

ENVIRONMENT CONDITIONS	
Operating Temperature	0°C to 60°C, 20~90% RH non-condensed
Storage Temperature	-20°C to 80°C, 20~90% RH non-condensed. (To allow 10 years of storage without excessive battery consumption).
Protection Class	IP20 2 - Protection against solid objects with a diameter greater than 12 mm. 0 - No protection for liquids
Power Supply	See specification of the source modules, however, does not support direct powering of the car battery.
Vibration and shock	5 Hz to 2 kHz, 0.4 mm pp / 2.5 g panel mounted, 1 hr per axis 10 g, 2 times
Place of Installation	Sheltered area, without humidity control.

Specifications for the CPU800 module

Order Code

CPU800 – Controller with redundant Ethernet ports

Description

CPU800 module is the eighth generation of Smar Controllers that include communication port and the ability to execute discrete control via ladder logic. In addition, the CPU800 controller has two Ethernet ports to ensure high availability of control and supervision, and also supports redundancy, providing the process with a high level of security.

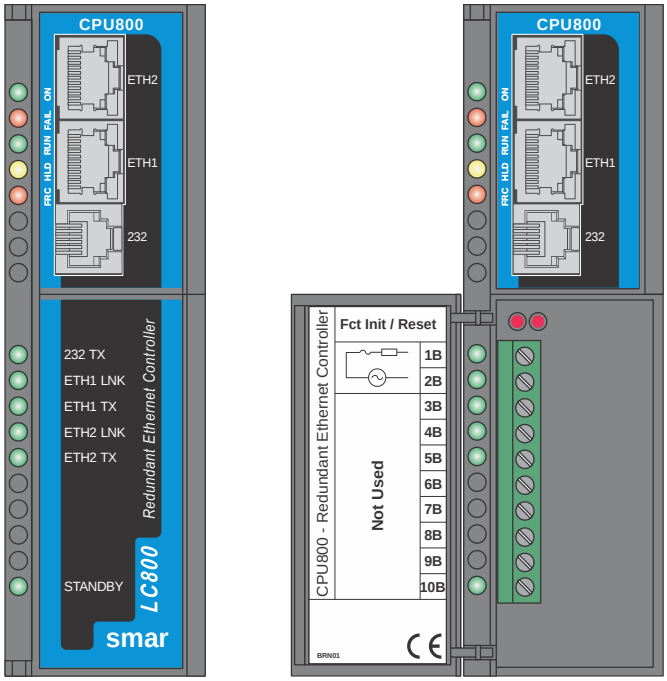
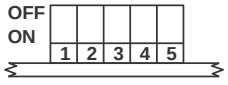


Figure 3.2 - CPU800 – Controller Module



	STORAGING	OPERATION
1 BATTERY	OFF	ON
2	OFF	OFF
3 SIMULATE	OFF	OFF
4 WATCHDOG	ON	ON
5	OFF	OFF

CPU800

Features and Limits for the Module

- 2 Ethernet 10/100 Mbps ports;
- Flexible Functional Block (FFB) support;
- 128 parameters can be linked externally via HSE links;
- Webserver;
- Modbus Gateway;
- Redundant operation;
- Real Time Clock (RTC) and watchdog;
- It has supervision for up to 2000 points per second;

Discrete Control

In order to preserve customers investment, the CPU800 module accesses the same I/O cards used in the LC700 system. Through the IMB (Inter-Module Bus), present in the rack where the CPU module is mounted, up to 16 racks R-700-4A or DF93 can be interconnected, each containing up to 4 cards. In case you have a redundant controller, the DF92 rack should be used. If DF92 is used, another 16 DF93 racks can be used. Additionally, there may be a need for other power supplies depending on the number of cards.

DISCRETE CONTROL FEATURES	
I/O Points*	Maximum 1024 discrete points or 512 analog points
Auxiliary Points	Maximum 4096 points
Functional Blocks for Ladder	Maximum 2000 blocks **
Configuration File	Maximum 120 kbytes **
Program run cycle for every 1000 Boolean operations (without redundancy)	10 ms (minimum)*** 32 ms (typical)****
Program run cycle with redundancy enabled	Adding to the run cycle From 10 ms (typical)***** and up to 50 ms (maximum)
Program Run Time	1,1 ms/Kbyte of program (minimum) 3,7 ms/Kbyte of program (typical)

* Total set of points including inputs and outputs, digital and analog. Maximum quantity may vary depending on the type of I/O hardware used.
** 120 kbytes and 2000 blocks available from firmware version 2.x. Previous versions support 60 Kbytes and 1200 blocks respectively.
*** Flexible block priority 1131 set to Zero (Very high priority), not using blocks and HSE links. Each 1000 Boolean operations use 8.6 Kbytes.
**** Total run time will vary depending on the adjusted priority of the task executing flexible block 1131. It must be compatible with the number of blocks and HSE links.
***** Total transfer time will be proportional to the program size.

Firmware Version and Device Revision

Some firmware version updates may change the version of the equipment, expressed through the Device Revision field and this should be considered during controller configuration. The section "Adding Functional Blocks" describes steps for this configuration. Current existing versions are:

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 for program	4 Mbytes
Flash for monitor	2 Mbytes

* It is maintained by the internal non-rechargeable battery

Battery

Battery type	Panasonic Battery BR-2/3AE2SP of Lithium
Capacity	1200 mAh
Devices maintained by the battery	RTC and NVRAM
Minimum service life	8 years (typical load of 17 µA)
Maximum service life	49 years (typical load of 2.8 µA)
Voltage	3V (submit for review when below 2.5V)

Ports and Communication Channels

ETHERNET PORTS	
Communication Rate	10/100 Mbps
Standard	IEEE 802.3u
Isolation	150 Vrms
Operation Mode	Full duplex
Connector	RJ45 with shielding*

*Grounded to the rack rail that is installed the CPU

MODBUS PORT	
Communication Rate (Maximum)*	115200 bps
Standard	EIA-232
Connector**	RJ12 with shielding
Maximum Current ***	0.5A @ 3.3V

* There is an increase in the error rate as we increase the communication rate above 19200 bps. In many situations these errors may be acceptable and not perceived by supervision.
** Grounded on the rack rail that is installed the CPU
*** Internally protected by solid state fuse

REDUNDANCY PORT	
Communication Rate (Maximum)*	115200 bps
Standard	EIA-232
Connector**	RJ12 with shielding
Maximum Current ***	0.5A @ 3.3V

* Rate for control information. Data traffic over Ethernet.
** Grounded on the rack rail that is installed the CPU
*** Internally protected by solid state fuse

FAILURE RELAY	
Type of Output	Solid state relay, normally closed (NC), isolated
Maximum Voltage	30 Vdc
Maximum Current	200 mA
Overload Protection	Not available. Must be provided externally
Normal Operation	Open contacts
Failure Condition	Closed contacts
Maximum length of the wiring connected to the relay	30 m

The load power supply driven by the fail relay must not be from a network outside the panel.

IMB BUS	
Voltage	5 Vdc
Bus	8 bits
Fault Signal	Yes
Hot Swap	Yes
Redundancy in bus access	Yes, using the DF92 rack

Module Characteristics

CONTROLLER	
CPU	ARM7TDMI Family
Bus	32 bits
Architecture	RISC
Performance	40 MIPS
CPU cache	8 kbytes
Clock	40 MHz
DMA	10 channels
Ethernet	Integrated MAC 10/100
Watchdog	Yes (200 ms cycle)
Operating Voltage	3.3 V for I/O

MODULE	
Operating Voltage	5 V (± 5% tolerance)
Typical Current	550 mA
Actual Consumption	2.75 W
Operating Temperature - Environment	0 – 60 ºC (IEC 1131)
Storage Temperature	-20 - 80 ºC (IEC 1131)
Air Relative Humidity (Operation)	5% - 95% (without condensation)
Cooling Mode	Air Convection
Dimensions (H x W x D,mm)	149 x 40 x 138 (without enclosure)

Electrical Certification

CPU800 follows the specifications of immunity tests applied to equipment in industrial installations, according to 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

Limits of Emission

ENCLOSE	
30 a 230 MHz (CISPR 16-1, CISPR 16-2)	40 dB (uV/m) *quasi peak, measured at* 10 m *distance*
239 a 1000 MHz (CISPR 16-1, CISPR 16-2)	40 dB (uV/m) *quasi peak, measured at* 10 m *distance*

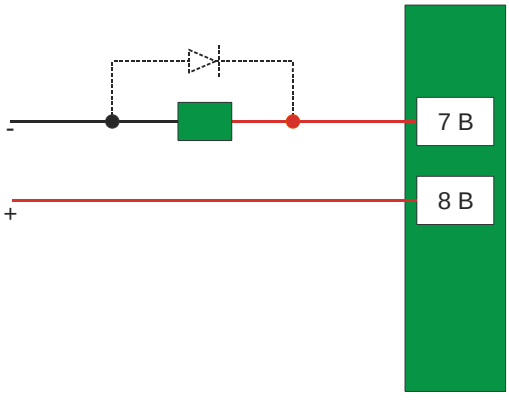
AC MAINS	
0,15 a 0,5 MHz (CISPR 16-1, CISPR 16-2)	79 dB (uV) *quasi peak* 66 dB (uV) *average*
0,5 a 5 MHz (CISPR 16-1, CISPR 16-2)	73 dB (uV) *quasi peak* 60 dB (uV) *average*
5 a 30 MHz (CISPR 16-1, CISPR 16-2)	73 dB (uV) *quasi peak* 60 dB (uV) *average*

Indication LEDs

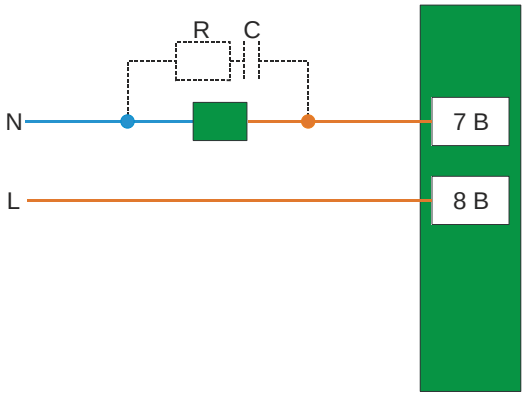
Table below shows the names, colors, descriptions, and behavior of the LEDs.

LED	COLOR	DESCRIPTION	BEHAVIOR
+5V DC (ON)	Green	Indicates when the module is on	Green lit when power is on the module
FAIL (FAIL)	Red	Indication of hardware failure	Red lit when in failure
RUN (RUN)	Green	Indicates when the controller is operating in normal mode	Green lit when in operation
HOLD (HLD)	Yellow	Indicates when the controller is in standby mode. In standby mode (HOLD) the controller does not execute no application and does not interfere with plant operation (access via I/O cards or via digital bus is disabled).	On when the controller is in standby mode (HOLD).
FORCE (FRC)	Red	1 - It signals different initialization or maintenance modes requested by the operator via front push-buttons (FACT INIT, HOLD and IP Address). 2 - Indicates power failure when the operating voltage starts to fall below the expected value of 4.8 V (low line). 3 - Indicates any problem of battery.	1 - Depending on the number of times the right push-button is pressed, the FRC LED flashes at a certain rate for a time interval to signal the chosen mode (see details in the *Troubleshooting* section). 2 - Permanently lit. Module will reset if the voltage reaches 4.6 V (HLD and FAIL LEDs light together temporarily). 3 - FRC LED flashing and HLD LED on during module start-up - indicates worn-out battery or rear battery DIP switch off (see *Troubleshooting* section for details)
232 TX	Green	Indicates activity on RS-232 port	Green flashing when RS-232 port is used (transmitting data).
ETH1 LNK	Green	Indicates when the Ethernet link is active (ETH1 port)	Green lit when Ethernet link was established (ETH1 port)
ETH1 TX	Green	Indicates communication activity at ETH1 port	Green flashing when there is activity at the port ETH1 (transmitting data)
ETH2 LNK	Green	Indicates when the Ethernet link is active (ETH2 port)	Green lit when Ethernet link was established (ETH2 port)
ETH2 TX	Green	Indicates communication activity at ETH2 port	Green flashing when there is activity at the port ETH2 (transmitting data)
STANDBY	Green	With the HOLD LED on, this flashing LED indicates that the firmware update is in progress. With the HOLD LED off, it indicates the role of the controller in redundancy as well as the status of synchronism.	There are several flashing patterns to indicate different synchronism states. See the redundancy section for details.

NOTE
To increase the durability of your contacts and to protect the module from reverse voltage damage, externally connect a clamping diode in parallel with each DC inductive load or connect a snubber RC circuit in parallel with each AC inductive load.



DC Load



AC Load

PS-AC-R – Power Supply Module - - 90 to 264 Vac input - Redundant

Description

This redundant power supply works independently or in conjunction with other 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:
5 Vdc @ 3 A: distributed by Power Lines in the Inter-Module-Bus (IMB) throughout the racks to supply the module circuits;
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 using DF93 racks, together 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
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. More details on the Power supplies positioning topic.
The **PS-AC-R CH1** jumper always must be connected to the **E** position.

Power supplies positions in the racks
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 using the R700-4A rack

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 **R-700-4A** 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

- Split power concept: In this case of redundancy, the user may have two power supplies modules in parallel in first and third slots of rack **R-700-4A**. The **CH1** jumper (power supply) must be set in **R** position in both modules and **W1** jumper (power supply) must be opened in 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 **R-700-4A**. In both modules, the jumper **CH1** must be set in the position **R** and **W1** jumper must be placed only in the backup module.

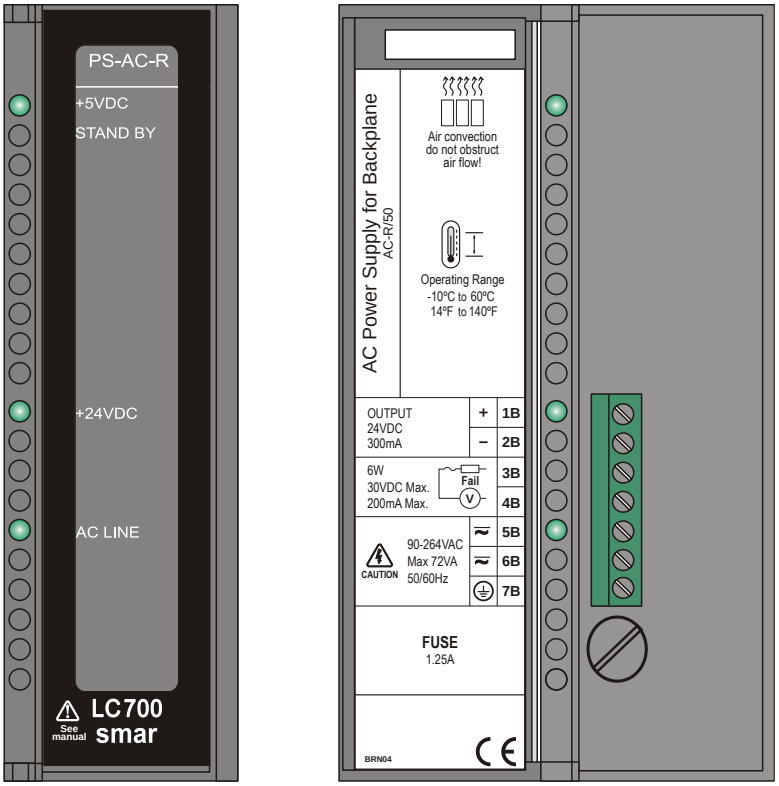


Figure 3.3 AC Power Supply Module

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. [ΔT < 740 µs]
Time until Power Fail	6 ms @ 102 Vac (120 Vac – 15%) [Full Load]
Time until Shutdown	> 27 ms @ 102 Vac; > 200 ms @ 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	+24 Vdc (Green LED)

ISOLATION	
Input, internal output and external output signals are isolated between them.	
Between outputs and ground	1000 Vrms
Between input and output	2500 Vrms

FAILURE RELAY	
Type of Output	Solid state relay, normally closed (NC), isolated
Limits	6 W, 30 Vdc max, 200mA max
Maximum Initial Contact Resistance	<13Ω
Overload Protection	Should be provided externally
Operation Time	5 ms maximum

TEMPERATURE	
Operation	-10 ºC to 60 ºC (14 ºF to 140 ºF)

DIMENSIONS AND WEIGHT	
Dimensions (L X H X D)	39.9 x 137.0 x 141.5 mm (1.57 x 5.39 x 5.57 in)
Weight	0.450 kg

CABLES	
One wire	14 AWG (2 mm^2)
Two wires	20 AWG (0,5 mm^2)

NOTES

- If the power consumption exceeds the power supplied, the 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.
- 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 a RC snubber circuit in parallel with each inductive AC load.
- 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.
- The redundancy feature is only assured for the hardware with GLL1270 equal or greater than Revision 2. Hardware models which are below the review referred need consulting the Smar technical support for compatibility check.

PS-DC-R – Power Supply for Backplane 20 – 30 Vdc

Description

This redundant power supply works independently or in conjunction with another redundant power supply module to ensure a constant power supply to backplane.
When two power supplies are used, they both divide the power that needs to be supplied to the system. When one of the sources fails, the other will automatically take over the operation. Each power supply has a relay to indicate failure, allowing the user to replace the damaged source.

This module has two voltage outputs:

a) **5 Vdc @ 3A** distributed by the power lines in the Inter-Module-Bus (IMB) through the racks to feed the module circuits.

b) **24 Vdc @ 300mA** for external use through 1B and 2B terminals.

DC voltage applied, 5 Vdc and the 24 Vdc are isolated from each other.

Configuration and Installation

For systems using DF93 racks, together with DF90 and DF91

Redundancy Option
Power Division Concept ("splitting power"): In this situation, the two sources supply power to a segment of the bus. If one is de-energized or fails, the other must be able to power the segment on its own. **CH1** Jumper must be placed in **R** position.

Expansion of load capacity with addition of sources
If the system requires more than 3A of current, it can be subdivided into up to 8 groups sized for consumption of up to 3A each and each group can be individually fed by a source. See more details in the topic Positioning of power supplies. **CH1** Jumper must be placed in **E** position.

For systems using the R700-4A rack

Single module: **less than** 3 A are required:
There is an addressing restriction regarding the location of the power supply. The restriction is that the first rack (0 address) must always have a power supply module in the first *slot*. **CH1** Jumper must be placed in **E** position.

More than one module: **more than** 3 A are required.
For systems using **R-700-4A** *rack*, the power supplies must always be placed in the first *slot* of their respective racks. The **W1** Jumper in the *rack* containing the new power supply must be cut off In this way, any new power supply will only supply power to the rack in which it is located and to the later ones (it will not supply to the previous racks). In all modules the **CH1** Jumper must be placed in **E** position.

Redundant Mode
In case of redundancy, the power supply modules must be placed in the first and third slots of the R-700-4A *rack*. In both modules, the **CH1** Jumper (of the power supply) must be placed in the **R** position. In this condition, the sources will divide the power supply. This operating topology is called "split power mode".

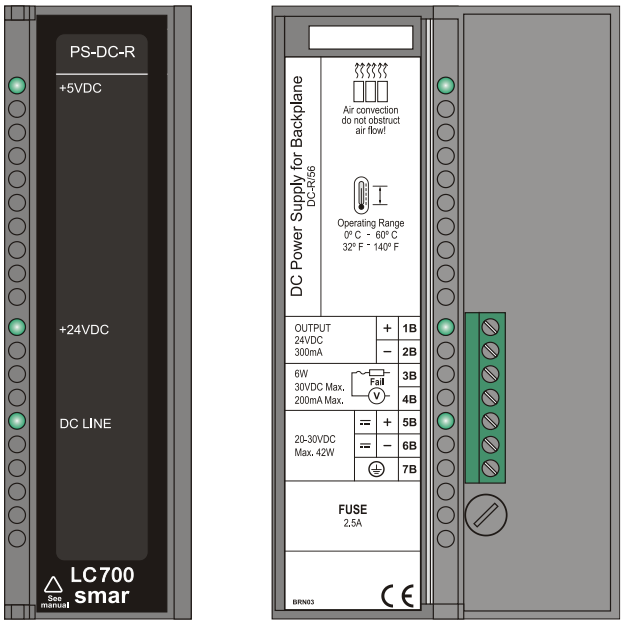


Figure 3.4 - DC Power Supply Module: PS-DC-R

Technical Specifications

INPUTS	
DC	20 to 30 Vdc
Maximum Current of “Rush” (Inrush Current)	< 20.6 A @ 30 Vdc [·T < 430 us]
Maximum Consumption	42 W
Indicator	DC 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	> 47 ms @ 24 Vac [Maximum Load]
b) Output 2 (external use)	24 Vdc +/- 10%
Current	300 mA Maximum
Ripple	200 mV Maximum
Short Circuit Current	700 mA
Indicator	+24 Vdc (green LED)

ISOLATION	
Input signal, internal outputs and external output are isolated from each other	
Between the outputs and the ground	500 Vrms
Between the input and output	1500 Vrms

FAILURE RELAY	
Type of Output	Solid state relay, normally closed (NC), isolated
Limits	6 W, 30 Vdc max, 200mA max
Maximum Initial Contact Resistance	<13Ω

FAILURE RELAY	
Overload Protection	Must be provided externally
Operation Time	5 ms maximum

TEMPERATURE	
Operating Temperature	-10 ºC to 60 ºC (14 ºF to 140 ºF)

DIMENSIONS AND WEIGHT	
Dimensions (L X H X D)	39.9 x 137.0 x 141.5 mm (1.57 x 5.39 x 5.57 in.)
Weight	0.450 kg

CABLES	
One wire	14 AWG (2 mm^2)
Two wires	20 AWG (0.5 mm^2)

NOTES

1. If the power consumed exceeds the power supplied, the LC800 system may operate in an unpredictable manner which may result in damage to the equipment or even personal injury. Therefore, power consumption should be correctly calculated, and more power supply modules installed if necessary.
2. Hardware revisions prior to GLL1279 Rev2 do not operate in redundancy.
3. To comply with EMC standards, the length of the wiring connected to the fault relay must be less than 30 meters. The power supply for the load driven by the failure relay must not be from an external network.

Power Consumption Calculation

Since the available power of the power supply is limited, it is necessary to calculate the power consumed by the modules in use. One way to do this is to build a spreadsheet to summarize all the currents provided and needed per module and associated equipment (such as interfaces).

Below is an example of a spreadsheet with module consumption and specification of some power supplies.

LC800 CONSUMPTION BALANCE										
Module	**Description**	**Qty**	**Consumption Unit (mA)**		**Total Current (mA)**		**Supply Unit (mA)**		**Total Current (mA)**	
			@24 V	**@5 V**	**@24 V**	**@5 V**	**@24 V**	**@5 V**	**@24 V**	**@5 V**
CPU800	Controller	1	0	550	0	550				
M-001	2*8 DI 24 VDC		65	80	0	0				
M-002	2*8 DI 48 VDC		65	80	0	0				
M-003	2*8 DI 60 VDC		62	80	0	0				
M-004	2*8 DI 125 VDC		40	80	0	0				
M-005	2*8 DI 24 VDC (sink)		0	80	0	0				
M-010	2*4 DI 120 VAC		0	50	0	0				
M-011	2*4 DI 240 VAC		0	50	0	0				
M-012	2*8 DI 120 VAC		0	87	0	0				
M-013	2*8 DI 240 VAC	2	0	87	0	174				
M-020	8 switches		0		0	0				
M-401-R	8 AI		0	320	0	0				
M-401-DR	8 AI		0	320	0	0				
M-402	8 temperature inputs		0	55	0	0				
M-101	16 DO (transistor)		65	70	0	0				
M-102	2*8 DO (transistor)		65	70	0	0				
M-110	8 DO (TRIAC)		0	70	0	0				
M-111	2*8 DO (triac)		0	115	0	0				
M-120	2*4 DO (relay)		134	20	0	0				

LC800 CONSUMPTION BALANCE										
Module	**Description**	**Qty**	**Consumption Unit (mA)**		**Total Current (mA)**		**Supply Unit (mA)**		**Total Current (mA)**	
			@24 V	**@5 V**	**@24 V**	**@5 V**	**@24 V**	**@5 V**	**@24 V**	**@5 V**
M-121	2*4 DO (relay)		134	20	0	0				
M-122	2*4 DO (relay)		134	20	0	0				
M-128	2*8 DO (relay)		180	30	0	0				
M-124	2*4 DO (relay)		134	20	0	0				
M-125	2*4 DO (relay)		134	20	0	0				
M-126	2*4 DO (relay)		134	20	0	0				
M-501	4 AO		180	20	0	0				
M-201	8 DI 24 VDC, 4 DO (relay)		67	60	0	0				
M-202	8 DI 48 VDC, 4 DO (relay)		67	60	0	0				
M-203	8 DI 60 VDC, 4 DO (relay)		67	60	0	0				
M-204	8 DI 24 VDC, 4 DO (relay)		67	60	0	0				
M-205	8 DI 48 VDC, 4 DO (relay)		67	60	0	0				
M-206	8 DI 60 VDC, 4 DO (relay)		67	60	0	0				
M-207	8 DI 24 VDC, 4 DO (relay)		67	60	0	0				
M-208	8 DI 48 VDC, 4 DO (relay)		67	60	0	0				
M-209	8 DI 60 VDC, 4 DO (relay)		67	60	0	0				
TOTAL					**0**	**724**				
PS-AC-R		1					300	3000	300	3000
PS-302		1					1500	0	1500	0
TOTAL									**1800**	**3000**

Positioning of Power Supplies

For systems that use the DF93 rack, together with DF90 and DF91

A source connected to a rack in this system provides current to the row of racks interconnected to it horizontally by their side connection terminals and vertically through DF90 cables, thus forming a group of rows of racks fed by the same source.

There can be only one source per system (or pair of redundant sources) or the system can be subdivided into several 1 of these groups, each powered by one source (or pair of redundant sources).

The recommended way to distribute the power of a source is by horizontal row groups of racks. In this scheme, each source should be positioned in the upper left corner of the row group of racks it feeds. The rack where the power supply is located should have the **W1** Jumper (from the rack) cut off and the DF90 cable should not be connected to the rows fed by other power supplies (top row). See the following figure for an example of a system powered by two sources, each of which serves a portion of rows, represented in green and blue.

1 Maximum of 8 groups allowed when using PS-DC-R sources

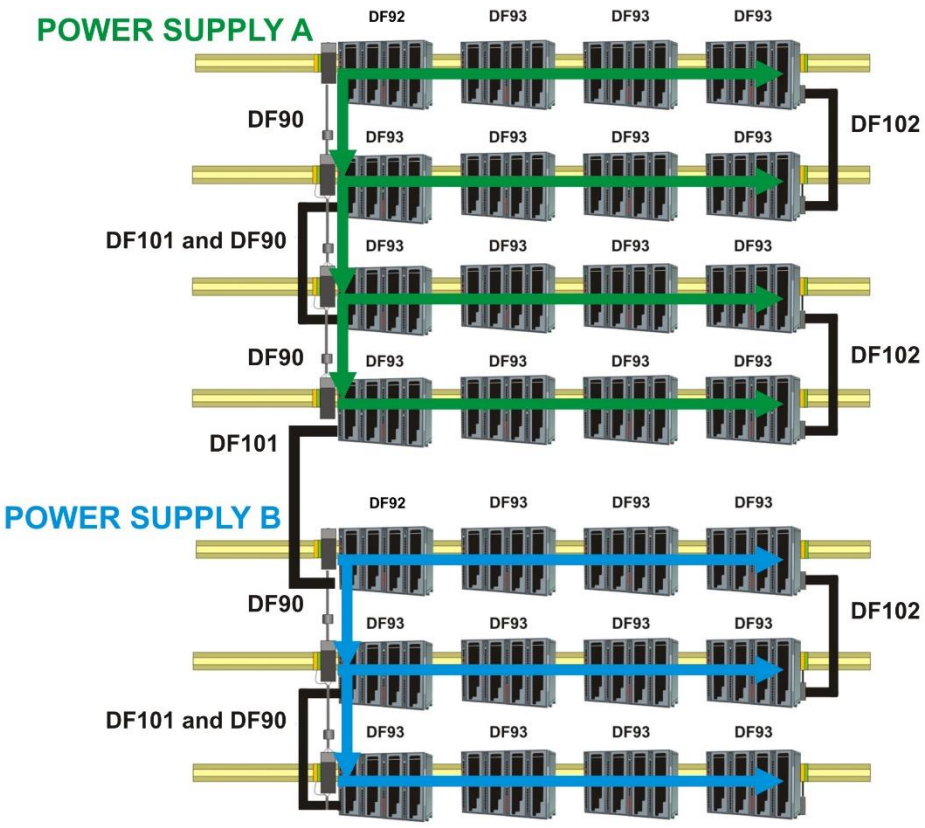


Figure 3.5 - System powered by two power supplies

Note that this system, for greater efficiency, is optimized for distribution of the feed by groups of racks. Thus, a source feeds an entire number of rows that it supports. However, in rarer cases, with long rows or many modules of higher consumption in the same row, there is the option to add sources in the middle of the rows, subdividing the power within them. In this case, the added source will only feed those modules positioned to its right in the same row, until the end of this row, or as far as there is another source added. In the rack where a power supply is added in this scheme, the **W1** Jumper must be cut off and the left side connection terminal (+5Vdc) must be disconnected (collected).

In this system, the PS-DC-R sources must have the **CH1** Jumper (from the source) always configured in **E**.

ATTENTION
The mixing of these sources configured with **CH1** in **R** and **E** in any **LC800** system is not allowed!

In DF93 it is recommended to position the redundant pair in the first and second slots, but they can be installed in any slots if necessary.

The system has diagnostics of the voltage level distributed by the racks and the capacity to support higher consumption modules at any position on the bus. Nevertheless, it is a good practice to position the higher consumption modules closer to the power supply modules to avoid unnecessary power transmission.

For systems using R-700-4A racks

1. Respect the maximum current values of the power supply module specification. In the case of PS-DC-R the 3 A limit must be observed.

2. After connection with long flat cables (FC-700-1A, FC700-2A, FC700-3A, FC700-4A), always place a new power supply module in the first slot of the first rack.

3. Use a maximum of 6 M-401R / M401DR modules per power supply, always placing the consecutive M-401R / M401DR and closer to the power supply. Due to the high current consumption of the M-401R / M401DR modules, placing them after other modules may cause an undesirable voltage drop on the bus.

4. When it is necessary to add interface modules to the same bus used by Input and Output modules, for example MB700, SI-700, in these cases it is recommended that these modules be placed as close as possible to the power supply because, as described in the previous item, placing them after other modules may cause an undesirable voltage drop on the bus.

5. To add a new power supply module:
   o Determine the rack where the new power supply module will be installed.
   o Cut off the **W1** jumper located in the rack.
   o Connect the new power supply to the first slot in the rack (0 slot).
   o In this case, the **CH1** jumper on all PS-DC-R modules must be in **E** position.

Types of Discrete Inputs

Hysteresis

Levels 1 and 0 have different trigger "ON" and "OFF" levels. Between these states the last state remains.

To prevent quick switches between 0 and 1 states, when an input is noisy near the transition levels, these inputs have hysteresis.

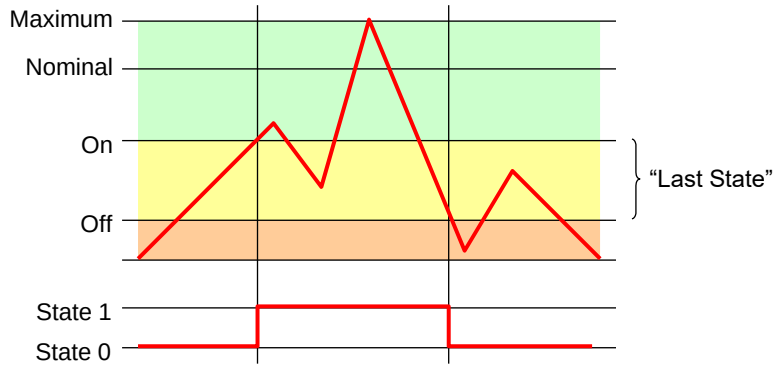


Figure 3.6 – I/O Module Input Hysteresis

When the signal level exceeds the ON level, the state becomes true and remains true even while the signal is below ON, as long as it remains above the OFF level. Only when the signal is below the OFF level, the state becomes false and remains so even if the signal rises but does not reach the ON level.

LC800 discrete input modules have trigger levels according to IEC 61131-2 for programmable controller hardware.

Wiring

NPN and PNP sensors

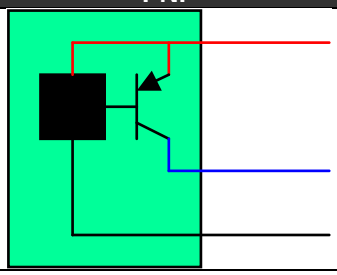
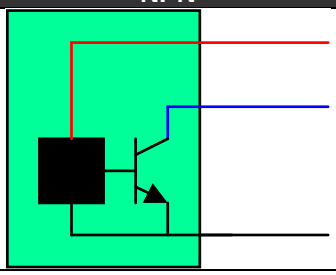
PNP	NPN
	
Active on the high Source Use M-001, M-002, M-003, M-004	Active on the low Sink Use M-005

Figure 3.7 – Types of Sensors

M-001/M-002/M-003/M-004 – DC Discrete Input Module

(Hot Swap and Device ID)

Order Code

M-001 (2 groups of 8 inputs isolated, 24 Vdc)
M-002 (2 groups of 8 inputs isolated, 48 Vdc)
M-003 (2 groups of 8 inputs isolated, 60 Vdc)
M-004 (2 groups of 8 inputs isolated, 125 Vdc)

Description

Module interprets the DC input voltage and converts it to a true (ON) or false (OFF) logic signal. It has 2 groups of 8 optically isolated inputs to detect 24/48/60/125 Vdc (M-001/M- 002/M-003/M-004, respectively).

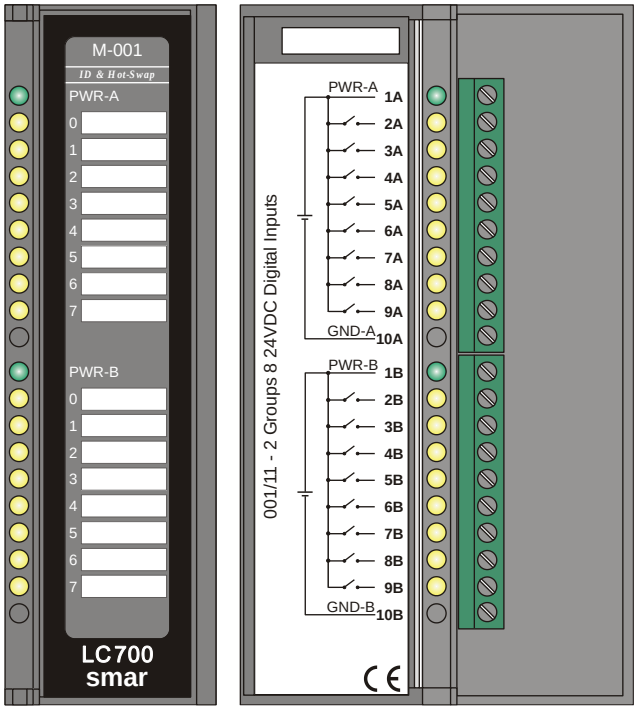


Figure 3.8 - M-001 DC input module

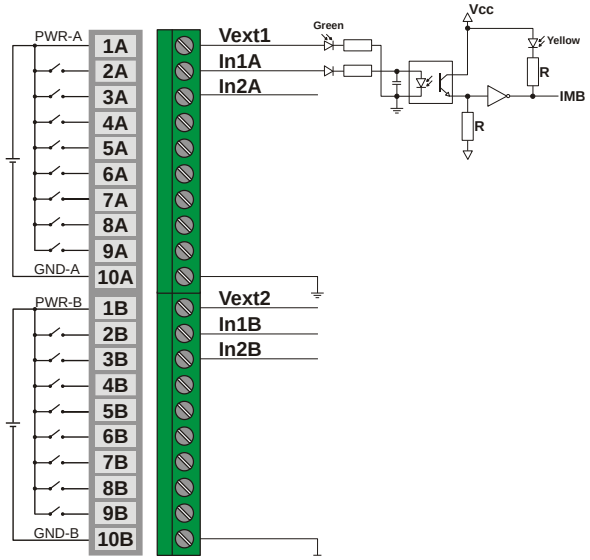


Figure 3.9 - External connection

Technical Specifications

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

ISOLATION	
Groups are individually isolated.	
Optical Isolation up to	5000 Vac

EXTERNAL POWER SUPPLY	
Power Supply per Group	20 - 30 Vdc (M-001) 36 - 60 Vdc (M-002) 45 - 75 Vdc (M-003) 95 - 140 Vdc (M-004)
Maximum Consumption per Group	65 mA @ 24 Vdc (M-001) 65 mA @ 48 Vdc (M-002) 62 mA @ 60 Vdc (M-003) 40 mA @ 125 Vdc (M-004)
Indicator	Green LED

INTERNAL POWER SUPPLY	
Supplied by IMB bus	5 Vdc @ 80 mA Maximum
Maximum Total Dissipation	0,4 W
Indicator	None

INPUTS	
Voltage Range for Logic Level "1"	20 - 30 Vdc (M-001) 30 - 60 Vdc (M-002) 38 - 75 Vdc (M-003) 95 - 140 Vdc (M-004)
Voltage Range for Logic Level "0"	0 - 5 Vdc (M-001) 0 - 9 Vdc (M-002) 0 - 12 Vdc (M-003) 0 - 25 Vdc (M-004)
Input Impedance (Typical)	3,9 kΩ (M-001) 7,5 kΩ (M-002) 10 kΩ (M-003) 39 kΩ (M-004)
Status Indicator	Yellow LED
Input Current per Point	8 mA @ 24 Vdc (M-001) 8 mA @ 48 Vdc (M-002) 7,5 mA @ 60 Vdc (M-003) 5 mA @ 125 Vdc (M-004)

SWITCHING INFORMATION	
Minimum voltage for logical level 1	20 Vdc (M-001) 30 Vdc (M-002) 38 Vdc (M-003) 95 Vdc (M-004)
Minimum voltage for logical level 0	5 Vdc (M-001) 9 Vdc (M-002) 12 Vdc (M-003) 25 Vdc (M-004)
Response time from "0" to "1"	30 μs
Response time from "1" to "0"	50 μs

DIMENSIONS AND WEIGHT	
Dimensions (W x H x D)	39.9 x 137.0 x 141.5 mm ; (1.57 x 5.39 x 5.57 pol.)
Weight	0.285 kg

CABLES	
One Wire	14 AWG (2 mm^2)
Two Wires	20 AWG (0,5 mm^2)

M-005 – DC Discrete Input Module

(Has Hot Swap and Device ID)

Order Code

M-005 (2 isolated groups of 8 inputs, 24 Vdc)

Description

This module interprets the DC input voltage and converts it to a true (ON) or false (OFF) logic signal. It has two groups of 8 optically isolated inputs.

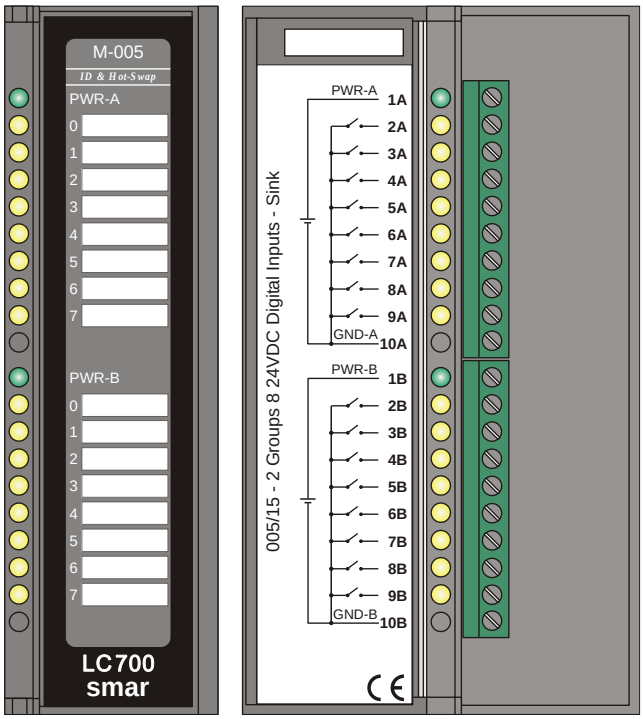


Figure 3.10 - – M-005 DC input module

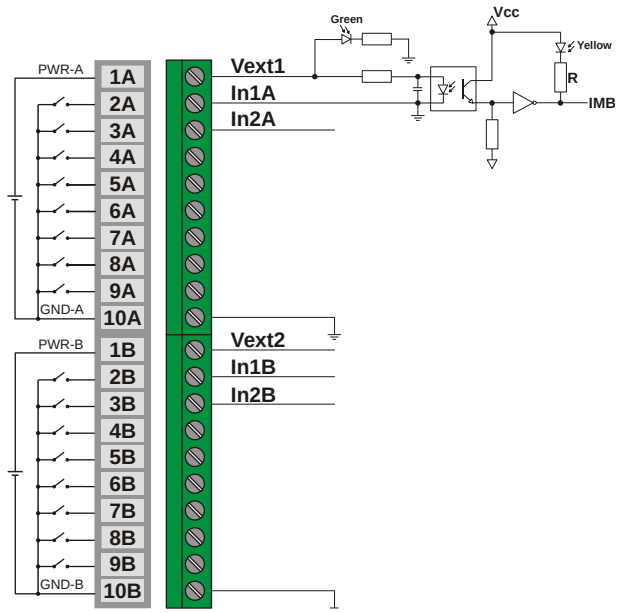


Figure 3.11 - External connection

Technical Specifications

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

ISOLATION	
Groups are individually isolated.	
Optical Isolation up to	5000 Vac

EXTERNAL POWER SUPPLY	
Power Supply per Group	20 – 30 Vdc
Maximum Consumption per Group	65 mA
Indicator	Green LED

INTERNAL POWER SUPPLY	
Supplied by IMB bus	5 Vdc @ 80 mA Maximum
Maximum Total Dissipation	0.4 W
Source Indicator	None

INPUTS	
Voltage Range for Logic Level "1"	0 – 5 Vdc @ Z_{carga} < 200 Ω
Voltage Range for Logic Level "0"	20 – 30 Vdc @ Z_{carga} > 10 KΩ
Input Impedance (Typical)	3.9 KΩ
Status Indicator	Yellow LED
Input Current per Point	7.5 mA (typical)

SWITCHING INFORMATION	
Response time from "0" to "1"	30 μs
Response time from "1" to "0"	50 μs

DIMENSIONS AND WEIGHT	
Dimensions (W x H x D)	39.9 x 137.0 x 141.5 mm; (1.57 x 5.39 x 5.57 pol.)
Weight	0.285 kg

CABLES	
One Wire	14 AWG (2 mm^2)
Two Wires	20 AWG (0.5 mm^2)

M-010/M-011 – AC Discrete Input Module

Order Code

M-010 (2 groups of 4 digital inputs, 120 Vac)
M-011 (2 groups of 4 digital inputs, 240 Vac)

Description
This module interprets the AC input voltage and converts it to a true (ON) or false (OFF) logic signal. It has two groups of 4 optically isolated inputs to detect 120/240 Vac (M-010 /M-011), respectively.

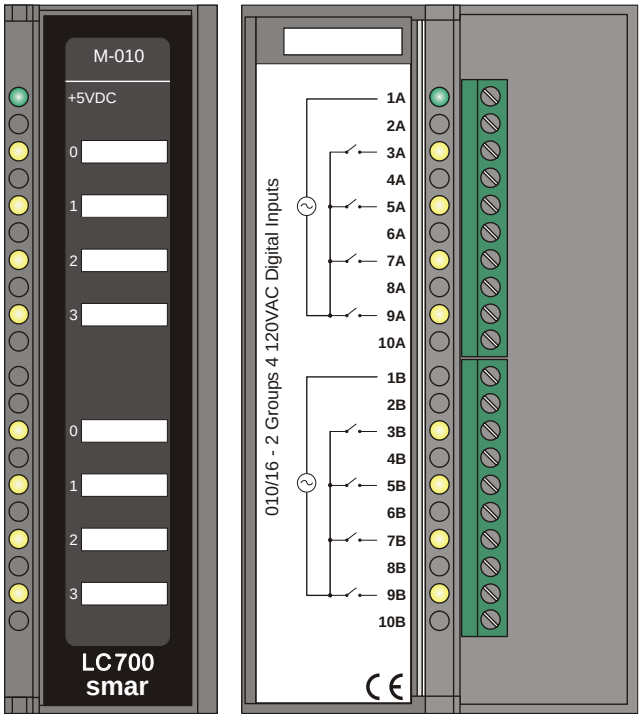


Figure 3.12 - AC Input Module – M-010

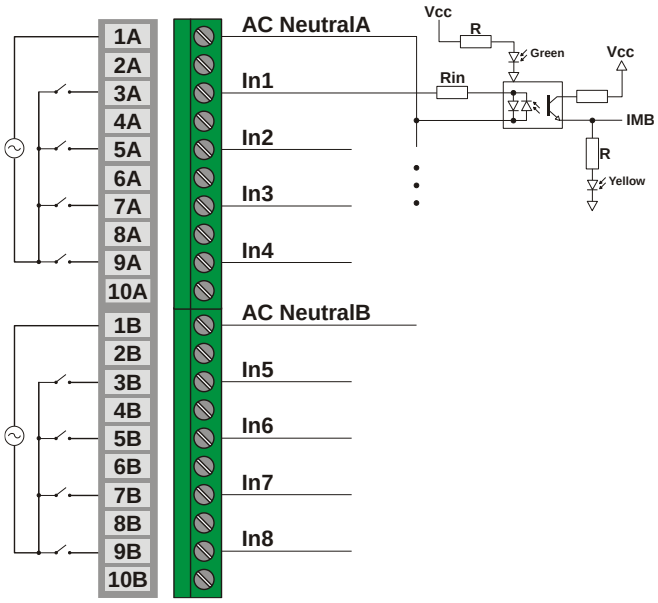


Figure 3.13 - External connection

Technical Specifications

ARCHITECTURE	
Number of Inputs	8
Number of Groups	2
Number of Points per Group	4

ISOLATION	
Groups are individually isolated.	
Optical Isolation up to	5000 Vac

EXTERNAL POWER SUPPLY	
Power Supply per Group	120 Vac (DF16)
	240 Vac (DF17)
Maximum Consumption per Group	10 mA
Indicator	None

INTERNAL POWER SUPPLY	
Supplied by IMB bus	5 Vdc @ 50 mA Maximum
Maximum Total Dissipation	0.25 W
Indicator	Green LED

INPUTS	
Voltage Range for Logic Level "1"	100-140 Vac (M-010) 200-264 Vac (M-011)
Voltage Range for Logic Level "0"	0-30 Vac (M-010) 0-50 Vac (M-011)
Input Current (Typical)	10 mA @ 60 Hz
Indicator	Yellow LED

SWITCHING INFORMATION	
Minimum voltage for logic level "1"	100 Vac (M-010), 45 a 60 Hz 200 Vac (M-011), 45 a 60 Hz
Maximum voltage for logic level "0".	30 Vac (M-010), 45 a 60 Hz 50 Vac (M-011), 45 a 60 Hz
Typical Hysteresis	70 Vac (M-010) 150 Vac (M-011)
Response time from "0" to "1"	5 ms
Response time from "1" to "0"	42 ms

DIMENSIONS AND WEIGHT	
Dimensions (W x H x D)	39.9 x 137.0 x 141.5 mm; (1.57 x 5.39 x 5.57 in.)
Weight	0.285 kg

CABLES	
One Wire	14 AWG (2 mm^2)
Two Wires	20 AWG (0,5 mm^2)

M-012/M-013 – AC Discrete Input Module

(Has Hot Swap and Device ID)

Order Code

M-012 (2 groups of 8 digital inputs, 120 Vac)
M-013 (2 groups of 8 digital inputs, 240 Vac)

Description

This module interprets the AC input voltage and converts it to a true (ON) or false (OFF) logic signal. It has 2 groups of 8 optically isolated inputs, to detect 120/240 Vac (M-012/M-013, respectively).

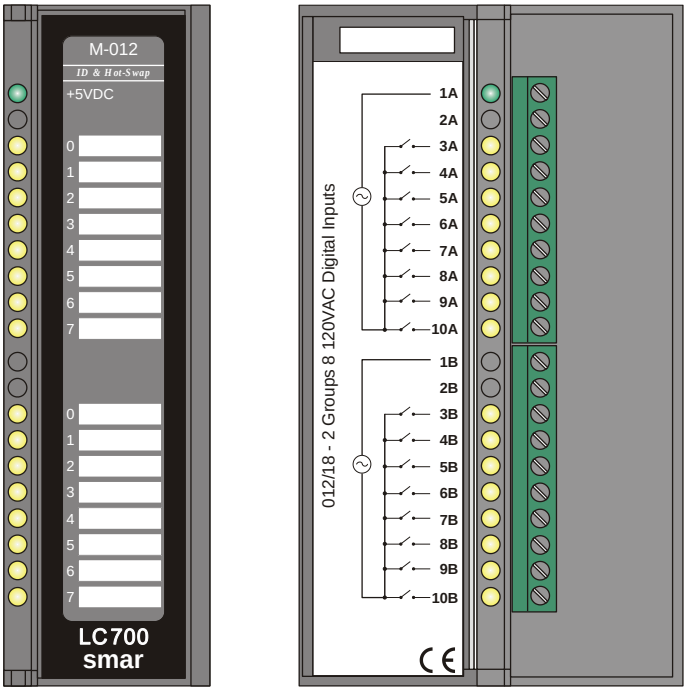


Figure 3.14 - AC Input Module - M-012

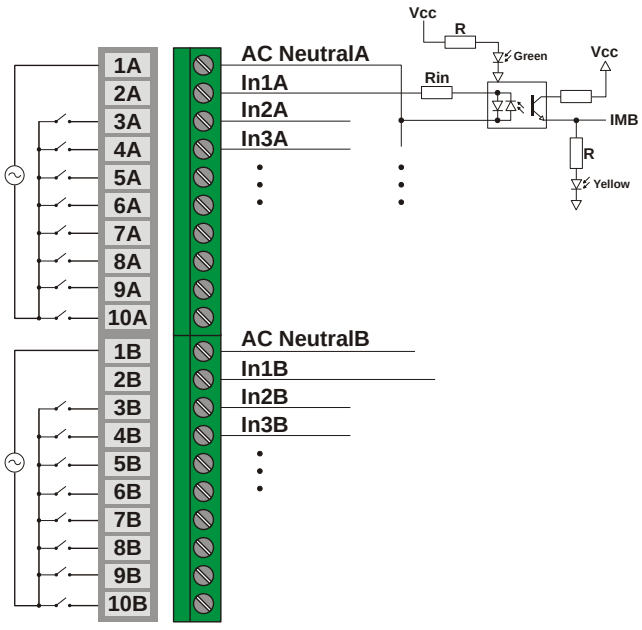


Figure 3.15- External connection

Technical Specifications

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

ISOLATION	
Groups are individually isolated.	
Optical Isolation up to	5000 Vac

EXTERNAL POWER SUPPLY	
Power Supply per Group	120 Vac (M-012) 240 Vac (M-013)
Maximum Consumption per Group	10 mA
Indicator	None

INTERNAL POWER SUPPLY	
Supplied by IMB bus	5 Vdc, @ 87 mA Maximum
Maximum Total Dissipation	0,435 W
Indicator	Green LED

INPUTS	
Voltage Range for Logic Level "1"	100-140 Vac (M-012) 200-264 Vac (M-013)
Voltage Range for Logic Level "0"	0-30 Vac (M-012) 0-50 Vac (M-013)
Input Current (Typical)	10 mA@ 60 Hz
Indicator	Yellow LED

SWITCHING INFORMATION	
Minimum voltage for logic level "1"	100 Vac (M-012), 45 a 60 Hz 200 Vac (M-013), 45 a 60 Hz
Maximum voltage for logic level "0".	30 Vac (M-012), 45 a 60 Hz 50 Vac (M-013), 45 a 60 Hz
Typical Hysteresis	70 Vac (M-012) 150 Vac (M-013)
Response time from "0" to "1"	5 ms
Response time from "1" to "0"	42 ms

DIMENSIONS AND WEIGHT	
Dimensions (W x H x D)	39.9 x 137.0 x 141.5 mm; (1.57 x 5.39 x 5.57 in.)
Weight	0.285 kg

CABLES	
One Wire	14 AWG (2 mm^2)
Two Wires	20 AWG (0,5 mm^2)

M-020 – Switch Input Module

Order Code

M-020 (1 group of 8 On-Off switches)

Description

This module simulates 8 discrete inputs through the use of push-button.

Module can be used as push-buttons. Push-button can be useful to intermediate with the program logic or in debugging processes for functionality checking and optimization.

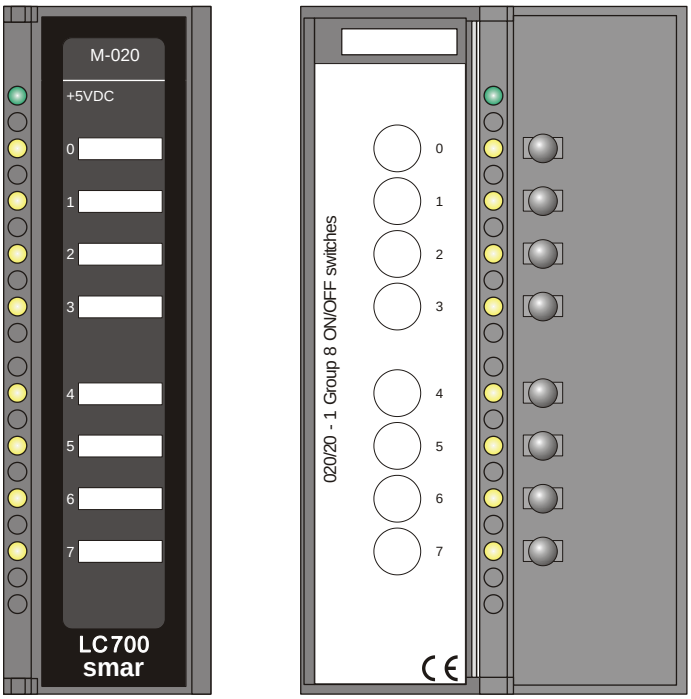


Figure 3.16 – Switch Input Module - M-020

Technical Specifications

INTERNAL POWER SUPPLY	
Supplied by IMB bus	5 Vdc @ 45 mA maximum
Maximum Total Dissipation	0.225 W
Source indicator	Green LED

SWITCHES	
Status Indication	Yellow LED
Logic of the Indicator	LED on - the switch is activated

DIMENSIONS AND WEIGHT	
Dimensions (W x H x D)	39.9 x 137.0 x 141.5 mm; (1.57 x 5.39 x 5.57 in.)
Weight	0.250 kg

M-302/M-303 – Pulse Input Module - DC Low/High Frequency

(Has Hot Swap and Device ID)

Order Code

M-302 (2 Groups of 8 Low Frequency 24VDC Pulse Inputs (0 - 100Hz))
M-303 (2 Groups of 8 High Frequency 24VDC Pulse Inputs (0 - 10KHz))

Description

These modules have two groups of 8 inputs to count pulses and accumulate them until the CPU module reads them. Soon after the CPU reading, each individual counter will be reset, the hardware is prepared not to lose any input pulse in this acquisition process.

Two function blocks can be used with the M-302 , M-303 and M-304 modules. Namely: ACC and ACC_N.

ACC samples a single channel, providing the flow, Q output, in a period determined by MP. The sum of the pulses is supplied at the TOT output.

ACC_N samples up to 4 channels at the same time. The operation is identical to the previous one, with each channel having a TOTn and MEMn output, just not providing the flow. For further details, see the LogicViewforFFB manual.

M-302 is dedicated to capture frequencies up to 100Hz and can be driven by a mechanical relay contact or a reed-switch. An internal unipolar filter has the cutoff frequency at approximately 200Hz.

M-303 is dedicated to capture high noise-free frequencies. It can read from 0 to 10 kHz. An internal filter discards frequencies around 20 kHz to eliminate noise.

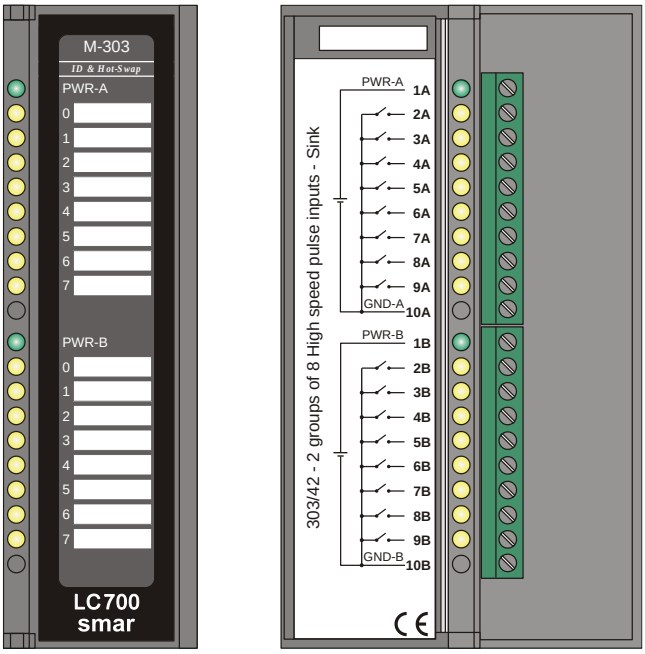


Figure 3.17 - M-303 Pulse Input Module

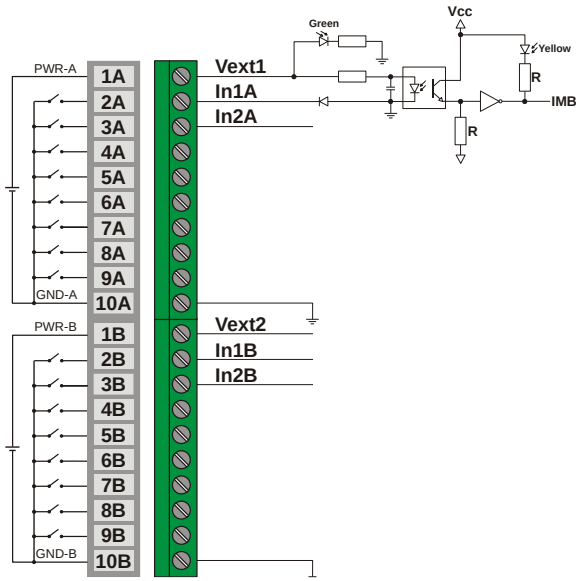


Figure 3.18- External connection

NOTE
To meet the requirements of EMC standards, use shielded cables for signal inputs (shielding should be grounded to the panel on one side of the cable only) and cables smaller than 30 meters for power inputs.

IMPORTANT
These modules have 12-bit counters and can accumulate up to 4096 pulses, for each of the 16 channels, before a count overflow occurs. Therefore, considering the maximum operating frequency, they have the following count overflow times: • M-302 : 4096 pulses / 10000 Hz = 0.4096 s; • M-303 : 4096 pulses / 100 Hz = 40.96 s; System macrocycle time must always be shorter than the counting overflow times of the accumulator pulse modules.

Technical Specifications

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

ISOLATION	
Groups are individually isolated.	
Optical Isolation up to	5000 Vac

EXTERNAL POWER SUPPLY	
Power Supply per Group	20-30 Vdc
Maximum Consumption per Group	65 mA @ 24Vdc
Indicator	Green LED

INTERNAL POWER SUPPLY		
	M-302	**M-303**
Supplied by IMB bus	90 mA	130 mA
Maximum Total Dissipation	0.425W	0.650W
Indicator	None	None

INPUTS	
Voltage Range for Logic Level "1"	0-5 Vdc; <200Ω (M-302/M-303)
Voltage Range for Logic Level "0"	20-30 Vdc; >10 KΩ (M-302/M-303)
Typical Impedance	3.9 kΩ
Status Display	Yellow LED
Typical Input Current per Point	7,5 mA
Maximum Input Frequency	M-302: 0-100 Hz M-303: 0-10 KHz

DIMENSIONS AND WEIGHT	
Dimensions (W x H x D)	39.9 x 137.0 x 141.5 mm; (1.57 x 5.39 x 5.57 in.)
Weight	0.342 kg

CABLES	
One Wire	14 AWG (2 mm^2)
Two Wires	20 AWG (0,5 mm^2)

M-304 – Pulse Input Module - AC High Frequency

Order Code

M-304 (2 Groups of 8 High Frequency AC Pulse Inputs (0 - 10KHz))

Description
This module is designed to be connected directly to AC signal generating sensors. These modules have two groups of 8 inputs to count pulses and accumulate them until the CPU module reads them. Soon after the CPU reading, each individual counter will be reset to zero, the hardware is prepared not to lose any pulse at the input in this acquisition process.

Two function blocks can be used with the M-302 , M-303 and M-304 modules. Namely: ACC and ACC_N.

ACC samples a single channel, providing the flow, Q output, in a period determined by MP. The sum of the pulses is supplied at the TOT output.

ACC_N samples up to 4 channels at the same time. The operation is identical to the previous one, with each channel having a TOTn and MEMn output, just not providing the flow. For further details, see the LogicViewforFFB manual.

M-304 can read from 0 to 10 KHz. An internal one-pole filter cuts around 20 KHz to eliminate high frequency noise.

NOTE
All the inputs of a group have a common reference. In the case of non-isolated sensors, the use of isolation transformers is recommended.

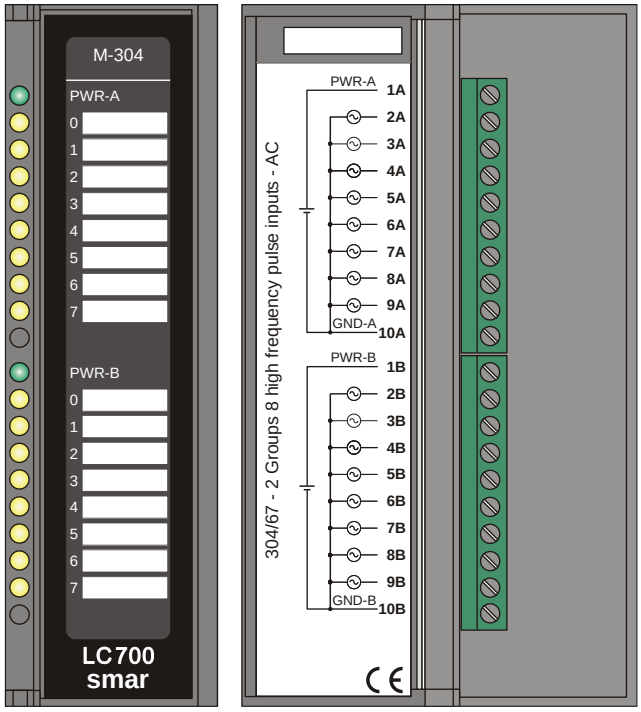


Figure 3.19- M-304 Pulse Input Module

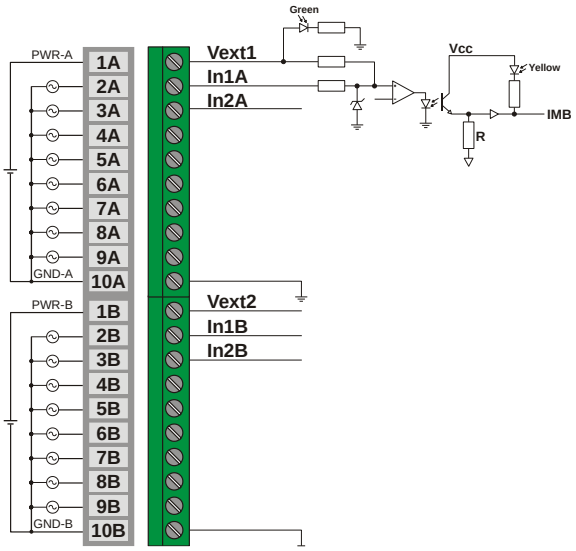


Figure 3.20- External connection

NOTE
To meet the requirements of EMC standards, use shielded cables for signal inputs (shielding should be grounded to the panel on one side of the cable only) and cables smaller than 30 meters for power inputs.

IMPORTANT
These modules have 12-bit counters and can accumulate up to 4096 pulses, for each of the 16 channels, before a count overflow occurs. Therefore, considering the maximum operating frequency, they have the following count overflow times: • M-304 : 4096 pulses / 10000 Hz = 0.4096 s; System macrocycle time must always be shorter than the counting overflow times of the accumulator pulse modules.

Technical Specifications

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

ISOLATION	
Groups are individually isolated.	
Optical Isolation up to	5000 Vac

EXTERNAL POWER SUPPLY	
Power Supply per Group	20-30 Vdc
Typical Consumption per Group	12 mA @ 24Vdc
Indicator	Green LED

INTERNAL POWER SUPPLY	
Supplied by IMB bus	130 mA
Maximum Total Dissipation	650 mW
Indicator	None

INPUTS	
Maximum input voltage	Vin = 30 Vac
Voltage level for ON state (Logic True)	Vin < -1,5 V
Voltage level for OFF state (Logic False)	Vin > +1,5 V
Display Status	Yellow LED
Typical Impedance	3,9 kΩ
Maximum Input Frequency	10 KHz

DIMENSIONS AND WEIGHT	
Dimensions (W x H x D)	39.9 x 137.0 x 141.5 mm; (1.57 x 5.39 x 5.57 pol.)
Weight	0.342 kg

CABLES	
One Wire	14 AWG (2 mm^2)
Two Wires	20 AWG (0,5 mm^2)

M-401-R/ M-401-DR – Voltage/Current Analog Input Module

(Has Hot Swap and Device ID)

Order Code

M-401-R (1 Group of 8 Voltage/Current Analog Inputs with Internal Shunt Resistors)
M-401-DR (1 Group of 8 Voltage/Current Differential Analog Inputs with Internal Shunt Resistors)

Description

These modules read 8 analog Voltage or current signals. Inputs are isolated from the IMB. Only the M-401-DR module has differential inputs.

M-401-R: Inputs are individually configured to read:

- 0-5 V, 1-5 V, 0-10 V, ± 10 V, with the internal shunt resistor in the "V" position.
- 0-20 mA, 4-20 mA, with the internal shunt resistor in the "I" position.

M-401-DR: Inputs are individually configured to read:

- 0-5 V, 1-5 V, 0-10 V, ± 10 V, with the internal shunt resistor in the "V" position.
- 0-20 mA, 4-20 mA with the internal shunt resistor in the "I" position.

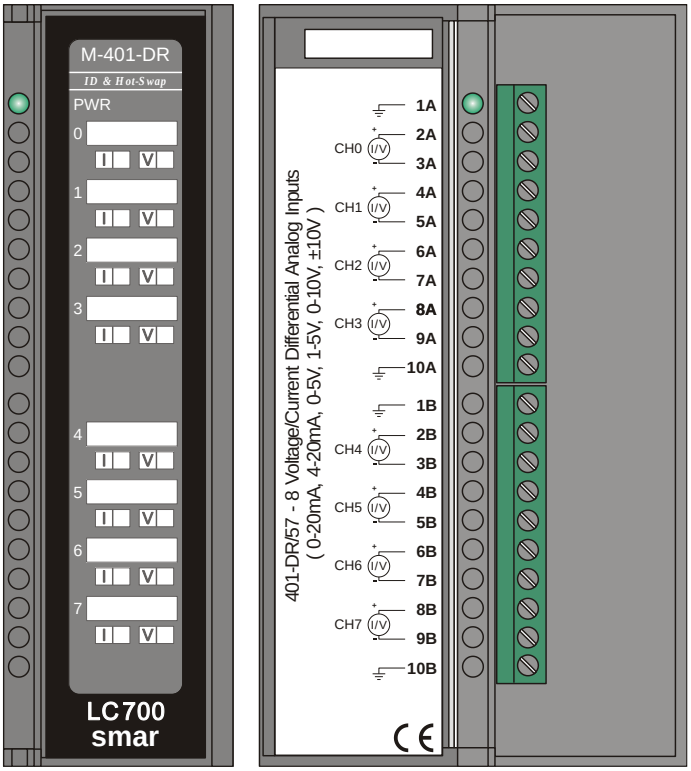
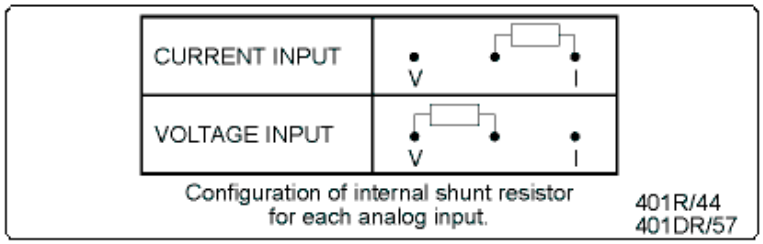


Figure 3.21 - M-401-DR Voltage/Current Analog Input Module



NOTE
To meet EMC standards, use shielded cables in input signal (ground the shield on the panel on one side of the cable only).

Note: The user may mark on the front label if the input is internally configured, in current "I" or voltage "V". (Regarding the position of the Shunt resistor).

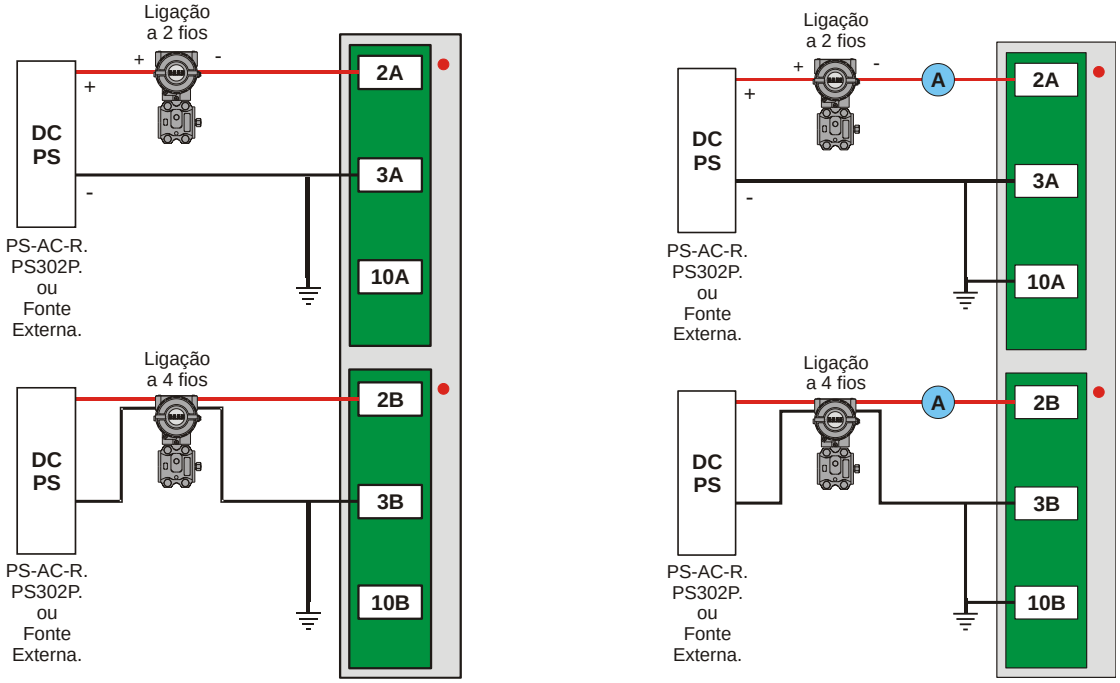


Figure 3.22- External connection

Note: In the figure above, the existence of an Ammeter is not mandatory for the M-401DR module.

Technical Specifications

ARCHITECTURE	
Number of Inputs	8
Number of Groups	1
Number of Points per Group	8

ISOLATION	
Bus channel	Insulation up to 1500 V_{RMS}

INTERNAL POWER SUPPLY	
Supplied by IMB bus	5 Vdc @ 320 mA maximum
Maximum Total Dissipation	1.6 W
Source Indicator	Green LED

INPUTS	
Linear Measuring Range	M401-R/M-401-DR: 0-20 mA, 4-20 mA, 0-5 V, 1-5 V, 0-10 V, ± 10V
Typical Input Impedance	M401-R/M-401-DR: 1 MΩ for voltage input 250 Ω for current input

A/D CONVERSION	
Conversion time	20 ms/channel
Sampling rate	5 Hz
Resolution	16 bits

ACCURACY AT 77ºF (25ºC)	
Range: 0-5 V, 1-5 V, 0-10 V	± 0.1% error (Linearity/Interference).
Range: 0-20 mA, 4-20 mA	± 0.12% error (Linearity/Interference).
Range: ±10 V	± 0.2% error (Linearity/Interference).

AMBIENT TEMPERATURE EFFECT	
Range: 0-20 mA, 4-20 mA, 0-5V, 1-5 V, 0-10 V	± 0.2% error / 77 °F (25 °C)
Range: ± 10V	± 0.1% error / 77 °F (25 °C)

DIMENSIONS AND WEIGHT	
Dimensions (W x H x D)	39.9 x 137.0 x 141.5 mm; (1.57 x 5.39 x 5.57 in.)
Weight	0.210 kg

CABLES	
One Wire	14 AWG (2 mm^2)
Two Wires	20 AWG (0,5 mm^2)

M-402 – Analog Input Module - Low Level/ Temperature Signal

(Has Hot Swap and Device ID)

Order Code

M-402 (1 Group of 8 Low Level Signal Inputs for TC, RTD, mV and Ohm)

Description

This module is able to measure temperature of a wide variety of thermocouples (TC) and RTD as well as millivolts and resistance with high accuracy. Temperature measurements are internally linearized and in the case of TC a cold joint compensation is already built into the terminals of the module.

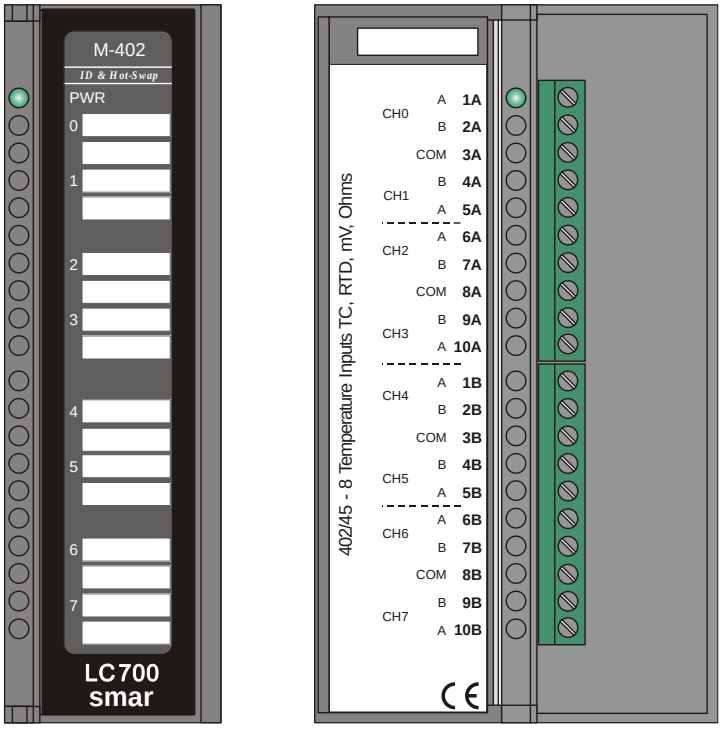
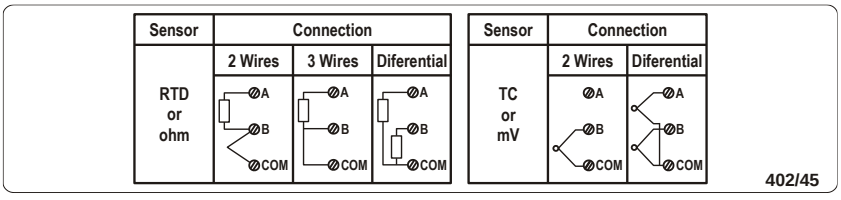


Figure 3.23 - M-402 Low Level and Temperature Signal Input Module



NOTE
To meet the requirements of EMC standards, use shielded cables for signal inputs (the shield must be grounded on the panel on one side of the cable only).

Sensor type, unit, range, damping and burnout for the input channel are configured in the configurator.

For each input, the M-402 provides an integer value and the status (boolean). Status indicates if there has been any burnout of the sensor. Status can be used to alert the operator and can also be used for failure in the interlocking logic.

DEFAULT TAG	DATA TYPES	PARAMETER
M-402G1B8Irrm.c	Boolean	Sensor burnout status
M-402G2NR8Irrm.c	Integer	Temperature value

Technical Specifications

ARCHITECTURE	
Number of Inputs	8
Number of Groups	1
Number of Points per Group	8

ISOLATION	
Bus channel	Insulation up to 1500 Vrms

INTERNAL POWER SUPPLY	
Supplied by IMB bus	5 Vdc @ 35 mA Maximum, during operation 5 Vdc @ 55 mA Maximum, during configuration
Maximum Total Dissipation	0.250 W
Source Indicator	Green LED

INPUTS	
Typical Input Impedance	1 MΩ

A/D CONVERSION	
Conversion time	90 ms/channel
Resolution	16 bits
Accuracy at 77ºF (25ºC)	0.05% of the span for ranges 3 and 6 *
Room Temperature Effect	0.004% of maximum span/ºC

* 0,15% of span for ranges 2 and 5.

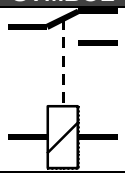
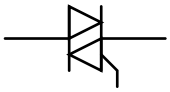
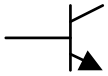
DIMENSIONS AND WEIGHT	
Dimensions (W x H x D)	39.9 x 137.0 x 141.5 mm; (1.57 x 5.39 x 5.57 in.)
Weight	0.202 kg

CABLES	
One Wire	14 AWG (2 mm^2)
Two Wires	20 AWG (0,5 mm^2)

SENSOR	2 OR 3 WIRES				DIFFERENTIAL	
	TYPE		RANGE [ºC]	RANGE [ºF]	RANGE [ºC]	RANGE [ºF]
RTD	Cu10 GE		-20 to 250	-4 to 482	-270 to 270	-486 to 486
	Ni 120 DIN		-50 to 270	-58 to 518	-320 to 320	-576 to 576
	Pt50 IEC		-200 to 850	-328 to 1562	-1050 to 1050	-1890 to 1890
	Pt100 IEC		-200 to 850	-328 to 1562	-1050 to 1050	-1890 to 1890
	Pt500 IEC		-200 to 450	-328 to 842	-650 to 650	-1170 to 1170
	Pt50 JIS		-200 to 600	-328 to 1112	-800 to 800	-1440 to 1440
	Pt100 JIS		-200 to 600	-328 to 1112	-800 to 800	-1440 to 1440
THERMOCOUPLE	B	+100 to 1800	+212 to 3272	-1700 to 1700	-3060 to 3060	-3060 a 3060
	E	-100 to 1000	-148 to 1832	-1100 to 1100	-1980 to 1980	-1980 a 1980
	J	-150 to 750	-238 to 1382	-900 to 900	-1620 to 1620	-1620 a 1620
	K	-200 to 1350	-328 to 2462	-1550 to 1550	-2790 to 2790	-2790 a 2790
	N	-100 to 1300	-148 to 2372	-1400 to 1400	-2520 to 2520	-2520 a 2520
	R	0 to 1750	32 to 3182	-1750 to 1750	-3150 to 3150	-3150 a 3150
	S	0 to 1750	32 to 3182	-1750 to 1750	-3150 to 3150	-3150 a 3150
	T	-200 to 400	-328 to 752	-600 to 600	-1080 to 1080	-1080 a 1080
	L	-200 to 900	-328 to 1652	-1100 to 1100	-1980 to 1980	-1980 a 1980
	U	-200 to 600	-328 to 1112	-800 to 800	-1440 to 1440	-1440 a 1440

SENSOR MV	2 WIRES	DIFFERENTIAL	RANGE
	-6 to 22 mV	-28 to 28 mV	1
	-10 to 100 mV	-110 to 110 mV	2
	-50 to 500 mV	-550 to 550 mV	3
SENSOR Ω	**2 OR 3 WIRES**	**DIFFERENTIAL**	**RANGE**
	0 to 100 Ω	-100 to 100 Ω	4
	0 to 400 Ω	-400 to 400 Ω	5
	0 to 2000 Ω	-2000 to 2000 Ω	6

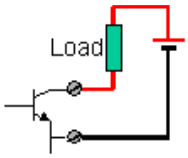
Types of Discrete Outputs

TYPE	CHARACTERISTICS	SYMBOL
Relay	○ AC or DC operation ○ Physically open when off: dry contact ○ High surge current and transient voltage capacity ○ Mechanical, damaged by use	
Triac	○ AC operation only ○ Surge current sensitive ○ Silent ○ Solid state, no moving parts, no mechanical parts	
Transistor	○ DC operation only ○ Surge current sensitive ○ Silent ○ Solid state, no moving parts, no mechanical parts ○ Quick	

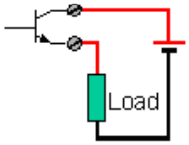
Sink and Source Outputs

Sink output:

Loads have common positive pole
Module group has common negative pole
Open Collector Configuration



Source output
Loads have common negative pole
Module group has common positive pole
Open emitter configuration



DC Inductive Load Switching

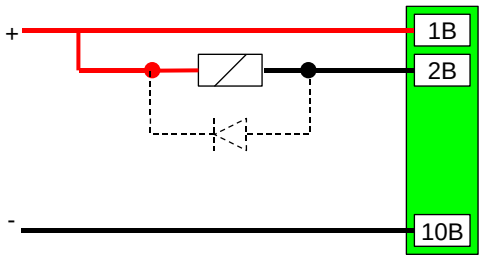


Figure 3.24 – DC Inductive Load Switching

A reverse direction connected diode can be used to protect the transistor output from triggering inductive surge loads when the output is switched to OFF.

AC Inductive Load Switching

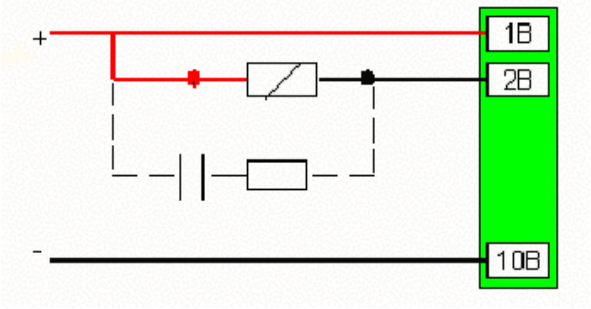


Figure 3.25- AC Inductive Load Switching

TRIAC Switching at Zero Crossing

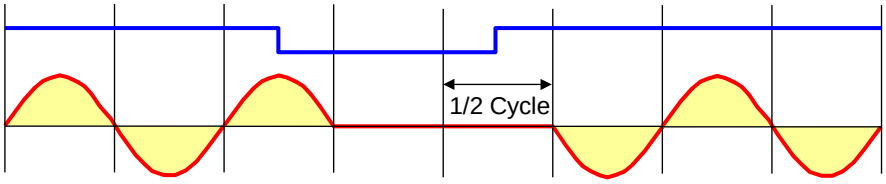


Figure 3.26- Triac Switching at Zero Crossing

TRIAC output switches the load to ON or OFF when the AC cycle crosses zero to ensure that there are no surges or noises due to the switching of inductive loads. Therefore, there may be a delay of up to ½ cycle waiting for the zero crossing.

For low power lamps, an shunt resistor may be required.

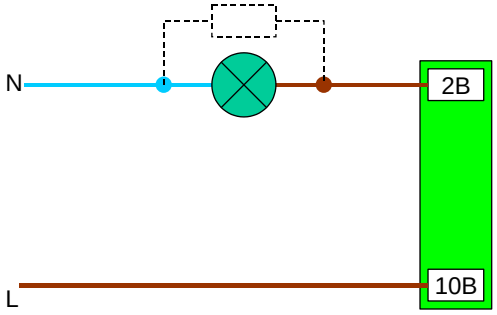


Figure 3.27- Lamp Switching

M-101 – DC Discrete Output Module

(Has Hot Swap and Device ID)

Order Code

M-101 (1 group of 16 open collector outputs)

Description

This module is designed with NPN open collector transistors that are able to drive relays, incandescent lamps, solenoids and other loads with up to 0.5 A per output. It has a group of 16 open collector outputs optically isolated from IMB. This means that they all have a common ground.

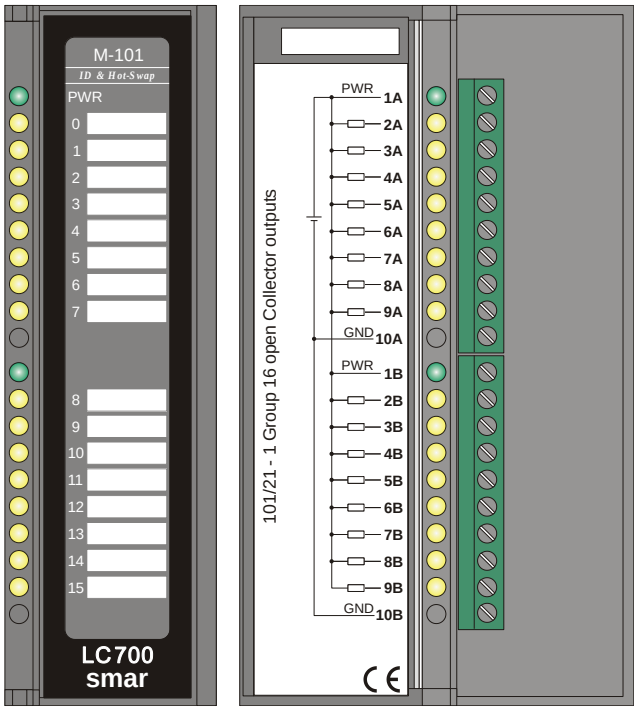


Figure 3.28- M-101 Open Collector Output Module

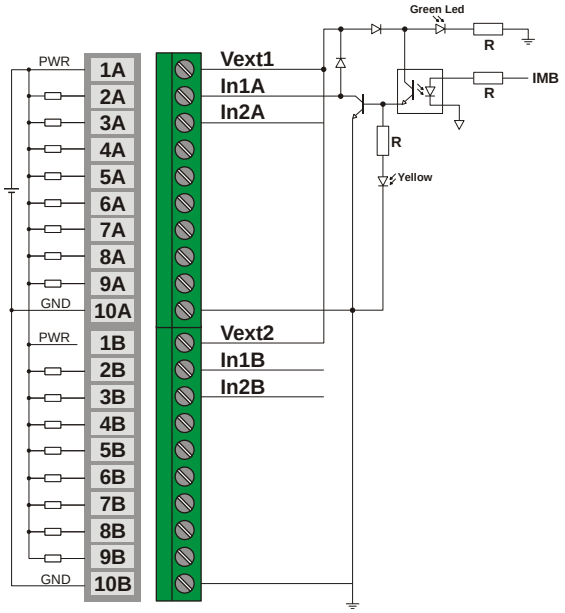


Figure 3.29 – External Connection

Attention

This module already provides, internally, a protection for switching inductive loads. At each terminal of the digital outputs there is a diode that suppresses the reverse voltage peak generated when switching off inductive loads. For this to work, it is necessary to connect the supply voltage of the loads to 1A terminal so that these diodes are properly placed in parallel with each load. If we do not turn on the voltage of the loads at 1A terminal and we do not have the supply voltage of the modules, besides having problems with burning the drivers, the diode ends up driving and activating the loads.

Technical Specifications

ARCHITECTURE	
Number of Inputs	16
Number of Groups	1
Number of Points per Group	16

ISOLATION	
Optical isolation up to	5000 Vac

EXTERNAL POWER SUPPLY	
Power Supply	20 to 30 Vdc
Maximum consumption	65 mA
Indicator	Green LED

INTERNAL POWER SUPPLY	
Supplied by IMB bus	5 Vdc @ 70 mA maximum
Maximum Total Dissipation	0.35 W
Indicator	None

OUTPUTS	
Maximum Switching Voltage	30 Vdc
Maximum Saturation Voltage	0.55 V @ 0.5 A
Maximum Current per Output	0.5 A
Status Indicator	Yellow LED
Logic Indicator	ON when the transistor is driving
Maximum Leakage Current	10 μA @ 35 Vdc
Switching capacity (lamp)	15 W

INDEPENDENT PROTECTION PER OUTPUT	
Thermal Shutdown	165 ºC
Thermal Hysteresis	15 ºC
Overcurrent protection	1.3 A @ 25 Vdc maximum

SWITCHING INFORMATION	
Time from 0 to 1	250 μs
Time from 1 to 0	3 μs

DIMENSIONS AND WEIGHT	
Dimensions (W x H x D)	39.9 x 137.0 x 141.5 mm; (1.57 x 5.39 x 5.57 in.)
Weight	0.260 kg

CABLES	
One Wire	14 AWG (2 mm^2)
Two Wires	20 AWG (0,5 mm^2)

M-102 – DC Discrete Output Module

(Has Hot Swap and Device ID)

Order Code

M-102 (2 Groups of 8 transistor outputs (source))

Description

This module is designed with NPN transistors that are able to drive relays and other loads with up to 1A per output. It has 2 groups of 8 optically isolated transistor outputs.

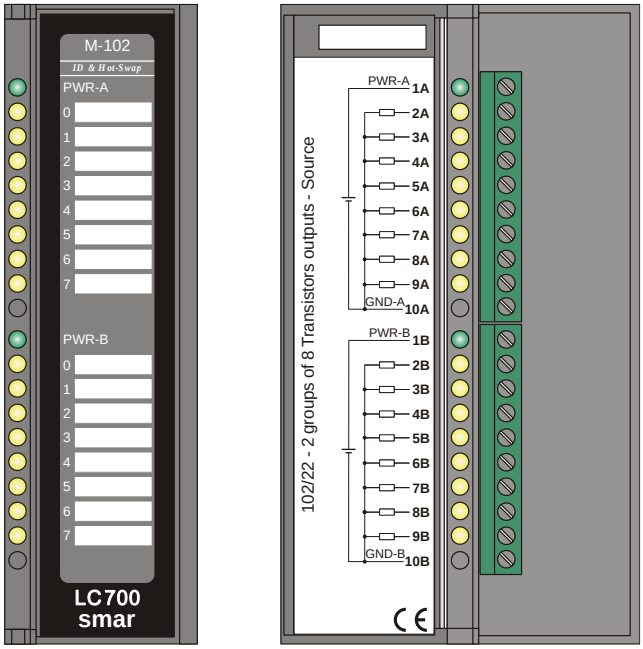


Figure 3.30 - M-102 transistor output module

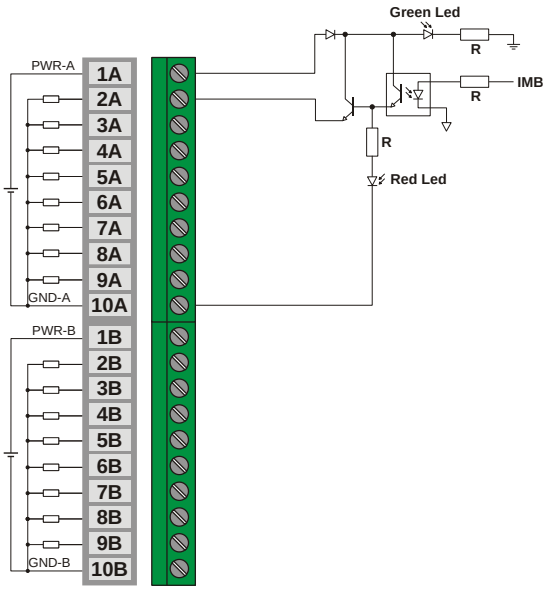


Figure 3.31 – External Connection

Technical Specifications

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

ISOLATION	
Optical isolation up to	5000 Vac

EXTERNAL POWER SUPPLY	
Power Supply	20 to 35 Vdc
Maximum consumption	65 mA
Source indicator	Green LED

INTERNAL POWER SUPPLY	
Supplied by IMB bus	5 Vdc @ 70 mA maximum
Maximum Total Dissipation	0.35 W
Source indicator	None

OUTPUTS	
Maximum Switching Voltage	35 Vdc
Maximum Saturation Voltage	0.3 V @ 1 A
Maximum Current per Output	1 A
Status Indicator	Yellow LED
Logic Indicator	ON when the transistor is driving
Maximum Leakage Current	200 μA @ 35 Vdc
Switching capacity (lamp)	15 W

INDEPENDENT PROTECTION PER OUTPUT	
Overcurrent protection	5.3 A

SWITCHING INFORMATION	
Time from 0 to 1	600 μs
Time from 1 to 0	300 μs

DIMENSIONS AND WEIGHT	
Dimensions (W x H x D)	39.9 x 137.0 x 141.5 mm; (1.57 x 5.39 x 5.57 in.)
Weight	0.260 kg

CABLES	
One Wire	14 AWG (2 mm^2)
Two Wires	20 AWG (0,5 mm^2)

M-110 – AC Discrete Output Module

Order Code

M-110 (2 Isolated Groups of 4 outputs of 240 Vac)

Description

This module is designed to drive relays, pilot lights, valves and other loads up to 1A per output. It has 2 optically isolated groups of 4 outputs. These outputs are capable of switching any voltage from 20 to 240 Vac.

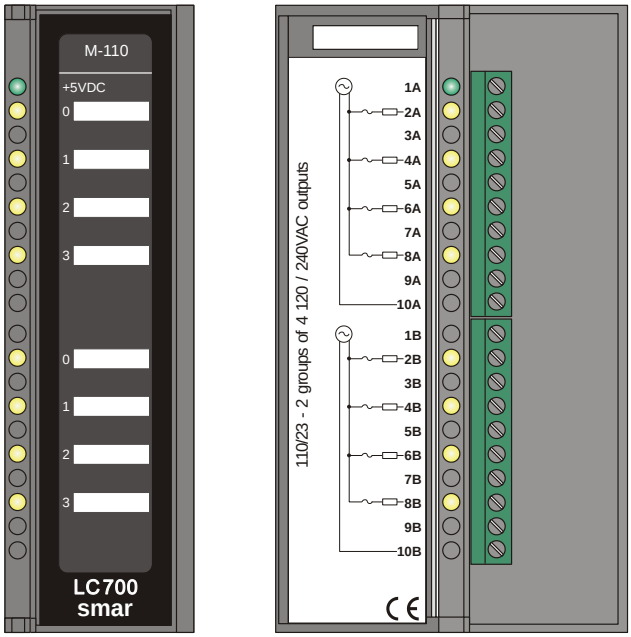


Figure 3.32 - M-110 AC Output Module

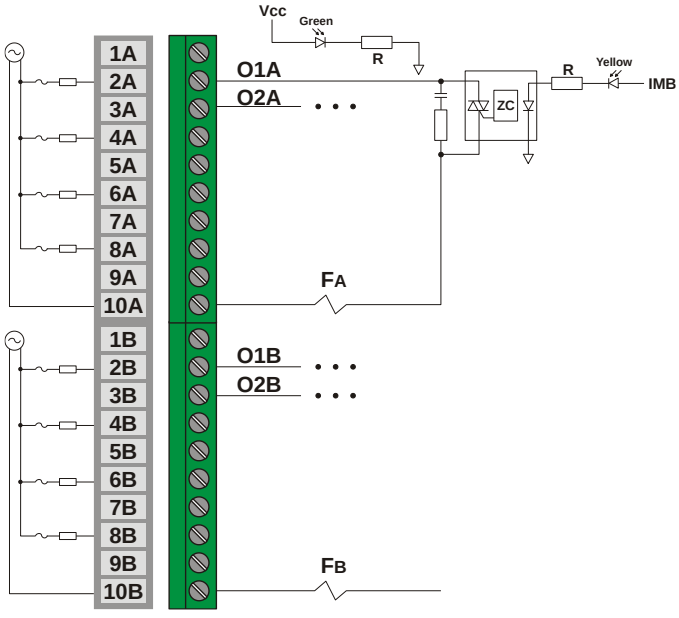


Figure 3.33 - External Connection

Technical Specifications

ARCHITECTURE	
Number of Inputs	8
Number of Groups	2
Number of Points per Group	4

ISOLATION	
Groups are isolated individually.	
Optical isolation up to	2500 Vac

EXTERNAL POWER SUPPLY	
Power Supply per Group	20 to 240 Vac, 45 to 65 Hz
Maximum consumption per group	4 A
Indicator	None
Protection	One fuse per group

INTERNAL POWER SUPPLY	
Supplied by IMB bus	5 Vdc @ 70 mA maximum
Maximum Total Dissipation	0.35 W
Indicator	Green LED

OUTPUTS	
Output Voltage	20 to 240 Vac, 45 to 65 Hz
Maximum Current per Output	1 A
Total Maximum Current per Group	4 A @ T_{room} 0-40 ºC (32-104 ºF) 2 A @ T_{room} 40-60 ºC (104-140 ºF)
Maximum Surge Current	15 A / 0.5 cycle, maximum 1 surge per minute
Status Indicator	Yellow LED
Logic Indicator	When Activated
Leakage Current (output off)	500 μA @ 100 Vac
Voltage Drop (output on)	1.5 Vac rms maximum
Output overload protection	It must be supplied externally (fast acting fuse when reaching 1.5 of nominal current).

SWITCHING INFORMATION	
Zero cross operation; Ton, Toff	1/2 cycle
RC Protection Circuit	62 Ω in series with 0.01 μF

DIMENSIONS AND WEIGHT	
Dimensions (W x H x D)	39.9 x 137.0 x 141.5 mm; (1.57 x 5.39 x 5.57 in.)
Weight	0.295 kg

CABLES	
One Wire	14 AWG (2 mm^2)
Two Wires	20 AWG (0.5 mm^2)

M-111 - AC Discrete Output Module

(Has Hot Swap and Device ID)

Order Code

M-111 (2 isolated groups of 8 outputs 240 Vac)

Description

This module is designed to drive relays, pilot lights, valves and other loads up to 1 A per output. It has 2 groups of 8 optically isolated outputs. These outputs are able to switch any voltage from 20 to 240 Vac.

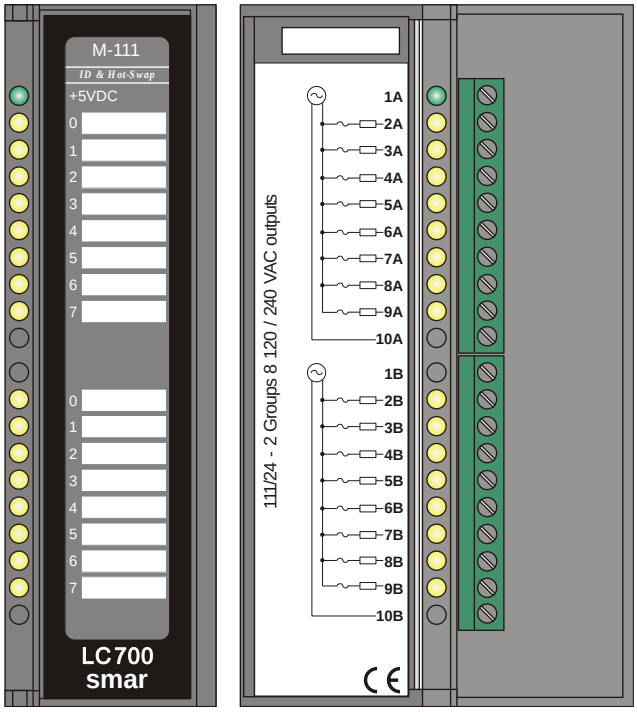


Figure 3.34 - M-111 AC Output Module

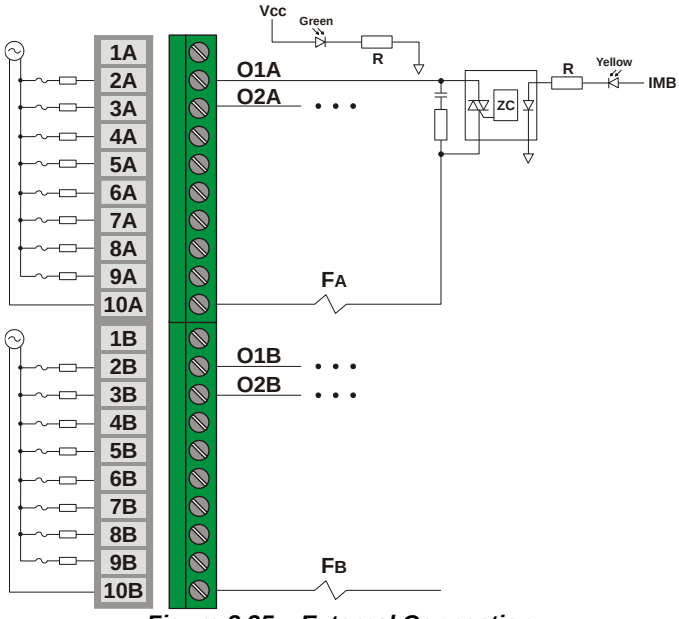


Figure 3.35 – External Connection

Technical Specifications

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

ISOLATION	
Groups are isolated individually.	
Optical isolation up to	2500 Vac

EXTERNAL POWER SUPPLY	
Power Supply per Group	20 to 240 Vac, 45 to 65 Hz
Maximum consumption per group	4 A
Indicator	None
Protection	One fuse per group

INTERNAL POWER SUPPLY	
Supplied by IMB bus	5 Vdc @ 115 mA maximum
Maximum Total Dissipation	0.575 W
Indicator	Green LED

OUTPUTS	
Output Voltage	20 to 240 Vac, 45 to 65 Hz
Maximum Current per Output	1 A
Total Maximum Current per Group	4 A @ T_{room} 0-40 ºC (32-104 ºF) 2 A @ T_{room} 40-60 ºC (104-140 ºF)
Maximum Surge Current	15 A / 0.5 cycle, maximum 1 surge per minute
Status Indicator	Yellow LED
Logic Indicator	When Activated
Leakage Current (output off)	500 μA @ 100 Vac
Voltage Drop (output on)	1.5 Vac rms maximum
Output overload protection	Must be supplied externally (fast acting fuse 1.5 times the nominal current)

SWITCHING INFORMATION	
Zero cross operation Ton, Toff	1/2 cycle
RC Protection Circuit	62 Ω in series with 0.01 μF

DIMENSIONS AND WEIG	
Dimensions (W x H x D)	39.9 x 137.0 x 141.5 mm; (1.57 x 5.39 x 5.57 in.)
Weight	0.330 kg

CABLES	
One Wire	14 AWG (2 mm^2)
Two Wires	20 AWG (0.5 mm^2)

M-120/M-121/M-122/M-124/M-125/M-126 – AC/DC Discrete Output Module

(Has Hot Swap and Device ID)

Order Code

M-120 (2 groups of 4 NO relay outputs with RC)
M-121 (2 Groups of 4 NC relay outputs with RC)
M-122 (1 group of 4 NO relay outputs and 1 group of 4 NC relay outputs with RC)
M-124 (2 groups of 4 NO relay outputs)
M-125 (2 groups of 4 NC relay outputs)
M-126 (1 group of 4 NO relay outputs and 1 group of 4 NC relay outputs)

Description

This relay output module is designed to switch pilot lights, valves and relay coils up to 5 A per output. Relays can drive loads from 20 to 110 Vdc or from 20 to 250 Vac. Two terminals are reserved for each relay output. This module has 2 isolated groups of relays, each one having its own supply.

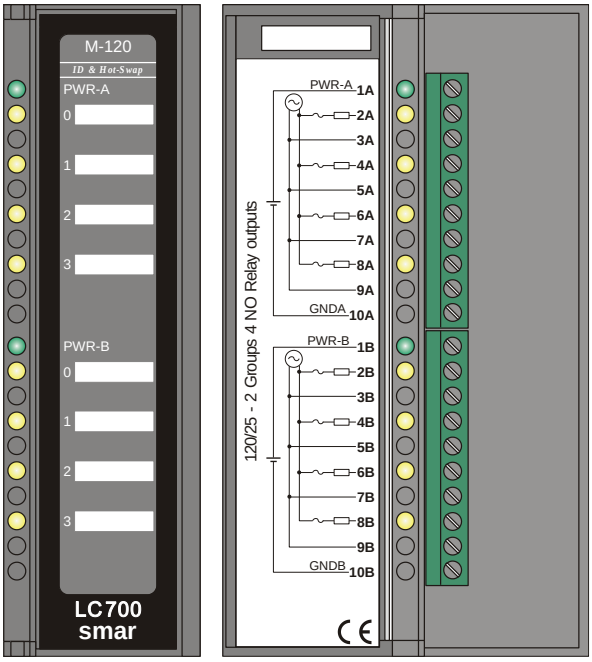


Figure 3.36- M-120 Relay Output Module

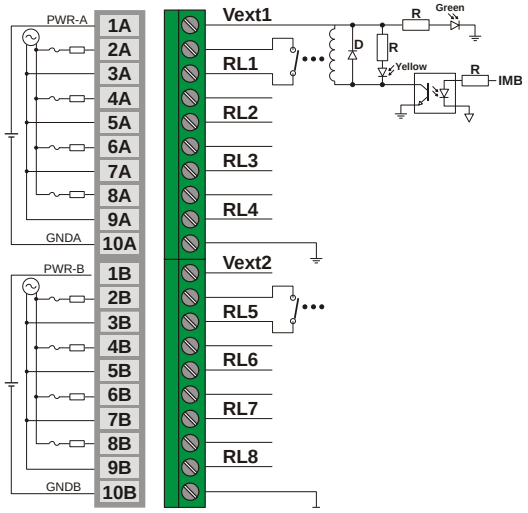


Figure 3.37 – External Connection

Power is required to drive the relay. The user can use the PS302P source or an external source. One source can drive several groups as long as the capacity is sufficient. Only one group per phase, but the groups can have different phases.

Technical Specifications

ARCHITECTURE	
Number of Inputs	8
Number of Groups	2
Number of Points per Group	4

ISOLATION	
8 contacts for individually isolated relays	
The driver for each relay is optically isolated from Backplane until	5000 Vac

EXTERNAL POWER SUPPLY	
Power Supply per Group	20 – 30 Vdc
Maximum Current per Group	52 mA @ 24 Vdc
Typical Consumption per Point	12 mA @ 24 Vdc
Source Indicator by Group	Green LED

INTERNAL POWER SUPPLY	
Supplied by IMB bus	5 Vdc @ 20 mA maximum
Maximum Total Dissipation	0.1 W
Source indicator	None

OUTPUTS	
Vac Range	20-250 Vac (M-120/M-121/M-122/M-124/M-125/M-126)
Vdc Range	20-125 Vdc (M-120/M-121/M-122/M-124/M-125/M-126)
Maximum current for 30Vdc/250 Vac	5A (resistive); 2A (inductive) (M-120/M-121/M-122/M-124/M-125/M-126)
Minimum Current	10 mA (M-120/M-121/M-122/M-124/M-125/M-126)
Maximum Initial Contact Resistance	30 mΩ (M-120/M-121/M-122/M-124/M-125/M-126)
Status Indicator	Yellow LED
Logic Indicator	ON if the relay coil is energized
Leakage current	500 μA @ 100 Vac (M-120/M-121/M-122) None (M-124/M-125/M-126)
Output overload protection	Must be provided externally

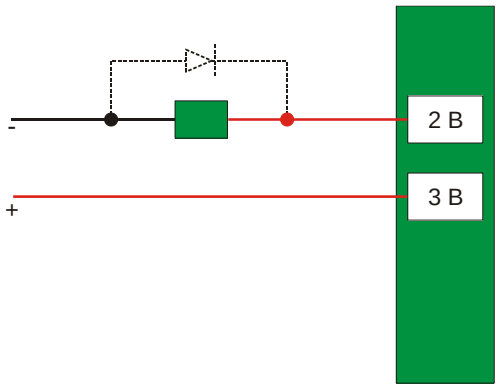
SWITCHING INFORMATION	
RC Protection Circuit	62 Ω in series with 0.01 μF (M-120/M-121/M-122) None (M-124/M-125/M-126)
Activation Time	10 ms Maximum (M-120/M-121/M-122/ M-124/M-125/M-126)
Shutdown Time	10 ms Maximum (M-120/M-121/M-122/ M-124/M-125/M-126)

ELECTRICAL LIFETIME	
Switching Cycles	100,000 operations @ maximum current (M-120/M-121/M-122/ M-124/M-125/M-126)

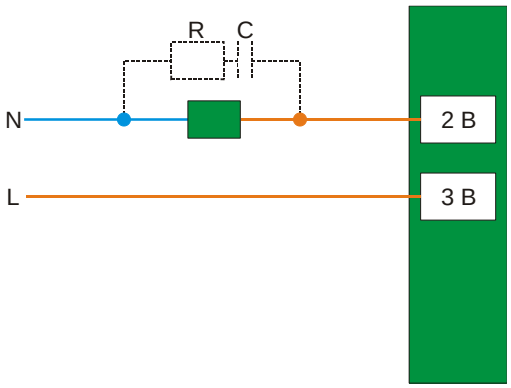
DIMENSIONS AND WEIGHT	
Dimensions (W x H x D)	39.9 x 137.0 x 141.5 mm; (1.57 x 5.39 x 5.57 in.)
Weight	0.305 kg

CABLES	
One Wire	14 AWG (2 mm^2)
Two Wires	20 AWG (0.5 mm^2)

NOTE
To increase the durability of your contacts and to protect the module from reverse voltage damage, externally connect a clamping diode in parallel with each DC inductive load or connect a snubber RC circuit in parallel with each AC inductive load.



DC Load



AC Load

M-123/M-127 – AC/DC Discrete Output Module

(Has Hot Swap and Device ID)

Order Code

M-123 (2 groups of 8 NO relay outputs)
M-127 (2 groups of 8 NO relay outputs with RC)

Description

This high density relay output module is designed to switch pilot lights, valves, as relay coils up to 5 A per output. Relays can drive loads from 20 to 30 Vdc or from 20 to 250 Vac. Each group of 8 relays has a common terminal and only one terminal is reserved for each relay output.

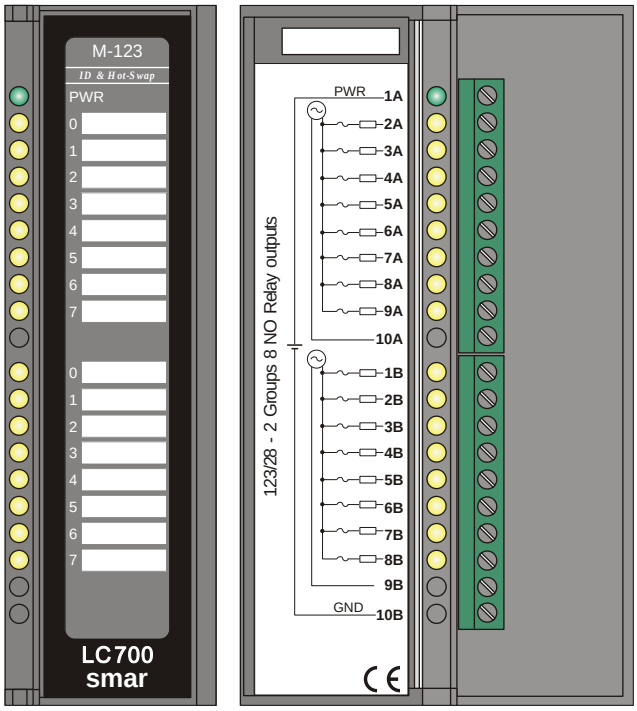


Figure 3.38 - M-123 High Density Relay Output Module

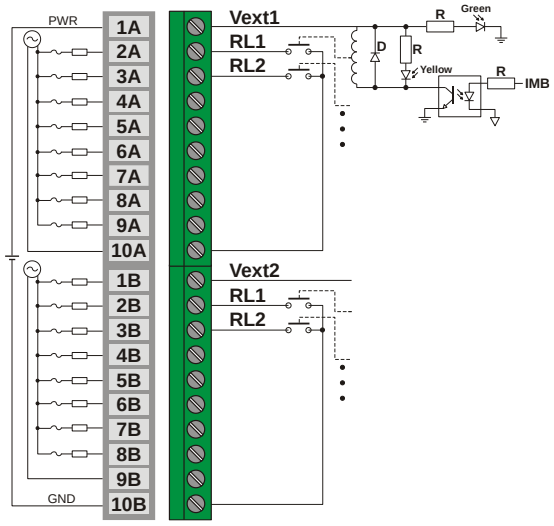


Figure 3.39 – External Connection

Power is required to drive the relay. The user can use the PS-AC-R source or an external source. One source can drive several groups as long as the capacity is sufficient. Only one group per phase, but the groups can have different phases.

Technical Specifications

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

ISOLATION	
The driver of each relay is optically isolated	5000 Vac
Each group of 8 relays has a common contact.	

EXTERNAL POWER SUPPLY	
Power Supply per Group	20 – 30 Vdc
Maximum Current per Group	90 mA @ 24 Vdc
Maximum Consumption per Point	11.3 mA @ 24 Vdc
Indicator by Group	Green LED

INTERNAL POWER SUPPLY	
Supplied by IMB bus	5 Vdc @ 30 mA maximum
Maximum Total Dissipation	0.15 W
Indicator	None

OUTPUTS	
Vac Range	20 – 250 Vac
Vdc Range	20 – 30 Vdc
Maximum current for 250 Vac	5A (resistive); 2A (inductive)
Maximum current for 30Vdc	5A (resistive); 2A (inductive)
Maximum Total Current per Group	10 A
Maximum Initial Contact Resistance	100 mΩ
Status Display	Yellow LED
Logic Indicator	ON if the relay coil is energized
Leakage Current	M-123: None
Output overload protection	Must be supplied externally

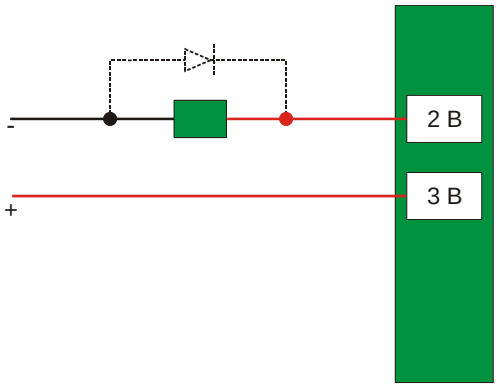
SWITCHING INFORMATION	
Operation Time	10 ms maximum
Release Time	10 ms maximum

ELECTRICAL LIFETIME	
Switching Cycles	Minimum of 20,000,000 operations @ maximum current

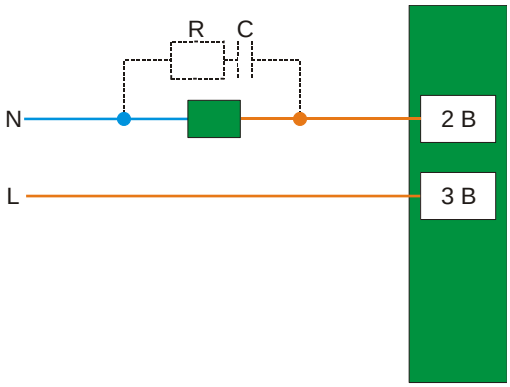
DIMENSIONS AND WEIGHT	
Dimensions (W x H x D)	39.9 x 137.0 x 141.5 mm; (1.57 x 5.39 x 5.57 in.)
Weight	0.301 kg

CABLES	
One Wire	14 AWG (2 mm^2)
Two Wires	20 AWG (0.5 mm^2)

NOTE
To increase the durability of your contacts and to protect the module from reverse voltage damage, externally connect a clamping diode in parallel with each DC inductive load or connect a snubber RC circuit in parallel with each AC inductive load.



DC Load



AC Load

M-501 – Current/Voltage Analog Output Module

(Has Hot Swap and Device ID)

Order Code

M-501 (1 Group of 4 analog outputs of Voltage/Current)

Description

This module provides 4 pairs of analog outputs. Each pair consists of one current and one voltage output. When activating an output, the corresponding pair is activated simultaneously. The current outputs can be individually configured in the 0-20 mA or 4-20 mA range. Output voltage ranges are: 0–5 V, 1–5 V, ±5 V, 0–10 V, 2–10V or ±10 V.

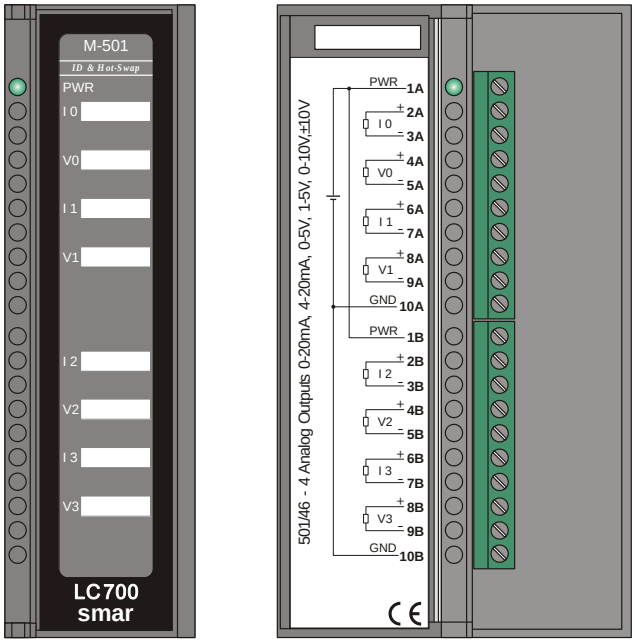


Figure 3.40 - M-501 Current and Voltage Analog Output Module

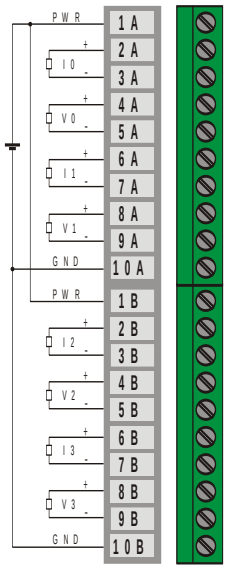


Figure 3.41 – External connection

Output signal range for the output channels is set at CONF700 (zero) and through the Dip Switches (span) in the module.

Dip Switch 1 - Up side: Sets the Channel 0 Range group (I0/V0)
Dip Switch 2 - Up side: Sets the Channel 1 Range group (I1/V1)
Dip Switch 1 - Down Side: Sets the Channel 2 Range group (I2/V2)
Dip Switch 2 - Down Side: Sets the Channel 3 Range group (I3/V3)

NOTE
To meet the requirements of EMC standards, use shielded cables for signal inputs (the shield must be grounded to the panel on one side of the cable only) and cables smaller than 30 meters for power inputs.

Technical Specifications

ARCHITECTURE	
Number of Inputs	4
Number of Groups	1
Number of Points per Group	4

ISOLATION	
Bus channel	Optical insulation up to 3700 V_{RMS}
Channel to external source	1500 Vac

INTERNAL POWER SUPPLY	
Supplied by IMB bus	5 Vdc @ 20 mA maximum
Maximum Total Dissipation	0.1 W

EXTERNAL POWER SUPPLY	
In Rush Current Consumption	2.3 A, 10ms Maximum @ 24VDC
Power Supply	20-30 Vdc
Maximum current	180 mA
Source indicator	Green LED

OUTPUTS	
Type of Output	Single ground
Load impedance	5 V: 2 kΩ minimum; 10 V: 5 kΩ minimum; 20 mA: 750 Ω maximum

	RANGE 1	RANGE 2	RANGE 3
OUTPUT VOLTAGE DIP SWITCH OFF	1 V to 5 V	0 to 5 V	-5 V to 5 V
OUTPUT VOLTAGE DIP SWITCH ON	**2 V to 10 V**	0 to 10 V	-10 V to 10 V
OUTPUT CURRENT	4 mA to 20 mA	0 to 20 mA	0 to 20 mA

A/D CONVERSION	
Conversion Rate	8 ms/channel
Resolution	12 bits
Accuracy at 77ºF (25ºC)	+/- 0.5% of span

DIMENSIONS AND WEIGHT	
Dimensions (W x H x D)	39.9 x 137.0 x 141.5 mm; (1.57 x 5.39 x 5.57 in.)
Weight	0.330 kg

CABLES	
One Wire	14 AWG (2 mm^2)
Two Wires	20 AWG (0.5 mm^2)

M-201 to M-209 – Discrete DC Input and AC/DC Output Module

Order Code

M-201 (1 Group of 8 inputs of 24Vdc and 1 Group of 4 NO relays)
M-202 (1 Group of 8 inputs of 48Vdc and 1 Group of 4 NO relays)
M-203 (1 Group of 8 inputs of 60Vdc and 1 Group of 4 NO relays)
M-204 (1 Group of 8 inputs of 24Vdc and 1 Group of 4 NC relays)
M-205 (1 Group of 8 inputs of 48Vdc and 1 Group of 4 NC relays)
M-206 (1 Group of 8 inputs of 60Vdc and 1 Group of 4 NC relays)
M-207 (1 Group of 8 inputs of 24Vdc and 1 Group of 2 NO and 2 NC relays)
M-208 (1 Group of 8 inputs of 48Vdc and 1 Group of 2 NO and 2 NC relays)
M-209 (1 Group of 8 inputs of 60Vdc and 1 Group of 2 NO and 2 NC relays)

Description

This module with DC inputs and relay outputs is designed to drive relays, pilot lights, valves and other loads up to 5 A and interprets the DC input voltage and converts them to a true or false logic signal.

It has 1 group of 8 optically isolated 24/48/60 Vdc inputs (M-201, M-204, M-207/M-202, M-205, M-208/M-203, M-206, M-209) and 4 relay outputs (M-201 to M-209). Relays can drive loads from 24 to 110 Vdc or from 24 to 250 Vac. Two terminals are reserved for each relay output.

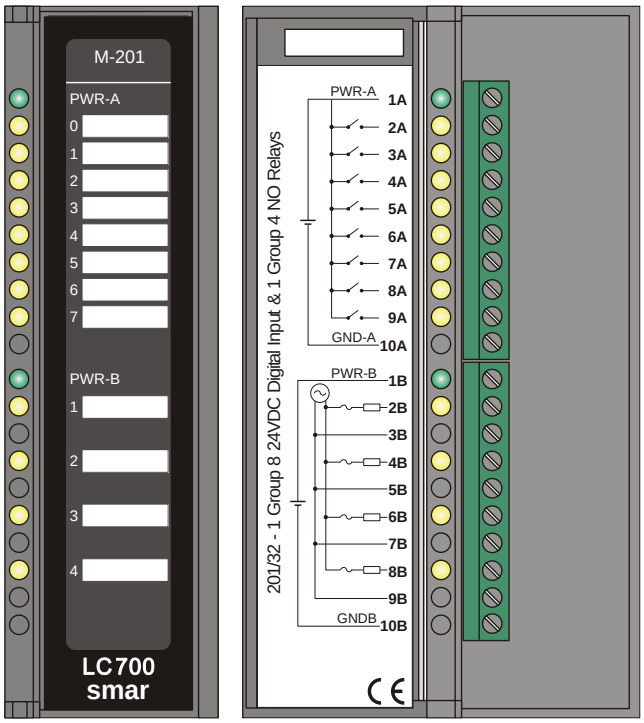


Figure 3.42 - M-201 DC Input and Relay Output Module

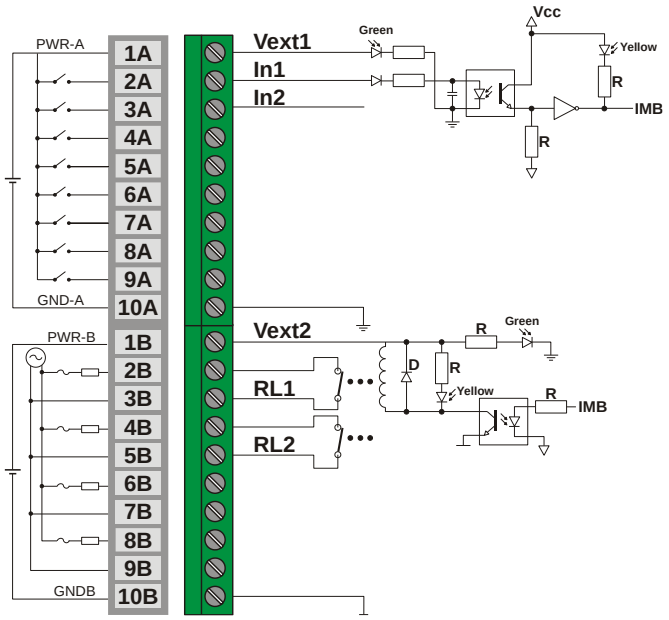


Figure 3.43 – External Connection

Power is required to drive the relay. The user can use the PS302P source or an external source. One source can drive several groups as long as the capacity is sufficient.

Technical Specifications

ARCHITECTURE	
Number of Groups	2
Number of Vdc Inputs	8
Number of Outputs	4

ISOLATION	
Groups are isolated individually. 4 relay contacts optically isolated. Power supply for the groups are isolated individually.	
Drive of each relay is optically isolated from the IMB up to	5000 Vac

INTERNAL POWER SUPPLY	
Supplied by IMB bus	5 Vdc @ 60 mA maximum
Maximum Total Dissipation	0.3 W
Indicator	None

For Vdc inputs:

ARCHITECTURE	
Number of Points	8

ISOLATION	
Isolation up to	5000 Vac

EXTERNAL POWER SUPPLY	
Power Supply for Inputs	20-30 Vdc (M-201, M-204, M-207) 36-60 Vdc (M-202, M-205, M-208) 45-75 Vdc (M-203, M-206, M-209)
Maximum Consumption per Group	65 mA @ 24 Vdc (M-201) 65 mA @ 48 Vdc (M-204) 62 mA @ 60 Vdc (M-207)
Indicator	Green LED

INPUTS	
Voltage Range for Logic Level "1"	20-30 Vdc (M-201, M-204, M-207) 30-60 Vdc (M-202, M-205, M-208) 38-75 Vdc (M-203, M-206, M-209)
Voltage Range for Logic Level "0"	0-5 Vdc (M-201, M-204, M-207) 0-9 Vdc (M-202, M-205, M-208) 0-12 Vdc (M-203, M-206, M-209)
Input Impedance (Typical)	3.9 KΩ (M-201, M-204, M-207) 7.5 KΩ (M-202, M-205, M-208) 10 KΩ (M-203, M-206, M-209)
Input Current per Point	8 mA @ 24 Vdc (M-201, M-204, M-207) 8 mA @ 48 Vdc (M-202, M-205, M-208) 7.5 mA @ 60 Vdc (M-203, M-206, M-209)
Status Display	Yellow LED
Logic Indicator	On when activated
Typical Input Current	7.5 mA

SWITCHING INFORMATION	
Minimum voltage for logic level "1"	20 Vdc (M-201, M-204, M-207) 30 Vdc (M-202, M-205, M-208) 38 Vdc (M-203, M-206, M-209)
Maximum voltage for logic level "0".	5 Vdc (M-201, M-204, M-207) 9 Vdc (M-202, M-205, M-208) 12 Vdc (M-203, M-206, M-209)
Time from “0” to “1”	30 µs
Time from “1” to “0”	50 µs

For relay outputs

ARCHITECTURE	
Number of outputs	4

ISOLATION	
Group is isolated individually. Each relay has 2 dedicated terminals.	
Optical isolation up to	5000 Vac (before relay isolation)

EXTERNAL POWER SUPPLY	
Power Supply per Group	20 – 30 Vdc
Maximum Consumption per Group	52 mA @ 24 Vdc
Typical Consumption per Point	12 mA @ 24 Vdc
Indicator by Group	Green LED

OUTPUTS	
Vac Range	20 – 250 Vac
Vdc Range	20 – 125 Vdc
Maximum current for 250Vac	5 A
Maximum current for 30 Vdc	5 A
Status Display	Yellow LED
Logic Indicator	ON if the relay coil is energized
Leakage current	500 μA @ 100 Vac

SWITCHING INFORMATION	
Protection RC circuit	62 Ω in series with 0.01μF
Time to activate	10 ms
Time to deactivate	10 ms

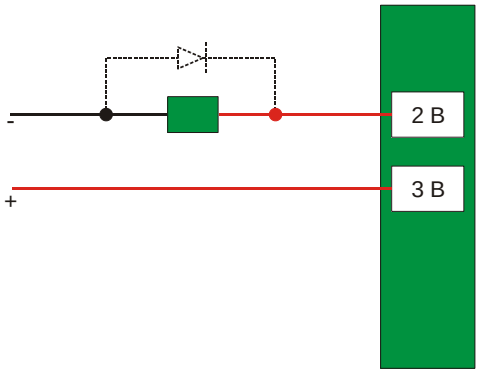
ELECTRICAL LIFETIME	
Switching cycles	100,000 operations @ maximum current

DIMENSIONS AND WEIGHT	
Dimensions (W x H x D)	39.9 x 137.0 x 141.5 mm; (1.57 x 5.39 x 5.57 in.)
Weight	0.298 kg

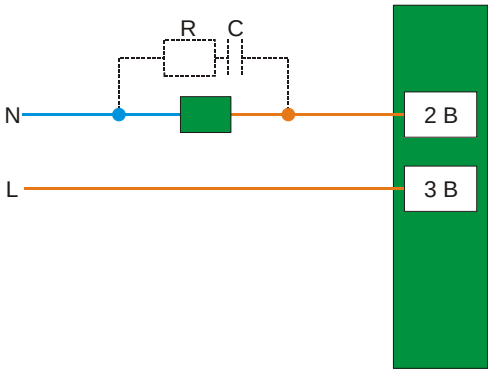
CABLES	
One Wire	14 AWG (2 mm^2)
Two Wires	20 AWG (0.5 mm^2)

NOTE

To increase the durability of your contacts and to protect the module from reverse voltage damage, externally connect a clamping diode in parallel with each DC inductive load or connect a snubber RC circuit in parallel with each AC inductive load.



DC Load



AC Load

SI-700 – EIA-232/EIA-485 Interface Module

Order Code

SI-700 (Interface EIA-232/EIA-485**)**

Description

This module converts the electrical characteristics of a communication signal in the EIA-232 specification to the EIA-485 specification. Due to fundamental differences between EIA-232 and EIA-485 objectives (the former is suitable for peer-to-peer communications). This module has been implemented to work automatically. No control signal is required to administer the bus on the EIA-485 side. User only needs to connect the transmission, reception and reference on both sides of the interface for it to work.

Converter circuit provides signal isolation to ensure a safe connection between the two systems. It uses the +5 Vdc lines of the IMB bus to energize the circuit.

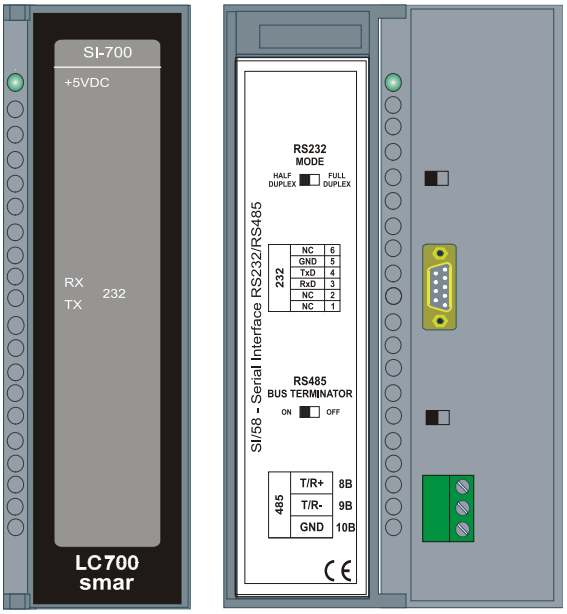


Figure 3.44- SI-700 EIA 232/EIA 485 Interface

Interface Settings

There are two interface settings located on the front of the panel to fit this interface to your applications: EIA-232 and EIA-485 Bus Terminator Mode

- **EIA-232 Mode: Half-Duplex/Full-Duplex**

EIA-232 Mode adapts the use of this interface to the communication driver developed for a given application. As this type of interface connects unidirectional buses to bi-directional buses, the unidirectional reception line bus may present the reflection of the signal transmitted in the bi-directional medium.

If the user driver does not properly handle the reception simultaneously with the message transmission, either by disabling the reception or by discarding the reflected message, the Half-Duplex option must be selected. If the reflected message does not cause any disturbance to the application, the Full-Duplex option can be selected.

- **EIA-485 Bus Terminator: On/Off**

EIA-485 is a Multi-Drop bus, and thus the driver transmitter is placed in the high-impedance (Hi-Z) state when no message is being transmitted. Thus, the EIA-485 bus requires a bus terminator to prevent noise problems during the EIA-485 idle state.

For the correct impedance matching, only one bus terminator must be activated. The other terminators must remain disabled.

Connectors
There are two types of connectors in front of the panel to connect two communication systems. The first, an RJ12 type connector, is used in 232 systems and the other, a terminal block type connector, is used in 485 systems.

RJ12 pinning

Pins	Description
1	Connected to Pin 6.
2	Not used
3	RxD: EIA-232 input signal - reception
4	TxD: EIA-232 output signal - transmission
5	GND: RS232 ground signal
6	Connected to pin 1

NOTE
Pins 1 and 6 are interconnected to allow intercommunication of modem signals when required by communication drives such as Clear-to-Send (CTS) with Request-to-Send (RTS).

Block Terminal Pinning

Pins	Description
1	+: RS485 Non-inverted sign
2	-: RS485 Inverted Signal
3	GND: Reference for RS485 communication signal

NOTE
GND pin is used to ensure a reference voltage for the EIA-485 nodes on the same bus. The 485 side of the 232/485 interface is isolated and is in the floating state. To avoid common mode high voltages, it is recommended to place all 485 nodes on the same voltage reference by connecting all GND pins together and grounding them at a single point.

Technical Specifications

Number of communication channels	1
Data communication interface	RS232 / RS485
Data Rate	Over 200 KBPS
RS232 side	Operation in Half-Duplex or Full-Duplex mode
RS485 side	Contains an internal terminator for 485 bus
485 Protection	No transmission when bus is in Break state
Isolation	1600 Vrms @ 1 minute, typical
Power Supply	Provided by IMB bus, +5 Vdc, @ 60 mA Typical

Note

In the interconnection of the 485 network, in order to comply with EMC (electromagnetic compatibility) requirements, a three-way shielded twisted cable must be used, in which two ways are used for communication and the third way as a reference. The shield must be connected at one end to the housing ground.

ICS2.0P – Serial Converter Interface Module

Order Code

ICS2.0P (Serial Converter Interface)

Description

ICS2.0P Serial Converter Interface is a device consisting of a universal power supply and inputs and outputs for the two 232 and 485 standard communication interfaces. The three modules: power supply, interface 232 and interface 485 are electrically isolated from each other, typically resisting up to a voltage of 1600 V_{RMS} (1 minute) or 2000 V_{RMS} (1 second).

Depending on their specificity, where two interfaces with totally opposite communication modes are connected (the 232 is essentially Full Duplex and the 485, Half Duplex), this interface allows the choice between Full Duplex and Half Duplex communication in its 232 interface. Besides this, because 232 is an interface focused on point-to-point communication and 485 is multipoint, it was decided to implement a mechanism to enable 485 transmission, totally automatic, independent of the Baudrate selected. To this characteristic another very interesting one was also added, which is the Bus Busy, that is, if the 485 line has a present signal or even is in break state, the circuit blocks any output signal from 232 bus to 485 bus.

For further details on the ICS2.0P module, refer to the equipment manual.

Technical Specifications

POWER SUPPLY	
Consumption	3 W max.
Input Voltage	90 to 240 Vac @ 48 to 70 Hz, monophasic or biphasic
Output Voltage	5 Vdc, 0,5 A max.
Protection	Against overcurrent, overvoltage, instantaneous surges and EMI.
Protection Fuse	250 mA

COMPLIANCE
According to CE

ISOLATION	
Galvanic and Optical	Up to 1600 V_{RMS} (1 minute) - between the power supply and the buses 2000 V_{RMS} (1 second) - between buses and communication.

COMMUNICATIONS	
Communication Rate	Up to 250 Kbps, self-adjusting

INDICATION
LEDs for powering and for presence of communication signals.

TEMPERATURE	
Operation	-10 to 60 ºC @ 100% RH max.
Storage	-30 to 90 ºC @ 90% RH max.

CONNECTION			
Pin	**I/O**	**Signal**	**Description**
1	I	L	Power phase input
2	I	N	Neutral (single-phase)/Phase (two-phase) Power Input
3	-	G	Housing grounding pin

Connection: 3 wires: L, N and G, via screw terminals.

Note: When using two-phase power input, the use of an external fuse on the N line is recommended.

FASTENING
Through support for own DIN rail or using empty slots of a R-700-4 model Rack (rack with 4 slots).

DIMENSIONS AND WEIGHT	
Dimensions (W x H x D)	40 x 127 x 142 mm; (1.57 x 5.00 x 5.59 in.)
Weight	0.265 kg

232 Interface

OPERATION MODE	Full Duplex or Half Duplex, configurable
PROTECTION	Voltage peaks
WIRING	Up to 15m (25m shielding), between ICS2.0P and 232 equipment

CONNECTION			
Pino	**I/O**	**Signal**	**Description**
2	O	TxD	232 input signal to be transmitted to the receiver of the 232 equipment.
3	I	RxD	232 input signal generated by the transmitter of the 232 equipment.
5	-	GND	Reference ground of 232 signals.

Connection: 3 wires: TxD, RxD and GND, through the 9-pin Delta connector, female.

485 Interface

OPERATION MODE	Automatic control of the transmission driver, regardless of the communication rate.
TERMINATORS	Activation through jumpers
PROTECTION	Voltage peaks
WIRING	Up to 1200m, without repeater, using two twisted pairs and with shielding. **Note:** Connect the shielding to the GND ground pin.

CONNECTION			
Pin	**I/O**	**Signal**	**Description**
1	I/O	+	Positive differential signal of 485.
2	I/O	-	Negative differential signal of 485.
3	-	GND	Grounding Useful to eliminate the effects of common mode voltage.

Connection: 3 wires, with differential (+) and (-) signals and GND ground.

DF93 - Rack with 4 slots (with diagnosis)

Description

DF93 rack is part of the new LC800 power system. Its constructive characteristics make it more efficient because it minimizes the voltage drop along the IMB bus. In addition, its diagnostic features help detect problems by minimizing downtime and maintenance. Diagnosis can be obtained visually (LEDs).

DF93 rack has Vdc and GND terminals on the sides (for power transmission). Its finish makes it impossible to have short between Vdc and GND connections on the sides.

As in the old system, new racks can be added to the LC800 system according to the need. Up to 15 racks are allowed. Racks can be connected to each other (expanding the bus) using flat cables (DF101 to DF107), DF90 (IMB power cable) and DF91 (side adapter).

It is important to remember that the distance between the first module and the last module of an expanded LC800 system cannot exceed 7 meters.

NOTE
Each rack has a key to select an address. 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. See also the Architecture section of the LC800.

There are some restrictions for module allocation in the rack:

1. First slot of rack 0 is always reserved for power supply modules.
2. Second slot in Rack 0 is always reserved for the controller module.
3. If additional power supplies are used, they must be placed in the desired rack slot 0 (W1 Jumper in the rack must be cut, and the DF90 cable coming from the previous racks must be disconnected before connecting the power supply).
4. The first rack must have a DF84 installed when the CPU800 executes local logic with discrete output modules.
5. The last rack must have a terminator installed - T-700 (right side) or DF96 (left side). For more details, see Chapter 2, in this manual.
6. You will need to use grounding terminals. See next figure.

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

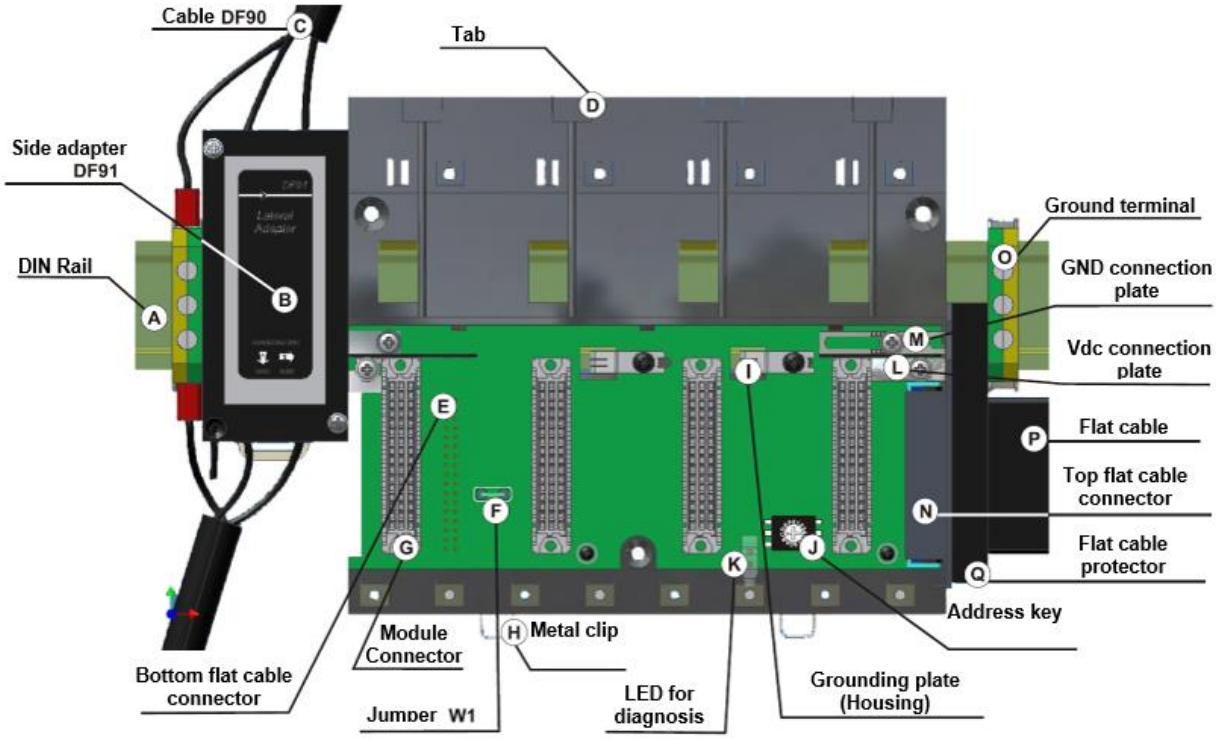


Figure 3.73 – DF93 Rack

Cables for rack interconnection and power distribution

Depending on the model of the rack different types of cables are required for interconnection between racks and for power distribution along the IMB bus. In the table below are the available types of cables.

System Base – DF93	
Code	**Description**
DF90	IMB Power Cable
DF101	Flat cable for left side rack connection - length 70 cm
DF102	Flat cable for right side rack connection - length 65 cm
DF103	Flat cable for right side rack connection - length 81 cm
DF104	Flat cable for right side rack connection - length 98 cm
DF105	Flat cable for right side rack connection - length 115 cm

or details on the correct installation of cables, please refer to Section 2.

Expansion flat cables for the base of the system with DF93

These flat cables are used when the LC800 is expanded into more than one row of racks (DF93), i.e. into different DIN rail segments, one below the other. To ground the shielding of these flat cables, use grounding terminal blocks near the connection of the flat cables to the racks.

- **DF101 - Flat cable for left side rack connection**
  It is installed in the rear connectors of the left end of each row of racks, interconnecting rows 2-3, 4-5 and 6-7 (if any). For grounding, the available terminal block next to each DF91 can be used.

- **DF102, DF103, DF104 and DF105 - Flat cables for right side rack connection**
  It is installed on the top connectors of the right end of each row of racks, interconnecting rows 1-2, 3-4 and 5-6 (if any). See the Installing section.

Flat cable Protector

To meet EMC requirements, the ESD shield must be installed on the right flat cable connection. Figure below shows the flat cable protector being fitted to the cable connector.

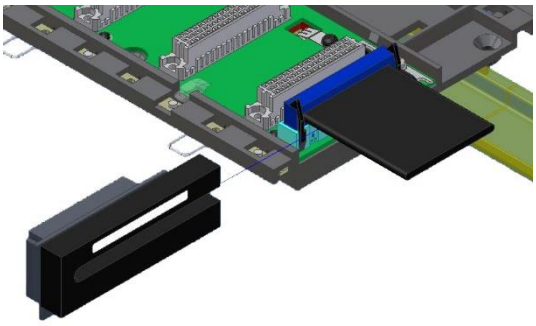


Figure 3.81 - Installing the flat cable protector

Following figure shows the protector installed to the connector.

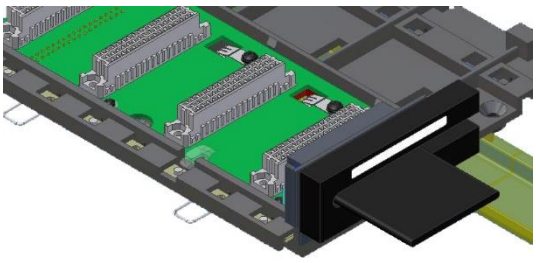


Figure 3.82 - Flat cable protector installed

DF90 Cable

Power expansion should be used when the LC800 is expanded into more than one row of racks, i.e. into different DIN rail segments, one below the other. DF90 is the IMB power transmission cable. Its constructive characteristics provide low voltage drop and EMI protection.

DF90 cable should only be connected through DF91. Its direct connection in racks is not supported, under risk of rack damage. For more details, see Chapter 2 in this manual.

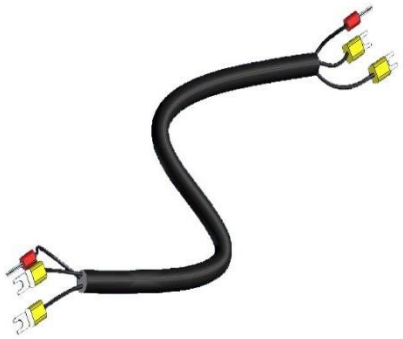
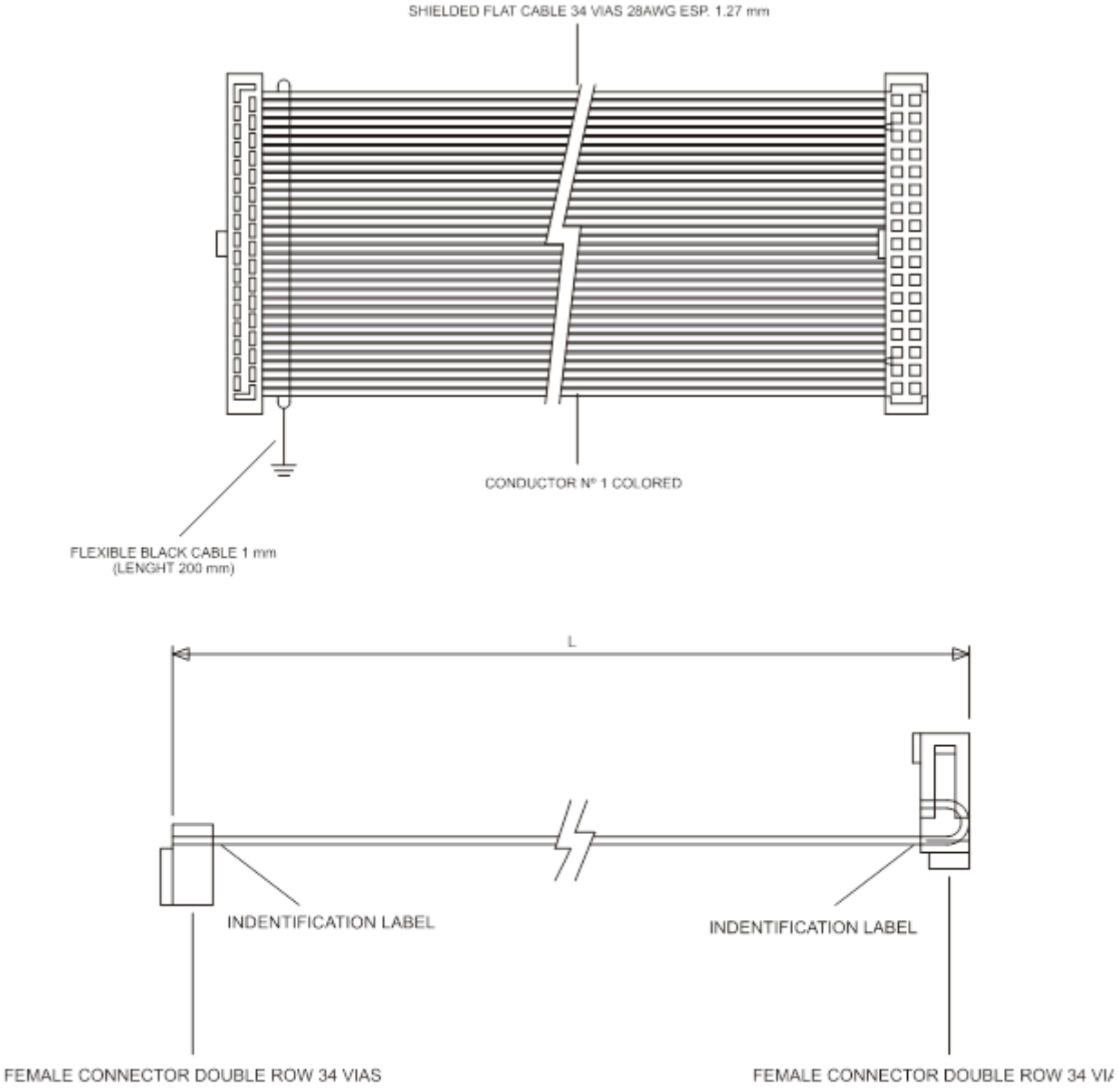


Figure 3.83 - IMB Power Cable (DF90)

Shielded Flat Cable

System Base – R-700-4A	
Code	**Description**
FC-700-1A	Flat cable to connect two racks - length 65 cm
FC-700-2A	Flat cable to connect two racks - length 81.5 cm
FC-700-3A	Flat cable to connect two racks - length 98 cm
FC-700-4A	Flat cable to connect two racks - length 110 cm



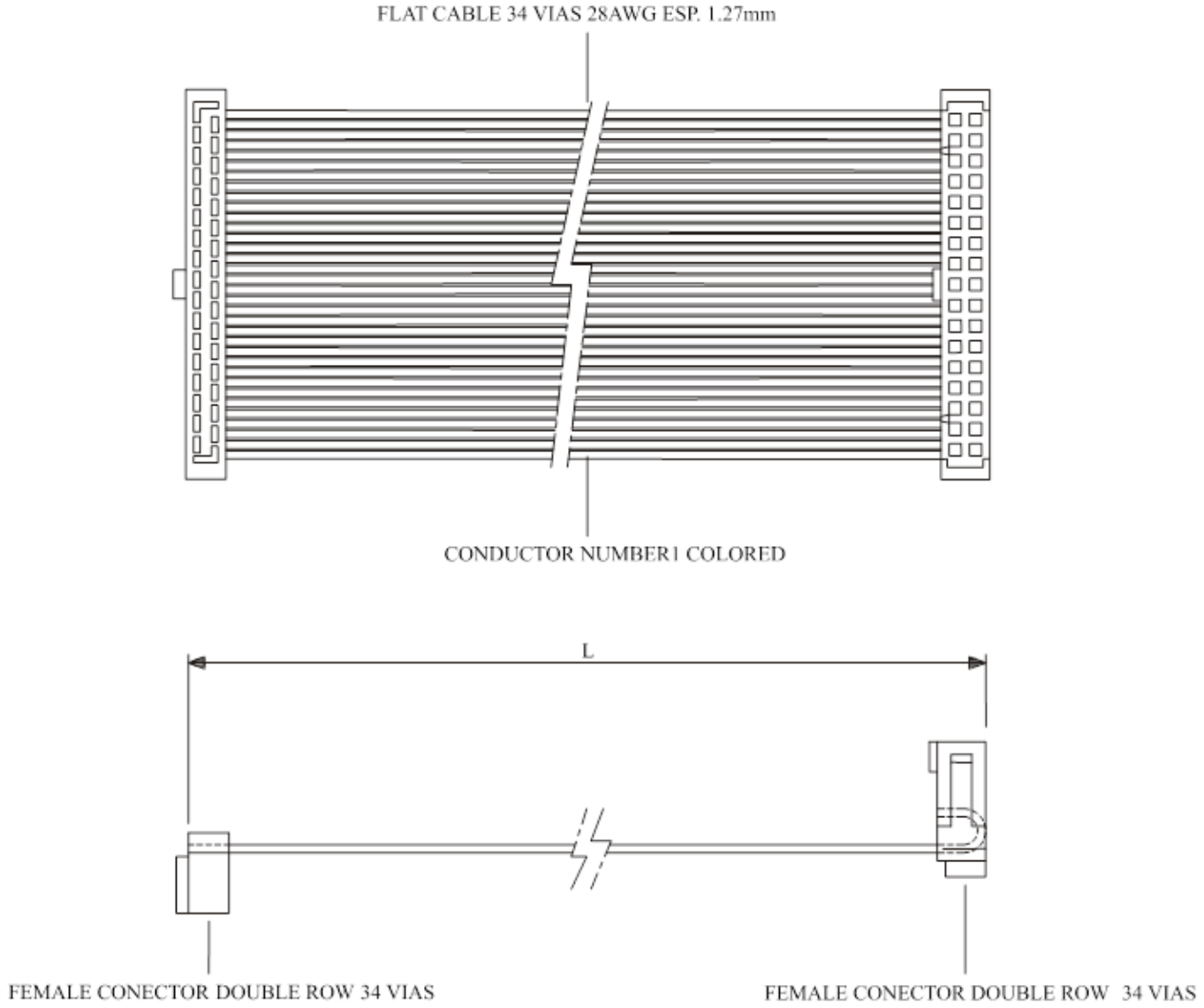
MODEL		LENGHT " L"	FLAT CABLE	TOLERANCE
DF4A	FC-700-1A	25.62" (651 mm)	25.90" (658 mm)	**+10-0 mm**
DF5A	FC-700-2A	32.04" (814 mm)	32.32" (821 mm)	+10-0 mm
DF6A	FC-700-3A	38.46" (977 mm)	38.74" (984 mm)	+10-0 mm
DF7A	FC-700-4A	44.88" (1140 mm)	45.15" (1147 mm)	+10-0 mm

Figure 3.84 – Shielded flat cable to connect 2 racks

Figure 3.85 – Example of Shielded flat cable

Flat Cable without shield

System Base – R-700-4A	
Code	**Description**
FC-700-0	Flat cable to connect 2 racks - length 6.5 cm
FC-700-1	Flat cable to connect 2 racks - length 65.0 cm
FC-700-2	Flat cable to connect 2 racks - length 81.5 cm
FC-700-3	Flat cable to connect 2 racks - length 98.0 cm
FC-700-4	Flat cable to connect 2 racks - length 114.0 cm



MODEL		LENGHT "L"	FLAT CABLE	TOLERANCE
DF3	FC-700-0	2.56" (65mm)	2.87" (73mm)	+ 2 - 0mm
DF4	FC-700-1	25.62" (651mm)	25.90" (658mm)	+ 10 - 0mm
DF5	FC-700-2	32.04" (814mm)	32.32" (821mm)	+ 10 - 0mm
DF6	FC-700-3	38.46" (977mm)	38.74" (984mm)	+ 10 - 0mm
DF7	FC-700-4	44.88" (1140mm)	45,15" (1147mm)	+ 10 - 0mm

Figure 3.86 - Flat cable to connect 2 Racks

T-700 - IMB Terminator for right side

Order Code

T-700 (IMB Terminator for the right side (on the last Rack))

Description

You should always use the T-700 Terminator in the last rack to match the impedance signals of the IMB.

Figure 3.87 - T-700 Terminator

NOTE
See “Installing the terminator in IMB - T-700” in Chapter 2 in this manual.

DF96 – IMB Terminator for the Left side

Order Code

DF96 (IMB Terminator for the left side)

Description

It is connected to the E connector of the last rack, when it is connected to the other racks by its right for impedance matching of IMB signals See figure below.

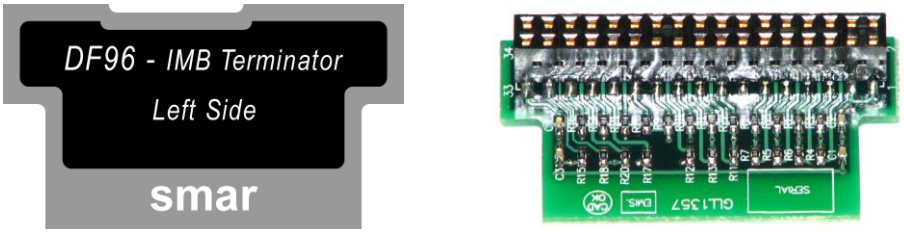


Figure 3.88 –DF96 Terminator

NOTE
See “Installing the terminator in IMB - DF96” in Chapter 2 in this manual.

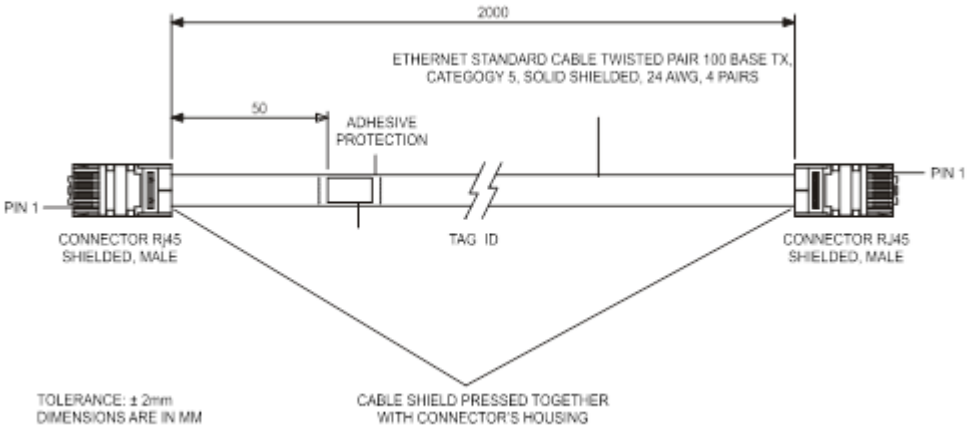
Ethernet Cable Specification

If a new Ethernet cable is required, the specifications for the Twisted Pair cable are given here, according to the Order Code for DF54 or DF55.

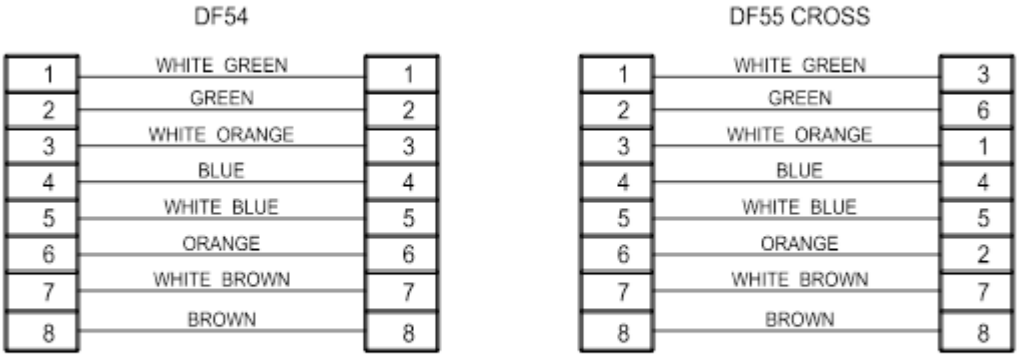
DF54/DF55

DF54 – Standard Ethernet Cable: to be used in a network between controllers and *Switch*/*HUB*.

DF55 – Cross Cable: to be used point to point communication between PC and CPU800.



CABLE CONNECTION DIAGRAM



OBS: COLORS ARE MERELY A SUGGESTION.
IS IMPORTANT TO OBEY THE COLORS PAIRS AS THE CABLE CONNECTION DIAGRAM.

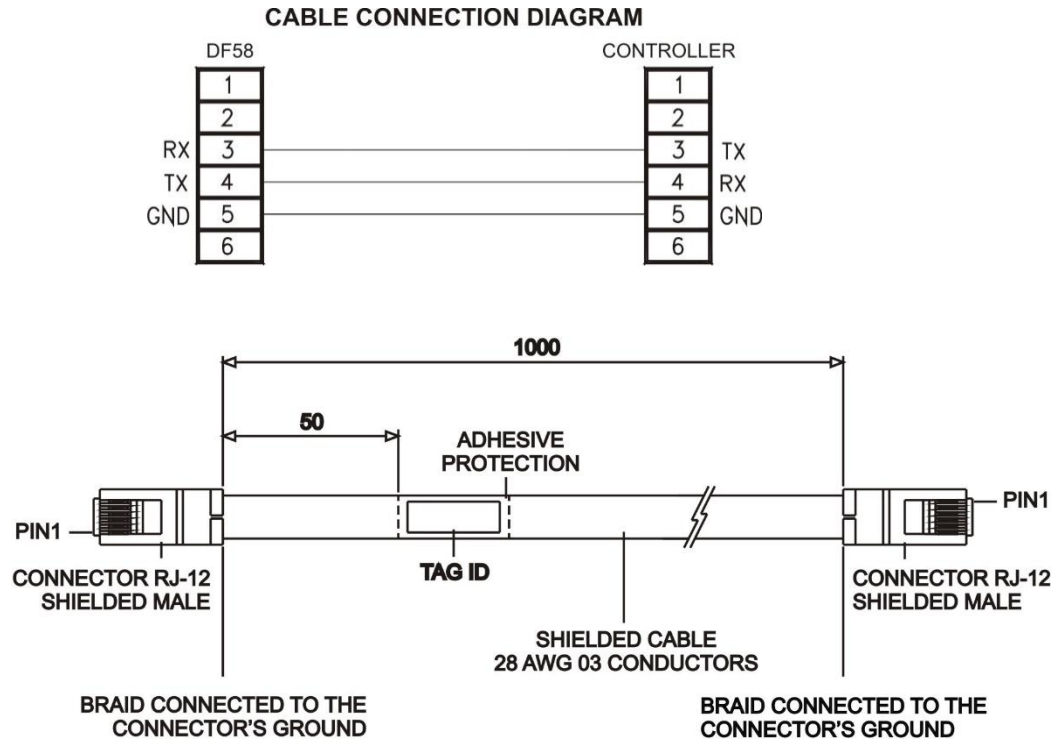
DF54 cable has the following length options:

PRODUCT	CLASS	OPTION
DF54		**TWISTED PAIR CABLE 100 BASE TX**
1 - CABLE LENGTH	1	0.5 m
	2	2 m
	3	3 m
	4	5 m
	5	10 m

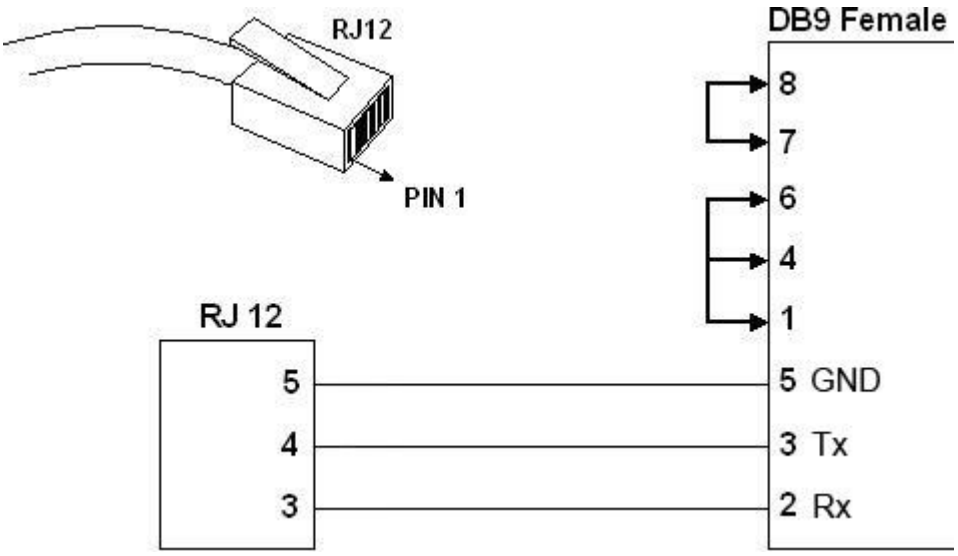
Serial Cable Specification

DF59

To connect **CPU800 and DF58 (RS232/RS485 interface)** you will need a **DF59** cable or make one according to the following diagram:



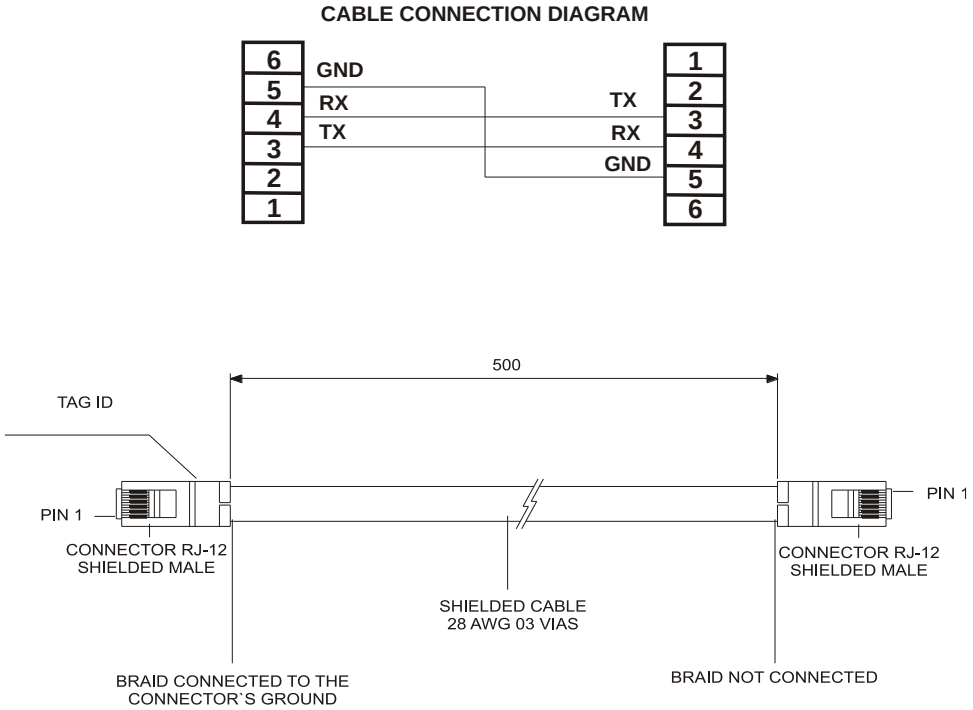
To assemble a serial cable between **CPU800 and the computer**, follow the instructions below. Figure shows a connection between RJ12 (used in the controller) and female DB9:



The Jumpers on the DB9 side are recommended, but not necessary, depending on the application running on the PC.

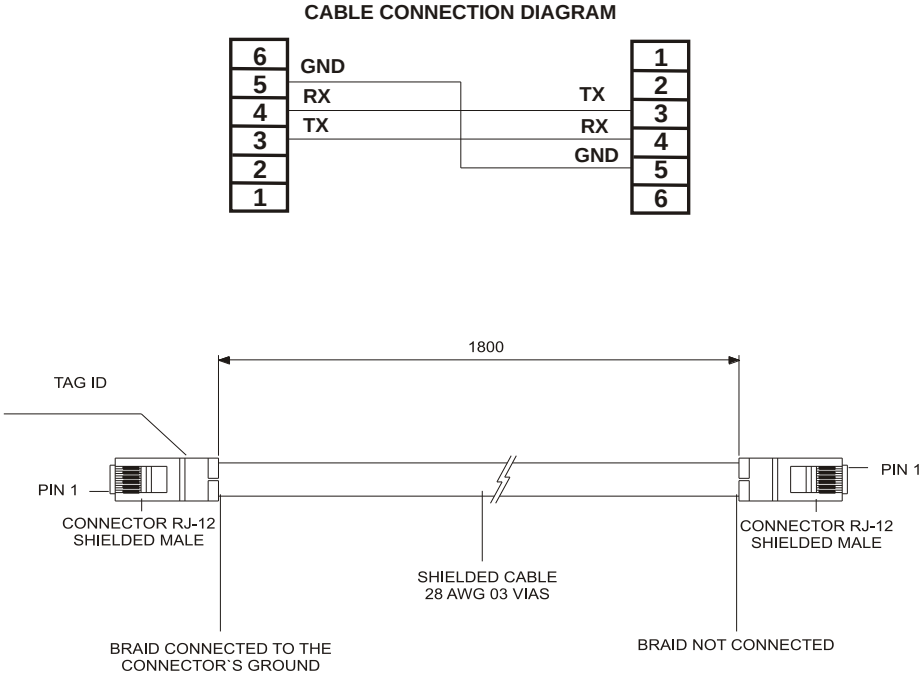
DF82

DF82 cable is used to interconnect redundant CPUs. Figure below shows the DF82 cable connection diagram.



DF83

DF83 cable interconnects redundant controllers. The figure below shows the cable connection diagram.



INSTALLATION

The objective of this Chapter is to provide the **General Procedures for the Installation of Smar Industrial Automation Systems**, including Programmable Controllers, I/O Modules, Operator Interface Terminals and Communication Networks.

This document is organized in the following sections:
– Considerations about the layout of conductors and channels;
– Conductor categories;
– Positioning of the conductors;
– Panel layout and rack mounting;
– Mounting and connecting the rack;
– Positioning the racks on the panel;
– Installation of poles on the rails to fix and secure the modules inside the panel;
– Connection and grounding;
– Power distribution;
– Summary of basic rules for mounting panels.

Use these procedures as a help tool to avoid Electro-Magnetic Interference (EMI) and transients that can cause issues in the automation system.

NOTES
1. These procedures are not intended to replace local electrical codes. 2. Although these rules apply to most installations, some electrically harsh environments may require additional precautions. 3. Recommendations to avoid issues with Electrostatic Discharge (ESD): - Ground yourself before touching the electronic circuitry to avoid electrostatic discharge, which may damage the equipment; - Keep the module ports closed when in operation; - Maintenance of the equipment, when energized, should only be performed by trained technicians.

Considerations about the layout of the conductors and conduits

The layout of the conductors reflects where the different types of I/O modules are positioned in the rack. For this reason, the user must first determine the location of the I/O modules, thus determining the cables direction.

However, when planning the location of I/O modules, group the modules, based on the conductor categories. Also, all conductors (AC or DC) placed in the same channel must have insulation for the highest voltage applied to any of the cables in the channel.

Conductor Categories

Group all wires and cables into the following three categories (Table 4.1). Refer to the specifications of each specific I/O module to classify the individual category of conductors for each I/O line.

GROUP THE CABLES ACCORDING TO THIS DESCRIPTION	CATEGORIES	EXAMPLES
AC Power and Control High power cables that are more tolerant to electrical noise than Category 2 conductors and can also generate more noise to be induced into adjacent cables	**Category 1**	-AC power lines for power supplies and I/O circuits. -AC high power digital I/O lines - for connecting AC I/O modules, rated for high power and high noise immunity. -DC high power digital I/O lines - for connecting DC I/O modules, rated for high power or with input circuits with large time constant filters, for high noise rejection. Typically for connection with dry contact switch, relay and solenoid valve.

GROUP THE CABLES ACCORDING TO THIS DESCRIPTION	CATEGORIES	EXAMPLES
Signal & Communication Low power cables that are less tolerant to electrical noise than Category 1 cables and should also generate less noise that can be induced into adjacent cables (they are connected to sensors and actuators relatively close to the I/O modules).	**Category 2**	- Analog I/O lines and DC power lines for analog circuits. - AC/DC low power digital I/O lines to connect I/O modules that are rated for low power, such as low power output modules. - DC low power digital I/O lines to connect I/O modules that are rated for low power and have input circuits with low time constant filters to detect pulses. They typically connect to equipment similar to switches, photoelectric sensors, and encoders. - Communication cables - for connection between CPU's or for communication interface modules, programming terminals, computers.
Internal to the panel Interconnect the system components within the panel	**Category 3**	- DC power cables for low voltage, power cables for the rack; - Communication cables; for connection between system components within the same panel, ICP-700-D3, Flat cable;

Table 4.1 - Grouping of conductors

Conductors Positioning

To reduce noise coupling from one conductor to another, it is recommended to keep electrically noisy wires, such as AC power cables, digital output cables, physically separated from low-level lines, such as analog input and output cables, or communication cables. Follow these procedures (Table 4.2) when routing wires and cables (inside or outside a panel).

NOTE
These procedures are for noise immunity only. Follow local standards for safety requirements!

CATEGORIES	ACCORDING TO THESE PROCEDURES
Category 1	- These conductors can be placed in the same channel or conduit with the machine supply conductors up to 600Vac (feeding equipment up to 100 hp).
Category 2	- If these conductors need to cross power lines, this must be done at right angles. - Distance at least 5 ft (1.5m) from high voltage panels, or RF / microwave radiation sources. - If the conductor is in channel or conduit, each segment of this metal channel or conduit should be "connected" to the adjacent segment so that it has continuity along its length, and should be connected at the input point of the panel. - Proper shielding (where applicable) and direct in a separate channel from category 1 conductors. - If in an adjacent metal channel or conduit, distance it at least 0,08m (3 in.) from category 1 conductors less than 20A; 0,15m (6 in.) from AC power lines of 20A or more, but up to 100 kVA and 0,3m (1 ft.) from AC power lines greater than 100 kVA. - If not in a continuous channel or conduit, distance it with at least 0,15m (6 in.) from category 1 conductors of less than 20A; 0,3m (1 ft.) from AC power lines of 20A or more, but only up to 100 kVA and 0,6m (2 ft.) from AC power lines greater than 100 kVA.
Category 3	- Direct conductors in separate channels from category 1 conductors with the same spacing listed for category 2 conductors, where possible.

Table 4.2 - Procedures for cable positioning for noise protection

IMPORTANT
These procedures assume that the user follows the Surge Suppression procedures. Although these rules apply to most installations, some electrically harsh environments may require additional precautions.

The use of the procedures in Table 4.2 are illustrated in Figure 4.1.

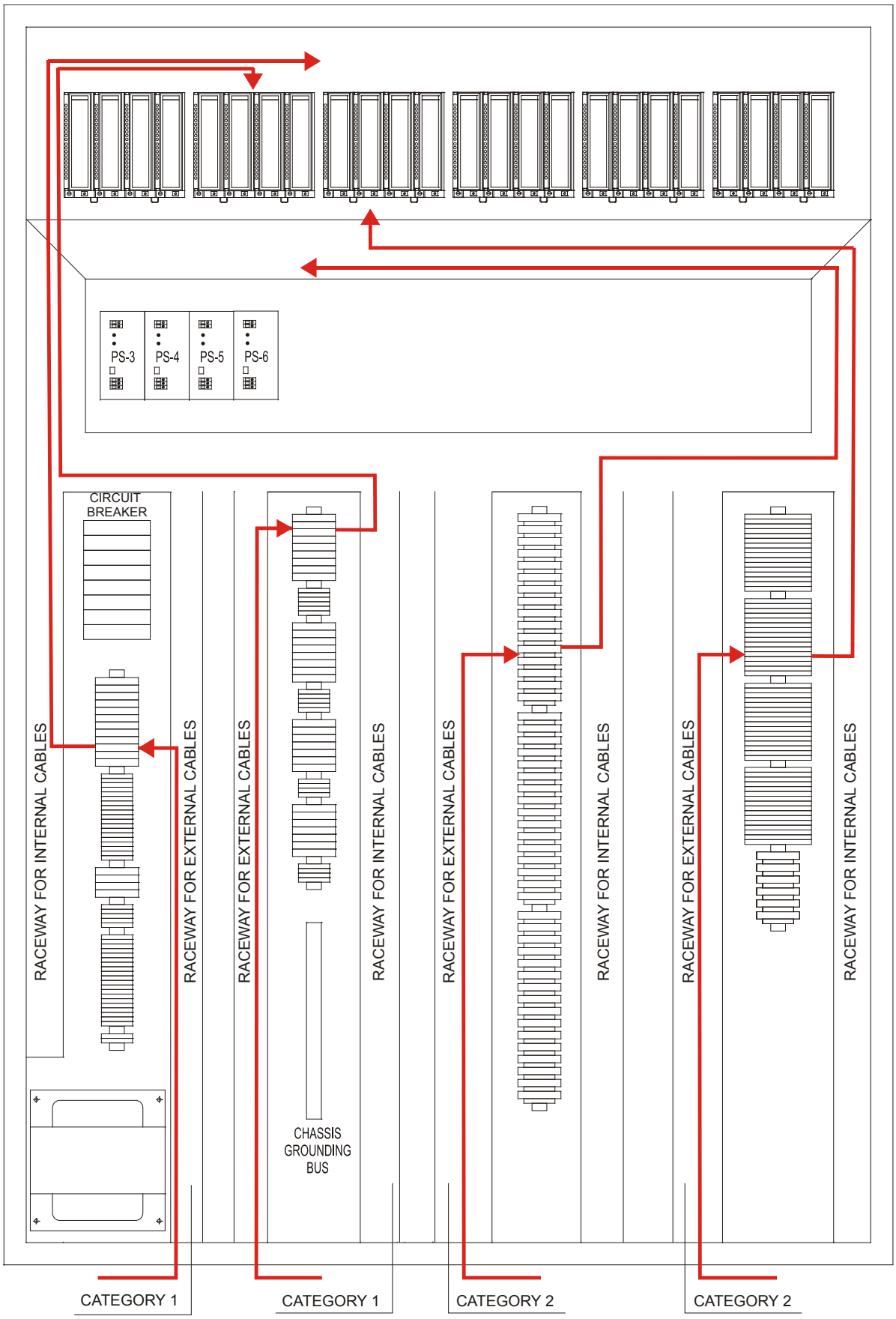


Figure 4.1 - Assembly Details

Panel layout and Rack assembly

It is important to design the panel correctly to ensure that the environmental and electrical characteristics are suitable for all equipment installed inside the panel. Installation of the system must be in accordance with all electrical and operating standards to ensure the good performance of the system. See the following figure for rack mounting instructions.

Mounting and connecting the Rack

See in Chapter 2: LC800 ARCHITECTURE

Positioning the Racks on the Panel

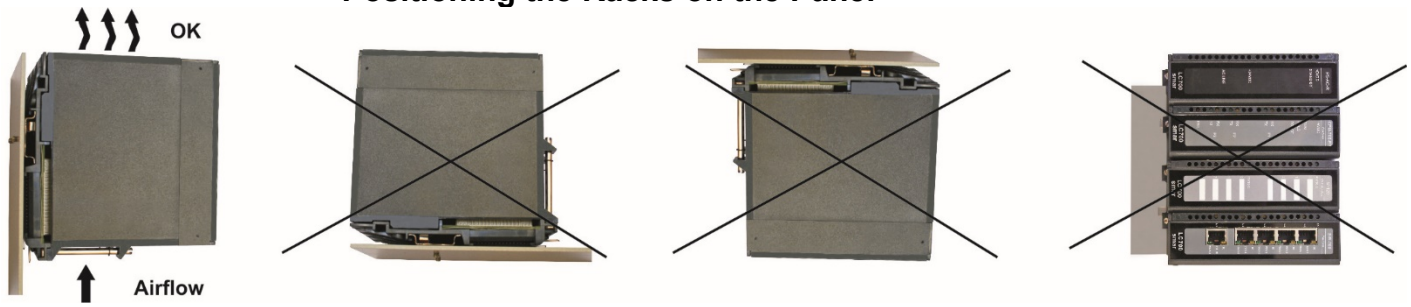


Figure 4.2 - Correct position for Rack mounting

1. Mount the racks horizontally, ensuring the air flow for module ventilation;
2. To avoid troubles (movement of the racks on the rail) due to vibration in the panel, at each end use a fixing connector;
3. Keep an adequate distance between the racks and the panel walls to ensure adequate cooling of the modules.

Installation of posts on the rails for fixing and modules´ safety inside the panel

This process is extremely necessary, because it will protect the Racks inside the panel, from the vibratory effect that is usually caused in the plant and causes its displacement causing great damage to the system.

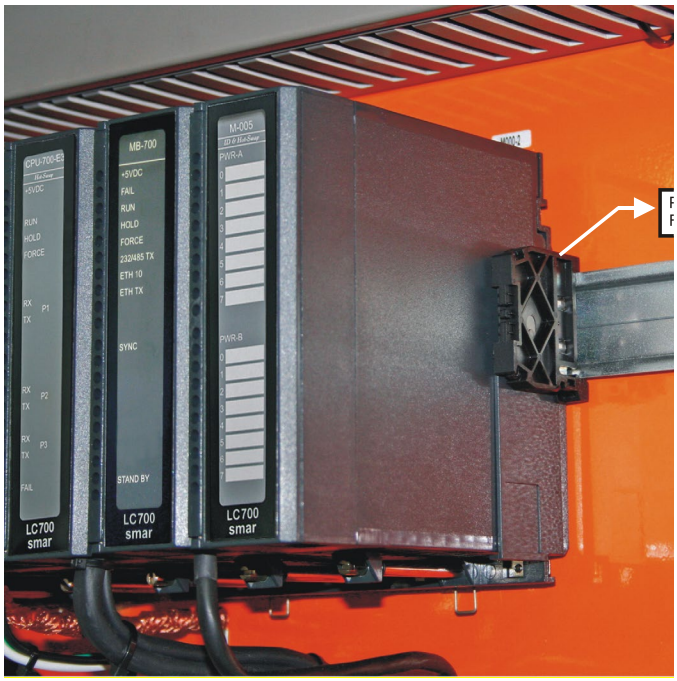


Figure 4.3 – Final post that holds the Racks on rail

Connection and Grounding

After establishing the whole layout, the user can start assembling, connecting and grounding each chassis. Connection is the linking of the metal parts of the chassis, mounting parts, frames, shielding, and panel, to reduce the effects of EMI and ground noise. Ground is to make the Connection to the grounding mesh to place the Equipment on the ground potential.

All equipment powered with AC load should be grounded on the BTC Ground Bar and all analog and digital equipment should be grounded on the BTA Ground Bar. See figure below, where are shown the BTA and BTC connections to the plant ground grid.

IMPORTANT
For full system security the BTA and BTC bars must also be grounded.

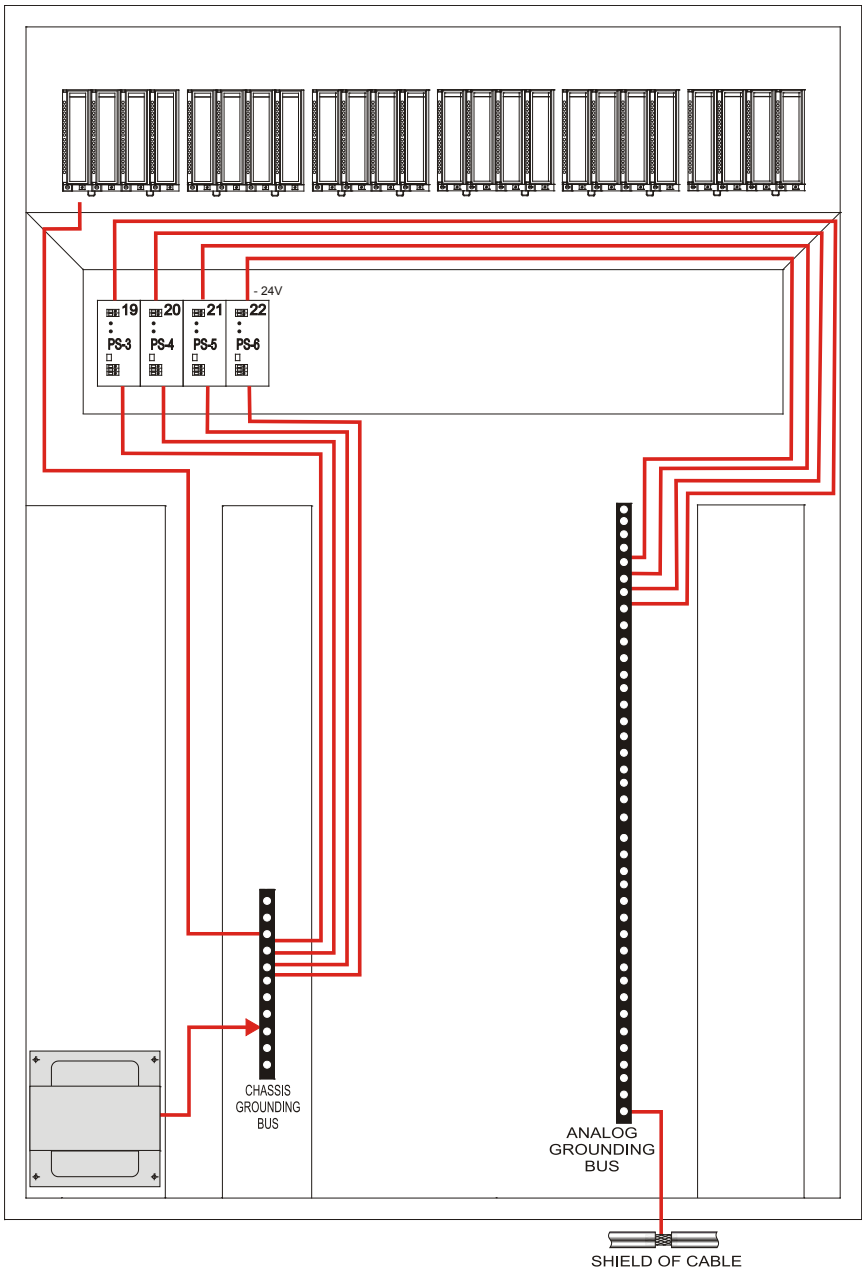


Figure 4.4 - Typical Grounding Configuration

Most of the modules, do not have the visible grounding chassis, connector or ground terminal, but are mounted on the rack, in DIN rail. The chassis of these modules are grounded through the DIN rail by

the rear grounding spring. On this DIN rail, place a grounding connector and through an individual conductor, connect it to the grounding bus (BTC).

BTC - Housing Ground Bar
The potential of the BTC is the reference of ground, for all electrical and AC parts of the equipment, inside the Panel. Connect the BTC, to the plant ground grid, using a copper conductor with at least 8 AWG specification for EMI protection.

BTA - Analog Ground Bar
The potential of BTA is the reference of ground, for all analog and digital part of the equipment, inside the Panel. Connect the BTA, to the plant ground grid, using a copper conductor with at least 8 AWG specification for EMI protection.

Shielded Cables
Some I/O connections, such as analog signals, communication, pulse inputs, require shielded cables to help reduce the effects of electrical coupling.

- Ground each shielding only at a single point. The shielding ground at both ends forms a "loop" of earth that can cause system failure.
- Connect each shield directly to the BTA (Analog Ground Bar).
- Use shielded cable with twisted pair of wires

Avoid interruption of shielding in junction boxes. Many types of shielded conductor connections are available from various manufacturers. If you need to interrupt the shielding in a junction box, do the following:

- Connect only category 2 conductors in the junction box.
- Do not remove the shield protection more than necessary to make the connection.
- Connect the shielding of the two cable segments to ensure continuity along the cable length.

Power Distribution

To isolate the noise coming from the plant, the user can use an isolation transformer to connect the power supply. Transformer provides DC isolation protecting the equipment against high voltage transients, which can be generated in the power distribution system.

In many industrial applications a step-down transformer is already required to reduce the voltage to 120 or 220 VAC.

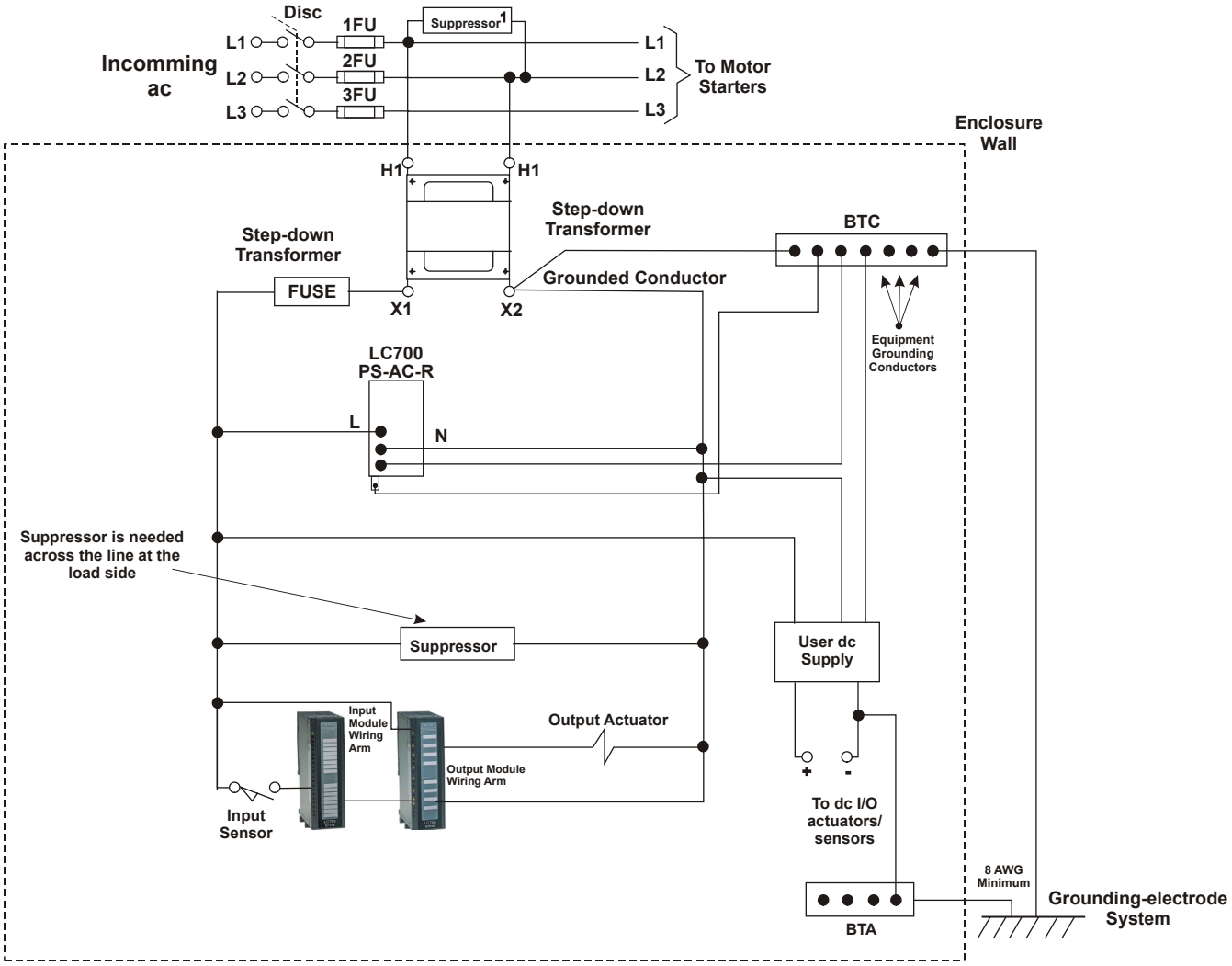


Figure 4.5 - Grounded AC Power Distribution System

NOTE

[1] To minimize EMI generation, connect a suppressor in parallel with the inductive load. Contact the motor manufacturer to check which is the recommended transient suppressor.

In many applications, a second transformer provides power to the input circuits and power supplies, for the isolation of output circuits

Second Transformer

Power supplies have circuits that suppress electromagnetic interference generated by other equipment. However, isolation between the circuits of the output modules, and the power supplies and input circuits, helps to prevent transients from the output, from being induced into the power supplies and inputs. In many applications, power is supplied to the input circuits and power supplies through a second transformer (Figure 4.6).

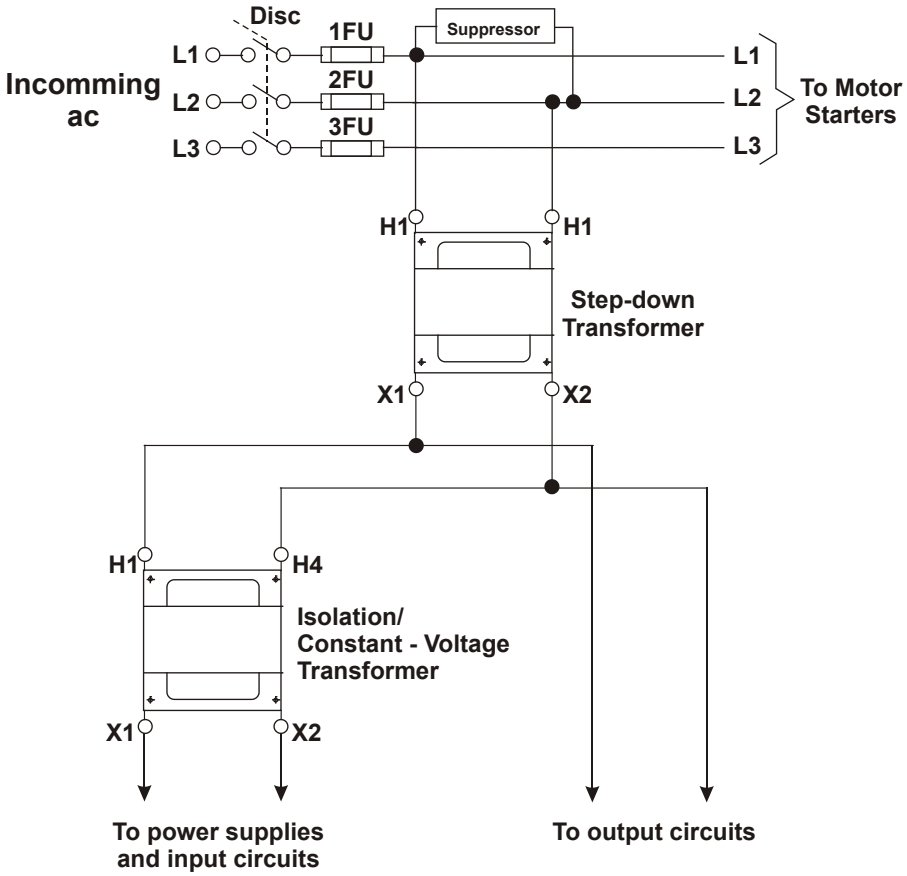


Figure 4.6 - Power Supplies and Input Circuits Receiving Power by a Separate Transformer

NOTE
To minimize the generation of temporary EMIs when power is interrupted by the interrupt switch, connect a suppressor to the side of the primary transformer.

Surge Suppression

During the switching of any inductive electrical load, transient voltage peaks (electrical noise) that can exceed 1KV appear. In many cases, this noise directly interferes with the switching command and even damages electronic components. These transient peaks have a very fast rise time, generating a high induced voltage where the wiring cables of an automation system act (due to capacitance) as transmitter and receiver of this signal.

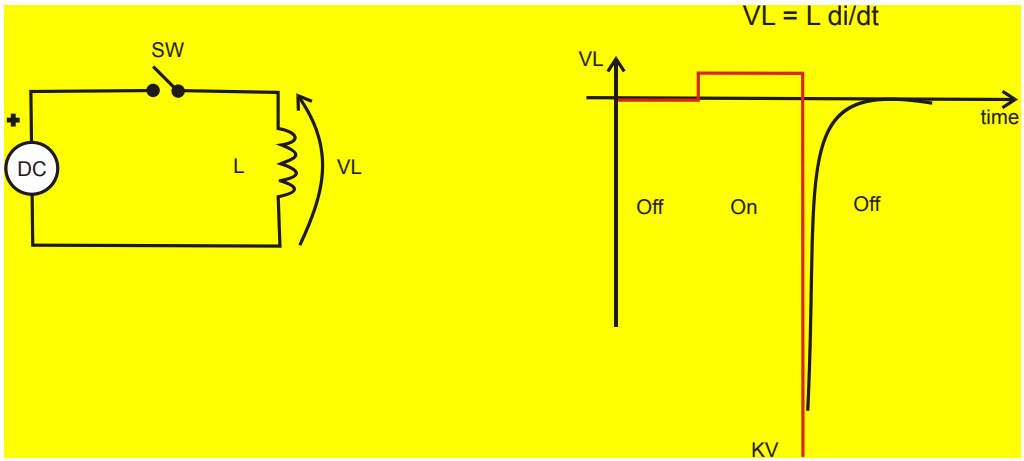


Figure 4.7 – Reverse Voltage Peak

There are some alternatives to avoid this interference, such as optical couplers, zero crossing switches ("Zero Crossing Switching"), indirect drives that avoid the arrival of noise at the command, but the noise generated by the switched device continues to exist, and is often induced in the wiring of the system, reaching other points of electronic automation causing intermittent defects in the system. Therefore, these ways of treating the noise are not effective. It must be eliminated exactly at the source of the noise, that is, to obtain a filter with better performance, it must be mounted, as close as possible to the switched load.

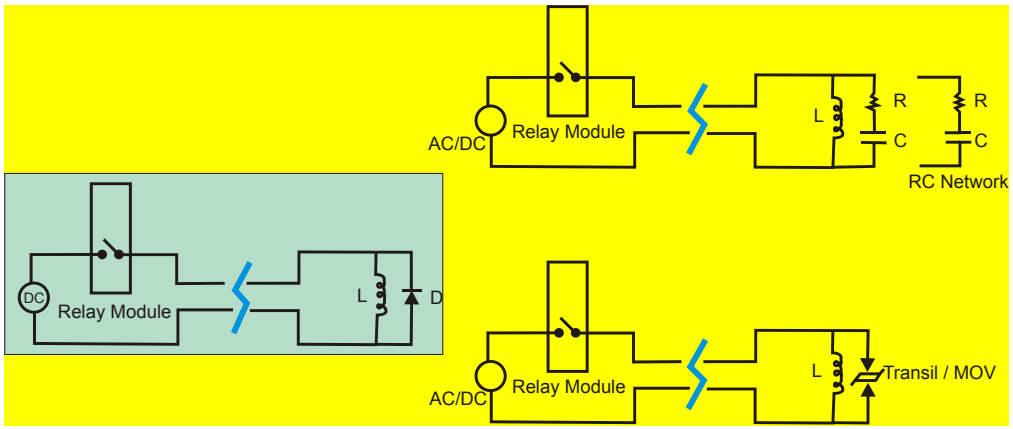


Figure 4.8 - Filters for AC and DC loads

Inductive Load Switching

See specification of each of the LC800 I/O module related to the R-C (snubber) circuit and protection diode:

- **Inductive DC load:** Although the LC800 digital output modules for the DC load have a protection diode, it is recommended to insert another protection diode close to the inductive load. This will avoid noise coupling in other cables that are in the same conduit.

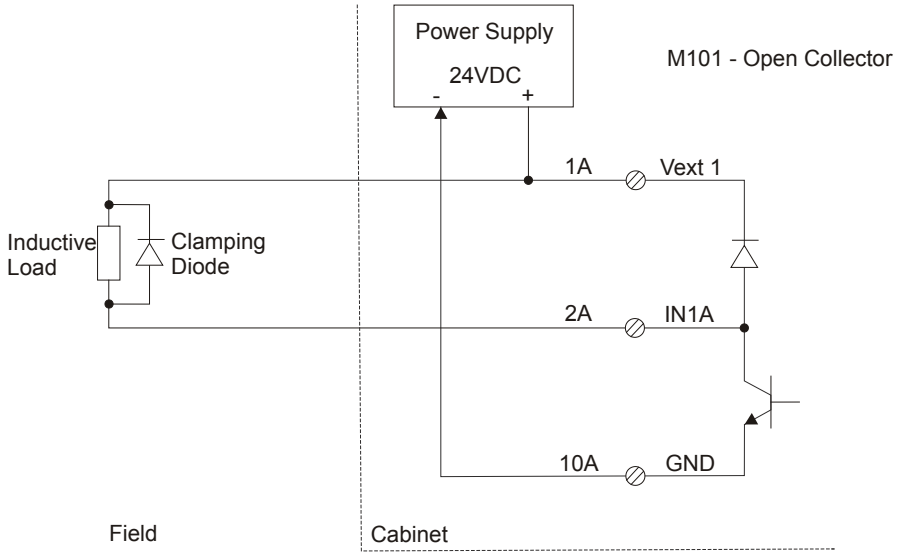


Figure 4.9 – Protection Diode in Parallel to DC Load

- **Inductive AC load:** Although the LC800 digital output modules for the AC load have a snubber circuit, it is recommended to insert another snubber circuit parallel to the load and close to them. This will avoid noise coupling in other cables that are in the same conduit.

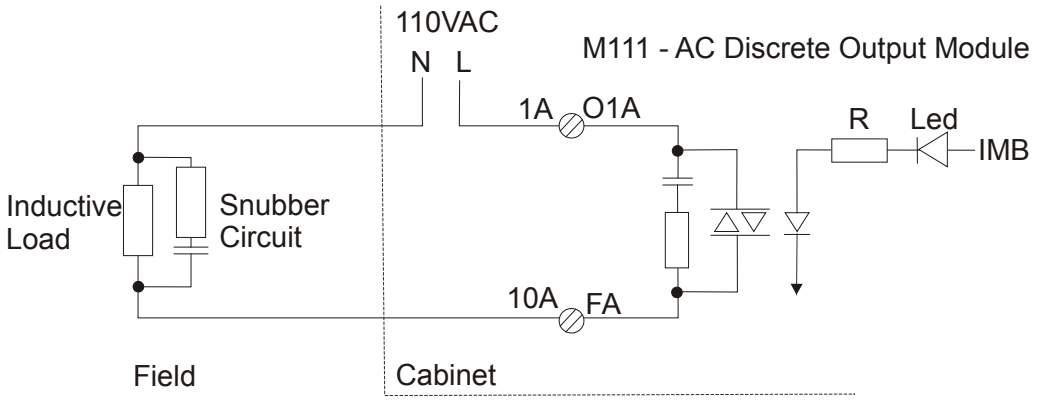


Figure 4.10 – Snubber Circuit in Parallel to AC Load

Suggestion for RC network components and the reaper diode

Maximum current of the reaper diode should be greater than or equal to the maximum load current and the maximum voltage should be 3-4 times greater than the circuit source at 24VDC and 8-10 times greater than the circuit source at 110VDC.

RC (AC) circuit capacitor should have a voltage 2-3 times higher than the power supply voltage. Recommended values:

Load Inductance	Capacitor
25-70mH	0.50µF
70-180mH	0.250µF
180mH - 10H	0.10µF

For loads up to 100 ohms, the RC circuit Resistor must be 1 - 3 ohms, 2 Watts.
For loads that exceed 100 ohms, the resistor value must be increased to 47 ohms, ½ Watt.

There are several manufacturers that supply RC filters, ready to be mounted on contactors, valves and other inductive loads, one of them is Murr Elektronik (www.murrelektronik.com) or the ICOS (www.icos.com.br).

Ferrite Beads
The use of Ferrite beads can provide additional suppression for EMI transients. The Ferrite from Fair-Rite Products Corporation (order code 2643626502) can be used on category 2 and 3 conductors. We can install them using tie straps. With a ferrite located near the end of a cable, induced EMI transients in the cable can be suppressed by the ferrite before entering the equipment.

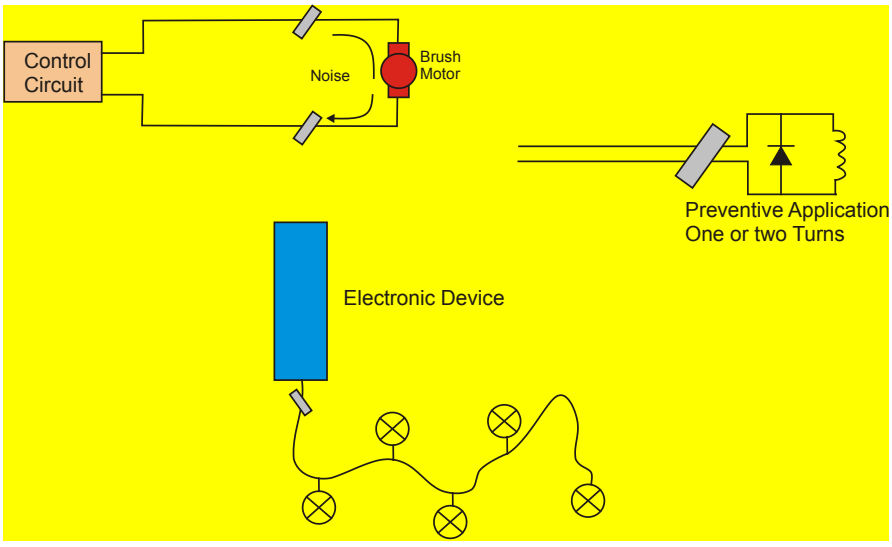


Figure 4.11 - Application of ferrites in control lines

Other Recommendations:

EIA-485

1. **Connecting the wires in an EIA-485 network**
The third wire must be connected to the references of all the connected drives. If the reference terminal is not connected, the reference between the drives will float, thus, leaving the data transmission more vulnerable to noise. Figure below shows the correct way to connect the P2 and P3 port in an EIA-485 network.

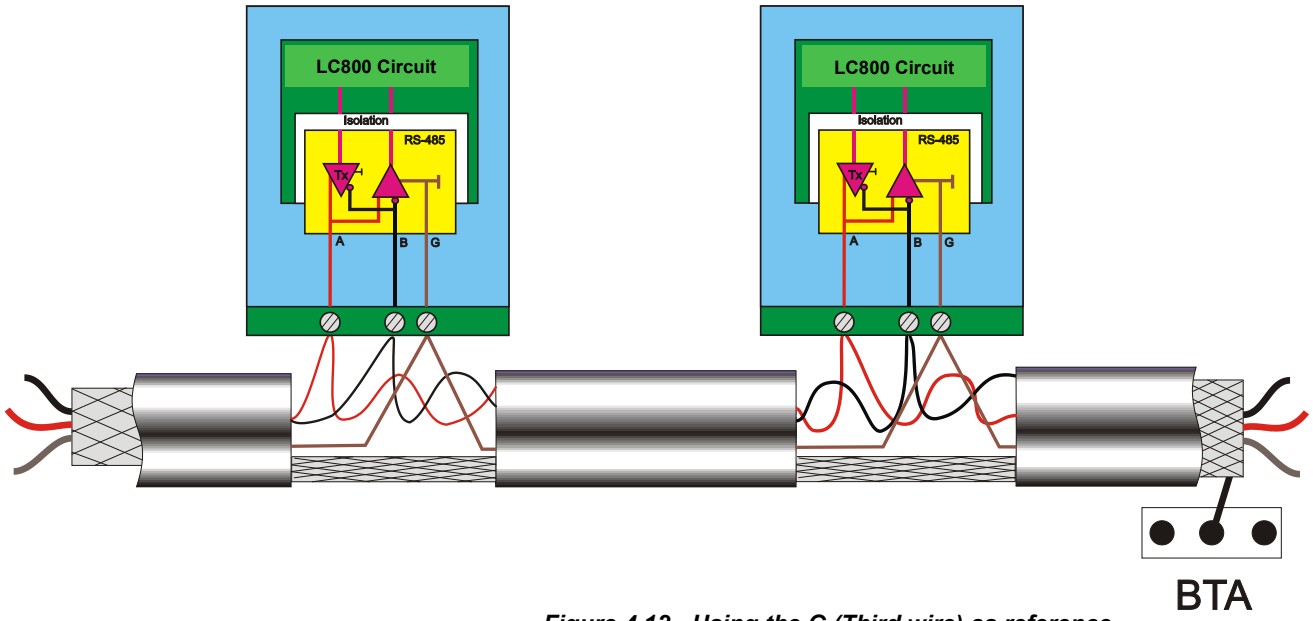


Figure 4.12 - Using the G (Third wire) as reference

2. **Topology and termination**
When the transmission rate is high and or the distance between the equipment is large, it is very important to pay attention to the topology and the terminators. Most acceptable topology is the "Daisy Chain" (D). In case the segments are not too long the "Backbone" (A) can be considered.

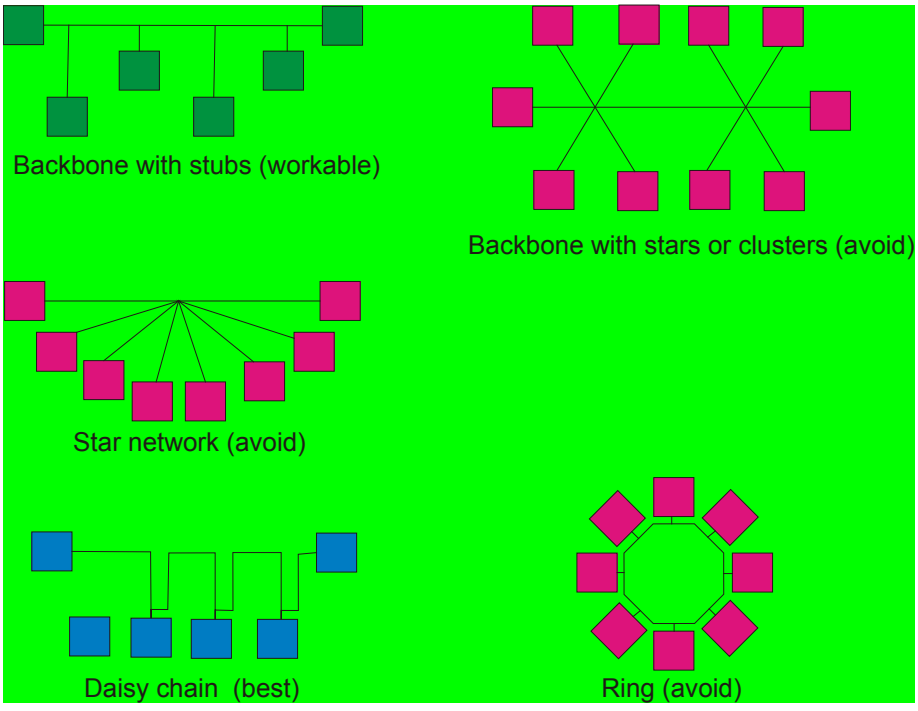


Figure 4.13 - EIA– 485 Network Topology

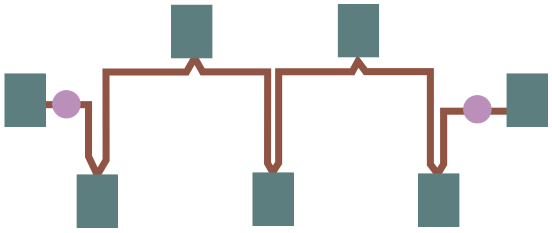


Figure 4.14 - Terminators for the EIA-485 Network

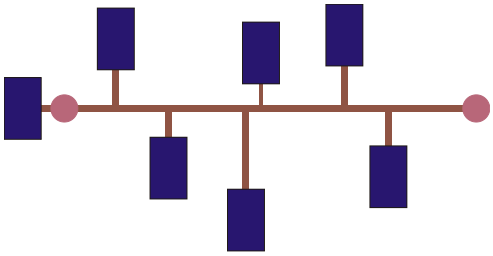


Figure 4.15 - Terminator

3. **Terminators**
Value of the terminator must be in accordance with the characteristic impedance of the transmission line cable and must be installed in parallel with the lines (A and B) according to figure 4.14 and 4.15.

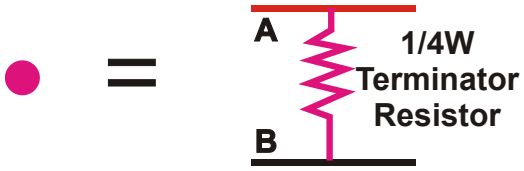


Figure 4.16 - Resistor value equal to Zo (Line Characteristic Impedance)

4. Use cables designed for RS-485.

Summary of Basic Rules for Panel Assembly

1. Install electronic equipment, Controllers (PLC), Transmitters, Recorders, Computers in a noise-free power supply. Never connect electronic equipment on a noisy power line;
2. Avoid Inductive Loads (solenoid valves, motors) together with electronic equipment inside the electronic panel, if necessary separate as much as possible;
3. Connect a suppressor in parallel with the inductive load;
4. Separate the wires according to the Categories;
5. Use line filter, at the power inputs of the panel: This will prevent receiving or sending noise from the electrical installation;
6. Make a good grounding for the racks;
7. Connect the grounding grid of the power supplies, the filter for common mode and for electrostatic discharges will be more effective;
8. Separate the power distribution in the Panel;
9. Use shielded cable for signals coming from the field;
10. Shield must be grounded at a single point;
11. Adopt Ferrite to filter out high frequency noise from lines coming from the field;
12. Apply to lines that are exposed to noisy environments;
13. Avoid circuit loops;

Chapter 5

SOFTWARE INSTALLATION

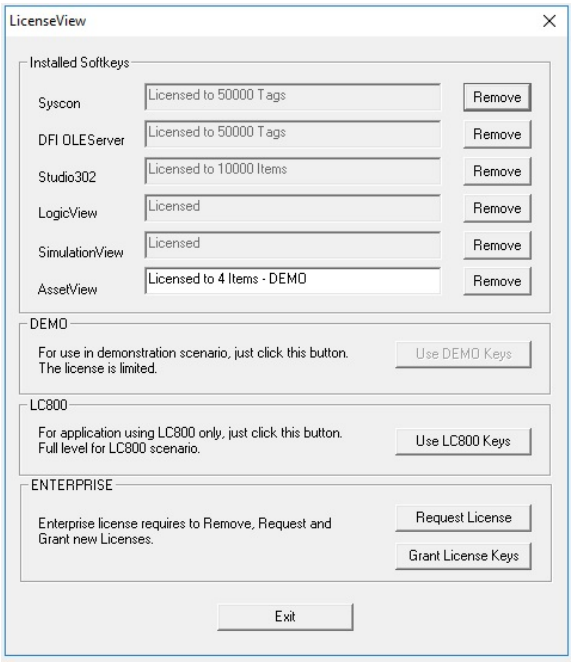
Installing Studio302

Install the programs that compose the **SYSTEM302** using the installation media. 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.

How to obtain the license for System Servers and Applications of LC800

LC800 system servers and applications are easily licensed by simply opening the **LicenseView** application located on the **Studio302** interface. A specific button for the LC800 license will be available.

NOTE
This license will be valid for DFI OLEServer, HSE OLEServer, Syscon and LogicView, which will be used to configure and operate the LC800 system.



Connecting CPU800 to your Subnet

Environment to work with **CPU800** involves a network (Subnet) that must have IP addresses for each connected device.

The automatic solution for assigning these addresses is to have a DHCP server *(Dynamic Host Configuration Protocol Server)*

This DHCP server will dynamically assign IP addresses to each device, thus avoiding any conflict such as the assignment of equal addresses to two different devices.

ATTENTION
To connect more than one **CPU800**, the following steps must be strictly executed for each CPU.

1- Connect the Ethernet cable (DF54) of the CPU800 module to the *Switch* (or *Hub*) of the subnet of which the CPU will be part;

NOTE
For point-to-point connection (**CPU800** connected directly to the computer) use the DF55 cross cable.

2- Turn on the CPU module. Make sure that the ETH10 and RUN LEDs are on;

3- Hold down Push-Bottom (Factory Init/Reset) from the left, then click Push-Bottom three times from the right. The FORCE LED will flash three consecutive times;

NOTE
If the user loses count of the number of times the right *Push-Bottom* was pressed, just check the number of times the FORCE LED is flashing every second. It will flash again once per second after the fourth touch (the function is cyclic).

4- Release the Push-Bottom from the left and the system will execute the RESET, passing to the firmware execution with the default values for the IP address and subnet mask.

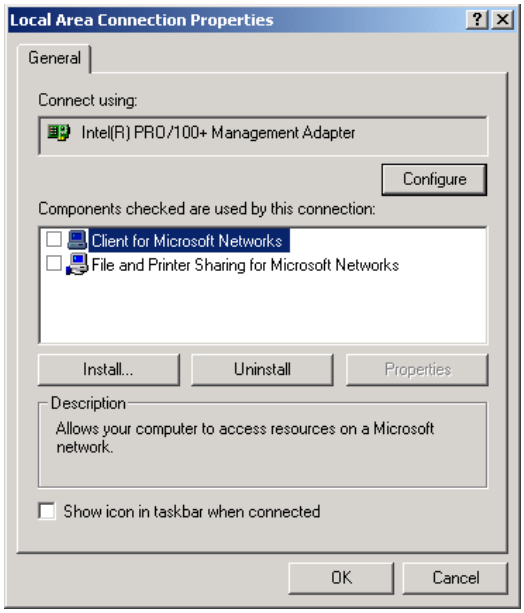
For Networks WITHOUT DHCP SERVER

5- If the network does not have a DHCP server, CPU800 will have 192.168.164.100 IP address and the following steps must be performed (based on systems using Windows 2000):

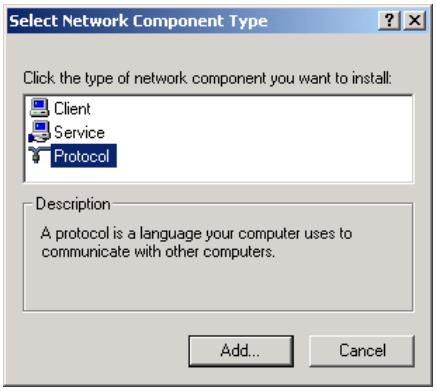
The IP address of the user's computer must be momentarily changed (network administration knowledge is required). Select the Start → Panel Control menu, and double-click the Network and Dial-Up Connections option or something similar;

NOTE
Click in **Local Area Connection** and then **Properties**. If TCP/IP Protocol exists in the list of components, go to step 10 or proceed with the installation using the Install button.

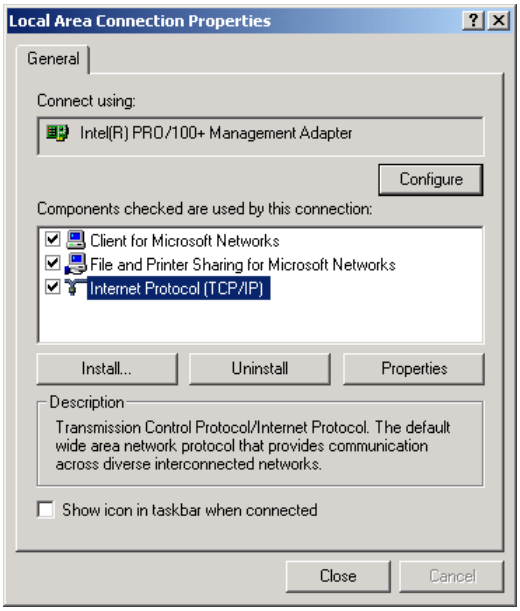
6- Click the **Install** button;



7- Choose **Protocol** and click in **Add**. See picture below:



8- Select Internet Protocol and click the **OK** button.



9- Select **Internet Protocol (TCP/IP)** and click the **Properties** button;

10- Note down the original IP address and subnet mask values of the computer to restore them at the end of the operation.

NOTE
If the IP address of the it is something of the type: 192.168.164.XXX, go to step 14.

11- Change the IP address and subnet mask of your computer, so that it is on the same subnet as **CPU800** (164). Preferably, the IP addresses to be used should be provided by your network administrator.

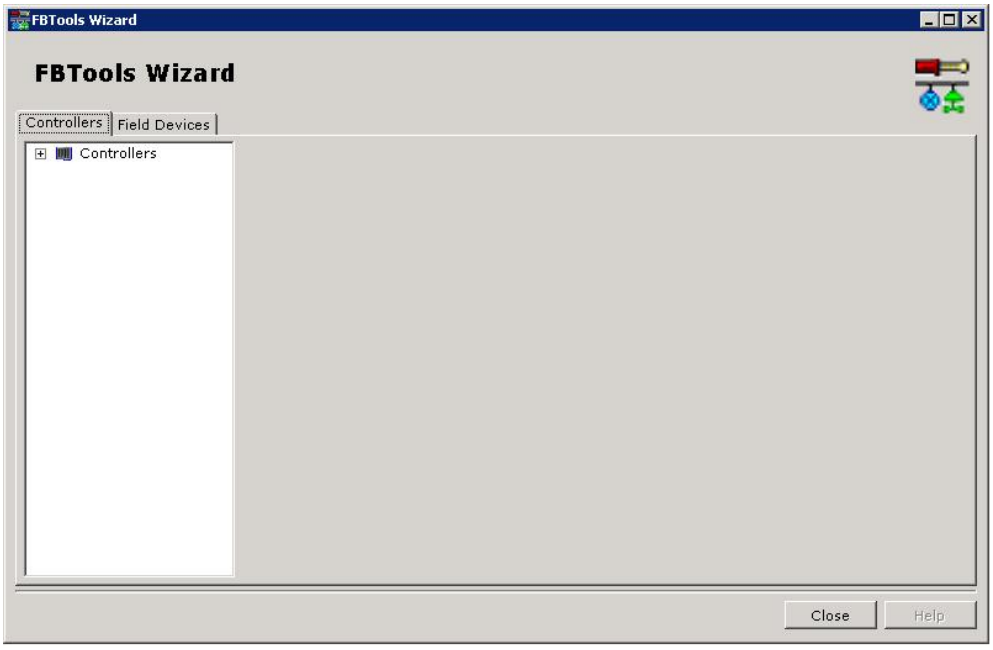
NOTE
The values should be something like this: IP Address 192.168.164.XXX and Subnet Mask 255.255.255.0. Keep the value of default Gateway.

ATTENTION
Do not use the 192.168.164.100 address since this is the default address used by the CPU800 module. Make sure that the chosen address is not in use.

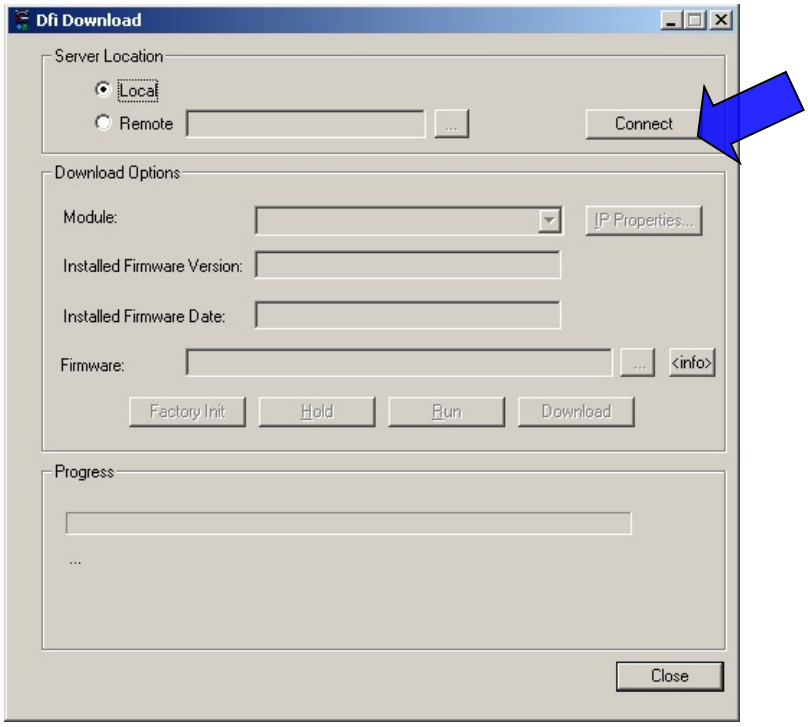
12- Click the **Apply** button.

13- Run the **FBTools Wizard**, through the **Studio302** toolbar. Click **Start menu → Programs → System302 → Studio302**. Do a login in the system. In the **Studio302** interface click the  icon in the main toolbar.

14- 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 **LC800** controller.

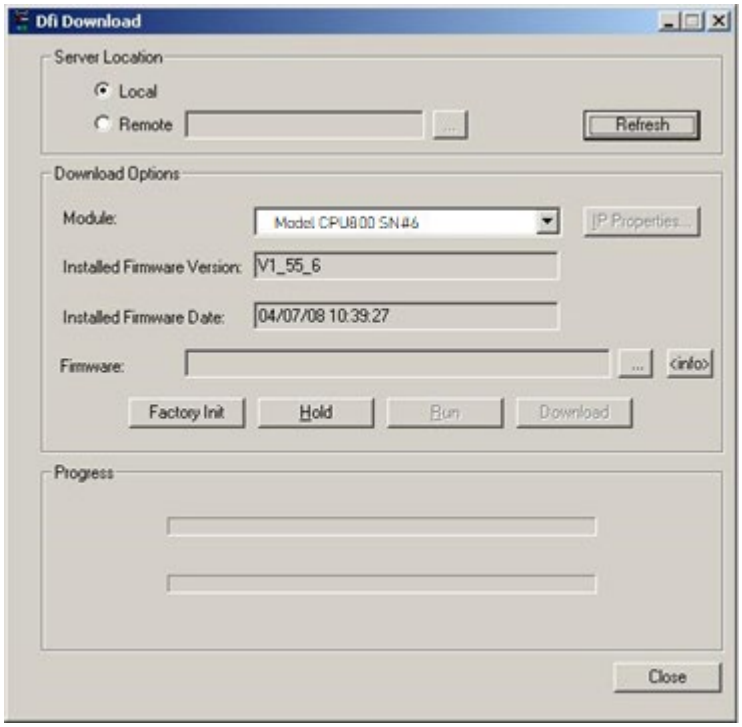


15- Right-clicking the **LC800** controller the **Dfi Download Classic** and **Batch Download** options will appear. Select **Dfi Download Classic** and the following figure will appear. Select the DFI OLEServer path to be used (Local is the default path), and click **Connect**.

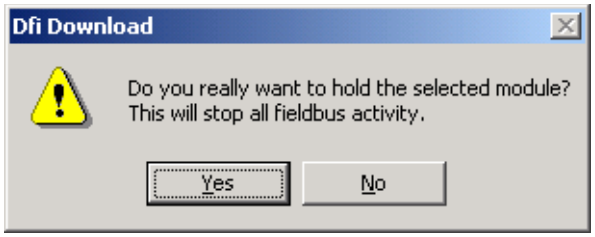


16- Select the **CPU800** in the **Module** box. Use the serial number as a reference that is in the external identification label.

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

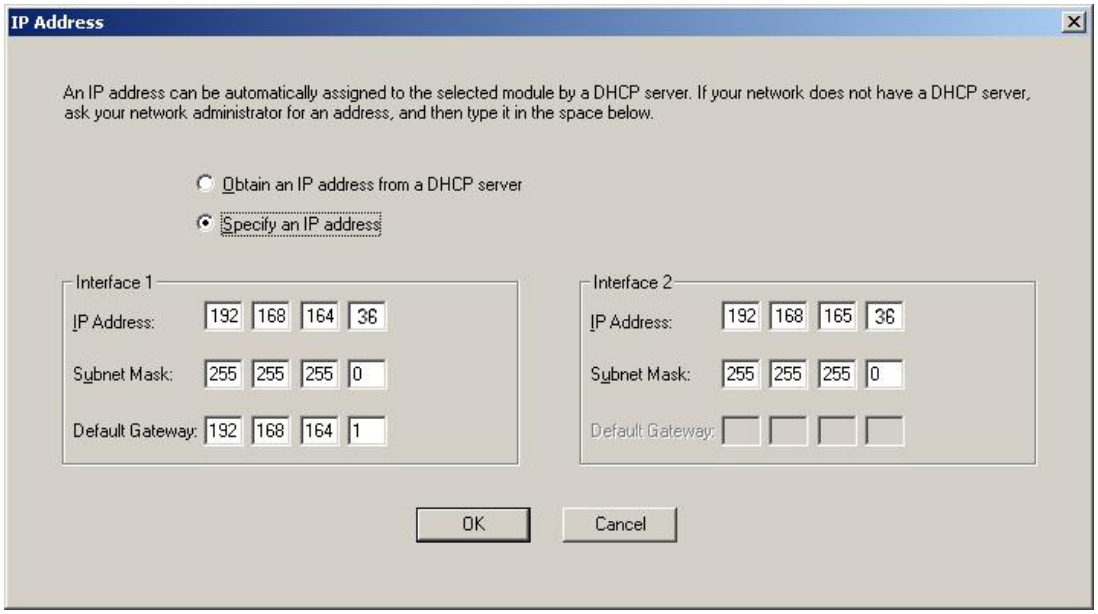


17- Click the **Hold** button to interrupt the firmware execution. When the user clicks the **Hold** button, the module will stop the firmware execution as well as all the activities in the Fieldbus line. Confirm the operation by clicking **Yes.**



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

18- Check if HOLD LED is ON. Click the **IP Properties** button to configure the IP address of the module. The IP Address dialog box will open.



20- 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 **CPU800** modules

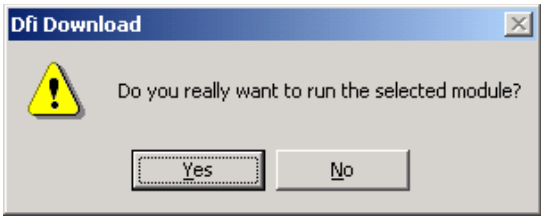
ATTENTION
Do not use the IP Address 192.168.164.100 (it is already being used by **CPU800**).

HINT
Write down the IP addresses that will be specified and the serial number of each CPU800 module. It will help in the identification and diagnostics of possible failures.

21- Click the **OK** button 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.

22- Click the **Run** button to execute the **CPU800** firmware again.

23- A dialog box will open to confirm the operation. Click the **Yes** button to continue.



24- The procedure to connect the **CPU800** to the subnet is complete. Repeat these steps above for the other modules.

NOTE
In case of there is more than one CPU to be set up, fulfill the following command to clear **ARP table**, before setting up the next CPU. C:\>arp -d 192.168.164.100 < enter >

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

Visualizing and Updating the Firmware

1. Make sure that the **CPU800** is ON and has been connected to the subnet, according to the procedures in "Connecting the CPU800 in the Subnet".
2. To continue, it will be necessary to interrupt the firmware execution in the **CPU800** module forcing it for the **Hold** mode.

   Maintain firmly pressed the Push-Bottom (Factory Init/Reset) of the left and after, click twice in Push-Bottom of the right. The LED FORCE will blink twice consecutive. Liberate the Push-Bottom (Factory Init/Reset) of the left, this will force the **Hold** mode.

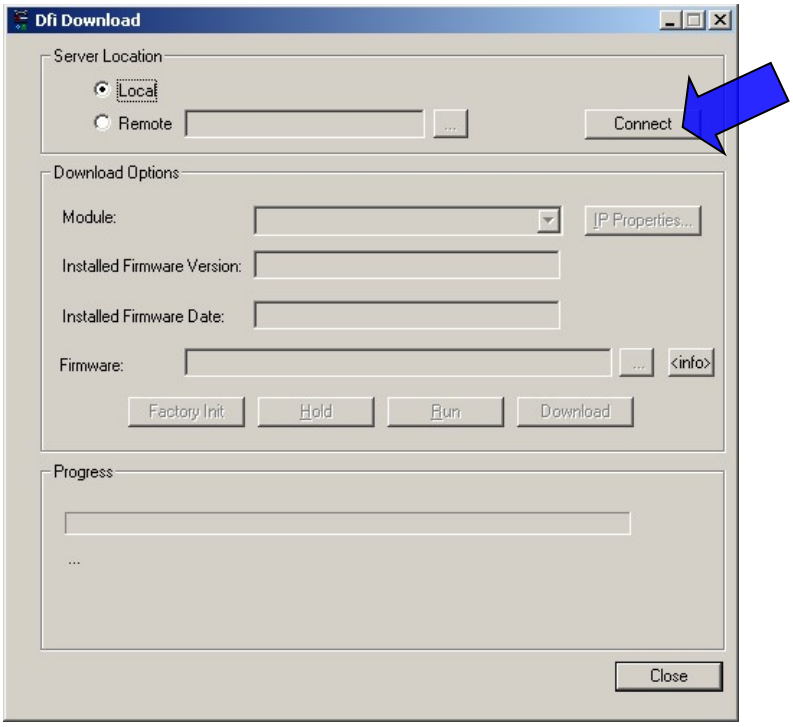
   For safety and audit trail, this is the only mode to force the **Hold** mode and then to start the firmware download process.
3. Be sure that LED HOLD is on.
4. Run the **FBTools Wizard**, as in step 13 of the previous topic.
5. Select the **CPU800** module and right-click it. Choose an option - **Dfi 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

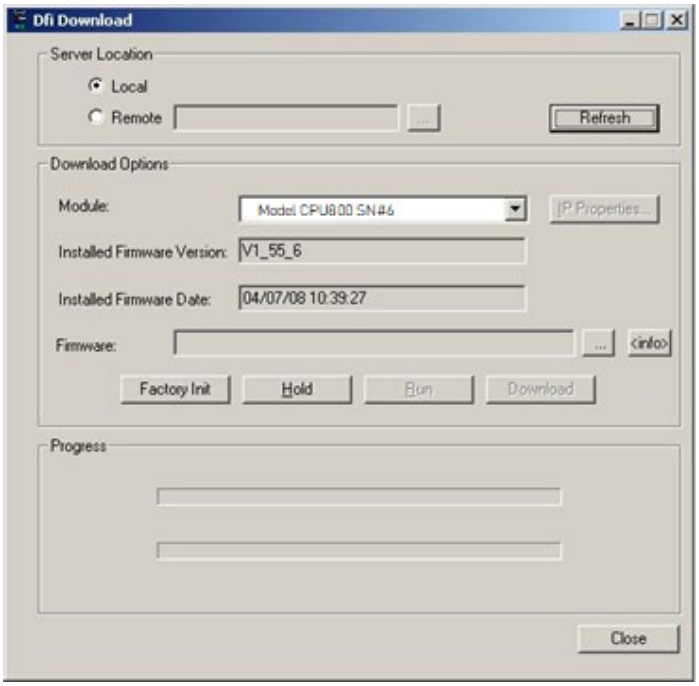
1. By selecting the **Dfi Download Classic** the **DFi Download** window will open. Select the DFI OLEServer path to be used (Local is the default path) and click the **Connect** button.



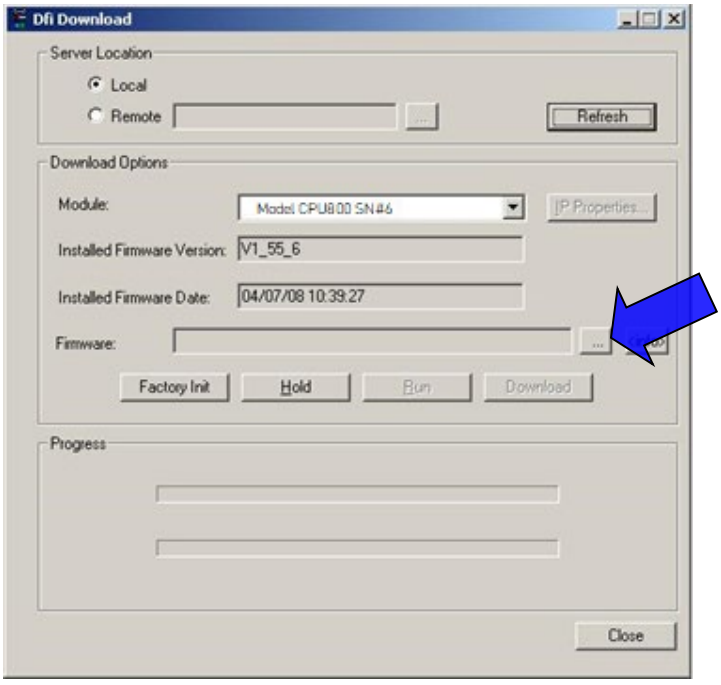
2. Select the CPU800 module in the **Module** box. Use the serial number as a reference (see the external identification label).

Note that the **DFI Download** dialog box shows the installed version and date of the current firmware loaded in the CPU800 module. This is the procedure indicated to verify the firmware version.

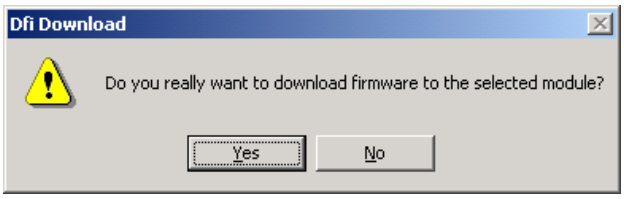
ATTENTION
The non-observance of this step can imply in serious damages.



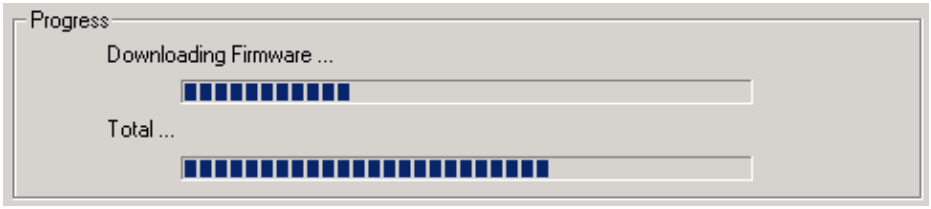
3. Click the  button to select the firmware file to be downloaded (CPU800*.ABS).



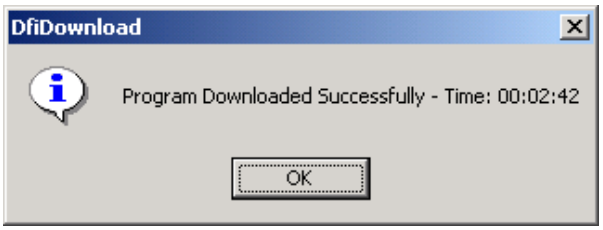
4. After selecting the firmware file, click the **Download** button to start the firmware download.
5. A message box will come up requesting a confirmation. Click **Yes** to continue.



6. The progress bar at the bottom of the dialog box will show the operation progress.



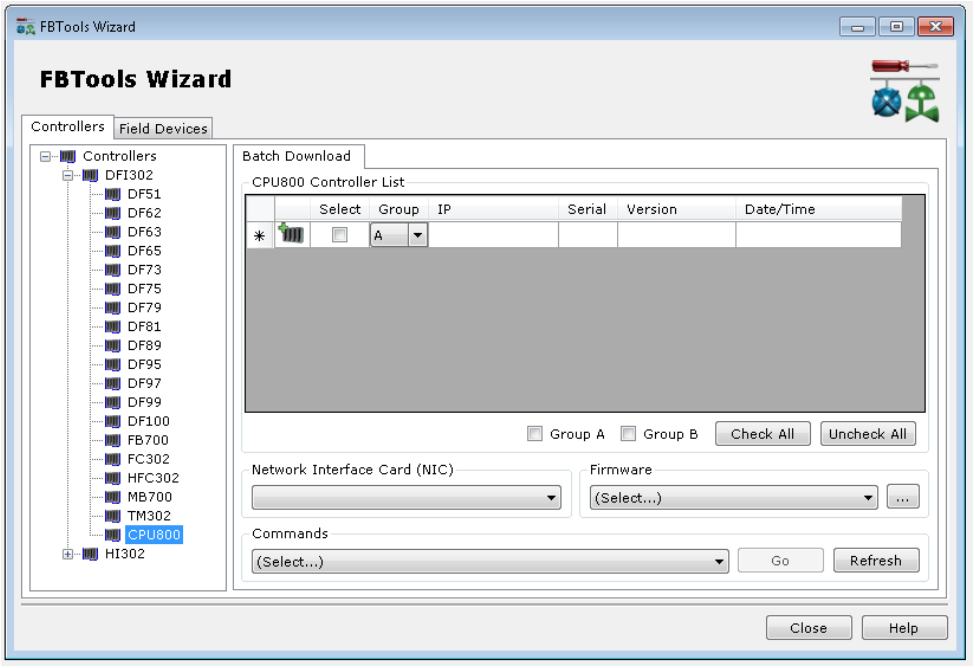
7. When the download is complete, a dialog box will appear confirming that the program was downloaded successfully. Click the **OK** button and wait a few minutes while the information is updated. The **CPU800** will be in "Run Mode". (Check if the RUN LED is ON).



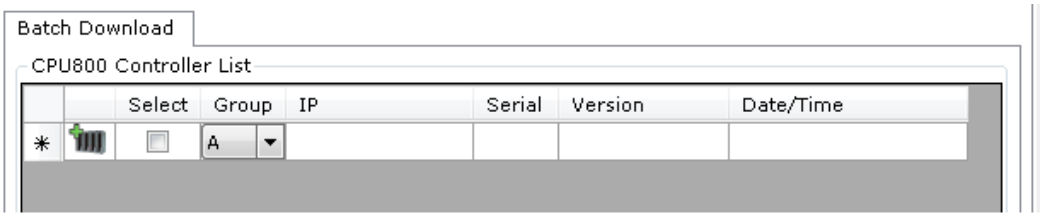
8. Click the **Close** button to exit from the **Dfi Download** dialog box.

Batch Download

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



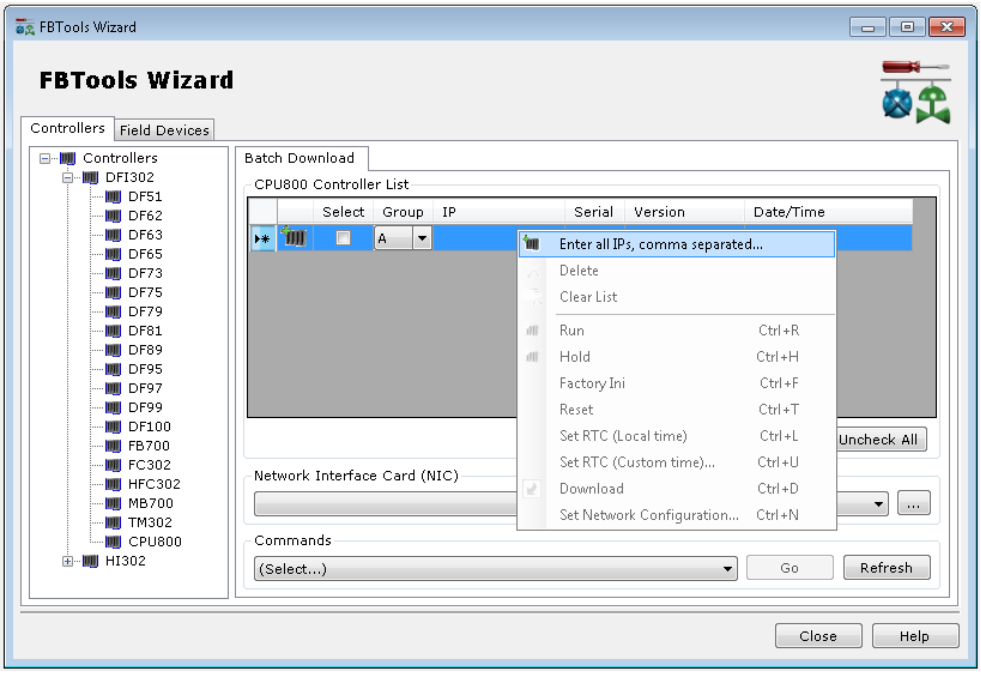
The controllers can be divided in two groups – A and B. The groups are used to classify the controllers. Typically, when redundancy is used, there is the option to change the firmware of all secondary controllers first, and then the primary ones. This procedure facilitates the hot swap maintenance of 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:

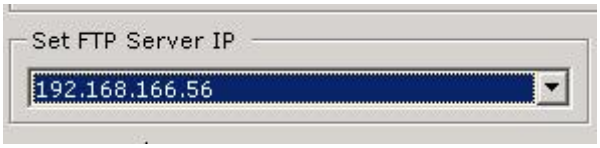


Through the **Enter all IPs, comma separated...** option the user can insert various IPs on the list simultaneously, separated by commas. After entering the IPs click **Insert** and make the association of groups A and B.

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

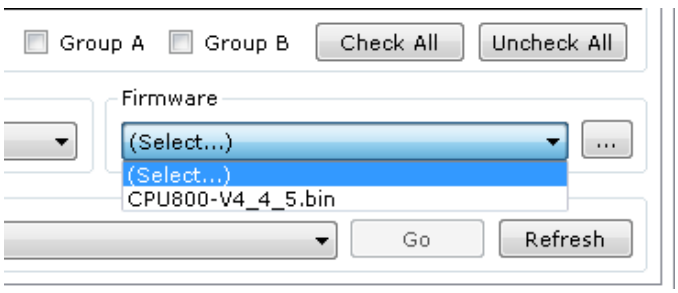
To select, or deselect, all controllers of groups A and B use the **Check All** or **Uncheck All** options, respectively. See the following figure:

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.

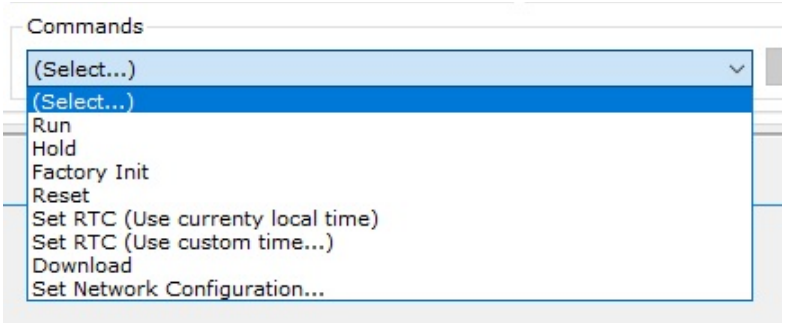


The available versions are in the **Firmware** field.

.

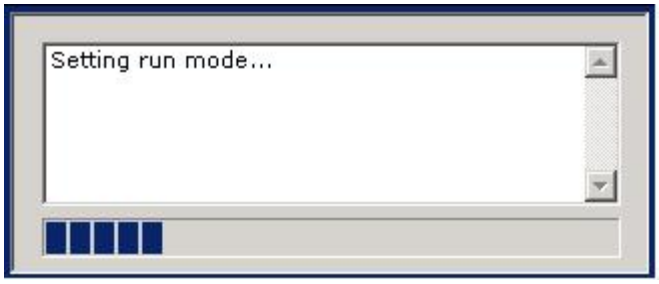


In the **Commands** field are the action options of the **Batch Download.** Select the controller, the command to be performed and click **Go**.

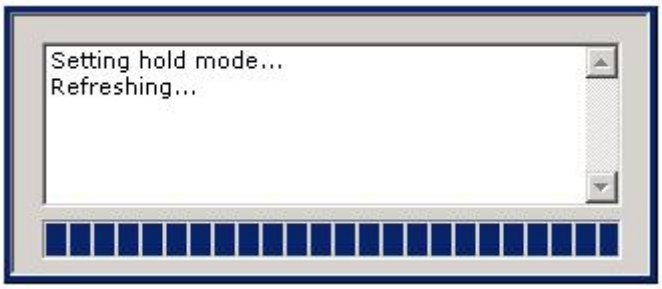


Here are the definitions of the above options:

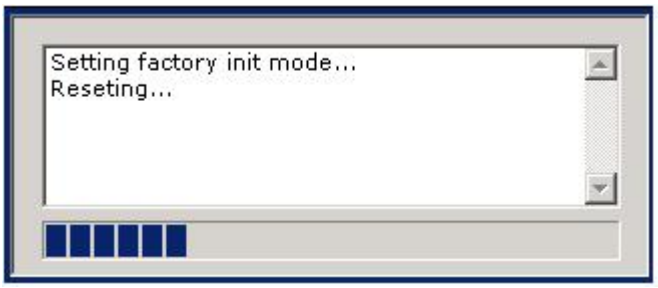
Run – Starts the firmware execution in the controller module. The following window will appear.



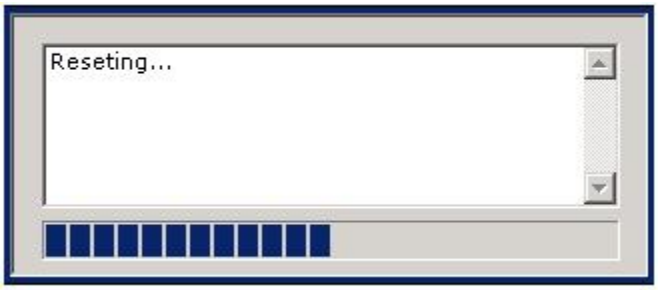
Hold - Interrupts the firmware execution in the controller. The following window will appear.



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:

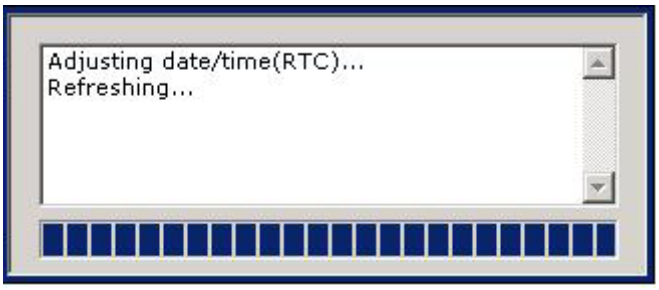


Reset – Restarts the controller, maintaining the configurations that were saved at the last download. Some dynamic parameters are erased, but not the static parameters. This is dependent on each function block. Refer to Function Blocks manual for further information. The following window will appear:

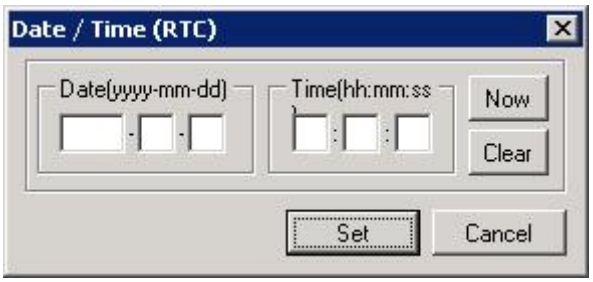


NOTE
In both cases, **Reset** and **Factory Init**, the firmware is kept. The controller's IP may be change only if is set the option to obtain it via DHCP Server. Otherwise, the controller will keep the last IP assigned.

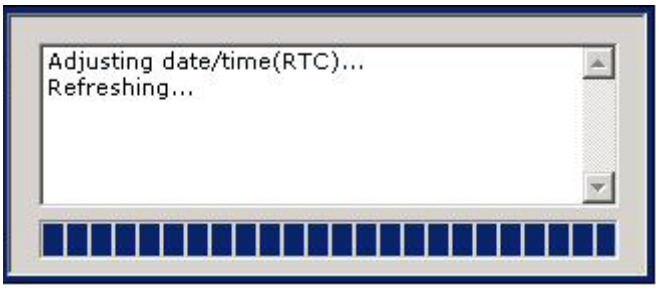
SetRTC (use currently local time) – Sends the Localtime to the controller. The following window will appear:



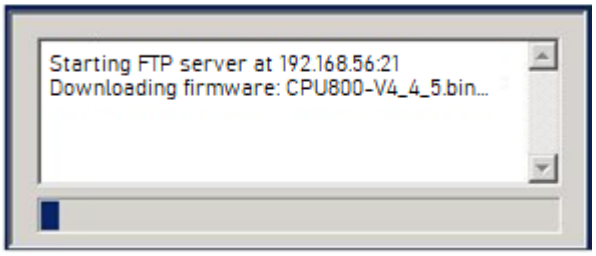
SetRTC (use custom time) – Sends the user-configured time to the controller in a properly window. See the following figure. Write the date and hour desired and click **Set**. If you want to insert the current date and hour, click **Now**. The **Clear** option clears the fields filled.



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

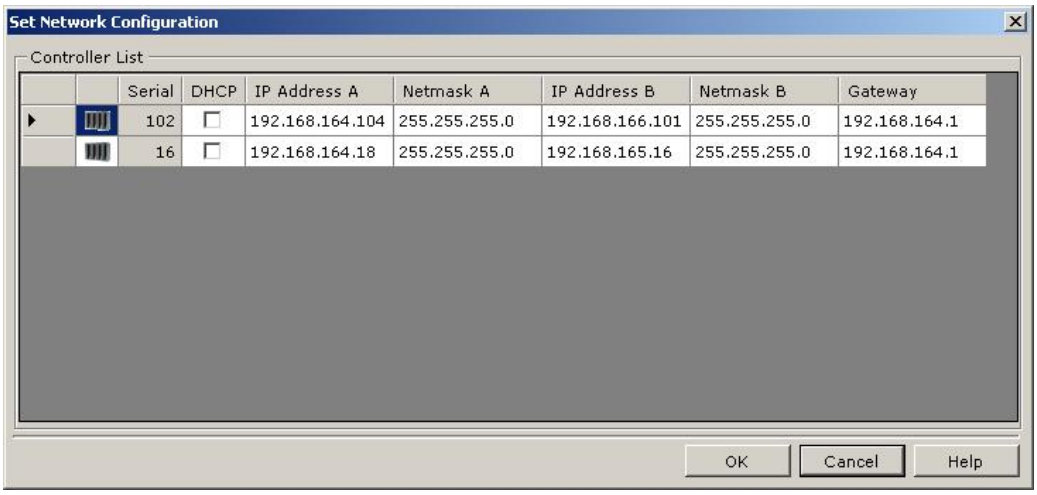


Download – Performs the firmware download. The following window will appear:

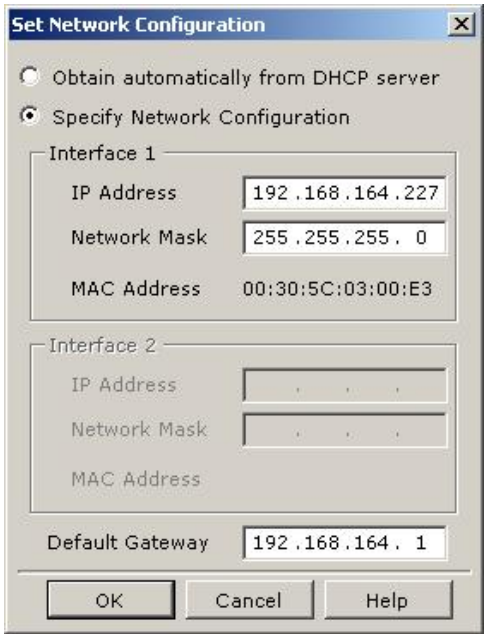


A progress bar will signal that the download is in progress. After this, confirm in the table that the information from the controller is corresponding to actions performed, for example, the firmware version.

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:

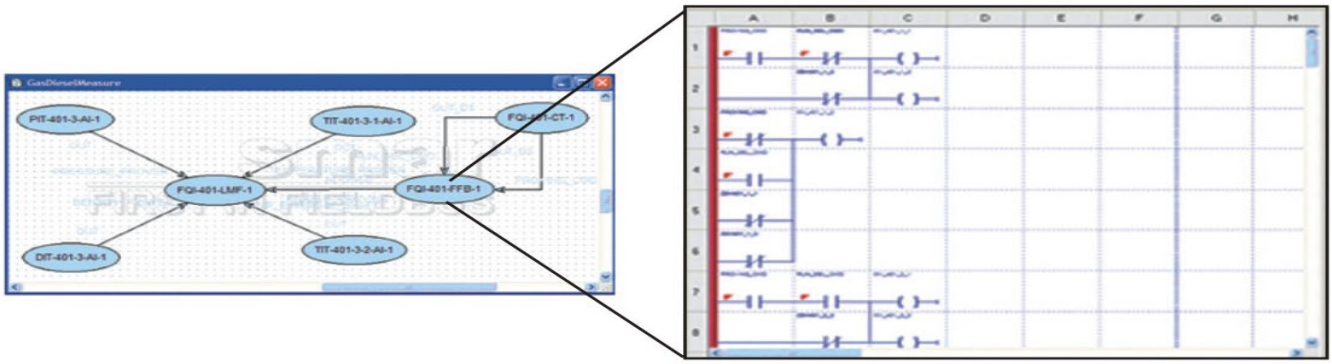


Chapter 6

LADDER LOGIC AND HORIZONTAL COMMUNICATION BETWEEN CPUS

Introduction

LC800 system incorporates an advanced configuration feature through the use of Flexible Functional Block (FFB 1131). Through this block is programmed all the discrete and analogical control strategy of the process. Also, through parameters of this block it is possible to connect different CPUs, thus allowing horizontal communication and interconnection of control strategies programmed in different CPUs.



Creating a control strategy

To create the control strategy simply enter the **Studio302** environment and within **Areas** select the **New area** option.

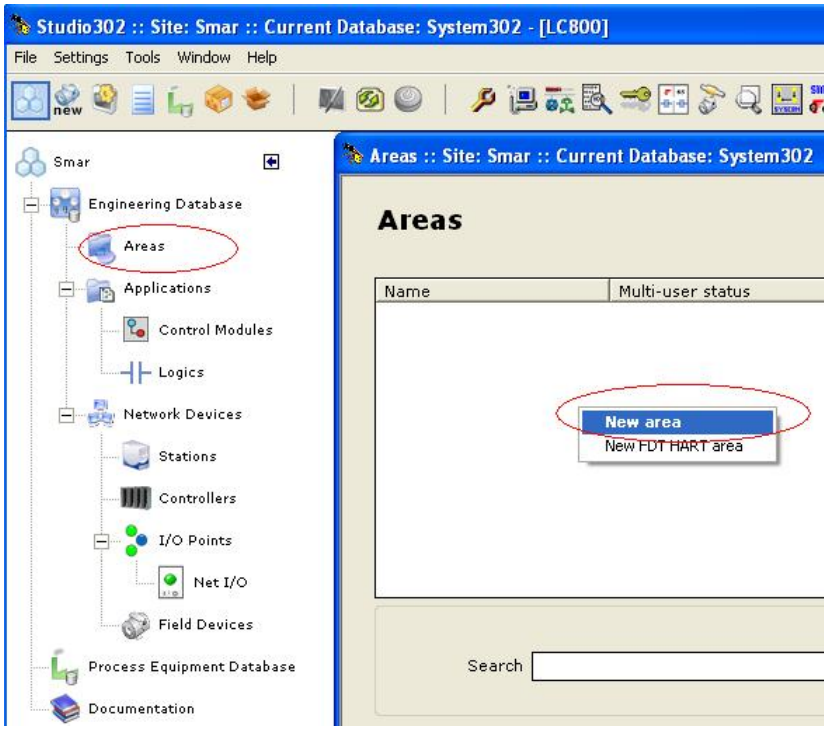


Figure 6.1 – Creating a new area

Then a window with the area template options will be displayed. The option for CPU800 must be selected and then press OK.

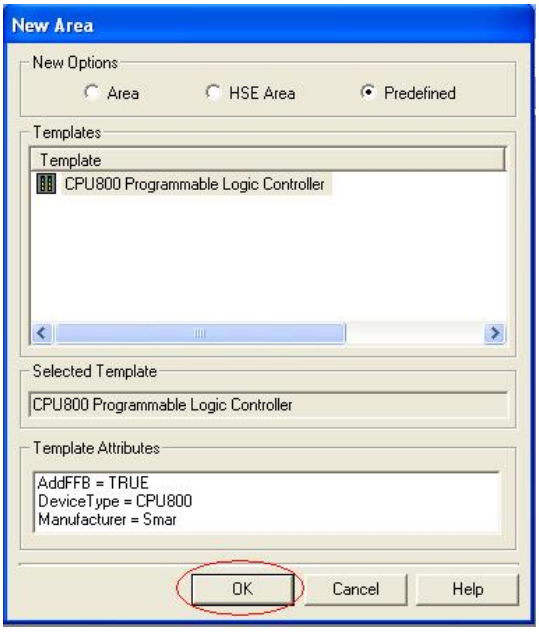


Figure 6.2 – Choosing the template using CPU800

Clicking the **OK** button will open the dialog box to give the area a name. You must assign a name to the area and click **OK**.

Figure 6.3 – New area name

Optimizing windows at Syscon

By clicking **OK**, automatically two new windows will open in **Syscon**. For a better view of the area, on the **Syscon** toolbar, click on the **Window** option and then select the **Tile** item. Following figure shows the two windows available so far:

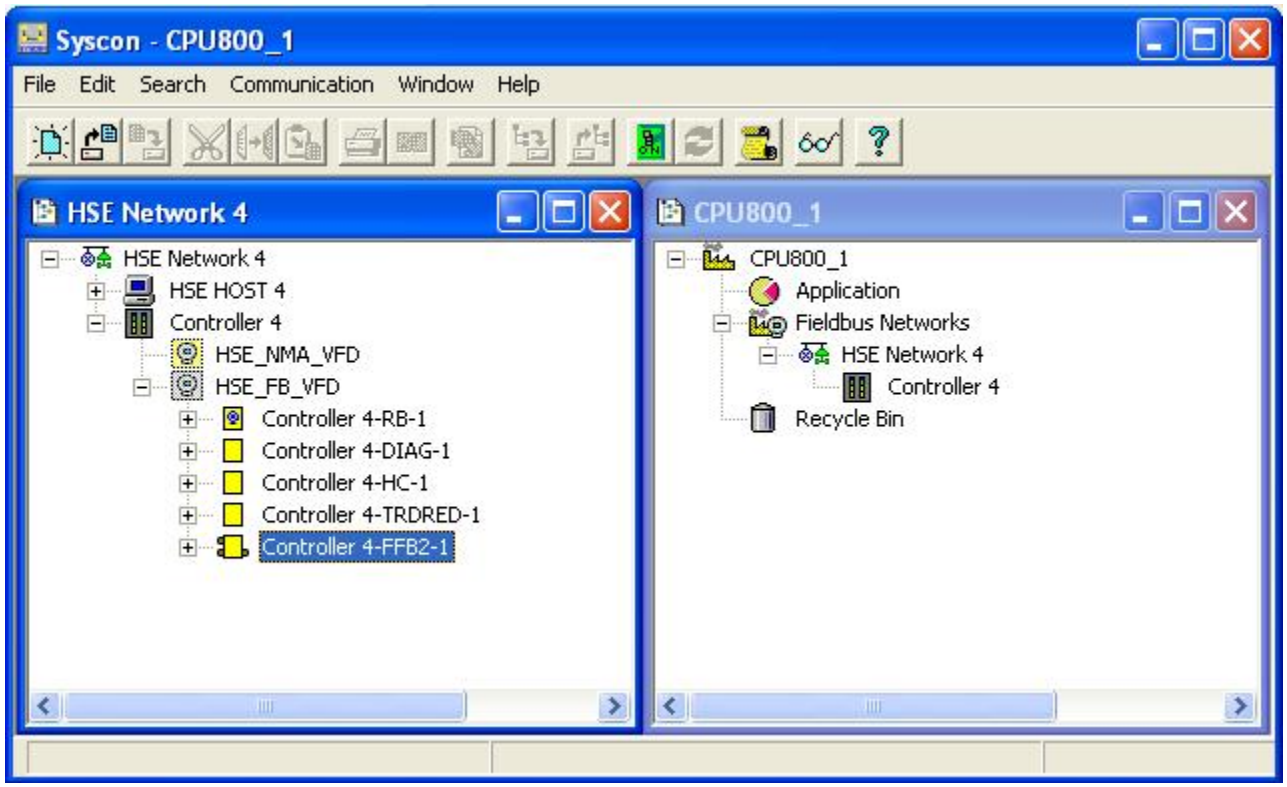


Figure 6.4 – Viewing the area windows with FFB

Setting the FFB Parameters

In the figure shown below, click on the HSE Network x[1] window and then click on the FFB block with the right button of *mouse*. The dialog box for setting parameters will open:

[1]This number x depends on whether another area was created before this one. As new HSE areas are created, this number will be incremented

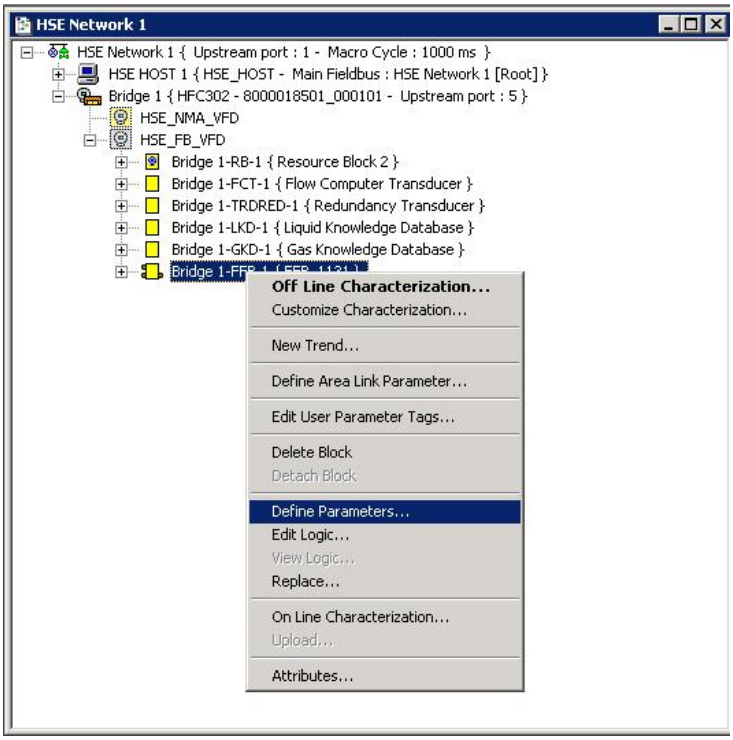


Figure 6.5 – Setting parameters for FFB

To define which types of I/O will be exchanged between logics through the parameters, select **Define Parameters** in the opened *popup*. The following window will appear:

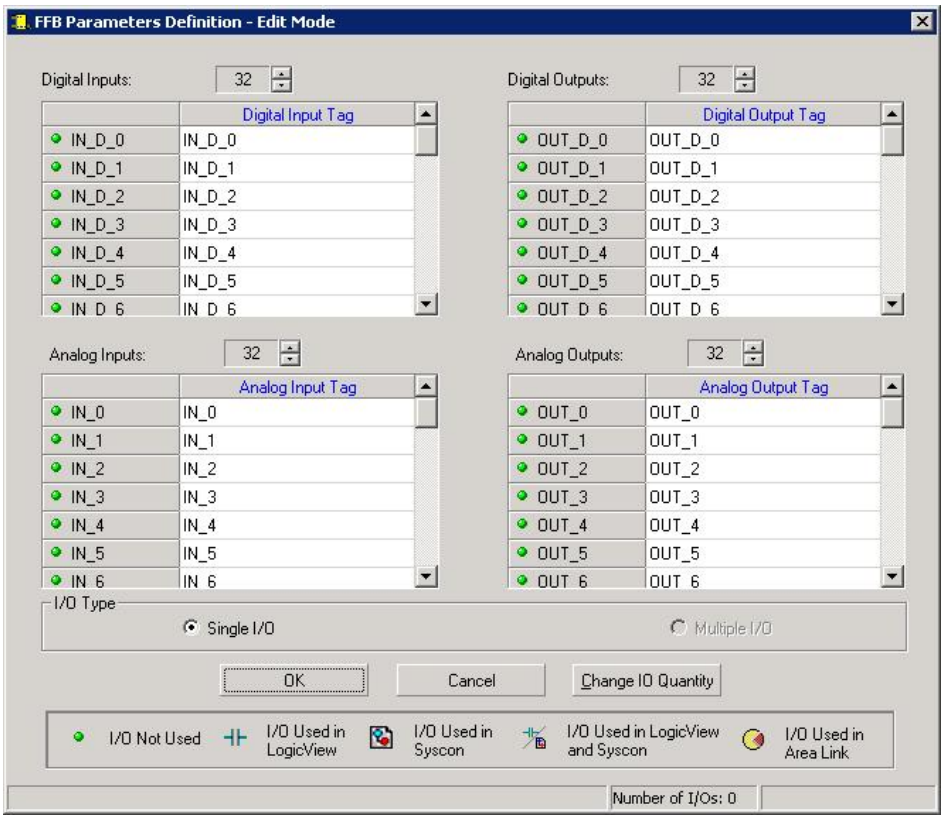


Figure 6.6 – Setting I/O types

NOTE
From version 7.3 of **SYSTEM302**, the FFB is automatically created with the following number of parameters: 32 DO, 32 DI, 32 AO and 32 AI.

In the previous window, the user may configure the number of analog and digital inputs and outputs: Analog Inputs, Analog Outputs, Digital Inputs and Digital Outputs. When clicking **OK**, the DI, DO, AI and AO points are generated. For more details on **FFB Parameters Definition**, see the Syscon manual.

To change the tags right click on the block icon in **Syscon** (in the *Process Cell, Fieldbus* window or strategy) and click **Edit User Parameter Tags**. The **User Parameter Tag** dialog box will open. For more details on changing tags, see the **Syscon** manual.

If not all I/O required at this time are known, new I/O may be defined later.

IMPORTANT
When the FFB block is used in the control strategy, it is recommended to predict reserve parameters for future use, thus avoiding a control stop impact during an incremental download, which will be necessary in the inclusion of a new strategy with new parameters. It is known that adding new parameters to the FFB, as well as changing the name of the parameter, will redefine the equipment's DDs, and this will require a broader download resulting in the exclusion of links and blocks and their re-establishment. The use of the reserved parameters already foreseen will not redefine new DDs and will only require the establishment of new links, using the existing reserved parameters. However, from version 7.3 of **SYSTEM302** when creating a new parameter, another 4 reserve parameters are automatically created for that same type.

Click again on FFB using the right button of *mouse*. The same dialog box that was shown earlier will appear. Now, the user must choose the **Edit Logic** option to edit the internal logic of the flexible functional block.

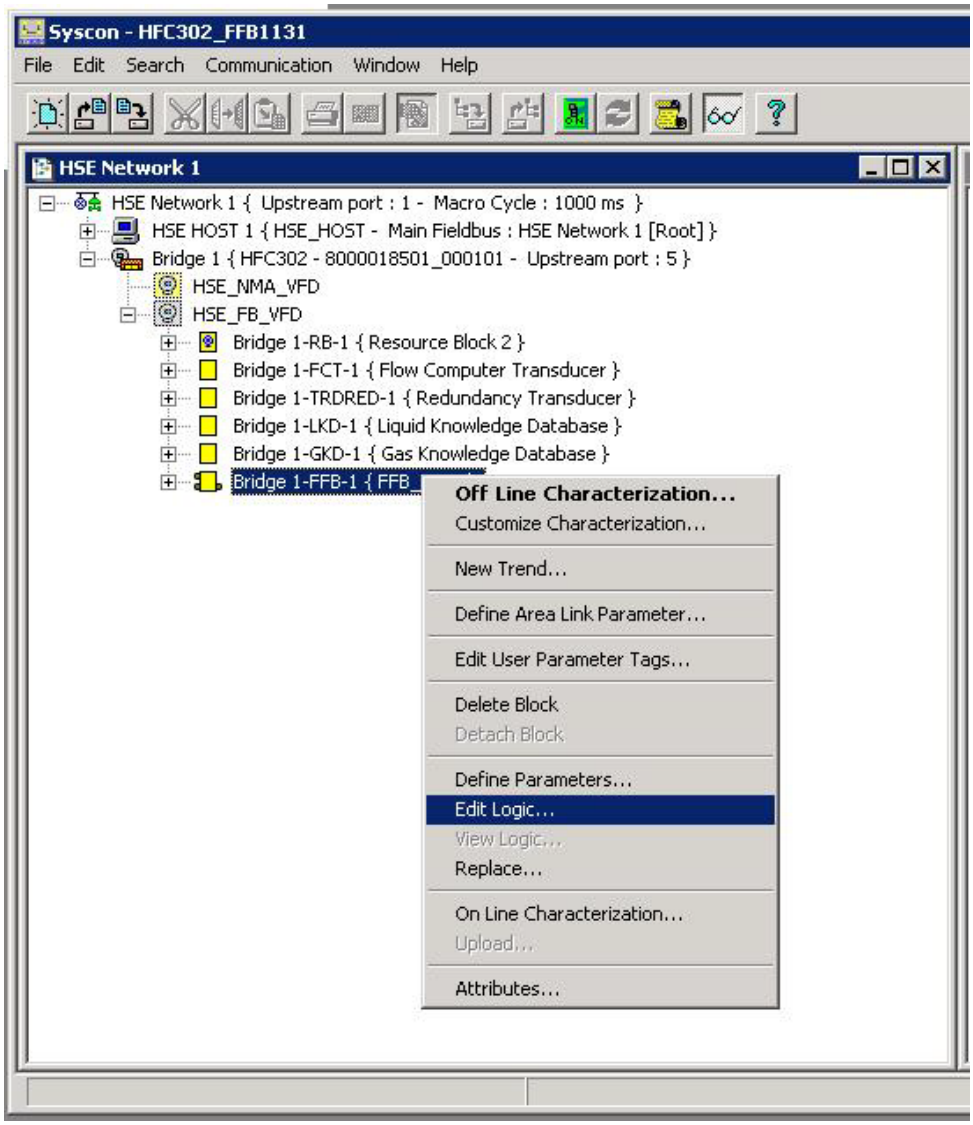


Figure 6.7 – –Edit Logic Option

At this point, a new view is opened to the user. A programming tool specialized in Ladder logic will allow the configuration of discrete logic. For more details on editing ladder logic, refer to the **LogicView for FFB** software manual.

Chapter 7

ADDIND REDUNDANCY

Introduction

In order to meet the requirements of fault tolerance, high availability and safety of the industrial process, the CPU800 controller of Smar's HSE line works with the *Hot Standby* redundancy strategy. In this strategy, the Primary controller performs all tasks, and the Secondary controller is the one that, continuously synchronized with the Primary, remains ready to assume the process in case of any failure in the Primary controller. This event, in which the Secondary assumes the process changing its function to Primary, occurs without any disturbance and in an autonomous way.

In this controller the redundancy implemented is *Device D-3* type, in accordance with the "*High Speed Ethernet (HSE) Redundancy Specification FF-953*" from Fieldbus Foundation™. For this capability (*Device D-3*), during the whole operation time, the controller pair is seen as a single equipment by the configurator. Thus, actions like commissioning, decommissioning, configuration *download* and parameterizations affect both controllers (Primary and Secondary).

Different types of failures, such as interface failures, are signaled even if they occur in the Secondary, this allows proactive maintenance, which thus ensures the availability of redundancy itself.

This new generation of *Hot Standby* redundancy of the CPU800 controller is endowed with greater diagnostic and fault detection capacity, autonomy during initialization and transparency for the configurator application.

IMPORTANT
Following features are valid for the CPU800 controller. It is assumed that the user is familiar with the **Studio302** and **Syscon** software. In case of doubt, refer to the respective manuals.

Hot Standby Redundancy

With *Hot Standby* Redundancy, complete system redundancy is achieved, considerably increasing fault tolerance, availability and process security. All controller functionalities and databases are provided with redundancy:
- Equipment redundancy.
- Network redundancy (or LAN redundancy, for controllers with two Ethernet ports - CPU800).
- Controller (executing functional blocks, including FFB/Ladder Logic);
- Supervision;
- Synchronism channel redundancy;

The procedures for configuration and maintenance are as simple as for non-redundant systems, saving time when putting the system into operation. Only one configuration *download* is required to configure the redundant pair. In case of replacement of a damaged controller, no *download* configuration or user intervention is required. The new controller inserted is automatically recognized, receiving all configuration from the controller in operation.

Preparing a Redundant System

In order to have a truly redundant system, not only must all equipment be redundant, but the architecture of the system as a whole must be designed as redundant. The more elements with redundancy capacity the system have, the greater its reliability and availability. A typical example of a redundant architecture based on the CPU800 controller can be seen in the following figure:

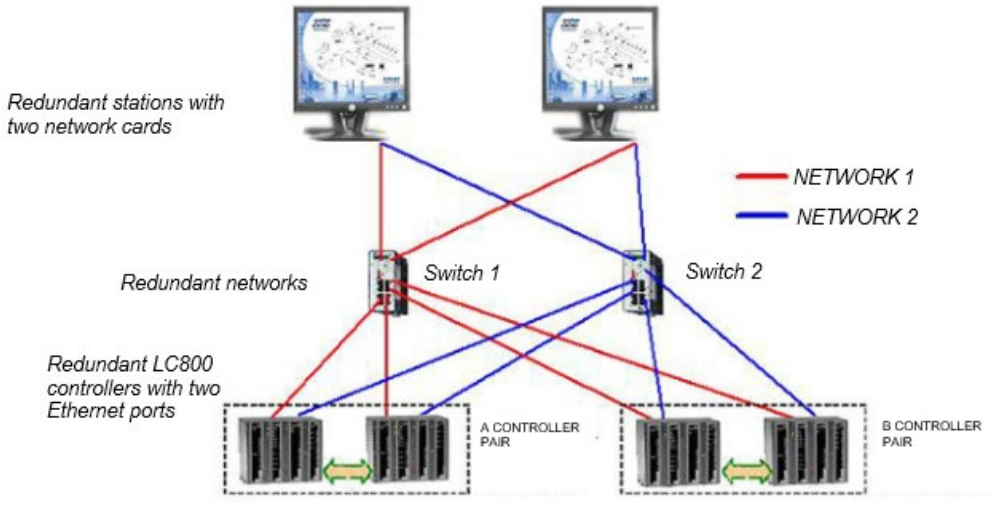


Figure 7. 1 – Redundant Architecture

Ethernet Network

- IP address of the Ethernet network used by the controller must follow Class C (255.255.255.0 mask).
- For controllers with two Ethernet interfaces the network nodes must be the same, one subnet must be used for the ETH1 interface and another subnet must be used for the ETH2 interface. Example: first CPU800 Interface (ETH1) = 192.168.164.34, second CPU800 Interface (ETH2) = 192.168.165.34. The node (34) in this example will be used as "node address" of the controller in the Syscon configuration file.
  This way there will be two subnets: 192.168.164.X and 192.168.165.X, the first serving all ETH1 interfaces and the second serving all ETH2 interfaces of all controllers. These two subnets must be designed physically separate, using different network elements.
- Workstations must have two network cards and each one must have the IP configured in one of the subnets designed as explained above.

Configuring the System302 ServerManager and Syscon

Figure 7. 2 – System302 ServerManager

Click the **Network** option and the following window will open.

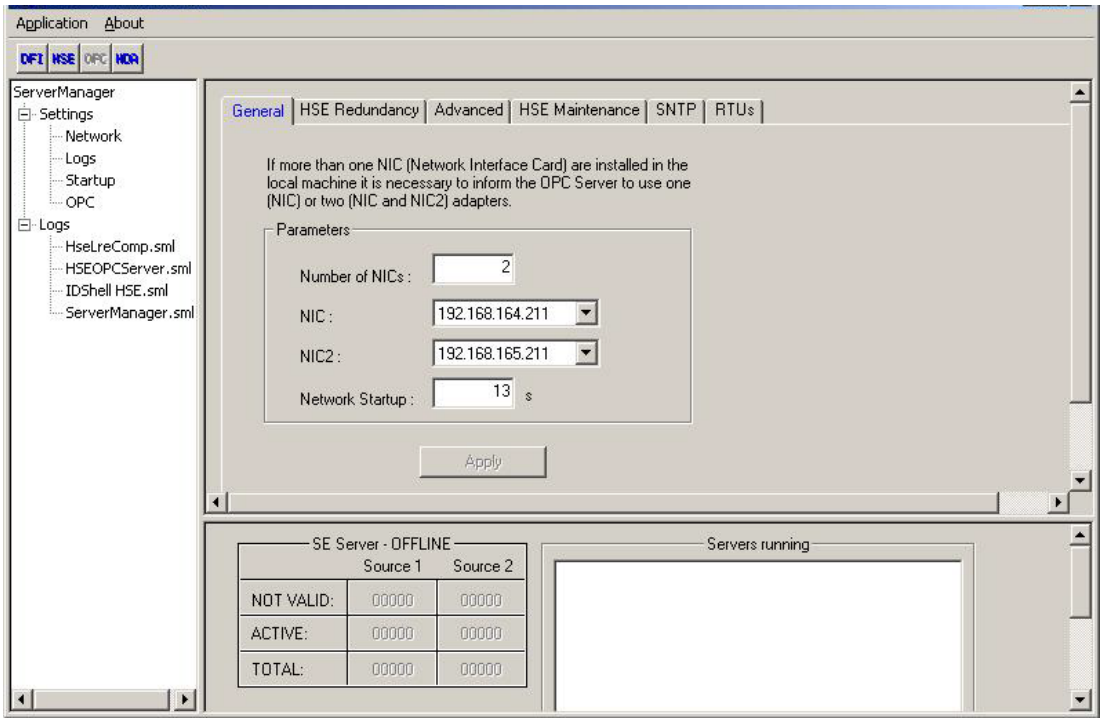


Figure 7. 3 – System302 ServerManager: General Tab

In the **General** tab, set the number of NICs (network cards) used in the machine to **2** (redundant system).
Select the IP addresses of the NICs to be used by **System302 ServerManager**.

Still in **System302 ServerManager**, on the **HSE Redundancy** tab, configure the fields as shown in the next figure.

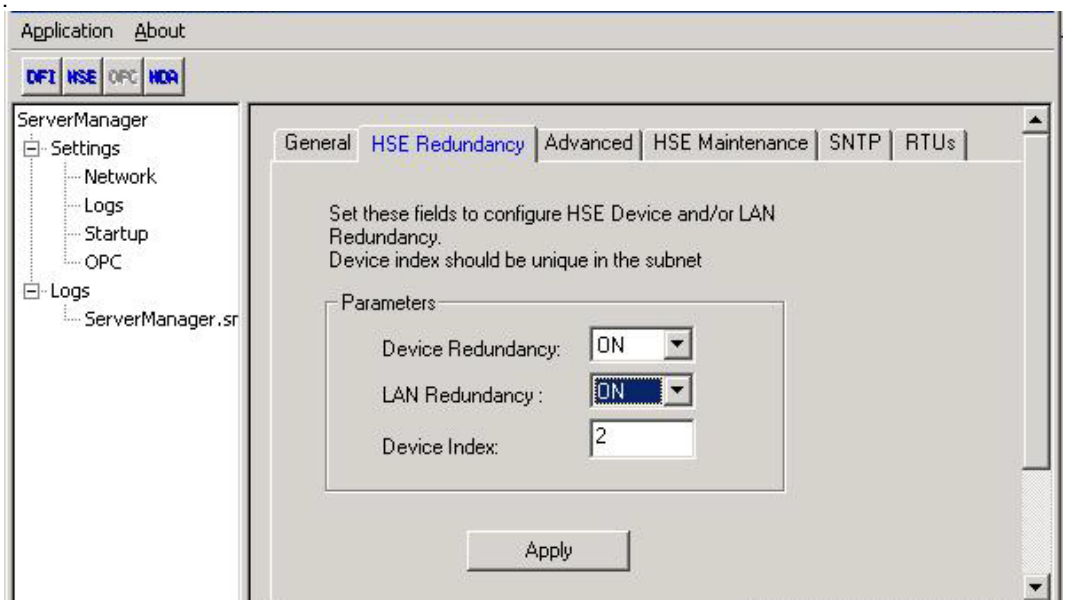


Figure 7. 4 – System302 ServerManager: HSE Redundancy Tab

Select **ON** for **Device Redundancy** and **LAN Redundancy**.

In the **Device Index** text box, enter a value between 1 and 9 for each machine, different for each machine. In the HSE network the *Device Index* represents the network address of each device for routing purposes, hence the need to be unique.

In the **Syscon** configurator, the precautions to be taken when configuring the control strategy are:
- Right click on each controller that will be redundant and choose the **Attributes** option;
- Configure the "**Is Redundant (HSE Only)"** item as enabled.

Synchronization channels

An RS232 serial port is dedicated to the synchronism between Primary and Secondary controllers using DF82 (0.5 m) or DF83 (1.8 m) cable. See the following two figures.

Thus, the distance between controllers is limited to 1.8 m, so they should preferably be installed on the same panel, but with independent power supplies and *no-breaks*.

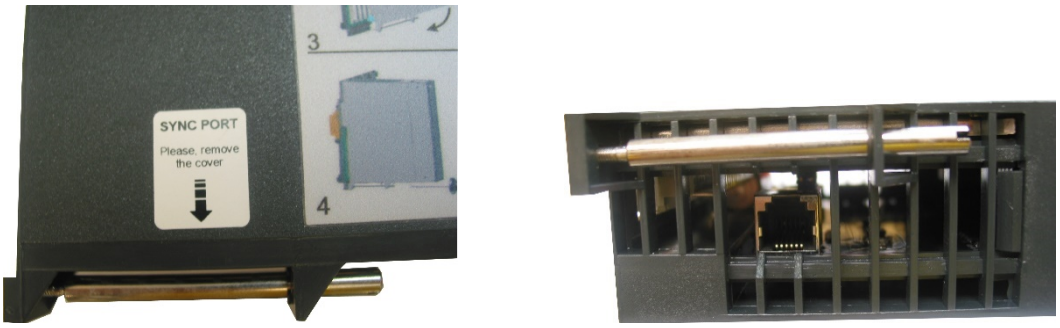


Figure 7. 5 – Label for location of the synchronism connector (left) and synchronism connector at the bottom of the controller module (right)

The synchronism between the controllers is through the serial port especially during initialization. After initializing the controllers, synchronization is performed through the Ethernet interfaces, which ensures a higher transfer rate for synchronization. If communication fails at one Ethernet interface, synchronism is established by the other interface. If there is a communication failure at both Ethernet interfaces, the synchronism is established by the serial synchronism port.

DIFFERENTIAL
CPU800 controller brings the differential of having synchronism channel redundancy. This means greater availability of the equipment's own redundancy. Three synchronism channel failures are required for controllers with two Ethernet interfaces (CPU800).

IMPORTANT
It is mandatory that the serial sync cable (DF82/DF83) always remains connected. This point-to-point connection is what determines the formation of a redundant controller pair during plant startup and during restart after scheduled stops.

I/O bus Access

To provide redundant access to the Input and Output modules, a suitable hardware topology using the DF78 or DF92 rack is required. The first two slots (*Power Supply 1* and *Power Supply 2*) must be inserted with DF50 (AC/DC) or DF56 (DC/DC) power supplies, thus providing power supply redundancy. And the controllers must be inserted side by side into *slots* CPU 1 and CPU 2. The following two figures illustrate the use of the DF78 rack.

The DF78 or DF92 rack allows you to access the I/O modules safely and transparently when using redundant controllers. Hot extraction/insertion (*Hot Swap*) of controllers is also possible for maintenance purposes.

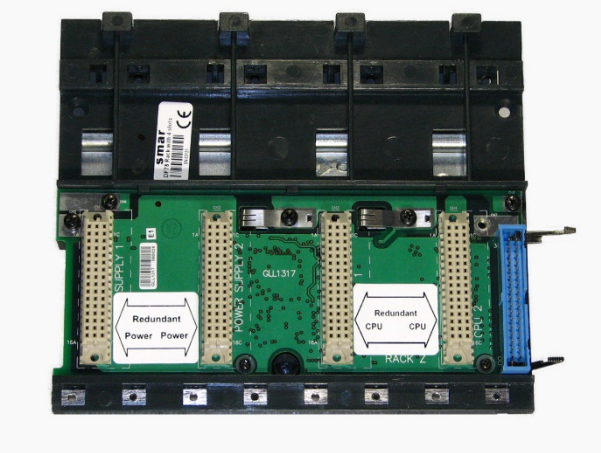


Figure 7. 6 – DF78 Rack

Figure 7. 7 – Example of module layout in DF78 rack (DF50-DF50-CPU1-CPU2)

Hot Standby Redundancy Operation

Redundancy Initialization

The controller that is initialized first becomes the Primary. If both controllers that form a pair are initialized at the same time, both will assume the same function in which they previously operated (non-volatile information).

In the absence of non-volatile information (starting immediately after firmware updating or *Factory Init* mode) and if both controllers are initialized at the same time, the controller that has the highest Serial Number will be chosen Primary and its partner will be the Secondary.

IMPORTANT
The controllers can define their function (Primary or Secondary) autonomously during initialization, no user action being required.

In addition to the information given above, during the entire operation time of the controller pair and in faultless conditions, the following is also available:

- There is no physical difference between the Primary and Secondary controllers;
- There is no preference between one controller and another or between one position or another in the rack to determine which controller should be the Primary.

Conditions leading to a switch over

The different failures that can occur in the system lead you to a switch over, when the controllers change functions. The Secondary assumes the function of Primary and vice versa in a smooth way. The possible causes of switch over are divided into two types:

General failures
When an entire controller fails:
- Hardware failure
- Power failure

- Removal of the rack controller

Faults of bad condition
When one of the interfaces of a Primary controller fails:
- Failure of all Ethernet cables directly connected to the Primary.
- Modbus communication failure (hardware or cables; if operating as master).
- Failure of all the Primary's HSE *links*.

The system is able to check which controller is in the best conditions, choosing it as Primary. As a general rule, the recovery of one failure at a time is ensured. That is, once a fault has occurred, a second fault can only be recovered by redundancy if the first fault has already been corrected. As long as the fault is not corrected, redundancy will not be fully available (in case of a bad condition fault), or even unavailable (in case of a general fault).

For general fault, as soon as the failed controller recovers, or is replaced, the controllers automatically become a redundant pair, i.e. the system automatically recognizes the new inserted controller.

To monitor the redundancy status, some parameters available in the *Redundancy Transducer* (**TRDRED**) functional block must be used. See the following table. For more details, see the Function Blocks manual.

PARAMETER	VALID RANGE/OPTIONS	DESCRIPTION
RED_PRIMARY_SN	0 ~ 65535	Indicates the serial number of the Primary controller.
RED_SECONDARY_SN	0 ~ 65535	Indicates the serial number of the Secondary controller.
RED_SYNC_STATUS	0: Not defined 1: Stand Alone 2: Synchronizing 3: Updating Secondary 4: Synchronized 5: WARNING: Role Conflict 6: WARNING: Sync Cable Fail 7: WARNING: Updating Secondary Fail	Indicates the synchronism state of the controller pair. 0: *Default* value just after initialization. 1: Non-redundant operation (*Stand Alone* state). 2: Checking configuration to synchronize. 3: Primary transferring configuration to Secondary. 4: Synchronized. Primary updates the Secondary continuously with the dynamic process variables. 5: Function conflict. The function (Primary/Secondary) could not be resolved autonomously. 6: Failure in all the synchronism cables (redundancy unavailable). Failure of the Primary before the synchronism has been completed (redundancy unavailable).
RED_PRIMARY_BAD_CONDITIONS	Bit 0: Modbus 1: H1-1 2: H1-2 3: H1-3 4: H1-4 5: Live List 6: Eth1 7: HSE link 8: Eth2 9: Serial Sync Cable 10: Unable to Sync	Bad conditions in the Primary/Secondary controller.
RED_SECONDARY_BAD_CONDITIONS		

Table 7.1 – Description of the main parameters of the Redundancy Transducer functional block

BIT	VARIABLE	INDICATION
0	Modbus	When working as a master and the Modbus slave equipment does not respond, it means that Modbus communication is in bad condition. The causes may be communication path failure or slave equipment failure.
1	H1-1	Failure in H1 channel, specifying the failed channel.
2	H1-2	
3	H1-3	
4	H1-4	
5	LiveList	The *Live List* H1 has not been completed in the Secondary controller.
6	Eth1	Eth1 interface synchronism failure.
7	HSE link	HSE *link* failure.
8	Eth2	Eth2 interface synchronism failure.
9	Serial Sync Cable	Serial sync cable failure.
10	Unable to Sync	Firmware versions with incompatibility of synchronism.

Table 7.2 – Description of the bits of RED_PRIMARY_BAD_CONDITIONS and RED_SECONDARY_BAD_CONDITIONS parameters

IMPORTANT
To know how to proceed regarding to the *warnings* of parameter **RED_SYNC_STATUS** and the indications of **BAD_CONDITIONS** parameters, see the Troubleshooting topic.

Standby LED Behavior

The possible flashing patterns for the Standby LED in controllers are summarized below. A representation is given in the following figure.

a. PRIMARY IN STAND ALONE: Standby LED off all the time, indicating that there is no partner connected.

b. SECONDARY SYNCHRONIZED: *Standby* LED on all the time, indicating that the secondary is completely synchronized with the primary and redundancy is available.

c. PRIMARY WITH PARTNER: Every three seconds, the Primary's *Standby* LED blinks briefly, indicating that the Primary has a partner.

d. SECONDARY SYNCHRONIZING: *Standby* LED blinking slowly, about one second off and one second on, indicating that the configuration synchronism is in progress.

e. FUNCTION CONFLICT: *Standby* LED blinking fast, indicating that the controller could not define its function during start. The Primary will have a pause of two seconds every 10 blinks, the Secondary will blink continuously.

f. PRIMARY - FAIL IN THE CABLE: the *Standby* LED will blink twice in the Primary, quickly, every 2 (two) seconds, indicating a failure in the serial sync cable.

g. SECONDARY - FAIL IN THE CABLE: the *Standby* LED will blink four times in the Secondary, quickly, every 2 (two) seconds, indicating a fault in the serial sync cable.

h. FAILURE IN THE PRIMARY WHILE UPDATING THE SECONDARY: *Standby* LED will blink three times in the Secondary, quickly, every 2 (two) seconds, indicating a general failure of the Primary before the "*Synchronized*" status is reached.

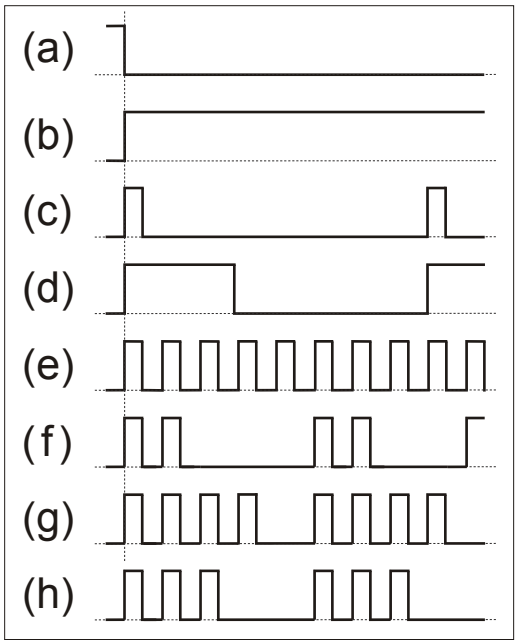


Figure 7. 8 – Standby LED Behavior

Procedures for Hot Standby Redundancy

Following are the steps for setting and maintaining of Hot Standby redundancy. It is recommended that all steps are read and understood before execution.

IMPORTANT
Before performing any of the following procedures, make sure you have followed the guidelines of the Preparing a Redundant System topic. In this section the following terms and their respective definitions are used: - Hold Mode: interrupts the execution of firmware in the controller module as well as all its tasks in the plant. - Run Mode: puts the firmware back in execution. - Factory Init mode: restores factory settings by deleting user assigned settings. For more information about these terms and how to perform the firmware update, refer to the Configuring section or the Troubleshooting section of this manual.

Configuring a redundant system for the first time

This is the procedure to configure the system for the first time with Hot Standby redundancy, at plant start-up.

1 - With the rack not powered, connect the serial sync cable to each controller.

2 - Connect the Ethernet cables to the corresponding interfaces of the controllers.

3 - Connect power to the rack where the controllers are inserted. Controllers will decide autonomously who will have the Primary and Secondary functions. Wait until one of the controllers displays the Standby LED permanently lit, indicating that the functions have been defined and the controller pair is synchronized.

on **Fieldbus Networks** **.** If in doubt about these operations, refer to the **Syscon** manual, especially the Creating a FOUNDATION fieldbus configuration section.

5 - The controller pair will synchronize the configuration (the *Standby* LED will flash). When the controller pair is synchronized (the *Standby* LED permanently lit in the Secondary), the Primary controller will be constantly updating the Secondary with the dynamic variables of the process".

Once the controller pair has the **Synchronized** and **<none>** *status* in **BAD_CONDITIONS** parameters, redundancy will be fully available and fault simulations can be made.

Changing the configuration

Run the download from the new configuration to the equipment commissioned at **Syscon**. The controller pair will re-synchronize automatically.

Replacing a failed controller module

In order to achieve a change process with a lot of security, we must guarantee some steps in the insertion of the new controller:

1 - With the new controller module out of the rack, turn off for at least 30 seconds the battery switch, which is at the bottom of the controller. Put **OFF** in the **BATTERY** position, wait 30 seconds and return to **ON**.

2 – Necessarily connect the synchronism cable (DF82/DF83) before inserting the new controller. This will avoid troubles of function conflict between controllers.

3 - If you can, connect all the cables: besides the synchronism cable and the Ethernet ports.

4 - Insert the new controller into the rack.

5 - If all cables have been connected in advance before the insertion of the new controller, the synchronism will start automatically (the *Standby* LED should blink on the new controller). When the system is synchronized (*Standby* LED is permanently lit), the Primary controller will be constantly updating the Secondary with the dynamic process variables.

6 - If only the synchronism cable has been connected in advance, connect the Ethernet cables.

7 - Once the system has the **Synchronized** and **<none>** *status* in the **BAD_CONDITIONS** parameters, redundancy will be fully available and fault simulations can be made.

8 - Any situation other than *Synchronized* should be referred to the behavior topic of the *Standby* LED to diagnose the situation.

Adding redundant controllers to a non-redundant system

A non-redundant controller actually has redundancy operation support, operating as Primary and in *Stand Alone* state.

Thus, a non-redundant system in operation may have redundant controllers added later without interrupting the process. It is only necessary that the non-redundant system has foreseen the precautions according to the Preparing a Redundant System section. The procedure is the same as in the previous section (Replacing a failed controller module).

Updating *Firmware* without interrupting the process

It is possible to make an upgrade of the controllers for more current versions of *f*irmware that add improvements or new features without interrupting the process.

In the following procedure, for reference purposes, we designate one of the controllers as A and the other as B. One can imagine controller A as the one that at the beginning of the procedure was the

Primary. In other words, these references A and B are static, and can even be related as A - left controller on the panel and B - right controller on the panel.
Follow the steps below:

1 - Make sure the system has **Synchronized** and **<none>** *status* in **BAD_CONDITIONS** parameters. Then, using **FBTools** update the firmware of controller A (the current Primary). At this time, the other controller (B) will take over the plant becoming the current Primary.

2 - After finishing the firmware update of A, the controller pair will synchronize with the current Primary (B) transferring all the configuration to the other one (A). Wait for the system to have the **Synchronized** and **<none>** *status* in the **BAD_CONDITIONS** parameters.

3 - Using **FBTools**, update the *firmware* of the current Primary controller (B). At this time, the other controller (A) will take over the plant becoming the current Primary.

4 - After finishing the *firmware* update, the controller pair will synchronize with the current Primary (A) transferring all the configuration to the other (B). Once the system has the **Synchronized** and **<none>** *status* in the **BAD_CONDITIONS** parameters, redundancy will be fully available and fault simulations can be made.

Once this procedure is over, both controllers will have the *firmware* updated and the original configuration preserved without having to interrupt the plant process.

Troubleshooting

Conflict of function

This exceptional situation occurs when some procedure is no longer followed. It is signaled both by **RED_SYNC_STATUS** parameter (value 5: **WARNING: Role Conflict**) and by the *Standby* LED (see *Standby* LED Behavior topic).

There is a chance of conflict only when a certain controller has already had a partner operating in redundancy when then one of the controllers is exchanged without *Factory Init* in the new controller inserted. In such a situation the redundancy does not define the role of the new controller for safety reasons and it is the user's responsibility to decide which controller has the expected configuration.

Solution: the user must perform the *Factory Init* mode on the controller that it wants to become the Secondary (this controller will have all the configuration deleted and will receive the configuration from the other controller).

Failure correction of synchronism cables

If any of the synchronism paths (Serial, Eth1, Eth2) fail, it is signaled by **BAD_CONDITIONS** parameters, respectively with: **Serial Sync Cable**, **Eth1** e **Eth2** (see Table 13.2). Although the synchronism channel is redundant (with up to three paths), it is recommended that as soon as a fault is signaled in one of the paths it is corrected.

Cable failures due to human intervention are quite common. For example, if Ethernet cables are swapped in the Secondary (Eth1 cable on the Eth2 interface, Eth2 cable on the Eth1 interface) the ETH1 LNK and ETH2 LNK LEDs in the Secondary will indicate the presence of the media (*Link*) normally. However, synchronous communication over Ethernet ports will not be established since subnets 1 and 2 are physically separated. This type of error will be noticed by the **BAD_CONDITIONS** parameters and diagnosed through analysis.

Solution:
- Check if the connectors are properly plugged in;
- Check the synchronism cables with fault indication as well as the network elements in case of a failure in the Ethernet interfaces.

Failure of the Primary before the synchronism has been completed.

This exceptional situation occurs when some procedure is no longer followed. It is signaled both by **RED_SYNC_STATUS** parameter (value **7<"WARNING: Updating Secondary Fail**) and by the *Standby* LED (see *Standby* LED Behavior topic).

There is a chance that this failure will occur only when the redundant pair is not yet with **RED_SYNC_STATUS** parameter in **Synchronized** when then the Primary is turned off. In such a situation, when the redundancy is not yet available, the Secondary is not able to take over the plant

safely. In this situation the Secondary remains with the same function and signals this state as a safety condition.

Solution:
- In case the user knows that the Primary just turned off has the complete configuration, put the Secondary in *Hold* and then turn the Primary on. A few seconds after this, remove the Secondary from *Hold*. The controllers will synchronize and only after **Synchronized** and **<none>** *status* in the **BAD CONDITIONS** parameters, fault simulations can be made.
- In case the user does not trust the configuration of the Primary, perform the same procedure of the above case, but repeat the *download* of the configuration.

Correction of bad conditions - Modbus

- Check if there are any failures in the wiring of the paths related to Modbus communication topology.
- Check the parameterization of Modbus functional blocks.
- Check that the converters/equipment used in Modbus communication topology are working normally.
- Check that the Modbus Slave unit is properly configured and working.

Correction of bad conditions - Incompatibility of synchronism

When performing the procedure "Update *firmware* without interruption of the process" it will usually occur momentarily the situation of one controller being with one version of *firmware* and another being with another version of *firmware*. Following momentary situations may arise:

a) Secondary with version of *firmware* more current than Primary (*Upgrade*): the synchronism is said to be compatible, and the controller pair synchronizes normally. That is, this scenario is perfectly supported.

b) Secondary with less current *firmware* version than Primary (*Downgrade*): the synchronism is said to be incompatible, and the controller pair will not synchronize indicating this situation as "**Unable to Sync**" in **BAD_CONDITIONS** parameters. That is, this scenario is not supported in the context of redundancy.

Solution for b case:
This scenario (*Downgrade*) should be avoided. Once a plant is operating with a version of *firmware* in the controllers, if for some reason you want to put it in operation with a previous version of *firmware* in the controllers, the alternative is, with the plant stop, to change the firmware of all the controllers (Primary and Secondary) and then perform the procedure of the “Configuring a redundant system for the first time” topic.

TROUBLESHOOTING

The **CPU800 module** provides some startup features to solve certain problems. These features are two small buttons available for the user, so that it can execute some reset actions of the controller (more details are presented in the following figure, showing the two small buttons located in the controllers).

ATTENTION
Whatever resource is used it can cause a serious impact on the system.

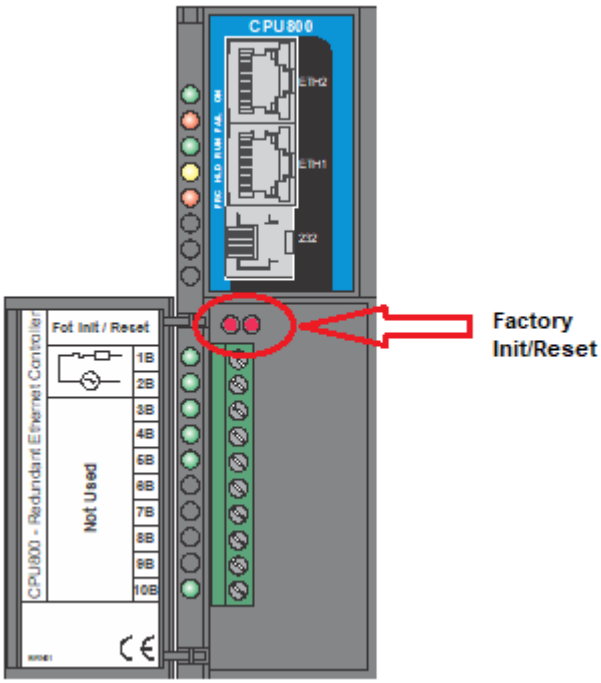


Figure 8.1. - Reset buttons

The following table shows the existing *Reset* options for the CPU800 module:

Name	Procedure Performed on the button	Action performed by the Controller
Reset	Click the *Push-Button* on the right.	The controller will execute the Reset taking a few seconds for the correct system initialization. A new IP will be assigned automatically (when available the DHCP Server on the network) or it will be maintained The last fixed IP configured, according to the procedure performed via FBTools and/or Mode 3. The controller must start in run mode (RUN) or HOLD mode depending on the last state before the *Reset*.
Mode 1 – Factory Init	Hold down the *Push-Button* on the left, then click the *Push-Button* on the right, checking if the FORCE LED is flashing once each second. Release *Push-Button* from left and the system will execute the *Reset*, deleting the previous settings.	The controller will execute a factory startup procedure deleting all the settings made by Syscon. new IP will be automatically assigned (when available the DHCP Server on the network) or will be maintained the last fixed IP configured, according to the procedure performed via FBTools and/or Mode 3. The controller must start in *Run* mode or HOLD mode depending on the last state before the *Reset*.
Mode 2 – Hold	Press and hold the *Push-Button* on the left, then click the *Push-Button* on the right twice ensuring that the FORCE LED is flashing 2 times every second. Release the *Push- Button* from left. The system will execute *Reset* and switch of mode. The LEDs can stay at HOLD or RUN depending on the switched mode.	With the controller in HOLD, you can use the FBTools Wizard to update the firmware or change the IP address. Use mode 2 again if you want to return to run mode for RUN.
Mode 3 – IP Automatic Assign	Press and hold the *Push-Button* on the left, then click the *Push- Button* on the right three times ensuring that the FORCE LED is flashing 3 times every second. Release the *Push- Button* from left.	A new IP address will be assigned automatically (if a DHCP Server is available) or a *default* IP will be assigned (192.168.164.100 for port 0 and 192.168.165.100 for port 1). Controller must start in *Run* mode or *Hold* mode depending on the last state before the Reset.

TIPS
- Once started, either mode (*Factory Init* or *Hold* Mode) can be aborted by holding *Push-Button* from the right and releasing *Push-Button* from the left. - If the user loses count of the number of times the right *Push-Button* was pressed, just check the number of times the FORCE LED is flashing every second. It will blink again once per second after the fourth touch, that is, the function is rotating. - To "click" on the *Push-Button* of *Factory Init/Reset* is suitable the use of some pointed instrument (e.g., ballpoint pen).

When to Use Factory Init/Reset Procedures

1. **How to "reset" CPU800 without turning it off?**

Use the Reset procedure.

2. **HOLD LED stays on even after a Mode 2 or an attempt to put CPU800 in RUN through FBTools.**

   The probable cause is the execution of CPU800 firmware on another hardware platform. If this is the case, contact Smar technical support.

3. **The ETH1 LNK or ETH2 LNK LED does not light, what is the procedure?**

   Check that the cable has been properly connected or that the cable is not broken. Remember the specification of the cables:
   DF54 - Standard Cable. To be used in a network between **CPU800** and *Switch/Hub*.
   DF55 - Cross Cable (*Cross*). To be used point-to-point between the computer and **CPU800**.

4. The FORCE LED is flashing, what is the procedure?

Use the *Reset* procedure. If the problem persists, you should replace the rack power supply module to check if the problem is solved.

5. FBTools does not show all the CPU's that are in the subnet, what is the procedure?

There is probably an IP address conflict on this subnet. To solve this type of problem, disconnect all controllers from this subnet and perform the "Connecting CPU800 to Subnet" procedure for each module, ensuring that the address to be used is not associated with other equipment on the network.

6. FBTools can't find CPU800, what is the procedure?

- Make sure that the initial connection procedure has been performed correctly, that is, initially the Default IP was placed via Reset Mode 3 and the computer was placed with IP 192.168.164.101.
- Ethernet cable used must be DF54 when using Hub or Switch. Use DF55 cable for direct connection between computer and CPU800.
- Test the computer's network card by running the ***ping*** command for the computer's own IP via *Prompt DOS*.
- Test the Ethernet connection by executing the ***ping*** command for CPU800.

7. The license is not accepted by the license program, what is the procedure?

Follow the procedures below:

1. Try to register the DEMO license. In **LicenseView** there is a button **Use DEMO keys**, if it works, the problem must be some key typing error.
2. If it still doesn't work, check for the **SmarOlePath** variable. Enter in **My Computer→ Properties → Advanced Tab → Environment Variables** and check for a SmarOlePath variable. If it doesn't exist, run the Interface Setup program from the Smar folder and it will be created.

NOTE
Use only characters that are numbers and dashes "-". Do NOT use spaces and characters symbols "! @ # $ % ^ & * ( ) _ + ~ < > , . / ? \ | { } [ ] :;"

3. Run the register of servers again. In Smar's folder (**Program Files\Smar\OleServers)** run the Register.Bat program.
4. If the previous options have failed, you can generate the license file manually:

Use an ASC text editor (e.g. Notepad), because the file cannot contain formatting characters. The name of each file and its contents are shown below:

File: Syscon.dat
SMAR-MaxBlocks-**55873-03243-22123-04737-10406**

File: OleServer.dat
#PCI OLE Server
SMAR-OPC_NBLOCKS**8-23105-23216-11827-2196**

File: DfiOleServer.dat
#DFI OLE Server
SMAR-DFIOPC_NBLOCKS**8-19137-32990-37787-24881-12787**

The keys shown are for the DEMO license, the keys provided by the company can be used.

8. **I cannot key the Modbus blocks to "Auto", even setting MODE_BLK. Target for "Auto" the MODE_BLK.Actual remains at "O/S".** In order for Modbus blocks to be set to "AUTO" it is necessary that the MODE_BLOCK of the *Resource* Block of DFI302 is first set to "AUTO" and that the LOCAL_MOD_MAP of each Modbus block is different from 255.

9. **I set a value other than 255 for the LOCAL_MOD_MAP of a Modbus block, but it remains at 255.**
Within the same type of Modbus block (MBCM, MBCS, MBSS, MBSM) there cannot be two blocks with the same **LOCAL_MOD_MAP**, the value must be between 0 and 15.

10. **I try to change a static value of a Modbus block, but the value is not updated.**
For a static value of a Modbus block to be updated, the block must first be set to "**O/S**", this allows static values to be changed.

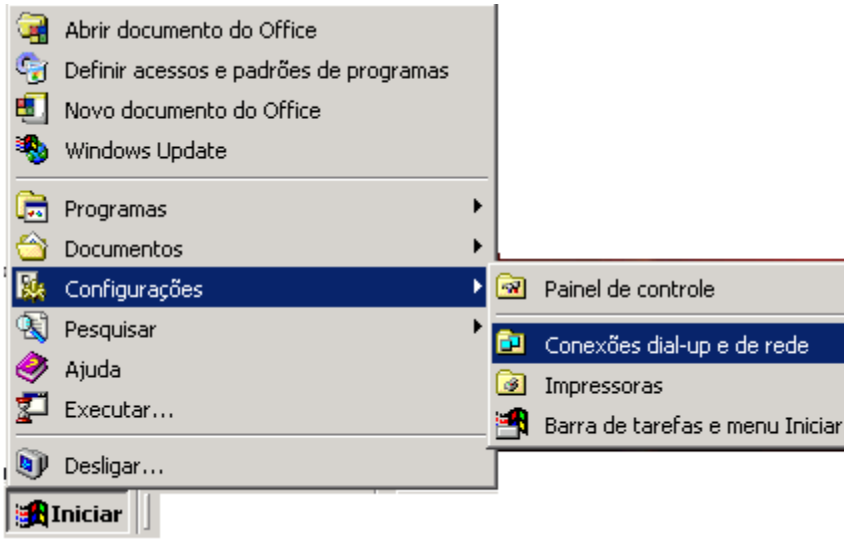
11. **After changing some static value of a block and setting MODE_BLK.Target to "AUTO", MODE_BLK.Actual does not go to "AUTO".**
    If any static parameter of a Modbus block is changed, the block will only go to "**AUTO**" after doing the "**On_Apply**" in the MBCF block.

12. **HOLD LED lit and FAIL LED flashing (similar to factory init) after CPU800 power up.**
    The configuration and reporting data may not be preserved in the power down due to two possible causes: a) the dip switch 1 on the back of the CPU800 is in the OFF position, in this case switching to the ON position; b) the battery charge is too low, in this case switching the battery or module.

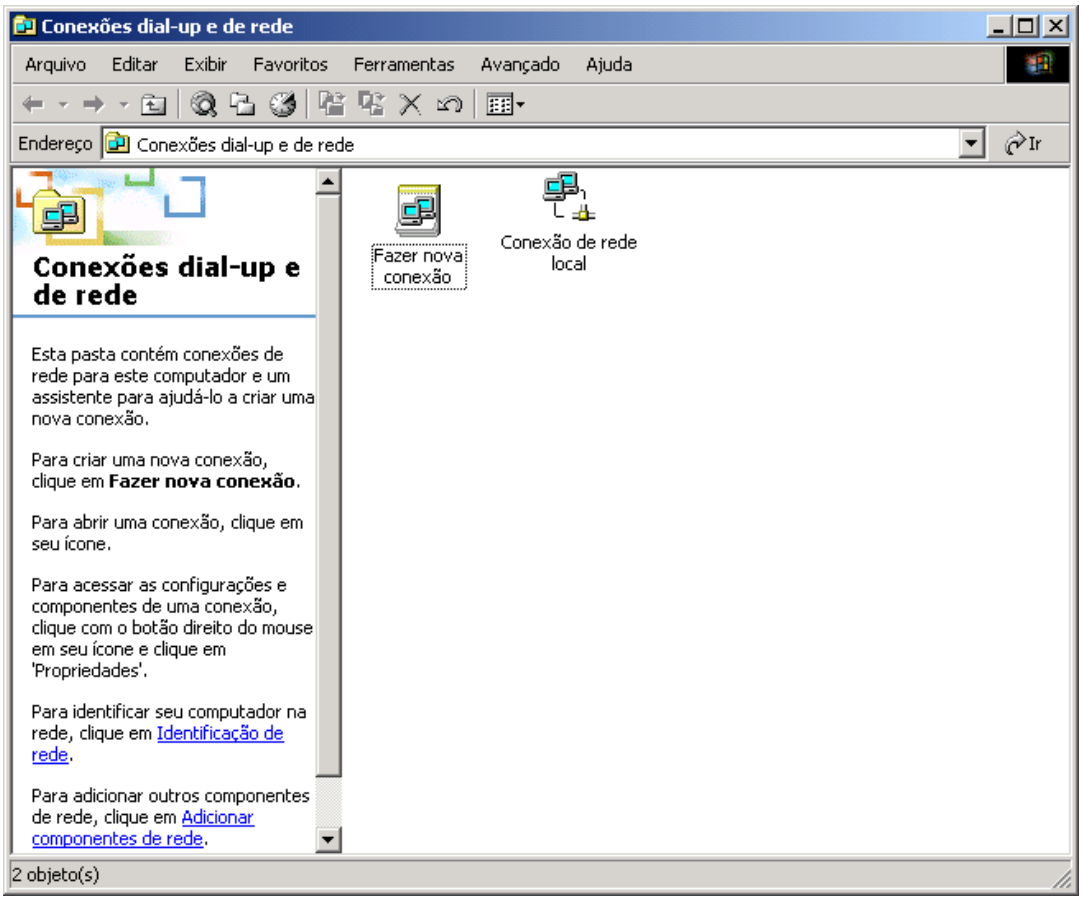
Incompatibility Issues in Communication between Computer and CPU800 Module when using DF55

A communication failure may occur between the CPU800 and the computer when using DF55 cable (*cross* cable) with the 3COM EtherLink XL10/100 PCI TX NIC (3C905B-TX) network card. In this case, the auto negotiation may fail and the connection will not be established. To solve this problem, the card must be configured at a fixed rate of 10 Mbps. To configure the board at this rate, follow the steps below:

1. Select ***Iniciar*** [**Start**] →***Configurações*** [**Configurations**] →***Conexões dial-up e de rede*** [**Dial-up and Network Connections**]. See figure below:

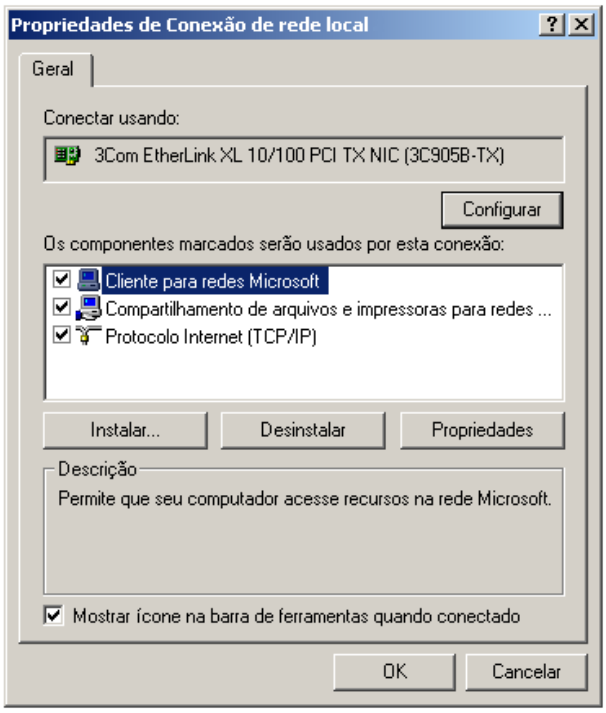


2. The following window will open:

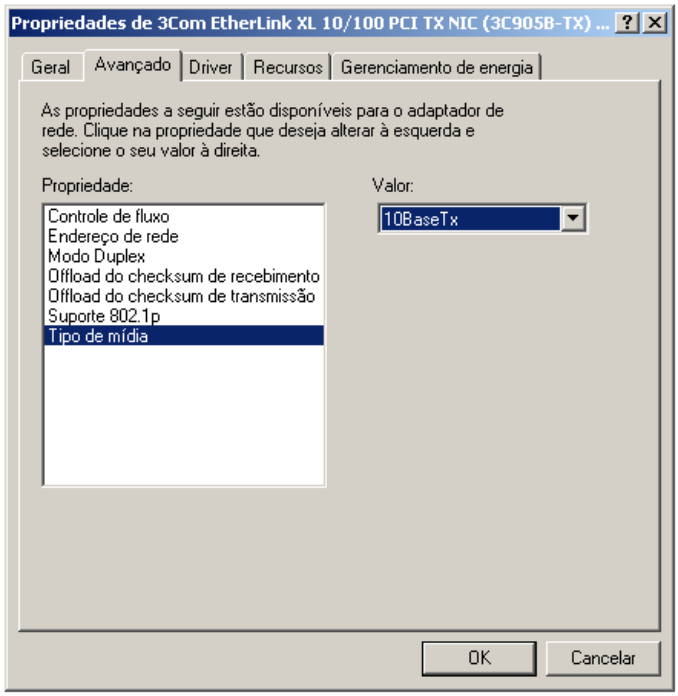


3. Double-click the **Conexão de rede local** [**Local Area Network Connection**] item. The following window will open:

4. Clicking the **Propriedades** [**Properties]** button will open the window for configuring the network. Then click on the **Configurar** [**Configure]** button, located below the field that displays the name of the card being used, to configure the rate for the card. See picture below:



5. The window with the card properties will open. Select the **Avançado** [**Advanced]** tab. In the left field select **Tipo de mídia [Media Type]**. In the right field select **10 BaseT** or **10 BaseT Full Duplex**. Then click **OK** button to complete this setting.



Appendix A

smar	SRF – Service Request Form	
	CPU800 – User's Guide	Proposal Nº:

COMPANY INFORMATION

Company: _____
Unit: _____
Invoice: _____

COMMERCIAL CONTACT

Full Name: _____
Phone: _____ _____ _____ _____ **Fax:** _____
E-mail: _____

TECHNICAL CONTACT

Full Name: _____
Phone: _____ _____ _____ _____ **Extension:** _____
E-mail: _____

EQUIPMENT DATA

Model: _____
Serial Number: _____

PROCESS DATA

Process Type (Ex. boiler control)**:** _____
Operation Time: _____
Failure Date: _____

FAILURE DESCRIPTON

(Please, describe the failure. Can the error be reproduced? Is it repetitive?)

_____
_____
_____
_____

OBSERVATIONS

_____
_____
_____
_____

USER INFORMATION

Company: _____
Contact: _____
Section: _____
Title: _____ **Signature:** _____
Phone: _____ _____ _____ _____ **Extension:** _____
E-mail: _____ **Date:** _____/ _____/ _____

For warranty or non-warranty repair, please contact your representative.
Further information about address and contacts can be found on https://www.smar.com.br/en/contact-us

Returning Materials

If necessary to return the instrument/device and/or configurator to SMAR, simply contact our office, informing the defective instrument serial number, and send it to our factory.

In order to speed up analysis and solution of the problem, the defective item should be returned with a description of the failure observed, with as many details as possible. Other information concerning the instrument operation, such as service and process conditions, is also helpful.

Returns or overhauls of out-of-warranty equipment must be accompanied by a purchase order or quote request.