Saitel DP

Backplane & Chassis RTU

User Manual

This manual provides general information about Saitel DP Platform, including installation, wiring and other useful data for installers and designers.

SE-F700-USR

Publication Date (02/2021)

Read carefully the information contained in this manual before assembly, installation and use of the equipment.

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Change Control

Rev	Date	Description
01	30-06-2020	Initial edition.
02	19-01-2021	The manual has been updated with information about webUI and TSV. Minor errors in the manual have been corrected.
03	13/07/2023	Minor errors in the manual have been corrected.

General Information

The Saitel platform and all its components have been developed in accordance to the requirements for a quality management system, complying with the ISO 9001:2015 Norm.

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File:	Saitel DP Platform – User Manual_EN_02.pdf
Retention period:	Permanent throughout its validation period + 3 years after its cancellation.

Reference Documents

User Manual	Document Code
Easergy Builder user manual	FTE-S856-MSS
webApp user manual	FTE-S856-WAT
IEC101 user manual	FTE-S854-I1D
IEC104 user manual	FTE-S854-I4D
IEC103 Master user manual	FTE-S854-I3D
Modbus user manual	FTE-S854-MBD
ISaGRAF user manual	FTE-ISD-S854
DNP user manual	FTE-S854-DNP
SOE user manual	FTE-S854-SOE
IEC61850 Ed1 user manual	FTE-S854-IEC61-1
IEC61850 Ed2 user manual	FTE-S854-IEC61-2
SM_CPU866e user manual	SE-M578-USR
SM_DI32 user manual	SE-M583-USR
SM_AI16 user manual	SE-M523-USR
SM_DO32T user manual	SE-M580-USR
SM_DO16R user manual	SE-M586-USR
SM_AI8AO4 user manual	SE-M525-USR
SM_SER user manual	SE-M581-USR
webUI user manual	SE-WUI-S854
TSV Devices user manual	FTE-TSV-S854

Software Version in this Manual

The information in this manual is valid for the software versions listed below. This information is also valid for later versions, although some parameters may change slightly:

Module	Description	Version
Baseline Software Platform	Baseline packaging	11.06.14_7172
Operating System	Linux	20.01.24.12.26.34
laqBinC	Local Acquisition	10.00.02
thm	Synchronization	06.00.02
coreDb	coreDb	10.01.11
chan	Channels	03.00.20
formBinC	Formula	10.00.13
webServer	Web server	03.03.02
webApp	Web interface	01.00.27
webUI Editor	webUI Configuration	01.02.04.00
webUI	Controller	02.00.01
supBinC	Supervision	10.01.21
soeBinC	Sequence of Events	10.00.07
ST_SER_C0.bin	SM_SER firmware	01.00.08
ST_DO32T_C0.bin	SM_DO32T firmware	01.00.04
ST_DI32_C0.bin	SM_DI32 firmware	01.00.06
ST_AI16_C0.bin	SM_AI16 firmware	01.00.03
ST_AI8AO4_C0.bin	SM_AI8AO4 firmware	01.00.03
ST_DO16R_C0.bin	SM_DO16R firmware	01.00.02
Terminal Server	TSV_SPlugin.msi	01.00.03

Important Information about Safety

Read these instructions carefully and look at the equipment to become familiar with it before trying to install, operate, service or maintain it. In this manual can be found different types of messages associated with situations that have different level of risk for people and / or for equipment.

This symbol indicates "**DANGER**" or "**WARNING**". This symbol informs of an electrical risk that will cause personal injuries if the instructions are not followed.

This symbol is associated to a safety alert. It is used to warn of possible personal injury hazards. The user must follow all instructions or messages associated to this symbol to avoid possible injuries.

⚠ DANGER
DANGER indicates a hazardous situation which, if not avoided, **will result** in death or serious injury.

⚠ WARNING
WARNING indicates a hazardous situation which, if not avoided, **could result** in death or serious injury.

NOTICE
NOTICE is used to address practices not related to physical injury. The safety alert symbol shall not be used with this signal word.

To Keep in Mind

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

Qualified personnel are individuals who:

- Have read and understood the information on the device and its user manual.
- Are familiar with the installation, commissioning, and operation of the equipment and of the system to which it is being connected.
- Are able to safely perform switching operations in accordance with accepted safety engineering practices and are authorized to energize and de-energize equipment and to isolate, ground, and label it.
- Are trained in the care and use of safety apparatus in accordance with safety engineering practices.
- Are trained in emergency procedures (first aid).

It is necessary to consider that the documentation of the equipment collects the instructions for its installation, set up and operation. However, the manuals could not cover all the possible circumstances neither include specific information on all the details.

In case of questions or specific problems about an Schneider Electric's equipment, contact with the sales office of Schneider Electric or with the customer care center and request the necessary information.

Symbols and Labels

Before the equipment is installed or commissioned, the user must understand the following symbols, which may be used on the equipment or referred to in the user documentation:

Table 1 – Symbols

Symbol	Associated Text	Description
	Possibility of electric shock	International Electrotechnical Commission (IEC) symbol associated to a DANGER or WARNING message indicating that there is an electrical risk. Failure to follow these instructions could cause damage to people or death.

Symbol	Associated Text	Description
	Caution, read the manual.	Symbol associated with a risk alert. The user must read the manual before handling the equipment.
	Possibility of electric chock	American National Standards Institute (ANSI) symbol associated to a DANGER or WARNING message indicating that there is an electrical risk. Failure to follow these instructions could cause damage to people or death.
	Protective earth connection	Associated symbol to the protective ground connection.
	Functional earth connection	Associated symbol to the functional ground connection.
	CE Mark	This symbol indicates that the equipment has been developed in compliance with all applicable European Directives.
	Electronic equipment. Special instructions must be followed for disposed.	This symbol indicates that, at the end of its life, this module must be disposed according to the WEEE Directive (Waste Electrical and Electronic Equipment).
	Compliant with RoHS.	The equipment has been designed and manufactured according to RoHS Directive (Restriction of Hazardous Substances).
	Direct Voltage	Symbol of direct voltage (V_{DC}).
	Alternate Voltage	Symbol of alternate voltage (V_{AC}).

Installation, Setup and Operation

Some devices use dangerous voltages (> 50 V), either the Schneider Electric device itself or some device connected to it. The user is responsible to check that the characteristics of each equipment are adapted and convenient for the installation. The user should read the instructions of installation before proceeding to the use or maintenance of the equipment.

⚠ DANGER

Not following these instructions can be dangerous for the people and the equipment.

Devices that handle dangerous tensions are marked with a sticker on the front label (size: 12,5 mm). This label must be visible all the time while the module is installed on the DIN rail.

The following products handle dangerous tensions:

- **SM_PS40:** Power supply module (P/N: M5084x000x and M5085x000x).
- **SM_DI32:** Digital inputs module (P/N: M583x0000x).
- **SM_DO32T** and **SM_DO16R**: These modules do not handle high voltages; they will not be marked at the factory. These modules must be marked with an electric risk label when some equipment that manage voltage higher than 50 V are connected to digital outputs.

Because of the variety of uses of the product, the managers of the application and use of this controller device will have to take the measures to the fulfillment of all the safety requirements and provision of each application. These requirements are according to the applicable laws, regulations, codes and standard.

Content

1 Saitel DP Family

Content

1.1 First Approach

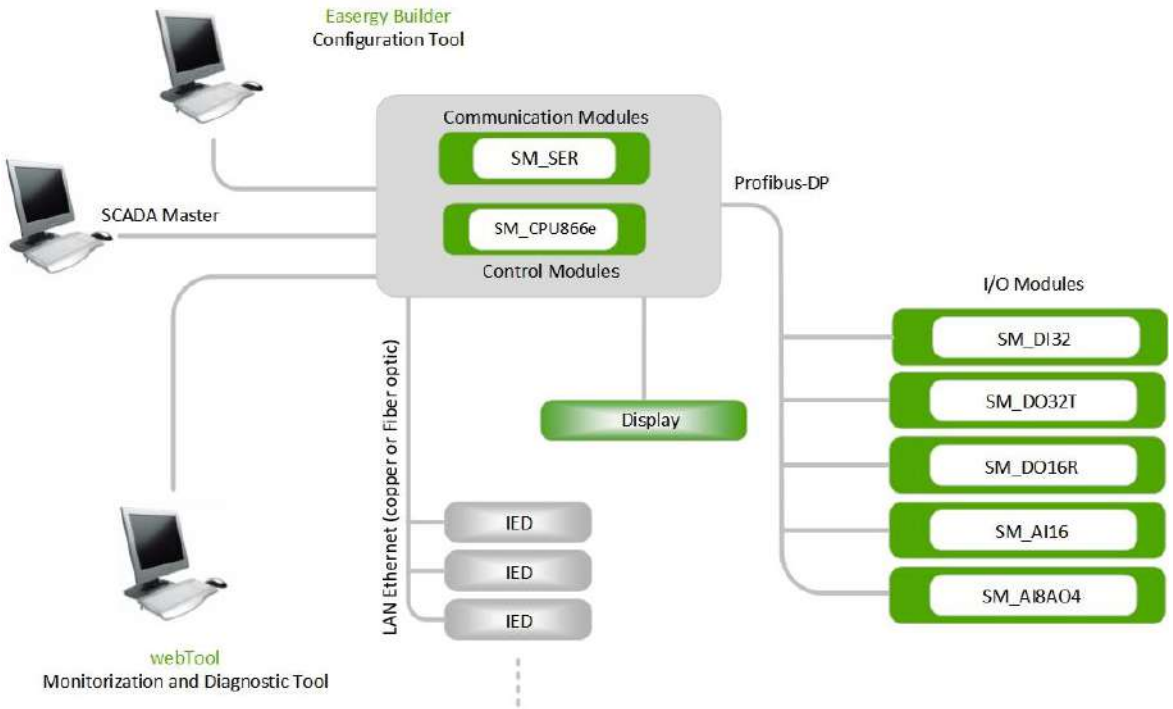
The Saitel DP platform is a complete set of devices provided by Schneider Electric for real-time control applications and power line automation. It is a high-technology platform which gives a solution to the business areas of Schneider Electric.

Figure 1 – Saitel DP in chassis and backplane.

Saitel DP's design has been optimized to meet the most demanding requirements of multiple sectors:

- Cost-efficiency, minimum downtime, and compliance with electrical safety, electromagnetic compatibility and environmental standards.
- Safety and reliability requirements for power, gas, water, residual water supply, etc.
- Centralized monitoring and control of geographically-distributed systems which support hierarchical data acquisition and redundant networks.
- Local monitoring and control with data sharing capabilities of plant-distributed devices.
- Quick troubleshooting by means of programmable automation execution.
- One of the most remarkable features of Saitel DP is its modular design. All I/O, CPU, power supply and communication modules have an identical format, sharing the same enclosure.

Figure 2 – Saitel DP architecture.



1.2 Saitel DP Modules

The Saitel DP electronic modules have been designed to operate in aggressive industrial environments, complying with the highest standards, such as Electromagnetic compatibility (EMC). The low-consumption design allows modules to operate without a forced ventilation system, which creates a wide range of possible applications.

1.2.1 General Features

The next figure shows an example of a Saitel DP module:

Figure 3 – Saitel DP module

The modules have a plastic enclosure that especially it is designed to facilitate the insertion and the wiring of the modules. The level of protection provided by the enclosure is IP20connections and disconnections.

⚠ DANGER

Never open the module's enclosure. Never install an electronic board without the plastic enclosure.

Internally, all modules are electrically connected to the backplane using a 48-pin connector on the rear side. In relation to the connection with external devices, all the elements required for the module's operation and maintenance tasks are located on the front side.

1.2.2 Configuration Switches

The modules integrate a 12-position switch on the rear side. The function of these switches depends on the module type, but in general, it is used to set the addresses and communication rate.

Figure 4 – Module's configuration switches

1.2.3 LED Indicators

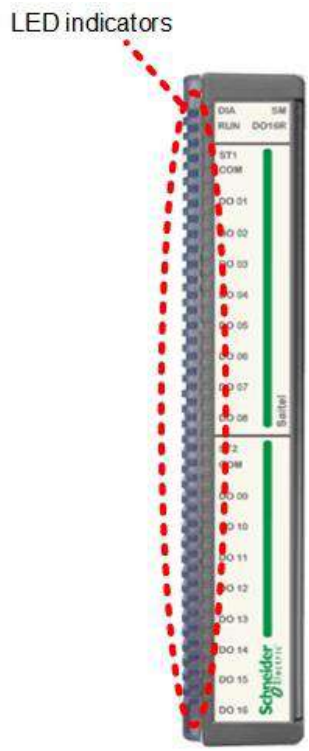
The Saitel DP modules include some visible LEDs (light emitting diodes) on the front side. All acquisition modules have common LEDs, and the rest are specific for each module, which are detailed in the corresponding user manual.

The front panel of each acquisition module has a red indicator **DIA** and a green indicator **RUN**. The module performs a self-check during the start-up process. When successful, the red indicator is switched off and the green indicator displays the module's configuration status.

If any problem is detected, the red indicator DIA is switched off. The meaning of these LEDs depends on the module type and it is explained in the user manual for each module.

This information will only be valid if the module is completely configured and operational.

Figure 5 – LED indicators



Consult the module's user manual for more information regarding interfaces, configuration switches and led indicators.

1.3 Types of Modules

1.3.1 CPU Modules

SM_CPU866e – High-Performance CPU

- OS: Linux.
- Web tool: webApp and webUI.
- Ethernet ports: 4 (copper or fiber optic).
- USB port and SD card.
- Synchronization: GPS / SNTP / IRIG-B / Protocol.
- Serial communications: 4 ports (RS-232).
- Watchdog output.
- Command console tool: RJ-45 port.
- Cybersecurity

1.3.2 Communication Modules

SM_SER – Communication module

- 8 serial ports.
- RJ-45
- Synchronous and asynchronous communications
- Synchronization from SM_CPU866e.
- RS-232 / RS-485 / RS-422

1.3.3 I/O Modules

The following I/O modules are available:

SM_DI32 – Digital Inputs

- 32 digital inputs (single/double/slow counter)
- Two removable connectors.
- Field connection: Terminal blocks or Flat Ribbon.
- There are two models of terminal blocks available for SM_DI32: TB_DI32/N (by Phöenix Contact) and TB_DI32/M (by Weidmüller). For more information see the manual.
- Auto-range for DI polarization. Available ranges:
    - 12 - 24 V_{DC}
    - 48 - 60 V_{DC}
    - 110 - 125 V_{DC}
    - 220 V_{DC}

SM_DO32T – Digital Outputs to Transistor

- 32 digital outputs to transistor.
- Two removable connectors for signals.
- One removable connector for polarization (only for field connection using flat ribbon).
- Field connection: Terminal blocks or Flat Ribbon
- Outputs type: Normally Open or Normally Closed contacts (configurable in the external terminal lock).
- DO polarization (auto-detected). Available levels:
    - 12 V_{DC}
    - 24 V_{DC}
    - 48 V_{DC}
- There are two models of terminal blocks available for SM_DO32T: TB_DO16/T (by Phöenix Contact) and TB_DO16/P (by Phöenix Contact). For more information see the manual

SM_DO16R – Digital Outputs to Relay

- 16 digital outputs to relay.
- Two removable connectors for signals.
- Only terminal block is available for field connection.
- Outputs type: SPST or Normally Open contacts.
- There is a model of terminal blocks available for SM_DO16R: FMC 1.5/20 STF 3.81 (1748532) (by Phöenix Contact. For more information see the manual
- Two polarization levels are available for DO. Depending on the ordering options, polarization input will be:
  - B2: 24 V_{DC}
  - B3: 48 V_{DC}

SM_AI16 – Analog Inputs

- 16 analog inputs
  - Voltage
  - Current (external resistor is required).
- Two removable connectors for signals.
- Field connection: Terminal blocks or Flat Ribbon
- There are two models of terminal blocks available for SM_AI16: TB_AI8/N (by Phöenix Contact) and TB_AI8/N (by Weidmüller). For more information see the manual

SM_AI8AO4 – Analog Inputs

- 8 analog inputs
  - Voltage
  - Current (external resistor is required).
- 4 analog outputs
  - Voltage (external resistor is required)
  - Current multirange.
- Two removable connectors for signals.
- Field connection: Terminal blocks or Flat Ribbon.
- There are two models of terminal blocks available for SM_AI8AO4: TB_AO4/N (by Phöenix Contact) and TB_AO4/N (by Weidmüller). For more information see the manual

1.3.4 Other Modules

Other modules are available in Saitel DP: power supply, backplanes, chassis and BP2F.

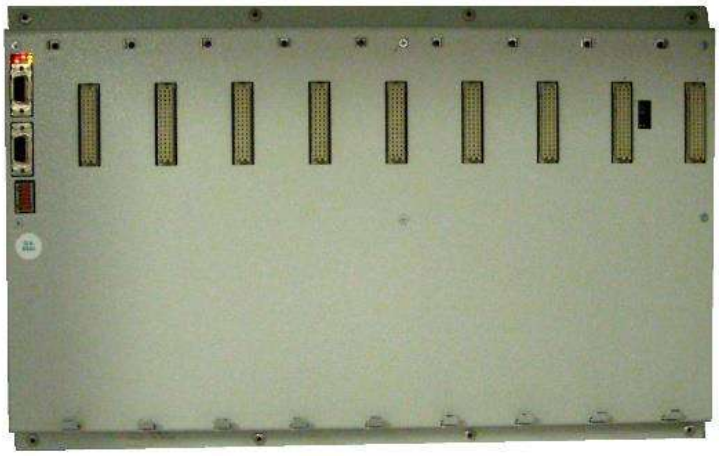
SM_PS40 – Power Supply

Saitel DP includes a power supply module which has been specifically designed to power the electronic components on the backplanes and provide the required polarization voltage to the acquisition modules. Saitel DP backplanes also support external power supplies.

- Power input depending on the P/N:
  - A2: 24 V_{DC}.
  - A3: 48 V_{DC}.
  - A4: 110 / 125 V_{DC}.
  - A5: 110 / 230 $V_{DC/AC}$.
- Power output: 5.4 V_{DC} to the backplane.
- Auxiliary power output: 24 V_{DC}, available or not depending on the P/N.

SM_BPX – 9-slot or 4-slot Backplane

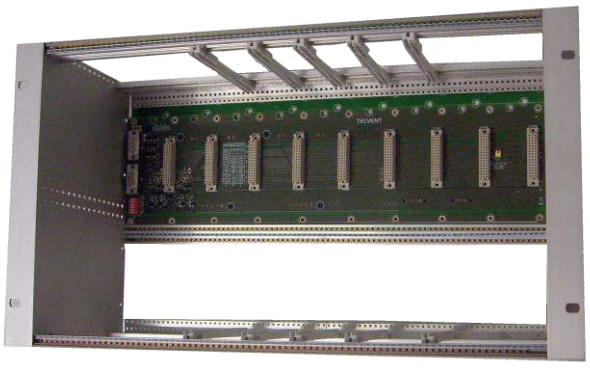
Saitel DP modules must be mounted on an electronic board named “backplane”. SM_BPX mounts this electronic board in a metallic enclosure which can be installed in a panel or flat wall.



- Power input: 5.4 V_{DC} (if a SM_PS40 module is not used)
- Two connectors for expansion and one connector for external power supply.
- Configuration switches for Profibus and synchronization expansion.
- Led indicators for bus communications and power.
- The number of slots depends of the P/N:
  - A4: 4-slot
  - A9: 9-slot

SM_CHX – 19-inch Chassis

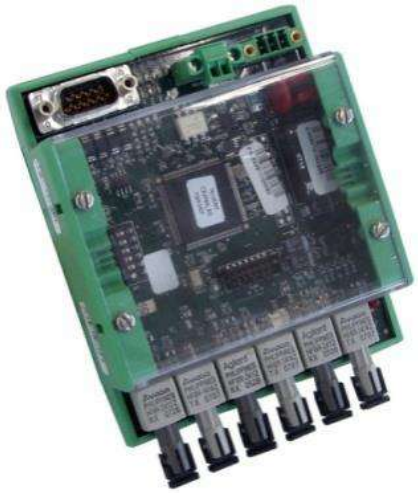
The electronic board backplane can be mounted in a 19-inch chassis:



- Power input: 5.4 V_{DC} (if a SM_PS40 module is not used)
- Two connectors for expansion and one connector for external power supply.
- Configuration switches for Profibus and synchronization expansion.
- Led indicators for bus communications and power.
- The number of slots depends of the P/N:
  - A4: 8-slot (2 x 4-slot)
  - A9: 9-slot

BP2F – Auxiliary Module for Expansion

BP2F (Backplane to Fiber) is a RS-485 to fiber optics converter, specifically designed by Schneider Electric for the communication between Saitel DP backplanes. This device allows the creation of a fiber optics bus for communications between backplanes physically far away avoiding distance and electromagnetic problems.



- Type of fiber optic depending on the P/N:
  - A1: 820 nm.
  - A2: 650 nm.
- Power input: 5.4 V_{DC}.

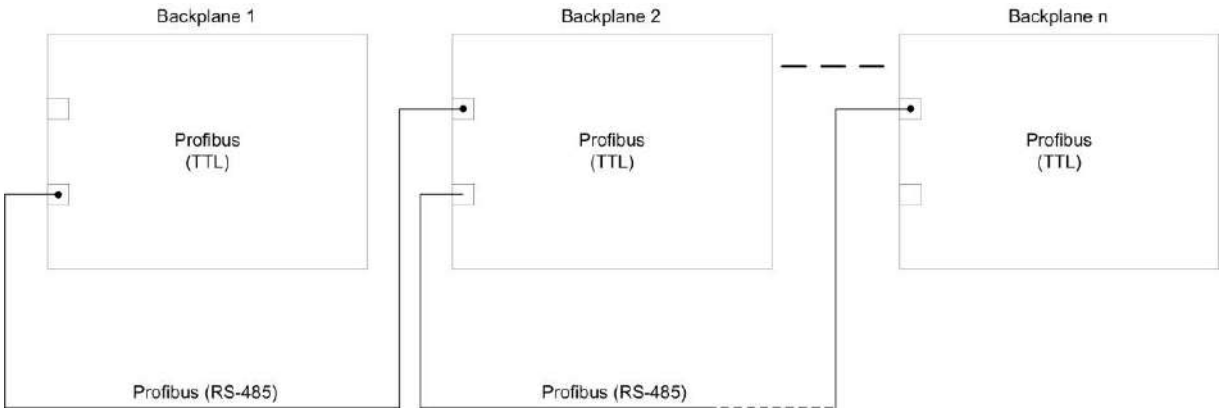
1.4 Profibus & Saitel DP

1.4.1 System Buses

Each backplane includes a multifunctional bus (Profibus TTL) that covers the power and intercommunication requirements. This bus is designed to be tolerant to power and communication failures. Additionally, a Profibus RS-485 is included to support backplane expansion.

The figure below shows schematically the situation of both buses in the system:

Figure 6 – Profibus TTL and Profibus RS-485



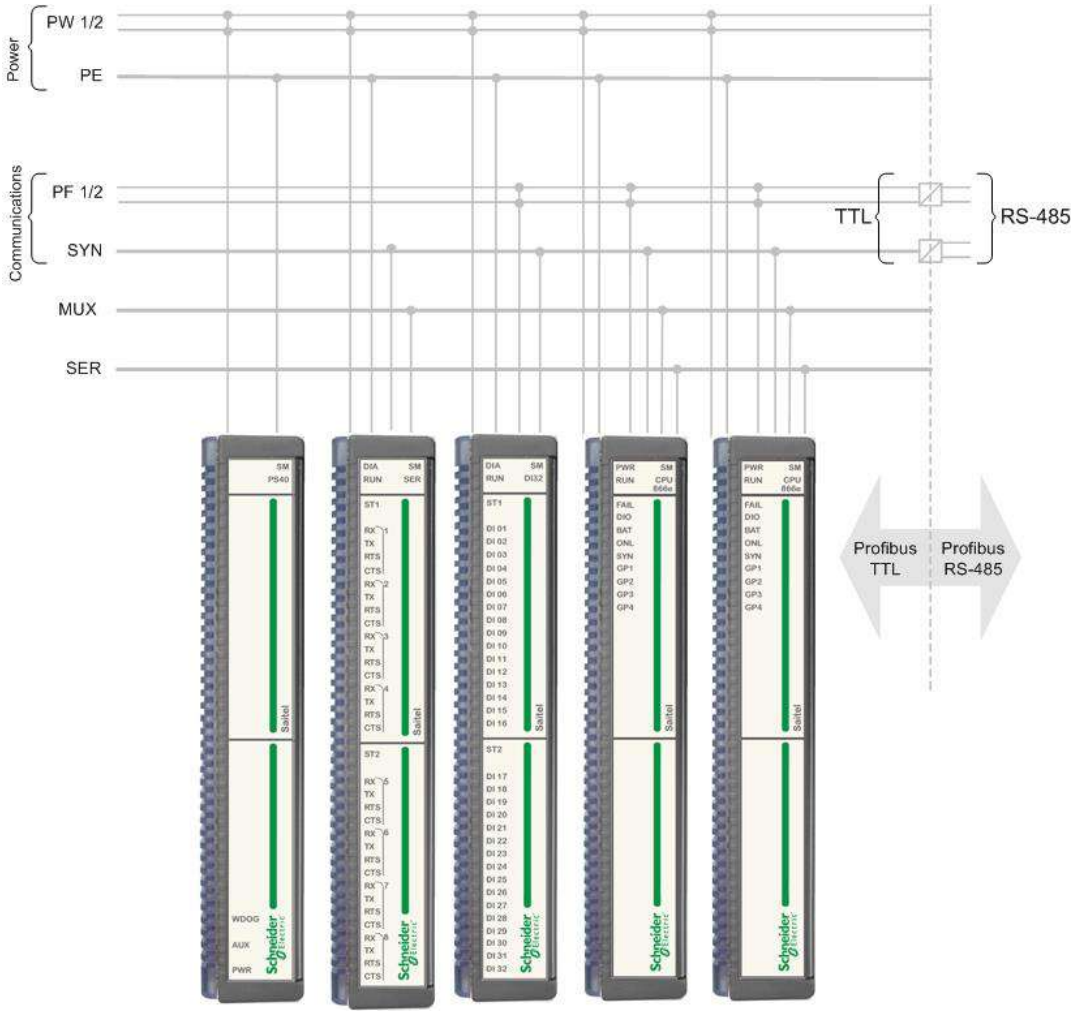
NOTICE
It is important to note that, both the first chassis and the last chassis or backplane, must be configured as bus terminations. See section 3.2 Backplane Modules in this manual.

These buses integrate the following bus lines:

- Profibus TTL:
    - **PE** - Protection ground.
    - **PW1/2** – Power bus (primary and redundant).
    - **PF1/2 (TTL)** - Primary and redundant Profibus TTL buses.
    - **MUX** - Serial data bus for communications with the SM_SER module.
    - **SYN (TTL)** - Bus for synchronization for the modules. (Pulse Per Second or PPS).
    - **SER** - Serial bus for synchronization between redundant CPU modules.
- Profibus RS-485:
    - **PF1/2 (485)** - Primary and redundant Profibus RS-485 buses.
    - **SYN (485)** - Bus RS-485 for synchronization for the modules. (PPS).

The figure below shows the buses available in the backplane:

Figure 7 – Buses in a backplane.

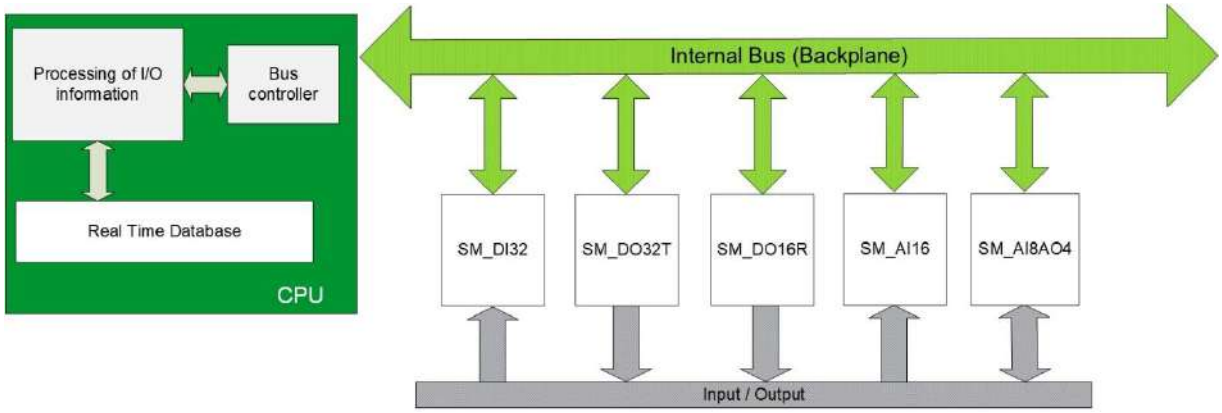


1.4.2 RTU Basic Functions

The control unit (CPU) performs the control functions for the complete system, centralizes the information acquired by other modules, and executes the programmable logic control, communication protocols and user-specific applications.

The communication with I/O modules is established by an internal high-speed bus that makes the system highly reliable even in noisy environments. This bus is implemented in the backplane

Figure 8 – Communication between the CPU and I/O modules.



The CPU module controls and manages the following functions:

Bus Controller

The Baseline software installed in the CPU controls the operation of both, CPU and I/O modules connected to the backplane.

This control includes:

- Operation mode monitoring. It performs functions as hardware and software Watchdog control, the states control of the I/O modules and the CPU and the provision of diagnostic information about the RTU status through LED indicators and several log files. These files can be consulted by a user with sufficient privileges through SFTP or webApp.
- Interface with the operator through the console, webApp (for supervision and maintenance) and Easergy Builder (for configuration).
- Firmware upgrade by SFTP or webApp (using an Ethernet port) or USB 2.0 port.

RTU Configuration

The CPU maintains and manages the information that supports the real-time database, coreDb. In this database, the I/O signals are related to the communication protocols signals. The configuration is based on XML files that are generated with the Easergy Builder tool. These files are generated on a PC and sent to the CPU via an SFTP connection through Ethernet ports.

RTU Synchronization

Up to two different synchronization sources can be configured. In this configuration is included the priority level for each source, so there will be a primary and a secondary source. If both sources are active, only the primary source will synchronize the system.

NOTICE
The primary source is used to synchronize the RTU, if available. Otherwise, the secondary source is used.

The available synchronization sources are:

- **GPS**: A GPS connected to a serial port. The time received from the GPS is used to set the system's clock and the RTC.
- **SNTP**: A SNTP source through Ethernet. CPU modules can operate as an SNTP client or as an SNTP server.
- **Protocol**: Most control protocols allow synchronizing slave devices.
- **Console**: The user can set the system's time manually from the console terminal.
- **IRIG-B**: It's possible to configure the CPU as a server and/or client. The communication always will be made with IRIG-B compliant devices.

If the synchronization source is not configured, the console device will always be created by default. The console operates as the lowest priority when another source is configured.

CPU Communications

Saitel DP supports the following communication protocols with field devices:

- IEC101 master and slave.
- IEC103 master.
- IEC104 master and slave.
- DNP 3.0 master and slave.
- Modbus master and slave.
- IEC61850 client, Edition 1 and 2.
- IEC61850 server, Edition 1 and 2.
- TSV Devices

I/O Acquisition

The CPU manages the information exchange with the I/O modules. This information is sent from the acquisition module to the CPU through the bus.

The software in the CPU adds the following features:

- Processing I/O information, which offers an added value to the information from field.
- Accessing the internal bus to exchange information with the I/O modules.

Real-time Database (coreDb)

The core of the Baseline Software Platform is the real-time database or coreDb. It is a real-time database which stores not only the information acquired from field devices, but also the information about the status of the CPU modules and I/O modules included in the RTU.

coreDb also relates the acquisition signals to the communication protocol signals. This database is generated in the CPU by using the configuration information.

The information which is received from field in real time is processed, stored in the coreDb and then related to the communication protocols signals of the RTU, which function is to transfer that information to the master device.

coreDb can also have as a source of information the result of a logic, which can be implemented by a third-party software such as ISaGRAF® or within the database itself witch an internal device of the type “Formula”.

Consult more information about this functionality in the Easergy Builder user manual.

Cybersecurity

SM_CPU866e is supplied with a standard security policy, complemented with the definition of an RBAC model (Role-Based Access Control). This model is defined and managed through a special tool, CAE (EcoStruxure™ Cybersecurity Admin Expert.

1.5 Redundant Configurations in Saitel DP

Due to the wide range of redundant configurations supported by Baseline Software Platform and Saitel DP, it is necessary to make a detailed analysis in order to determine the concepts applicable to functionalities and to set a common terminology.

It should be highlighted that redundancy always intends to increase the level of reliability and availability of the critical elements within a control system.

Redundant configurations are defined to strengthen the following parts of the control system:

- **Power supply**: This is the first doubled element in the system, since a power supply fails would mean a total power-off of the system. Power supply units are also devices which transfer powers, sometimes extremely high and could cause a significant wear of the components. All Saitel P modules and most auxiliary elements support a redundant power supply.
- **CPU**: The SM_CPU866 and SM_CPU866e modules allow defining configurations with CPU redundancy with a high level of flexibility meeting the specific requirements of any system.
- **Acquisition bus**: The acquisition bus allows the CPU to acquire data from acquisition modules. Saitel DP backplanes include a double acquisition bus. The CPU module together with the acquisition modules implement the functions to make an efficient use of these redundant communications.
- **Communication channels**: Several master and slave communication protocols support a double communication channel, which are switched with certain rules according to the protocol.
- **System’s duality**: All the system’s components are doubled under this configuration. This is the typical configuration of data hubs and communication front-ends.

Different types of redundancy can be combined in order to make the system as much robust as possible with doubled elements..

1.5.1 Power Supply Redundancy

Power supply redundancy consist of the use of multiple power supply units for the same backplane. Thus, the power supply reliability is much improved.

The SM_BPX and SM_CHX backplane have two different power supply options available:

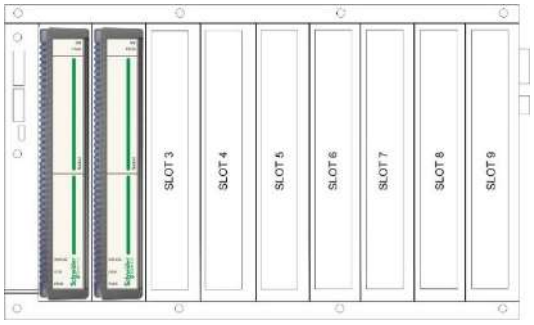
- Power supply using SM_PS40 units
- Power supply using external power supply units.

In both cases, it is possible to have a simple or redundant configuration.

Power Supply Redundancy in SM_BPX

In the redundant configuration, the first SM_PS40 module is connected to the slot 1 in the backplane and the second SM_PS40 module is connected to the slot 2 in the backplane.

Figure 9 – SM_BPX backplane with two SM_PS40 modules.



If an external power supply module is used to power the backplane, it is connected to the lateral connector (see connector 5 in Figure 44). The connector pinout is shown in paragraph 0.

The combination of an external power supply unit and a SM_PS40 module is possible providing they both are not the primary or secondary power supplies.

⚠ WARNING
If two power supplies are connected as primary or secondary power supplies, the electronic components may be damaged.

Each power supply must be available to provide the 100% of the required power, regardless if SM_PS40, an external power supply or a combination of the two options is used. Therefore, there are four possible redundant configurations

Figure 10 – Two SM_PS40 modules.

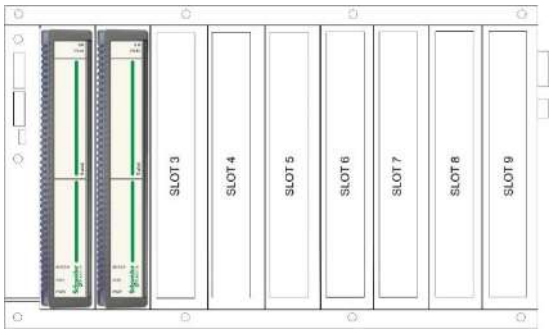


Figure 11 – Two external power supplies.

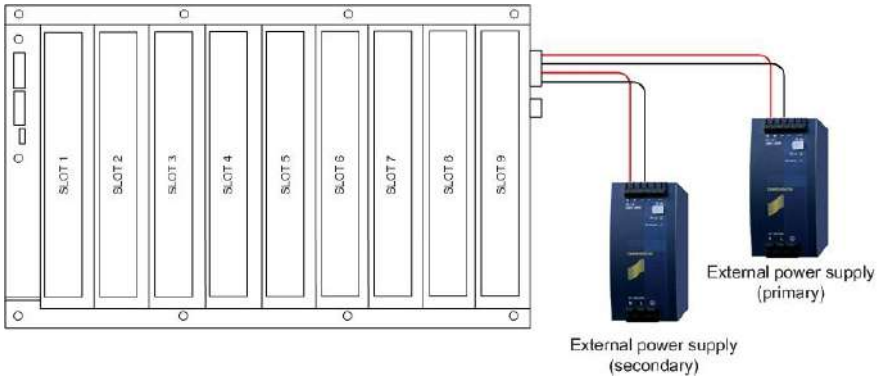


Figure 12 – One SM_PS40 (primary) and one external PS (secondary).

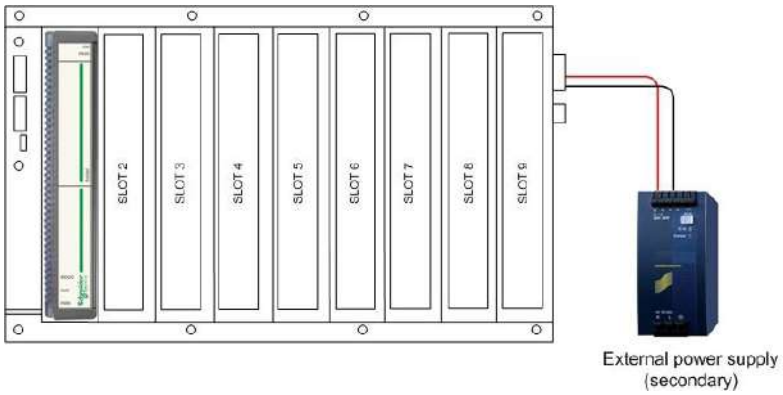
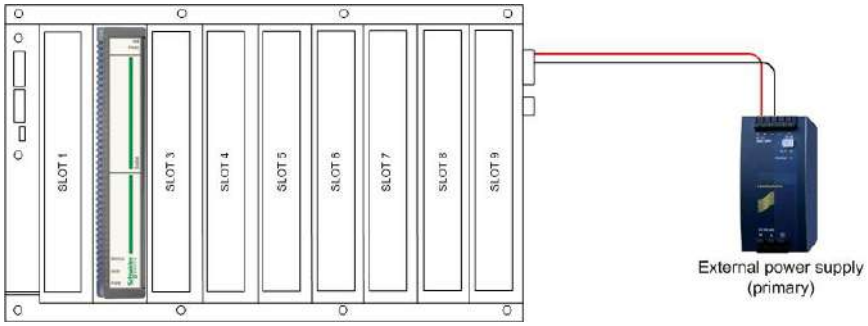


Figure 13 – One external PS (primary) and one SM_PS40 (secondary).



For any of the configurations described above, the power redundancy is achieves using the adequate wiring.

Power Supply Redundancy in SM_CHX

The SM_CHX backplane has the same power supply options as the SM_BPX backplane, so the redundancy configuration is similar.

The difference is that the connectors for external power sources are located at the back of the circuit board rather than on the side (see connector 3 in Figure 46). The pinout of this connector is detailed in section 0 of this manual.

There are four possible redundant configurations.

Figure 14 – Two SM_PS40 modules.

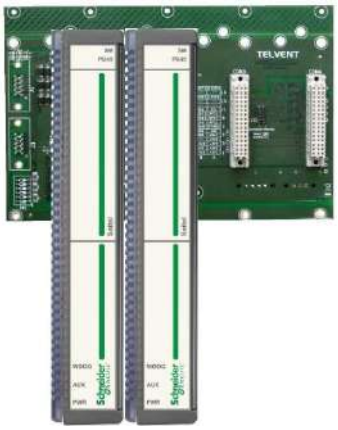


Figure 15 – Two external power supplies.

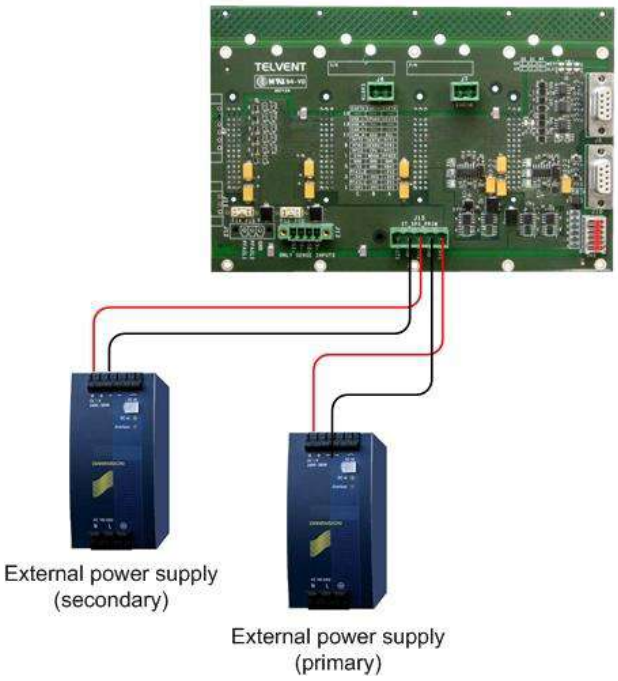


Figure 16 – One SM_PS40 (primary) and one external PS (secondary).

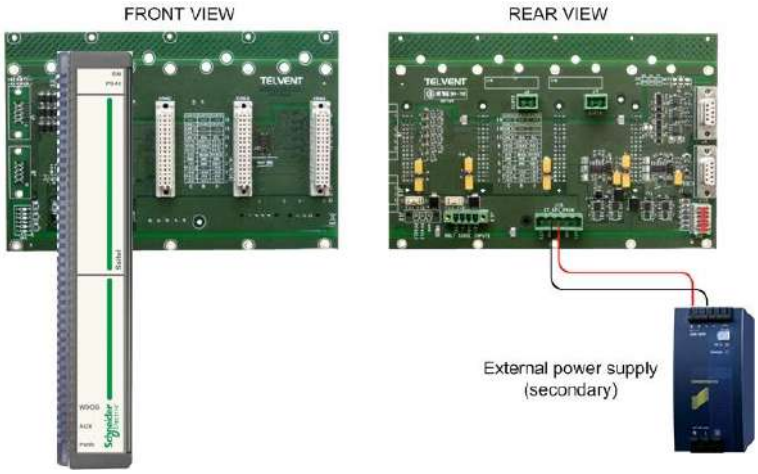
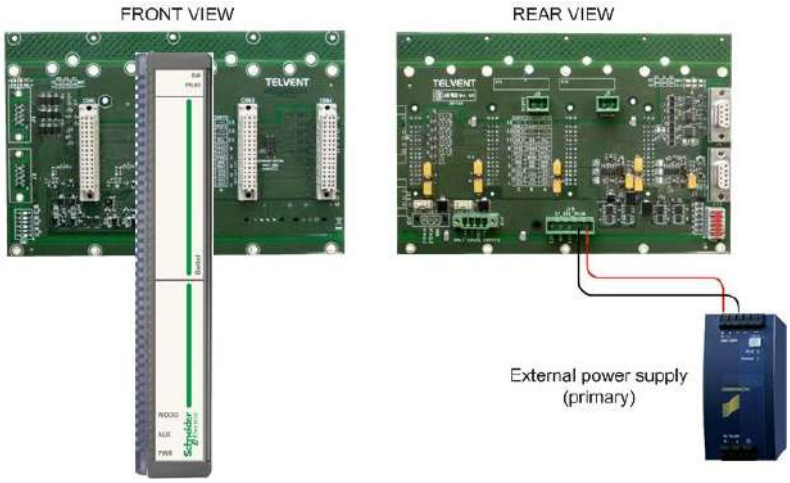


Figure 17 – One external PS (primary) and one SM_PS40 (secondary).



1.5.2 CPU Redundancy

The SM_CPU866e module, together with the backplanes (SM_BPX and SM_CHX), supports the definition of different redundancy configurations of the CPU.

The redundancy types are defined by:

- **Physical site**: The two CPU are installed consecutively in the same backplane or in different backplanes.
- **Switching mechanism**: The switching can be arbitrated by the MSAC module or managed by the CPU modules themselves.
- **Switching type**: Both "cold" and "hot" switching are possible. In the first case, the database of the STANDBY device is not updated with the ONLINE device's database, but it only updates when switching is triggered. In the second case, the STANDBY device is constantly updating the database with the ONLINE device.
- **IP address allocation**: Baseline Software Platform allows configuring a number of IP addresses associated to the ONLINE CPU. These addresses are assigned dynamically to allow CPU modules in redundant systems to inter-communicate and use the same IP address after switching.

1.5.2.1 CPU Physical Site

Two CPU Modules in the Same Backplane

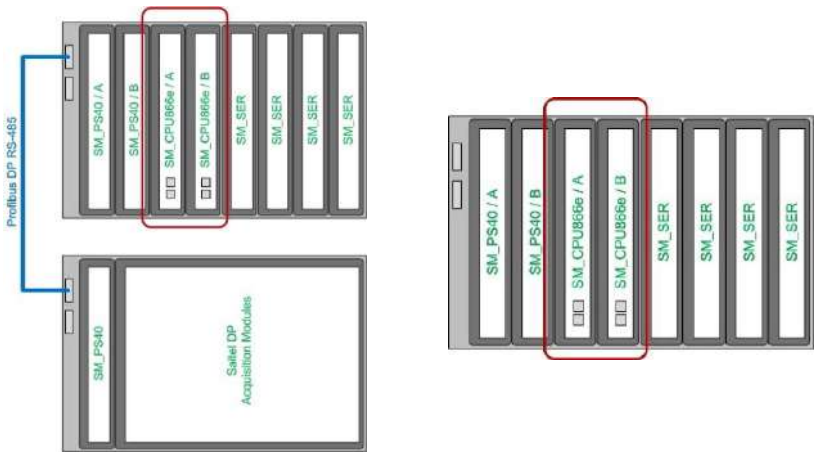
This is the simplest redundant configuration as it makes the best use as possible of the features of the backplanes (SM_BPX and SM_CHX). It is the only configuration which allows the two CPU modules to share the SM_SER communication modules. It also allows (alike in other configurations) acquisition modules to be shared.

NOTICE
Both CPU modules must be installed in consecutive slots in the backplane.

If there are two CPU modules in the same backplane, the switching mechanism can be controlled by the MSAC module or be managed by the two CPU. In this case, Both CPU can intercommunicate through a dedicated high-speed channel included in the backplanes or through a serial or Ethernet link.

Its main disadvantage is that a malfunction in the CPUs' backplane, caused by any of the modules, affects the two CPU similarly. Therefore, there are simple faults which might make the two CPU fail.

Figure 18 – Two CPU modules in the same backplane.



Two CPU Modules in Different Backplanes

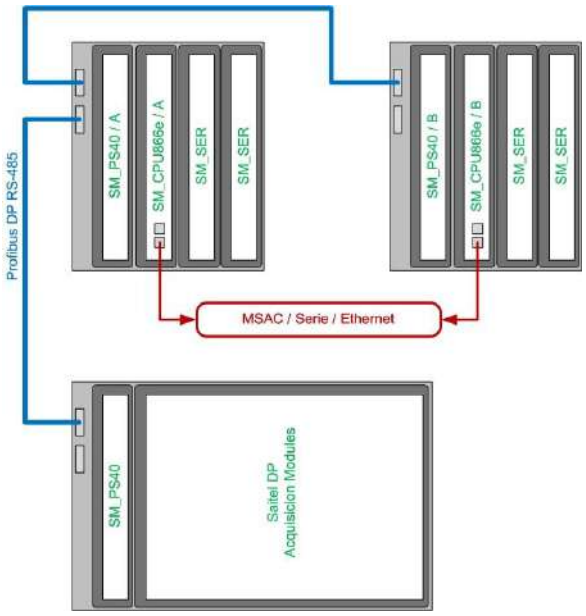
This configuration requires an additional backplane; moreover, the number of SM_SER communication modules, which are doubled, cannot communicate with the CPU if they are nor in the same backplane.

The switching mechanism is controlled by the MSAC module or managed directly by the two CPU modules. In this case, both CPU can intercommunicate through a serial or Ethernet link.

This configuration prevents a simple failure in the backplane from affecting the system completely.

NOTICE
No other acquisition module can be installed in the backplanes in which the CPU modules are located, since the CPU will not be able to access the acquisition data of the modules located in the backplane of the other CPU.

Figure 19 – Two CPUs in different backplanes.



1.5.2.2 Switching Mechanisms

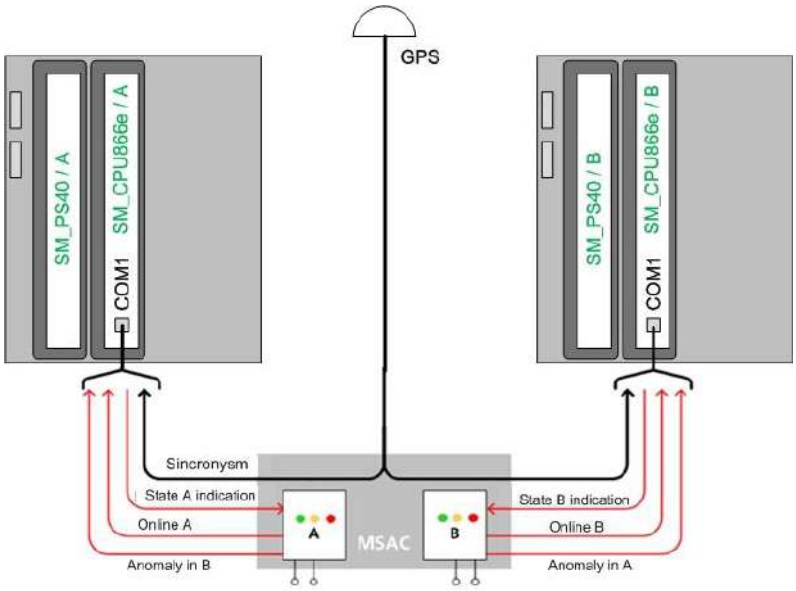
MSAC Module

MSAC (Signaling, Arbitration and Switching Module) can, in redundant CPU configurations, perform the following functions:

- Using a powerful "hardware" protocol, it detects if a CPU is operational or not. It arbitrates which of the two CPU is ONLINE or STANDBY.
- If a GPS is used for synchronization, the synchronization signal is broadcasted to the two CPU.
- It links each CPU to a relay output, which is activated if the device is operational (ONLINE or STANDBY) and deactivated if a FAIL status is detected. This relay output can interrupt the output polarization, signaling, etc.

The MSAC module includes a set of LEDs to indicate the state of each CPU.

Figure 20 – Switching using the MSAC module.



The CPU (A or B) reports its status to the MSAC. If it is ONLINE, it generates a pulse train, which is not generated if it is FAIL. The MSAC reports the other CPU whether it should switch to ONLINE or not, and if the other CPU is in a FAIL status.

RCAP Protocol

If there is no MSAC module installed, the switching van be performed through the RCAP (Redundancy Control Asymmetric Protocol) protocol.

In this case, there is a communication channel, which can also be redundant, between the CPU modules. Using this channel, the CPU modules manage the switching through a Schneider Electric proprietary protocol (RCAP). The communication channels include:

- Ethernet. Communications are established using an IP address through an Ethernet port.
- Serial. The CPU modules communicate using a serial port in the SM_CPU866e module.
- Communication through the backplane (only available when the two CPU are installed in the same backplane). The backplane incorporates a dedicated serial channel so that the CPU modules can communicate.

This switching mechanism is specially recommended when the two control modules are installed in the same backplane or when they are installed at a short distance.

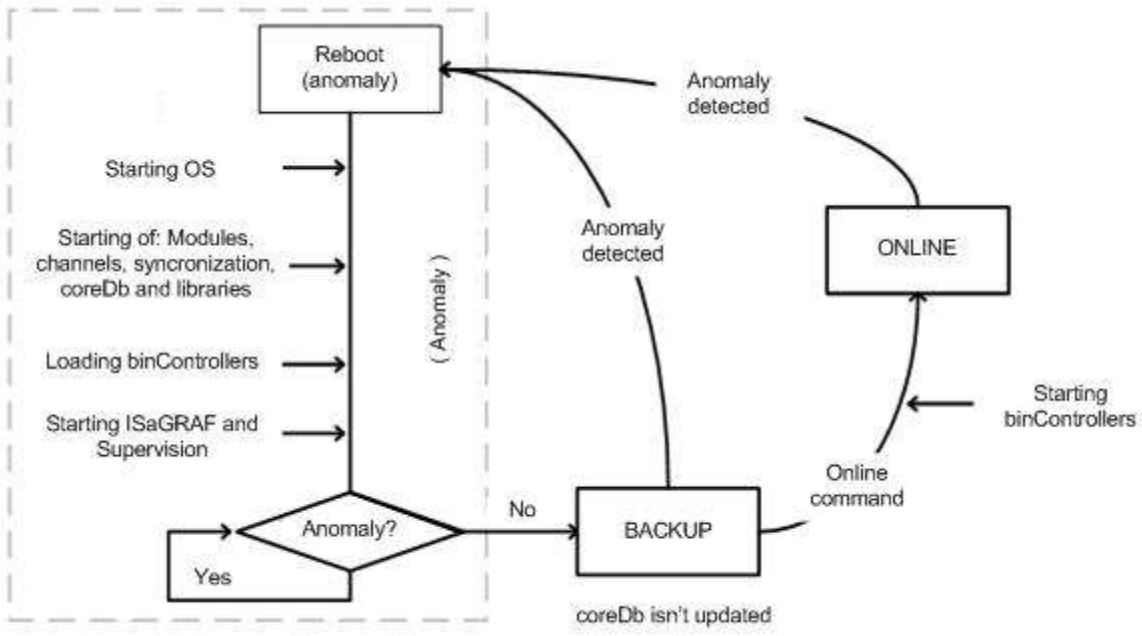
1.5.2.3 Switching Mode

There are two types of switching: “Cold Data” and “Hot Data”.

Cold Data

Under this mode, there is no communication between the two CPU, and when the switching is performed, the new ONLINE CPU initializes with a database with default values.

Figure 21 – Switching status under Cold Data mode.



There are three status defined for each CPU:

- **STANDBY**: Under this status, the CPU is operational, the defined software modules (coreDb, synchronization, web server,...) in AutoLoad.cfg, the supervision module and ISaGRAF are loaded. The other BinControllers are not executed. The CPU does not access to the acquisition bus, the SM_SER communication bus or generate the PPS. The database is not updated.
- **ONLINE**: Under this mode, the CPU is operational and all applications are executing. The protocol BinControllers are executed. The communication is activated through the acquisition bus and SM_SER communication bus; the PPS is generated.

  After the switching, communications and acquisition are resumed, and all parameters use default values.

- **FAIL**: Under this status, the CPU is not operational.

By adding a second CPU to a control system, this configuration has the advantage of improving availability considerably so that maintenance, database modifications and testing tasks can be carried out over the STANDBY CPU, not comprising the system's performance.

Hot Data

Under Hot Data mode, there is a high-speed communication channel (Ethernet or backplane) between the two CPU, which is used to update the STANDBY CPU's database with the ONLINE CPU's database. When a switching is performed, the new ONLINE CPU starts with updated values. In this operation mode, database IDs must be the identical.

The update is performed by exception; it only sends the values of the points which have changed, except for the first time when the entire database is updated.

The information which is shared by the two CPU is exclusively related to coreDb points; internal information about the BinControllers is not shared. This is the reason why, some information may be lost after a switching. Examples of this type of information are events and commands.

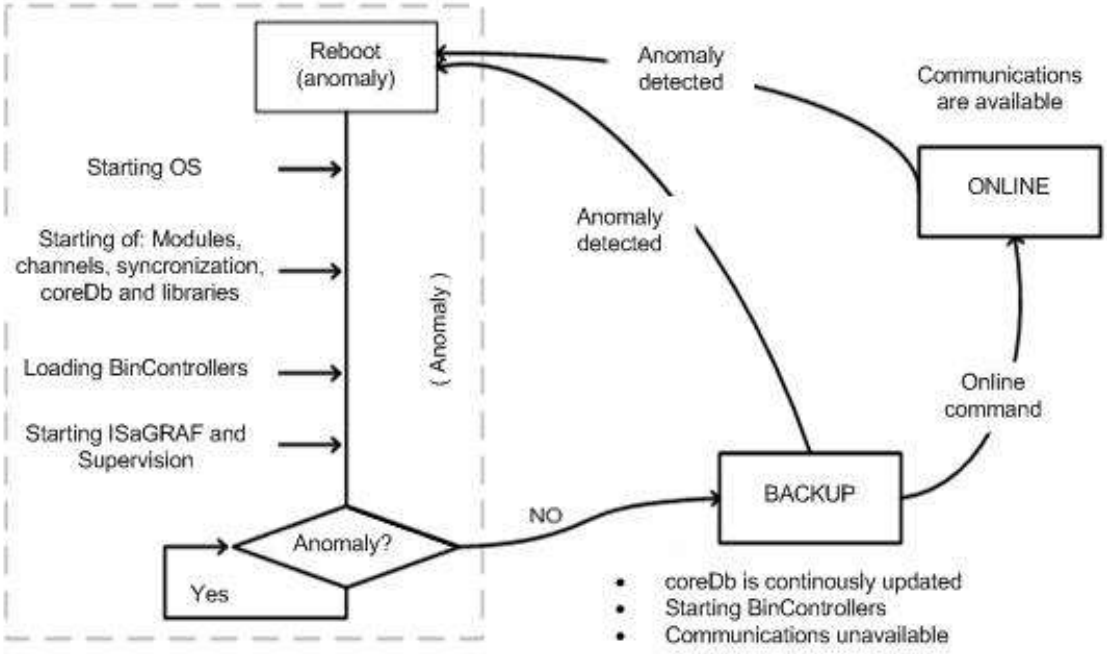
The use of a BinController of the laq type which uses a Profibus protocol sending the status of the outputs constantly achieves that the values sent as outputs will match the values corresponding to the actuations performed on the points associated in coreDb.

For BinControllers using other protocols (101,104, DNP) which send commands by exception, no command is sent after a switching.

ISaGRAF and supervision BinControllers are executed in the STANDBY CPU. The points with sources in the supervision BinController are not shared by the two CPU.

Both CPU can initialize in different moments, so there is no guarantee that ISaGRAF sequential program is under the same status in both CPU. If status synchronization between both programs is required, it must be implemented in the program itself using ISaGRAF variables mapped to coreDb signals.

Figure 22 – Switching status under Hot Data mode.



There are three status defined for each CPU:

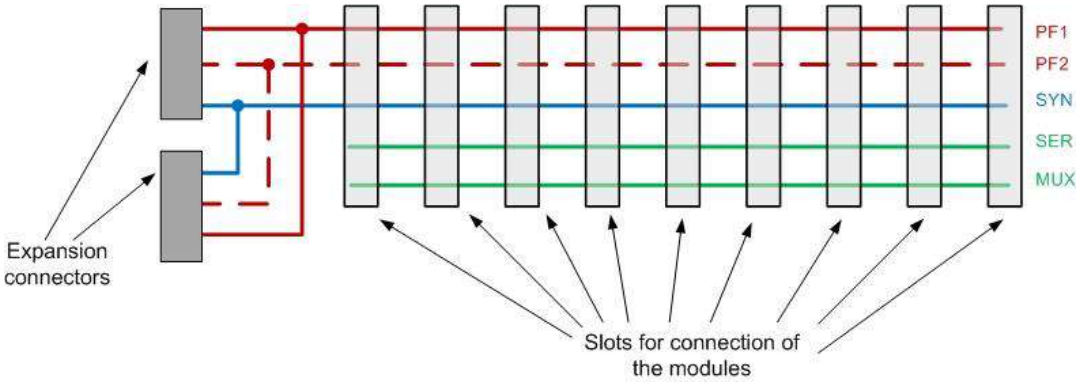
- **STANDBY**: Under this status, the CPU is operational, the defined software modules in AutoLoad.cfg (coreDb, synchronization, web server,...), the supervision module and ISaGRAF are executed. The other BinControllers are not executed. The CPU does not access to the acquisition bus, the SM_SER communication bus; the PPS is not generated and dbNET is disabled. Data related to the point status are received from the other CPU and updated in coreDb.
- **ONLINE**: Under this mode, the CPU is operational and all applications and protocol BinControllers are executing. The communication is activated through the acquisition bus and communication bus; the PPS is generated.
- **FAIL**: Under this status, the CPU is not operational.

NOTICE
Hot Data switching has several peculiarities. We recommend you to contact Saitel Support Service to analyses each particular case.

1.5.3 Acquisition Bus Redundancy

The backplanes in Saitel DP include four communication buses for module interconnection.

Figure 23 – Communication buses in the backplane



These four buses are:

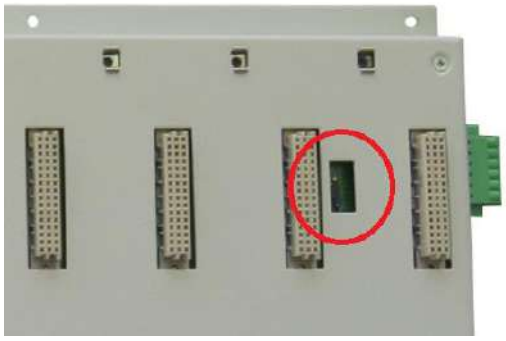
- Double Profibus-DP communication bus for the communication between I/O modules and control module (PF1 and PF2).
- Communication bus for synchronizing acquisition modules (SYN).
- High-speed communication bus for the communication between the control module and communication modules, SM_SER.
- High-speed communication bus for the communication between the two control modules installed at the same backplane (CPU).

The acquisition bus redundancy in Saitel DP is achieved by the Profibus DP (RS-485) double bus. This bus enable distributed acquisition architectures to be defined; it is highly flexible and robust and can cover distances of up to 1500 meters. The communication rate for these channels is selectable from 9.6 kbps and 1.5 Mbps.

Profibus redundancy is expandable to other backplanes since the channels: PF1, PF2 and SYN are outputs in the backplane through the expansion connectors.

NOTICE
The backplanes in Saitel DP family have a jumper (J2) which is required to configure the system with Profibus-DP redundant communications. If the jumper is installed, the Profibus-DP redundancy is enabled.

Figure 24 – Jumper for Redundancy



Profibus implementation for Saitel DP has the following features:

- There is only one serial controller for the two Profibus buses.
- Messages both from the master and the slaves are broadcasted through the two buses.
- Both the master and the slaves select the reception bus.
- The redundant bridge must be installed in the backplane in order to be able to select the listening bus. If uninstalled, the listening bus will always be the bus 1.
- When there is no response in the master (including the attempts), the system switches to the active listening bus.
- If communication is lost between a slave and the master through the two channels during more than 8 seconds, this event is detected and the adequate diagnostic led is lit.
- The buses are alternatively monitored every minute. Therefore, both fault detection and recovery may be delayed one minute.

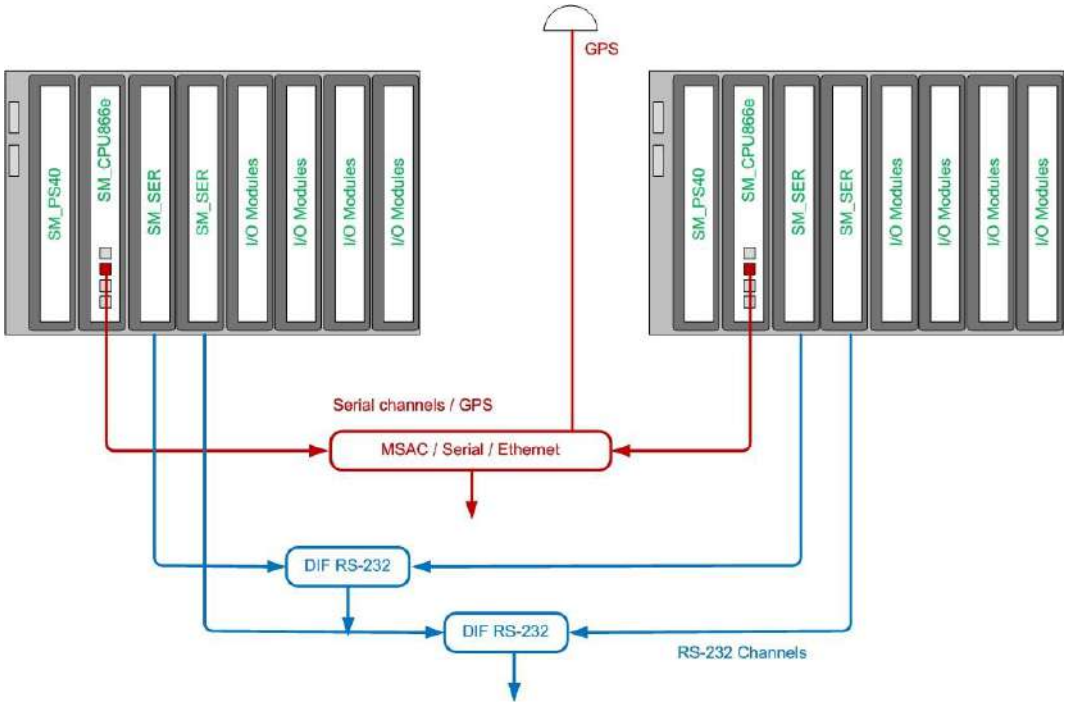
1.5.4 System's Duality

The system's duality is the last option in order to maximize the system's availability. Duplicity means that all system's elements are doubled. This is the typical configuration of data hubs and communication front-ends.

In terms of redundancy, there are two CPU in different backplanes with a specific number of communication modules associated. Both hot and cold switching, which is arbitrated by the MSAC module, are possible. Even though generally there is no acquisition, it is possible to have acquisition modules installed in the CPU's backplanes in this case.

Communication channels are multiplexed by using a logic device.

Figure 25 – Dual system



1.5.5 Recommendations

Following paragraphs provide information about the different types of existing redundancies and which is the most adequate redundancy for each case. Due to the wide range of redundancy possibilities available for Saitel 2000DP, these proposals are general and open, so it is possible that the least recommended options here are the most appropriate for a specific project

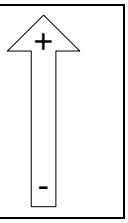
1.5.5.1 Power Supply

In non-redundant configurations, the use of an external power supply module is recommended as the most appropriate option for the backplanes. For the same reasons, it is the recommended option here.

In this case, two slots are not occupied; they can be used for communication or acquisition modules. Moreover, since the power supply source is different to the polarization source (if acquisition is available), one can be down without affecting the other.

The table below summarizes the options in order of preference:

Table 1 – Recommendation for redundant power supplies

Configuration	
Two external PS	
One SM_PS40 (primary) and one external PS (secondary)	
One external PS (primary) y one SM_PS40 (secondary)	
Two SM_PS40	

1.5.5.2 Control Unit

It should be noted that all options are not possible sometimes, especially due to location restrictions in the CPU modules, database specifications or other requirements.

This section does not cover the switching modes, since it is case-specific.

Regardless these aspects, the preferences both in terms of the control mechanism of the CPU modules and the exchange methods for the database are explained in detailed in further sections. The recommendations below take into consideration not only the reliability but also the communication rate provided by each option.

Table 2 – Recommendation for redundant CPU modules

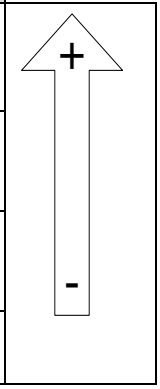
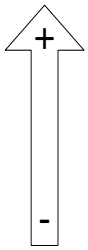
Configuration	Features	
Backplane	The dedicated communication channel integrated in the backplane for switching is very robust and accessible for the CPU modules only.	
Channel through a serial port.	A direct wiring between the configured serial ports should be used, preferably ports in the CPU module although the SM_SER module is also possible.	
Channel through a Ethernet port.	A crossed Ethernet cable must be used, since it allows longer distances than serial communication to be covered. In this case, a dedicated channel is not required but very recommended.	
MSAC	This option allows for a single synchronization source for the entire system.	

Table 3 – Communication options for “Hot Data” CPU modules

Configuration	Features	
Backplane	The dedicated communication channel integrated in the backplane to transmit the database values is the same as the channel for switching control.	
Channel through a Ethernet port.	It is less robust than the existing channel in the backplane, but it is the only method available to update the database of the stand-by CPU if it is installed in a different backplane. Whenever possible, it is recommended to have this channel in a dedicated network.	

1.5.5.3 Acquisition Bus (Profibus)

If the specific subsystem consists only on a backplane, a Profibus redundancy (that is, setting the enabling jumper or not) has no effect. Nevertheless, when communications with the acquisition must be established outside the backplane, then they must be more secured.

To do so, it is possible to take two channels from the same expansion connector or obtain each channel for a connector.

When distances are relatively long, copper wires should not be used, but optic fiber instead. In this case, the recommended converter is BP2F.

NOTICE
Cooper wired are generally recommended for the connection within a cabinet and optic fiber wires between different cabinets.

For the particular case of a system with redundant CPU modules in different backplanes, the status of Profibus communications in the STANDBY (inoperational) CPU can be monitored by the ONLINE CPU.

To do so, at least one acquisition module is required in the CPU backplanes. The ONLINE CPU will be able to access to those modules, and the status of the module’s diagnostic signals of the STANDBY CPU will be the status of the Profibus channel (or channels) of the STANDBY CPU.

Therefore, the status of the Profibus channel in the backplane of the STANDBY CPU will be provided by the acquisition module.

Following paragraph includes some example of Probifus expansion.

If the bottom CPU is the ONLINE CPU will be able to know that the upper CPU in STANDBY status has lost the Profibus channel when the I/O module does not respond.

1.6 RTU Expansion

The RTU can be expanded to other backplanes (including only I/O modules) according to the system requirements. All technical information about RTU expansion is included in chapter Physical Mounting & Installing.in this manual.

Each backplane must be connected to the following using only one or two DB9 connectors, depending on the system architecture.

NOTICE
It is important to consider that the synchronization bus (SYN) only can be expanded using one cable. You could expand it using the PF1 or PF2 cable, but only one of them. Otherwise the system could have problems with the synchronization in the acquisition backplanes.

Following figures show some example for single and redundant systems, using copper or fiber optic:

Figure 26 – Backplane expansion – A main backplane / A single expansion cable

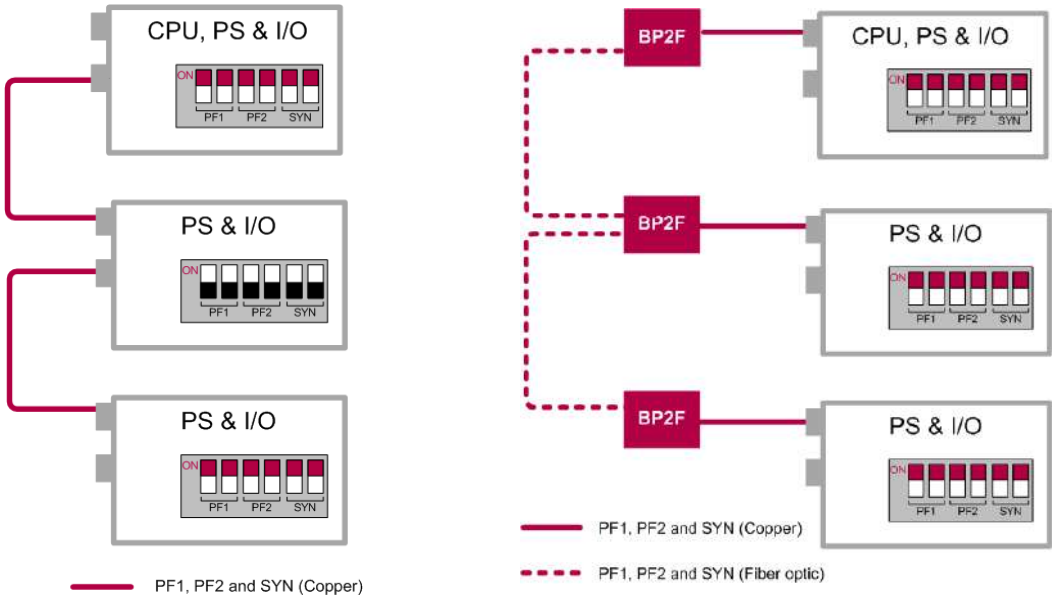


Figure 27 – Backplane expansion – A main backplane / A cable for each profibus

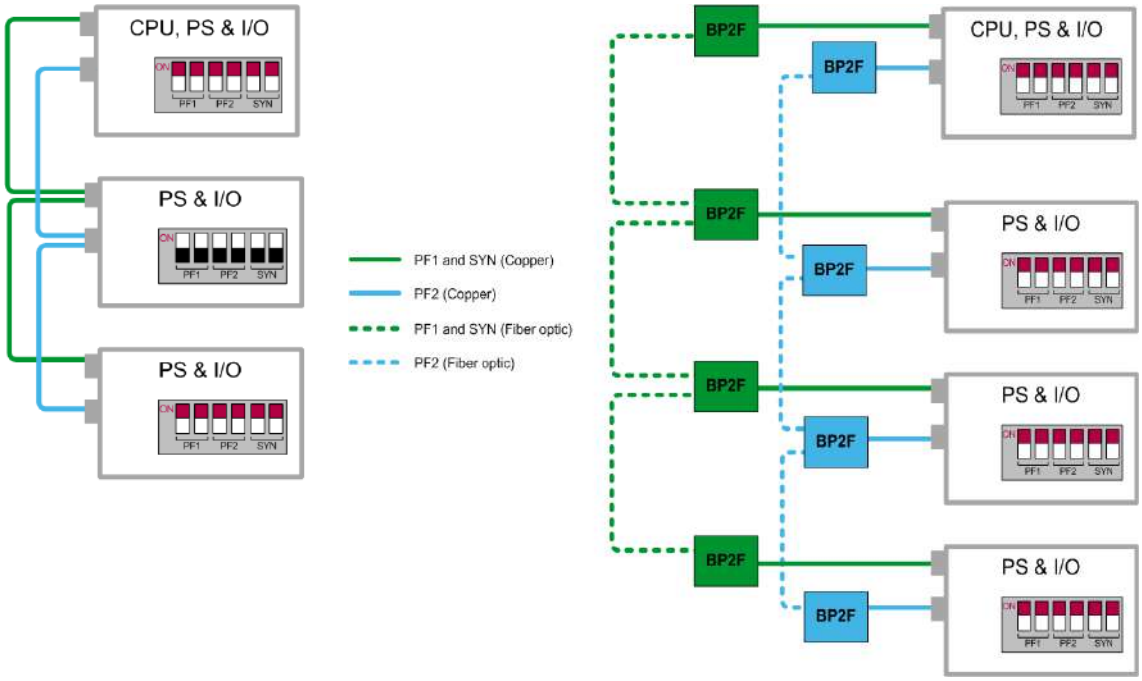


Figure 28 – Backplane expansion (using copper) – Redundant backplanes / Two expansion cables

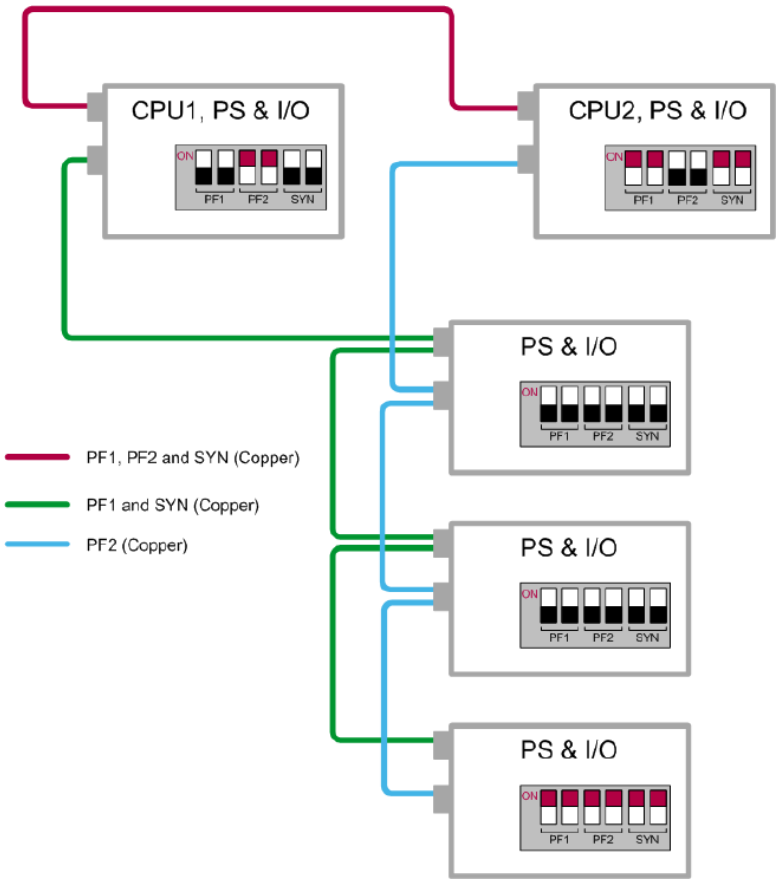
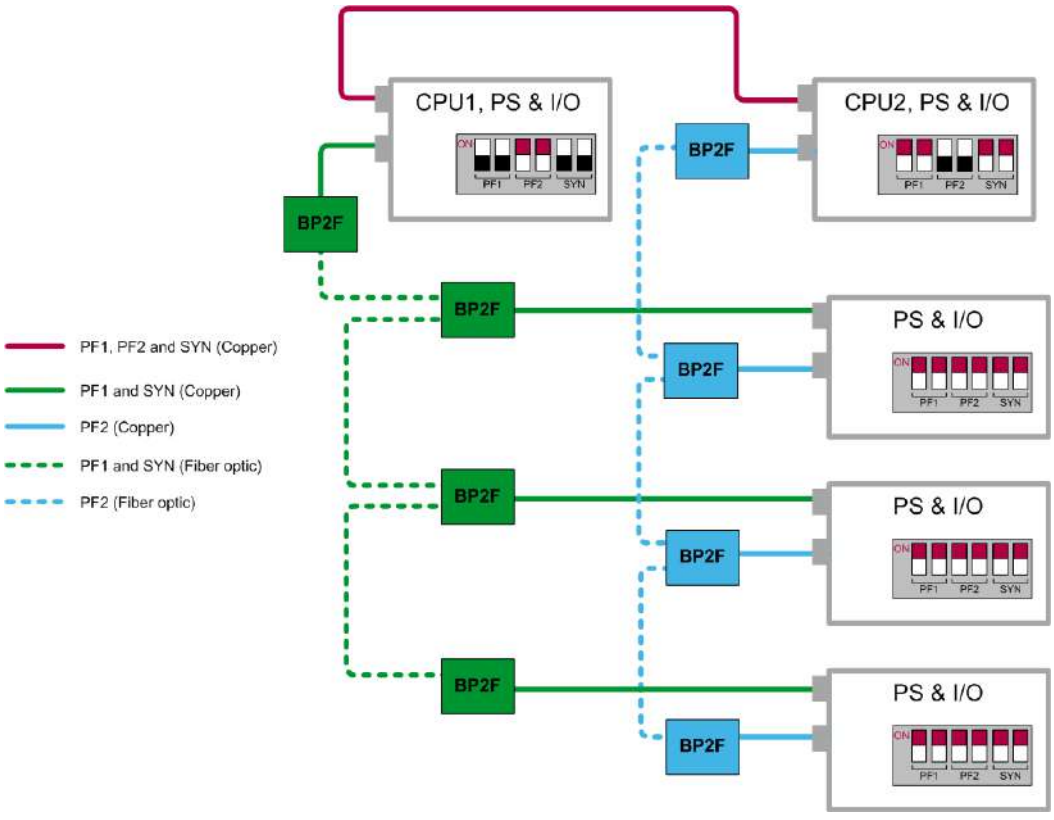


Figure 29 – Backplane expansion (using FO) – Redundant backplanes / Two expansion cables



2 Baseline Software in Saitel DP

Contents

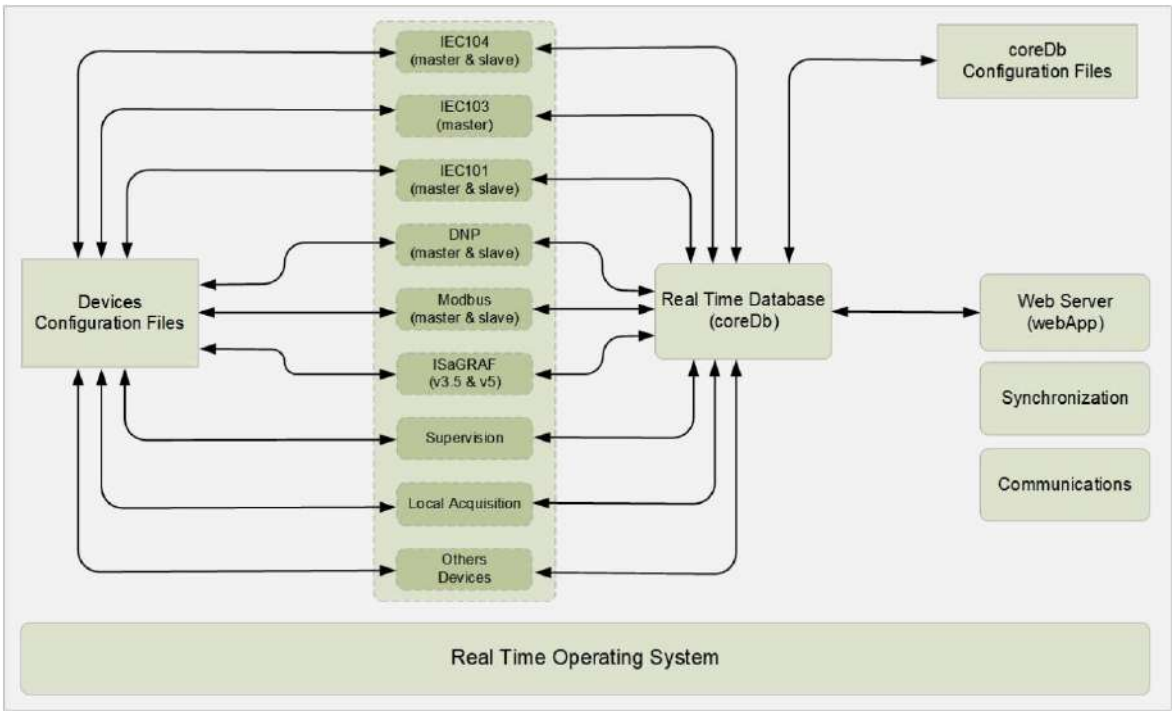
2.1 General Description

The Baseline Software Platform is used with Saitel products and other Schneider Electric products. It consists of:

- Real-time operating system (RTOS): Linux.
- Real-time applications and configuration files (XML format).
- Software tools: Configuration, local and remote maintenance, supervision and monitorization.

The following figure shows the different applications included in the software platform, as well as additional applications (**Devices**) implementing new Devices or protocols to upgrade Easergy Builder.

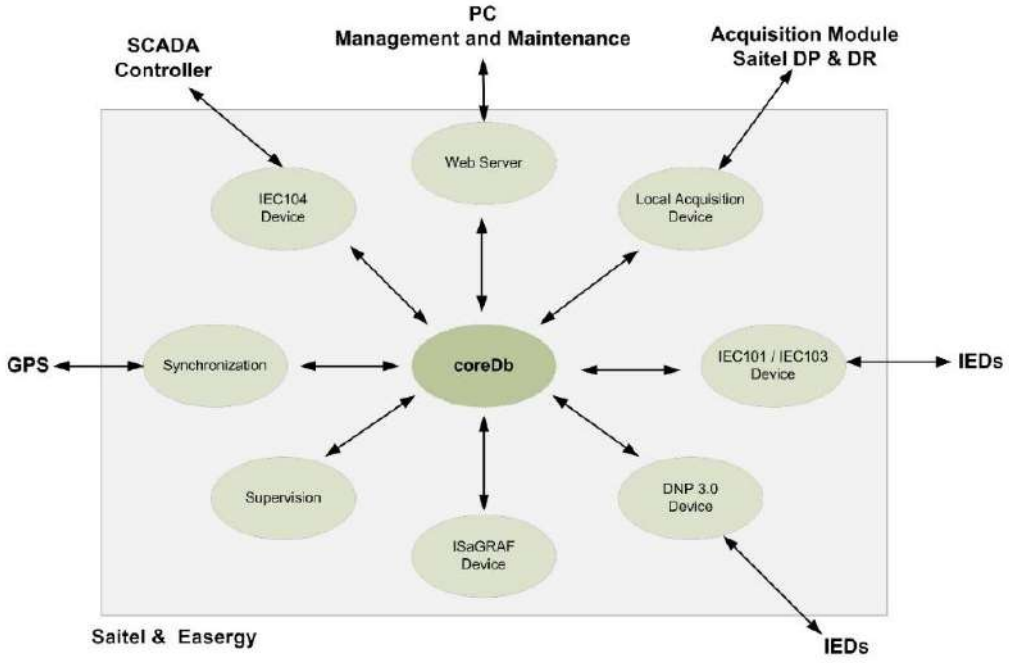
Figure 30 – Baseline Software Platform.



The operating system abstracts the hardware from the software applications and manages the applications in real time. It integrates the basic protocols to access the remote unit (SFTP, SSH, etc.) and manage multiple users.

The real-time database, named coreDb, is probably the most important element. All the other elements are developed around coreDb.

Figure 31 – Relation between coreDb and other applications.



The following concepts are related to coreDb:

- **Device Controller** (also referred to as Controller): Real-time application that accesses coreDb. Each Controller acts as a producer and/or consumer of information managed by coreDb.
- **Point**: Each register of coreDb is a point. A point can be included in the table Status, Analog, Command or Setpoint.
- **Device**: A set of I/O points that share a common source/destination. A typical example of a Device is an IED that communicates with the RTU, or the representation of a SCADA exchanging information acquired or generated by the RTU. A Device is always associated to a type of Controller.
- **Source**: Origin of the value of a coreDb data point. Any coreDb data point can have several different sources (in one or several Devices). This means that a value of a database point can be configured to be updated by several different entities.
- **Destination**: Target of the value of a coreDb data point. coreDb data points can be configured to have several different destinations (in one or several Devices).

NOTICE
It should be noted that any coreDb signal can be associated to more than one source; this is only applicable to Command and SetPoint tables. Allocating more than source to one point is **not recommended** in Status and Analog tables.

- **Coordinate**: Point identification within a Device. It is unique for each point and has a different structure for each Controller.
- **Configuration Plugin**: Specific Configuration plugins extend the Easergy Builder application to configure Device Controllers.

The user can modify the configuration of each Controller and Device using the appropriate Plugin. Once the database is completely configured, the files with the new information can be generated and transferred to the RTU, where they will be processed by the software on startup.

NOTICE
The information exchange, that is, the exchange of configuration data between the RTU and Easergy Builder is not continuous, but performed through XML files under user's request. **When the configuration is modified in Easergy Builder and the XML files are sent to the RTU, it is necessary to reboot the RTU**.

2.2 Main Elements

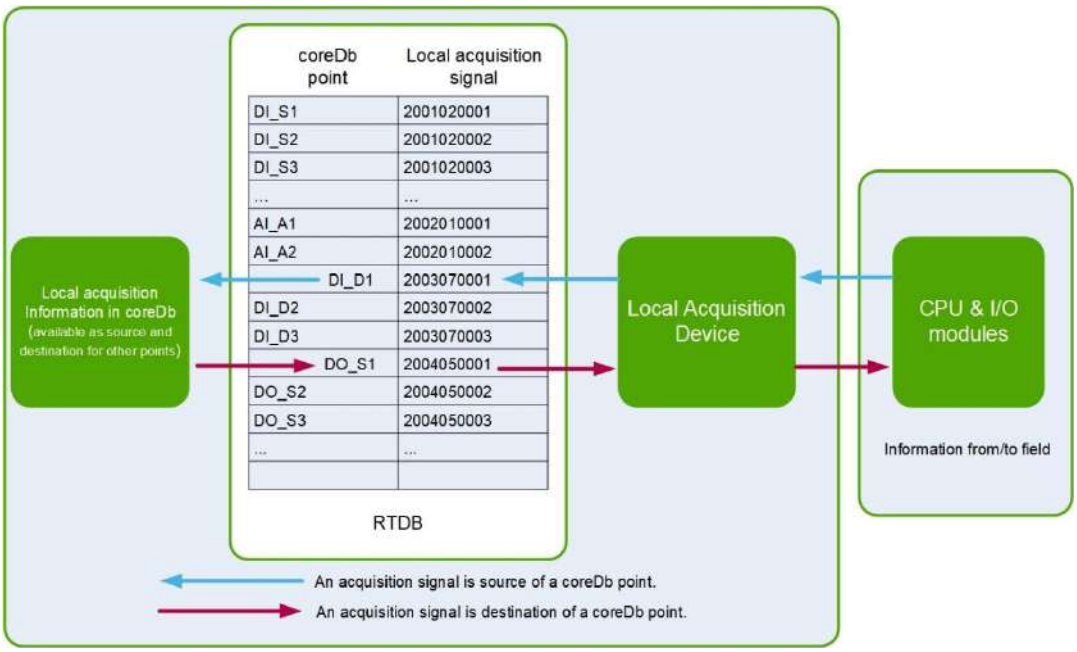
For the user, the Baseline Software Platform has the following main elements:

2.2.1 coreDb – Real Time DataBase (RTDB)

coreDb is the real-time database which stores not only the information acquired from field devices, but also the information about the CPU and I/O modules status that are part of the RTU. coreDb also relates the acquisition signals to the communication protocol signals. This database is generated in the CPU by using the configuration information.

The information which is received from field in real time is processed, stored in the RTDB and then related to the communication protocols signals of the RTU, which function is to transfer that information to the master device.

Figure 32 – Interfaces with coreDb.



CoreDb points are organized in four tables: Status, Analog, SetPoint and Command to group the different types of points. These internal tables present the following differences:

- Depending on the **point type**: status, and command tables support integer values, whereas setpoint and analog tables manage floating values.
- Depending on the **treatment of the point**: Status and Analog points can be locked or reset to initial values, whereas the other two signal types cannot. All types can retain the value in a non-volatile memory.

2.2.2 Devices

Each type of device keeps a list of its associated points, identified by unique labels. These labels allow the identification of each device point unequivocally as source or destination of a coreDb data point.

Each point is a piece of information produced (or consumed) by a Device. Within a single Device, point identifiers (coordinates) are unique and cannot be used by two different points.

2.2.3 User Interfaces

The user can use the following tools in order to access to the RTU information:

- **Easergy Builder**: configuration tool for Schneider Electric RTUs that uses the Baseline Software Platform. It has to be installed in a PC, and among other features, it can be used to perform: offline configuration of the general settings of an RTU (IP address, user administration, communication channels and so on), design and maintenance of coreDb, administration of the synchronization mechanisms, configuration of the supervision and monitoring features.
- **Console**: advanced diagnostic (for expert users only, local or remote connection). It is possible to connect the PC through the serial cable to the CON port or using an Ethernet cable to an ETH port and SSH.
- **webApp**: is the local and remote user interface for online monitoring, operating and maintaining the CPU.
- **webUI**: Web tool simuling a small SCADA. (Only available for SM_CPU866e).

2.2.4 Cybersecurity

The module SM_CPU866e is provided with a standard security policy and a default RBAC (Role-Based Access Control) model), allowing different levels of user access adapted to this CPU usage compliant with standard IEC 62351-8. This model is defined and managed by a special tool - CAE. Based in this model, authorized users can create and manage other users in the system. Also, the CPU includes a firewall.

2.3 Software Tools

A basic configuration is included with CPU, which should be adapted to the requirement of the system. Depending on the CPU and the baseline installed on it, following software tools will be available for configuration or maintenance:

- **Easergy Builder**: Engineering tool for the RTU OFFLINE configuration. It allows to include and adapt the different functions of the RTU to the system where it is being integrated. It is a software tool that needs to be installed on a PC.
- **CAE**: Only available for SM_CPU866e with baseline 11.06.00 and later. Engineering tool for defining the security policy and assigning roles to users. It allows defining a series of rights and responsibilities in the system for authorized users. It defines WHO, WHAT, WHEN and HOW can the user do it, according to the RBAC model. It is a software tool that needs to be installed on a PC.
- **webApp**: Web tool for online maintenance and monitoring of the RTU with SM_CPU866e as CPU. Using the configuration defined in Easergy Builder and loaded in the CPU, the user can consult and/or change some parameters through the WEB server. Unlike Easergy Builder, webApp does NOT allow adding new features. Only the parameters included in the configuration can be changed.

- **SFTP**: Manual exchange of configuration files (for expert users only).
- **Console**: This tool should only be used by advanced users with a wide knowledge of the system. The connection can be made through a serial channel (PC's COMx port) or using SSH through an Ethernet port. The console is a commands tool, which the user could execute or not depending on the level of privileges assigned to him
- **ISaGRAF** (version 3 and 5): Third party software for design, configuration, debugging and optimization of the embedded logic programs.
- **webUI:** Only available for SM_CPU866e. It has two different environments:
    - **webUI (Real Time):** It allows to monitor graphically the information included in the different screens designed by the user through the editor included in Easergy Builder (webUI Add-on).
    - **webUI Editor:** (webUI Add-on): Editor included in Easergy Builder for creating and editing webUI screens. It allows to design new screens for the configuration loaded into the RTU or also modify the information displayed in those already available.

2.4 Software Compatibility

Following table shows devices and tools available for SM_CPU866e:

Table 2 – Software compatibility

Software Function	SM_CPU866e
DNP Master Protocol	√
DNP Slave Protocol	√
Easergy Builder	√
Formula	√
IEC101 Master Protocol	√
IEC101 Slave Protocol	√
IEC103 Master Protocol	√
IEC104 Master Protocol	√
IEC104 Slave Protocol	√
IEC6180 Server Ed 1	×
IEC6180 Client Ed 1	×
IEC6180 Server Ed 2	√
IEC6180 Client Ed 2	√
TSV Devices	√
ISaGRAF	√
ISaGRAF5	√
MICOM Master Protocol	√
Modbus Master Protocol	√
Modbus Slave Protocol	√
Operating System	Linux
Saitel DP local acquisition (laq)	√

Software Function	SM_CPU866e
Sepam Protocol	√
Sequence of events (SOE)	√
Synchronization (thm)	√
Supervision	√
webApp	√
webUI	√
webTool	×

2.5 Local Acquisition

Local acquisition is understood as the handling carried out by the system of the information arriving to the CPU from field devices either through available integrated local acquisition in the CPU itself or through external I/O modules.

This manual describes the configuration of the local acquisition signals in general terms, with no comprehensive information about the configuration of each I/ module. This chapter explains how information is processed by the CPU once it is received from each module.

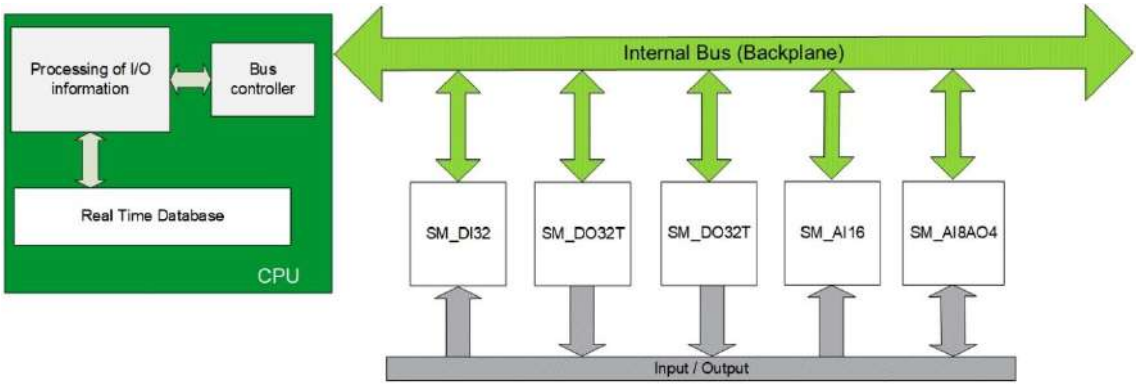
For more detailed information about each I/O module, please refer section 4.6 and the corresponding user manual.

2.6 Treatment of Local Acquisition Signals

2.6.1 Introduction

The input/output information processing is performed between the I/O modules and the CPU, which will be in charge of the data exchange with the real-time data base by means of the internal data bus. The information processing consists of treating and adapting the inputs and a conditioning of the field outputs.

Figure 33 – Data processing in the CPU



All the signals stored in the real-time database are associated to quality information. This information is generated by the status controller block, which uses the following information to generate the quality flag:

- Diagnostic information, which is transmitted to the head unit by the I/O module.

- Diagnostic information and internal bus status.
- Information generated by other processing blocks in the same CPU.

The status of each signal and its associated quality bits can be viewed from Saitel Webtool, as described in the user manual of this tool.

The following sections explain the types of data that Saitel DP can manage through the acquisition block. These sections also describe the information processing procedure and the quality associated to the stored data.

2.6.2 Digital Inputs

Saitel DP manages digital inputs with or without timestamp. In both cases, the values are 0 and 1. The I/O module transmits the signal's value to the CPU whenever it changes; it also attaches a timestamp if using this type of signals.

The quality values associated to the signal's values are:

- Invalid value due to a polarization failure.
- Locked signal.
- Invalid time; the module is not synchronized (only for signals with timestamp).

The types of points managed by RTDB and that are defined in function of these digital inputs are:

- Single digital.
- Double digital.
- Slow counter.

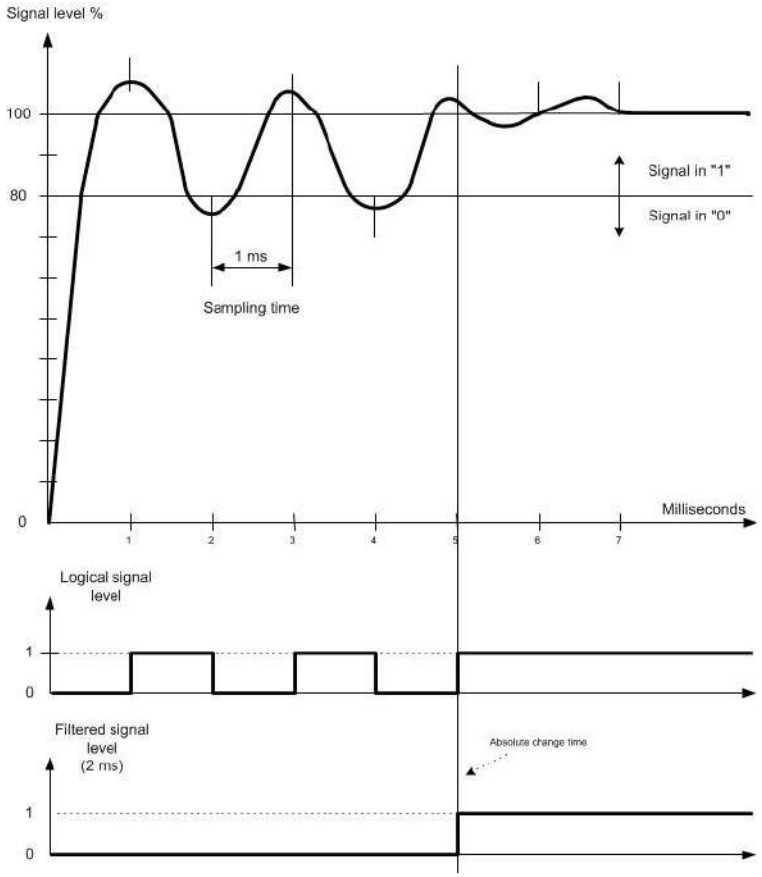
The digital inputs processing received from the field devices includes the functions explained below. Each processing will be applied or not depending on the type of point generated.

Digital Filtering

Digital filtering allows eliminating the changes made to the inputs if these changes are not retained for a minimum amount of time "**Filtering Time**" or **TF**.

The filtering response from a digital input is shown in the following figures.

Figure 34 – Digital filtering



This functionality is applicable to all the points generated from digital signals, being single, double or slow counters.

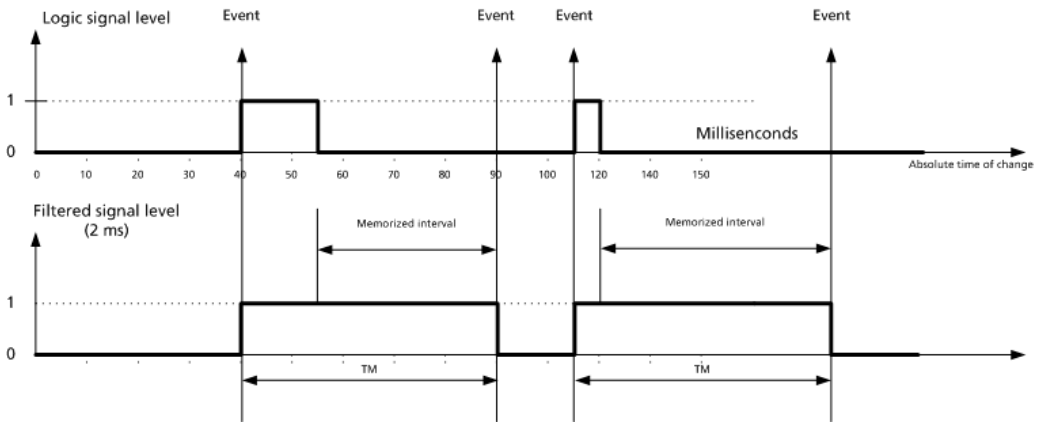
The memory time can range between 0 and 255 ms.

Change Memory

The change memory can store the changes detected in the inputs for a specified period of time "**Memory Time**" or **TM**. It only applies to single and double points. It doesn't apply in counter signals. If the TM parameter is set to 0, this function is disabled

The change memory response for a digital input is represented in the following figures.

Figure 35 – Change memory



The memory time can range between 0 and 2559 ms.

Inversion

It only applies to single and double points. It doesn't apply in counter signals. By using this mechanism, the input can be configured as enabled when the value is "1" or disabled when the value is "0".

Edge Configuration for Counters

It applies only for signals defined as slow counters (DI_CNT). It allows configuring each slow counter as single (DblCnt = "N") or double (DblCnt = "Y") counter. In the first case the counter is incremented when a rising edge is detected in the input. However, the double counters are incremented when both rising and falling edges are detected.

2.6.3 Digital Outputs

All Saitel DP output signals are direct, that is, each output signal is triggered by a direct command. Each signal can be single or double, and it can be configured as latched or with an associated pulse time.

NOTICE
Please note that when a point is defined as double in the coreDb, the two field signals to be wired must be contiguous and on the same acquisition block. **IMPORTANT:** When the RTU is operating under "Local" mode, all commands received on the digital outputs are rejected. This is not applicable for analog outputs.

A single command is used to run the command:

- Running command → Activated output.
- Completed command → Deactivated output.

For a double command, two outputs are used to run the command:

- Deactivation command → Output 1 "ON", Output 2 "OFF".
- Activation command → Output 1 "OFF", Output 2 "ON".
- Two outputs can never be activated simultaneously.

The digital outputs processing includes the following functions:

Pulse Time

The pulse time is only applicable when the point is defined as pulsing; it specifies the output duration. It can be configured through the system's parameter called Execution Time or ExeTime, which indicates the time in millisecond units, although with an accuracy of 100 ms. Its value is selectable from 0 to 65535, but it shoudn't be configured below 10 ms.

2.6.4 Analog Inputs

Saitel DP allows managing analog input signals related to voltage and current. These analog inputs have a quality bit associated which indicates whether the value is invalid due to a power supply failure.

Previously to store the information into the corresponding point in the coreDb, the system performs the following processing only for the first two types of signals:

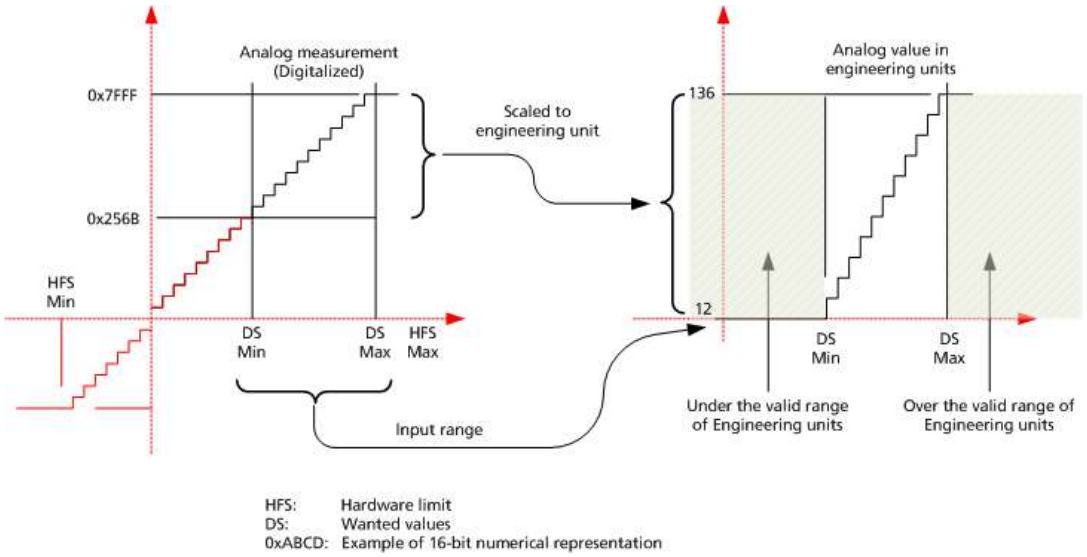
Input Range

It is possible to define in coreDb the input range for each analog signal received from an I/O module. It even allows defining a different range for each signal.

The processing of the received analog measurement includes the value conversion to the range defined in the coreDb.

The figure below shows the range conversion:

Figure 31 – Converting input range to engineering units.



NOTICE
The analog input processing distinguishes between unipolar and bipolar input ranges.

Out-of-Range Detection

If the system detects that the value is higher or lower than the valid range, after the conversion to engineering units (grayed area in previous figure), it will be indicated in the signal quality flag with the corresponding bit activation,

Scaling to Engineering Units

This functional block can convert the analog measurement value expressed in field units to engineering units (UI). The user defines the relation between two points within the field values range and their corresponding values in the engineering units scale. Based on this relation, the system defines the scaling formula which will be used to convert any field value within its valid range to engineering units.

Range Checking

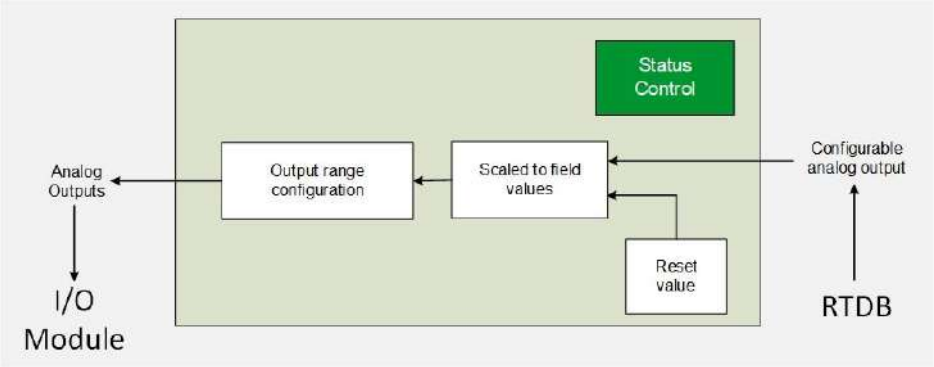
The user can define four alarm values associated to each signal: Very low, low, high, and very high. Each value has an alarm flag associated which is transmitted as an input to the “status controller” block.

2.6.5 Analog Outputs

NOTICE
The RTU operation in “Local” mode does not affect the execution of analog outputs; only commands (digital outputs) are discarded.

The processing of analog outputs consists of the following steps:

Figure 31 – Processing analog outputs.



Reset Value

The user must define the output reset value, that is, the output initial value after resetting the acquisition block.

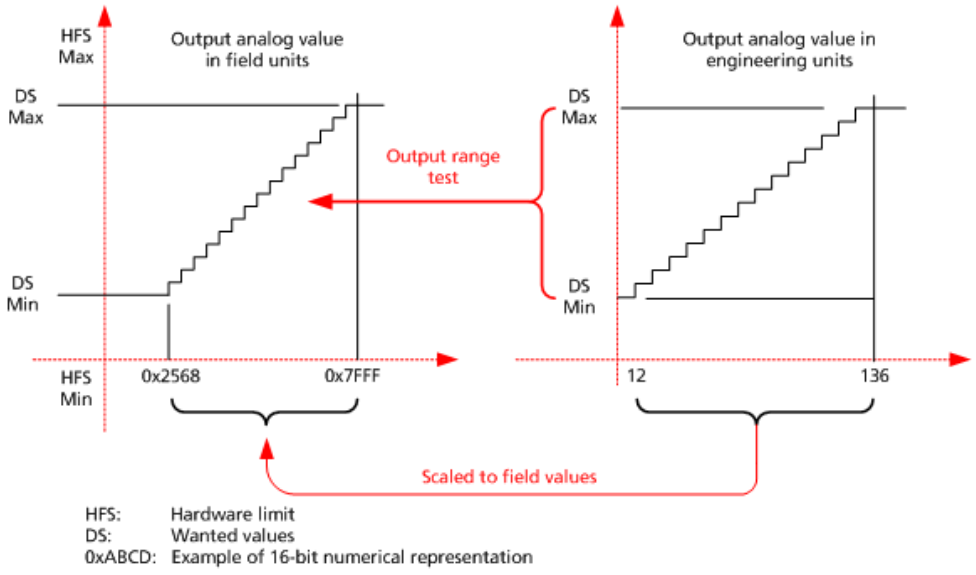
Keep

If the analog module is not in RUN status (LED Run is off) and maintenance is configured, the analog output will retain the last value written to it, or the reset value otherwise.

Scaling to Field Values

This module performs the opposite process than the “Scaling to Engineering Units” in analog input processing, that is, it converts the output value expressed in engineering units to its corresponding field units.

Figure 31 – Scaling to field values.



The configuration of this scaling is the same as described for the processing of analog inputs in paragraph “Scaling to Engineering Units”.

Output range configuration

The user can define the output range for each analog output using Easergy Builder. If the hardware supports multirange, it should be configured with a range as close as possible to the user-defined range. In any case, the user can define a value range different to the hardware range for each analog signal.

3 Physical Mounting & Installing

Contents

3.1 RTU Installation

3.1.1 Handling Modules

While all electronic components are installed into their enclosure, they are protected for relevant levels of electrostatic discharge.

⚠ WARNING
The enclosure shouldn't be retired when isn't necessary, because this action has a risk for the equipment.

Please follow all recommendations indicated in paragraph 0

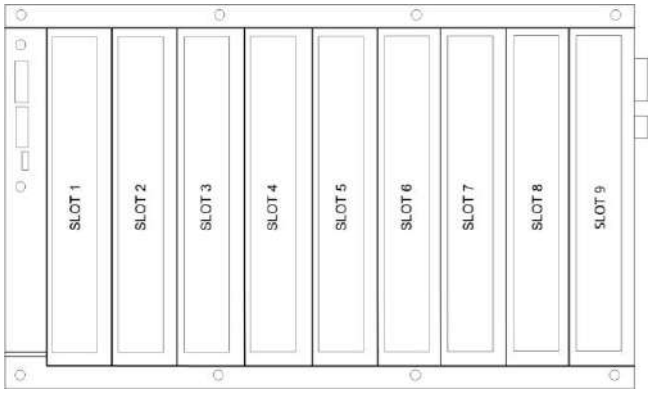
3.1.2 Modules Location within the Backplane or Chassis

All modules must be installed always in vertical position.

When using a power supply such as the SM_PS40 module, it must be located in the position 1 (slot1 left-hand side). In redundant-power supply configurations, there must be two reserved positions for the two power supply modules. These positions must be 1 and 2.

Remaining modules can be located in any position (slot) within the chassis.

Figure 36 – Backplane`s positions.



Modules must be grouped to minimize the adverse effects caused by noise and heat, therefore, modules, and more specifically the **CPU modules**, must be placed as far as possible from the modules which operate at alternating currents or high currents.

If the system has redundant CPUs, both control modules must be put together in the backplane.

CPUs and SM_SER modules, only can be installed in the first backplane when the RTU is expanded to others backplans.

⚠ WARNING
When installing a SM_CPU866e module with fiber optic, we have to make sure that there is enough space between the front of the module and the cabinet door when it is closed, because the fiber optics can be pinching with the risk of breakage. In addition, have in account that the module's flap door must remain opened.

3.1.3 Mount and Dismount Procedures

Saitel DP modules can be installed in a 19-inch chassis (SM_CHX) or a backplane (SM_BPX).

When SM_BPX module is used, some problems with the installation of the modules are detected. On the other hand, there are some configurations working correctly but the modules haven´t been mounted correctly. This situation produces a mechanical instability and might cause serious problems.

Following picture shows three modules inserted on the backplane. One of them has been inserted incorrectly in spite of it is functional totally.

Figure 37 - Saitel DP module inserted incorrectly

Consult application note FTE-AN010-F700 for more information about:

- How the user should mount a Saitel DP module on a panel-mounted backplane.
- How the user should verify the installation.
- Actions that the user should do when an incorrect mounting is detected.

To mount the module in the chassis or backplane, please follow the following instructions:

- Switch off the power supply.
- Mount the module at the desired position, and if you are using a backplane mounting, verify that the rear rails are properly mounted using the pre-drilled holes on the backplane.
- Firmly press the module to assure the connector fits in the connector properly. Check whether the module is correctly mounted to the backplane base.
- Fix the module using the screw located at the top.
- Insert the terminal (mounting option A1) or flat ribbon (mounting option A2) connectors.

3.2 Backplane Modules

All Saitel DP modules (power supply, CPU, communications, I/O acquisition) are installed into a backplane. These backplanes work as an electromechanical device which provides the following functions:

- Mechanical function. Allow insertion and removal of the modules into the system and its physical support. The backplane provides the mechanical integration in the location or enclosure that it is located.
- Electrical function. It allows the distribution of:
    - The power supply to the modules need.
    - The internal bus for the modules installed in the backplane.
- Expansion. Allow electrical connection (at data level) between different backplanes to increase the number of modules integrated into the system.

From revision D0 and later, the backplane allows the following functions:

- Supervision: Monitoring and control of the power supply to the modules and signaling Profibus communication lines between modules.
- Protection: Protection against permanent damages for overload from external power supplies.

Each Saitel DP subsystem is made up by:

- A main "backplane" where the CPU is installed. If you have redundant CPUs, both modules could be installed into the same backplane or you could install each CPU into a different backplane.
- Depending on the needs, the system will have one or more acquisition backplanes.

A main backplane and as many expansion backplanes as required.

The main backplane supports one or two control units, acquisition modules, and SM_SER communication modules, if necessary.

Acquisition backplanes are used when the available positions in the main backplane are occupied, or when implementing a distributed system of I/O modules. These secondary backplanes do not include any control units or communication modules.

There are two basic backplane models. The only difference between the two models is the mechanical solution used.

Figure 38 – Panel mounted solution

Figure 39 – Chassis solution

Both models are based on the same board called ST_BPX4S or ST_BPX9S depending on the ordering options (number of slots).

NOTICE
Revisions previous to D0 of SM_CHX and SM_BPX mount the board ST_CHBPx. This board could not have some functionality detailed below.

Both backplane models have the same electrical features:

- 4 or 9 slots to connect the Saitel DP modules.
- High-speed internal bus for the communication between the CPU and the communication modules SM_SER.
- High-speed internal bus for the communication between the CPU modules (in redundant CPU configurations).
- High-speed internal bus (Profibus) for the communication between the acquisition modules and the CPU.

- Profibus (TTL) - Profibus (RS-485) conversion for backplane interconnection. See Figure 2 6.
- Double power-supply bus (redundant). Both can be used in two way (mutually exclusive):
    - Using Saitel DP power supplies (SM_PS or SM_PS40), in simple or redundant configuration.
    - Using external power supplies, in simple or redundant configuration.

⚠ WARNING
Don't use the modules SM_PS40 or SM_PS together with external power sources. Doing so may cause permanent damage to the equipment.

3.2.1 SM_BPXx Model

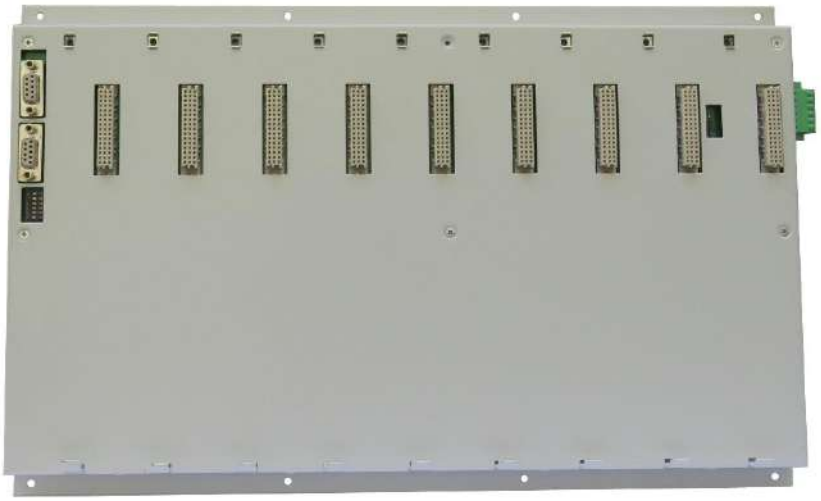
In this model, the electronic board is installed in a metal enclosure where the electronic is hidden. Only the necessary elements for the configuration are accessible. There are two models:

- SM_BPX4, with 4 slots.
- SM_BPX9 with 9 slots.

The difference is the number of modules that it can mount. The other features are identical.

The following figure shows an example of this type of backplane:

Figure 40 – SM_BPX9 – Front view.



3.2.1.1 Mechanical Features

The modules can be mounted in a panel or flat wall made of any material capable of supporting the total weight of the assembly. The module's weight and connection cables must be taken into account.

If several backplanes need to be mounted in a column structure, you must leave a minimum space (57 mm) between the lower and upper fixing flanges of the backplanes. Never cover the modules' ventilation grilles with feed-through, cable trays or any other assembly elements.

The necessary space around the backplane must be respected in order to allow assembly and disassembly of the modules.

Figure 41 – Necessary space for assembly and disassembly the modules.

The SM_BPX module has two fixing flanges located at the upper and lower parts respectively. There are several drill holes of 4 mm in diameter for wall or panel fixing. The number and location of the drill holes depending on the model, 6 in the SM_BPX4 and 8 in the SM_BPX9.

Figure 42 – SM_BPX4 - Drill-hole arrangement.

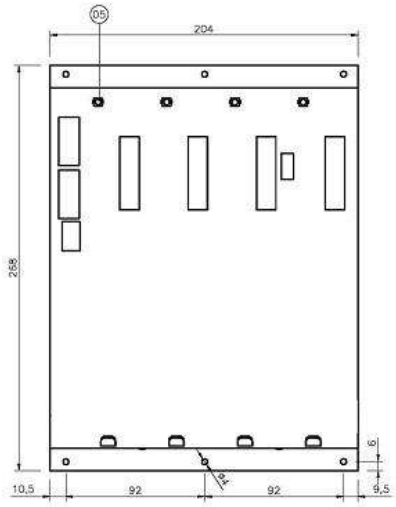
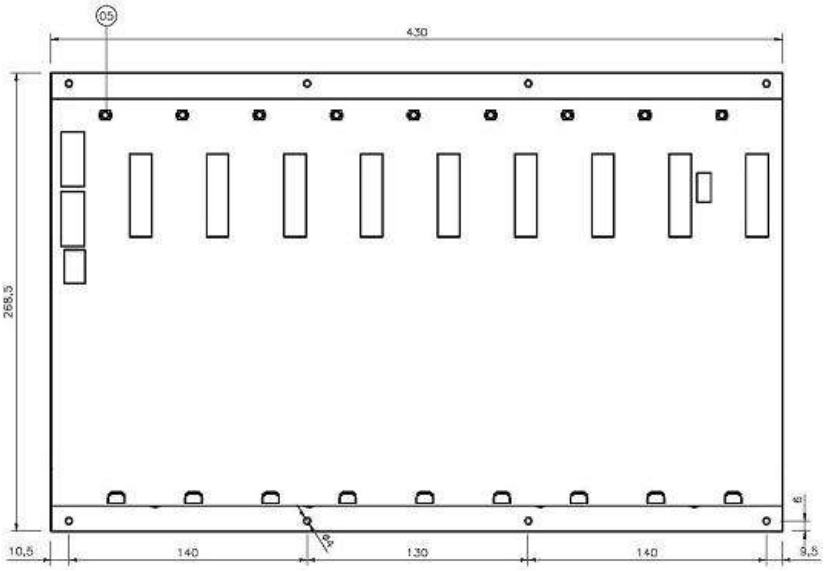
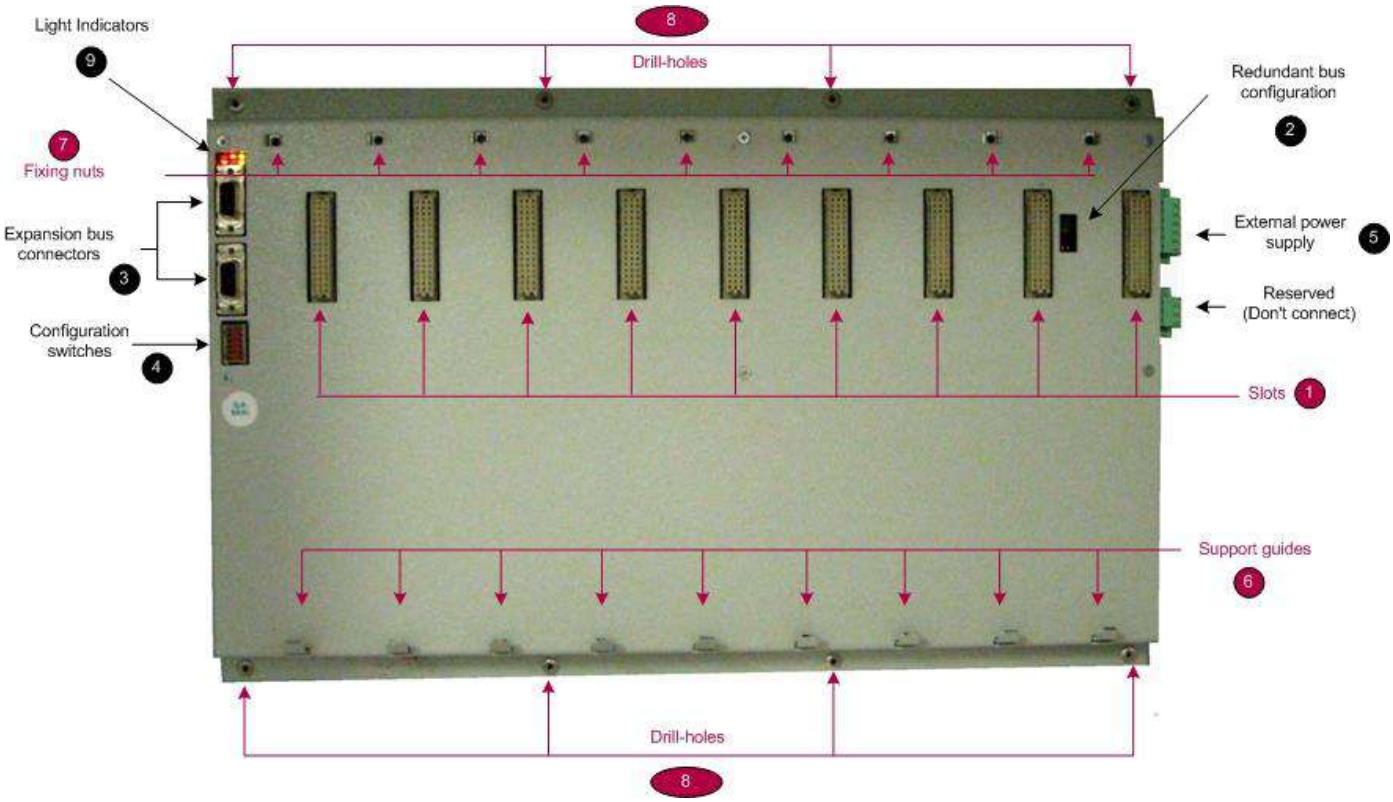


Figure 43 – SM_BPX9 - Drill-hole arrangement.



The dimension values are given in millimetres . All connectors are located in the front and right side of the module.

Figure 44 – SM_BPX9 – Front view.



- **1**: Connectors (slots) for the Saitel DP modules. The female connectors are installed on the backplane and on the rear panel for each module the male connector is installed.
- **2**: Jumper to configure redundant communication systems. If the jumper is mounted, it enables redundant Profibus-DP.
- **3**: Two connectors in order to expand the internal bus to other backplanes. See paragraph 3.4 .
- **4**: Configuration switches for the expansion of the internal bus.
- **5**: External power supply connector. It allows connecting up to two different power supplies: primary and secondary.
- **6**: Guides for supporting Saitel DP modules when they are mounted on the backplane.
- **7**: Fixing nuts that allow screwing the module and securing it to the metal enclosure.
- **8**: Drill-holes to fix the backplane to the bottom panel.
- **9**: Lighted indicators (Only for revision D0 and later of SM_BPX and SM_CHX)

3.2.1.2 Technical Specifications

Table 3 – SM_BPXx Technical specifications

SM_BPXx			
Mechanical features	Slots	SM_BPX4	4
		SM_BPX9	9
	Dimensions	SM_BPX4	268 x 204 x 25.5 mm
		SM_BPX9	268.5 x 430 x 25.5 mm
	Weight	SM_BPX4	1.25 kg.
		SM_BPX9	3.35 kg.
Consumption	100 mW		
Connectors	Saitel DP module		48-contact DIN 41612 connectors
	External power supply		6-way screw terminal (1.5 mm² / 15 AWG)
	VSENSE		3-way screw terminal (1.5 mm² / 15 AWG)
	Profibus expansion		2 female DB9 connectors
Voltage levels	Operating nominal voltage		5.4 ±0.2 V_{DC}
	Startup nominal voltage		> 5.3 V_{DC}
	Maximum current (for each power supply bus)		7 A
	Maximum consumption (for the entire backplane)		38 W
	Overcharge voltage (without risk for the electronic)		< 24 V_{DC}
	Overcharge voltage (with damages)		> 30 V_{DC}
	Safety power-off (overvoltage)		> 5.9 V_{DC}
	Safety power-off (undervoltage)		< 4.9 V_{DC}

3.2.2 SM_CHX Model

The SM_CHX model uses the same electronic board that SM_BPX, but it is mounted using a standard 19''-chassis. There are two models:

- SM_CHX4, with 4 slots.
- SM_CHX9 with 9 slots.

3.2.2.1 Mechanical Features

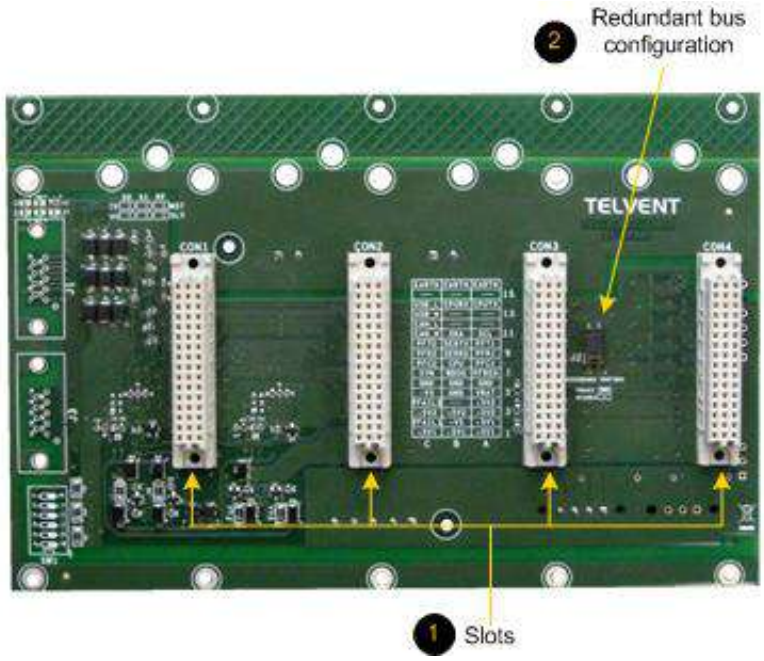
Both, SM_CHX9 and SM_CHX4 backplane modules are designed to be fixed on a metallic panel 19'' wide, 6 U high and 180 mm deep. This chassis provides the mechanic support to fix all the modules. The SM_CHX4 has a format that allows to mount two boards in the same chassis (one next to the other). This option is the most suitable in solutions which give access to the rear part of the electronic components.

For SM_CHX, the power connector, bus expansion connectors and configuration switches are located on the back side of the card to be accessible from the back of the chassis.

The necessary space around the backplane must be respected in order to allow assembly and disassembly of the modules.

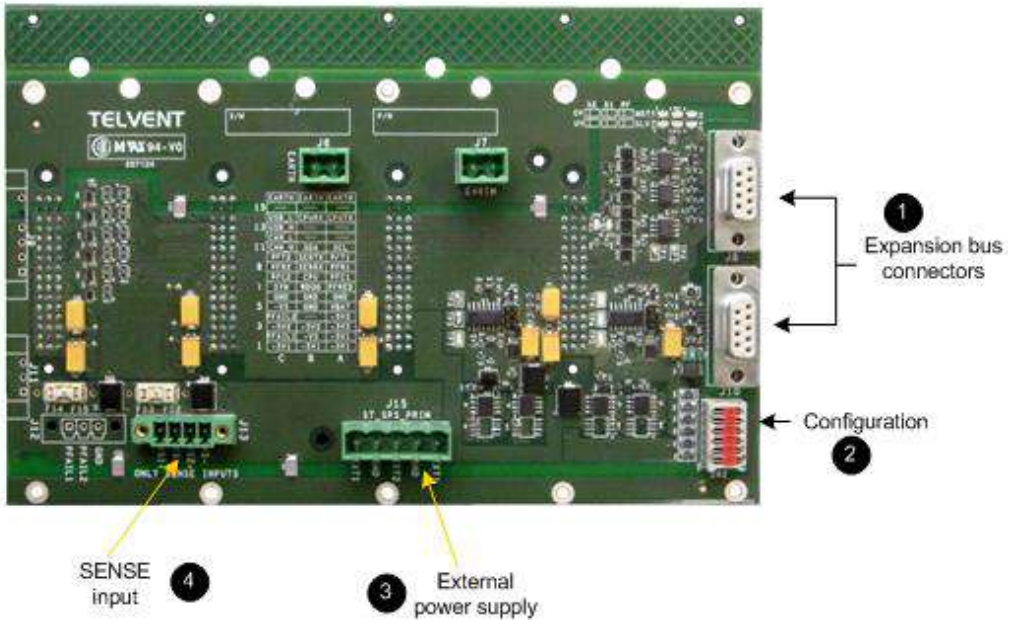
It is necessary to distinguish between the component side or front and soldering side or rear, as it has connectors on both sides.

Figure 45 – SM_CHX4 – Front view



- **1**: Connectors (slots) for the Saitel DP modules. The female connectors are installed on the backplane and on the rear panel for each module the male connector is installed.
- **2**: Jumper to configure redundant communication systems. If the jumper is mounted, it enables redundant Profibus-DP.

Figure 46 – SM_CHX4 – Front view



- **1**: Two connectors in order to expand the internal bus to other backplanes. See paragraph 3.4
- **2**: Configuration switches for the expansion of the internal bus.

- **3**: External power supply connector. It allows connecting up to two different power supplies: primary and secondary.
- For the module with 9 slots, there are two power connectors, which allows to keep the power when it is necessary to disconnect one power supply.
- **4**: SENSE input. It is available in case the system requires to connect a “SENSE input” from an external power supply.

3.2.2.2 Technical Specifications

Table 4 – SM_CHXx Technical specifications

SM_CHXx			
Mechanical features	Slots	SM_CHX4	8 (4 + 4)
		SM_CHX9	9
	Dimensions	19-inch rack	
Consumption	100 mW		
Connectors	Saitel DP module		48-contact DIN 41612 connectors
	External power supply		6-way screw terminal (1.5 mm² / 15 AWG)
	VSENSE		3-way screw terminal (1.5 mm² / 15 AWG)
	Profibus expansion		2 female DB9 connectors
Voltage levels	Operating nominal voltage		5.4 ±0.2 V_{DC}
	Startup nominal voltage		> 5.3 V_{DC}
	Maximum current (for each power supply bus)		7 A
	Maximum consumption (for the entire backplane)		38 W
	Overcharge voltage (without risk for the electronic)		< 24 V_{DC}
	Overcharge voltage (with damages)		> 30 V_{DC}
	Safety power-off (overvoltage)		> 5.9 V_{DC}
	Safety power-off (undervoltage)		< 4.9 V_{DC}

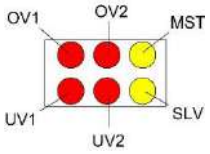
3.2.3 Supervision

NOTICE
Supervision is only available for revision D0 and later of the modules SM_BPX and SM_CHX.

By the light indicators above the expansion connectors (see Figure 44) the user can monitor the activity of the Profibus communications and the status of the power.

Each led is identified as follow:

Figure 47 – Supervision leds on the backplane



Where:

- MST: Supervision of the transmission from CPU.
- SLV: Supervision of the transmission from slave modules.
- OV1 / UV1: Supervision of the power bus PW1 (see paragraph 1.4 . This power bus is associated with the SM_PS or SM_PS40 installed on slot 1 or with the external power supply at left in the connector, identified previously as “secondary power supply” or +5 V2.
- OV2 / UV2: Supervision of the power bus PW2 (see paragraph 1.4 . This power bus is associated with the SM_PS or SM_PS40 installed on slot 2 or with the external power supply at right in the connector, identified previously as “primary power supply” or +5 V1.

Supervision of the Profibus

The yellow leds MST and SLV show the status of the Profibus communications. Following table describes the meaning of these leds:

MST	SLV	Status	Description
		Idle	No questions or answers have been detected from master nor slave module.
		Correct	Questions have been detected from a master in both channels (with redundancy) and answers from an slave in both channels.
		No answer	Questions have been detected from a master in both channels, but any slave module is responding.
		Degraded, answer.	Questions have been detected from a master in both channels (with redundancy) and answers have been detected from an slave in only one channel.
		Degraded, question	Questions have been detected from a master in only one channel (with redundancy) and answers have been detected from an slave in both channels.
		Problem in the question	The transmission lines of the master modules in both channels are blocked. Impossible to communicate with the slaves modules. A malfunction in the supervisor of Profibus is possible too.
		Problem in the answer	The transmission lines of the slaves modules in both channels are blocked. Impossible to communicate with the master modules. A malfunction in the supervisor of Profibus is possible too.

On Fast blinking Slow blinking Off

Supervision of the Power

Revision D0 and later of the backplane include a supervisor of the power. It has three main functions:

- Prevent the modules are powered with incorrect voltages.
- Indication of the “quality” of the power supplied by the backplane to the modules.
- Limit the number of startup when a problem is detected about the consumption.

The power status is displayed by the leds OV1/OV2 and UV1/UV2. The following table shows the status of these indicators and the meaning:

OVx	Uvx	Status	Description
		Power-off for overvoltage	Power voltage above the maximum.
		High-high voltage (very high voltage)	Power voltage much higher than the nominal value. The system can startup but cannot work fine.
		High voltage (warning voltage)	Power voltage slightly above the nominal value. Correct state for startup and working.
		Optimum	Power voltage into the nominal value range. Optimum state for startup and working. Both leds are lighted each 3 s.
		Low voltage (warning voltage)	Power voltage slightly under the nominal value. Correct state for working but not for the startup. Depending on voltage level the system could be restarted.
		Low-low voltage (very low voltage)	Power voltage much lower than the nominal value. The system can startup but cannot work fine. Unsafe state for working and startup. If the voltage level is decreased, the backplane could be power off.
		Power-off for undervoltage	The voltage level is much lower than the minimum.
		Blocked	The maximum number of retries to boot has been exceeded. The supervisor will not attempt more reconnections until the power supply is completely removed.
		No operative	Without power supply or the voltage supervisor is broken.

 On  Fast blinking  Slow blinking  Off

3.3 Powering a Saitel DP RTU

There are several options to power a Saitel DP RTU:

- Using Saitel DP power supplies (redundant or not).
- Using external power supplies (redundant or not)
- Mixing both, an external and a Saitel DP power supply.

More information about redundant configurations in paragraphs 1.5.1 and 1.5.5 in this manual.

If an external power supplies are used, depending on the type of backplane, SM_BPX or SM_CHX, the detailed wiring is explained in paragraph 3.2.1 and 0.

3.3.1 Power Supply Requirements

⚠ WARNING
The voltage input for the backplane is 5.4 ± 0.2 V_{DC}. The external voltage input isn't protected against overvoltage nor polarity inversion, so an incorrect wiring or an incorrect adjustment of the supply voltage could damage electronic.

SM_PS40 module is scalable to supply power to the modules connected to the backplane, as required. When using auxiliary power supplies, it is necessary to scale them depending on the installed Saitel DP modules.

The power consumption for each module is indicated on the technical label and is included in the technical specification table in the module's user manual. The consumption of all modules will be added plus a safety margin (between 20% and 50% of the full power). The power supply efficiency typically, 70 - 90%) shall also be considered, in order to protect the chassis and power supply from overloading.

3.3.2 SM_PS40 (Saitel DP Power Supply)

⚠⚠ DANGER

Some Saitel DP modules have hazard of electric chock, electric arc or burns. For any of these cases, follow these instructions

- Only qualified personnel should install this equipment. Such work should be performed only after reading this entire set of instructions and checking the technical characteristics of the device.
- NEVER work alone.
- Turn off all power supplying this equipment before working on or inside it. Consider all sources of power, including the possibility of backfeeding.
- Always use a properly rated voltage sensing device to confirm that all power is off.
- Start by connecting the device to the protective earth and to the functional earth.
- Screw tight all terminals, even those not in use.

Failure to follow these instructions will result in death or serious injury.

The following figure shows a schematic front view:

Figure 48 - SM_PS40 – Front view

The SM_PS40 module converts the input power into a regulated 5.4 V_{DC} output to power the electronic control components of the modules within the backplane. Additionally, depending on ordering option, this module can provide an auxiliary voltage for the polarization of the I/O interfaces of the acquisition modules.

The functional features of this block are:

- Compliance with EMC standards for industrial environments.
- Depending on ordering option:
    - Direct and/or alternating input current can be used.
    - Auxiliary output of 24 V_{DC} will be available.

- Galvanic isolation.
- Communication of power faults to the CPU.
- A test device (two terminals) is available allowing to check the level voltage on the bus using a voltmeter.

⚠ WARNING
In order to make the system work properly, the voltage must be 5.4 ± 0.2 V_{DC}.

The following figure show the SM_PS40 module interface:

Figure 49 - SM_PS40 – User interface

⚠ WARNING
When you install the SM_PS40 module into the backplane, you must be sure that it is not connected to the power. If the user doesn't follow this instruction, an electric spark will be generated injuring the equipment.

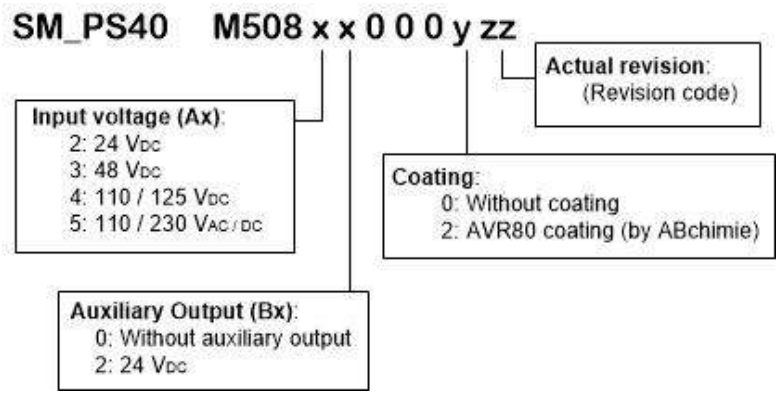
The SM_PS40 module can be use in two different modes:

- **Simple**. The module is installed in the first slot (left-hand-side) in the backplane.
- **Redundant**. Two identical modules are used. The modules are mounted side by side from the first slot (left-hand-side) in the backplane.

3.3.2.1 Ordering Options

The following ordering options are available for this module:

Figure 50 - SM_PS40 – Ordering options



3.3.2.2 Connections

Main Power Input

Input power supply voltage must be connected using the three-pole connector identified as "POWER":

- Model: Phoenix Contact Combicon: 3-MC 1.5/2 –ST-5.08.
- Screw-terminals for cables with a maximum 2.5 mm^2 gauge.
- Two terminals for direct or alternating current (1,2).
- A terminal for Ground Protection (GND).

Following table shows how the connection has to be made depending on the type of current (alternate or direct):

Connector POWER	Direct current	Alternate current
1	Positive	Phase
2	Negative	Neutral
GND	GND	GND

NOTICE
The power supply input is protected against inversion of polarity.

Auxiliary Power Output

The auxiliary output is available (only for ordering option B2) through a front two-pole connector with the following features:

- Model: Phoenix Contact Combicon: 2-MC 1,5/2 –ST-3.5.
- Screw-terminals for cables with a maximum 1.5 mm^2 gauge.
- Two terminals for direct current (with the labels "-" and "+").
- Recommended cable: Rigid or flexible. 0.14-1.5 mm / 28-16 AWG (For PE, 5 mm).

3.3.2.3 LED Indicators

The following table shows the meaning for each LED:

● , ● → On ○ → Off

WDOG	PWR	AUX	Description
○	●	○	If auxiliary output is not mounted in the module, the indicator AUX must be off. If this auxiliary output is mounted, revise fuse F2. If it is correct, consult the support service.
		●	
	○		Main power supply is not powered.
●			Without function for new systems

3.3.2.4 Technical Specifications

Table 5 – SM_PS40 Technical specifications

SM_PS40		
Input voltage level	Option A2:	24 V_{DC}
	Option A3	48 V_{DC}
	Option A4:	110 / 125 V_{DC}
	Option A5:	125 V_{AC} / 230 V_{AC} / 220 V_{DC}
Isolation	Input / Output	3 kV_{RMS}
	Input / Ground	1.5 kV_{RMS}
	Output / Ground	0.5 kV_{RMS}
Power output	Main	5.4 V_{DC} (40 W at 25 ºC / 30 W at 70 ºC)
	Auxiliary (Option B0)	Not available
	Auxiliary (Option B2)	24 V_{DC} (25 W)
Protection	Output	Permanent short-circuit.
	Input	Overvoltage / Overcurrent
Maximum cutting time	50 ms	
Typical efficiency (full load)	85%	
Consumption	60 W Max.	
	The typical efficiency at full load is 79%	
Weight	900 g	

3.3.2.5 Certification Tests

Table 6 – SM_PS40 Certification tests

EMC		
EMC tests according to	IEC/TS 61000-6-5:2015	
	EN 61000-6-4 (2007) / A1 (2011)	
Emission EMC tests	Radiated emissions EN 55022:2010 + AC:2011	From 30 to 1000 MHz (Class A)
	Radiated emissions EN 55032 (2015))	From 30 to 6000 MHz (Class A)
	Continuous conducted emissions on power leads EN 55022: 2010 + AC:2011 CISPR 16-2-1 (2014)	From 0.15 to 30 MHz (Class A)
	Discontinuous conducted emissions on power leads EN 55014-1 (2006) / A1 (2009) / A2 (2011)	From 0.15 to 30 MHz (Class A)
Immunity EMC tests	Electrostatic discharges (ESD) EN 61000-4-2:2010	Air ±8 kV / Direct and indirect contact ±6 kV
	Radiated, radio-frequency, electromagnetic field EN 61000-4-3 (2006) / A1 (2008) / A2 (2010)	From 80 to 1000 MHz (Level: 10 V/m) From 1000 to 2700 MHz (Level: 3 V/m). From 2700 to 6000 MHz (Level: 1 V/m).
	Electrical fast transient/burst EN 61000-4-4 (2012)	Power (AC and DC) and other lines Level: ±4 kV Repetition: 5 kHz & 100 kHz
	Surge EN 61000-4-5 (2014)	Symetrical: AC: ±2 kV, DC: ±1 kV Asysymmetrical: AC: ±4 kV, DC and others ±2 kV
	Conducted disturbances, radio-frequency fields EN 61000-4-6:2014	0.15 – 80 MHz, AM 1 kHz 80% (Level: 10 V_{RMS}).
	Voltage Dips EN 61000-4-11 (2004)	AC: 100% (100 ms) and 30% (20 ms) DC: 100% (50 ms), 50% (100 ms) and 30% (100 ms)
	Magnetic field EN 61000-4-8:2010.	100 A/m, 1000 A/m (50 Hz).
	Immunity to conducted disturbances, induced by radio-frequency fields EN 61000-4-16 (2016)	Power: 30 V (50 Hz), 300 V (50 Hz)
	Damped oscillatory wave EN 61000-4-18:2007 + A1:2010	Power: ±1 kV (symmetrical), ±2.5 kV (asymmetrical)
	Ripple on DC power supply EN 61000-4-17	10% Un at 100Hz, 150Hz and 300Hz
Electric Safety	Insulation coordination for measuring relays and protection equipment. Requirements and tests IEC 60255-5:2000 / EN 60255-5:2001 / UNE EN 60255-5:2002 (Paragraph 6)	
RoHS III	Directive 2015/863/EU	Verification of Lead, Cadmium, Mercury, Chrome and Bromine
Environmental tests	Cold - EN 60068-2-1:2007	-40 ºC during 16 h (100 h)
	Dry heat - EN 60068-2-2:2007	+85 ºC during 16 h (100 h)
	Damp heat - EN 60068-2-30:2005	+25 ºC a +55 ºC with 95% RH (2 cycles of 24h each)

3.3.3 Using External Power Supplies

The power supply wiring depends on the backplane model. Following paragraph show

SM_BPX Power Supply

The SM_BPX module integrates a connector at the right side to connect one or two external power supplies. It is identified as number 5 in previous figure.

Note that pin 1 is the first one from the right when the backplane is horizontal or the upper one when the backplane is on vertical position. The connection is as follow:

Table 7 – Pinout of the connector for external power supplies

Pin	Signal	Description
1	Ground	Ground protection
2	-	Don't connect
3	+5 V2	Secondary power supply
4	GND	
5	+5 V1	Primary power supply
6	GND	

More information about connection of two external power supplies in paragraph 1.5 .

Figure 51 – Connecting external power supplies to a SM_BPX

SM_CHX Power Supply

There are two power supply options for the modules, through the backplane:

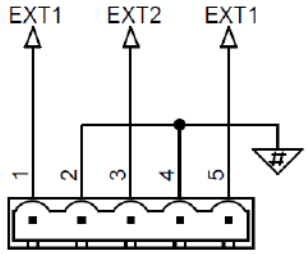
- Using Saitel DP power supply (SM_PS40).
- External power supply through.

In case of backplane SM_CHX, we have to distinguish between models with 4 positions and models with 9 positions, because the model with 9 positions has the connectors J14 and J15 for primary and secondary power supply and the models with 4 positions only have connector J15.

⚠ WARNING
J14 and J15 connectors are ONLY for power **INPUT**. Using these connectors as a power output could cause important damage to the equipment.

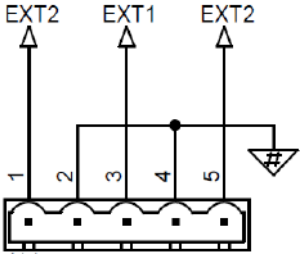
The power connectors of the SM_CHX9 module have the following pinout:

Table 8 – Pinout of the power supply connector in SM_CHX9



Connector J15

Pin	Signal	Description
1	EXT1	Positive external power supply 1
2	GND	Negative external power supply 1
3	EXT2	Positive external power supply 2
4	GND	Negative external power supply 2
5	EXT1	Positive external power supply 1



Connector J14

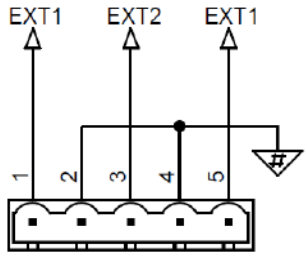
Pin	Signal	Description
1	EXT2	Positive external power supply 2
2	GND	Negative external power supply 2
3	EXT1	Positive external power supply 1
4	GND	Negative external power supply 1
5	EXT2	Positive external power supply 2

According to the description of these connectors, we have the following options for wiring the power supply:

- Use a single connector, wiring all the pins as indicated in the table above. In this case, we have the two power supplies associated with the same connector.
- Use both connectors, which is the recommended option. In this case, it will be necessary to wire only the pins 1 and 2 of each connector, with which we will have associated the external source 1 to the first connector (J15) and the external source 2 to the second connector (J14).

For SM_CHX4, only connector J15 is available, so we have the two external power supplies associated with the same connector.

Table 9 – Pinout of the power supply connector in SM_CHX4



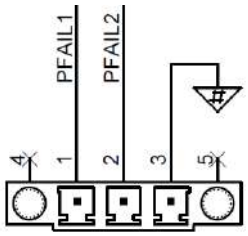
Connector J15

Pin	Signal	Description
1	EXT1	Positive external power supply 1
2	GND	Negative external power supply 1
3	EXT2	Positive external power supply 2
4	GND	Negative external power supply 2
5	EXT1	Positive external power supply 1

SM_CHX Power Supervisor

The connector J12 is available for supervision of both power buses.

Table 10 – Pinout of the power supervisor



Connector J12

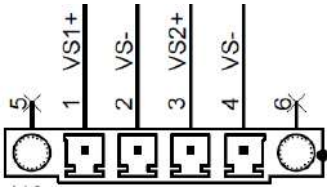
Pin	Signal	Description
1	PFAIL1	Power failure in SM_PS40 in SLOT2 or external power supply 1.
2	PFAIL2	Power failure in SM_PS40 in SLOT1 or external power supply 2.
3	GND	Reference to 0 V.

Both signals, PFAIL1 and PFAIL2 are output from the backplane (open collector). They are active in low level.

SENSE Input

A SENSE input is available, which can be wired to the source if necessary. We will use connector J3.

Table 11 – Pinout of the SENSE input



Connector J13

Pin	Signal	Description
1	VS1 +	Positive of SENSE (Power supply 1)
2	VS -	Negative of SENSE (Power Supply 1)
3	VS2 +	Positive of SENSE (Power supply 2)
4	VS -	Negative of SENSE (Power Supply 2)

NOTICE

Other connectors may be installed in the back of the board, such as GND, PFail and ST_SPS_SEC. These mustn't be wired. They are only included for compatibility with previous versions of the module.

3.3.4 Recommendations for External Powering

⚠ WARNING

The voltage input for the backplane is 5.4 ± 0.2 V_{DC}. The external voltage input isn't protected against overvoltage, so an incorrect wiring or an incorrect adjustment of the supply voltage could damage the electronics.

On a voltage drop, the backplane is shutdown when the voltage level falls to 5.0 V_{DC}, and on a power surge, the backplane is shutdown when the voltage level comes to 5.8 V_{DC}.

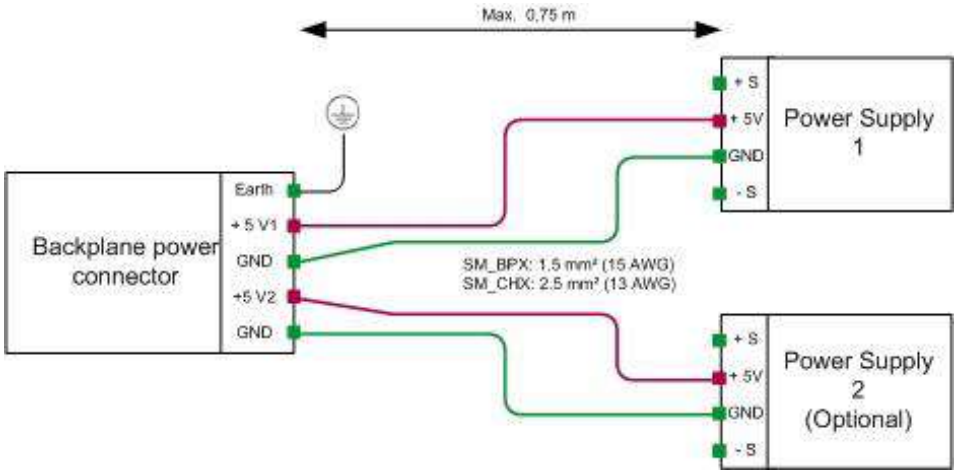
The best way to power the backplanes is depending on both the number of available power supplies as the distance from these power supplies up to the backplanes.

The total power of the power supplies used must be the equal or greater than the sum of the powers required for all backplanes powered more a reserved margin (usually from 25% to 50% of the total power).

A Power Supply for Each Backplane

The distance between each power supply and the backplane can't be greater than 0.75 m.:

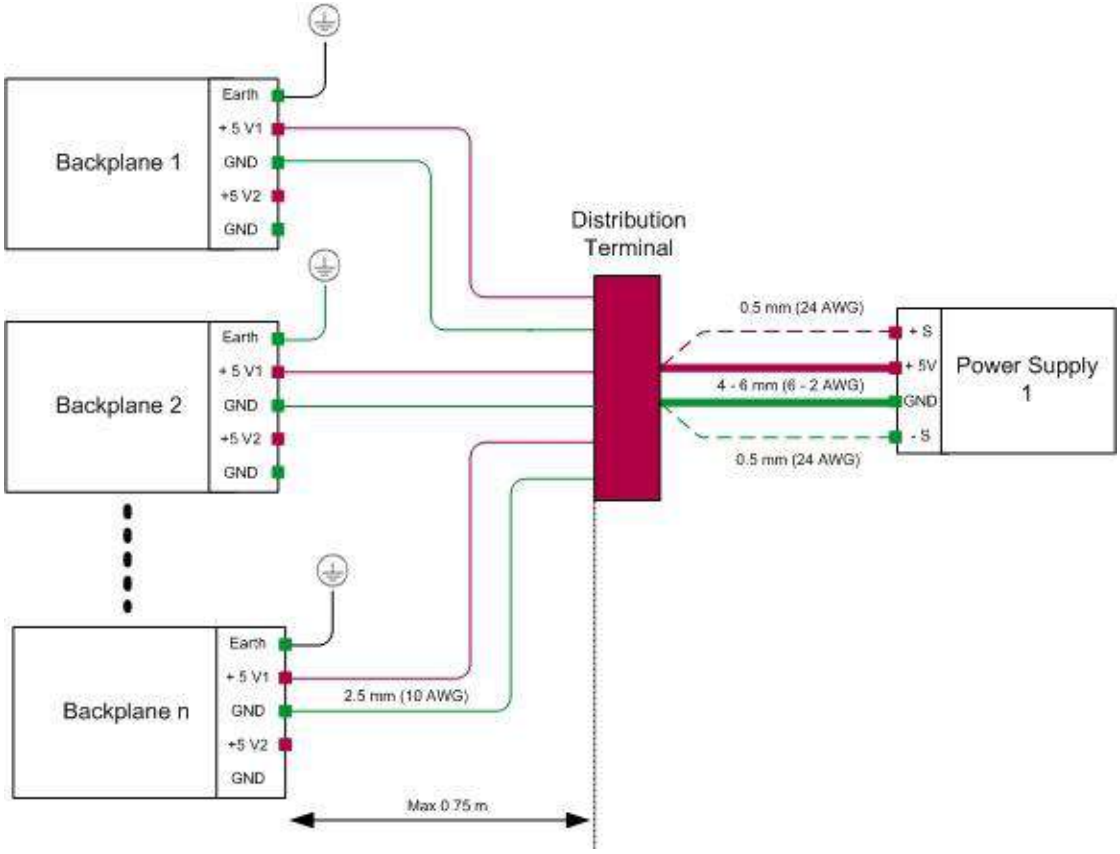
Figure 52 – A power supply for each backplane



A Power Supply for Several Backplanes

In this case a distribution terminal should be installed. The distance (length of the cable) between this terminal and the backplanes should be 0.75 m maximum:

Figure 53 – A power supply for several backplane



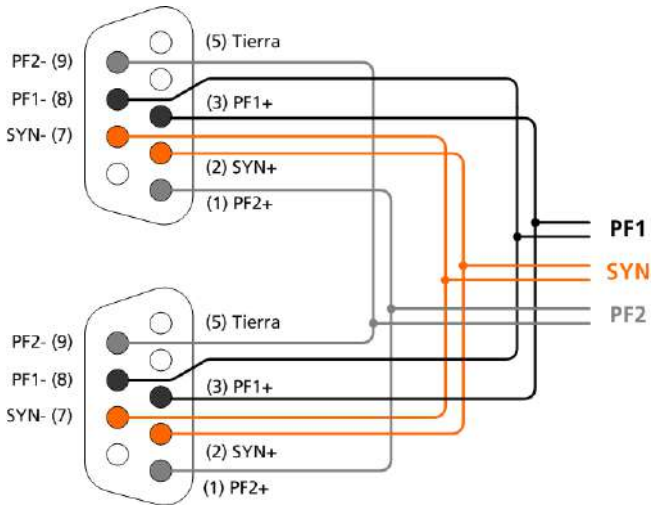
⚠ WARNING
The powering of several backplanes mustn't be wired cascade, i.e., the power of the first backplane mustn't be extended to the others. For each backplane, the power is received directly the source, using a star configuration, as shown in the previous figures.

3.4 Backplane Expansion

The first point to consider is whether the PPS(Pulse Per Second signal) is required or not, and if the communications are simple or redundant. The SM_BPX and SM_CHX include electronic for expansion of the three buses, including the terminating resistors.

Once buses to expand are known, please, note that although there are two connectors for expansion (identified with the number 3 in Figure 44 and number 1 in Figure 46) from the electrical point of view both are the same.

Figure 54 – Connectors for expansion.



The backplanes can be expanded by interconnecting the channels GND, SYN and Profibus of the different backplanes (PF1 and PF2).

⚠ WARNING
Pin 6 (+5V) only should be connected in order to power a BP2F (bus expansion through fiber optic).

In the backplane the female connector is installed and the male connector will be installed in the cable used for the expansion. It is recommended to use a metallic and shielded connector with an output angle for the cable of 180º (reference: FCK1GA):

Figure 55 – Expansion cable connector.

Each bus in use (PF1, PF2, SYN) requires a shielded twisted-pair connection cable. There are two types of cables depending on the distance between the backplanes (according to EIA RS-485):

- Cable type A:
    - Impedance: 135 - 165 Ω (f = 3 to 20 MHz).
    - Capacity < 30 pF/m.
    - Resistance < 110 Ω/km
    - Conductor area ≥ 0.34 mm^2 (22 AWG).
- Cable type B:
    - Impedance: 100 - 130 Ω (f <100 kHz).
    - Capacity < 60 pF/m.
    - Conductor area ≥ 0,22 mm^2 (24 AWG).

The following table shows the maximum length of cable type A and cable type B for the different transmission speeds:

Table 4 – Cable length for the different transmission speeds.

Rate (kbit/s)	9.6	19.2	93.75	187.5	500	1500
Cable A length (m)	1200	1200	1200	1000	400	200
Cable B length (m)	1200	1200	1200	600	200	70

The cable's shield must be connected to the ground protection using the fixing screws of the connector.

If the expansion needs to be installed outside the cabinet a BP2F is recommended (see paragraph 3.4.2). Otherwise, a cable with mechanical protection must be used.

An example of a cable can be: Belden 9841.

The following section details how to wire the bus expansion depending on the system needs. For each backplane, the position of the switches is shown.

3.4.1 Expansion using RS-485 (Copper)

NOTICE
If the expansion needs to be installed outside the cabinet a BP2F is recommended (see "Auxiliary Modules Manual"). Otherwise, a cable with mechanical protection must be used.

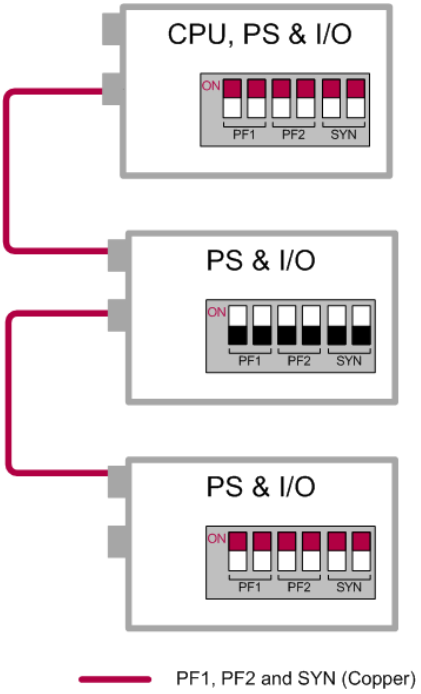
The following scenarios are described:

- One main backplane (with single or dual CPU) and a single cable for PF1, PF2 and SYN.
- One main backplane (with single or dual CPU), a cable for PF2 and another cable for PF1 and SYN.
- Two main backplanes, a cable for PF2 and another cable for PF1 and SYN.

A Main Backplane / A Single Cable for PF1, PF2 and SYN

There is a main backplane and other acquisition backplanes. Regarding bus redundancy, although there is a double bus, in this case both use the same cable for the expansion.

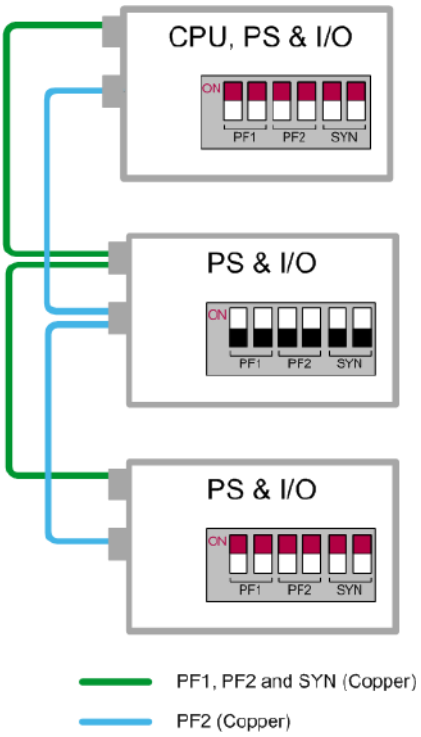
Figure 56 – Backplane expansion (using copper) – A main backplane / A single expansion cable.



A Main Backplane / A Cable for PF1 and SYN / A Cable for PF2

If the system requires a redundant cable (a cable for each profibus), the configuration is shown in the following figure:

Figure 57 – Backplane expansion (using copper) – A main backplane / A cable for each profibus.



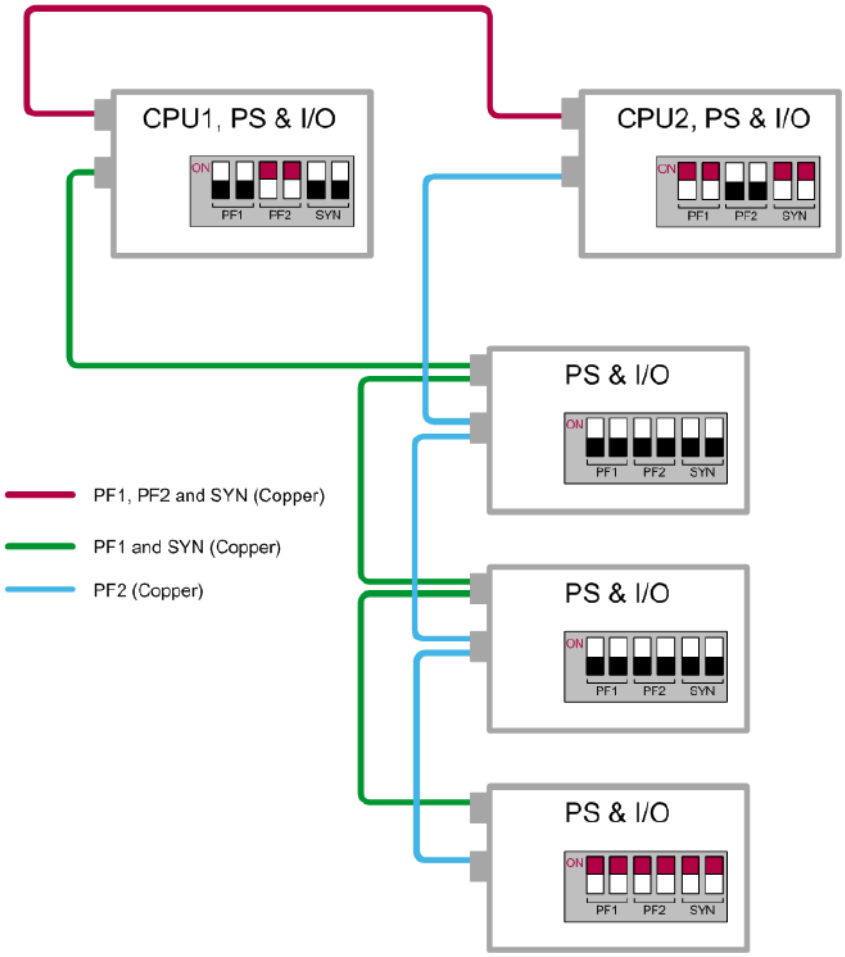
NOTICE
It is important to consider that the synchronization bus (SYN) only can be expanded using one cable. You could expand it using the PF1 or PF2 cable, but only one of them. Otherwise the system could have problems with the synchronization in the acquisition backplanes.

Two Main Backplanes / A Cable for PF1 and SYN / A Cable for PF2

If you have two main backplanes but you don't need to use a double wiring, the backplane expansion is shown in Figure 44 and Figure 46, where the second main backplane is considered as an acquisition backplane. These backplanes, all switches must be set to OFF.

If you need a cable for each profibus, see the following figure:

Figure 58 – Backplane expansion (Copper) – Two main backplanes / Two expansion cables.



3.4.2 BP2F Module (Expansion with Fiber Optic)

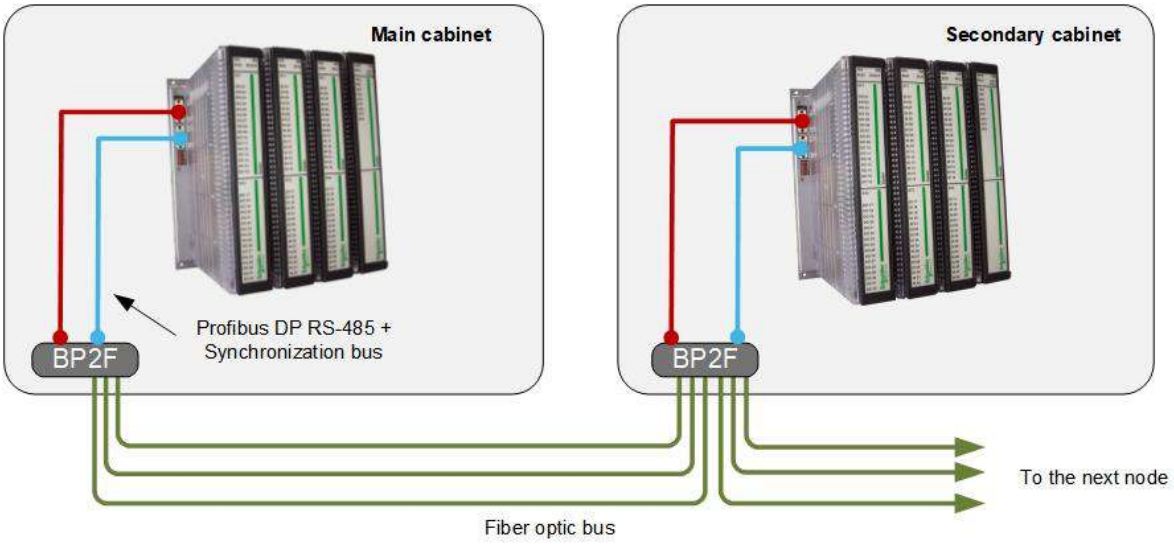
BP2F (Backplane to Fiber) is a RS-485 to fiber optics converter, specifically designed by Schneider Electric for the communication between Saitel DP backplanes. This device allows the creation of a fiber optics bus for communications between backplanes physically far away avoiding distance and electromagnetic problems.

The BP2F device converts and regenerates the signal, allowing the connection of a large number of nodes to the fiber optics buses.

Figure 59 – BP2F module

The figure below shows a schema of the creation of a fiber optic bus for the intercommunication of backplanes:

Figure 60 – BP2F – Fiber optic bus for the intercommunication of backplanes

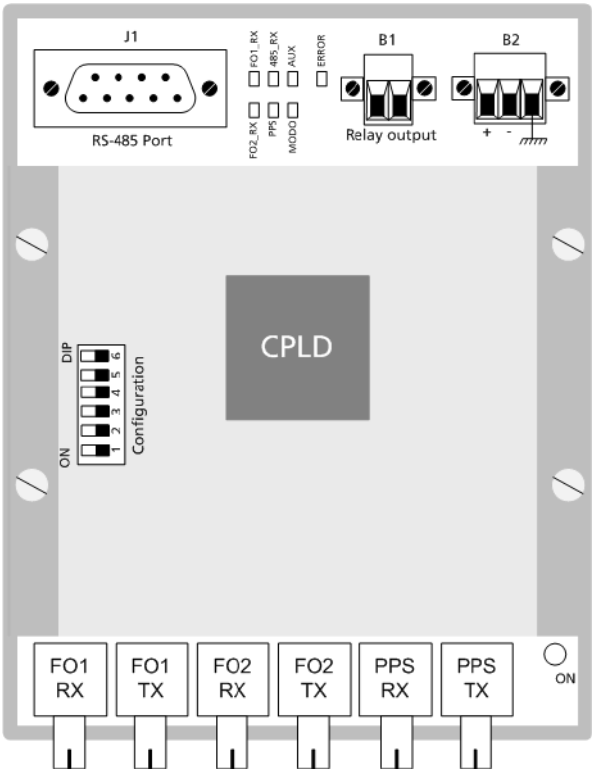


Its main functional features are:

- RS-485 to fiber conversion. A RS-485 driver is used to communicate with Saitel DP's backplane; the fiber transceptors allow communicating with other buses.
- The consumption is minimal thanks to a low-consumption CPLD. The power is supplied through the backplane.
- Signal regeneration between nodes.
- Transmission of pulse per second and Profibus communications.
- Conversion of Profibus-DP and synchronization buses.
- Master (main) and slave (secondary) modes.
- Compact mechanical solution for DIN rail mounting.

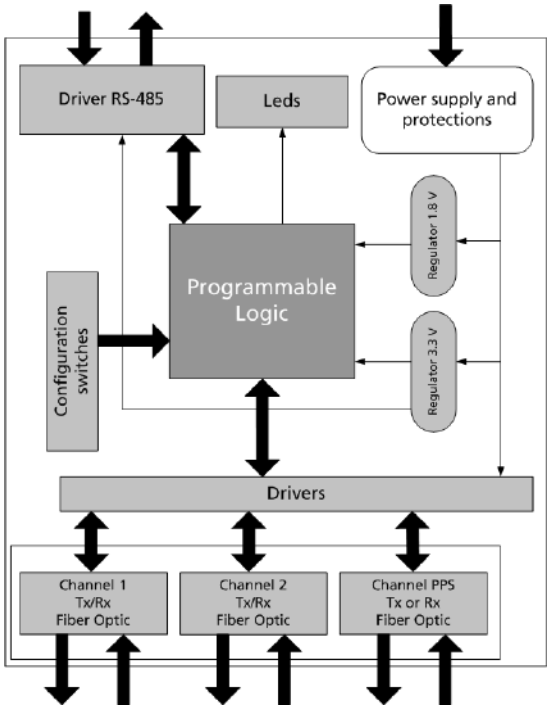
In the next figure, you can see the situation of the main components:

Figure 61 – BP2F - Front view



The block diagram is illustrated below:

Figure 62 – BP2F – Block diagram



As shown in the figure, you can distinguish the following blocks:

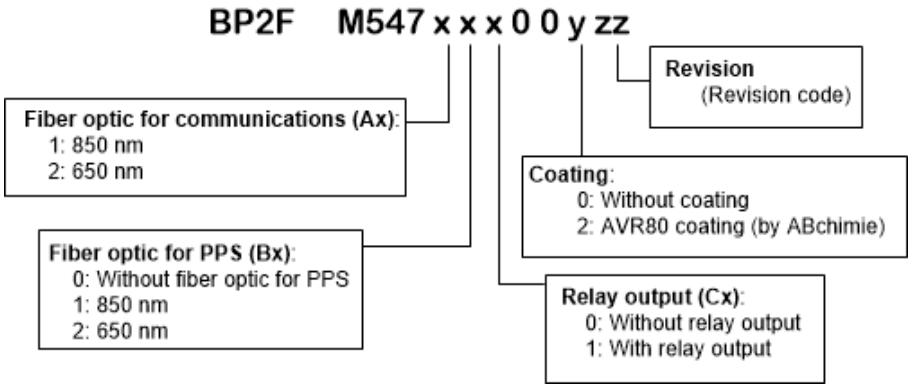
- Fiber optic communications. Transceptors are used to enable communications in wave lengths of 650 nm and 850 nm, depending on the chosen option.

- The Driver RS-485 controls the direction of RS-485 communications (in half-duplex mode) and regenerate the signal received from fiber ports. Two drivers are used:
    - One for Profibus communications.
    - Another for pulse per second transmission.
- 6 LED indicators.
- 6 Configuration switches used to:
    - Selecting between master/slave functionalities.
    - Selecting the rate.
- This module controls the direction of RS-485 communications and regenerate the signal received from fiber ports.

3.4.2.1 Ordering Options

The following ordering options are available for this module:

Figure 63 – BP2F – Ordering options



3.4.2.2 Power Supply

The device's main supply voltage is 5.4 V. There are two available options to achieve this:

- The expected voltage can be supplied to the device over the DB-9 port connected to the backplane.
- Another options is to use a switched regulator to supply the required 5.4 V with an input range of 4 ~ 6 V. This provides a stable supply voltage, better isolation and a wider operating range.

⚠ WARNING
It is very important to keep in mind that only one power supply input can be connected, never using both of them simultaneously.

The LED AUX on, indicates that the supply voltage level is less than the voltage level specified by the manufacturer for a correct performance. However, if the supply voltage is too low or if the equipment is not connected to the power source, the LED AUX will be off.

3.4.2.3 Configuration

The next table shows the configuration switches of BP2F:

- Switch 1: BP2F can be configured to work as a master (led off) or slave (led on). The master mode is used when it is connected to a backplane with a CPU.

- Switches 2 and 3: Selection of the communications baudrate.
- Switch 4: Configuration of regeneration of PPS signal (yes or not). When the switch 4 is on, you have to configure the switch 5.
- Switch 6: Enable the detection of reception in FO1.

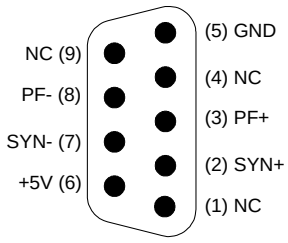
Table 12 – BP2F – Configuration switches

Switch 1		**Mode**	**Description**
on		Master	BP2F connected to the CPU
off		Slave	BP2F connected to slaves
Switch 2	**Switch 3**	**Rate**	
off	off	1.5 Mbps	
off	on	500 kbps	
on	off	187.5 kbps	
on	on	1.5 Mbps	
Switch 4		**Mode**	**Description**
off		Normal	The pulse is sent as it arrives
on		To regenerate the pulse	A square signal is generated
Switch 5		**Mode**	**Description**
off		Falling Edge	Regenerates keeping the falling edge for synchronization
on		Rising Edge	Regenerates keeping the rising edge for synchronization
Switch 6		**Mode**	**Description**
off		No monitoring	B1 -> closed LED AUX -> off
on		Detect Rx activity in FO1	If FO1_RX =OK --> B1 closed & LED AUX off. If FO1_RX = FAIL --> B1 open, LED AUX on & disable transmissions on FO1_TX.

3.4.2.4 Backplane Connection

Physically, the expansion interface is a male DB-9 connector with the following pin assignment.

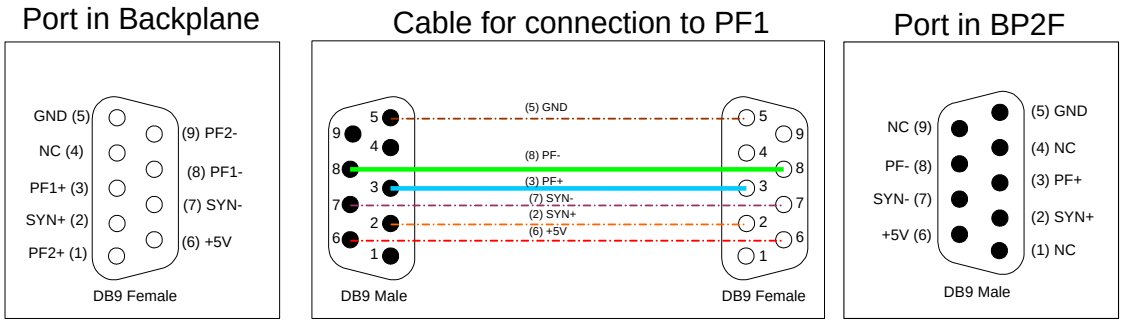
Table 13 – BP2F – DB-9 pinout

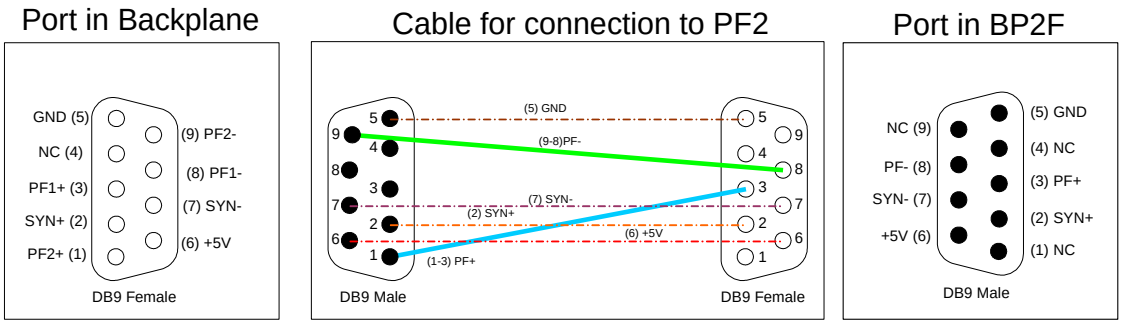


Pin	**Description**
3	PF+, Profibus-DP standard.
8	PF-, Profibus-DP standard.
2	SYN+, Pulse-per-second signal extension.
7	SYN-, Pulse-per-second signal extension.
1, 4 y 9	Not connected

Wiring between the BP2F device and the backplane will depend on which Profibus (PF1 or PF2) is expanded:

Figure 64 – BP2F - Connection of cable for BP2F to Profibus





3.4.2.5 LED Indicators

The device has the necessary LEDs to inform the user about its correct or incorrect operation at all times (see figure 8-6). The device includes the following LEDs:

Figure 65 – BP2F – LED indicators

- LED **MODE**: Operation mode. It indicates if the device operates as master or slave (LED Mode).
- LEDs **F01_Rx**, **F02_Rx** and **485_Rx**: Reception indicators. There is a LED associated to each communication port to know if data are being received: 2 to the fiber optic port, 1 for the RS485 port.
- LED **PPS**: It shows the signal received through RS-485 port PPS, if operating as master, or the fiber reception port if operating as slave.
- LED **ERROR**: Shows abnormal situations detected in communications. When is lighted indicates simoultaneous communication in different ports or the anti-streaming function is activated.
- LED **AUX**: Indicates anomaly in communications if switch 6 is in ON position. It is lighted too when the internal supply voltage level is less than the voltage level specified by the manufacturer for a correct performance (failure in DC/DC converter).

3.4.2.6 Technical Specifications

Table 14 – BP2F Technical specifications

BP2F		
Electronic	CPLD	Coolrunner 2 of 128 macrocells
	Clock	24-MHz (1.5 Mbps x 16).
Functional modes	Backplane with CPU	Master device
	Acquisition backplane	Slave device
Other features	Mechanical mounting	DIN rail (DIN35)
	Power input	5.4 V_{DC}
	Consumption	1 W (Typical)
	Dimensions	95 x 125 x 40 mm
Connection Option A1 (850 nm)	Type of fiber	Multimode fiber optics 62.5/125 µm or HCS 200 µm
		Wavelength 820 nm
	Connector type	ST
	Maximum distance at 1.5 Mbps.	MM fiber optic 1.5 km (maximum attenuation 3 dB/km).
		HCS fiber 500 m (maximum attenuation 10 dB/km).
Connection Option A2 (650 nm)	Type of fiber	Plastic fiber (POF) or HCS 200 µm
		Wavelength 650 nm.
	Connector type	Versatile Link (Avago).
	Maximum distance at 1.5 Mbps.	POF 50 m (maximum attenuation 0.23 dB/m).
		HCS Fiber 200 m (maximum attenuation 10 dB/km)

3.4.3 Using BP2F for Expansion

The device can establish Profibus and PPS communications. Depending on it, the RS-485 communications will have a behavior or another.

3.4.3.1 Profibus Communications

In Profibus RS-485 communications, the driver initializes in reception mode. If any communication is received from RS-485 (start bit detection), it will be transferred to the fiber ports. When detecting the first bit, the regeneration sequence starts, sending the byte with a half-bit delay. The stop byte will be monitored. If there is an error, its LED will be switched on indicating the communication error, so the rate settings must be revised.

In case of fiber optic Profibus communications, the fiber port will be polled. If any communication is received, it will be sent to another fiber transmitter and to the RS-485 Profibus driver (activating the driver previously)

Profibus conflicts are solved as follows:

- In order to prevent errors in two simultaneous receptions, when detecting a start bit in the reception of any port, the reception through other ports will be cancelled until the message is completely forwarded.
- Anti-streaming, in order to prevent a bus from cancelling all the communications, a system to detect this anomaly is integrated (set to '0' for 1 ms). When a new transition to standby status is received, this system will allow the bus to retransmit (RS-485 communications are interrupted)

- A relay contact closure on (terminal B1) is included to indicate bus anomalies. This signal is used to report remote faults.

3.4.3.2 Detection of FO1 activity.

The BP2F can be configured to monitor the activity of the reception line in the FO1 port.

If the device doesn't detect activity on the FO1 reception line, it will disable outgoing transmissions through the FO1 transmission line. The relay output (B1) will open and the LED AUX will switch on to indicate the anomaly.

When the BP2F detects activity in the FO1 reception line, transmissions through this port will be re-enabled, the LED AUX will switch off and the B1 relay contact will close.

To enable this feature, set the configuration switch 6 to on (see paragraph 3.4.2.3). Otherwise, the device will operate in standard mode.

3.4.3.3 Pulse per Second Communications

Based on a master or slave BP2F, you have the following issues:

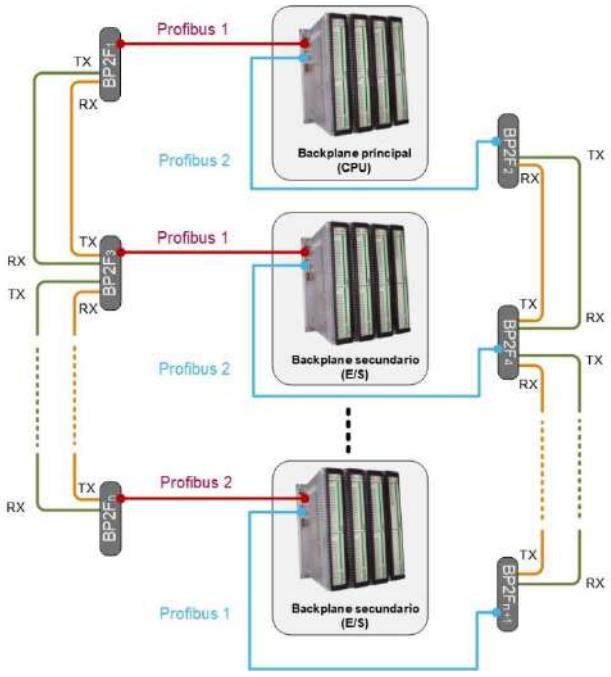
- PPS signal in the master BP2F. The RS-485 port is always in reception mode and its signal is transmitted through the fiber optic port with no delay. A pulse treatment is included in the master BP2F which adds a minimal delay of 1 / 24 MHz to the master plus the propagation time. The signal is repeated in the rest of devices, which only has a propagation delay through logic ports.
- PPS signal in the slave BP2F. The RS-485 port is always in transmission mode. This port is used to transmit the signal received from the PPS reception line. The signals received from the reception port is transmitted through the transmission fiber port.

The number of supported nodes is limited by the maximum delay allowed in the network (<10 µs).

3.4.3.4 Interconnecting Backplanes

The following figure shows how all backplanes are interconnected:

Figure 66 – Expanding backplanes with fiber optic



3.5 Field Connection

Acquisition modules can be connected to the field using two different procedures:

- A1: **Terminal connection** or direct connection. It is used when the length of the field cabling is short, for example, when interconnections and assemblies are done within the cabinet, signals are generated in a close site or proceed from an interface cabinet located at the same site, etc.
- A2: **Flat-ribbon connection** through terminal blocks. It is used when the distance between the module and the signal source is long or when the cable gauge needs to be bigger than 0.5 mm^2 due to the cabling layout.

The following figures show the available connection options A1 and A2:

Figure 67 – Terminal connection (A1)

Figure 68 – Flat ribbon connection (A2)

A module can be easily replaced by disconnecting the two field-connectors and removing the module from its slot, in both direct and terminal-block connections.

In some modules, input circuits need to be polarized in order to perform signaling and command functions.

3.5.1 A1 – Terminal Connection

The acquisition modules have Eurostyle ™ 20-way and 3.81 mm connectors, allowing the user to use multiple solutions to your needs header connector (terminal screw, spring, small screw ...). An example is shown in the following figure:

Figure 69 - Header connector for Saitel DP acquisition modules

- **Manufacturer**: Phoenix Contact
- **Reference**: FMC 1.5/20 STF 3.81 (1748532).

3.5.2 A2 – Flat Ribbon Connection (Terminal Blocks)

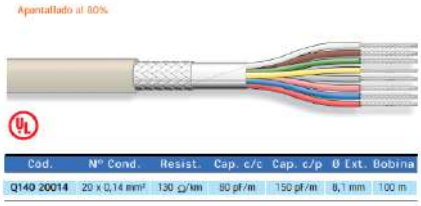
When the connection is established through terminal blocks, they can be simple connecting interfaces made up by a flat ribbon and terminals. These spring-type terminals with capacity for 2.5 mm^2 gauge cables have a DIN 35 rail mounting base. The flat ribbon cable has 20 ways, so two terminal blocks for each module are required.

3.5.3 Wiring Recommendations for I/O Modules

It is necessary to take into account the following considerations regarding the wiring of the modules:

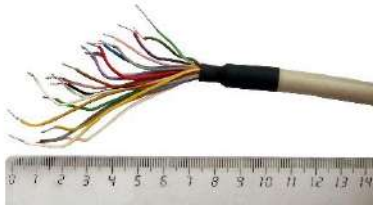
- **Recommended cable type**: Low voltage computer with 20 x 0.14 by EMELEC.

Figure 70 - Cable for field connection



For connection, you should remove the shield of the cable between 8 and 10 cm and protect the cut with an insulating material, as shown in the figure:

Figure 71 - Prepared cable for field connection



The shield at the end of each individual cable should be removed for a distance of 0.5 cm, which will be the part of copper to introduce in the terminal:

Figure 72 - Wiring a module with terminals

You can see that the space is enough to the door to be closed:

Figure 73 - Position of the cables when they are installed

To avoid jerking and the weight of the cable doesn't fall on the terminal, when the module is installed in the cabinet, both wires will be joined with a plastic bracket, and they should be fixed to the cabinet or chassis too.

The following image shows an example:

Figure 74 - Mounting cables to the cabinet or chassis

3.6 Wiring recommendations for EMC

To improve the EMC behavior of the equipment, it is recommended to follow the following indications in the wiring of the cabinet.

Considering the wiring types which could be used, there are several groups:

Table 15 – Wiring groups

Group	Connection type
1	Analog inputs and outputs.
2	Digital inputs and outputs.
3	Communications.
4	Main and auxiliary power supply and polarization of the field signals.
5	Ground protection for safety and EMC.

3.6.1 Common Recommendations

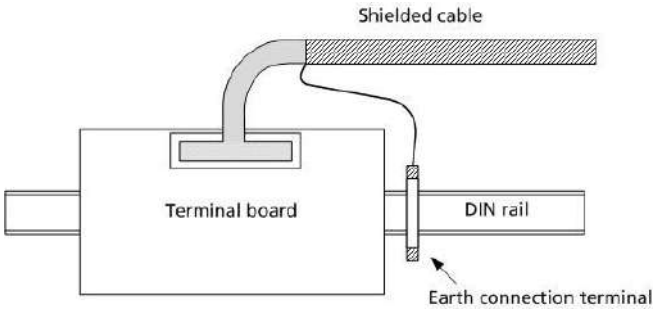
- Whenever possible, cables of groups 1, 2 and 3 must be wired separately. That is, the analog, digital, and communication signals should have separate gutters.
- If separate wiring is not possible and the number of signals is low, exceptionally this gutter may be shared. In this case, as analog and communication signals are the most sensitive, these two types of signals should be wired through the same gutter, whereas digital signals should be wired separately.
- When none of the above is possible, it is extremely important to avoid analog, digital and communication signals to be wired in parallel. If there are some sections in which parallel wiring cannot be avoided, these should be as short as possible.
- If the cables need to be crossed, theses crossings will be perpendicular to each other.
- In order to increase protection in the field inputs and outputs, terminal blocks are normally used to reinforce the protection barrier. The power supply and protection terminal blocks of DI, DO, AI and AO are protection barriers. The input wiring to these elements must always be independent from the output wiring of these barriers. They should never share the gutter.

NOTICE
Analog, digital and communication cables should never share the gutter with power supply or polarization cables. Field input signal cables must never be laid using cables with filtered signals.

3.6.2 Analog Inputs and Outputs Signals

In the case of analog signals, always shielded cables should be used for the connection of the analog module to the resistor and protection terminal block. The cable shield corresponding to the terminal block connection must be grounded using a DIN-rail terminal.

Figure 75 – Analog signals wiring.



3.6.3 Communications

The communication bus can be installed using 2-wire communication or 4-wire communication. In order to increase the immunity to electromagnetic interference (EMC), the use of a shielded twisted pair is recommended.

⚠ **WARNING**
Particular care must be taken when connecting the shielding to make sure it is effective.

The shield connection depends on the equipotentiality between the connected devices:

- **Guaranteed equipotentiality**: Both devices are connected to an ground system, so that the same potential level is guaranteed The shield must be connected at both ends.
- **Limited equipotentiality**: Both devices are connected to ground but not to the same ground system. To limit the difference of potential that can be produced among them a cable with the appropriate cross-section will be installed between the grounding of both. The shield must be connected at one end.
- **No guaranteed equipotentiality**: Ground connection of both devices can't be guaranteed (both devices must be connected to a ground system). Copper mustn't be used in this case.

⚠ ⚠ DANGER
Connecting NOT equipotential devices could be hazardous for persons and equipment.

RS-485 Communications

For RS-485 the pairs are shielded individually or all together by a copper braid. The recommendations for the cable are:

- Resistance: < 100 Ω/km.
- Section: 0.22 mm^2 (24 AWG)
- Characteristic impedance: 120 Ω.
- Maximum length: 1200 m.

RS-422 Communications

For RS-422 the pairs must be shielded individually. The recommendations for the cable are:

- Resistance: < 100 Ω/km.
- Section: 0.22 mm^2 (24 AWG)
- Characteristic impedance: 100 Ω.
- Maximum length: 1200 m.

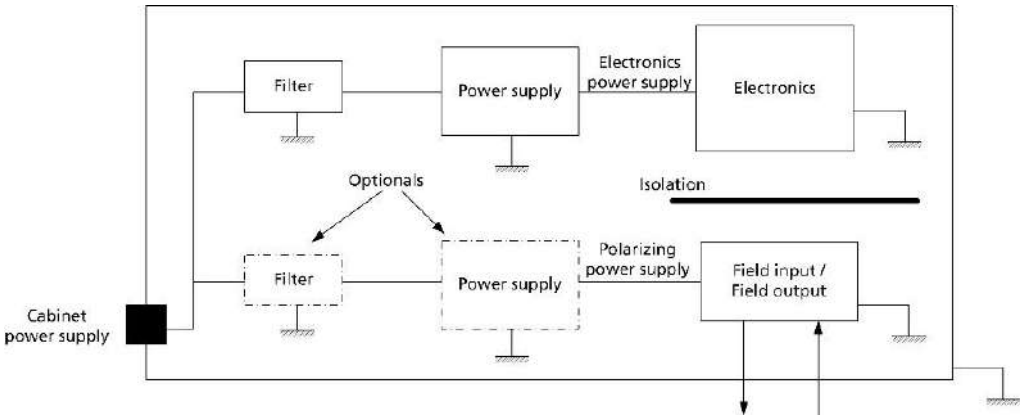
3.6.4 Group 4 (Power Supply)

The power supply for the electronic elements is the main barrier between the existing disturbances in the power supply line and the system. That is the reason why, this power supply is equipped with some additional filters to achieve a good EMC behaviour of the system. It is extremely important to keep the filter's input wiring independent from the output wiring.

Polarization

The output of the polarizing power supplies follows the same route in the field as the digital signals in which they are used, so the treatment is the same as for a field input/output signal. In some projects, supplementary filters are installed. In these cases, the wiring should be independent for the filter's input and output.

Figure 76 – Polarizing power supply output.



Auxiliary

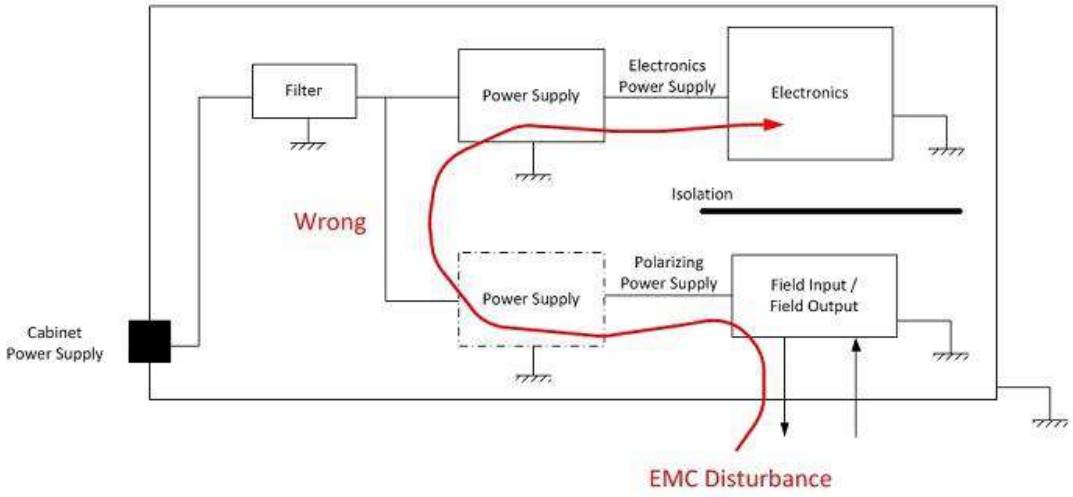
The auxiliary power supply and its wirings do not have any galvanic connection to Saitel DP, so they should be sufficiently separated from each other (independent gutters and layout) in order to avoid possible disturbances to reach the Saitel DP wiring itself. In some projects, supplementary filters are installed. In these cases, the wiring should be independent for the filter's input and output.

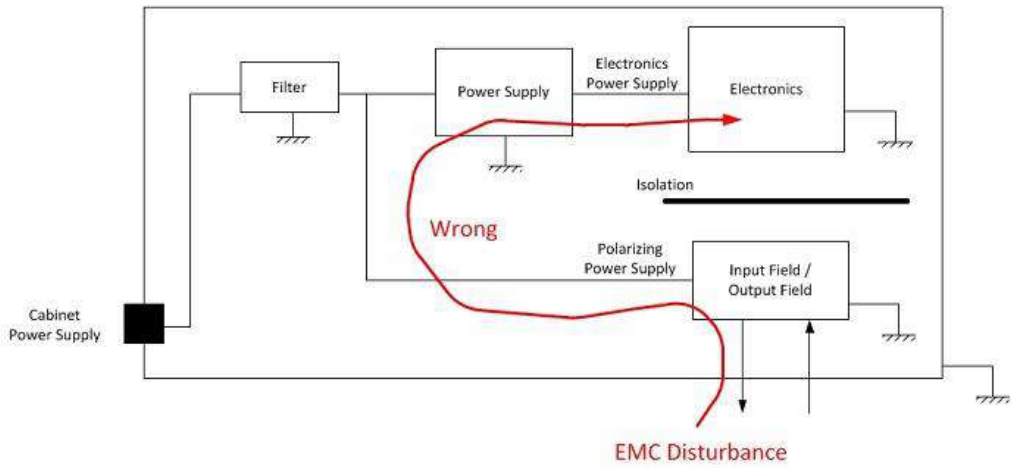
Filtering

Generally, a filter will be included as a means to reinforce the protection of the power supply of the electronic elements. The use of filters for the polarizing power supply is optional.

The polarizing power supply should never be combined with the power supply for electric elements. The filter cannot be shared in any case, as the polarizing power supply goes to field with the rest of inputs/outputs. As shown in the figures, an incorrect connection of the polarization power supply reduces the effect of the protection barriers.

Figure 77 – Example of incorrect connections of the polarization power supply.





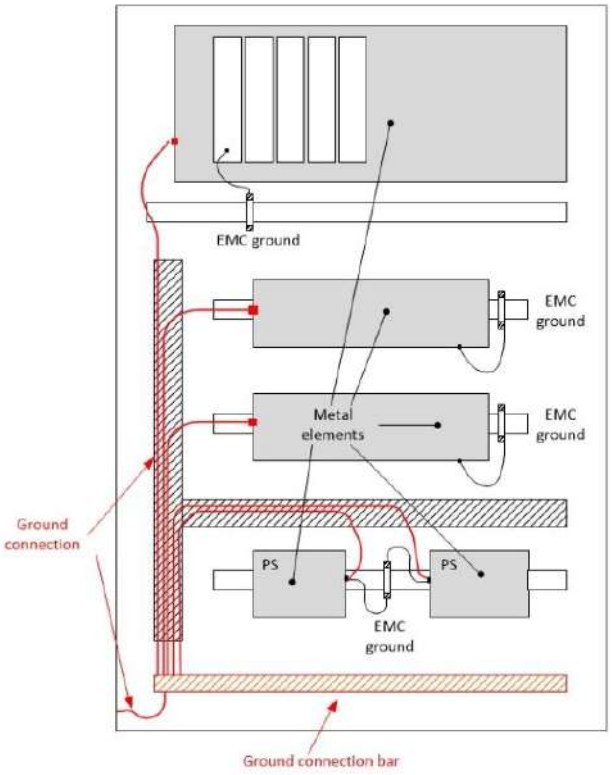
3.6.5 Group 5 (Ground Connection)

General Recommendations

The cable section used should be have the appropriate size for each installation, and grounding braid should be used whenever possible.

The equipment or cabinet need to have a ground wire in a given point in order to achieve a low impedance for the rest of the elements. Horizontal copper bars, as well as vertical cooper bars (whenever possible) should be assembled. All metal pieces of the equipment shall be connected to the ground protection. If metal cabinets are used, the cabinet's walls can also be used to distribute the EMC ground.

Figure 78 – General scheme of a CORRECT ground connection.



Ground Connection for Human Protection

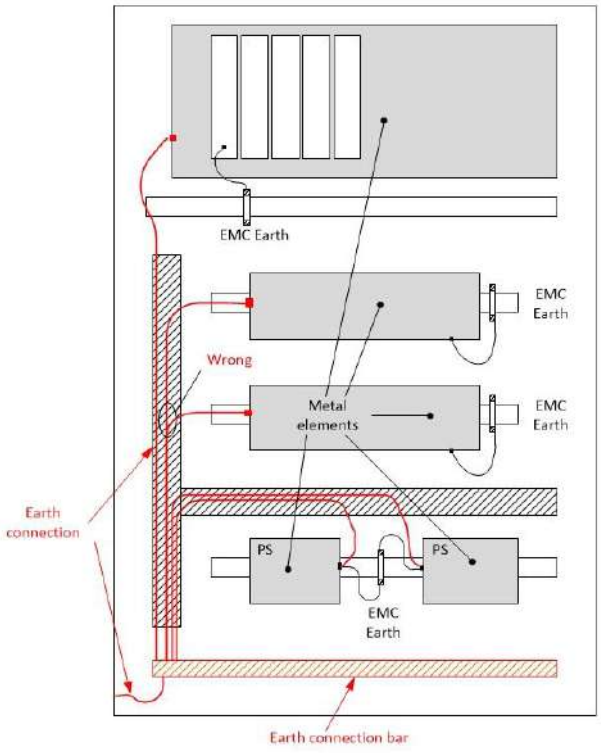
All metal elements need to be connected to the ground protection.

All connections must be established through a dedicated cable and connected to the main ground connection bar of the cabinet.

⚠ WARNING
A “cascading” ground connection of the elements is not allowed, as the ground disconnection of one element would leave other elements within the cabinets without an ground connection.

Previous figure shows a correct connection, in which all metal elements are connected through a dedicated cable to the ground-connection bar. In following figure, the two ground connection cables are joined together to simplify the connections, resulting in an incorrect ground connection.

Figure 79 – General scheme of an INCORRECT ground connection.



Ground Connection to avoid Electromagnetic Disturbances (EMC)

The connections to metal parts (which are ground connected) must be rather short.

Ground distribution will be done using the shortest cable lengths as possible. It is very relevant that EMC ground-connection cables are as short as possible, therefore the entire cabinet metal surface will be used for the connection.

The electronic elements with metal coating, such as power supplies, must be ground connected in two points. Firstly, they are connected to the ground protection using a cable with section enough, linking the ground terminal and the ground-connection bar. Secondly, there is a second cable linking the ground terminal to the closest metal surface (as shown in the previous figures through the power supply elements).

It is recommended to use flexible grounding braid for mobile earth parts (such as the cabinet’s doors). The grounding braid must be short but with a wide surface (the surface is an essential value in order to reduce high-frequency disturbances).

4 Configuration & Maintenance

Content

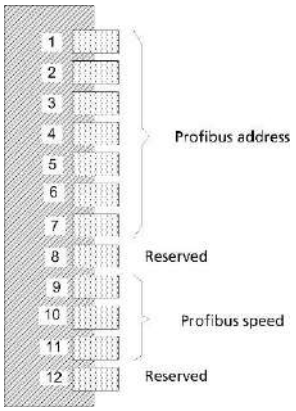
4.1 Profibus Configuration

The module's identification and Profibus communication speed can be set using the microswitches on the module's rear panel.

NOTICE
It is possible to connect up to 96 Saitel DP modules.

Each microswitch has the following functions:

Figure 80 – Profibus switches for module configuration.



I/O Modules Addressing

The module's identification must be unique, selecting between 1 and 96 using microswitches 1 to 7. The address 0 and from 97 to 127 are reserved and never can be assigned. In other case, several messages are generated when the system boot.

The address definition will be as follows:

$$P1*2^0 + P2*2^1 + P3*2^2 + P4*2^3 + P5*2^4 + P6*2^5 + P7*2^6$$

Assuming Px is the value assigned to the position of microswitch x (0 is OFF and 1 is ON). For example, if switches 2, 4 and 5 are in the ON position, the Profibus address of the module is 26.

Communication Modules

For communication modules, microswitches 1 to 4 are used to identify the position of the module in the bus. This position identifies the physical name of each serial port. For example, serial ports of SM_SER in position 1 are MUX1 to MUX8. MUX9 to MUX16 are the serial ports in the SM_SER in position 2.

CPU Modules

Configuration switches in the SM_CPU866e modules must be as follow:

- Switches 1 to 7 must be OFF.
- **Switch 9** configures the console communications rate: ON → 19.200 bps and OFF → 38.400 bps. When the CPU is booting, a message with the selected configuration will be shown: "Dip-Switch 9 OFF: CONSOLE_TTY Set to 38400".
- **Switch 5** is used for connection / disconnection of the battery.
- For revision Lnx_15:11:26:07:49:11 of Linux and later, if **switch 10** is ON, when the CPU is rebooted, information about IP addresses and users are restore to factory values. More about default users and IP addresses in the SM_CPU866e user manual.

Profibus Communication Rate

The Profibus communication speed must be the same for all Saitel DP modules, which is determined by the speed of the master, configured by software, in the control module. The speed is set using microswitches 9, 10 and 11 as shown in the following table:

Table 5 – Profibus configuration

Position 11	Position 10	Position 9	Profibus Rate
OFF	OFF	OFF	19.2 kbaud
OFF	OFF	ON	93.75 kbaud
OFF	ON	OFF	187.5 kbaud
OFF	ON	ON	500 kbaud
ON	OFF	OFF	1.5 Mbaud
ON	OFF	ON	Not available
ON	ON	OFF	Not available
ON	ON	ON	Not available

NOTICE

For optimal system performance is recommended to set the Profibus rate to 1.5 Mbaud.

Microswitches 8 and 12 are reserved and must be set to OFF, except for the SM_DI32 module. For more information, consult the SM_DI32 user manual.

Profibus Redundancy

About the redundancy of Profibus-DP; the jumper used to configure the internal bus as redundant or nor is identified with number 2 in Figure 44 (SM_BPX) and Figure 46 (SM_CHX).

If the jumper is mounted, the internal bus is redundant.

NOTICE

If you do not use the configuration of redundant Profibus-DP, you must remove the jumper, as indicated in the following image.

RS-485 Termination Resistor

Apart from the expansion connectors, there are several micro-switches in the backplane front panel to set the RS-485 termination resistors.

The RS-485 standard defines a asynchronous serial communication with differential levels, which requires termination resistors to be included in the bus ends. When interconnecting the backplanes, it is necessary to include the termination resistors in the first and the last backplane of the bus. In order to connect the termination resistors, the micro-switches next to the expansion connectors must be set to on. Where PF1 is associated with Profibus 1, PF2 with Profibus 2 and SYN with the synchronization bus.

Figure 81 – Backplane microswitches.

4.2 Starting with Saitel DP in Easergy Builder

NOTICE
To perform the operations described in this chapter, the user must be familiar with the Easergy Builder tool. Otherwise, please, refer to the tool's user manual.

4.2.1 Creating a Saitel DP RTU

Once the CPU is powered and correctly initialized, run Easergy Builder in the PC and create a Saitel DP RTU. When the RTU is created, a window is shown allowing set all I/O modules installed in the backplane:

Figure 82 – Configuring backplane

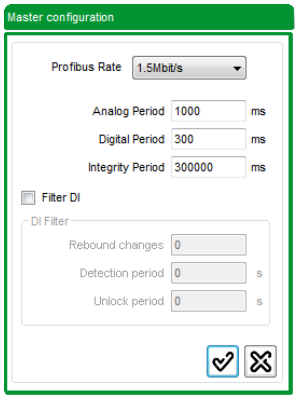
This window allows:

- Add or remove module in the backplane. Use button to add new modules and to remove a module.
- The address for each module is displayed under its picture and it can be changed using . The address for each module must be the same that is indicated with its rear switches.

NOTICE
A maximum of 96 Saitel DP modules can be added to a backplane.

- Use button to configure the time parameters of the polling and digital filtering:

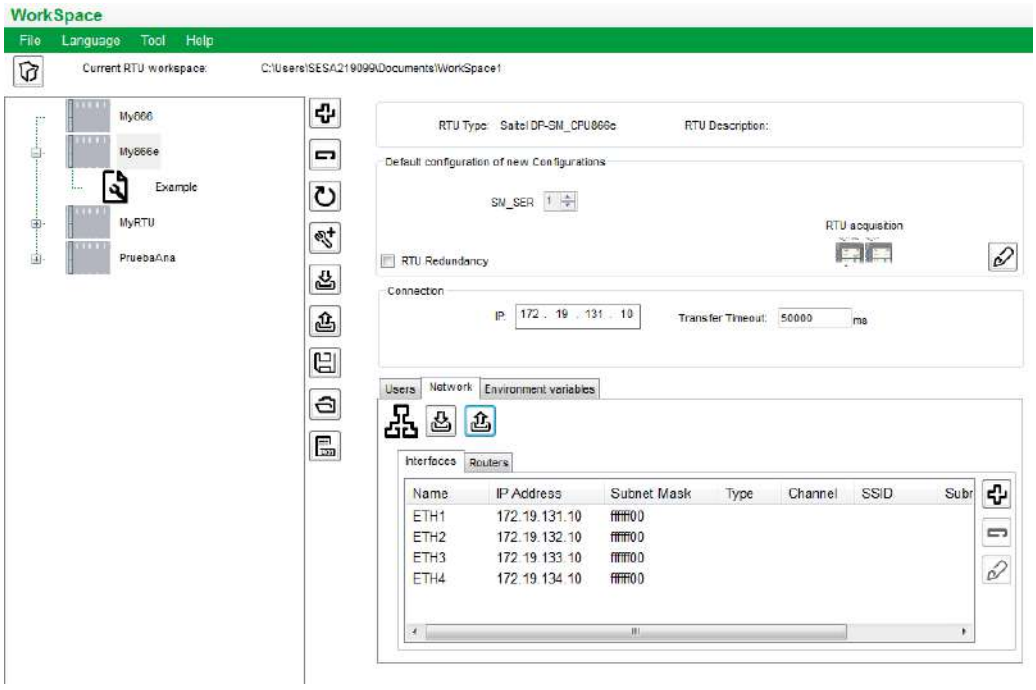
Figure 83 – Acquisition strategy window



- **Profibus Rate**: This value is depending on position of switches 9, 10 and 11 in the modules installed on the backplane.
- **Analog and Digital period**: Interval of time for the acquisition of analog and digital input signals when they are configured to be updated periodically (ChgEvt of the signal is set to “N”). Default value for digital signals is 1000 ms (10 ds) and for analog signals is 300 ms (3 ds). Both values have to be changed in intervals of 100 ms.
- **Integrity period**: When a digital signal is set to be updated by event (ChgEvt of the signal is set to “Y”), this value indicates that if during this time no event occurred, the signal is updated anyway. This assures the integrity of the signal. Default value is 300 s (3000 ds) and it has to be changed in intervals of 100 ms.
- **Filter DI**: This mark allows you to configure the filtering parameters for digital inputs.
  - **Rebound changes**: Number of changes necessaries in order to activate the anti-rebound filter (default value = 5).
  - **Detection period**: Time window when the number of rebound will be counted in order to activate the anti-rebound filter blocking the signal. This time is expressed in seconds (default value = 1 s).
  - **Unlock period**: Time without changes in a blocked signal in order that this signal is unblocked. This time is expressed in seconds (default value = 1 s).

In the main workspace window, use button and to save and load templates with standards configuration of backplanes. These templates are stored in XML files.

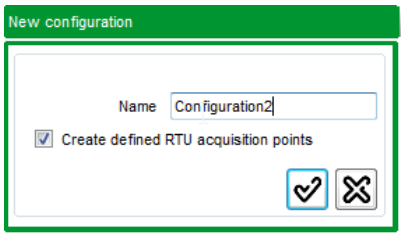
Figure 84 – Initial configuration of the RTU



4.2.2 Adding a Configuration

This section shows how you can create a new configuration using Easergy Builder. Select the RTU and press button :

Figure 85 – New configuration



Write the name of the new configuration.

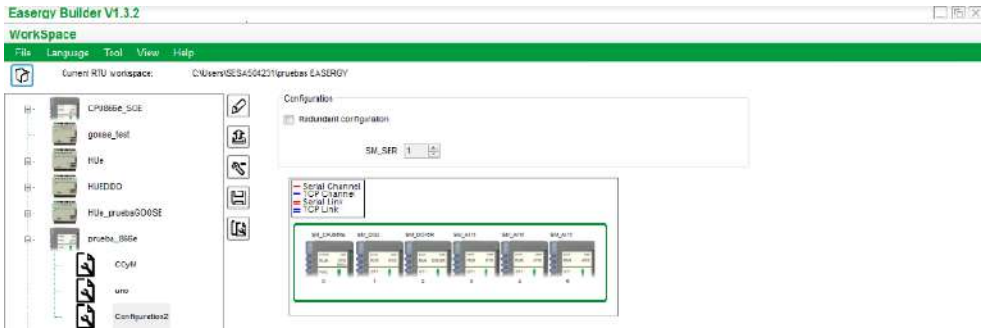
If the RTU was created with an acquisition configuration by default, for a new configuration you can select the field “Create defined RTU acquisition points” in order to include all points of the pre-defined I/O modules in coreDb.

For example, for the RTU created in the previous paragraph, this configuration will include a module SM_DI32, one module SM_DO16R and three modules SM_AI16. If “Create defined RTU acquisition point” is checked, following registers will be included in coreDb:

- 32 digital inputs in status table.
- 16 digital outputs in status table.
- 48 analog inputs in analog table.

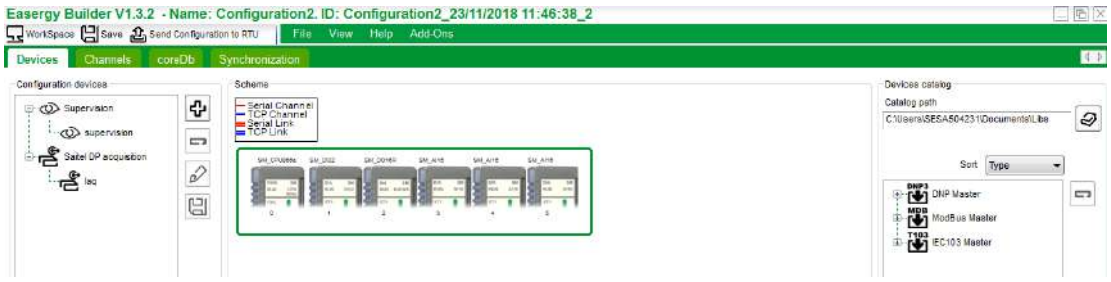
Other points associated to each module will be included too. The new configuration is available for the RTU.

Figure 86 – New configuration in the RTU tree



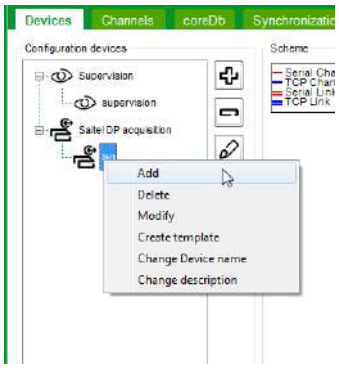
Double clicking on it will switch to Configuration mode where the new configuration can be edited.

Figure 87 – Configuration mode



Right-clicking on the configuration name, a contextual menu is displayed:

Figure 88 – Contextual menu for Configuration



This menu allows:

- Add, remove or modify a device.
- Create a template with the information associated to this device.
- Change the name or description of the Device (description field allows 128 characters maximum.

4.2.3 Channel Configuration

In the Easergy Builder Manual you can find the general operations that we should know to create and edit the communication channels available in the CPU and communications modules.

In Configuration mode, select tab Channels in order to access channel management window.

Figure 89 – Module management window

The following section details the channels to be defined and the parameters that must be assigned depending on the module.

NOTICE
The CON port cannot be used for communications, and that is the reason why we do not have to include it in the channel list.

The channels that must be defined for a SM_CPU866e are:

Table 6 –Communication channels to be defined for a SM_CPU866e

Name	Description	Type	Channel	Protocol
COM1	GPS or RS-232 communications.	ASYNC	COM1	RS-232
COM2	RS-232 communications.	ASYNC	COM2	RS-232
COM3	RS-232 communications.	ASYNC	COM3	RS-232
COM4	RS-232 communications.	ASYNC	COM4	RS-232

The name for each channel is chosen by the user.

NOTICE

If it is configured “RTS Control” as AUTO (see section “Channels” in the Easergy Builder manual):

- For COM1 and COM2, the hardware will do the control of the signals RTS and CTS. **WARNING!!** → If CTS signal is not received, nothing will be transmitted.
- For RS-485, the management of the signal RTS and switching between RX mode and TX mode, are controlled by the hardware. **This is much recommended**!

If in the backplane there are installed one or more modules SM_SER, you must define other channels, as is explained in the following table:

Table 7 –Communication channels to be defined for SM_SER modules

Name	Description	Type	Channel	Protocol
COM11	Port 1 in the module SM_SER with address 1	ASYNC	SM_SER1-COM1	RS-232/RS-485/RS-422
COM21	Port 2 in the module SM_SER with address 1	ASYNC	SM_SER1-COM2	RS-232/RS-485/RS-422
COM31	Port 3 in the module SM_SER with address 1	ASYNC	SM_SER1-COM3	RS-232/RS-485/RS-422
COM41	Port 4 in the module SM_SER with address 1	ASYNC	SM_SER1-COM4	RS-232 (all versions)
				RS-485/RS-422 (B4 and later)
COM51	Port 5 in the module SM_SER with address 1	ASYNC	SM_SER1-COM5	RS-232/RS-485/RS-422
COM61	Port 6 in the module SM_SER with address 1	ASYNC	SM_SER1-COM6	RS-232/RS-485/RS-422
COM71	Port 7 in the module SM_SER with address 1	ASYNC	SM_SER1-COM7	RS-232/RS-485/RS-422
COM81	Port 8 in the module SM_SER with address 1	ASYNC	SM_SER1-COM8	RS-232 (all versions)
				RS-485/RS-422 (B4 and later)
COM12	Port 1 in the module SM_SER with address 2	ASYNC	SM_SER2-COM1	RS-232/RS-485/RS-422
COM22	Port 2 in the module SM_SER with address 2	ASYNC	SM_SER2-COM2	RS-232/RS-485/RS-422
COM32	Port 3 in the module SM_SER with address 2	ASYNC	SM_SER2-COM3	RS-232/RS-485/RS-422
COM42	Port 4 in the module SM_SER with address 2	ASYNC	SM_SER2-COM4	RS-232 (all versions)
				RS-485/RS-422 (B4 and later)
COM52	Port 5 in the module SM_SER with address 2	ASYNC	SM_SER2-COM5	RS-232/RS-485/RS-422
COM62	Port 6 in the module SM_SER with address 2	ASYNC	SM_SER2-COM6	RS-232/RS-485/RS-422
COM72	Port 7 in the module SM_SER with address 2	ASYNC	SM_SER2-COM7	RS-232/RS-485/RS-422

Name	Description	Type	Channel	Protocol
COM82	Port 8 in the module SM_SER with address 2	ASYNC	SM_SER2-COM8	RS-232 (all versions)
				RS-485/RS-422 (B4 and later)
…				
COM18	Port 1 in the module SM_SER with address 8	ASYNC	SM_SER8-COM1	RS-232/RS-485/RS-422
COM28	Port 2 in the module SM_SER with address 8	ASYNC	SM_SER8-COM2	RS-232/RS-485/RS-422
COM38	Port 3 in the module SM_SER with address 8	ASYNC	SM_SER8-COM3	RS-232/RS-485/RS-422
COM48	Port 4 in the module SM_SER with address 8	ASYNC	SM_SER8-COM4	RS-232 (all versions)
				RS-485/RS-422 (B4 and later)
COM58	Port 5 in the module SM_SER with address 8	ASYNC	SM_SER8-COM5	RS-232/RS-485/RS-422
COM68	Port 6 in the module SM_SER with address 8	ASYNC	SM_SER8-COM6	RS-232/RS-485/RS-422
COM78	Port 7 in the module SM_SER with address 8.	ASYNC	SM_SER8-COM7	RS-232/RS-485/RS-422
COM88	Port 8 in the module SM_SER with address 8	ASYNC	SM_SER8-COM8	RS-232 (all versions)
				RS-485/RS-422 (B4 and later)

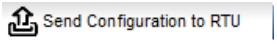
The name for each channel is chosen by the user.

4.2.4 Transferring the Configuration to the RTU

By now, you have completed the following tasks:

- Configuring the IP address of the CPU.
- Loading/Updating the software
- Configuring the backplane with Easergy Builder

The next step is transferring the configuration from Easergy Builder (in the PC) to the CPU.

If Configuration mode is active, select button 

. If WorkSpace mode is active select button  . Then, you are prompted to confirm the project save operation. Press "**Yes**" and the log window will display the information about the operation progress.

Finally, reset the RTU and, if the process is correct, the console will display the information about the initialization progress of operating system and then the application).

If all is correct, the message "CONF OK" should be shown.

```
(Example2_7/24/2014 10:16:02 AM_2)CONF OK
NO REDUNDANCY
2014-07-24  10:37:13.950 INFO    sysAutoLoadModule: Function coreDbShowState called
0x1fffe00 (tRootTask): usrAppInit exit
```

4.3 Configuring Redundant CPUs

Saitel DP allows defining redundant configurations with great flexibility, meeting the requirements of any system.

From a functional point of view, the CPUs provide several configuration options depending on the redundancy level:

- Control of the switching mechanism.
- Redundant operation mode.

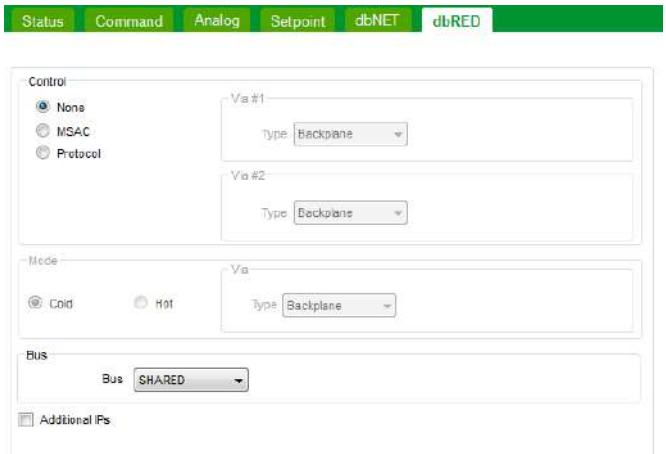
It is also possible to define floating IP addresses, which are assigned dynamically to the CPU that is HOT.

When a RTU is created in Easergy Builder, you can check the field “RTU Redundancy” in order to all configurations for this RTU are redundant. By default, all configurations for this RTU will be redundant.

When a new configuration is created for a RTU, you can select if this configuration is redundant or not.

In Configuration mode of Easergy Builder, select “**coreDb → dbRED**" to configure the redundancy. This tab is available only for redundant Configurations.

Figure 90 – Redundant configuration.



In the configuration screen there are four zones; Control, Mode, Bus and Additional IPs.

Control mechanism

For Saitel DP, the control mechanism can be managed by:

- **None**: Default value. Without redundancy.
- **MSAC**: Switching is performed by the MSAC module. This module manages the switching between two RTUs by hardware, and other functions as well.

- **Protocol**: Switching by RCP (Redundancy Control Asynchronous Protocol). In this case, there is a redundant switching channel between both CPUs, which is used to manage the switching operation using a Schneider Electric-proprietary protocol.

  "Via #1" and "Via #2" will be available when "Protocol" is selected:

  - **Backplane**. Only available when both CPUs are installed on the same backplane.
  - **Net** (by Ethernet). IP addresses must be set for CPU A and B.
  - **Serial**. A port must be set.

Mode

Set the communication mode between both CPUs (HOT and STANDBY):

- **Cold redundancy**: There is no communication between both CPUs, and when the switching is performed, the new HOT CPU starts with a database with default values.
- **Hot redundancy**: There is a high-speed communication channel (Ethernet o backplane) between both CPUs, which is used to update the STANDBY CPU's database with the HOT CPU's database. When a switching is performed, the new HOT CPU starts with updated values.

NOTICE
In this operation mode, database IDs must be identical, i.e., it is very important to use the **SAME configuration project** to configure both CPUs.

In this case "Via" allows selecting the replication mechanism:

- Backplane
- Net (by Ethernet): the IP addresses must be set for CPU A and B.

The update is done by exception (only the variables that have changed), except the first time that the complete database is updated. The supervision signal **DB_UPDATE** monitors the process.

Bus

It indicates if the CPUs share the same Profibus or not (SHARED or DIFFERENT, respectively), regardless of whether they are in the same backplane or use RS-485 expansion. This is useful to detect the operating state in dual redundant systems.

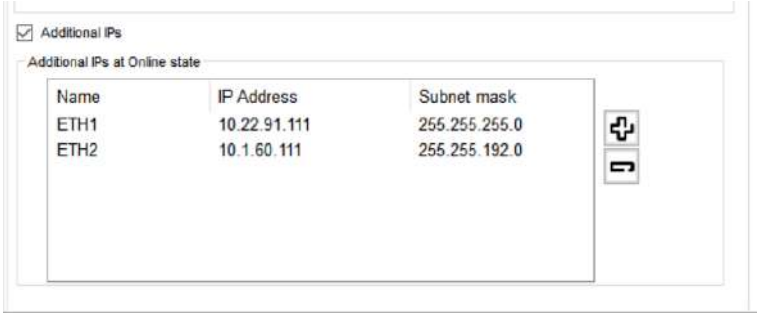
- **SHARED**: In this case, the bus of the STANDBY CPU is disabled.
- **DIFFERENT**: If checked, the bus is enabled even if the CPU is in STANDBY mode, so it can receive diagnostics from the modules.
- **NO_ACCESS.** No access to the bus regardless the CPU state (FAIL,STANDBY or ONLINE).

Additional IPs

It allows configuring a number of IP addresses associated to the CPU that is in HOT. These directions are associated in a dynamic way, so that in a redundant system they allow to communicate always with the CPU that is active.

Regarding virtual addresses, it is even possible to assign multiple IP addresses to each port:

Figure 91 – Associating several IP addresses to a port.



NOTICE
If a static IP address and a virtual address are defined for the same device in the same subnet, a warning console message will be displayed to notify this abnormal situation (sup_redAddIPs: dev xxx ip x.x.x.x subnetMask xxxxxxxx). This message is a warning from the operating system; nevertheless, it will not cause a system malfunction, since the configuration will operate properly.

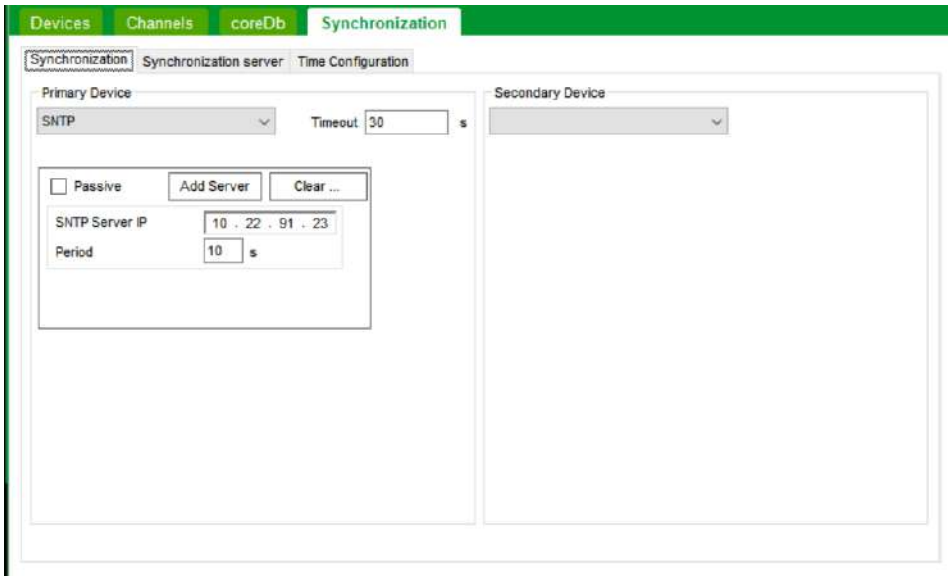
The allocation of A or B to a determined CPU is performed with the environmental variable SLOT. If there are two redundant CPUs, they will be distinguished by the value of the field **SLOT**. By default, the CPU will have the value **A**, so the change to **B** must be done directly in the secondary CPU.

4.4 Synchronization

The factory configuration does not include a defined Synchronization Device. The configuration source is defined in Easergy Builder. webApp only allows changing the configuration once it has been previously defined with Easergy Builder.

For SM_CPI866e, you can define two synchronization channels: a primary channel and a secondary channel, which will be used when the primary channel is not available

Figure 92 – Synchronization configuration.



Available synchronization sources are:

- **PROTOCOL**: Time is received through a user-specific protocol. Most telecontrol protocols enable slave devices to be synchronized.
- **SNTP**: The remote unit will operate as a SNTP client; therefore you will need to indicate the SNTP server's IP address and the synchronization period through that server.
- **IRIG**: The time received from the IRIG device is used to set the system's clock and RTC. The configurable formats are: IRIG-B002, IRIG-B003, IRIG-B006, and IRIG-B007.
- **GPS**: GPS35 and GPS16 of Garmin have been validated.
- **PTP**: As indicated in the IEEE-1588 standard, a PTP master will synchronize the accessible slave PTP devices through one or multiple Ethernet interfaces.
- **Console**, using the commands:
    - **thmShow**: It displays the states of the synchronization devices and the information about current time and date.
    - **thmConsoleSetTime "YY:MM:DD:HH:NN:SS"**:It configures the date and time manually.

Moreover, the SM_CPU866e module can be configured as a Simple Network Time Protocol (SNTP) server, a PTP server or a IRIG-B server.

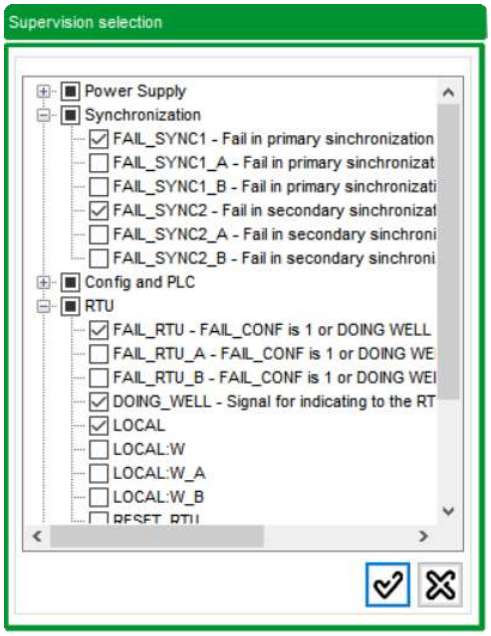
For further details about synchronization configuration, please refer to the Easergy Builder user manual.

4.5 Supervision

The **Supervision** Device is a default Device in Easergy Builder. The Device is used to monitor the status of CPU's components and generates information about other components in the RTU.

You can double click the "Supervision" Device in the tree to see a complete list of all the concepts you can monitor in this type of CPU:

Figure 93 – Supervision points for Saitel DP



It is always advisable to load the supervision Device, which is required to monitor the mentioned elements of the CPU and essential in redundant configurations. The CPU itself cannot arbitrate with another CPU in redundant systems, so there must be a monitoring part. Currently, only the supervision Device can do these tasks, and in practice only this Device is used.

For redundant configurations, most of the supervision points are also available with "_A" and "_B" suffixes in order to provide CPU-related information. For example, the points PS1_V, PS1_V_A, and PS1_V_B are available for power supply voltage. Regardless which CPU is in online mode, you can know the information about both CPU's.

The information generated by the monitoring module is supplemented with the control and diagnostic information generated in each Device.

NOTICE
For supervision device, the coordinates are the points name. For example, the coordinate associated to the FAIL_PLC point is "**FAIL_PLC**".

4.6 Local Acquisition

The local acquisition Device for Saitel DP is named "**laq"** and it is created by default for each Saitel DP configuration.

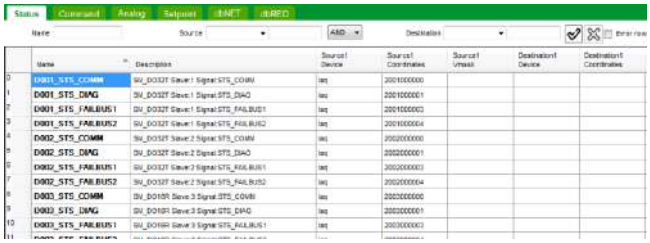
Figure 94 – Configuring local acquisition for Saitel DP

The laq Device supports communication between inputs and the outputs managed by the acquisition blocks and coreDb points. The first step to configure the acquisition settings is including all I/O modules in the backplane.

In Configuration mode, select coreDb tab in order to access to coreDb information:

Figure 95 – coreDb Menu

The information stored into each table is available selecting the corresponding tab: Status, Command, Analog and Setpoint. For example:



This screen displays all status signals existing in coreDb. It specifies the name, the signal description, the producer (source) from which information will be sent and the consumer (destination) which will receive the information.

4.6.1 Configuring the Local Acquisition

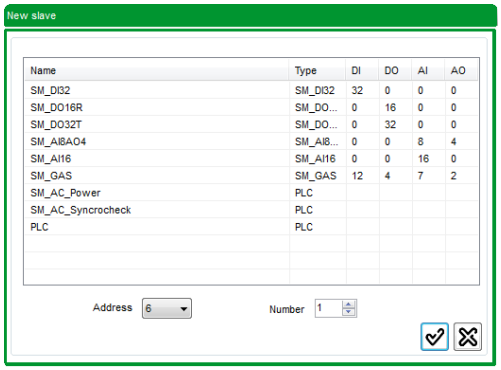
The local acquisition software is intended to exchange the information with the I/O modules installed in Saitel DP.

In relation to the acquisition strategy of the local acquisition, the communication is established using Profibus. It is a master/slave protocol based on polling operations, that is, all modules are polled sequentially one after the other.

NOTICE
The valid range for Profibus address in Saitel DP is between 0 and 96.

The following types of modules can be configured:

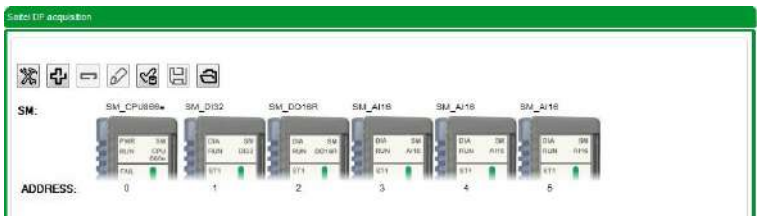
Figure 96 – Available Saitel DP modules in Easergy Builder



Each acquisition signal is associated to a coreDb point as source. This point can be used as a source or destination for others coreDb points.

To access to the local acquisition configuration interface, double-click on the laq Device:

Figure 97 – Configuring local acquisition



Acquisition strategy

Set the refresh and integration periods for the different types of signals.

Add a new module

Add a new module.

Remove a module

Remove a module.

Change address of the selected module

Change the address for a module.

Create module points on coreDb

Create in coreDb acquisition and diagnostics points for all included modules.

Save LAQ configuration

Save the current Device's settings in a XML file.

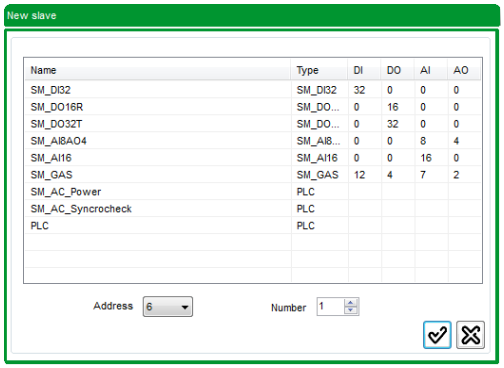
Load LAQ Configuration

Load the Device's settings previously saved in a XML file.

4.6.1.1 Adding New Modules

Press "Add New Module" to add new modules. The following window will appear:

Figure 98 – Adding new I/O modules

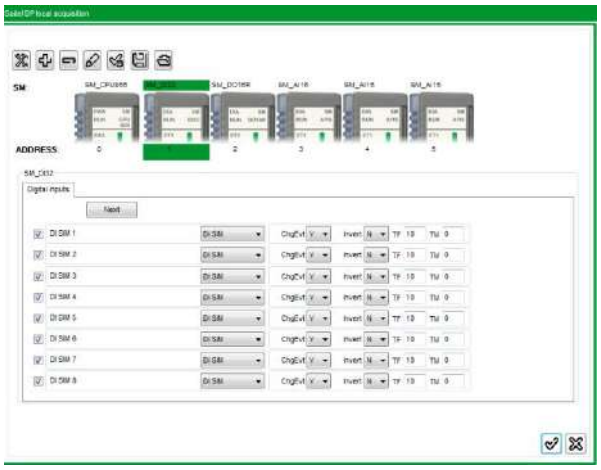


Select the module to be included on the list. Enter the number of modules of the selected type to be added in the field "**Number**". Select OK button and new modules will be included in the RTU. A Profibus address is automatically assigned to each module. This address can be changed using button .

The new address can be selected. Only unassigned addresses will be available.

Once the modules are added, it is necessary to configure the associated signals. To do so, click the corresponding module on the picture and its signals will be shown.

Figure 99 – Configuring acquisition signals for a I/O module



The configuration for each type of module which can be added is explained in further sections.

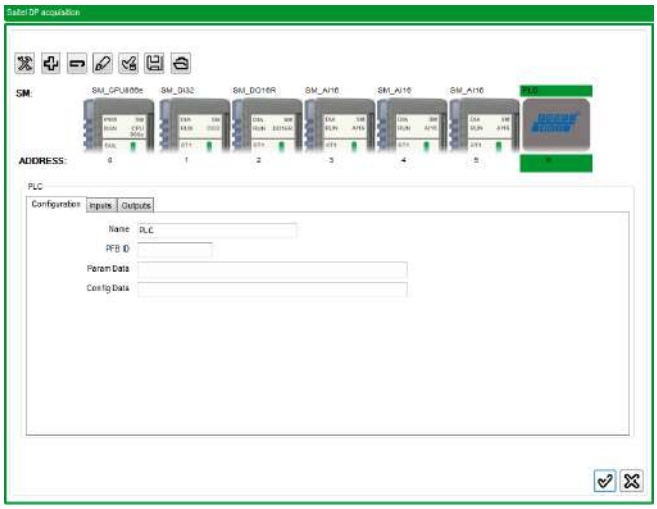
4.6.1.2 Deleting a Module

To delete a module, select it on the picture and use button . The module will be removed from the tree after confirming the operation.

4.6.1.3 PLC Configuration

By selecting a PLC module on the picture, the following configuration window will be displayed:

Figure 100 – PLC module configuration



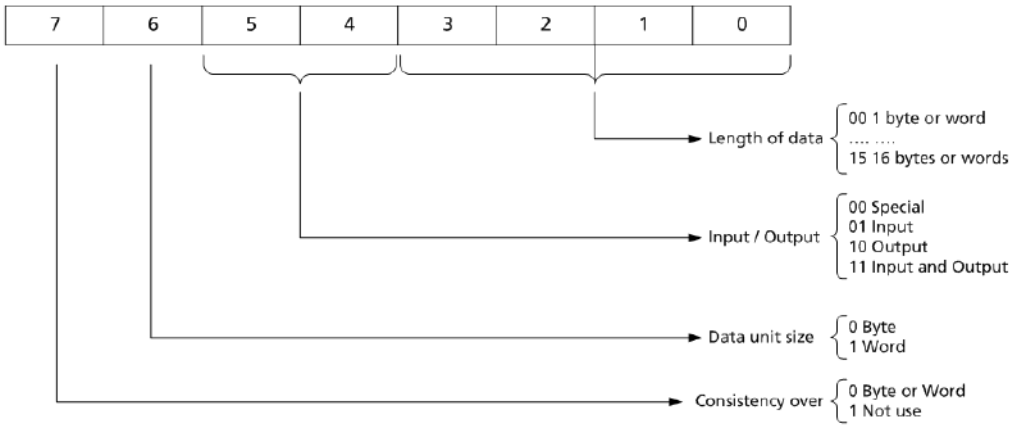
There are three tabs; Configuration of the PLC, Inputs configuration and Outputs configuration.

PLC Configuration

The information entered in “Device ID”, “Param Data” and “Config Data” fields must be consistent with the information contained in the GSD file provided by the PLC’s manufacturer which is being configured.

- **Name**: Device or PLC's name
- **PFB ID**: PLC Identifier; a 4-digit hexadecimal number provided by the manufacturer. Enter the string labeled as Ident_Number in the “General Parameters” tab included in GSD file. For example, if “Ident_Number = 0x05FC”, the user should indicate “05FC” as PFB ID.
- **Param Data**: These are the data to be sent by the master Profibus when “Send Parameter Data” is enabled. In the GSD file, there is a section named “UserPrmData: Length and Preset:” which includes a string labeled as User_Prm_Data. This string will be entered in this field. For example, “User_Prm_Data=0x00,0x00,0x00”.
- **Config Data**: Sequence of bytes in hexadecimal that describes the map size for inputs and outputs for the Profibus slave. The documentation of the slave (device master file) must specify the map size of inputs and outputs. The format of these bytes is described in the standard EN 50170-8-2: 1996 page 832. A partial length is detailed simultaneously in each byte for inputs, outputs or inputs and outputs. The length of the complete map is the addition of the length indicated in all bytes. Below is an excerpt from the standard explaining the bytes format in hexadecimal:

Figure 101 – Example of a PLC Configuration



A GSD file is the configuration file supplied for the provider for the PLC. Following table shows a part of this file for a PLC by ABB:

```
;=============================================================
;General parameters
;=============================================================
GSD_Revision    =3
Vendor_Name     ="ABB"
Model_Name      ="PDP22-FBP ABB"
Revision        ="V 1.0"
Ident_Number    =0x082D
Protocol_Ident =0
Station_Type    =0
…
;=============================================
; Module Definition List
;=============================================
;
Module="UMC22-FBP (V3.0)" 0x11, 0x21, 0x50     ; 16DI, 16DO, 1AI
1
Ext_Module_Prm_Data_Len=42                                  ; number of used data byte
Ext_User_Prm_Data_Const(0) =  \ ; initialising of param data
                                0x00,0x00,0x00,0x32,0x00,0x01,0x00,0x00,0x00,0x32,0x01, \
                                0x01,0x01,0x00,0x0A,0x1E,0x04,0xB0,0x00,0x01,0x02,0x04, \
                                0xB0,0x00,0x00,0xC8,0x00,0x14,0x00,0x00,0x00,0x00,0x00, \
                                0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x0A,0x00
```

The content of the identifier “Ident_Number” must be included into the field “PFB ID”. The hexadecimal numbers following the module’s name must be included into the field “CFG_DATA”. Finally, the hexadecimal string following the identifier “Ext_User_Prm_Data_Const(0)” must be included into the field “PARAM_DATA”.

When the content of the messages to be exchanged with the PLC is completely defined, the user can configure the input and output signals which will store the information contained in these messages.

Use "**Add**" and "**Remove**" buttons to add and remove inputs from the list, respectively. After pressing "**Add**", an input will be added with default settings, which can be modified, (except NUMBER) by clicking the selected item.

Select an input and press the "**Remove**" button to delete it from the list.

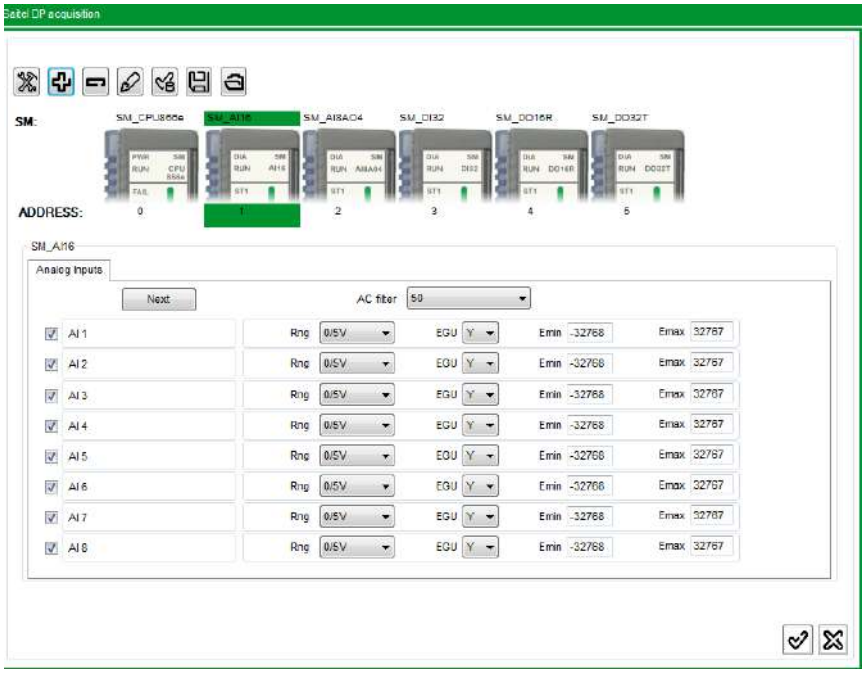
Press "Add" on the tab "Inputs" and a new Input will be created. The information associated for each signal is:

- Point number.
- Point's name
- Type of point (size in bits within the message). The size can be 1, 2, 8, 16, 32 bits or 1 bit event.
- Address of the information related to the signal within the message.

4.6.1.4 SM_AI16 Configuration

By selecting a SM_AI16 module you can see the following window:

Figure 102 – SM_AI16 Module Configuration



This module includes 16 analog signals to be configured. Each signal has associated the following fields:

- **AIx**: Signal description. This value can be changed although it does not affect the signal's identification, as its identification label, which is automatically attached, is internal and cannot be changed. This is applicable to all signal descriptions in all modules.
- **Rng**: Signal's voltage range.

- **EGU**: Flag indicating whether engineering units are considered. El value “N” indicates “**engineering units**” (the Bin output will be between EMIN and EMAX) and the value “Y” indicates “**counts**”. These signals when configured in engineering units can take a value between:
    - **EMin**: Minimum value expressed in engineering units. The range is: -32768 to 32767.
    - **EMax**: Maximum value expressed in engineering units. The range is: -32768 to 32767.
- The “**AC FILTER**” field is associated to a band rejection filter at 50/60 Hz to avoid the damaging effects of network noise. If no filter needs to be used, set NONE.

4.6.1.5 SM_AI8AO4 Configuration

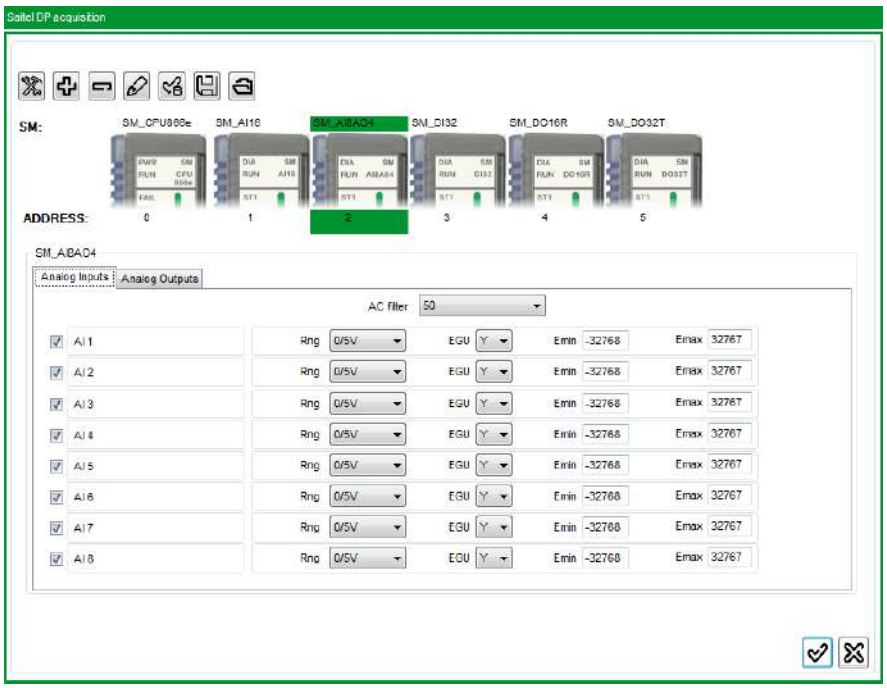
Select a SM_AI8AO4 module on the tree to open the configuration screen, which includes a module with analog inputs and outputs. The configuration window has two panels:

- Analog Inputs
- Analog Outputs

The analog inputs panel is identical to the panel described for SM_AI16 module, but this time it has 8 signals only instead of 16.

The second panel, labeled as “Analog Outputs” is used to configure the analog outputs:

Figure 103 – Configuration of analog outputs in a SM_AI8AO4 module



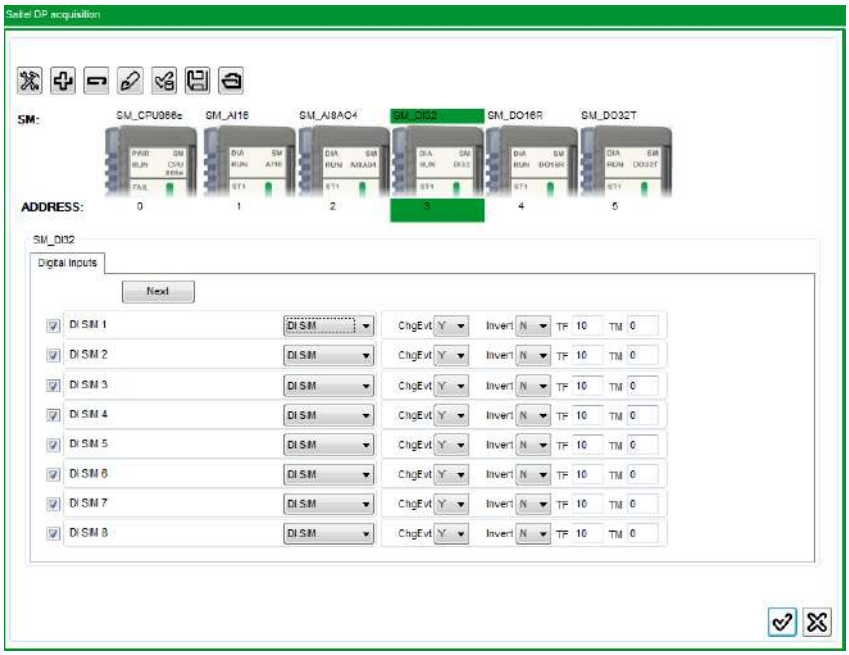
- **Rst**: Value taken by the output after a CPU reset (% of output range).
- **Keep**: If the value is set to “Y” the output is retained. if the communication with the CPU is lost.

Other parameters on this screen are detailed in paragraph “SM_AI16 configuration”.

4.6.1.6 SM_DI32 Configuration

Select a SM_DI32 module on the tree to open the configuration screen:

Figure 104 – Configuration of digital inputs in SM_DI32 module



For each signal, the following items can be defined:

- **Input type**. The following options are available:
  - **DI_ISIM**: Simple Digital
  - **DI_IDOB**: Double Digital
  - **DI_CNT**: Slow Counter.
- **ChgEvt**: It indicates whether changes may generate events. The “Y” value will generate events, whereas “N” value will not generate them.
- **Invert**: It indicates whether the signal is inverted.
- **TF**: Filtering time expressed in milliseconds; a change in the value which last less than the TF will not be registered. Thus, glitches will not be detected.
- **TM**: Time in memory, expressed in units of 10 milliseconds. It is the time that a pulse will be stored in memory in order to ensure the correct detection by the logic executed.
- **DBLCNT**: Pulse counter. This field is available for DI_ICNT signals; the value “Y” indicates that the two edges of each pulse are counted, whereas the value “N” indicates that only one edge is counted.
- **TS**: Settling time, expressed in units of 100 milliseconds. This field is only definable for double signals. It is the maximum allowed time in an invalid state (11, 00).

If any signal is set a double digital signal, the next signal available will be disabled, since a double signal takes two signals:

A detailed explanation of TF, TM, and TS is included in the corresponding section of the Saitel DP module manual.

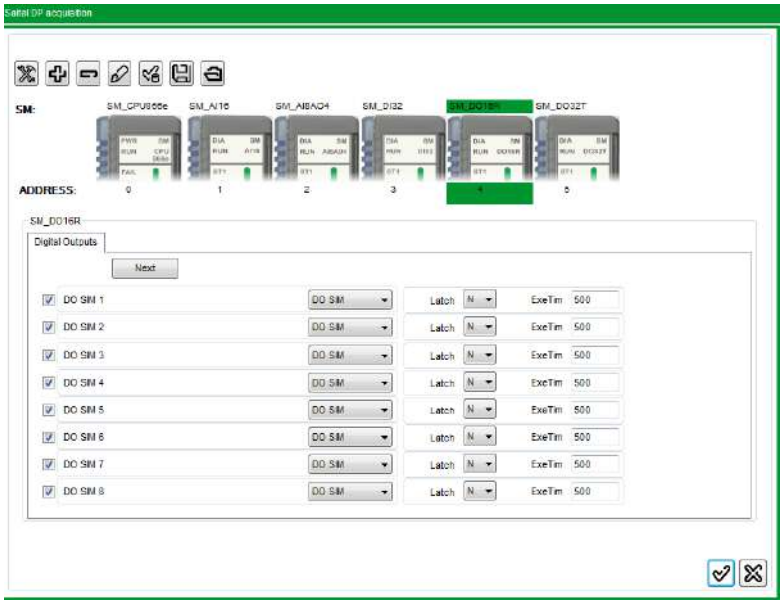
If a signal is set as DI_CNT, the parameters to be defined include the filed DBLCNT. The value “Y” indicates that both edge of each pulse are counted, whereas the value “N” indicates that only one edge is counted.

Finally, the button labeled with an horizontal arrow is used to access the rest of digital inputs of the module, that is, from 17 to 32.

4.6.1.7 SM_DO16R Configuration

The following configuration panel is displayed when selecting a SM_DO16R module:

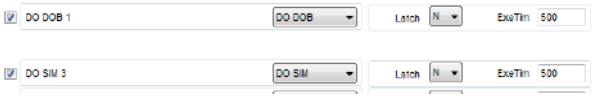
Figure 105 – SM_DO16R module configuration



For each signal, the following items can be changed:

- **Signal type**. The following items can be selected:
  - **DO_SIM**: Simple digital output.
  - **DO_DOB**: Double digital output.
- **Latch**: The value “Y” indicates the signal is retained, whereas the value “N” indicates it is not.
- **ExeTime**: Time in which the signal’s value is retained. It is applied when the value of field **Latch** is “N”. The value is expressed in milliseconds, but its accuracy is 100 ms.

Like digital inputs, if you set a signal as DO_DOB, the following signal is not available:



4.6.1.8 SM_DO32T Configuration

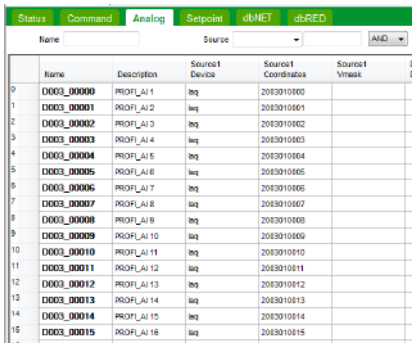
The configuration panel for SM_DO32T module is identical to the panel of SM_DO16R explained.

4.6.1.9 Generating Point in coreDb

When all modules have been configured in the acquisition local panel, all acquisition and supervision signals associated to these modules have to be included in coreDB by pressing button  .

For example, for the module SM_AI16, the following signals are included into the analog table:

Figure 106 – Analog signals included in coreDb



4.6.2 Signal Identification - Coordinates

The coordinate is an unique identifier of a signal within a Device. Its definition is different for each Device Controller and the local acquisition is defined with ten digits with the following format:

2 XXX YY ZZZZ

Where:

- **2**: For Saitel DP, the first number of the coordinate for all local acquisition signals must be 2.
- **XXX**: Number that identifies the module. It will be the address configured using microswitches on the rear side of the I/O module. The CPU modules are associated to 000 and address 001 and onwards can be used for I/O modules.
- **YY**: Type of signal, which includes:
    - 00: Diagnostic signals.
    - 01: Analog signal (signed 32-bit signal).
    - 02: Simple digital input (1 bit).
    - 03: Counter (32 bits).
    - 04: Analog output (16 bits).
    - 05: Simple digital output (1 bit).
    - 07: Double digital input (2 bits).

- 08: Frequency meter.
- 09: Quick counter (32 bits).
- 15: Double digital output (2 bits).

- **ZZZZ**: Signal number within the acquisition block. The number ranges from 0000 to 9999. For Diagnostic signals (YY = 00), then 0000 → module´s communication state and 0001 → Module's hardware state.

Example:

In coreDb we create a point to with the local acquisition signal (Device laq) with the coordinate 2005030002 is assigned as the source. It means that this coreDb point obtains its value from the third signal (0002) of 32-bits counter type (03) in module number 5 (05) of the RTU.

4.6.3 Diagnostic Signals

The following tables describe the coordinates of the diagnostic signals provided by the local acquisition controller. They are valid for all modules except for the STS_PPS indication, which is only available in those modules with a digital input. It will adopt the correct value for the rest of modules. Its name and complete coordinate (for this signals CC=00) is equivalent:

Table 8 – Diagnostic signals of the Saitel DP local acquisition

Coordinate		Description
Name	DDDD	
STS_COMM	0000	Module offline. Value 1 indicates that there is not communication with the module.
STS_DIAG	0001	Module with diagnostics. Value 1 indicates a diagnostics. Usually correspond to a polarization event in the module.
STS_PPS	0002	PPS Indication. Value 1 indicates that there is a digital input configured as event in the module and PPS signal is not received.
STS_FAILBUS1	0003	Value 1 indicates a communication event in Profibus1.
STS_FAILBUS2	0004	Value 1 indicates a communication event in Profibus2.

If a coreDb point has assigned the signal 2003000000 as source, the value of this point indicates the communication status of the module 003 (address).

The value of the signal 2007000004 changes to 1 when the communication with the module 007 is lost.

4.7 Other Available Functions in Saitel DP

4.7.1 Formulas

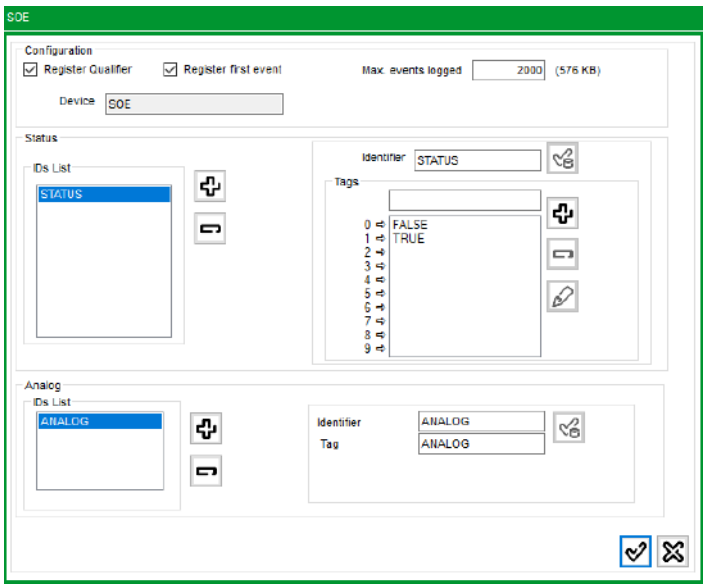
coreDb signals can be associated to a series of functions such as: mathematic operations, logical operations or event triggering. All these functions are implemented and controlled by the Formula Device available in Easergy Builder.

In Easergy Builder user manual, you can find all the details about the use of this Device, as well as available functions.

4.7.2 Sequence of Events (SOE)

HU includes a Sequence of Events file that registers the events produced in the RTU. This functionality must be configured by the user, with the Easergy Builder tool.

Figure 107 – SOE configuration



For additional information about how to configure the SOE, please refer to the Easergy Builder user manual and SOE manual

4.7.3 PLC Configuration

The HUe module integrates the use of ISaGRAF®, that is, a logic programming tool working under the IEC 61131-3 environment to develop PLC programs.

ISaGRAF® is a third party tool consisting of two parts:

- Runtime: Control and execution environment for logic programs. The licence is included as part of the Baseline Software Platform installed in the HUe module.
- Workbench: Development environment. It is installed in a PC, and needs to be purchased for the project, since it requires an additional license that is not included as part of our software platform.

The logic programming languages include:

- **SFC**: Sequential Function Chart
- **FBD**: Function Block Diagram
- **LD**: Ladder Diagram
- **ST**: Structured Text
- **IL**: Instruction List

To let ISaGRAF® interact with coreDb, you need to define a Device of this type in Easergy Builder.

For detailed information about the use of ISaGRAF® inside Saitel, please refer to the Device user manual.

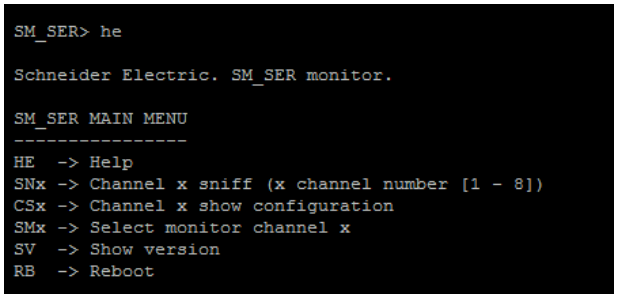
4.7.4 Monitoring Communications

SM_SER allows monitoring its channels using the COM8 port. In order to use this monitoring tool, the following procedure should be follow:

- The switch 12 of the SM_SER module must be ON
- Connect the PC with the module using the COM8 port by default. This port can be changed to channel x using command SMx (more information later in this paragraph).
- Open a terminal window similar to the console tool.

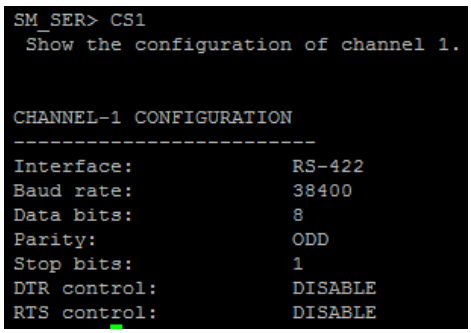
A prompt for the SM_SER module should be shown, for example “SM_SER>”. Execute the command “help” and you can see a help with available commands:

Figure 108 – SM_SER Main Menu.



- **HE**: Show this menu.
- **SNx**: Start monitoring (sniff) for channel x, where x is from 1 to 8.
- **CSx**: Show configuration of channel x. For example:

Figure 109 – Channel configuration in SM_SER.



- **SMx**: Change the monitor channel to channel x. This operation must be confirmed before channel x is the new channel monitoring.
- **SV**: Show the software version installed in the module (SM_SER).
- **RB**: Reboot

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Glossary

A

A: Ampere.

AC: Alternate Current.

AI: Analog Input.

ANSI: American National Standards Institute.

AO: Analog Output.

AWG: American Wire Gauge.

B

Baseline: Schneider Electric's software platform.

Bps: Bits per second.

C

ºC: Celsius degree.

COM: Puerto de comunicaciones.

CON: Console port.

coreDb: Real-time database.

CPU: Central Processing Unit.

CTS: Clear to Send.

D

DB: Database.

DC: Direct Current.

DI: Digital Input.

DIN: Deutsches Institut für Normung.

DO: Digital Output.

DRAM: Dynamic Random Access Memory.

E

EGU: Engineering unit.

EMC: ElectroMagnetic Compatibility.

EN: English languaje.

EPROM: Erasable Programmable Read Only Memory

ETH: Ethernet port.

F

FTP: File Transfer Protocol.

G

g: Gram.

GPS: Global Positioning System.

H

HU: Head Unit. Saitel DR CPU.

HU_A: Saitel DR Advanced Head Unit.

HU_AF: Saitel DR Advanced Head Unit with acquisition.

HU120: Saitel DR High-Performance Head Unit with acquisition.

HUe: Saitel DR High-Performance Head Unit.

Hz: Hertz.

I

IEC: International Electrotechnical commission.

IED: Intelligent Electronic Device.

I/O: Input / Output.

IP: Internet protocol.

IRIG: Inter Range Instrumentation Group.

IRIG-B: Mode B of the standard IRIG.

ISO 9001: International standard for Quality Systems.

ITB: Intelligent Terminal Block.

K

KB: Kilobyte.

Kbaud: Kilobaud.

kHz: Kilohertz.

L

LAN: Local Area Network.

laq: Saitel DP local acquisition device.

LED: Light Emitting Diode.

M

mA: Milliampere.

MHz: Megahertz.

MB: Megabyte.

Mbaud: Megabaud.

Mbps: Megabits per second.

m: Meter.

mm: Millimeter.

ms: Millisecond.

MSAC: Supervision, Arbitration and Switching Module.

N

N/A: Non-Application.

NVRAM: Non Volatile Random Access Memory.

P

PC: Personal Computer.

PLC: Programmable Logic Controller.

PPS: Pulses per Second.

PS: Power Supply.

PWR: Power.

R

RAM: Random Access Memory.

RCP: Redundancy Control asynchronous Protocol.

RS-232: Communication standard.

RS-485: Multipoint differential Bus.

RTC: Real Time Clock.

RTDB: Real Time DataBase.

RTOS or OS: Real-time operating system.

RTS: Request To Send.

RTU: Remote Terminal Unit.

Rx: Reception

S

s: Second.

SCADA: Supervisory Control And Data Acquisition.

SM_AI16: I/O module with 16 analog inputs.

SM_AI8AO4: I/O module with 8 analog inputs and 4 analog outputs.

SM_CPU866e: High-performance control module.

SM_DI32: I/O module with 32 digital inputs.

SM_DO16R: I/O module with 16 analog outputs to relay.

SM_DO32T: I/O module with 16 analog outputs to transistor.

SM_PS40: High-performance power supply.

SM_SER: Serial communications module..

SNTP: Simple Network Time Protocol.

SRAM: Static Random Access Memory.

T

TCP/IP: Transmission Control Protocol/Internet Protocol.

TFTP: Trivial File Transfer Protocol.

TU: Terminal Unit.

Tx: Transmission.

V

VAC: Volt of Alternate Current.

VDC: Volt of Direct Current.

W

W: Watt.

QR code

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Schneider Electric

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