XPSMF60

Hardware Manual

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All pertinent state, regional, and local safety regulations must be observed when installing and using this product. For reasons of safety and to help ensure compliance with documented system data, only the manufacturer should perform repairs to components.

When devices are used for applications with technical safety requirements, the relevant instructions must be followed.

Failure to use Schneider Electric software or approved software with our hardware products may result in injury, harm, or improper operating results.

Failure to observe this information can result in injury or equipment damage.

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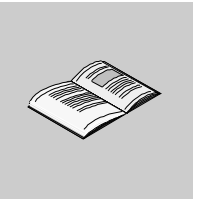
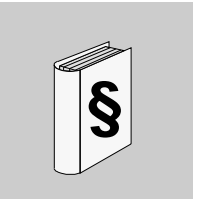


Safety Information



Important Information

NOTICE

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

The addition of this symbol to a Danger or Warning safety label indicates that an electrical hazard exists, which will result in personal injury if the instructions are not followed.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

⚠ DANGER

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

⚠ WARNING

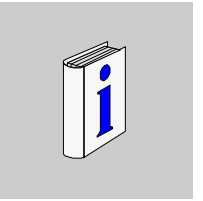
WARNING indicates a potentially hazardous situation, which, if not avoided, **can result** in death, serious injury, or equipment damage.

⚠ CAUTION
CAUTION indicates a potentially hazardous situation, which, if not avoided, **can result** in injury or equipment damage.

PLEASE NOTE

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.

About the Book



At a Glance

Document Scope

This manual describes the XPSMF60 Safety Programmable Logic Controller (PLC).

The following descriptions of the XPSMF60 Safety PLC are included in this manual:

- dimensions and installation
- application and function
- equipment description
- application examples

Validity Note

This documentation is valid for XPSMF60 Safety Programmable Logic Controller (PLC)

Product Related Information

The XPSMF60 Safety PLC has been tested and certified by TÜV for functional safety in accordance with CE and the standards listed below:

- TÜV Anlagentechnik GmbH Automation, software, and information technology Am Grauen Stein 51105 Köln
- Certificate and test report No. 968/EZ 128.04/03 Safety-related automation devices
  HIMatrix F60
- International standards
  - IEC 61508, parts 1-7: 2000, up to SIL 3
  - EN 954-1: 1996, up to Category 4
  - EN 54-2: 1997
  - EN 298: 1994
  - NFPA 72: 1999
  - NFPA 8501:1997
  - NFPA 8502: 1999
  - EN 61131-2: 1994 and A11: 1996, A12: 2000
  - EN 61000-6-2: 2000, EN 50082-2: 1996, EN 50081-2: 1993
- National standards
  - DIN V VDE 0801: 1990 and A1: 1994
  - DIN V 19250: 1994, up to RC6
  - DIN VDE 0116: 1989, prEN 50156-1: CDV 2000

The corresponding programming software is XPSMFWIN. The software is executable in the Microsoft Windows 2000/XP. The software helps the user to create safety-related programs and operate the Programmable Electronic System (PES).

NOTE: The declaration of conformity is provided within the hardware product's packaging. All devices are labelled with the CE sign.

User Comments

We welcome your comments about this document. You can reach us by e-mail at techcomm@schneider-electric.com.

Overview: XPSMF60

1

Overview

This chapter contains an overview of the XPSMF60 modular Safety PLC.

What's in this Chapter?

This chapter contains the following topics:

Introduction

XPSMF60 Safety PLC

XPSMF60 is a Safety PLC, designed to monitor safety functions up to safety Category 4 according to EN 954-1 and SIL 3 according to IEC 61508. XPSMF60 is a modular programmable electronic system (PES) in a metal rack system housing with various input/output modules.

The Safety PLC is a highly visible product thanks to its red color housing. The product's overall ingress protection rating is IP 20. The XPSMF60 is an extremely versatile product and can be used in all areas of a factory floor. In areas where conditions are harsh, explosive or generally dangerous, extra protection in the form of enclosures is available to optimize the product's performance, prolong its life, and improved safety within each factory environment. The XPSMF60 is a very powerful Safety PLC and is very easy to program and install.

XPSMF60 Modules

The XPSMF60 Modular System Safety PLC can use 8 out of 9 standard modules. XPSMFPS 01 (power supply module) and XPSMFCPU 22 (central module) must always be installed. Any combination of the 7 I/O modules can be used in the 6 available slots.

The following table describes the XPSMF60 modules:

Module	Properties	I/O Range
XPSMFCPU 22	central module	4 Ethernet ports, integrated switch, Modbus slave
XPSMFPS 01	power supply unit	
XPSMFAI 8 01	analog input module	8 unipolar inputs 0 to +/-10 VDC 4 bipolar inputs -10 to +10 VDC with shunt of 0 mA / 4 to 20 mA
XPSMFAO 8 01	analog output module	8 outputs 0 to +/-10 V / 0 mA / 4 to 20 mA
XPSMFDI 24 01	digital input module for high voltages	24 inputs, 110 VDC, 127 VAC
XPSMFDI 32 01	digital input module, configurable with Line Control	32 digital inputs 24 VDC
XPSMFDO 8 01	digital output module with relay outputs	8 relay contact outputs 110 VDC, 230 VAC

Module	Properties	I/O Range
XPSMFDIO 24/16 01	digital input/output module, outputs configurable as pulsed outputs for Line Control	24 digital inputs 24 VDC 16 digital outputs 24 VDC
XPSMFCIO 2/4 01	counter module	2 counters to 1 MHz 4 digital outputs

Other XPSMF Safety PLCs

Along with XPSMF60, the entire product line of XPSMF Safety PLCs is available from Schneider Electric. You can distinguish between the products and their functionality using labels, as explained below.

Any Schneider Electric Safety PLC has a label that standardly comprises the following elements:

Element	Description
F1 F2 F3 F30 F35 F60	Remote I/O module contains digital inputs. Remote I/O module contains transistor and relay outputs. Remote I/O module contains either analog or digital inputs / outputs. Compact Safety PLC Compact Safety PLC Modular Safety PLC
DI DO DIO AI AO AIO	digital inputs digital outputs digital inputs and outputs analog inputs analog outputs analog inputs and outputs
8 16	number of inputs or outputs
01 02	release number
XPSMF	Preventa Safety PLC range

Programming

To program the XPSMF60, you need a PC running the XPSMFWIN programming environment and program languages FBD and SFC, according to the IEC 61131-3. The software tool helps you to create safety-related programs and operate the unit.

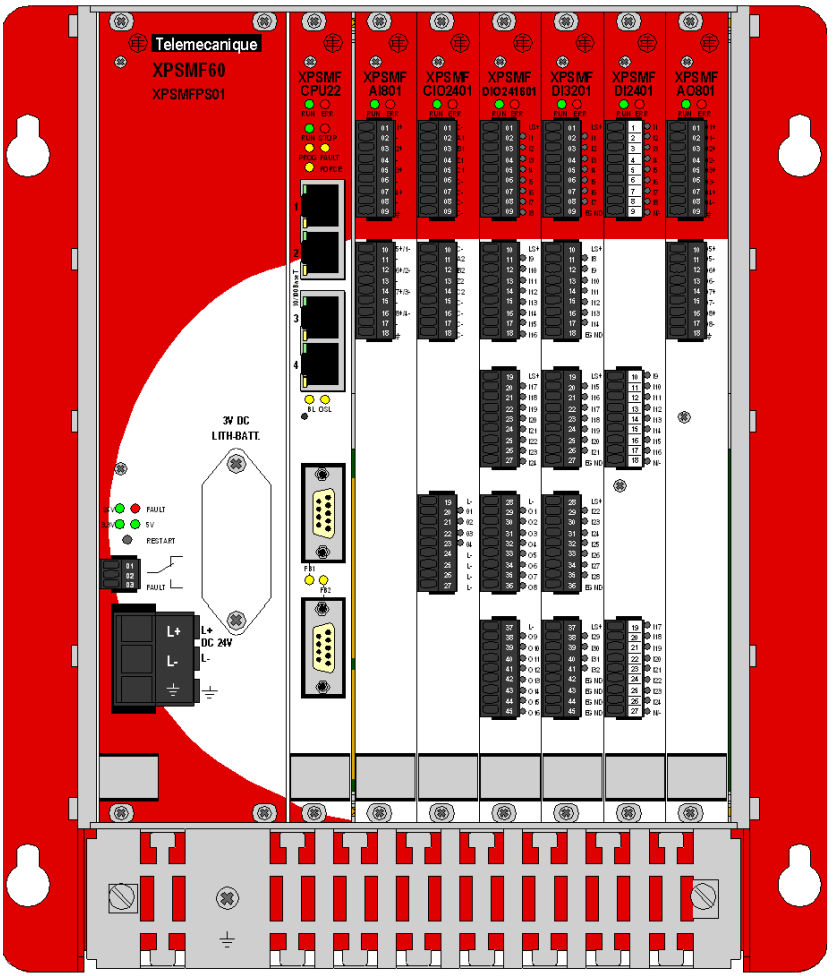
Representation

Overview

This section provides images of the XPSMF60 Safety PLC.

Front View

The following image shows the front view of the XPSMF60 Safety PLC:



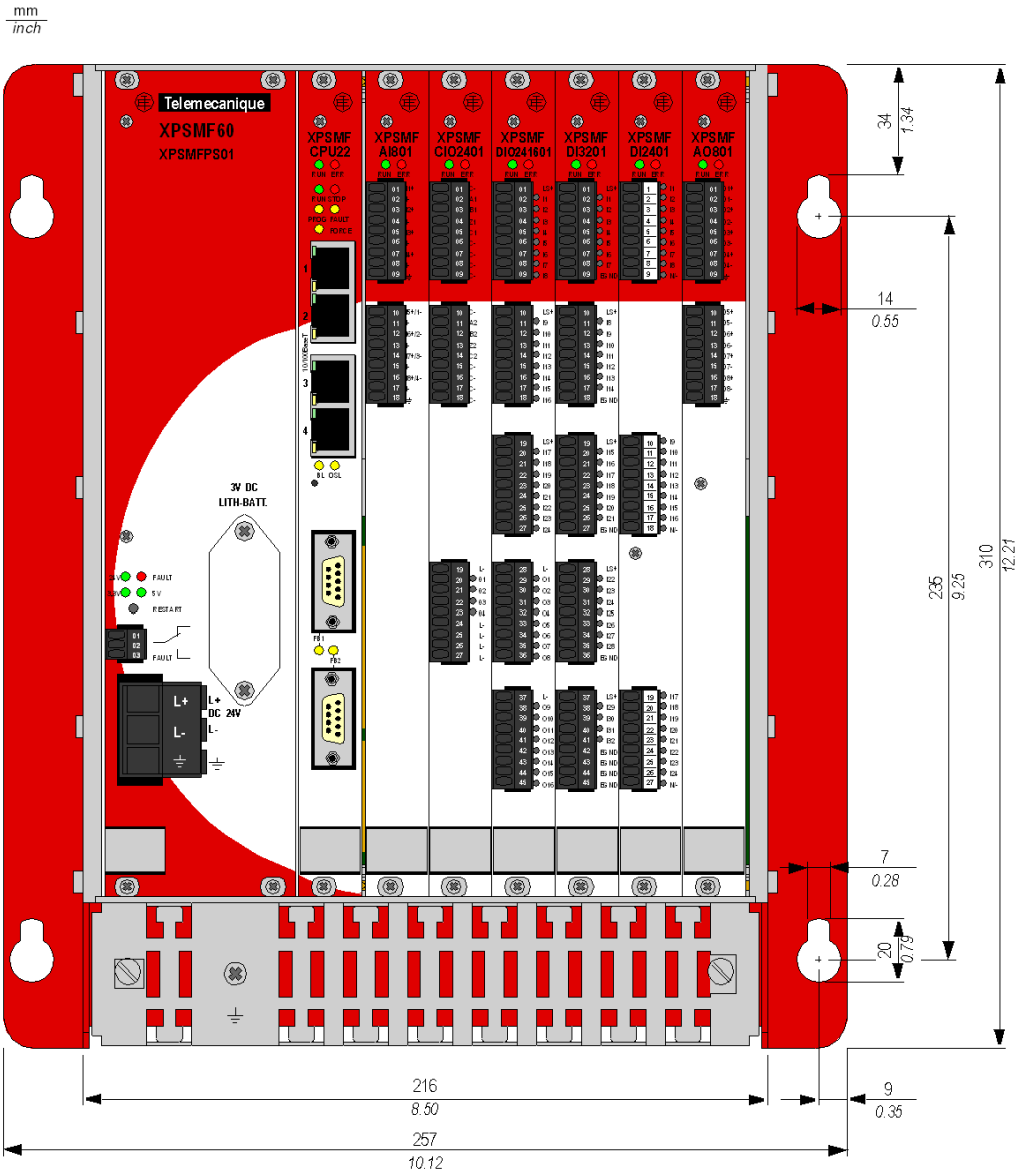
Dimensions

Overview

The following section contains information about the dimensions of the XPSMF60 Safety Modular System PLC and shows the front view of the Safety Modular System PLC.

Front View Dimensions

The following image shows the front view dimensions of the XPSMF60 Safety Modular System PLC:

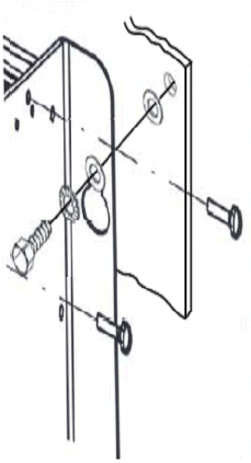


Installation

Introduction

The XPSMF60 Safety Modular System PLC must be mounted on a vertical, flat, and even base. Secure the unit with screws that are maximum 6 mm in diameter and have head diameter of maximum 13 mm (0.51 in.). The screws should be capable of bearing the weight of the unit.

The following image illustrates installation of the unit on a vertical surface:



⚠ CAUTION

OVERHEATING

- For effective cooling, install the unit vertically with the fans directed downwards.
- Leave 100 mm (3.94 in.) above and below the unit.
- Ensure that the unit is NOT mounted above potential sources of heat (e.g., heating equipment).
- Take into consideration the installation procedure and maximum operating temperature.

Failure to follow these instructions can result in injury or equipment damage.

During the module installation, ensure the power supply unit is not connected to the terminals. Only qualified personnel should be responsible for replacing modules and modifying the system.

NOTE: The installation must be performed so that:

- the device is not subject to heat emission from neighboring devices and
- devices with high EMC interference do not affect the XPSMF60.

Heat emission and electromagnetic compatibility (EMC) must be checked for devices from other manufacturers to ensure that the operation of the Safety Modular System PLC is not affected by any external device.

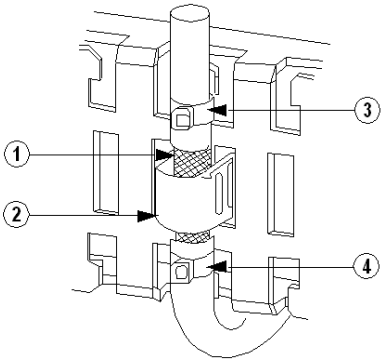
The overall installation space for all cables must also be taken into account to ensure sufficient ventilation. Additional measures, such as installing heat extraction fans, can be taken if the housing of the product becomes warm.

Securing Cable and Connecting the Shielding

The cables are driven in vertically from below and secured with two cable binders to the earthing grid.

The shielding of a cable is attached to the earthing grid with a bracket. The bracket is also positioned over the cable shielding that is not insulated and pushed into the rectangular openings of the earthing grid on both sides until it is firmly in place.

The following image illustrates cable connection and shielding:



1 Cable shielding
2 Earthing bracket
3 Cable binder / Cable tie for securing cable
4 Cable binder / Cable tie for securing cable

NOTE: The shield clamp may not be used as a strain relief for the connected cable.

⚠ CAUTION

STATIC SENSITIVE COMPONENTS

The Safety PLC can be damaged by static electricity. Observe the electrostatic precautions below when handling the Safety PLC.

Failure to follow these instructions can result in injury or equipment damage.

Observe the following precaution when handling static sensitive components:

- Keep static producing material (plastic, upholstery, carpeting) out of the immediate work area.
- Store the Safety PLC in it's protective packaging when it is not installed.
- When handling the Safety PLC, wear a conductive wrist strap.
- Avoid touching exposed conductors and components leads with skin or clothing.

Available Modules

Modular spacing unit (SU) has the width of 5.08 mm (0.2 in.). 40 SUs are available, 24 of which can be used with any of the input and output modules, as required.

The following table shows a list of modules available:

Designation	Functions	Width
XPSMFPS 01	power supply module	12 SU
XPSMFCPU 22	central module with communication	4 SU
XPSMFAI 8 01	8 analog inputs	4 SU
XPSMFAO 8 01	8 analog outputs	4 SU
XPSMFCIO 2/4 01	2 counters, 4 digital outputs	4 SU
XPSMFDI 32 01	32 digital inputs	4 SU
XPSMFDI 24 01	24 digital inputs (110 VDC)	4 SU
XPSMFDIO 24/16 01	24 digital inputs, 16 digital outputs	4 SU
XPSMFDO 8 01	8 relay outputs (up to 230 VAC / 110 VDC)	4 SU

Order of Assembly

The following table explains the assembly of modules (from left to right):

Slot	Module
Slot 1	only for power supply module XPSMFPS 01
Slot 2	only for central module XPSMFCPU 22
I/O Slots (numbered 3-8)	I/O modules with various functions, as required

⚠ CAUTION
INCORRECT PLACEMENT OF MODULES Assemble the unit in the order assigned in the user program. Altering the module layout can be carried out only when the system is not in operation. The relevant modified user program must be re-loaded. **Failure to follow these instructions can result in injury or equipment damage.**

Inserting Modules

The following table describes how to insert modules:

Step	Action
1	Push the module without tilting it as far as it can go into the guide supports located at the top and bottom of the housing.
2	Push the upper and lower ends of the front plate until the connector of the module is firmly in place in the socket of the backbone.
3	Secure the module with two screws on the upper and lower sides of the front panel.

Removing Modules

The following table describes how to remove modules:

Step	Action
1	Remove all connectors from the front panel.
2	Loosen the securing screws on the upper and lower sides of the module's front panel.
3	Using the grip (at the bottom of the front plate), loosen the module and pull it out of the guide supports.

Connecting Operating Voltage

Electrical connection is carried out via a 3-pole withdrawable connector on the front panel of the power supply module (XPSMFPS 01). The connector can accommodate lines of up to 6 mm^2 (AWG 10).

The following table shows the dependency between connection and functions:

Connection	Function
L+ DC 24 V	voltage supply L+ (24 VDC)
L- DC 24 V	voltage supply L- (24 VDC, reference pole)
⏚	earthing / shielding

If a shielded line is used for the voltage supply, the shield is also connected via the earthing contact to the connector of the voltage supply.

During operation, the 24 VDC is automatically monitored; reactions are dependent on the voltage levels shown in the table below:

Voltage Level	Reaction of the Controller
19.3 to 28.8 VDC	normal operation, no reaction
< 18.0 VDC	alarm state 1 (internal variables are written and put to the inputs/outputs)
< 12.0 VDC	disconnection

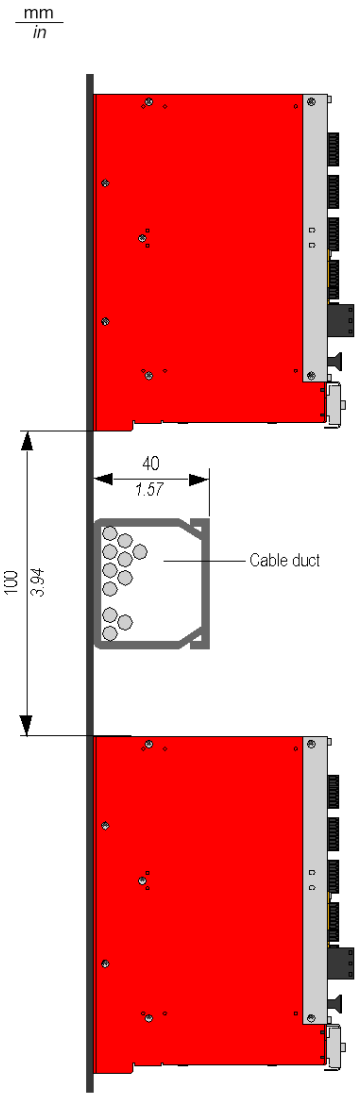
The operating voltage can be evaluated on a programming unit running the software XPSMFWIN via the **Power Supply State** system signal.

NOTE: The power supply must fulfil the requirements of IEC/EN 61131-2 or SELV (Safety Extra Low Voltage) or PELV (Protective Extra Low Voltage).

Air Circulation

The ventilation slots in the housing must not be covered. When installing the XPSMF60 ensure that the vertical distance between units is 100 mm (3.94 in.) or more.

Use of cable ducts with horizontal mounting of compact devices on rails:



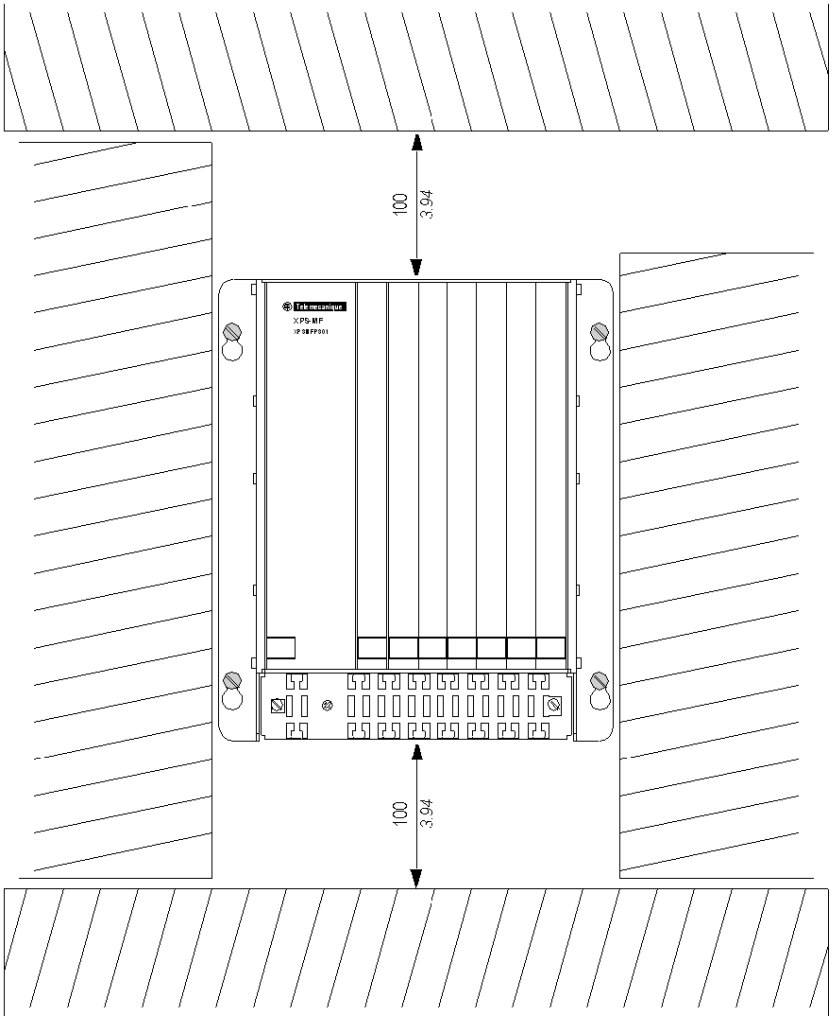
Minimum clearance between the Safety Modular System PLCs:

No.	Description
1	Installation with spacers: the height of cable ducts is greater than 40 mm / 1.57 in.; the vertical separation increases.
2	The XPSMF60 Safety Modular System PLC is mounted vertically.
3	The minimum distance between units is 100 mm / 3.94 in.

NOTE: If the cable ducting is greater than 40 mm / 1.57 in., then a greater separation is required between other units or devices.

Minimum clearances required by the XPSMF60 Safety PLC

mm
in



On open mounting surfaces, observing the minimum clearance and ensuring unobstructed air circulation will help maintain the optimum operating temperature.

Heat

Increasing integration of electronic components into smaller parts results in large amounts of heat dissipation on a small surface area. The amount of heat produced depends on the external load of the device. Depending on the design of the device, installation, design location, air circulation, and environmental conditions make a very significant impact on the operating temperature of the product.

It is important to comply with the approved environmental conditions when installing the device. Reduced operating temperature extends the life of the device and reliability of the installed components.

If the XPSMF60 requires an additional enclosure to increase the ingress protection, the enclosure case must be designed in such a way that the heat generated inside it can dissipate from the surface of the enclosure. The type of enclosure and location of installation selected must easily allow heat dissipation. If possible, a fan should be used to ensure air circulation.

NOTE: An additional enclosure can be used to increase the ingress protection of the XPSMF60 Safety Modular System PLC.

The enclosure's surface area, A is calculated depending on the mounting or installation type as follows:

The following table is used to calculate the recommended enclosure size for mounting the XPSMF60.

Case installation		**Calculation of A [m^2] ($1m^2$=$10.76ft^2$)**
Single case free on all sides		A = 1.8 x H x (W + D) + 1.4 x W x D
Single case for wall mounting		A = 1.4 x W x (H + D) + 1.8 x H x D
End case free-standing		A = 1.4 x D x (W + H) + 1.8 x W x H
End case for wall mounting		A = 1.4 x H x (W + D) + 1.4 x W x D
Center case free-standing		A = 1.8 x W x H + 1.4 x W x D + H x D

Case installation		Calculation of A [m^2] (1m^2=10.76ft^2)
Center case for wall mounting		A = 1.4 x W x (H + D) + H x D
Center case for wall mounting, top surface covered		A = 1.4 x W x H + 0.7 x W x D + H x D
A the enclosure's surface area **W** width **H** height **D** depth		

Internal Convection

With internal heat convection, the heat is dissipated outside through the walls of the housing. This is possible when the ambient temperature is lower than that inside the housing.

The following table describes the variables used to calculate the internal convection:

Variable	Description
P_v [W]	heat output (heat dissipation) of the electronic components
A [m^2]*	effective surface area of the housing
k [W/m^2 K]*	the housing heat transfer coefficient (e.g., Steel sheet: approximately 5.5 W/m^2 K)*

* (1m^2=10.76ft^2)

The maximum temperature increase of all electronic devices inside the housing is calculated as follows:

$$(\Delta T)max = \frac{Pv}{k \bullet A}$$

The power dissipation P_v can be calculated based on the values of the electrical power of the controller, its inputs, and outputs.

Monitoring Temperature State/Operating Temperature

The controllers are designed to operate with the maximum temperature of 60 °C (140 °F). The temperature states in single modules and PLCs are evaluated by the CPU module or the PLC's CPU for compact systems. The temperature state of a particular module or PLC is measured by a sensor. The sensor monitors the temperature state of the PLC automatically and continuously.

The XPSMF60 has two fans behind the earthing grid which are controlled by the CPU module.

The following table shows the dependency of the fan state on the temperature state:

Temperature State	Fan State
<50 °C / 122 °F	normal (both fans ON)
>50 °C / 122 °F	both fans in full operation

You can evaluate the fan states (system signal fan state) using a PC running XPSMFWIN programming environment.

The following table shows the ranges in which the temperature state signals the measured temperature:

Temperature Range	Temperature State
<60 °C / 140 °F	normal
60 to 70 °C 140 to 158 °F	high temperature
>70 °C / 158 °F	very high temperature
Return to 64 °C / 147.2 °F	high temperature
Return to <54 °C / 129.2 °F	normal

NOTE: The difference in temperature increase and decrease ranges is the result of the sensor's hysteresis that equals 6 °C / 10.8 °F.

Temperature state **High temperature** indicates the following:

operating temperature = max temperature (delta T)max + ambient temperature >= 60 °C / 140 °F.

In this case, support the internal convection by increasing the free space between the PLCs.

Temperature state **Very high temperature** indicates the following:

operating temperature = max temperature (delta T)max + ambient temperature >= 70 °C / 158 °F.

In this case, support the internal convection by integrating additional active cooling elements (fan, coolant devices, etc.) or increasing the free space around the PLCs.

If the sensor indicates a temperature increase above the critical threshold, the temperature state changes. The temperature states can be evaluated using the **Temperature State** system signal in the XPSMFWIN programming environment.

Application and Function

2

Overview

This chapter describes the application and function of XPSMF60 Safety PLC.

What's in this Chapter?

This chapter contains the following topics:

Initial Operation

Overview

The following section contains information about the initial operation of the XPSMF60 Safety PLC.

First Power-Up

The following table describes the first power-up behavior of the XPSMF60 Safety PLC:

Stage	Description
1	Power Supply LED (green) is illuminated for 0.5 s.
2	All LEDs are illuminated for 5 s.
3	24VDC LED is illuminated. Prog LED (orange) is flashing. The Safety PLC is awaiting a program.

Connection with Existing Configuration and Program

The following table describes initial operation when the XPSMF60 Safety PLC is connected with an existing configuration and program:

Stage	Description
1	Power Supply LED (green) is illuminated for 0.5 s.
2	All LEDs are illuminated for 5 s.
3	24VDC LED (green) is illuminated. Program LED (orange) is flashing for 15 s.
4	Program checked. 24VDC LED (green) is illuminated. RUN LED (green) is illuminated or flashing dependant on the program settings.

⚠ DANGER

HAZARD OF ELECTRICAL SHOCK, EXPLOSION OR ARC FLASH

Disconnect all power before servicing equipment.

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

Application

Overview

The XPSMF60 modular Safety PLC is certified to the following standards:

- SIL 3, according to IEC 61508
- Category 4, according to EN 954-1
- EN 61131-2
- EN 54-2
- DIN V 19250 up to RC6
- NFPA 8501, NFPA 8502
- NFPA 72

The extensive hardware range and safe data transmission allow the system to be optimized to suit anticipated or existing plant structures.

The safety-related networking of the Safety PLC takes place on Ethernet using SafeEthernet protocol, which is based on standard Ethernet technology and is certified to TÜV/BG. The Ethernet medium allows safety data to be transmitted up to 100 Mbit/s half duplex and 10 Mbit/s full duplex and supports the use of the entire range of Ethernet functions for networked applications.

A combination of a high-speed Safety PLC and a high-speed safety bus protocol (SafeEthernet) offers new levels of flexibility for automation process solutions.

Current system limits of safety-related automation concepts are disappearing. Scope is being created for truly application-based solutions.

Key features of the XPSMF60 Safety PLC:

- certification up to SIL 3, according to IEC 61508
- category 4, EN 954-1
- communication via SafeEthernet and Modbus
- versatility
  You can use the Safety PLC in all environmental conditions with additional equipment.
- quick and easy network configuration
- user-friendly interfaces

Use in Central Fire Alarm Systems

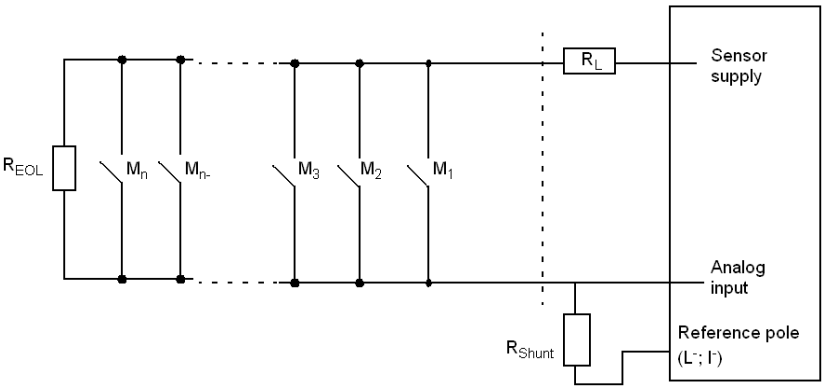
All XPSMF systems with analog inputs can be used for controlling and indicating equipment in accordance with DIN EN 54-2 and NFPA 72. The user program must perform the functions that, according to the standards, are performed by central fire alarm systems.

A central fire alarm system can easily achieve the required maximum cycle time of 10 seconds (DIN EN 54-2) as the typical cycle time of the XPSMF range is in the millisecond range. The required error response safety time of 1 second in that case is also easy to achieve.

As required by EN 54-2, the fire alarm system must remain in the fault report state 100 seconds after the XPSMF60 received the fault report.

Using the energize to trip principle with line monitoring the fire alarms are connected to detect short-circuits and breaks.

The following diagram shows the required fire alarm wiring schematic:



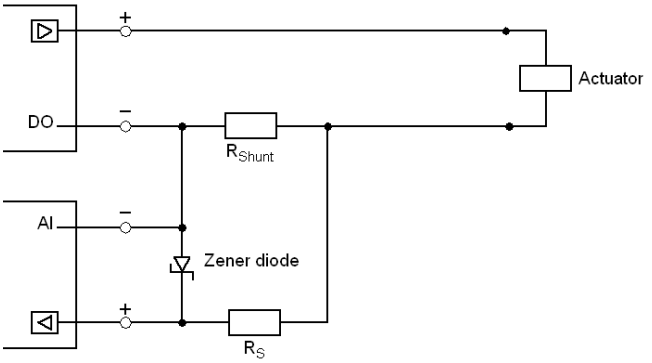
M: Fire alarm
R(EOL): Terminating resistor on the last sensor in the loop
R(L): Limitation of the maximum permitted current in the loop
R(Shunt): Measuring resistor

For application, the resistance of R_{EOL}, R_L, and R_{Shunt} should be calculated depending on the number of sensors used and the number of sensors per alarm loop. The relevant data sheet contains all the required information provided by the sensor manufacturer.

The alarm outputs are used to activate lamps, sirens, horns, etc. They operate based on the energize to trip principle. The outputs must be monitored for line breaks and short-circuits. This can be done by returning the output signals from the actuator directly to the inputs.

The current in the actuator circuit should be monitored through an analog input with a shunt.

A series connection of Z diode protects the input against overvoltage in case of short-circuit as follows:



The user program controls all visual display systems, light panel indicators, LED displays, audible alarms, etc. The routing of fault signals via input and output modules or to routing equipment must be performed using the deenergize to trip principle.

Fire alarms can be transmitted from one XPSMF60 to another using the Ethernet communications standard available. Any breakdown in communications must be signalled.

XPSMF60 that is used in fire alarm systems must have a redundant power supply. Precautions must also be taken against power supply failures, e.g., using a battery-powered horn. No interruption is allowed while switching between the main supply and back-up supply. Voltage dips of up to 10 ms are permitted.

When a fault occurs, the operating system writes signals specified by the user program. This allows error signalling to be programmed to signal errors detected by the system. If an error occurs, safety-related inputs and outputs are switched off, e.g., 0-signals are applied to all the channels of faulty inputs, and all the channels of faulty outputs are switched off.

Function

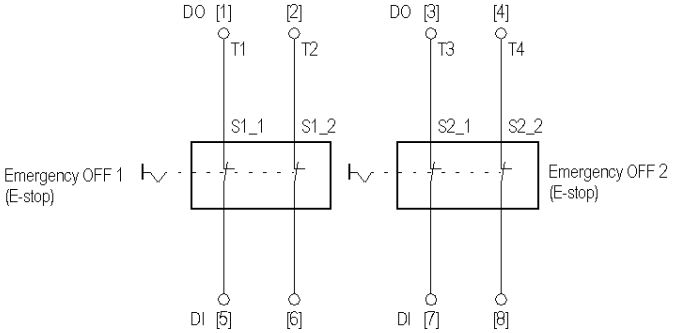
Overview

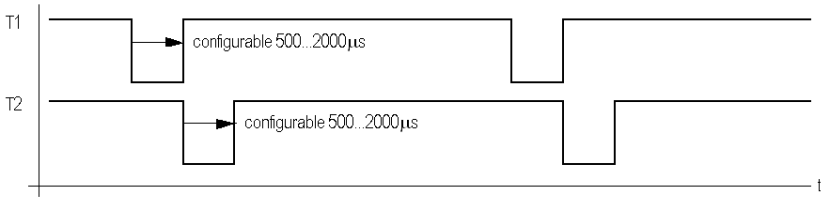
This section describes functions of the XPSMF60 Safety PLC.

Line Control

Line Control is a short-circuit and line break monitoring system, e.g., for Emergency Stop Control (category 4, according to EN 954-1), which can be configured on the XPSMF60 system. Digital outputs DO1 to DO8 can be connected to the DI digital inputs of the same system.

The following diagram shows connection of digital outputs and digital inputs:





The above time graph shows the variation of two pulsed channels. When connected, the inputs of the system are expecting the specific pulse value. If the pulse is not received or an alternate pulse is received, the system will automatically set the output of the specific system to the safe "zero" state. If a line break, short circuit or an alternate signal is present, the FAULT LED on the front of the Safety PLC will flash repeatedly until the problem is fixed. The system will then cyclically reconnect all the pulsed outputs.

⚠ WARNING

PULSED OUTPUT

Pulsed outputs must not be used as safety-related outputs!

Failure to follow these instructions can result in death, serious injury, or equipment damage.

The following faults may occur:

- short circuit between 2 parallel lines
- change of 2 lines, e.g., DO 2 to DI 7 (configured), DO 2 to DI 6 (wired)
- earth fault on 1 of the lines (only with earthed reference pole)
- line break
- opening of the contacts (i.e., one of the Emergency Stop switches is pressed)

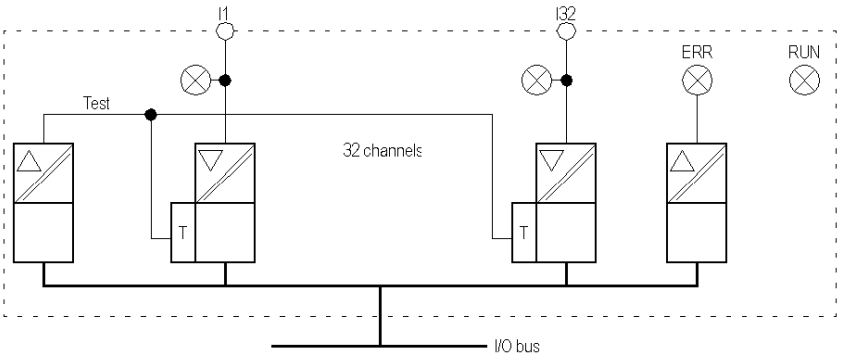
If any of the faults occur,

- the FAULT LED on the front panel of the Safety PLC is illuminated,
- the outputs are set to 0, and
- the fault code is generated.

NOTE: The XPSMF60 Safety PLC is designed for the deenergize to trip principle. If a fault occurs, the input and output signals revert to voltage- or current-free states to ensure safe operation.

XPSMFDI3201 Module

The following is the block diagram of module XPSMFDI3201:



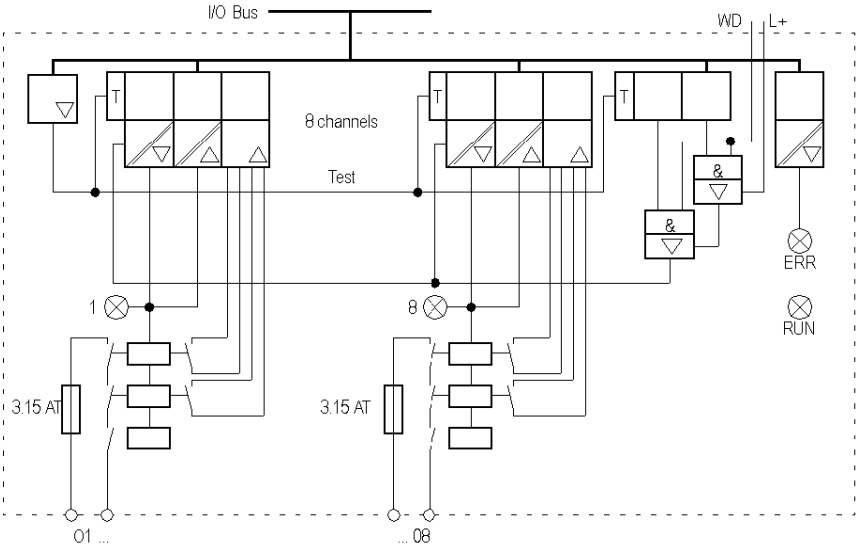
The following table shows connections of the digital inputs to the corresponding terminals of the XPSMFDI3201 module:

Terminal No.	Designation	Function (Inputs)
01	LS+	sensor supply for inputs 1 to 7
02	I1	digital Input 1
03	I2	digital input 2
04	I3	digital input 3
05	I4	digital input 4
06	I5	digital input 5
07	I6	digital input 6
08	I7	digital input 7
09	EGND	reference pole
10	LS+	supply for inputs 8 to 14
11	I8	digital input 8
12	I9	digital input 9
13	I10	digital input 10
14	I11	digital input 11
15	I12	digital input 12
16	I13	digital input 13
17	I14	digital input 14
18	EGND	reference pole
19	LS+	supply for inputs 15 to 21
20	I15	digital input 15
21	I16	digital input 16
22	I17	digital input 17
23	I18	digital input 18
24	I19	digital input 19
25	I20	digital input 20
26	I21	digital input 21
27	EGND	reference pole
28	LS+	supply for inputs 22 to 28
29	I22	digital input 22
30	I23	digital input 23
31	I24	digital input 24
32	I25	digital input 25

Terminal No.	Designation	Function (Inputs)
33	I26	digital input 26
34	I27	digital input 27
35	I28	digital input 28
36	EGND	reference pole
37	LS+	supply for inputs 29 to 32
38	I29	digital input 29
39	I30	digital input 30
40	I31	digital input 31
41	I32	digital input 32
42	EGND	reference pole
43	EGND	reference pole
44	EGND	reference pole
45	EGND	reference pole

XPSMFDO801 Module

The following is the block diagram of module XPSMFDO801:

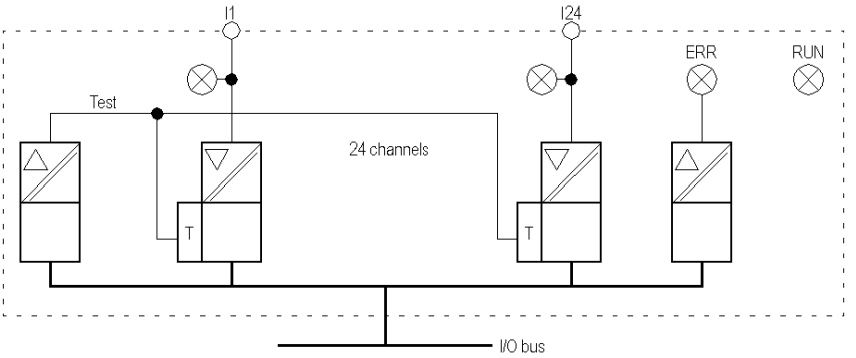


The following table shows connections of the digital inputs to the corresponding terminals of the XPSMFDO801 module:

Terminal No.	Designation	Function (Relay Inputs)
01	1	contact 1, terminal A
02		contact 1, terminal B
03	2	contact 2, terminal A
04		contact 2, terminal B
05	3	contact 3, terminal A
06		contact 3, terminal B
07	4	contact 4, terminal A
08		contact 4, terminal B
09	5	contact 5, terminal A
10		contact 5, terminal B
11	6	contact 6, terminal A
12		contact 6, terminal B
13	7	contact 7, terminal A
14		contact 7, terminal B
15	8	contact 8, terminal A
16		contact 8, terminal B

XPSMFDI2401 Module

The following is the block diagram of module XPSMFDI2401:

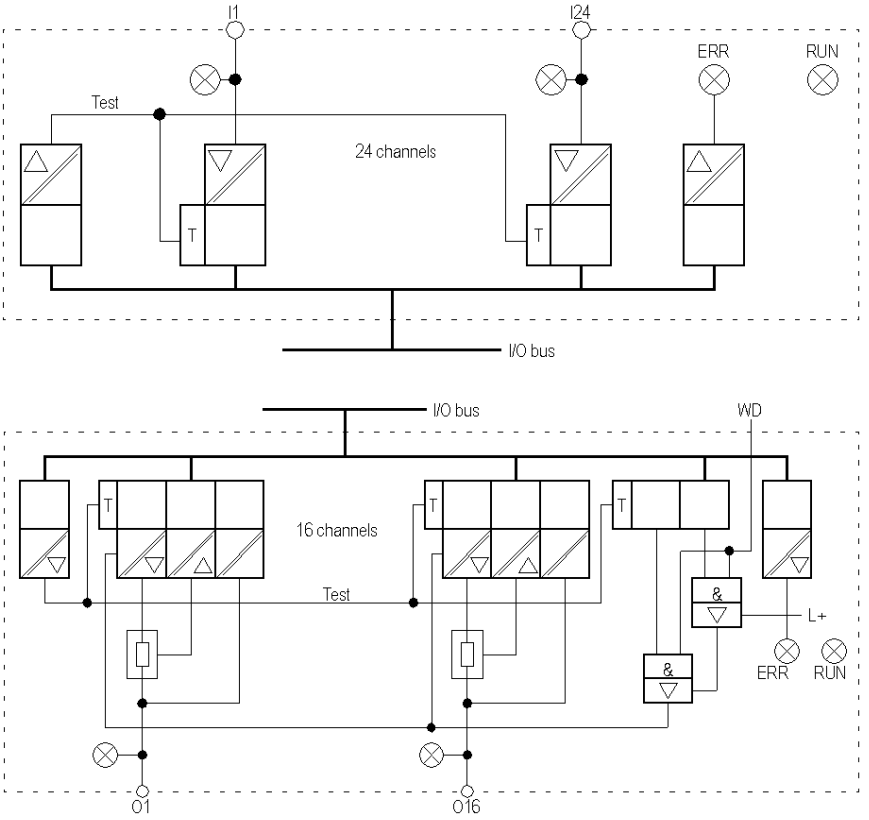


The following table shows connections of the digital inputs to the corresponding terminals of the XPSMFDI2401 module:

Terminal No.	Designation	Function (Inputs)
01	I1	input 1
02	I2	input 2
03	I3	input 3
04	I4	input 4
05	I5	input 5
06	I6	input 6
07	I7	input 7
08	I8	input 8
09	N/-	common reference pole
10	I9	input 9
11	I10	input 10
12	I11	input 11
13	I12	input 12
14	I13	input 13
15	I14	input 14
16	I15	input 15
17	I16	input 16
18	N/-	common reference pole
19	I17	input 17
20	I18	input 18
21	I19	input 19
22	I20	input 20
23	I21	input 21
24	I22	input 22
25	I23	input 23
26	I24	input 24
27	N/-	common reference pole

XPSMFDIO241601 Module

The following is the block diagram of module XPSMFDIO241601:



The following table shows connections of the digital inputs to the corresponding terminals of the XPSMFDIO241601 module:

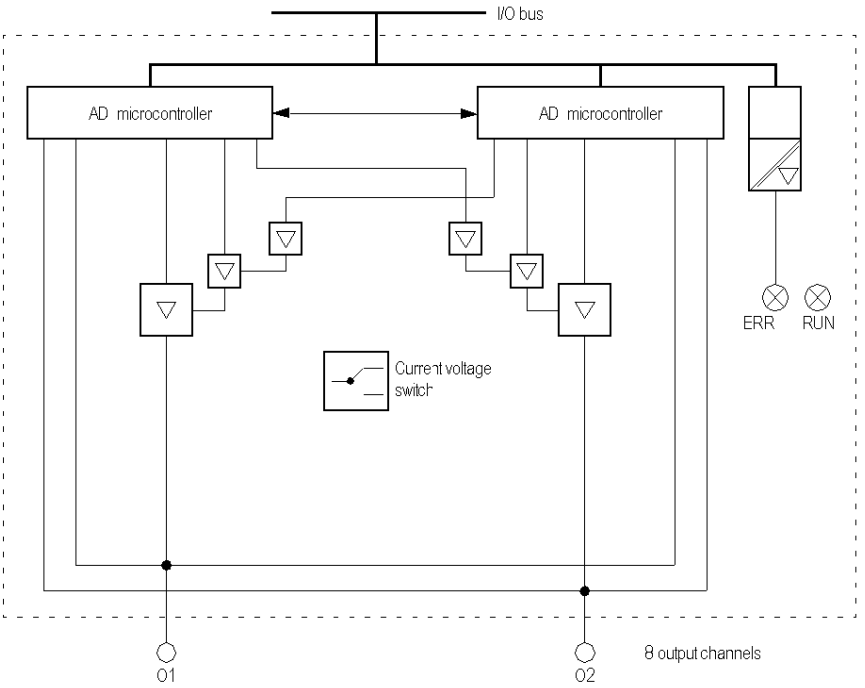
Terminal No.	Designation	Function (Inputs)
01	LS+	sensor supply for inputs 1 to 8
02	I1	digital input 1
03	I2	digital input 2
04	I3	digital input 3
05	I4	digital input 4
06	I5	digital input 5

Terminal No.	Designation	Function (Inputs)
07	I6	digital input 6
08	I7	digital input 7
09	I8	digital input 8
10	LS+	supply for inputs 9 to 16
11	I9	digital input 9
12	I10	digital input 10
13	I11	digital input 11
14	I12	digital input 12
15	I13	digital input 13
16	I14	digital input 14
17	I15	digital input 15
18	I16	digital input 16
19	LS+	supply for inputs 17 to 24
20	I17	digital input 17
21	I18	digital input 18
22	I19	digital input 19
23	I20	digital input 20
24	I21	digital input 21
25	I22	digital input 22
26	I23	digital input 23
27	I24	digital input 24
28	L-	reference pole for outputs 1 to 8
29	O1	digital output 1
30	O2	digital output 2
31	O3	digital output 3
32	O4	digital output 4
33	O5	digital output 5
34	O6	digital output 6
35	O7	digital output 7
36	O8	digital output 8
37	L-	reference pole for outputs 9 to 16
38	O9	digital output 9
39	O10	digital output 10
40	O11	digital output 11

Terminal No.	Designation	Function (Inputs)
41	O12	digital output 12
42	O13	digital output 13
43	O14	digital output 14
44	O15	digital output 15
45	O16	digital output 16

XPSMFAO801 Module

The following is the block diagram for XPSMFAO801 module:



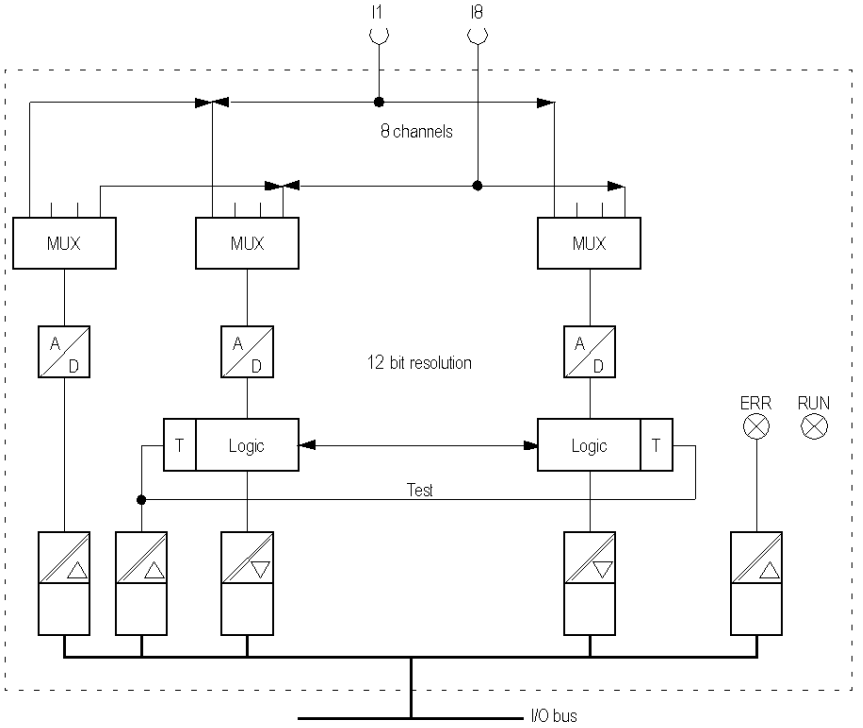
The following table shows connections of the digital inputs to the corresponding terminals of the XPSMFAO801 module:

Terminal No.	Designation	Function
01	O1+	analog output 1
02	O1-	reference pole output 1
03	O2+	analog output 2

Terminal No.	Designation	Function
04	O2-	reference pole output 2
05	O3+	analog output 3
06	O3-	reference pole output 3
07	O4+	analog output 4
08	O4-	reference pole output 4
09	⏚	earth/shielding
10	O5+	analog output 5
11	O5-	reference pole output 5
12	O6+	analog output 6
13	O6-	reference pole output 6
14	O7+	analog output 7
15	O7-	reference pole output 7
16	O8+	analog output 8
17	O8-	reference pole output 8
18	⏚	earth/shielding

XPSMFAI801 Module

The following is the block diagram for XPSMFAI801 module:



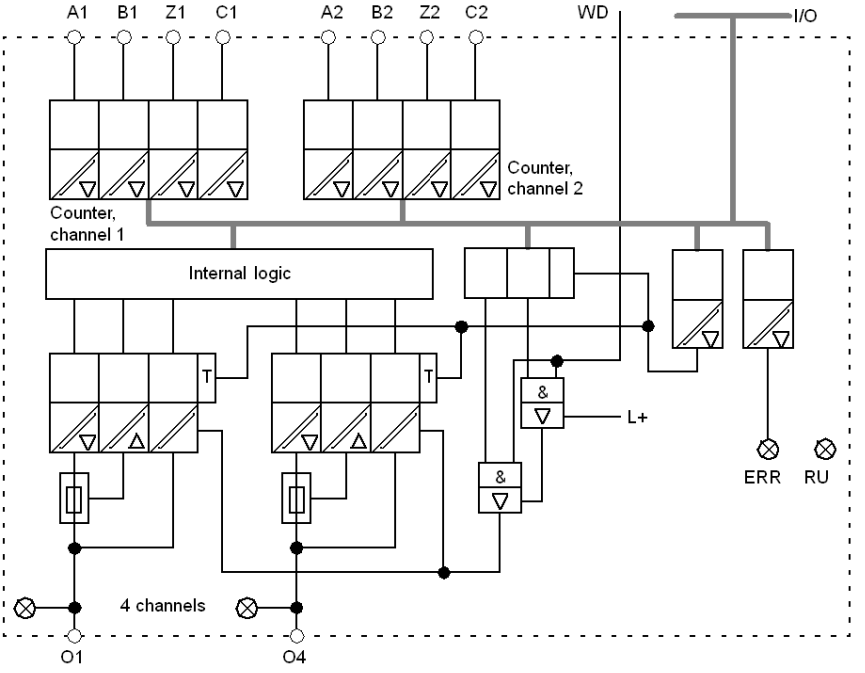
The following table shows connections of the digital inputs to the corresponding terminals of the XPSMFAI801 module:

Terminal No.	Designation	Function
01	I1+	analog input 1
02	I-	reference pole input 1
03	I2+	analog input 2
04	I-	reference pole input 2
05	I3+	analog input 3
06	I-	reference pole input 3
07	I4+	analog input 4
08	I-	reference pole input 4
09	⏚	earth/shielding

Terminal No.	Designation	Function
10	I5+/I1-	analog input 5
11	I-	reference pole input 5
12	I6+/I2-	analog input 6
13	I-	reference pole input 6
14	I7+/I3-	analog input 7
15	I-	reference pole input 7
16	I8+/I4-	analog input 8
17	I-	reference pole input 8
18	⏚	earth/shielding

XPSMFCIO2401 Module

The following is the block diagram for XPSMFCIO2401 module:



The following table shows connections of the digital inputs to the corresponding terminals of the XPSMFCIO2401 module:

Terminal No.	Designation	Function (Inputs)
01	C-	common reference pole
02	A1	input A1 or bit 1
03	B1	input B1 or bit 2
04	Z1	input Z1 or bit 3
05	C1	input C1 or bit 4
06	C-	common reference pole
07	C-	common reference pole
08	C-	common reference pole
09	C-	common reference pole

Terminal No.	Designation	Function (Inputs)
10	C-	common reference pole
11	A2	input A2 or bit 1
12	B2	input B2 or bit 2
13	Z2	input Z2 or bit 3
14	C2	input C2 or bit 4
15	C-	common reference pole
16	C-	common reference pole
17	C-	common reference pole
18	C-	common reference pole

Terminal No.	Designation	Function (Outputs)
19	L-	common reference pole
20	1	digital output 1
21	2	digital output 2
22	3	digital output 3
23	4	digital output 4
24	L-	common reference pole
25	L-	common reference pole
26	L-	common reference pole
27	L-	common reference pole

Surge on Digital Inputs

In the case of digital inputs, an EN 61000-4-5 surge impulse can be read as a short-time high signal (caused by the short cycle time of the XPSMF60 system).

To avoid errors in these cases, 1 of the following measures must be taken in respect to the applications:

- installation of shielded input lines to prevent the effects of surges in the system
- noise blanking in the application program - a signal must be present for at least 2 cycles before it is evaluated

NOTE: Proper EMC design techniques will allow the designer of the safety system to achieve the maximum performance by using the minimum response time of the safety PLC.

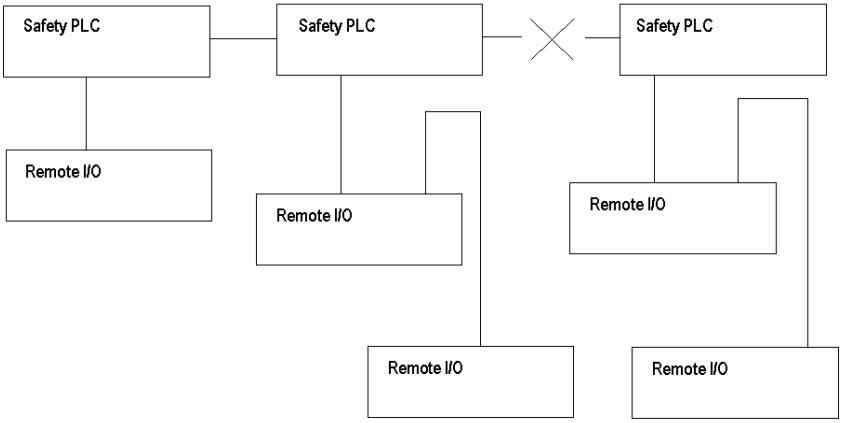
Cable Disconnection

In a Safety PLC network, areas are covered using the Safety network. Therefore, damage or disconnection of the communications cable may occur. In the system below, the X represents a cable break between Safety PLC 2 and Safety PLC 3. The communications between each of the systems will cease.

As a result, the following will occur:

If...	Then...
the Safety PLC 2 system was dependent on the inputs of the Safety PLC 3 system.	the corresponding outputs will automatically be set to "zero".
the Safety PLC 3 system was dependent on the inputs of the Safety PLC 2 system.	the corresponding outputs will automatically be set to "zero".
the systems are still provided with the 24 V DC power supply.	the two systems will continue to operate the remaining inputs and outputs of each separate system.

The following diagram shows an example of the Safety PLC network interruption:



If the local network is reacting only on the inputs of the same system, the PLC system continues to run without failure.

Power Supply Interruption

The following table shows reactions to the changes in operating voltage:

Voltage Level	Reaction of the Controller
19.3VDC to 28.8VDC	normal operation
< 18.0VDC	alarm state (Internal variables are written and put to the inputs/outputs).
< 12.0VDC	Inputs and outputs are switched off.

If power supply is interrupted, all inputs and outputs discontinue and return to the off "safe" state.

Small System Reconfiguration

A Safety PLC can be reconfigured while the network is executing an existing configuration. The resources that require reconfiguration must be stopped. The following table describes the reconfiguration procedure:

Step	Action
1	Using the XPSMFWIN programming environment, stop the system of the Safety PLC which requires the new configuration.
2	Download the new configuration fully checked by a qualified safety engineer to the Safety PLC or Remote I/O module via Ethernet cable Cat 5, grade D or better.
3	Once the module is re-programmed, start the device.
4	Execute the new configuration immediately.

Large System Reconfiguration

The following table describes the reconfiguration procedure for large systems:

Step	Action
1	Stop the relevant resources within the network using the XPSMFWIN programming environment, small segments of a network can be reconfigured in stages.
2	Connect your PC to any Ethernet communications point.
3	Download the new configuration(s) fully checked by a qualified safety engineer to the Safety PLC network via Ethernet cable Cat 5, grade D or better.
4	Restart all devices, preferably in stages - system by system.

Equipment Description

3

Overview

This chapter contains the equipment description of XPSMF60 Safety PLC.

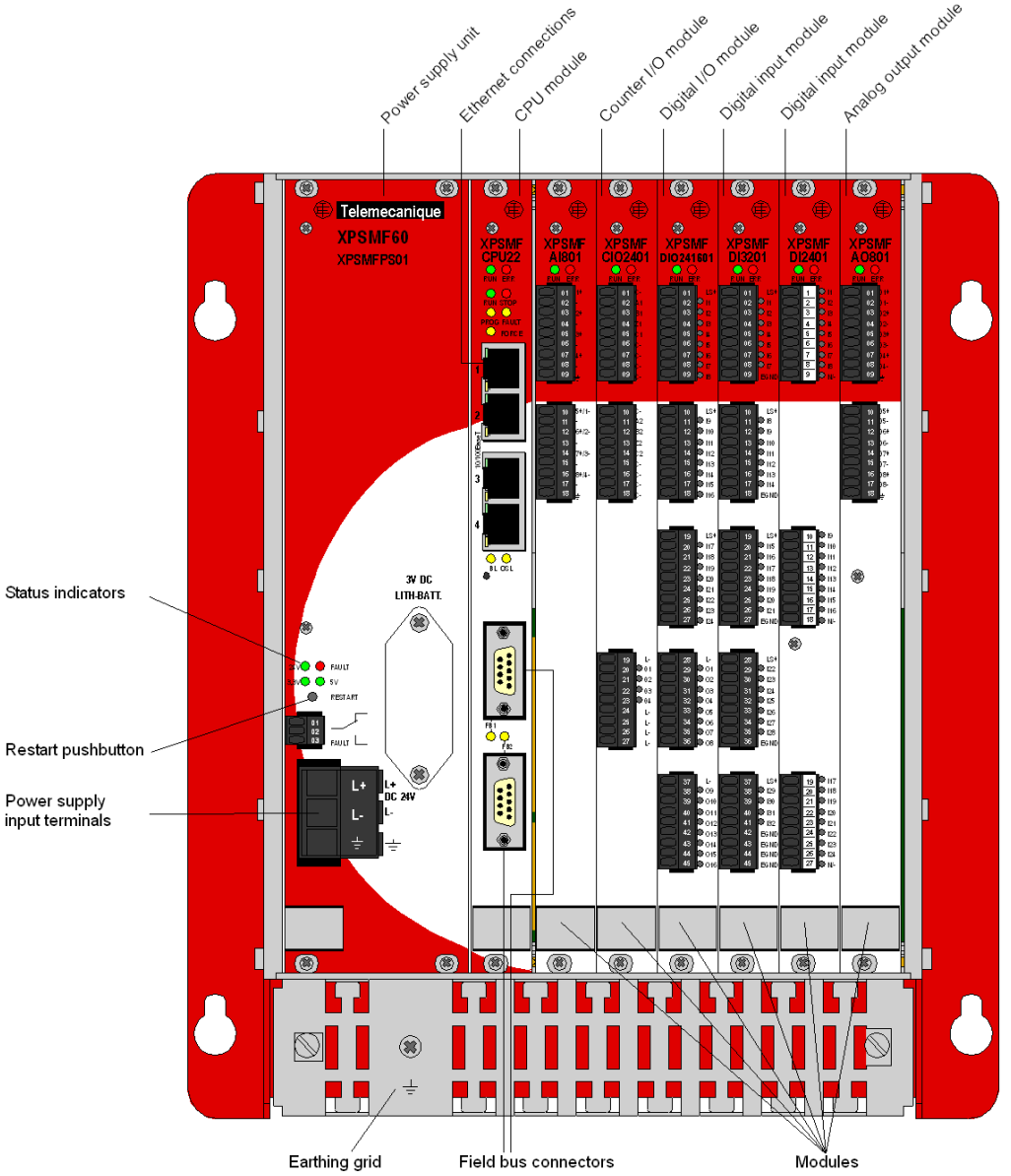
What's in this Chapter?

This chapter contains the following topics:

Housing Elements

Front View

The following image shows the various elements of the XPSMF60 front panel:


Power supply unit
Ethernet connections
CPU module
Counter I/O module
Digital I/O module
Digital input module
Digital input module
Analog output module
Telemecanique
XPSMF60
XPSMFPS01
XPSMF CPU22
XPSMF AI801
XPSMF CIO2401
XPSMF DIO241601
XPSMF DI3201
XPSMF DI2401
XPSMF AO801
Status indicators
Restart pushbutton
Power supply input terminals
3V DC LITH-BATT.
FAULT
SV
RESTART
L+
L-
DC 24V
Earthing grid
Field bus connectors
Modules

Reset Button

Overview

The device is equipped with a reset button. Use the reset button, for example, when you have lost the PC connection password.

Using Reset Button

You can access the reset button through the small round opening in the front plate of the housing.

Push the button only while you reboot the device and keep the button pressed for at least 20 s. Pushing the reset button while the device is running produces no result.

Effect

When you push the reset button,

- all accounts are deactivated (except the default `Administrator` account without password) and
- IP addresses and system ID (SRS) are set to default values.

NOTE: After the reset button has been activated, values are modified and remain valid until the next reboot. After the next reboot, the previous values are restored. You can enter new information, if necessary.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

While operating the reset button, the field bus cables should be disconnected from the field bus terminals to avoid malfunctions.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Communication

Overview

The Safety PLCs communicate with each other and the PC over Ethernet using SafeEthernet protocol.

The Safety PLCs communicate with each other and with a PC through a star or linear Ethernet layout. A PC can be connected at any place in the network.

The communication section is connected to the safe microprocessor system via a Dual-Port RAM. It controls communication between PES and other systems via powerful interfaces. The XPSMF60 Safety PLC supports Modbus slave serial communication for non-safety-related data transfer.

- 100 BaseT: SafeEthernet, Modbus TCP/IP
- Field buses: Modbus serial slave

Safety-Related Communication Via Switches

In contrast to a hub, a switch can store data packets for a short period of time in order to establish a temporary connection between two communication partners (transmitter/receiver) for transferring data. This way, collisions (typically occurring in hubs) can be avoided, and the load on the network can be reduced. For controlled data transfer, every switch needs an address/port relation table. This table will be automatically generated in a self-learning process. Each port in the switch is correlated to the defined MAC addresses. According to this table, incoming data packets are switched directly to the corresponding port.

The switch automatically switches between the transfer rates of 10 and 100 MBit/s full and half duplex transmissions.

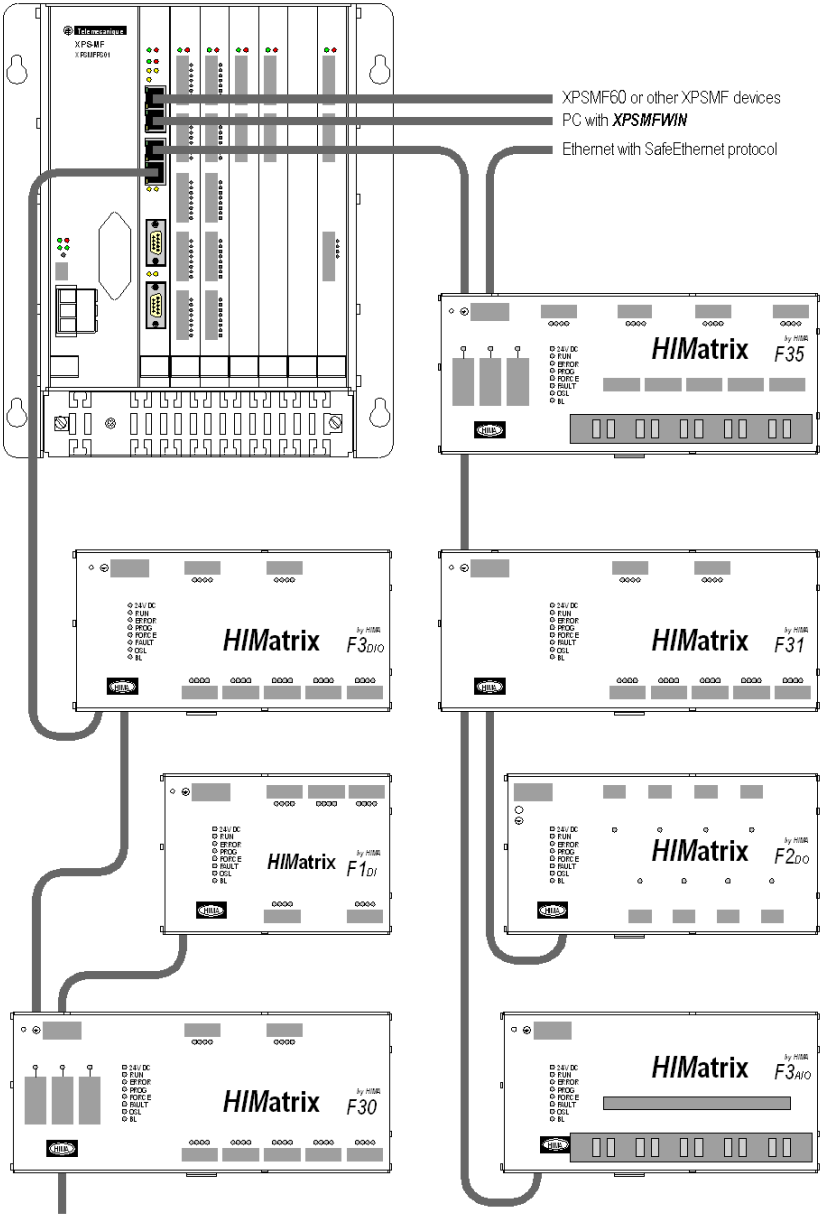
The switch controls communication between different devices. The switch can address up to 1000 absolute MAC addresses.

Autocrossing recognizes if cables with crossed wires have been connected, and the switch adjusts accordingly.

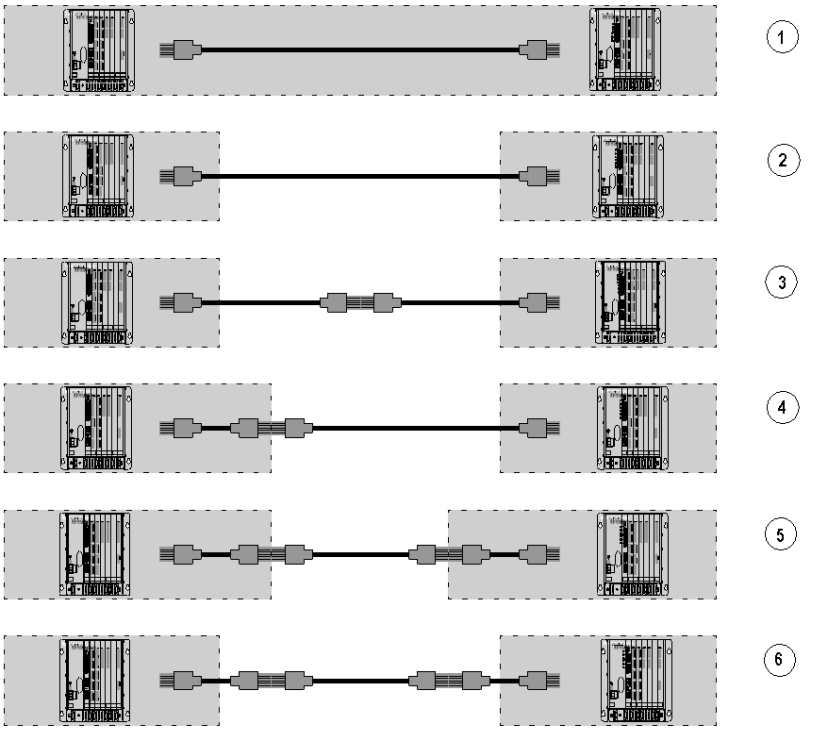
For networking via Ethernet, the XPSMF60 Safety PLC is equipped with four connections arranged on the lower and upper side panels of the case. Various systems can be networked as required via Ethernet star or line configuration. A PC can also be connected wherever required.

NOTE: When building the network, ensure that no network loops are formed. The system must receive data along only one path.

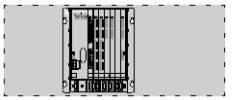
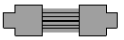
The following scheme shows a SafeEthernet networking example:



The following is a Ethernet cable connection diagram:



Legend:

	device in case
	connector
	coupling (plug and socket

Connector pairs and cable distances:

Number	Number of Plug Connector Pairs	Maximum Cable Distance
1	2	100 m / 328.1 ft
2	2	100 m / 328.1 ft

Number	Number of Plug Connector Pairs	Maximum Cable Distance
3	3	100 m / 328.1 ft
4	3	100 m / 328.1 ft
5	4	100 m / 328.1 ft
6	4	100 m / 328.1 ft

When using specified cables and plug connectors approved to 100 MHz, the maximum cable distance is 100 m (328.1 ft) with a maximum of six connector pairs. A combination of a plug and a socket is considered one pair.

Use optic fiber cables with converters for greater distances.

Configuring a SafeEthernet protocol connection over Ethernet has the following advantages:

- very fast packet transfer between the collision areas
- significant increase of data throughput with full-duplex mode
- Prevention of collisions allows deterministic operation.

Non-Safety-Related Communication

The XPSMF60 Safety PLC is equipped with sockets for field bus communication. The XPSMF60 Safety PLC supports the Modbus slave field bus protocol.

The total length of the Modbus network with all branch lines can reach 1200 m (3,937 ft). Bidirectional repeaters are required for greater lengths. In total, three repeaters can be used to reach a maximum range of 4800 m (15,748 ft).

RS485 (Modbus slave) is on field bus 2.

NOTE: Safety-related communication is not possible with the field bus interfaces.

The following Modbus functions are supported by the Modbus slave:

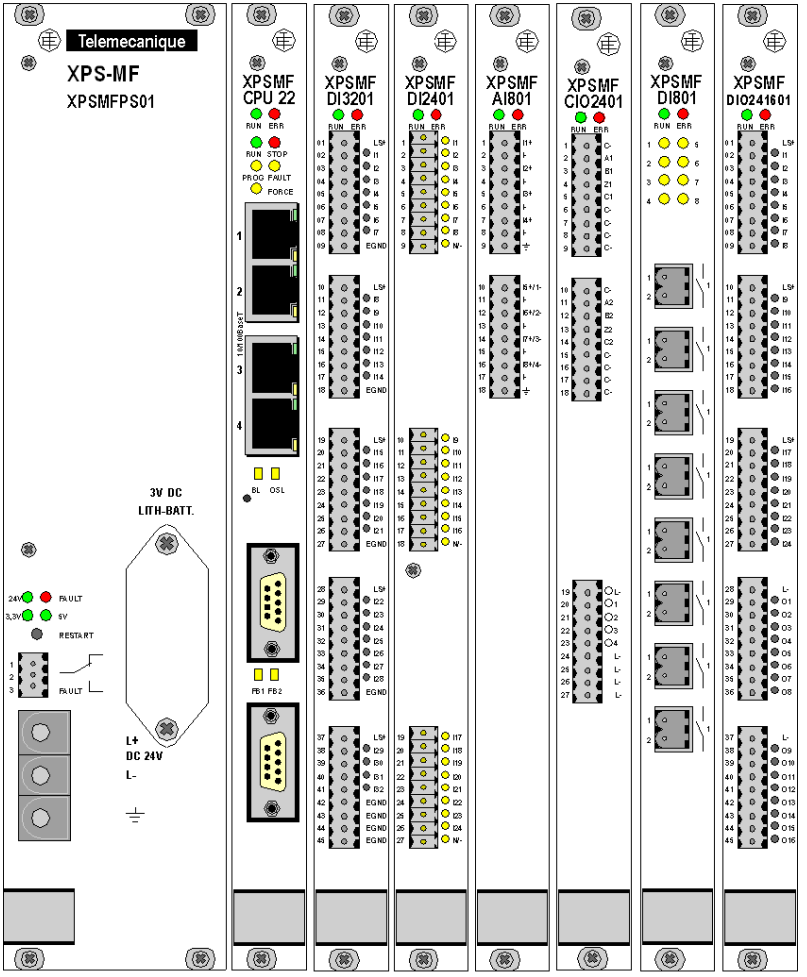
Element	Code	Type	Description
READ COIL	01	BOOL	Reads several variables (BOOL) from the slave's import or export area.
READ DISCRETE INPUT	02	BOOL	Reads several variables (BOOL) from the slave's export area.
READ HOLDING REGISTER	03	WORD	Reads several variables of any type from the slave's import or export area.
READ INPUT REGISTER	04	WORD	Reads several variables of any type from the slave's export area.
READ WRITE HOLDING REGISTER	23	WORD	Writes and reads several variables of any type in and from the slave's import area.
WRITE MULTIPLE COIL	15	BOOL	Writes several variables (BOOL) in the slave's import area.

Element	Code	Type	Description
WRITE MULTIPLE REGISTER	16	WORD	Writes several variables of any type in slave's import area.
WRITE SINGLE COIL	05	BOOL	Writes one single variable (BOOL) in the slave's import area.
WRITE SINGLE REGISTER	06	WORD	Writes one single variable (WORD) in the slave's import area.
DIAGNOSTICS	08	x	Only subcode 0: loopback function of the slave.
READ DEVICE IDENTIFICATION	43	x	Supply the slave's identification data to the master.

LEDs

LED Alignment

The following image shows the alignment of the LEDs of the different modules:



XPSMFPS01 LEDs

The following table describes behaviors of the LEDs:

LED	Color	Status
24 V	green	24 V voltage present
5 V	green	5 V voltage present
3.3 V	green	3.3 V voltage present
FAULT	red	Error function, voltages are switched off. Module must be replaced.

XPSMFCPU22 LEDs

The following table describes system LEDs:

LED	Status	Meaning
RUN	on	normal state of PES (CPU in **STOP** or **RUN** mode.)
	flash	A new operation system is being loaded.
	off	The CPU is in **ERROR STOP** mode (see below.)
ERR	on	• The CPU has discovered a hardware fault and is switching to `ERROR STOP` mode. Hardware faults occur in the CPU in one or more inputs/outputs and in the counters. • The CPU has detected a software error in the operating system. • The watchdog has triggered the `ERROR STOP` mode, because the cycle time has been exceeded. • The CPU has stopped executing the user program and ended all the hardware and software tests; all outputs have been reset. The CPU can only be started again through a command from a PC.
	flash	If all LEDs are simultaneously on, the boot loader has detected an error in the operating system; a new operating system must be loaded.
	off	No errors have been detected.

The following table describes behaviors of the program LEDs:

LED	Status	Meaning
RUN Green	on	The CPU is in **RUN** or **STOP** operating mode.
	off	The CPU is not in **RUN** mode.

LED	Status	Meaning
STOP Red	on	● The CPU is in **STOP** mode and is not executing any user program. ● All outputs are reset to a safe power free state. ● The **STOP** mode can be triggered by setting the **EMERGENCY STOP** system to **TRUE** in the user program or by a direct command from the PC.
	off	The CPU is in **RUN** mode. A new operating system is being loaded.
PROG Yellow	on	A new configuration is being loaded to the CPU.
	flash	The CPU is switching from **INIT** to **STOP**. The Flash ROM is being loaded with a new operating system.
	off	No configuration or operating system is being loaded.
FAULT Yellow	on	The PES configuration is faulty.
	flash	An error has occurred during the `write` cycle for a Flash ROM. One or more I/O errors have occurred.
	off	None of the above errors have occurred.
FORCE Yellow	on	The CPU is in **RUN** operating and Forcing is active.
	flash	The PES is in **STOP** mode, but Forcing is prepared if the PES is started.
	off	Forcing is not activated.
OSL Yellow	flash	Operating system and Emergency Loader are active.
BL Yellow	flash	`COM` is in `INIT_FAIL` state.

The following table describes Communication Display LEDs that indicate the safety-related communication via SafeEthernet:

LED	Status	Meaning
Col Green	on	full duplex operation
	flash	collision
	off	half duplex operation, no collision
Tx Yellow	on	connection present
	flash	interface activity

The following table describes LEDs that indicate non-safety-related communication via field buses:

LED	Status	Meaning
FB1/FB2 Orange	on	Modbus serial slave interface is configured and communication is running.
	flashing irregularly	
FB1/FB2 Orange	on	Interface is configured, but no communication is running.
	flashing regularly	
FB1/FB2 Orange	not illuminated	The COM is in the state `STOP_INVALID_CONFIG` or the interface is not configured in XPSMFWIN.

XPSMFAO801 LEDs

The following table describes the LEDs of the XPSMFAO801 module:

LED	Status	Meaning
RUN Green	on	operating voltage present
	off	no operating voltage
ERR Red	on	module fault or external error
	off	no errors in module and/or no channel errors

XPSMFAI801 LEDs

The following table describes the LEDs of the XPSMFAI801 module:

LED	Status	Meaning
RUN Green	on	operating voltage present
	off	no operating voltage
ERR Red	on	module fault or external error
	off	no errors in module and/or no channel errors

XPSMFDI3201 LEDs

The following table describes the LEDs of the XPSMFDI3201 module:

LED	Status	Meaning
RUN Green	on	operating voltage present
	off	no operating voltage
ERR Red	on	module fault or external error
	off	no errors in module and/or no channel errors

XPSMFDI2401 LEDs

The following table describes the LEDs of the XPSMFDI2401 module:

LED	Status	Meaning
RUN Green	on	operating voltage present
	off	no operating voltage
ERR Red	on	module fault or external error
	off	no errors in module and/or no channel errors

XPSMFDIO241601 LEDs

The following table describes the LEDs of the XPSMFDIO241601 module:

LED	Status	Meaning
RUN Green	on	operating voltage present
	off	no operating voltage
ERR Red	on	module fault or external error
	off	no errors in module and/or no channel errors

XPSMFDO801 LEDs

The following table describes the LEDs of the XPSMFDO801 module:

LED	Status	Meaning
RUN Green	on	operating voltage present
	off	no operating voltage
ERR Red	on	module fault or external error reaction according to diagnosis
	off	no errors in module and/or no channel errors

XPSMFCIO2401 LEDs

The following table describes the LEDs of the XPSMFCIO2401 module:

LED	Status	Meaning
RUN Green	on	operating voltage present
	off	no operating voltage
ERR Red	on	module fault or external error reaction according to diagnosis
	off	no errors in module and/or no channel errors

Wiring

Ethernet Wiring

Industrial standard cables can be subjected to extreme mechanical stresses. The minimum SafeEthernet protocol communication requires Category 5 twisted pair cable with a class D rating, for greater distances and less possibility for errors occurring, fiber optic cable should be used.

The controllers communicate at 100 Mbit/s (Fast Ethernet) and 10 Mbit/s during full duplex mode. The XPSMF60 Safety PLC has an "auto cross-over" function built into the switch, which allows the use of both a 1:1 cable and a cross-over cable.

The outer shielding of the twisted pair cable must be earthed at both ends. If an RJ 45 connector is used, it automatically connects the cable's shield to the housing of the controller.

The use of the specified cables and plug connectors approved to 100 MHz, enables the maximum cable length of 100 m (328.1 ft) with the maximum of six connector pairs. A combination of plug and socket is considered one pair. For greater distances, use optical fibre cables with converters.

Configuring a Ethernet ("Switched Ethernet") has the following advantages:

- very fast packet transfer between the collision areas
- significant increase of data throughput in full-duplex mode
- Prevention of collisions allows a deterministic approach.

Interface Elements

When connecting a PLC over Ethernet communication, the following interface elements are recommended: FL CAT5 TERMINAL BOX of Phoenix Contact (R). The controllers are mounted on an earthed EN mounting rail. The conductors of the field cable are attached to the interface terminals. It is important to make sure that the cable shield is also connected via the strain relief.

Prefabricated patch cables are used to connect the interface element and the XPSMF60 PLC. If the rail is earthed in accordance with the standards, it is enough to mount an interface element on a rail.

Specified Cables

The cables are specified by category depending on their transmission and high-frequency properties as follows:

Category	Specification	Approved
1	-	no
2	up to 1 MHz	no
3	up to 16 MHz	no

Category	Specification	Approved
4	up to 20 MHz	no
5	up to 100 MHz	yes
6	up to 250 MHz	yes
7	up to 600 MHz	yes

The channel as a point-to-point transmission path is defined as follows:

Class	Specification	Approved
A	up to o.1 MHz	no
B	up to 1 MHz	no
C	up to 16 MHz	no
D	up to 100 MHz	yes
E	up to 250 MHz	yes
F	up to 600 MHz	yes

The higher the letter, the greater the demand on the transmission channel. For Ethernet communication at 100 MHz, Category 5 (or higher) cables and at least Class D capacity are required.

RJ45 Connector

For direct Ethernet plug connections without interface elements, you can use connectors such as IP 20 Data Plug (Harting(R)). You can assemble the cable quickly by crimping the conductors; special tools are not required.

Switches

To span distances of more than 100 m (328.1 ft) using SafeEthernet protocol, rail switches of the RS2 series (Hirschmann(R)) with optical fibre ports are recommended.

RS-485 Transfer Mode System

The Modbus serial protocol communicates via the non-safe RS-485 transfer mode system.

The following table shows an overview of the basic physical features of RS-485 transfer mode system:

Basic features of the RS-485 transfer mode system:

Scope	Feature	Comment
Network Topology	linear bus, active bus termination on both ends	Branch lines should be avoided.
Medium	shielded twisted cable	Shielding may not be required, depending on the environment.
Number of Stations	32 stations in each segment without repeater	With a repeater extendable up to 126 stations.
Connector	9-pole MIN-D connector	- - -

Wiring and Bus Termination

The following table shows pin assignments of the SUB-D sockets FB1 and FB2 (with plug-in module for Modbus slave (RS 485)):

Connection	Signal	Function
1	- - -	- - -
2	RP	5 V, decoupled with diodes
3	RxD/TxD-A	receive/transmit data A
4	CNTR-A	control signal A
5	DGND	data reference potential
6	VP	5 V, positive pole of supply voltage
7	- - -	- - -
8	RxD/TxD-B	receive/transmit data B
9	CNTR-B	control signal B

IP Addressing and System ID

Overview

A transparent label provided with the controller can be used to note the IP address and system ID (SRS, System-Rack-Slot) following a modification:

IP_._._._SRS_._._

Default value for IP address: 192.168.0.99

Default value for SRS: 60000.0.0

The ventilation slots in the housing of the Safety PLC must not be covered with the label.

For more information about changing the IP address and system ID, see the XPSMFWIN Software manual.

NOTE: Each Ethernet board has a unique Ethernet address. It is a 48 bit number: the first 24 bits indicate the manufacturer, while the last 24 bits are a unique number for each Ethernet board/controller-chip assigned by the manufacturer. The number is also called MAC ID.

TCP/IP Description

The IP address is an identifier for a device in a network. IP addresses are 32-bit numbers. To make it easier to memorize them, they are usually expressed in four 8-bit numbers (e.g., 192.168.10. IP addresses are unique, no other device within the network can share the same address.

The following information is required to install the TCP/IP protocol on a PC:

- the IP address assigned to the PC
- the part of the IP address (the subnet mask) that distinguishes other networks

NOTE: The operator must ensure that the Ethernet used for Peer-to-Peer communication is adequately protected from unauthorized access (i.e. by hackers). The nature and extent of the measures to be taken must be determined in conjunction with the approval authorities.

SafeEthernet

Overview

This section provides information about SafeEthernet protocol and OSI model.

Description

In the field of automation, requirements, such as determinism, reliability, interchangeability, extensibility, interoperability and the overall safety are central themes. Based on the Ethernet technology, SafeEthernet provides a transfer protocol for transmitting safety-related data up to RC 6 or SIL 3. SafeEthernet implements a mechanism that can detect and react to the following:

- corruption of transmitted data
- incorrect address allocation for the messages (transmitter, receiver)
- incorrect data sequence (repetition, loss, change)
- incorrect timing (delay, echo)

SafeEthernet is based on the standard Ethernet or FastEthernet according to IEEE 802.3.

The transmission of the safety-related data does not change the protocol frame of the standard Ethernet.

According to the Black Channel Approach in SafeEthernet, "insecure transmission channels" (Ethernet) are used and controlled by safety-related protocol mechanism at transmitter and receiver. This way, regular Ethernet network components, such as hubs, switches, routers, and PCs supplied with network interfaces can be used within a safety-related network. The significant difference to standard Ethernet is determinism, the real-time ability of SafeEthernet.

A special protocol mechanism ensures deterministic behavior even in case faults occur or new communication participants emerge. New components are automatically integrated into the running system. All components of the network could be changed while the system is running. With the use of switches, transmission times can be clearly defined. This way, Ethernet works in real time. Possible transfer speed up to 100 Mbit/s for safety-related data is higher than the speed normally used. Copper lines as well as fiber optic cables can be used as transmission media. The integration of firm intranets as well as connections to the Internet, can be realized with SafeEthernet technology. The terms for safety-related communication have to be considered.

Therefore, only one network for safety and non-safety data transfer is necessary. SafeEthernet can be fitted to existing Ethernet networks with adjustable network profiles. With SafeEthernet, you can set up flexible built-up system structures for decentral automation with defined reaction times. According to the requirements, the intelligence can be centralized or distributed to the participants in a decentral way within the network. There is no limit to the number of safe participants of the network and the amount of transferred safe data to get the needed reaction times. A central controller and the built-up of parallel structures is therefore superfluous.

The transmission of standard and safe data can be integrated into one network. A separate safety bus can be saved. The Safety PLC's switches perform the tasks normally carried out by network switches.

Operation Parameters of the Ethernet Interfaces

Up to COM OS version 8.32 all Ethernet ports of the integrated Ethernet switches have the same settings:

- Autoneg/Autoneg for Speed Mode
- Flow-control Mode

Other settings are not possible and will be rejected by the PLC when loading a configuration.

The Ethernet interfaces 10/100 BaseT of the device have the following parameters:

Firm operating parameters	
Speed Mode	Autoneg
Flow-Control Mode	Autoneg

Other devices combined with the Safety PLC or remote I/O device must have the following network settings:

Admissible settings of other devices	
Speed Mode	Autoneg
Flow-Control Mode	Autoneg
or	
Speed Mode	Autoneg
Flow-Control Mode	Half Duplex
or	
Speed Mode	10 or 100 Mbit/s
Flow-Control Mode	Half Duplex

Non-admissible settings of other devices	
Speed Mode	Autoneg or 10 or 100 Mbit/s
Flow-Control Mode	Full Duplex

For COM OS version > 8.32 and XPSMFWIN Hardware Management version > 7.56.10 each Ethernet port of the integrated switch can be individually configured. See also in the appendix *Connection Diagrams, Examples of Application, and Error Codes, page 95*.

Connections for SafeEthernet/Networking Examples

For the networking via SafeEthernet protocol, the devices are equipped - depending on the design - with 4 RJ 45 connections arranged on the XPSMFCPU 22 module. See example of a *Safety-Related Communication Via Switches, page 53*.

The various systems can be networked together as required via Ethernet (star or line configuration). A programming unit (PC) can also be connected wherever required.

NOTE: Ensure that no network loops are formed when connecting systems together. The system must receive data packets along one path only.

Modbus TCP/IP

The Modbus serial slave field bus protocol can communicate with the Modbus TCP/IP protocol via the Ethernet interfaces on the Safety PLC.

Standard Modbus communication transfers the slave address and a CRC checksum in addition to the instruction code and the data. In Modbus TCP/IP the subordinate TCP/IP protocol handles this function.

NOTE: More information about Modbus TCP/IP protocol can you find in the online help of XPSMFWIN.

Used Network Ports for Ethernet Communication

UDP ports and usage

UDP Ports	Usage
8000	programming and operation with XPSMFWIN
8001	configuration of the remote I/O via PLC
6010	SafeEthernet
6005/6012	if TCS_DIRECT was not activated within HH network

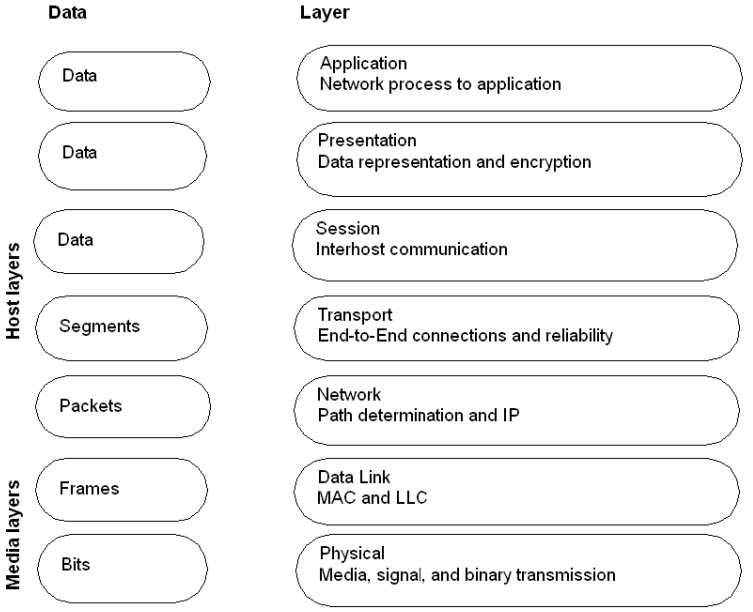
TCP ports and usage

UDP Ports	Usage
502	Modbus (changeable by user)

OSI model

The model divides the functions of a protocol into a series of layers known as a 'protocol stack' (e.g., TCP/IP stack). Lower layers are implemented in hardware, while higher layers are used in software. Each of the layers is a transport platform for the next higher level and relies on the next lower level .

The following image is a graphic representation of the OSI layers:



The following table describes the seven OSI layers (bottom-top):

Number	Layer	Data	Description
Media Layers			
1	Physical Layer Media, Signal, and Binary Transmission	bits	Defines all electrical and physical specifications for the devices.

Number	Layer	Data	Description
2	Data Link Layer MAC and LLC	frames	Provides the functional and procedural means to transfer data between network entities and detect and correct errors that may occur in the Physical layer.
3	Network Layer Path Determination and IP	packets	Provides the functional and procedural means of transferring variable length data sequences from a source to a destination via one or more networks.
Host Layers			
4	Transport Layer End-to-End Connections and Reliability	segments	Provides transparent transfer of data between end users.
5	Session Layer Interhost Communication	data	Provides the mechanism for managing the dialog between end-user application processes.
6	Presentation Layer Data Representation and Encryption	data	Relieves the Application layer of concern regarding syntactical differences in data representation within the end-user systems.
7	Application Layer Network Process to Application	data	Interfaces directly to and performs common application services for the application processes.

Operating Conditions

Overview

The XPSMF60 Safety PLC has been developed in compliance with the requirements of the following standards for EMC, climate and environment:

IEC 61131-2	programmable controllers, part 2, equipment requirements and tests
IEC 61000-6-2	EMC generic standards, part 6-2, immunity for industrial environments
IEC 61000-6-4	EMC general emission standard, industrial environment

To use the XPSMF60 Safety PLC, the following conditions must be fulfilled:

Protection Class	protection class II according to IEC/EN 61131-2
Pollution	pollution degree II
Altitude	< 2000 m / 6561.7 ft
Enclosure	standard: IP 20. If requested by the relevant application standards (e.g., EN 60204, EN 954-1), the device must be installed in a required enclosure (e.g., IP 54).

Climatic Conditions

The most important tests and limit values for climatic conditions are listed in the following table:

EN 61131-2	**Climatic Tests**
- - -	Operating temperature: 0 to 60 °C (32 to 140 °F) (Test limits -10 to +70 °C, 14 to 158 °F)
- - -	Storage temperature: -40 to 85 °C (-40 to 185 °F) (with battery only -30 °C, -22 °F)
6.3.4.2	Dry heat and cold withstand test: 70 / - °C (158 / -13 °F), 96 h, EUT power supply disconnected.
6.3.4.3	Change of temperature, withstand and immunity test: -25 / 70 °C (-13 / 158 °F) and 0 / 55 °C (32 / 131 °F), EUT power supply disconnected.
6.3.4.4	Cyclic damp heat withstand test: 25 / 55 °C (77 / 131 °F), 95% relative humidity, EUT power supply disconnected.

Mechanical Conditions

The most important test and limit values for mechanical conditions are listed in the following table:

EN 61131-2	Mechanical Tests
- - -	Vibration test, operating: 5 to 9 Hz / 3.5 mm (0.14 in), 9 to 150 Hz / 1g
6.3.5.1	Immunity vibration test: 10 Hz to 150 Hz, 1 g, EUT operating, 10 cycles per axis
6.3.5.2	Immunity shock test: 15 g, 11 ms, EUT operating, 2 cycles per axis

EMC Conditions

The most important tests and limit values for EMC conditions are listed in the following tables:

EN 61131-2	Noise Immunity Test
6.3.6.2.1 IEC/EN 61000-4-2	ESD test: 4 kV contact/ 8 kV air discharge
6.3.6.2.2 IEC/EN 61000-4-3	RFI test (10 V/m): 26 MHz to 1 GHz, 80% AM
6.3.6.2.3 IEC/EN 61000-4-4	Burst test: 2 kV power supply / 1 kV signal lines
6.3.6.2.4 IEC/EN 61000-4-12	Damped oscillatory wave immunity test: 1 kV

IEC/EN 61000-6-2	Noise Immunity Test
IEC/EN 61000-4-6	Radio frequency common mode: 10 V 150 kHz to 80 MHz, AM
IEC/EN 61000-4-3	900 MHz pulses
IEC/EN 61000-4-5	Surge: 2 kV, 1 kV, 0.5 kV

IEC/EN 61000-6-4	Noise Emission Test
EN50011 Class A	Emission test: radiated, conducted

Voltage Supply

The most important tests and limit values for the voltage supply of the equipment are listed in the following table:

IEC/EN 61131-2	Verification of DC Power Supply Characteristics
- - -	The power supply must meet alternatively the following standards: IEC 61131-2 or SELV (Safety Extra Low Voltage) or PELV (Protective Extra Low Voltage.)
- - -	Fusing the XPSMF60 Safety PLC must be performed according to the power supply data sheet.
6.3.7.1.1	Voltage range test: 24 VDC, -20% to 25% (19.2 VDC to 30.0 VDC.)
6.3.7.2.1	Momentary interruption immunity test: DC, PS 2: 10 ms.
6.3.7.4.1	Reversal of DC power supply polarity test: application note in the power supply data sheet.
6.3.7.5.1	Backup duration withstand test: Test B, 1000 h

Technical Characteristics

Mechanical Data

Power supply connectors 1

Connection Diameters, Single Lead Connection	
Without lead end sleeves	solid 0.75 to 16 mm^2 stranded 0.75 to 16 mm^2 AWG 19
Stranded with lead and sleeves (without plastic sleeves)	0.15 to 16 mm^2 AWG 22-14
Stranded with lead end sleeves (with plastic sleeves)	0.75 to 6 mm^2 AWG 19

Power supply connectors 2

Connection Diameters, Multiple Lead Connections (2 Leads Max, Same Diameters)	
Without lead end sleeves	solid 0.75 to 6 mm^2 stranded 0.75 to 6 mm^2 AWG 19
Stranded with lead and sleeves (without plastic sleeves)	0.5 to 6 mm^2 AWG 28
Stranded with lead end sleeves (with plastic sleeves)	0.5 to 4 mm^2 AWG 20

Signal line connectors 1

Connection Diameters, Single Lead Connection	
Without lead end sleeves	solid 0.14 to 1.5 mm^2 stranded 0.14 to 1.5 mm^2 AWG 28-16
Stranded with lead and sleeves (without plastic sleeves)	0.25 to 1.5mm^2 AWG 22-16
Stranded with lead end sleeves (with plastic sleeves)	0.25 to 0.5 mm^2 AWG 22-20

Signal line connectors 2

Connection Diameters, Multiple Lead Connections (2 Leads Max, Same Diameters)	
Without lead end sleeves	solid 0.14 to 0.5 mm^2 AWG 28-20 stranded 0.14 to 0.75 mm^2 AWG 28-18
Stranded with lead and sleeves (without plastic sleeves)	0.25 to 0.34 mm^2 AWG 22
Stranded with lead end sleeves (with plastic sleeves)	0.5 mm^2 AWG 20

Stripping Length and Torque

Stripping length	9 mm (0.35 in)
Torque	0.22 to 0.25 Nm (1.9 to 2.2 lb-in)

Technical Data

The XPSMF60 Safety PLC technical data are presented in the following tables:

User Memory	max. 500 kB user program max. 500 kB user data
Interface Safe Ethernet	4*RJ-45, 10/100 Base T with integrated switch
Modbus Serial Slave	XPSMFADAPT from SUB-D9 to RJ 45 connector
Operating Voltage	24 VDC -15%/+20%, Wss <=15%, from a power supply with protective separation, conforming to IEC61131-2 requirements Observe polarity!
Current Consumption	max. 30 A (with maximum load) idle current: 1.5 A
Operation Temperature	0 to 60 °C / 32 to 140 °F
Storage Temperature	-40 to +85 °C / -40 to 185 °F
Fuse (external)	32 A
Battery Backup	none
Protection	IP 20, free slots covered with plates
Dimensions	260 x 312 x 245 mm / 10.24 x 2.28 x 9.65 in. (width x height x depth)
Weight	approximately 10 kg / 22.05 lb (fully assembled with modules)

Supply Voltage

The XPSMF60 Safety Modular System PLC is a single voltage system. The required operating voltage is defined in accordance with IEC/EN 61131-2.

The following table describes the operating voltage:

Supply Voltage	
Nominal Value	24 VDC, -15...+20%
Max. Permissible Function Limits in Continuous Operation	18.5 to 30.2 VDC (including ripple)
Max. Peak Value	35 VDC for 0.1s
Permissible Ripple	w < 5% as r.m.s. value w_{ss} < 15% as value peak-to-peak
Reference Potential	L - (negative pole) Earthing the reference potential is permitted.

Module XPSMFDO801

The following table provides technical data about XPSMFDO801:

Relay Outputs	8 potential-free NO contacts
Switching Voltages	>= 6 V, <= 250 VAC/250 VDC
Switching Current	internally fused with 3.15 A breaking capacity 100 A
Switching Capacity AC	TÜV: max. 400 VA, cos phi = 0.5, max. 250 VAC, max. 600 VA, cos phi = 1, max. 250 VAC
Switching Capacity DC (Non-inductive)	UL: 30 VDC @ 3 A at resistive load 60 VDC @ 0.3 A at resistive load TÜV: up to 30 VDC: max. 90 W (3.15 A) up to 70 VDC: max. 35 W (0.5 A) up to 127 VDC: max. 40 W (0.315 A) up to 250 VDC: max. 60 W (0.25 A) (external fusing adapted)
Operating Data	3.3 VDC/0.2 A 24 VDC, +/-10%/0.7 A
Ambient Temperature	0 to +50 °C / 32 to 122 °F
Storage Temperature	-40 to +85 °C / -40 to 185 °F
Space Required	6 units high, 4 SU
Weight	600 g / 1.32 lb

The following table provides information about XPSMFDO801 relays outputs:

Design	Safety relays: 2 safety relays with positively guided contacts, 1 standard type relay.
Degree of Protection	IP 40
Contact Material	silver alloy, gold-flashed
Switching Time	approx. 30 ms
Reset Time	approx. 20 ms
Bounce Time	approx. 30 ms
Service Life Mechanical Electrical	 >= 3 x 10^6 switching cycles >=2.5 x 10^5 switching cycles with ohmic full load and <=0.1 switching cycles per second

Module XPSMFDI3201

The following table provides technical data about XPSMFDI3201:

Number of Inputs	32, electrically isolated
Input Voltage 1 Signal 0 Signal	nom. 24 VDC 10 to 30 V max. 5 V
Input Current 1 Signal 0 Signal	 2 mA @ 10 V, 5 mA @ 24 V 1.0 mA @ 5 V
Operating Data	3.3 VDC / 0.05 A 24 VDC / 0.2 A
Ambient Temperature	0 to 60 °C / 32 to 140 °F
Storage Temperature	-40 to +85 °C / -40 to 185 °F
Space Required	6 units high, 4 SU
Weight	260 g / 0.57 lb

Module XPSMFDIO241601

The following table provides technical data about XPSMFDIO241601:

Number of Inputs	24, electrically isolated
Input Voltage 1 Signal 0 Signal	nom. 24 VDC 10 to 30 V max. 5 V

Input Current 1 Signal 0 Signal	 2 mA @ 10 V, 5 mA @ 24 V 1.0 mA @ 5 V
Operating Data	3.3 VDC / 0.3 A 24 VDC / 0.5 A
Ambient Temperature	0 to 60 °C (32 to 140 °F)
Storage Temperature	-40 to +85 °C (-40 to +185 °F)
Space Required	6 units high, 4 SU
Weight	260 g / 0.57 lb

The following table provides technical data about XPSMFDIO241601 outputs:

Number of Outputs	16, electrically isolated
Output Voltage	18.4 to 26.8 VDC
Internal Voltage Drop	max. 2 V @ 2 A
Output Current (at 30 ^{o}C)	2 A per channel, max. 8 A per module, permanently short-circuit proof as per IEC 61131-2
Minimum Load	2 mA per channel
Leakage Current (0 Signal)	max. 1 mA @ 2 V

Module XPSMFDI2401

The following table provides technical data about XPSMFDI2401:

Number of Inputs	24, electrically isolated
Input Voltage 1 Signal 0 Signal	nom. 110 VDC, 127 VAC (one-phase) >=79 V <=20 V
Input Current 1 Signal	 2.2 mA @ 79 V
Operating Data	3.3 VDC / 0.05 A 24 VDC / 0.1 A (1 signal = 79 V)
Ambient Temperature	0 to +60 °C (32 to 140 °F)
Storage Temperature	-40 to +85 °C (-40 to +185 °F)
Space Required	6 units high, 4 SU
Weight	260 g / 0.57 lb

Module XPSMFCIO2401

The following table provides technical data about the outputs of XPSMFCIO2401:

Number of Outputs	4 digital outputs
Output Voltage	18.4 to 26.8 VDC
Output Current	0.5 A per channel, max. 2 A per module, permanently short-circuit proof as per IEC 61131-2
Internal Voltage Drop	max. 3 VDC / 0.05 A
Minimum Load	2 mA per channel
Leakage Current (0 Signal)	max. 1 mA / 2 V
Current Consumption	24 VDC / 0.1 A plus output load

The following table provides technical data about of XPSMFCIO2401:

Technical Data	
Input Voltages	5 to 24 V
Input Current	<=3 mA
Input Resistance	3.7 kΩ
Counting Frequency	0 to 1 MHz
Resolution	24 bit
Accuracy of the Time Base	0.2 %
Operating Data	24 VDC / 0.1 A plus output load 3.3 VDC / 0.8 A 5 VDC / 0.1 A
Ambient Temperature	0 to +60 °C (32 to 140 °F)
Storage Temperature	-40 to +85 °C (-40 to +185 °F)
Space Required	6 units high, 4 SU
Weight	260 g / 0.57 lb

Module XPSMFAI801

The following table provides technical data about XPSMFAI801:

Number of Inputs	8 unipolar or 4 bipolar
Nominal Input Value	up to +/-10 VDC or 0 to +20 mA (with shunt)
Range of Use	0 to +/-10.25 VDC or 0 to +/-20.5 mA (with shunt)
Max. Input Signal	+/-10.7 VDC

Shunt (for Current Measurements)	250 or 500 Ω
Overvoltage Protection	+/-15 VDC (range 30 VDC)
Effective Resolution	9 bit
Max. Resolution	12 bit
Input Resistance	1 MΩ
Source Resistance of Input Signals	<= 500 Ω
Measurement Errors: Calibration Error, Zero Point Calibration Error, Terminal Point Channel Error Temperature Factor, Zero Point Temperature Factor, Terminal Point Linearity Error Long-term Drift Repeat Accuracy Largest Error Over Entire Temperature Range	of upper range value max. +/-0.2% max. +/-0.2% max. +/-0.5% max. +/-0.5% / 10 K max. +/-0.5% / 10 K max. +/-0.5% max. +/-0.5% max. +/-0.5% max. +/-1%
Safety Accuracy	max. +/-1%
Largest Transient Deviation	+/- 1%
Measured Value Renewal	once per cycle of XPSMF60
Scanning Period	approx. 45 microseconds
Operating Data	24 VDC / 380 mA 3.3 VDC / 150 mA
Ambient Temperature	0 to +60 °C (32 to 140 °F)
Storage Temperature	-40 to +85 °C (-40 to +185 °F)
Space Required	6 HU, 4 SU
Weight	240 g / 0.53 lb

Module XPSMFAO801

The following table provides technical data about XPSMFAO801:

Number of Inputs	8 analog outputs
Nominal Output Value	0 to +/-10 VDC or 0 to +20 mA
Max. Output Value	0 to +/-10.25 VDC or 0 to +21 mA
Overvoltage Protection	24 VDC
Effective Resolution	7 bit
Max. Resolution	12 bit
Output Resistance	<=600 Ω (current operation) >1 kΩ (voltage operation)

Operating Data	3.3 VDC / 130 mA 5 VDC / 280 mA 24 VDC / 630 mA
Measurement Errors: Calibration Error, Zero Point Calibration Error, Terminal Point Channel Error Temperature Factor, Zero Point Temperature Factor, Terminal Point Linearity Error Long-term Drift Repeat Accuracy Largest Error Over Entire Temperature Range	of upper range value max. +/-0.2% max. +/-0.2% max. +/-0.5% max. +/-0.5% / 10 K max. +/-0.5% / 10 K max. +/-0.5% max. +/-0.5% max. +/-0.5% max. +/-1%
Safety Accuracy	max. +/-1%
Symmetry Tolerance (Voltage Output)	max. +/-1%
Ambient Temperature	0 to +60 °C (32 to 140 °F)
Storage Temperature	-40 to +85 °C (-40 to +185 °F)
Space Required	6 units high, 4 SU
Weight	280 g / 0.62 lb

Module XPSMFCPU22

The following table provides technical data about XPSMFCPU22:

User Program	max. 500 kB user program max. 500 kB user data
Interfaces: SafeEthernet Modbus Slave	 4 x RJ-45, 10/100 BaseT with integrated switch SUB-D 9-pin (FB2) - use adaptor XPSMFADAPT for SUB-D9 to RJ 45 connector
Operating Data	3.3 VDC / 1.5 A 5 VDC / 0.1 A
Back-up for Date/Time	goldcap
Ambient Temperature	0 to +60 °C (32 to 140 °F)
Storage Temperature	-40 to +85 °C (-40 to +185 °F)
Space Required	6 units high, 4 SU
Weight	280 g / 0.62 lb

Module XPSMFPS01

The following table provides technical data about XPSMFPS01:

Operating Voltage	24 VDC, -15 to +20%, w_{ss}<=15% **Observe polarity!** From a power supply with protective separation, conforming to IEC 61131-2 requirements.
Current Consumption	max. 30 A external protection with 32 A
Output Voltages	3.3 VDC / 10 A 5 VDC / 2 A
Ambient Temperature	0 to +60 °C (32 to 140 °F)
Storage Temperature	-40 to +85 °C (-40 to +185 °F)
Space Required	6 units high, 12 SU
Weight	820 g / 1.81 lb

Additional Items

Overview

This section lists additional items that can be used with or alongside the Safety PLC.

List of Additional Items

- Power Supply Unit-24 VDC with protective separation from power supply: IEC 61131-2
  Product ranges: ABL7RE or ABL8RP
  Location: *www.telemecanique.com*
- Suitable DIN Rail for mounting the controller
  AM1•• range of DIN rail is acceptable and can be found under the Cable and Wiring Accessories in Control and Connection Components Catalog.
- OtherSafe PLC controllers and IO
  - XPSMF60•• The XPSMF60 controller is a modular PES in a rack system housing. The controller is able to house up to six of the following modules (see the table below). The number of times a particular module is used in the XPSMF60 is not restricted.
  - XPSMF3DIO•• Remote Input and Output modules. The number of inputs and outputs may vary depending on the model.
  - XPSMF2DO•• Remote Output Module. The number of outputs varies.
  - XPSMF1DI1601 Remote Input Module with 16 digital outputs.
- Safety Modules Various safety modules and safety controllers (see Machine Safety in the Essential Guide). Module functions range from emergency stop to light curtain monitoring.
- Standard Controllers: Non-Safety data transfer (see Automation, automation and Control, Essential Guide, 2005). Standard controllers operate both large and small machinery. Ranges: Twido, Micro, Premium, and Quantum.
- Safety Devices Switches and Actuators:
  - coded magnetic switches, limit switches, rotary lever or spindle, emergency stops, foot switches, switch disconnectors
  - mat
  - light curtains
  - 2 hand control units
  - motor starters

  (See Safety section or the Essential Guide for more details.)
- Human Machine Interface Devices (to increase safety awareness)
  - pushbuttons and pilot lamps
  - beacons
  - sirens
  - magelis displays

  (See Operator Dialog section of the Essential Guide for more information.)

NOTE: All the catalogs and guides are available at *http://www.telemecanique.com*.

Maintenance and Repair

4

Maintenance and Repairs

At a Glance

The XPSMF60 Safety PLC is designed for industrial applications. All the Safety PLC's components have a very high availability and are compliant with the requirements of IEC 61508 for PFD and PFH in accordance with SIL 3.

⚠ WARNING

OFFLINE PROOF TEST

Offline Proof Test according to IEC 61508-4 must be conducted to verify proper operation.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Offline Proof-Test

The offline proof-test recognizes dangerous concealed faults that would affect the safe function of the plant.

Safety systems have to be subjected to an offline proof test in intervals of 10 years. By an analysis using the calculation tool SILence, the interval often may be extended. (SILence is a separate program. Contact the service for more information or take a look at the HIMA homepage for a test version of the software SILence.)

For relay modules, the proof test for the relays has to be carried out in intervals defined for the respective plant.

Execution of the Offline Proof-Test

The execution of the offline proof test depends on the configuration of the plant (EUC = equipment under control), which risk potential it has, and which standards for operation are applied and form the bases for the approval by the test authority in charge.

According to the standards IEC 61508 1-7, IEC 61511 1-3, IEC 62061, and VDI/VDE 2180 sheet 1 to 4, in case of safety-related systems the operating company has to arrange for proof tests.

Periodic Proof Testing

The modules can be proof tested by executing the full safety loop.

In practice the input and output field devices have a more frequent proof test interval (e.g., every 6 or 12 months) than the modules. If the end-user tests the complete safety loop because of the field devices then the modules are automatically included in these tests. No additional periodic tests are required for the modules.

If the proof test of the field devices does not include the modules then the PES needs to be tested as a minimum once in 10 year. This can be done by executing a reset of the modules.

In case there are periodic proof test requirements for specific modules then the end-user should refer to the data sheets of these modules.

Replacing Faulty Modules

If an XPSMF60 Safety PLC module fails, the following replacement procedure is used:

Step	Action
1	Disconnect power supply to the specific module.
2	Disconnect all terminals of that particular module (removing input or output wires is not required).
3	Ensure use of an electrostatic armband and touch an earthed object.
4	Remove the screws at the top and bottom of the module.
5	Replace the faulty module with a new one.
6	Secure the new unit with screws.
7	Reconnect power supply.
8	Connect all I/O terminals to the new module. Rewiring is not necessary, but the terminals must be inspected to ensure they are in good operating condition.
9	Re-establish network connection, using the XPSMFWIN.

Replacing Faulty CPU

To replace a faulty CPU, do the following:

Step	Action
1	Disconnect power supply to the XPSMF60.
2	Disconnect field bus and Ethernet network cables.
3	Ensure use of an electrostatic armband and touch an earthed object.
4	Remove the screws located at the top and bottom of the CPU module.
5	Replace the faulty CPU module with a new one.
6	Secure the new CPU with screws.
7	Reconnect network and field bus cables.
8	Reconnect power supply.
9	Connect a PC running XPSMFWIN and reconfigure the IP address and SRS.
10	Download the program.
11	Restart the XPSMF60.

Testing the Inputs and Outputs for Interference Voltage and Earth Faults

Inadmissible interference voltage can be measured with a universal tester. We recommend testing every single terminal for unapproved interference voltage.

When testing the external cables for insulation resistance, short-circuit, and line break, the cables must not be connected at both ends to prevent defects or destruction of the XPSMF60 caused by excessive voltages.

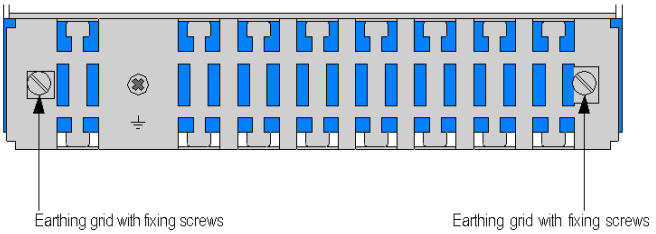
Earth faults are to be tested before connecting the field cable to the devices. The feed voltage must be disconnected from the sensors, as well as between the negative pole and the actuators. If the negative pole is earthed during operation, the earth connection must be disconnected while testing for earth faults. This also applies to the earth connection of an existing earth fault tester. Every terminal can only be tested against earth with a resistance tester or a similar test instrument.

Testing the insulation of one or more wires against earth is admissible, but not 2 muted wires. High voltage testing is also not admissible.

Guidelines to measure circuit voltage and insulation resistance can be found in EN 50178.

Changing the Fans

Follow the instructions when replacing the fans of the Safety PLC:

Step	Action
1	Loosen both fixing screws (left and right) on the earthing grid. The following image shows the earthing grid: 
2	Move the earthing grid and the attached cables, so you can remove the fan support plate.
3	Loosen the connector (for the voltage supply of the fans) and pull out the fan support plate.
4	Loosen the four fixing screws on each fan to be able to remove and then replace them. **The fans can be replaced while the PES is in operation. You do not have to switch it off. Replace the fans every 5 years in case the device works in regular temperature (less than 40 °C/ 104 °F) or every 3 years in case the device works in higher temperatures (more than 40 degrees centigrade).**

FAULT Contact

The module is equipped with a potential-free changeover contact. Errors occurring in the Safety PLC are displayed by the LEDs of the module and can be examined through system signals with the user program from a PC.

Additionally, the contact can be controlled by the user program using the four ORed system signals (Module CPU XPSMF60, register outputs, signals Relay Contact 1-4).

The following table describes the dependency of contact connections and the state of the device:

Contact Connections	State
1-2 closed (2-3 open)	Device functions correctly.
1-2 open (2-3 closed)	Device has no operating voltage or the CPU is in ERROR STOP mode.

The electrical connection of the contact is carried out via a 3-pole removable terminal connector on the front panel of the module. The connector can accommodate lines up to max. 1.5 mm (AWG 16).

Faults

Faults in the central module generally cause a shutdown of the entire Safety PLC and are indicated on the CPU by the LEDs. Faults in the input and output modules are automatically detected during operation and indicated on the front panel of the affected module by the ERR LED. You can diagnose errors with a programming unit, even if the PLC has stopped, provided that communication has not been affected.

Before replacing an I/O module, check whether an external line fault is present and that the relevant sensor/actuator is functioning correctly.

Response to Faults

A fault occurring in the input or output channel has no effect on the Safety PLC. Only the defective channel is interpreted as faulty, not the entire PLC. The remaining safety functions are not affected and remain active. If a defective input channel is detected, the operating system passes the safe value "0" to be processed. Defective output channels are set to a power-free state. If a single channel cannot be switched off separately, the whole output module is interpreted as defective. The fault status signal is set, and the CPU signals the type of fault to the user program.

If an error occurring in the input or output module disappears again, the error status is reset and normal operation is resumed. The frequency with which faults occur is statistically evaluated. If the specified error frequency is exceeded, the status of the module is permanently set to defective. The module does not operate even after the fault has disappeared. You can manage the release of the module and erase the fault statistic by changing the CPU state from STOP to RUN. With this change, the fault of the module will be registered.

If a fault is detected in the CPU, the module goes into ERROR STOP mode, and all outputs are set to the safe (de-energized) state. The CPU goes into the STOP state if a fault in the user program occurs. If a fault occurs in the I/O modules, does not activate a safety-related shut-down or lasts for more than 24 hours, the CPU only goes into STOP state. Both faults are not interpreted as CPU faults.

Short-Circuit Characteristics of the Output Channels

If a short-circuit occurs in an output channel, the Safety PLC switches off the affected channel. If multiple short-circuits occur, the channels are switched off individually in accordance with their power consumption.

If the maximally permitted current for all outputs is exceeded, all outputs are shut down and cyclically reconnected.

⚠ WARNING

SHORT-CIRCUIT CONDITION

The output circuit terminals must not be connected with the connected load. In case of a short-circuit, the resulting high current may damage the terminals.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Repair of Controllers and Modules

You may not repair the XPSMF60 Safety PLC or its modules. Defective devices must be returned to Schneider Electric for repair.

The validity of the safety certificate will expire if unauthorized repairs have been made on the device. The manufacturer will bear no responsibility for unauthorized repairs. Unauthorized repairs will also cancel all warranties for the device.

Appendices

Connection Diagrams, Examples of Application, and Error Codes

A

Overview

This chapter contains connection diagrams, examples of application, and error codes.

What's in this Chapter?

This chapter contains the following topics:

Error Codes

Diagnostics

Using the XPSMFWIN programming environment, all the Safety PLC's inputs and outputs can be viewed. Each Safety PLC provides diagnostic signals with reference to their status, error codes, and channel status.

In XPSMFWIN all diagnostic information can be viewed in 2 ways:

- Using the **On-line** test function - it can monitor the values of the signals and variables within the logic plan, while the systems are executing the program.
- Using the **Diagnostics** window that displays all states of the CPU, COM, and I/O modules.

Description of Error Codes

The error codes listed in this section appear in XPSMFWIN programming environment.

NOTE: The signals for the error codes of the hardware channels are always located in the register **Inputs**. The signals for the parametrization or configuration of the hardware channels are located in the register **Outputs**, whether those are physical inputs or outputs. The hardware channel for a physical input is always located in the register **Inputs**, and the channel for a physical output is located in the register **Outputs**.

XPSMFDO801 Module Signals

The following table explains signals and error codes of the XPSMFD0801 module digital inputs:

System Signal	R/W	Meaning	
Module.SRS [UDINT]	R	slot number (system-rack-slot)	
Module.Type [UINT]	R	type of module, setpoint: 0xF906 [63750 dez]	
Module.Error Code [WORD]	R	error codes of module	
		0x0000	I/O processing, may be faulty.
		0x0001	no I/O processing (CPU not in RUN)
		0x0002	no I/O processing during start-up tests
		0x0004	manufacturer interface in operation
		0x0010	no I/O processing: incorrect configuration
		0x0020	no I/O processing, error rate exceeded
		0x0040/0x0080	no I/O processing: configured module not inserted

System Signal	R/W	Meaning	
DO.Error Code [WORD]	R	error codes for all digital outputs	
		0x0001	module error
		0x0002	MEZ test: safety switch 1 failed
		0x0004	MEZ test: safety switch 2 failed
		0x0008	FTZ test of test pattern failed
		0x0010	MEZ test of readback channels failed
		0x0020	MEZ test, active disconnection failed
		0x0040	error with initialization: relays
		0x0100	FTZ test of CS (ship select) signals failed
		0x0400	FTZ test: 1. temperature threshold exceeded
		0x0800	FTZ test. 2. temperature threshold exceeded
		0x1000	MEZ test: status of safety switch
		0x2000	MEZ test: status of safety switch
		0x4000	MEZ test: active disconnection by watchdog failed
DO[xx].Error Code [BYTE]	R	error codes for the digital output channels	
		0x01	error in digital output module
		0x04	error reading back the digital outputs
		0x10	error reading back relay [x].1 (The channel is permanently deactivated.)
		0x20	error reading back relay [x].2 (The channel is permanently deactivated.)
		0x80	Channel cannot be activated after deactivation by ● user program, ● forcing or ● channel/module failure.
DO[xx].Value [BOOL]	W	Output value of digital output channels	
		0 1	output power-free output activated

XPSMFDI3201 Module Signals

The following table explains signals and error codes of the XPSMFDI3201 module digital inputs:

System Signal	R/W	Meaning	
Module.SRS [UDINT]	R	slot number (system-rack-slot)	
Module.Type [UINT]	R	type of module, setpoint: 0xF807 [63495 dez]	
Module.Error Code [WORD]	R	error codes for the module	
		0x0000	I/O processing, may be faulty.
		0x0001	no I/O processing (CPU not in **RUN**)
		0x0002	no I/O processing during start-up tests
		0x0004	manufacturer interface in operation
		0x0010	no I/O processing: incorrect configuration
		0x0020	no I/O processing, error rate exceeded
		0x0040/0x 0080	no I/O processing: configured module not inserted
DI.Error Code [WORD]	R	error codes for all digital inputs	
		0x0001	module error
		0x0002	FTZ test of test pattern failed.
		0x0004	FTZ test: 1. temperature threshold exceeded.
		0x0008	FTZ test: 2. temperature threshold exceeded.
DI[xx].Error Code [BYTE]	R	error codes for the digital input channels	
		0x01	error in digital input module
		0x10	short-circuit of the channel
		0x80	line interruption between pulsed output DO and pulsed input DI, for example: • line break • open switch • L + undervoltage
DI[xx].Value [BOOL]	R	input value of digital input channels	
		0	input not set
		1	input set

System Signal	R/W	Meaning	
DI No. of Pulse Channels [USINT]	W	number of pulsed outputs (feed outputs)	
		0	no output channel-provided for line control
		1	output channel 1 provided for line control
		2	output channel 1 and 2 provided for line control
		...	...
		8	output channel 1 to 8 provided for line control
Pulsed outputs must not be used as safety-related outputs!			
DI Pulse Slot [UDINT]	W	pulse module slot, value has to be set to 1	
DI[xx].Pulse Channel [USINT]	W	source channel of the pulse feed	
		0	input channel
		1	pulse from DO channel 1
		2	pulse from DO channel 2
		...	...
		8	pulse from DO channel 8
DI Pulse Delay [10E-6s] [UINT]	W	waiting time for Line Control (short-circuit proof as per IEC 61131-2).	

XPSMFDIO241601 Module Signals

The following table explains signals and error codes of the XPSMFDIO241601 module digital inputs:

System Signal	R/W	Meaning	
Module.SRS [UDINT]	R	slot number (system-rack-slot)	
Module.Type [UINT]	R	type of module, setpoint:0xF708 [65025 dez]	
Module.Error Code [WORD]	R	error codes for the module	
		0x0000	I/O processing, may be faulty.
		0x0001	no I/O processing (CPU not in **RUN**)
		0x0002	no I/O processing during start-up tests
		0x0004	manufacturer interface in operation
		0x0010	no I/O processing: incorrect configuration
		0x0020	no I/O processing, error rate exceeded
		0x0040/0x0080	no I/O processing: configured module not inserted

System Signal	R/W	Meaning	
DI.Error Code [WORD]	R	error codes for all digital inputs	
		0x0001	module error
		0x0002	FTZ test of test pattern failed
DI[xx].Error Code [BYTE]	R	error codes for the digital input channels	
		0x01	error in digital input module
		0x10	short-circuit of the channel
		0x80	line interruption between pulsed output DO and pulsed input DI, for example: ● line break ● open switch ● L + undervoltage
DI[xx].Value [BOOL]	R	input value of digital input channels	
		0	input not set
		1	input set
DI No. of Pulse Channels [USINT]	W	number of pulsed outputs (feed outputs)	
		0	no output channel-provided for line control
		1	output channel 1 provided for line control
		2	output channel 1 and 2 provided for line control
		...	...
		8	output channel 1 to 8 provided for line control
Pulsed outputs must not be used as safety-related outputs!			
DI Pulse Slot [UDINT]	W	pulse module slot	
DI[xx].Pulse Channel [USINT]	W	source channel of the pulse feed	
		0	input channel
		1	pulse from DO channel 1
		2	pulse from DO channel 2
		...	...
		8	pulse from DO channel 8
DI Pulse Delay [10E-6 s] [UINT]	W	waiting time for Line Control (short-circuit proof as per IEC 61131-2)	

System Signal	R/W	Meaning	
DO.Error Code [WORD]	R	error codes for all digital outputs	
		0x0001 0x0002 0x0004 0x0008 0x0010 0x0020 0x0100 0x0200 0x0400 0x0800 0x1000 0x2000	module error MEZ test, safety switch 1 failed MEZ test, safety switch 2 failed FTZ test of test pattern failed MEZ test of readback channels failed MEZ test, active disconnection failed FTZ test of CS (ship select) signals failed all outputs switched off, total current exceeded FTZ test: 1. temperature threshold exceeded FTZ test: 2. temperature threshold exceeded FTZ test: monitoring of auxiliary supply: 1. undervoltage MEZ test: status of safety switches
DO[xx].Error Code [BYTE]	R	error codes of digital output module	
		0x01 0x02 0x04	error in digital output module output switched off due to overload error reading back the digital outputs
DO[xx].Value [BOOL]	W	output value of digital output channels	
		0 1	output power-free output activated

XPSMFDI2401 Module Signals

The following table explains signals and error codes of the XPSMFDI2401 module digital inputs:

System Signal	R/W	Meaning	
Module.SRS [UDINT]	R	slot number (system-rack-slot)	
Module.Type [UINT]	R	type of module, setpoint: 0xFA05 [64005 dez]	
Module.Error Code [WORD]	R	error codes of module	
		0x0000 0x0001	I/O processing, may be faulty.
		0x0002	no I/O processing (CPU not in RUN)
		0x0004	no I/O processing during start-up tests
		0x0010	manufacturer interface in operation
		0x0020	no I/O processing: incorrect configuration
		0x0040	no I/O processing, error rate exceeded
		0x0080	no I/O processing: configured module not inserted

System Signal	R/W	Meaning	
DI.Error Code [WORD]	R	error codes for all digital inputs	
		0x0001	module error
		0x0002	FTZ test of test pattern failed
		0x0004	FTZ test: 1. temperature threshold exceeded
		0x0008	FTZ test: 2. temperature threshold exceeded
DI[xx].Error Code [BYTE]	R	error codes for the digital input channels	
		0x01	error in digital input module
DI[xx].Value [BOOL]	R	input value of digital input channels	
		0 1	input not set input set

XPSMFAI801 Module Signals

The following table explains signals and error codes of the XPSMFAI801 module digital inputs:

System Signal	R/W	Meaning	
Module.SRS [UDINT]	R	slot number (system-rack-slot)	
Module.Type [UINT]	R	type of module, setpoint: 0xFD02 [64770 dez]	
Module.Error Code [WORD]	R	error codes of module	
		0x0000	I/O processing, may be faulty.
		0x0001	no I/O processing (CPU not in RUN)
		0x0002	no I/O processing during start-up tests
		0x0004	manufacturer interface in operation
		0x0010	no I/O processing: incorrect configuration
		0x0020	no I/O processing, error rate exceeded
		0x0040/ 0x0080	no I/O processing: configured module not inserted

System Signal	R/W	Meaning	
AI.Error Code [WORD]	R	error codes for all analog inputs	
		0x0001	module error
		0x0008	FTZ test: walking bit of data bus faulty
		0x0010	FTZ test: error checking coefficients
		0x0020	FTZ test: operating voltages faulty
		0x0040	A/D conversion faulty (DRDY_LOW)
		0x0080	MEZ test: cross links of MUX faulty
		0x0100	MEZ test: walking bit of data bus faulty
		0x0200	MEZ test: multiplexer addresses faulty
		0x0400	MEZ test: operating voltages faulty
		0x0800	MEZ test: measuring system (characteristic) faulty (unipolar)
		0x1000	MEZ test: measuring system (final values, zero point) faulty (unipolar)
		0x2000	MEZ test: measuring system (characteristic) faulty (bipolar)
		0x4000	MEZ test: measuring system (final values, zero point) faulty (bipolar)
		0x8000	A/D conversion faulty (DRDY_HIGH)
AI[0x].Error Code [BYTE]	R	error codes for the analog input channels	
		0x01	error in analog input module
		0x02	<= V3 operating system CPU: measured values invalid, >= V4 operating system CPU: not used
		0x04	A/D converter faulty since V4 operating system CPU also: measured values invalid
		0x08	measured value not inside the safety accuracy
		0x10	measured value overflow
		0x20	channel not in operation
		0x40	address error of both A/D converters
AI[0x].Value [INT]	R	analog value of each channel [INT] from -1000 to +1000 (-10 to + 10 V) The validity depends on the value AI[0x].Error Code. analog value of each channel [INT] from -2000 to +2000 (-10 to +10 V) The validity depends on the value AI[0x].Error Code.	

System Signal	R/W	Meaning	
AI[0x].Used [BOOL]	W	channel configuration	
		1	in operation
		0	not in operation.
AI.Mode [BOOL]	W	all channels unipolar or differential 0 - unipolar measurement 1 - bipolar measurement	

XPSMFAO801 Module Signals

The following table explains signals and error codes of the XPSMFAO801 module digital inputs:

System Signal	R/W	Meaning	
Module.SRS [UDINT]	R	slot number (system-rack-slot)	
Module.Type [UINT]	R	type of module, setpoint:0xFB04 [64260 dez]	
Module.Error Code [WORD]	R	error codes of module	
		0x0000	I/O processing, may be faulty.
		0x0001	no I/O processing (CPU not in RUN)
		0x0002	no I/O processing during start-up tests
		0x0004	manufacturer interface in operation
		0x0010	no I/O processing: incorrect configuration
		0x0020	no I/O processing, error rate exceeded
		0x0040/ 0x0080	no I/O processing: configured module not inserted
AO.Error Code [WORD]	R	errror codes for all analog outputs	
		0x0001	module error
		0x0002	FTZ test: error checking coefficients
		0x0004	no communication to AO module, PES faulty

System Signal	R/W	Meaning	
AO[0x].Error Code [DWORD]	R	error codes for the analog output channels	
		0x0000 0001	CPU F60: AO module error
		0x0000 0002	CPU F60: faulty monotonicity counter
		0x0000 0004	CPU F60: faulty secure addressing
		0x0000 0008	CPU F60: CRC faulty
		0x0000 0010	CPU F60: faulty WD time in ADyC
		0x0000 0020	CPU F60: communication to ADyC not possible
		0x0000 0040	CPU F60: Coltage does not match the initial state.
		0x0000 0080	CPU F60: AO [8], value not specified range
		0x0001 0000	ADyC: error reading back
		0x0004 0000	ADyC: error with analog voltage supply
		0x0008 0000	ADyC: error with MEZ test of safety switches
		0x0080 0000	ADyC: 2 safety switches are faulty
		0x0200 0000	ADyC: initialization of ADyC
		0x1000 0000	ADyC: error due to exceeded temperature
		0x2000 0000	ADyC: warning due to exceeded temperature
		0x8000 0000	CPU F60: redundant ADyC channel indicates error

System Signal	R/W	Meaning	
AO[0x].Value [INT]	W	Output value of AO channels (version FS1000): voltage characteristic: -1000 to +1000 (-10 to +10 V) current characteristic: 0 to +1000 (0 to +20 mA) current characteristic: -1000 to 0 (0 mA) **Values are proved for plausibility before standardization.** Current characteristic: ● values < 0: standardization with 0 ● values > 1000: standardization with 1000 Voltage characteristic: ● values < -1000: standardization with -1000 ● values > 1000: standardization with 1000 Output value of AO channels (version FS2000): voltage characteristic: -2000 to +2000 (-10 to +10 V) current characteristic: 0 to +2000 (0 to +20 mA) current characteristic: -2000 to 0 (0 mA) **Values are proved for plausibility before standardization.** Current characteristic: ● values < 0: standardization with 0 ● values > 2000: standardization with 2000 Voltage characteristic: ● values < -2000: standardization with -2000 ● values > 2000: standardization with 2000	
AO[0x].Mode [USINT]	W	current or voltage channel measurement	
		0	voltage characteristic
		1	current characteristic
AO[0x].Used [BOOL]		channel configuration	
		1	in operation
		0	not in operation

XPSMFCIO2401Module Signals

The following table explains signals and error codes of XPSMFCIO2401 inputs:

System Signal	R/W	Meaning
Module.SRS [UDINT]	R	slot number (system-rack-slot)
Module.Type [UINT]	R	type of module, setpoint: 0xFC03

System Signal	R/W	Meaning	
Module.Error Code [WORD]	R	error codes for the module	
		0x0000 0x0001 0x0002 0x0004 0x0010 0x0020 0x0040/ 0x0080	I/O processing, may be faulty no I/O processing (CPU not in the RUN) no I/O processing during start-up tests manufacturer interface in operation no I/O processing: incorrect configuration no I/O processing: error rate exceeded no I/O processing: configured module not inserted
Counter.Error Code [WORD]	R	error codes for both counters	
		0x0001 0x0002 0x0004 0x0008 0x0010 0x0020 0x0040 0x0080 0x0100 0x0200	error in module error comparing the time base address error reading the time base parameters for the time base faulty address error reading the counter content configuration of counter damaged address error reading the Gray Code FTZ test of the test pattern failed FTZ test, error checking the coefficients error at initial parameterization of the module
Counter[0x].Error Code [BYTE]	R	error codes for counters 1, 2	
		0x01 0x02 0x04 0x08	counter module error error comparing contents of counters error comparing the time stamps of counters error setting the configuration (reset)
Counter[0x].Value [UDINT]	R	content of counters: 24 bit for pulse counter, 4 bit for Gray Code	
Counter[0x].Time Stamp [UDINT]	R	time stamp for `Counter[0x].Value`, 24 bit, time resolution 1 µs	
Counter[0x].Value Overflow [BOOL]	R	counter overflow indication TRUE: 24 bit overflow since last cycle (only if `Counter[0x].Auto. Advance Sense` FALSE) FALSE: no overflow since last cycle	
Counter[0x].Time Overflow [BOOL]	R	overflow indication for the time stamp of the counters TRUE: 24 bit overflow since last measurement FALSE: no 24 bit overflow since last measurement	
Counter[0x].Auto. Advance Sense [BOOL]	R/W	automatic counter direction recognition TRUE: automatic recognition On FALSE: manual setting of counter direction	
Counter[0x].Reset [BOOL]	R/W	reset counter TRUE: no reset FALSE: reset	

System Signal	R/W	Meaning
Counter[0x].Direction [BOOL]	R/W	counting direction of counter (only if Counter[0x].Auto.Advance Sense FALSE) TRUE: downwards (decrementation) FALSE: upwards (incrementation)
Counter[0x].5/24 V Mode [BOOL]	R/W	counter input 5 V or 24 V TRUE: 24 V FALSE: 5 V
Counter[0x].Gray Code [BOOL]	R/W	decoder/pulse operation TRUE: Gray Code Decoder FALSE: pulse operation

The following table explains signals and error codes of XPSMFCIO2401 outputs:

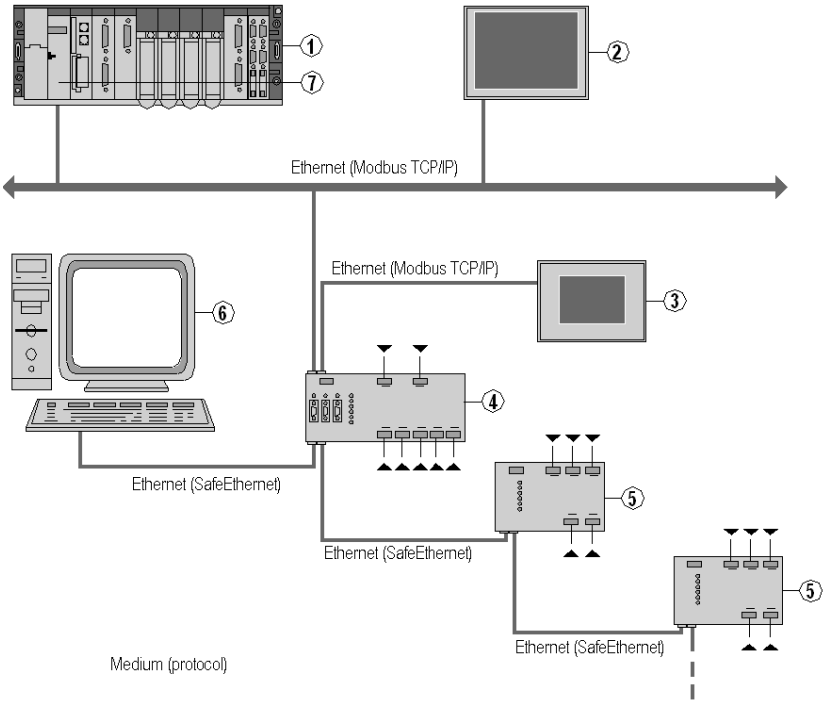
System Signal	R/W	Meaning	
Module.SRS [UDINT]	R	slot number (system-rack-slot)	
Module.Type [UINT]	R	type of module. setpoint:0xFC03	
Module.Error Code [WORD]	R	error codes for the module	
		0x0000 0x0001 0x0002 0x0004 0x0010 0x0020 0x0040/0x0080	I/O processing, may be faulty no I/O processing (CPU not in **RUN**) no I/O processing during the start-up tests manufacturer interface in operation no I/O processing: incorrect configuration no I/O processing: error rate exceeded no I/O processing: configured module not inserted
DO.Error Cod [WORD]	R	error codes for all digital outputs	
		0x0001 0x0002 0x0004 0x0008 0x0010 0x0020 0x0100 0x0200 0x0400 0x0800 0x1000 0x2000	module error MEZ test, safety switch 1 failed MEZ test, safety switch 2 failed FTZ test of test pattern failed MEZ test of readback channels failed MEZ test, active disconnection failed FTZ test of CS signals failed all outputs switched off, total current exceeded FTZ test: 1. Temperature threshold exceeded FTZ test: 2. Temperature threshold exceeded FTZ test: monitoring of auxiliary supply 1: undervoltage MEZ test: status of safety switches
DO[0x].Error Code [BYTE]	R	error codes for the digital output channels	
		0x01 0x02 0x04	module error output switched off due to overload error reading back the digital outputs

System Signal	R/W	Meaning	
DO[0x].Value [BOOL]	W	output value of digital output channels	
		0 1	output power-free output activated

Wiring Examples

SafeEthernet protocol and Ethernet Wiring Example

The following scheme shows an example of Ethernet and SafeEthernet protocol networking:



Elements of the network

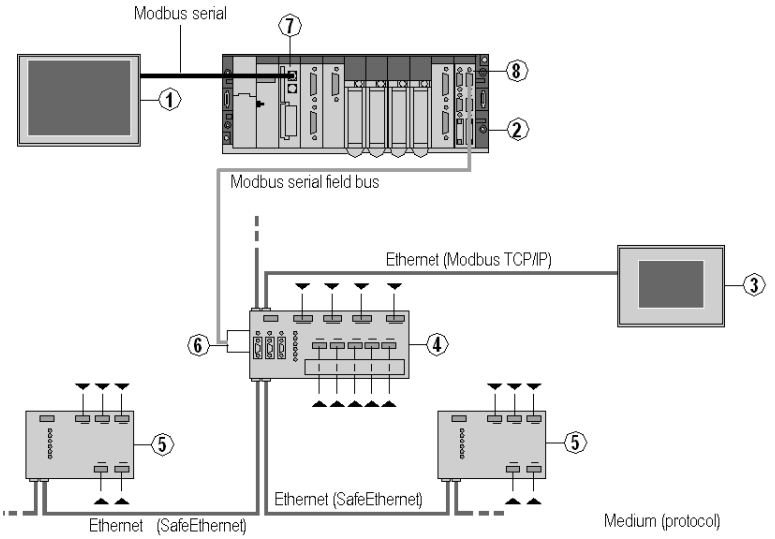
No.	Element
1	Atomation Platform Premium PLC
2	Magelis graphic terminal
3	Magelis graphic terminal
4	XPSMF30 safety PLC
5	XPSMF 1/2/3 DIO/AIO Remote I/O
6	PC
7	TSX ETY100 (Modbus TCP/IP) Module

The above application shows the communication between a Safety PLC and a Premium PLC over Ethernet using Modbus TCP/IP protocol and Ethernet using SafeEthernet protocol. The data exchange between the Safety PLC and the Premium PLC is non-safety data transfer. The two systems can work together sending and receiving data in both directions over Modbus TCP/IP. In this case, it allows non-safe data transfer over Ethernet through the Safety PLC.

Now, the data from a safety-related input can control a safety output within the Safety PLC system and a non-safety output through the Premium PLC system. The PLC system can transmit its non-safe data over Ethernet controlling a non-safety-related output. This allows the cabling system to be used to transfer both safe and non-safe data.

SafeEthernet Wiring Example

The following scheme shows an example of SafeEthernet protocol and Modbus protocols networking:



Elements of the network

No.	Element
1	Magelis graphic terminal
2	Automation platform 'Premium'
3	Magelis graphic terminal
4	XPSMF30 Safety PLC
5	XPSMF 1/2/3 DIO/AIO

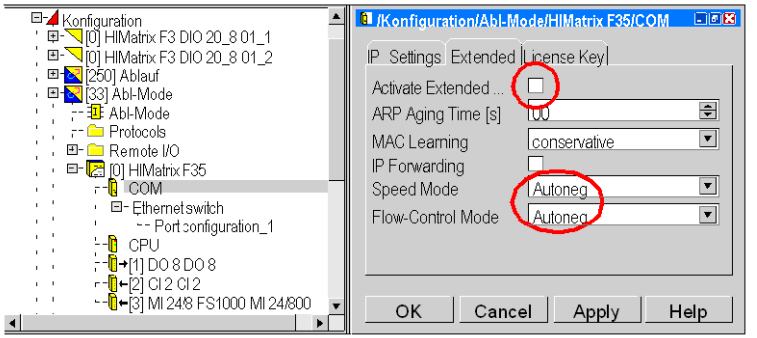
No.	Element
6	XPSMF ADAPT
7	TER Connection on Premium Processor
8	TSXSCY21601 Modbus Serial Module

The application above shows the combination of a Safety PLC system and a Premium PLC system connected via Modbus serial. The data exchange between the Safety PLC system and the Premium PLC system over Modbus serial is non-safe data transfer. The communication allows the two systems to work together. The PLC system can send the non-safe data over to the Safety PLC. The Safety PLC can transmit the non-safety-related data over SafeEthernet protocol to one of the safety remote I/O modules. The module can control a non-safety-related output. This enables the use of a single transmission line over large distances for safe and non-safe data transfer.

Configuration of Ethernet Interfaces

Communication Settings

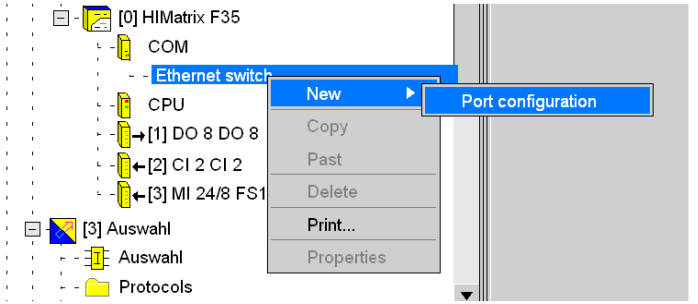
For setting the communication parameters proceed as follows:

Step	Action
1	Open the **Extended** tab.
2	In the **Speed Mode** list, select **Autoneg**.
3	In the **Flow-Control Mode** list, select **Autoneg**.
4	Select the **Activate Extended Settings** check box. **Result:** The selected parameters are activated.  **Note:** The parameters of the **Extended** tab are explained in detail in the online help of XPSMFWIN.

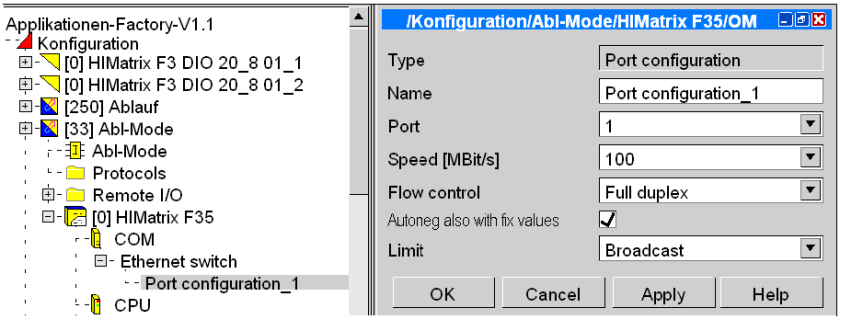
Port Settings

The port settings of the integrated switch can be parameterized individually from COM OS version > 8.32 and XPSMFWIN Hardware Management version > 7.56.10. Using the context menu of the communication **COM** settings select **Ethernet switch** → **New** → **Port configuration**. A configuration menu can be established for each switched port.

Setting a port configuration



Parameters of a port configuration



The following table contains the parameter descriptions:

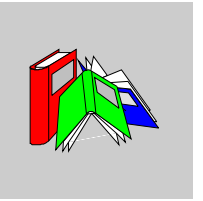
Parameter	Description
Port	Port number, as assigned on device. **Note:** Only 1 configuration is possible per port. **Value range** 1...n, depending on the resource
Speed [MBit/s]	The following selections are available: **10 MBit/s** data rate 10 MBit/s **100 MBit/s** data rate 100 MBit/s **Autoneg (10/100)** automatic setting of the baud rate The default setting is **Autoneg**.
Flow control	The following selections are available: **Full duplex** communication in both directions at the same time **Half duplex** communication in one direction **Autoneg** automatic control of communication The default setting is **Autoneg**.

Parameter	Description
Autoneg also with fix values	The *Advertising* (transfer of **Speed** and **Flow control** properties) is made with fixed parameter values. Thereby other devices, whose port settings are **Autoneg**, can recognise how the PLC ports are set.
Limit	Limit incoming Multicast and/or Broadcast packages. The following selections are available: **Off** no limit **Broadcast** limit Broadcast (128 kbit/s) **Multicast and Broadcast** limit Multicast and Broadcast (1024 kbit/s) The default setting is **Broadcast**.

Activation of Settings

Parameters are set in the **COM** window of the Hardware Management screen. Before the changes/settings become active the application program must be compiled using the Code Generator and then transferred to the PLC(s). The communication properties can be changed in the online mode using the Control Panel. The settings become active immediately, but are not transferred to the application program.

Glossary



A

AI

analog input

AIO

analog input/output

AO

analog output

AWG

american wire gauge (wire diameter)

C

COM

communication module

CPU

central processing unit

CRC

cyclic redundancy check

D

DI

digital input

DIO

digital input/output

DIP

dual in-line package, toggle switch with two possible positions (on/off or 1/0)

DO

digital output

E

EMC

electromagnetic compatibility

F

FB

field bus

FBD

functional block diagram

FTT

fault tolerance time

FTZ

see FTT.

H

H signal

high signal

I

IEC

international electrotechnical commission

L

L signal

low signal

M

MEZ

see MFOT.

MFOT

multi-fault occurrence time

O

OLE

object linking and embedding

OPC

OLE for Process Control

OSI Model

open system interconnection model

P

PADT (PC)

programming and debugging tool (according IEC 61131-3)

PELV

protective extra low voltage

PES

programmable electronic system

PFD

probability of failure on demand

PFH

probability of failure per hour

R

R

read

R/W

read/write

RC

requirement class

S

SELV

safety extra low voltage

SFC

sequential function chart

SIL

Safety Integrity Level (according to IEC 61508)

SNTP

Simple Network Time Protocol (REC 1769)

SRS

system-rack-slot

T

TMO

timeout

W

W

write

WD

watchdog

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X