Manual

Planar4®

Safety and System Manual

All the current manuals can be obtained upon request by sending an e-mail to: documentation@hima.com.

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Table of Contents

1 Introduction

The safety and system manual describes the configuration and mode of operation of the safety-related Planar4 controller system.

Planar4 can be used for various control tasks within the process and factory automation industry.

1.1 Structure and Use of the Document

This system manual is composed of the following chapters:

- Product Description
- Product Data
- Installation
- Programming and engineering
- Start-up, maintenance
- Communication
- Safety, availability and requirements
- Certification
- Symbols used in the data sheets
- Operation
- Decommissioning
- Transport
- Disposal
- HIMA service, training and hotline
- Appendix

1.2 Target Audience

This document is aimed at the planners, design engineers and programmers of automation systems as well as the persons authorized to start up, operate and maintain the devices and systems concerned. Specialized knowledge of safety-related automation systems is required.

All staff members (planning, installation, commissioning) must be informed about the risks and potential consequences resulting from the manipulation of a safety-related automation system.

Planners and configuration engineers must have additional knowledge about the selection and use of electrical and electronic safety systems in automated plants, e.g., to prevent improper connections or faulty programming.

The operator is responsible for qualifying the operating and maintenance personnel and providing them with appropriate safety instructions.

Only staff members with knowledge of industrial process measurement and control, electrical engineering, electronics and the implementation of PES and ESD protective measures may modify or extend the system wiring.

1.3 Writing Conventions

To ensure improved readability and comprehensibility, the following writing conventions are used in this document:

Bold	To highlight important parts. Names of buttons, menu functions and tabs that can be clicked and used in the programming tool.
Italics	Parameters and system variables, references.
`Courier`	Literal user inputs.
RUN	Operating states are designated by capitals.
Chapter 1.2.3	Cross-references are hyperlinks even if they are not specially marked. In the electronic document (PDF): When the cursor hovers over a hyperlink, it changes its shape. Click the hyperlink to jump to the corresponding position.

Safety notices and operating tips are specially marked.

1.3.1 Safety Notices

Safety notices must be strictly observed to ensure the lowest possible risk.

The safety notices are represented as described below.

- Signal word: warning, caution, notice.
- Type and source of risk.
- Consequences arising from non-observance.
- Risk prevention.

The signal words have the following meanings:

- Warning indicates hazardous situations which, if not avoided, could result in death or serious injury.
- Caution indicates hazardous situation which, if not avoided, could result in minor or moderate injury.
- Notice indicates a hazardous situation which, if not avoided, could result in property damage.

⚠ SIGNAL WORD

Type and source of risk!

Consequences arising from non-observance.

Risk prevention.

NOTICE

Type and source of damage!

Damage prevention.

1.3.2 Operating Tips

Additional information is structured as presented in the following example:

i The text giving additional information is located here.

Useful tips and tricks appear as follows:

TIP The tip text is located here.

2 Safety

All safety information, notes and instructions specified in this document must be strictly observed. The product may only be used if all guidelines and safety instructions are adhered to.

The product is operated with SELV or PELV. No imminent risk results from the product itself. Use in the Ex zone is only permitted if additional measures are taken.

2.1 Intended Use

This chapter describes the conditions for using the Planar4 system.

2.1.1 Scope

The safety-related Planar4 systems are certified for use in process controllers and protective systems.

2.1.1.1 Application in Accordance with the De-Energize to Trip Principle

The Planar4 system is designed in accordance with the de-energize to trip principle.

If a fault occurs, a system operating in accordance with the de-energize to trip principle enters the de-energized state to perform its safety function.

2.2 Operating Requirements

2.2.1 Electromagnetic Compatibility (EMC)

The modules of the Planar4 system meet the requirements of the EMC Directive of the European Union. The data sheets and modules bear therefore the CE marking.

i Since no magnetic field sensitive components are used in the Planar4 system, testing in accordance with IEC/EN 61000-4-8 is not required.

The following electromagnetic compatibility (EMC) requirements result from the standards mentioned in Chapter 10.2:

2.2.1.1 IEC 61000-6-2 Immunity for Industrial Environments

Test standards	Interference immunity tests in accordance with IEC 61000-6-2	Criterion[1)]
IEC/EN 61000-4-2:2009	ESD test: 4 kV contact discharge, 8 kV air discharge	B
IEC/EN 61000-4-3:2011-04	RFI test (10 V/m): 80 MHz…1 GHz, 80 % AM RFI test (3 V/m): 1.4 GHz…2 GHz, 80 % AM RFI test (1 V/m): 2.0 GHz…2.7 GHz, 80 % AM	A
IEC/EN 61000-4-4:2012	Burst test Supply voltage (24 VDC): 2 kV Field lines: 1 kV	B
IEC/EN 61000-4-5:2014	Surge: Supply voltage (24 VDC): 0.5 kV CM, 0.5 kV DM Field lines: 1 kV CM	B
IEC/EN 61000-4-6:2014	High frequency, asymmetrical Supply voltage (24 VDC): 10 V, 150 kHz…80 MHz, 80 % AM Field lines: 10 V, 150 kHz…80 MHz, 80 % AM	A
[1)] Criterion A: During and after interference, the module continues to operate as intended with no degradation of performance or loss of function. Criterion B: After interference, the module continues to operate as intended with no degradation of performance or loss of function. For additional details on the criteria, refer to the IEC 61000-6-2 standard.		

Table 1: Interference Immunity Tests in Accordance with IEC 61000-6-2

2.2.1.2 IEC 61326-3-1 Increased Interference Immunity for Safety-Related Systems

Test standards	Interference immunity tests (increased immunity) in accordance with IEC 61326-3-1	Criterion[1)]
IEC/EN 61000-4-2:2009	ESD test: 6 kV contact discharge, 8 kV air discharge	DS
IEC/EN 61000-4-3:2011-04	RFI test (20 V/m): 80 MHz…1 GHz, 80 % AM RFI test (10 V/m): 1.4 GHz…2 GHz, 80 % AM RFI test (3 V/m): 2.0 GHz…2.7 GHz, 80 % AM RFI test (3 V/m): 2.7 GHz…6 GHz, 80 % AM	DS
IEC/EN 61000-4-4:2012	Burst test Supply voltage: 3 kV Field lines: 2 kV	DS
IEC/EN 61000-4-5:2014	Surge: DC supply voltage: 2 kV CM, 1 kV DM Field lines: 2 kV CM	DS
IEC/EN 61000-4-6:2014	High frequency, asymmetrical 10 V, 150 kHz…80 MHz, 80 % AM Field lines: 10 V, 150 kHz…80 MHz, 80 % AM	DS
IEC/EN 61000-4-16:2016	Supply and field lines: 10…1 V, 20 dB/decade (1.5…15 kHz) 10 V (15…150 kHz) 10 V constant (60 s, with DC, 16²/₃ Hz, 50/60 Hz, 150/180 Hz) 100 V temporary (1 s, with DC, 16²/₃ Hz, 50/60 Hz, 150/180 Hz)	DS
[1)] Criterion DS: The module functions that are intended for executing a safety application - are not affected or - are influenced in a specified and recognizable state. For additional details on the criteria, refer to the IEC 61326-3-1 standard.		

Table 2: Interference Immunity Tests (Increased Immunity) in Accordance with IEC 61326-3-1

2.2.1.3 Emission

IEC 61000-6-4	Electromagnetic compatibility (EMC) Generic standards - Emission standard for industrial environments Disturbance suppression for electrical equipment and systems The modules do not exceed the threshold of class A for group 1 and are intended for use in industrial environments.

2.2.2 Environmental Requirements

The modules of the Planar4 system are designed for use in the following environmental requirements:

Environmental temperature range around the operating modules	-25…+70 °C
Permissible storage temperature	-40…+85 °C
Permissible humidity rating	
Annual average	≤ 75 %
on 30 days per year	95 %
on other days of the year in compliance with the annual average	85 %
Mechanical stress threshold based on EN 50178:1997	
Vibration	10…150 Hz, 1 g
Shock	15 g / 11 ms
Permissible mechanical stress in stationary, non-vibration-free devices or vehicles, but not installed in engines or ships	
Air pressure	
Altitude	≤ 1000 m

i Modules of the HIMA Planar4 system may also be operated at altitudes of more than 1000 m, if the power dissipation reduction (and thus the reduction of the output load capability) is taken into account.
At an altitude of 1000 m or above, the power dissipation at nominal voltage must be reduced by 10 % for each 1000 m increase in height.

2.3 ESD Protective Measures

Only personnel with knowledge of ESD protective measures may modify or extend the system or replace a module.

NOTICE

Electrostatic discharge can damage the electronic components within the controllers!

- **When performing the work, make sure that the workspace is free of static, and wear a grounding strap.**
- **If not used, ensure that the modules are protected from electrostatic discharge, e.g., by storing them in their packaging.**

Only personnel with knowledge of ESD protective measures may modify or extend the system wiring.

2.4 Residual Risk

No imminent risk results from a Planar4 system itself.

Residual risk may result from:

- Faults related to engineering
- Faults related to the logic
- Faults related to the wiring

2.5 Safety Precautions

Observe all local safety requirements and use the protective equipment required on site.

2.6 Emergency Information

A Planar4 controller is a part of the safety equipment of an overall system. If the controller fails, the system enters the safe state.

In case of emergency, no action that may prevent the Planar4 controller from operating safely, is permitted.

3 Product Description

The HIMA Planar4 system is a modular, electronic circuit system with Eurocard modules for assembling hard-wired, safety-related control and monitoring systems. The application-specific programming of the systems is performed without software by applying various wiring techniques such as soldering, termipoint or wire wrap on the backplane. The system is only operated with a 24 VDC system voltage, simple configuration rules and practical design allow for easy implementation. All the modules are equipped with a self-diagnostic function for detecting faults. Additional communication modules enable data transmission to other systems.

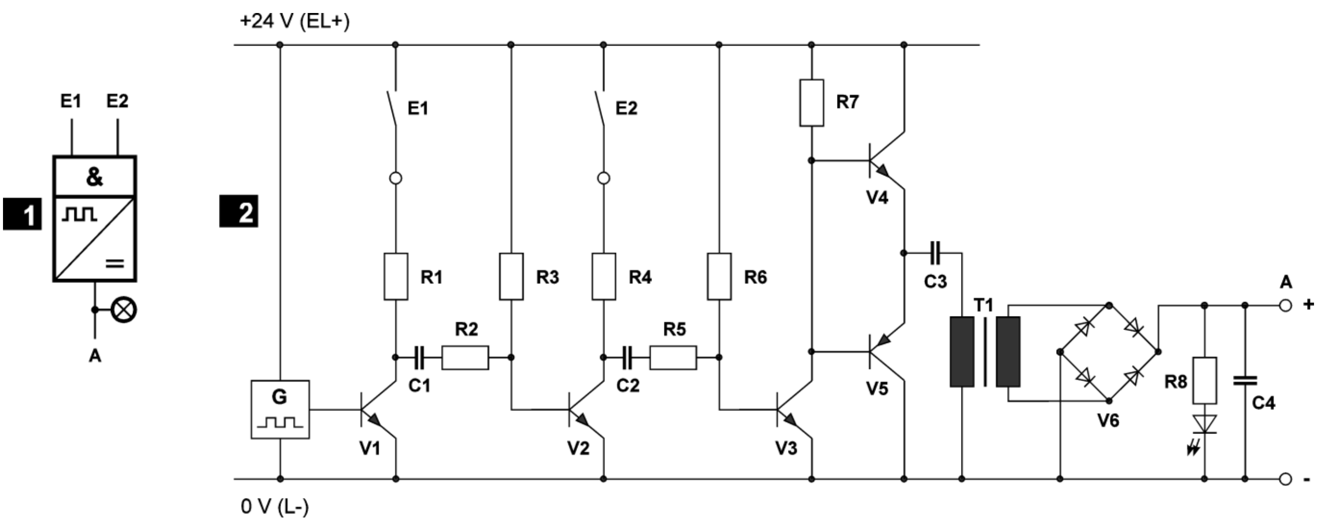
The Planar4 system has been certified by the TÜV and is suitable for use in safety-related applications up to SIL 4 in accordance with IEC 61508.

3.1 Safety-Related Counters

A safe controller must be designed so that no component failure or other potential influences may cause impermissible fault conditions.

The dynamic principle is applied to the safety-related Planar4 modules. The input and output signals are static DC signals, whereas the internal processing of these signals is dynamic. To this end, each safety-related module has its own integrated function frequency generator.

As an example, Figure 1 presents the basic structure of an AND function in safety-related design. The V1 transistor can only amplify the square wave signal from the function frequency generator if the E1 sensor is closed. V2 transistor with the E2 sensor has the same functionality. The output stage is thus controlled and AC voltage is generated at the secondary side of the transformer, which is available at output A after rectification as 1-signal.



1 Symbol 2 Wiring

Figure 1: AND Function in Safety-Related Implementation

If a components within the safety circuit fails, the output is de-energized. The safety function is not impaired if up to three faults occur in the circuit. The dynamic principle ensures that all the requirements for safe failure behavior are met.

The safety-related system modules are tested in accordance with IEC 61508. All the modules without microprocessor can be used for SIL 4 in accordance with IEC 61508. Modules with microprocessor and 1oo1 structure can be used for SIL 3 in accordance with IEC 61508, whereas modules with microprocessor and redundant structure (1oo2 or 2oo3) can be used for SIL 4 in accordance with IEC 61508. The safety-related system modules are marked in the corresponding data sheet with the TÜV conformity mark.

3.2 Diagnostics and Fault Indicators

The entire Planar4 system is equipped with a self-diagnostic function.

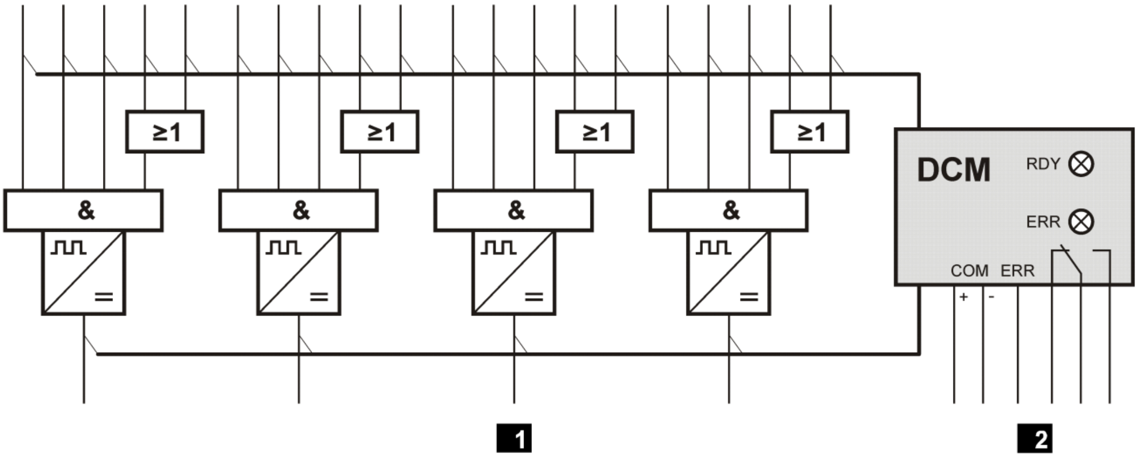
A diagnostic and communication module (DCM) is integrated in each module, capturing each input and output signal and simulating the module's functionality. This simulation is compared with the actually available function.

The DCM is therefore able to immediately detect signal deviations and report them as follows:

- The red ERR LED on the front plate of the defective module is activated.
- The ERR output (for busbar wiring) is activated.
- A relay (with potential-free contact for loop wiring) is de-energized.

In the event of failure, this allows a defective module to be located quickly. The faulty module can be replaced during operation.

Figure 2 illustrates the functional principle. To provide a clearer exposition, the input and output signals from the DCM are represented as bus cables. They are interference-free individual connections.



1 Safety-related AND function 2 Diagnostic and communication module

Figure 2: Diagnostic and Communication Module

The green RDY LED (ready) signals that the existing supply voltage (24 VDC) is at least 20 V.

If a fault only occurs temporarily, the error signal remains stored in the module. This also occurs if a fault signal is created by the DCM due to external factors, e.g., a short-circuit on an output. The fault signal can only be reset by temporarily switching off the supply voltage, e.g., by removing and reinserting the module. In modules with hardware revision 10 (AS10), this is done by pressing the reset key on the communication or reset module.

In input modules with line monitoring, the external lines are checked for open-circuits and short-circuits. A line fault is not reported via ERR. These faults are displayed via separate signal outputs and LEDs on the front plate. The fuses in output circuits are monitored as well and reported if a fault occurs.

To achieve maximum availability, HIMA recommends configuring the controller redundantly. If a module fails, the system can thus continue to operate with one channel. After detecting a fault, the faulty module must be replaced within the MTTR, see Chapter 9.2.

3.3 Communication with Other Systems

Communication between hard-wired controllers and other systems, e.g., a process control system, is ensured by the diagnostic and communication module (DCM) integrated in the HIMA Planar4 system modules.

For this purpose, a communication module (Modbus, PROFIBUS DP or Ethernet) is inserted in slot 21 on each designated Planar4 subrack.
The communication module reads the data from Planar4 modules (slots 1…20) and transmits it to other systems.

A repercussion on the safety function is excluded.

A detailed description of communications to other systems is provided in Chapter 8 of this safety and system manual.

Each subrack needs its own communication manual.

The following information can be read out of the modules:

- General details such as type and status of the inserted module, faults in input and output circuits, voltage supply.
- Signal state of all inputs and outputs.
- Events (binary signal changes of the inputs and outputs with timestamp).
- Residual runtimes for delay functions, actual values and thresholds of limit indicators.

Communication with other systems is divided into three levels:

- Communication within each module with the diagnostic and communication module (DCM), module data processing.
- Communication within the subracks between the modules and the communication module via the backplane (cyclic scanning of all the modules via the communication module).
- External communication between the communication module and other systems via a bus.

4 Product Data

4.1 Supply Voltage

The HIMA Planar4 system is a single voltage system. According to IEC 61131-2, the required module supply voltage is defined as follows:

Supply voltage	
Nominal value	24 VDC, -15…+20 %, r_P ≤ 5 %, SELV, PELV
Maximum supply voltage	30 VDC
Lloyd’s Register Type Approval, July 2013 ▪ Voltage tolerance continuous ▪ Voltage cyclic variation ▪ Voltage ripple	 ±10% 5% 10%
Reference potential	L- (negative pole) The reference potential may be grounded.

Table 3: Supply Voltage

The modules are equipped with an overvoltage protection, which simultaneously protects against inverse polarity. If the existing supply voltage is ≥ 20 V, it is reported on the module front plate through the green RDY LED (RDY = ready).

4.2 Definition of Signals and Nominal Load Factors

The signal levels of the Planar4 system modules are based on the IEC 61131-2 and can be combined with all HIMA controllers.
The input and output loads can be obtained from the nominal load factors specified in the data sheets.
Designation of nominal load factors

Designation with number and letter F, e. g., 10 F. The data sheets do not distinguish between Fan_{in} (F_i) and Fan_{out} (F_o), since input (F_i) and output (F_o) load capabilities can be clearly discerned.
The values are specified in the following table.

Designation	Values
Nominal load factor Marking in HIMA data sheet Electrical value	F = Fan Numerical data and letter F 10 F $F_i = Fan_{in}$ (input load capability) $F_o = Fan_{out}$ (output load capability) 1 F = 2 mA at 24 V (R_i = 12 kΩ) The nominal load factor applies at a nominal voltage of 24 V
Signal voltage at the inputs 0 signal (L signal) 1 signal (H signal) Typ. switching threshold	 -3…+5 V or open input +15…+33 V +10 V
Signal voltage at the outputs 0 signal (L signal) 1 signal (H signal)	 0…+2 V +15…+30 V
Edge steepness at the inputs	≥ 1 V/ms

Table 4: Definition of Signals and Nominal Load Factors

4.3 Short-Circuit Withstand Capability of Outputs

The outputs marked as short-circuit-proof are capable of withstanding short-circuits against L- and L+. In accordance with DIN EN 50178 (VDE 0160), an output may be marked as short-circuit-proof if a short-circuit of any duration is not able to cause unacceptable heating or any damage. After elimination of the short-circuit, the equipment must be again completely operable without replacing any components. This does not apply, however, if a fuse in the output circuit prevents the electronic short-circuit current limitation from being reached.

The short-circuit withstand capability and safety against damage of the module inputs and outputs is ensured against L- and L+ without restrictions. During tests and start-ups, L+ and L- can be switched on to an input to force the 1 and 0 signal, respectively, without affecting the output signal of the previous output.

If short-circuits occur or if the signal is activated, the diagnostic and communication module (DCM) may report a fault on the module. This does not affect the module's operation. The error message, however, remains stored until the temporary disconnection of the supply voltage, e.g., by removing and inserting the module.

4.4 Module Current Consumption

The current values specified in the data sheets under Operating Data apply to functional modules, i.e., the current details also include the required input wirings and thus the input currents. The load of the control outputs is thus automatically taken into account.

The control current consumption of a wired system is obtained by adding the current values specified in the operating data of the data sheets.

The current consumption of the power circuit is obtained adding the current values of the connected loads (lamps, solenoid valves, relays, etc.).

4.5 Fault Relay Data on the Diagnostic and Communication Module

The following table lists the fault relay data on the diagnostic and communication module.

Specifications for the fault relay	
Contact material	Ag alloy, gold plated
Switching voltage	≤ 30 VDC/VAC, ≥ 10 mV
Switching current	≤ 1 A, ≥ 10 µA
Switching capacity DC	≤ 30 W, induction-free load
Switching capacity AC	≤ 30 VA, cos φ > 0.7
Bounce time	< 2 ms
Lifetime: mechanical	> 10^7 switching operations
Lifetime: electrical	> 10^5 switching operations at ohmic load and ≤ 0.1 switching operations/s
DCM relay contact transistor	Max. 100 mΩ

Table 5: Specifications for the Fault Relay

4.6 Planar4 Subrack

If the communication option is not used in a Planar4 controller, a mono 19-inch subrack without backplane is sufficient for mounting. With 32-pole female connectors, all system functions can be used except for communications. For basic wiring, only use the following connectors:

EL+	z30, d30
L-	z32, d32
Error message (busbar)	d28
Error message (break contact)	z26-d26

Figure 3 shows the principle of the subrack basic wiring. Due to EMC, HIMA recommends to avoid using loose wiring of communication lines within this subrack. The subrack with backplane must be used.

CAUTION

For safety reasons, the reference pole L- to the power distributors and the subracks must be laid out as a loop. Both loop ends must be connected to two separate terminals on the L- busbar. L- must not be fused.

For wiring protection, the individual circuits are protected with 4 A fuses located in the current distribution modules. These are connected to a back-up fuse of preferably 16 A. If the total current exceeds 16 A, several 16 A back-up fuses must be placed. Back-up fuses, distribution elements such as rails, and diodes for redundant supply are mounted on cartridges for the 19-inches field.

If a communication module is used, HIMA recommends to use the subrack with backplane. The PCB includes the entire basic wiring (power supply, fault and error messages, and communications). More space is thus available for wiring the functions. Slot 21 is reserved for the communication module.

Figure 4 shows a schematic diagram of the backplane. Additionally, the figure provide the example of how to use the potential-free terminal blocks (XG.2 through XG.5, each consisting of seven bridged terminals) for further wiring.

To keep mechanical stress on the soldered joints at the connection pins to a minimum, pull the terminal block plugs, XG.1 through XG.6, out of their sockets prior to connecting or removing wires.

If not all subrack slots are used, the contact loop terminals for the error signal (z26-d26) must be bridged or connected to the EC terminals of the XG.1 or XG.6 block.

An ERR fault signal is available at the E terminal as a collective signal for further processing.

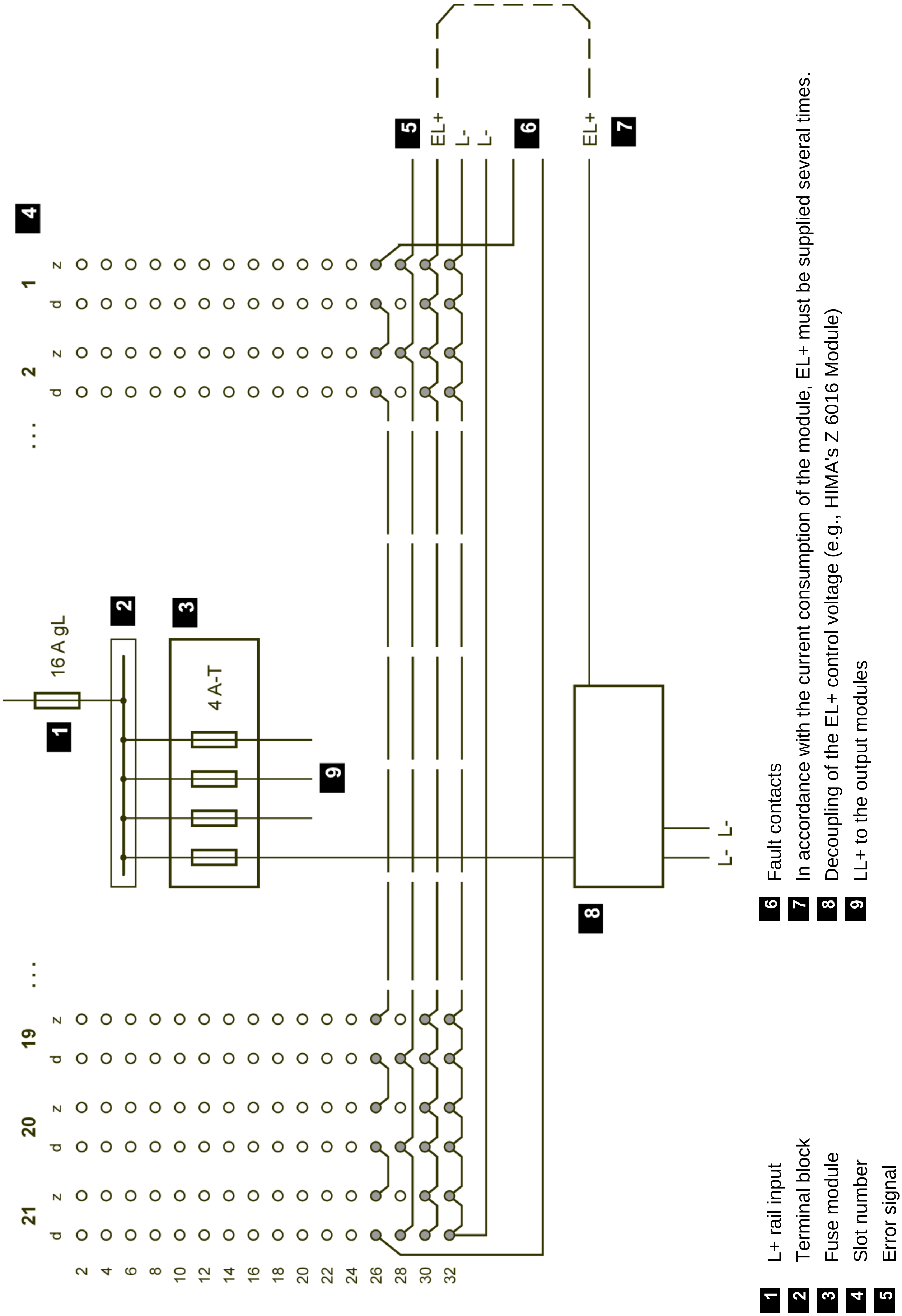


Figure 3: Basic Wiring of a Subrack with Backplane.

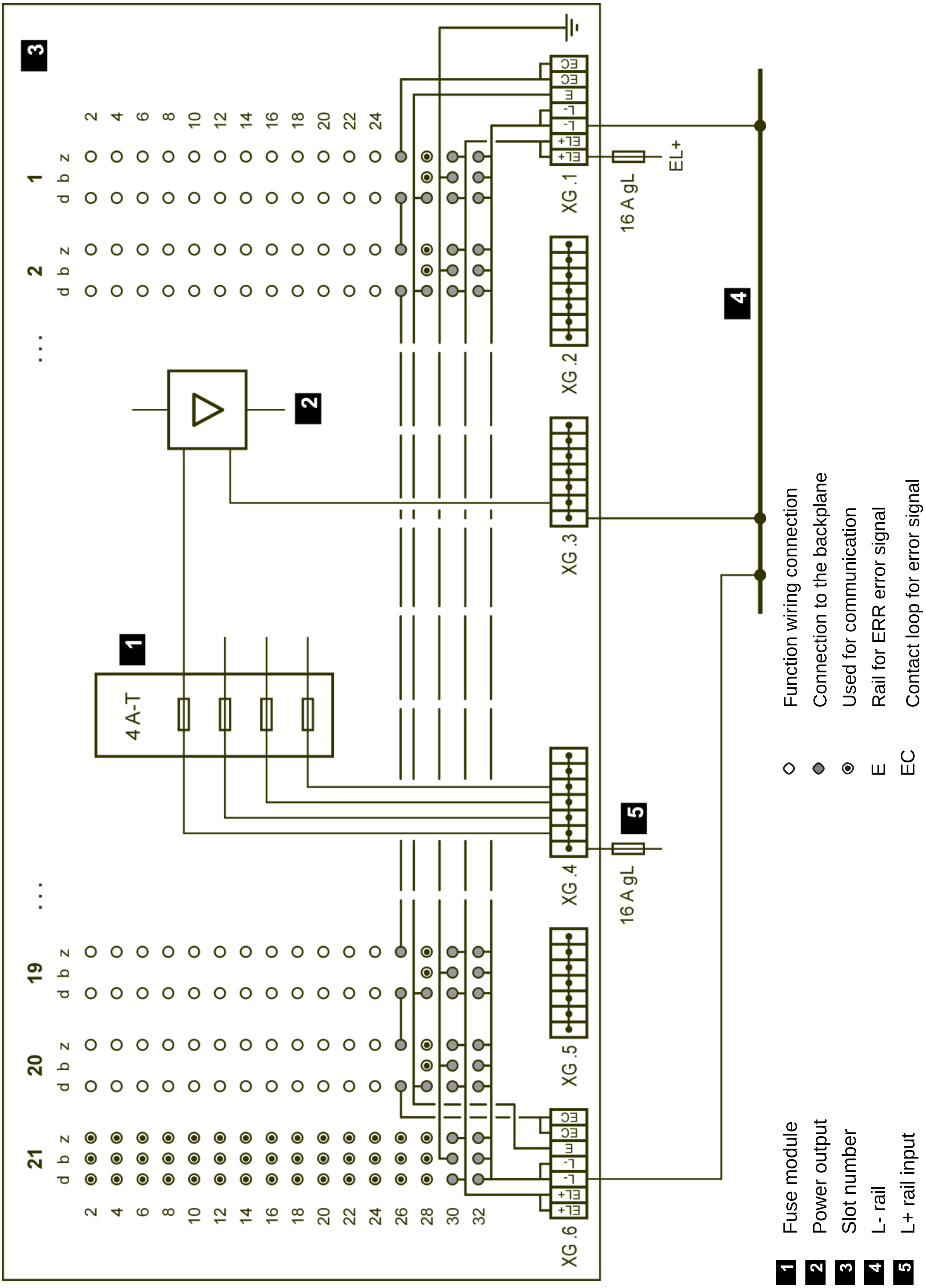


Figure 4: Subrack Backplane, Schematic Diagram with Wiring Example

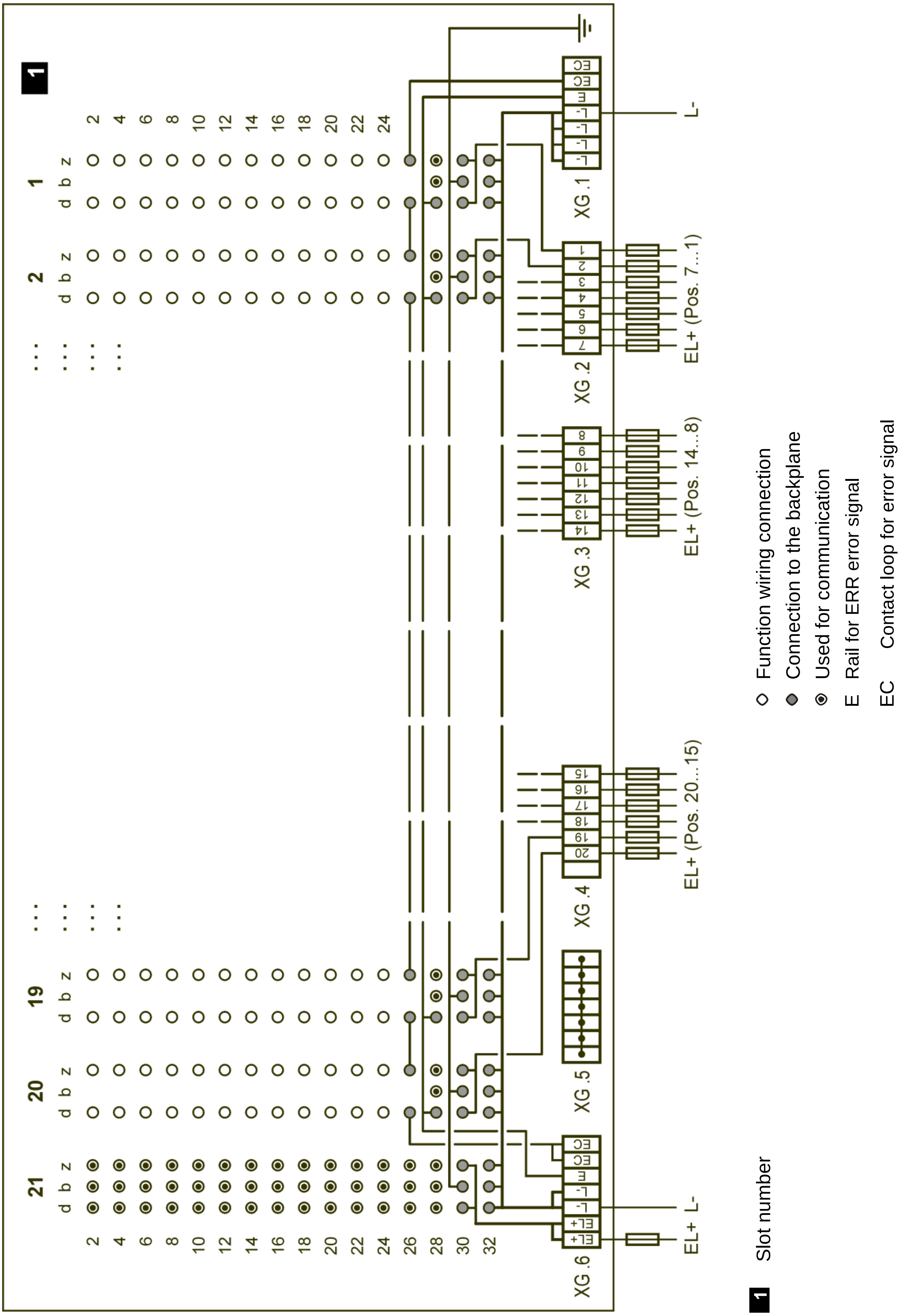


Figure 5: Subrack Backplane, EL+ for Each Slot, Schematic Diagram

4.7 Planar4 Modules

The modules are mounted on Eurocard printed circuit boards (160 x 100 mm) made of glass-fiber reinforced epoxy resin. The traces are tin-plated and coated with a solder mask.

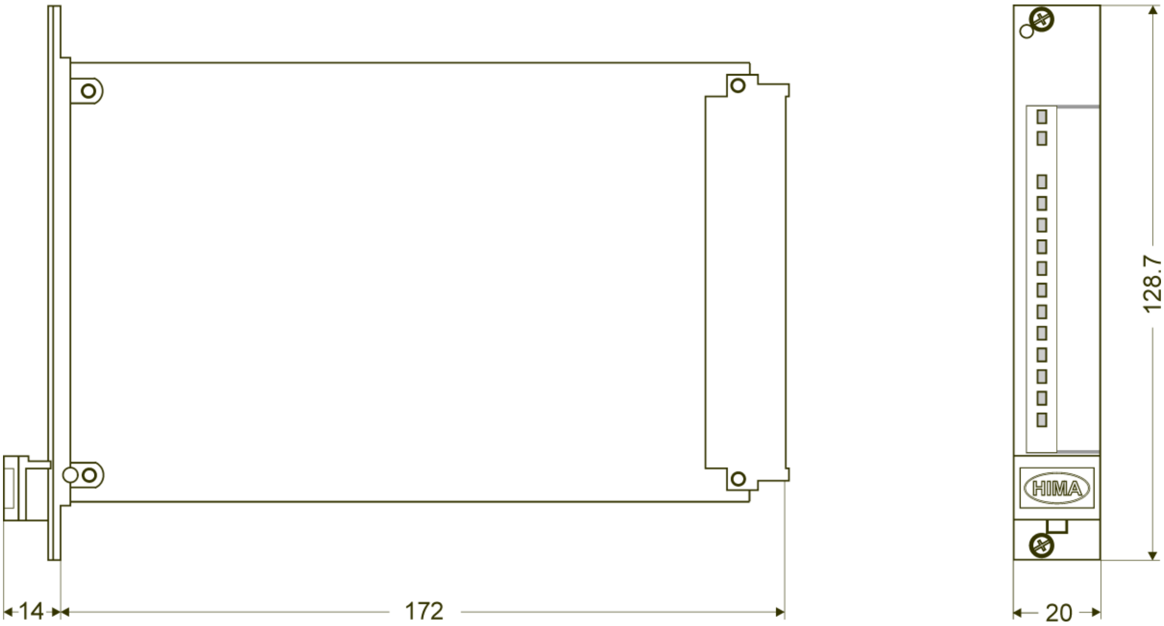


Figure 6: Module Side and Front View

LEDs, switches and operating elements are arranged on the front plate, depending on the module type. The module type and labels of LEDs and operating elements are printed on the front plate. After releasing the fastening screws, the module can be levered out by pushing down the movable handle on the front plate.

A male connector type F in accordance with EN 60603 is used as a male connector. The male connectors on the modules and the female connectors on the subracks meet at least the requirement class 2 in accordance with EN 60603. The contact joints are hard gold plated

The module data sheets specify the space requirements:

3 RU	1 RU (rack unit) = 44.45 mm
4 HP	1 HP (horizontal pitch) = 5.08 mm

4.7.1 Function and Designation of the Planar4 Modules

The module's type designation is composed of five digits. It is structured according to the following key:

Digit 1	2	3	4	5	Allocation
1					Input modules
2					Output modules
3					Relay modules
4					Logic function modules
5					Time delay modules
6					Analog modules
7					
8					Communication module
9					Power supply, accessories
	0				No certification
	1				(Ex) certificate
	2				TÜV certificate, safety-related
	3				(Ex) and TÜV certificate
	4				
		0…9	0…9		Count numbers 00…99
				0	Standard configuration
				1…9	Modification

Table 6: Type Designation

4.7.1.1 Input Modules

Module		Inputs				Output	
Type	Functions	Proximity switch	Contact	(Ex)i	Line monitoring	1-signal	SIL
12 100	4	•	•		•	•	4
13 110	2	•	•	•	•	•	4

Table 7: Input Modules

If a mechanical contact is used in an input module instead of a proximity switch, the mechanical contact must be connected on site with resistors. To this end, observe the information provided in the corresponding data sheet. Notices for Ex use of modules are provided in Chapter 5.4 and in the Planar4 Ex manual (HI 800 685 E).

4.7.1.2 Output modules

Module		Inputs		Output			
Type	Functions	1-signal	With pre-logic	Switch	Fuse with monitoring	Power	SIL
22 100	4	•	•			25 V/3 W	4
22 120	1	•	•	•	•	25 V/24 W	4
22 121	1	•	•	•	•	60 V/24 W	4

Table 8: Output Modules

4.7.1.3 Relay Modules

Module		Inputs		Output			
Type	Functions	1-signal	With pre-logic	Fuse	Fuse with monitoring	Switching voltage	SIL
32 100	2	•	•		•	24 VDC, 24 VAC	4
32 101	2	•	•		•	48/60 VDC, 60 VAC	4
32 102	2	•	•		•	110 VDC, 127 VAC	4
32 103	2	•	•		•	220 VDC, 230 VAC	4
32 110	4	•	•	•		≤ 250 VDC / VAC	2

Table 9: Relay Modules

4.7.1.4 Logic Function Modules

Module			
Type	Functions	Logic function	SIL
42 100	4	AND function with 5 inputs, 1 of which with OR	4
42 110	8	AND function with 2 inputs	4
42 200	7	AND/OR/blocking/inverting function	4
42 300	8	OR function with 2 inputs	4
42 400	4	Blocking/inverting function, non-inverted and inverted output	4
42 500	4	2oo3 selection function	4

Table 10: Logic Function Modules

4.7.1.5 Time Delay Modules

Module			
Type	Functions	Description	SIL
52 100	1	Time delaying function	3/4[1)]
52 110	4	SEVA time delaying function up to 15 s	4
[1)] With redundant wiring (1oo2 or 2oo3), usable for SIL 4 in accordance with IEC 61508.			

Table 11: Time Delay Modules

4.7.1.6 Analog Limit Indicator

Module			
Type	Functions	Description	SIL
62 100	2	Analog limit indicator 0/4…20 mA	3/4[1)]
[1)] With redundant wiring (1oo2 or 2oo3), usable for SIL 4 in accordance with IEC 61508.			

Table 12: Analog Limit Indicator

4.7.1.7 Communication Modules

Module			
Type	Functions	Description	SIL
80 105	1	Communication module for Modbus, interference-free	-
80 106	1	Communication module for PROFIBUS DP, interference-free	-
80 107	1	Communication module for Ethernet (OPC Server), interference-free	-

Table 13: Communication Modules

4.7.1.8 Reset Module

Module			
Type	Functions	Description	SIL
80 110	1	For resetting the (ERR) error LED of all the Planar4 modules of a subrack	-

Table 14: Reset Module

4.7.1.9 Power Supply Modules and Accessories

Module			
Type	Functions	Description	SIL
90 100	4	24 VDC fuse module with monitoring	-
90 300	2	Bypass module, interference-free	-
90 900	-	Subrack, solder terminal	-
90 901	-	Subrack (Ex)i, solder terminal	-
90 902	-	Subrack, termipoint / wire wrap	-
90 910	-	Subrack, solder terminal, separate power supply to each slot	-
90 911	-	Subrack (Ex)i, solder terminal, separate power supply to each slot	-
90 912	-	Subrack, termipoint/wire wrap, separate power supply to each slot	-

Table 15: Power Supply Modules and Accessories

5 Installation

This chapter discusses relevant aspects for mounting and wiring the Planar4 system.

5.1 Mounting

The Planar4 modules are included in a 19-inch subrack with 21 slots. The subracks can be mounted in frames or racks with a row of holes. Additionally, special subracks with backplane containing a slot for a communication module and the entire basic wiring, error messages and communication are available, see Chapter 4.6.

5.1.1 Control Cabinets and Enclosures

Standard control cabinets with 19-inch frame may be used for assembling the Planar4 systems. These control cabinets must meet the following requirements:

- For mounting in zone 2, at least IP54 in accordance with IEC 60079-15 must be achieved, see the Planar4 Ex manual (HI 800 685 E).
- Access protection (security): Control cabinets must be lockable to avoid unauthorized manipulation of the Planar4 system.
- The enclosure (control cabinet) in use must be labeled with the CE marking.

5.1.2 Shielding within the Input and Output Areas

Lay field cables for sensors and actuators separately from the power supply lines and at a sufficient distance from electromagnetically active devices (electric motors, transformers).

To avoid interferences, ensure that the field cables are provided with continuous shielding. To this end, connect the shielding on both ends of the field cables. This applies, in particular, to field cables of analog inputs and proximity switches.

If high compensation currents are expected, the shielding must be applied on at least one end. Further measures must be implemented to avoid compensation currents, e.g., capacitive connection of the shielding on the other end.

5.1.3 Power Dissipation of Planar4 Modules

Planar4 modules may cause heat loss depending on their function and external wiring. For this reason, the arrangement of the modules within the subrack and the ventilation within the control cabinet must be taken into account within the system design.

The power dissipation P_V of Planar4 modules results from the sum of the P_V values specified in the following table:

Module	Pv	Module	Pv	Module	Pv	Module	Pv
12 100	5.5 W	32 102	9 W	42 400	4 W	80 107	9 W
13 110	4 W	32 103	9 W	42 500	4 W	80 110	0.5 W
22 100	9 W	32 110	9 W	52 100	3 W	90 100	1 W
22 120	10 W	42 100	4.5 W	52 110	4.5 W	90 300	1.5 W
22 121	10 W	42 110	7 W	62 100	5 W		
32 100	9 W	42 200	5 W	80 105	9 W		
32 101	9 W	42 300	1 W	80 106	9 W		

Table 16: Power Dissipation of Planar4 Modules

The following table specifies the maximum current that may be applied to load the output circuits of the Planar4 relay amplifier modules.

Module	Max. current/channel	Remark
32 100	3 A	If current I > 2 A per channel, the adjacent right slot must remained unused to prevent hot spots from occurring.
32 101	3 A	
32 102	3 A	
32 103	3 A	
32 110	2 A	If current I > 1 A per channel, the adjacent right slot must remained unused to prevent hot spots from occurring.

Table 17: Current via Output Circuit of Relay Amplifier Modules

i If the power dissipation within the control cabinet is > 300 W or if that of an individual subrack is > 70 W, operation is only permitted with a circulation fan (e.g., a K 9203A rack fan). Ventilation ensures that the heat lost within the enclosure (control cabinet) is uniformly distributed.

5.1.4 Lightning Protection for Data Lines in HIMA Communication Systems

To minimize problems due to lightning:

- Completely shield the field wiring of the HIMA communication systems
- Properly ground the system

Install lightning protection devices in places outside of buildings and exposed to lightning.

5.1.5 Grounding Concept

Observe the requirements specified in the low voltage directives SELV (Safety Extra Low Voltage) or PELV (Protective Extra Low Voltage).
Functional ground is prescribed to improve the electromagnetic compatibility (EMC). Implement the functional ground in the control cabinet so that it meets the requirements for protective ground.

All Planar4 systems can be operated with grounded L- or ungrounded L-.

5.1.5.1 Ungrounded Operation

In ungrounded operation, a single ground fault does not affect the safety and availability of the controller.

If several undetected ground faults occur, faulty control signals can be triggered. For this reason, HIMA recommends using ground fault monitoring for ungrounded operation. Only use ground fault monitoring released from HIMA.

5.1.5.2 Grounded Operation

Requirements for grounded operation are proper ground conditions and, whenever possible, separate ground connection, in which no parasitic currents may flow. Only the negative pole L- may be grounded. The positive pole EL+ must not be grounded a potential ground fault on the sensor wire would bridge the affected sensor.

L- can only be grounded at one point within the system. L- is usually grounded directly behind the power supply unit (e.g., on the busbar). Grounding should be easy to access and well separate. The grounding resistance must be ≤ 2 Ω.

5.1.5.3 Measures for Installing the Control Cabinet in Conformity with the CE Label

All Planar4 system modules are labeled with the CE marking.

The enclosure (control cabinet) in use must be labeled with the CE marking.

To prevent EMC issues when installing controllers in control cabinets and support frames, ensure proper and interference-free electrical installation in the vicinity of the controllers, e.g., do not lay power lines together with 24 VDC supply lines.

5.1.5.4 Grounding the HIMA Controllers

While also taking the EMC aspects into account, implement the following grounding measures to ensure the safe function of HIMA controllers.

All tangible surfaces of the Planar4 system (e.g., subracks) are electrically conductive (ESD protection). Use cage nuts with claw fasteners to ensure the safe electrical connection of components such as subracks and the control cabinet.
The claw fasteners penetrate the components' surface and ensure safe contact. Stainless steel screws and flat washers must be used to prevent electrical corrosion.

5.2 Power Supply

The Planar4 system is connected to 24 VDC. All power supply units in use must comply with SELV (safety extra low voltage) or PELV (protective extra low voltage) requirements.

In connection with the power supply of HIMA systems, the following terms are used:

- **L+** Power supply, positive pole
- **L-** Reference potential, negative pole
- **LL+** Power voltage, positive pole
- **LL-** Power voltage reference potential, negative pole
- **EL+** Control voltage, positive pole

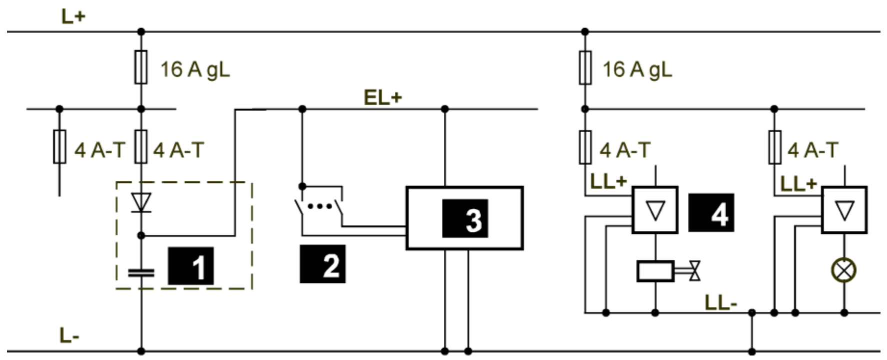
The same definitions are also used for LL+ and EL+, see Chapter 4.1. Due to the permissible ripple of control voltage (EL+) and power voltage (LL+), power supply units with bridge rectification and smoothing or stabilized power supply units are required for single-phase connection. The PS 1000 power supply unit from HIMA meets these requirements and is also able to compensate for voltage dropouts of 20 ms at full load.

i To reduce transient surges, HIMA recommends using the H 7034 mains filter directly before the 24 V supply of the Planar4 system.

Voltage that can compensate voltage drops of maximum 20 ms per second (in accordance with NAMUR NE21), is referred to as control voltage (EL+). This requirement can also be met by the L+ supply voltage, e. g., using the HIMA standard power supply units or using a battery back-up.

High current peaks (e.g., caused by lamps, 7…10-fold nominal current) must be compensated by sufficiently dimensioned power supply units or by back-up batteries. If this is not ensured, a decoupled EL+ control voltage is required for supplying the electronic modules.

The decoupling consists of a power diode and a capacitor (10000 µF per 1 A current input). The capacitor supports the control voltage EL+, whereas the diode prevents a feedback to the power voltage.

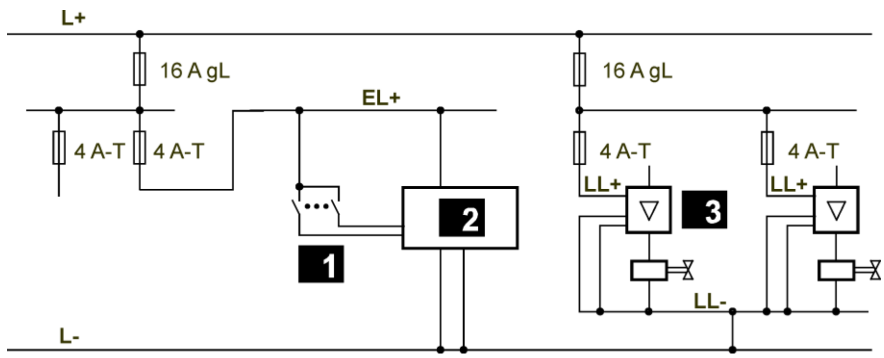


1 Decoupling (e.g., HIMA's Z 6016 Module)
2 Sensor
3 Electronics
4 Amplifier

Figure 7: Principle of Supply with Decoupling

Decoupling of control voltage and power voltage can also be achieved using two separate power supply units.

Operation without decoupling may only be avoided if the user provides secured 24 VDC supply voltage in accordance with NE21 or uses a supply voltage with defined failure monitoring (HIMA's power supply unit PS 1000).



1 Sensor
2 Electronics
3 Amplifier

Figure 8: Principle of Supply without Decoupling

For redundant power supply, additional diodes must be used to decouple the voltage sources connected in parallel. These diodes are already integrated in the HIMA standard power supplies.

5.3 Connecting the Field Cables

In general, field cables can be connected in various ways in the control cabinets or directly on the racks:

- Terminals in the control cabinets or support frames:
  Terminal blocks with terminal strips are arranged on the rear side of the control cabinet or support frame. In this classical method, the internal cables on one side of the terminals are routed to the connection points of the female connector in the racks, while the cores on the other side of the terminals are connected to the field cables.
- Male connectors in the control cabinets or support frames:
  Male connectors are used instead of the terminal strips to allow quick connection of the system on site using ready-made cables.
- Field cables may only be connected to input and output modules. Otherwise, the required immunity cannot be guaranteed!

5.3.1 Error Signal (EC) Contact Loop

The contact loop for the error signal (EC) may only be supplied from the 24 V voltage supply of the Planar4 system.

5.4 Intrinsically Safe Circuits and Modules

To prevent ignition of an explosive atmosphere, different types of protection in accordance with IEC 60079-0 are applied to electrical equipment.

Two variants are used in the Planar4 system:

– Modules for activating (Ex)d valves.

– Modules with (Ex)i circuits.

This equipment is referred to as associated electrical equipment.

If (Ex)d equipment is used, only fuses complying with the specifications provided in the test certificate may be used on the respective module.

For circuits with type of protection 'intrinsic safety' (marked as 'i' in accordance with IEC 60079-11), currents and voltages in the sensor circuits must be limited to prevent sparks or thermal effects from causing ignition of the explosive atmosphere during operation or in the event of faults (under specific test conditions).

Intrinsically safe amplifiers support the transmission of control commands from intrinsically safe circuits to non-intrinsically safe circuits and vice versa. Thanks to the design of these modules, the intrinsically safe circuits within the modules are reliably protected against parasitic voltage interference from non-intrinsically safe circuits. The intrinsically safe circuits are galvanically separated from the supply voltage and output circuits up to 250 V.

The intrinsically safe parts of the associated electrical equipment are classified in categories 'ia' and 'ib'. Additionally, the equipment is classified in Group I (mines susceptible to firedamp) and Group II (explosive atmospheres other than mines susceptible to firedamp). Temperature (T1…T6) is not specified since this is associated electrical equipment that must be installed outside the area with explosive atmosphere.

Marking of the control circuit of an associated equipment:

II(1)G [EEx ia] IIC (in accordance with European Directives)

II	Area of application: Equipment-group
(1)G	Area of application: Equipment category
[ ]	Marking of an associated equipment
EEx	Equipment with type of protection in accordance with EN
ia	Type of protection *intrinsic safety*, Category ia
IIC	Group II subdivision (gas test mixture, 21 ± 2 % of hydrogen in air)

Modules with intrinsically safe circuits have an EU type examination certificate. Those certificates are part of the corresponding data sheet of this safety and system manual.

The certificate number provides the following details:

PTB 97 ATEX 2164 X (in accordance with European Directives)

PTB	Test institute
97	Year of issue
ATEX	Type examination complying with the relevant directive
2	Marking of the testing department
164	Consecutive number
X	Special Conditions

The special conditions (X) are, e.g., notices about:

- Arrangement of the modules outside the area with explosive atmosphere.
- Installation with degree of protection IP20 in accordance with DIN EN 60529 (VDE 0470 Part 1) (protection against mid-size objects, no water protection),
- Interconnection of intrinsically safe circuits (the details specified in the certificate for parallel connection do not mean that proper operation of the modules is also ensured if it is connected in parallel).
- Characteristics of wiring.

Modules with intrinsically safe circuits are marked in the data sheets with the Ex symbol.

When installing HIMA modules with intrinsically safe circuits in the subracks and cabinets, the following points must be observed (see also DIN EN 60079-25-0 (VDE 0170-1), DIN EN 60079-25-11 (VDE 0170-7), DIN EN 60079-14-2007 (VDE 0165 Part 1)):

- Use of female connectors with high tracking resistance und coding pins
- Separation between intrinsically safe and non-intrinsically safe terminals, distance of ≥ 50 mm or partition (arcing distance ≥ 50 mm).
- Intrinsically safe lines and insulated cables in light-blue color
- Separation between intrinsically safe and non-intrinsically safe lines and cables or supplementary insulation
- Use of wiring guards or covering the female connectors with heat-shrinkable sleeves.
- Use of power supply units with protective separation.
- Output voltage of the power supply units limited to ≤ 30 V.
- Protection against parasitic voltage drain in the system

CAUTION

In modules with intrinsically safe circuits, a coding pin in the subrack female connector (connector d6) must protect the intrinsically safe circuits by hindering that non-intrinsically modules can be inserted in intrinsically safe slots. The slot must be marked with an indication of the module type.

5.5 Circuits with Protective Separation

For protection against electric shock, HIMA recommends operating controllers with SELV or PELV in accordance with DIN EN 50178: 1997 (VDE 0160). This protective measure is intended to allow safe work such as maintenance or repair during operation. This substantially increases the system availability.

The relay modules, 32 10n and 32 110, feature protective separation of the inputs or supply voltage from the output contacts in accordance with DIN EN 50178 (VDE 0160). The air and creepage distances are designed for overvoltage category III up to 300 V.

The output contacts are separated from one another up to 250 V in accordance with EN 60664-1 (VDE 0110-1), overvoltage category III.

If the switching voltages do not comply with SELV or PELV, measures must be implemented to ensure that the wiring is touch protected, e.g., by completely covering the rear side or by covering the connections with heat-shrinkable sleeves.

5.6 Wires and Fuses

Observe the following points when laying the wires:

- Proper wiring
- Cable/wire bending radius
- Strain relief
- Wires to solder terminals must be supported
  - Use heat-shrinkable sleeves for female connector terminals
  - Use the cable channel of the Planar4 subrack for cables and wires
- Cable/wire load capacity

The Planar4 system must be fused with a time-lag fuse.

5.6.1 Wire Color Coding

HIMA recommends and uses the following colors for solid wires jumpers and for the power supply wiring in the control cabinet with single cores:

Color	Description
Red (RD)	LL+, EL+ (24 VDC)
Black (BK)	L- (reference pole)
Gray (GY)	Signal lines
Brown (BN)	Circuits with U > 50 V, U > 120 VDC
Light-blue (BU)	Intrinsically safe circuits

Table 18: Wire Color Coding

5.6.2 Wire Cross-Sections

5.6.2.1 Supplying the Planar4 Control Cabinet

A 24 VDC supply voltage externally must also be fused externally.

The supply voltage wiring within the cabinet is implemented in accordance with the following table:

Current (external fuse)	Terminal size	Ø	Wiring in the control cabinet
I ≤ 16 A	4 mm^2	2.5 mm^2	Directly on potential distributor
I > 16 A I ≤ 35 A	10 mm^2	6 mm^2	On distribution cartridge K . . . .
I > 35 A I ≤ 63 A	35 mm^2	16 mm^2	On distribution cartridge K . . . .

Table 19: Supply Wire Cross-Section

5.6.2.2 Wire Cross-Sections in HIMA Systems

Wire cross-sections behind fuses are measured in accordance with the following table:

Fuse	Cross-section
4 A gL or T	1.0 mm^2
10 A gL	1.5 mm^2
16 A gL	2.5 mm^2
25 A gL	4.0 mm^2
35 A gL	6.0 mm^2
50 A gL	10 mm^2
63 A gL	16 mm^2

Table 20: Wire Cross-Sections Behind Fuses

Used single core: H07V-K

5.6.3 Fuses

Miniature fuses

(G fuses, 5 x 20 mm and 5 x 25 mm)

In this case, the DIN EN 60127-2 standard applies.

The tripping characteristic is identified in the two stages:

- F (quick-acting)
- T (time-lag)

Fuses in the EL+ control voltage supply and the LL+ power voltage are only intended for line protection. For this reason, fuses below 4 A are not required (on fuse modules). The subracks with backplane and the fuse modules may be protected using back-up fuses, preferably with 16 A.

CAUTION

To ensure the modules' proper operation, the L- reference pole must not be fuse-protected. For safety reasons, the reference pole L- to the power distributors and the subracks must be laid out as a loop. Both loop ends must be connected to two separate terminals on the L- busbar. The modules of the Planar4 system have at least two L- connectors.

The power supply unit is fuse-protected against short-circuits in the system supply. Fuse-protection of the L- negative pole is allowed if it is ensured that the system is completely self-contained and that no electrical connections to other systems exist before the fuse.

6 Programming and Engineering

Programming of the Planar4 system logic is performed without software by applying various wiring techniques such as soldering, termipoint or wire wrap on the backplane. This chapter provides relevant details for implementing the logic functions and structuring the system.

i Field cables may only be connected to input and output modules. Otherwise, the required immunity cannot be guaranteed!

6.1 Configuration Notes for Safety Circuits

6.1.1 De-Energize to Trip Principle

The de-energize to trip principle is basically applied to the safety-related controllers of the Planar4 system, i.e, the controller enters the state defined as safe (de-energized) whenever an open-circuit occurs or a safety-related module fails. This principle is also applied to the controlled systems.

6.1.2 Self-Locking Circuits (Memory)

Applying the de-energize to trip principle, the binary circuit memory (flip-flop) is replaced by a self-locking circuit. Ensure that the self-locking function is enabled both in the event of de-energization and in case of faults (including open-circuits). The technical implementation in the circuit must be the dominant reset (OFF with 0 signal).

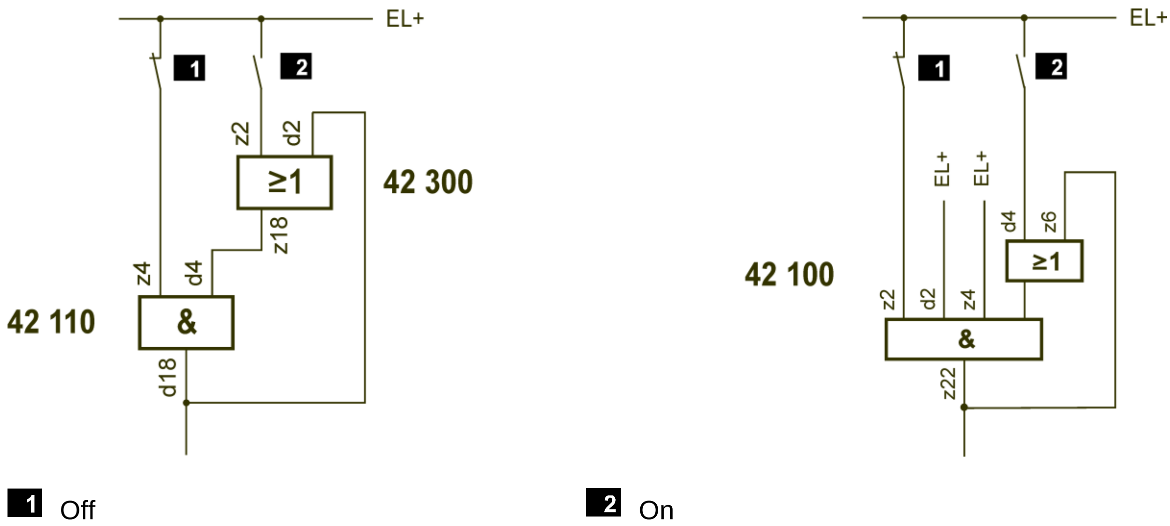


Figure 9: Self-Locking Circuits

i Due to the internal circuitry structure of the modules, the self-latching feedback loop should be connected to the d input or, if more inputs exist, to the input with the highest identification number.

6.1.3 Inversion (Blocking/Inverting Function)

Particular attention is due if an inverter is implemented **directly** within the safety-related circuit, since a module input (including that of an inverter as well) cannot differentiate between a 0 signal and a line break (open-circuit). This fact applies to all hard-wired system as well as relay circuits. The signal inversion must be performed at any other suitable point, e.g., using a break or a make contact (applying the de-energize to trip principle) or, for inductive sensors, implementing a special design of the damping element.

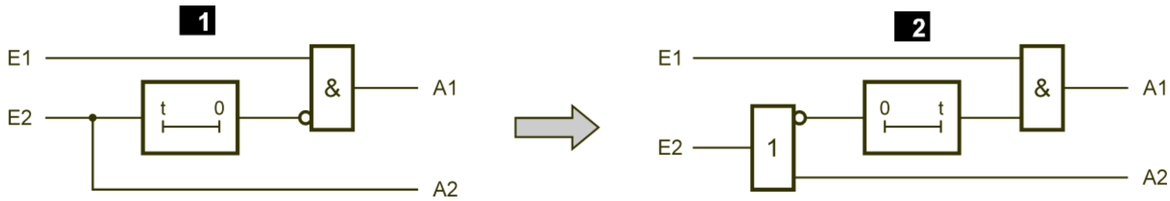
If the direct and the inverted signals in a safety-related controller are further processed, implementation of the blocking/inverting function is mandatory. It is important that the direct signal after the blocking function is also received at the direct output. The internal circuit structure of the blocking function prevents a 1 signal (or overlapping signal) from being applied to the inverted and the direct output simultaneously.

1 Correct **2** Not recommended

Figure 10: Signal Inversion in Safety-Related Controllers

In the logic circuit represented in Figure 11, an open-circuit before or after the time-delay function or failure of the time-delay function would prevent E2 from switching off the A1 output.

The practical implementation of the function in accordance with Figure 11 with an inverter includes a blocking function for the E2 signal input as well as a changed time-delay function (time-off instead of time-on delay). Even in this case, however, an open-circuit before the blocking function prevents A1 from switching off, whereas A2 is switched off.



1 Logic function **2** Implementation of the function

Figure 11: Problems of the Signal Inversion

6.1.4 Input Circuits for Proximity Switches

The safety-related input modules of the Planar4 system correspond to the implementations provided in the DIN EN 60947-5-6 standards, DC interfaces proximity switches and switching amplifiers. To obtain the safety-related evaluation of a process signal, however, the used proximity switch must also have been tested with respect to safety.

A mechanical contact with a serial and a parallel resistor may also be used instead of a proximity switch. These resistors must be installed directly at the mechanical contact to ensure detection of line faults. The resistor specifications are provided in the data sheets of the input modules.

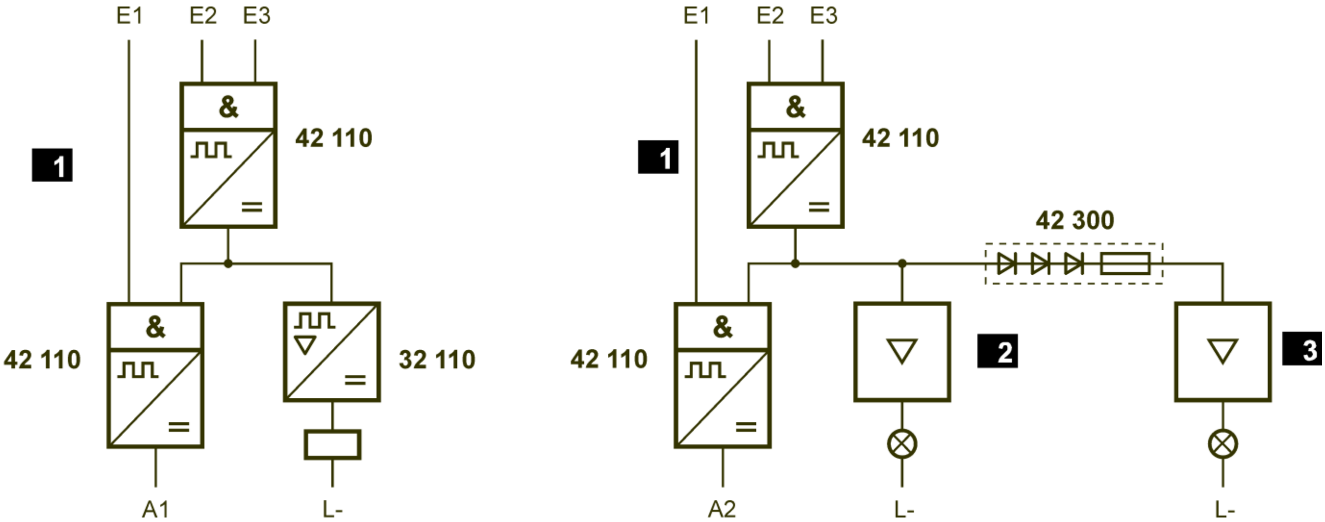
An option for applying **non-safety-related** proximity switches (in accordance with DIN EN 60947-5-6) is to evaluate the process signal through two separate proximity switches in accordance with the redundancy principle, either through two channels of one input module or two input modules. The two output signals must be connected via an AND operation. The notices provided in the data sheet for the input module must be observed.

Since the electrical and mechanical switching points of the sensors may diverge, the use of an equivalence monitoring with time delay is mandatory to preclude unwanted switching functions. The effort can be reduced by using the safety-related module with 2oo3 selection functions for the signals. The function must be tested periodically, e.g., once per year.

6.1.5 Coupling to Safety-Related Counters

Signals of safety circuits may be transferred to other non-safety-related modules. For economic reasons, this may be beneficial. The non-safety-related modules must have interference-free inputs to ensure that no repercussions on the safety circuits occur when they fail.

All the inputs of the safety-related modules and the inputs of the communication modules of the Planar4 system are interference-free.



1 Safety circuits

2 Interference-free module

3 Non-interference-free module

Figure 12: Coupling to Safety-Related Counters

If other **non-interference-free** modules are used for coupling to safety circuits, **non-interference** must be guaranteed by interconnecting an OR function branch (see Figure 11).

6.2 General Notices for Configuring the Logic

6.2.1 Edge Steepness of Signals

The signals for controlling the Planar4 modules must have an edge steepness of 1 V/ms.

The safety function and the diagnostics of a module are independent from one another. If the edge steepness of input signals is two small, a module error may be diagnosed.

6.2.2 Wired OR Connection

Wired OR connections are not allowed for logic module outputs, since they may cause diagnosis of a module error. OR functions must be implemented with OR modules.

To this end, power outputs have a second output that is decoupled with a diode. Interruption within the diode is not detected.

6.2.3 Time Delay with RC Circuit

RC circuits may not be used to delay signals, since this may cause diagnosis of a module error, refer to the section about the signal's edge steepness.

Suitable modules must be used for time delay functions.

6.2.4 Loop for L- Reference Pole

For safety reasons, the reference pole L- to the power distributors and the subracks must be laid out as a loop. Both loop ends must be connected to two separate terminals on the L- busbar. L- must not be fused.

6.2.5 Supply voltage

To ensure the controller's proper operation, the 24 VDC supply voltage must be monitored with a voltage measuring facility. If the voltage drops to a value ≤ 18 VDC, the supply voltage of the controller or at least the output modules must be switched off.

6.2.6 Fault Signals of Modules

Manipulations to the wiring of a subrack may cause the diagnostic and communication module (DCM) to signal a fault on the module. The module's functioning is not affected, but the error message remains stored until the temporary disconnection of the supply voltage, e.g., by removing and inserting the module.

6.2.7 Internal Logic Connection

The cable length between two modules within the control cabinet may not exceed 10 m.

This applies for the internal logic connections between:

- Two logic modules
- Input module and logic module
- Logic module and output module

i The maximum cable length within the control cabinet between the 52 100 time delay module and other modules may not exceed 3 m.

7 Start-Up, Maintenance

To ensure that safety of the Planar4 system modules and their functions is not compromised or endangered, the notices in the present safety and system manual and in the module-specific data sheets must be observed carefully prior to performing start-up, maintenance, changes and overhauls.

NOTICE

Malfunction due to electrostatic discharge!

Damage to the controller or electronic devices connected to it!

Only qualified personnel may perform maintenance actions to supply, signal and data lines. Implement ESD protection measures. Personnel must be electrostatically discharged prior to any contact with the supply or signal lines!

7.1 Start-Up

Only power up the Planar4 system after the hardware is completely mounted and all the cables are connected. First start up the control cabinet, then the Planar4 system itself.

NOTICE

System damage possible!

Possible system damage caused by safety-related automation systems improperly connected or configured.

Check all connections and test the entire system before start-up!

7.1.1 Starting-up the Control Cabinet

Prior to connecting the supply voltage, check if all cables are properly connected, thus ensuring that no risk exists for controller and system.

7.1.1.1 Mounting and Removing Modules

The modules are not coded. Ensure that the allocation of slot to module type is performed in accordance with the labeling. Check that the fuse modules in use, including fuses, are complete.

i Modules of the Planar4 system may be removed or inserted without interrupting the power supply. However, potential effects on the overall function of the controller must be taken into account.

7.1.1.2 Testing the Inputs and Outputs for External Voltages and Ground Faults

Impermissible parasitic voltages (in particular with 230 VAC against ground or L-) can be measured using a universal measuring instrument. HIMA recommends testing every individual terminal for impermissible parasitic voltage.

When testing external cables for isolation resistance, potential short-circuits or open-circuits, no cable ends must be connected to prevent potential damage or destruction of modules caused by high voltage.

The ground fault check is performed prior to connecting the field cables in the control cabinet. The supply voltage connector for the sensors must be separated from the minus pole of the actuators. If the negative pole is grounded during operation, the ground connection must be interrupted for the duration of the ground fault check. The same applies to the ground connection of ground fault measuring facility, which may be connected to the system.

Monitoring via a ground fault facility is not required for the outputs of modules 22 100, 22 120 and 22 121, since they are galvanically separated.

The test of every connector against ground can be performed using an ohmmeter or an equivalent measuring facility.

i In this system state, only the isolation of individual lines or a group of lines may be tested against ground, but not two lines against one another. Otherwise there is a risk of failures. Tests with high voltage are also not permitted.

The standard for measuring voltage and isolation resistance is EN 50178 (VDE 0160).

7.1.1.3 Voltage Connection

NOTICE

When the modules are delivered, they are screwed tightly to the subrack. For this reason, check proper polarity, voltage and ripple prior to connecting the 24 VDC supply voltage. Reverse polarity causes the module fuses, which may not be replaced by the user, to trip.

7.2 Changes

Whenever possible, disconnect the voltage supply to the controller during work, since short-circuits in the signal wiring may endanger its safety function.

NOTICE

It is mandatory to use a low voltage soldering iron with isolating transformer for soldering. When performing work with soldering irons that are directly connected to 230 VAC, semi-conductor devices may be destroyed. This may also happen if the voltage supply of the controller is disconnected.

For other wiring types such as termipoints, ensure that a suitable special tool is used.

If changes are performed in the power supply area, the mandatory cross-sections must be observed, see Chapter 5 for details. The connection of the L- reference pole in the subrack and other integrated devices that are supplied with 24 VDC must be implemented as ring wiring.

Short-circuits, signal activation or similar effects to the wiring of the subrack may cause the diagnostic and communication module (DCM) to report a fault on the module. This does not affect the module's operation. The error message, however, remains stored until the temporary disconnection of the supply voltage, e.g., by removing and inserting the module.

7.3 Maintenance

This chapter describes the maintenance actions for the Planar4 systems required in terms of safety and provides recommendations to increase availability.

i Only qualified personnel may perform maintenance actions to the Planar4 system, taking all ESD protection measures into account. Personnel must be electrostatically discharged prior to any direct contact with the module and lines!

7.3.1 Proof Test

The proof test reveals dangerous undetected faults that could otherwise affect the safe function of the system.

HIMA safety systems must be subject to a proof test in intervals of **10 years**. It is often possible to extend this interval using a calculation tool to analyze the implemented safety loops.

Wear in relay modules may occur if heavy loads are applied to the relay outputs or if the relay outputs are frequently switched. These modules should be replaced whenever the number of switching operations has reached the value specified in the data sheet. For further details, refer to the data sheets for the relay modules 32 100, 32 101, 32 102, 32 103, 32 110. Refer to the functional safety data manual (HI 804 001 E) for the proof test intervall applying to these relay modules.

7.3.1.1 Performing the Proof Test

The proof test execution depends on the following factors:

- Plant characteristics (EUC = equipment under control).
- Plant's intrinsic risk potential.
- The standards applicable to the plant operation and required for approval by the responsible test authority.

According to IEC 61508 1-7, IEC 61511 1-3, IEC 62061 and VDI/VDE 2180, Sheets 1 to 4, the operator of the safety-related systems is responsible for proof testing.

In practice, the proof test interval required for the input and output field devices is shorter (e.g., every 6 or 12 months) than that required for the Planar4 system. Testing the entire safety loop together with a field device automatically includes the test of the Planar4 system. There is therefore no need to additionally proof testing the HIMA controller.

If the proof test of the field devices does not include the Planar4 system, the Planar4 system must be tested at least once every 10 years. This can be achieved by shutting down and restarting the Planar4 system.

7.3.2 Replacing Modules

A Planar4 module can be removed and inserted while the Planar4 system is operating.
Defective modules must be immediately replaced with faultless modules of the same type or with an approved replacement model.
Only the manufacturer is authorized to repair the module.

7.3.3 Replacing the Electrolytic Capacitors

The electrolytic capacitors of the Planar4 system must be replaced in the following intervals:

Modules	Period
80 105	≤ 20 years[1)]
80 106	
80 107	
80 110	Not required! No electrolytic capacitor present
For all the other Planar4 modules	≤ 10 years[1)]
Z 6016	≤ 10 years[1)]
[1)] The lifetime of electrolytic capacitors depends on the temperature (typical manufacturer specifications: >10 years at ≤ 40°C)	

Table 21: Interval for Exchanging Electrolytic Capacitors

The electrolytic capacitors may only be replaced by HIMA!

Equipment with a safety certificate is safety-relevant. The validity of the certificate expires if unauthorized repair is performed to safety-related modules of the Planar4 system.

The warranty is void and no legal responsibility is taken by HIMA for unauthorized repair.

8 Communication

The communication module in slot 21 of a Planar4 subrack allows data to be transmitted to other systems via RS485 (Modbus, PROFIBUS DP) or Ethernet 10BASE-T (OPC with TCP/IP protocol). Depending on the type of transmission, different types of communication modules may be used.

The following data types can be transmitted:

Data type	Modbus RS485	PROFIBUS DP RS485	Ethernet (OPC)
BOOL: Status of modules, inputs and outputs	•	•	•
WORD / UBYTE: Module type, actual values, thresholds	•	•	•
Events (Signal changes of inputs and outputs with date and timestamp)	•		
Time synchronization	•		

Table 22: Data Types and Communication

8.1 Communication via Modbus Protocol

The Planar4 systems can be operated as a Modbus slave via the RS485 interface. For further information on the Modbus protocol, see the Modbus organization (www.modbus.org).

i Only the function codes specified in the following chapters are available for Planar4.

The default settings are 1 stop bit, even parity bit and 9600 baud.

The communication module also supports 19 200 and 57 600 Baud.

The RTU (remote terminal unit) is the only mode of transmission between HIMA systems. Data is transmitted asynchronously with 8 bits and CRC security code.

In general, the RTU mode of transmission has the following format:

Start	Slave no.	Code	Data	Test data	Transmission end
T1 T2 T3	1 byte	1 byte	1)	2 bytes	T1 T2 T3
1) The number of bytes depends on the function, number of addresses and data					

Table 23: RTU

Start	Transmission start and end are marked
Slave no.	Address of the slave system. Slave number set in the communication module
Code	Function code: Writing or reading of variables or events
Data	The data includes start address, number of addresses and data depending on the function. Refer to the specification in the Modbus protocol.
Test data	CRC code (cyclic redundancy check) automatically created by the sending system.
Transmission end	Identified by a pause of 3.5 characters (bytes) (T1 T2 T3)

The Modbus protocol is used to implement the following functions for communication within the Planar4 system:

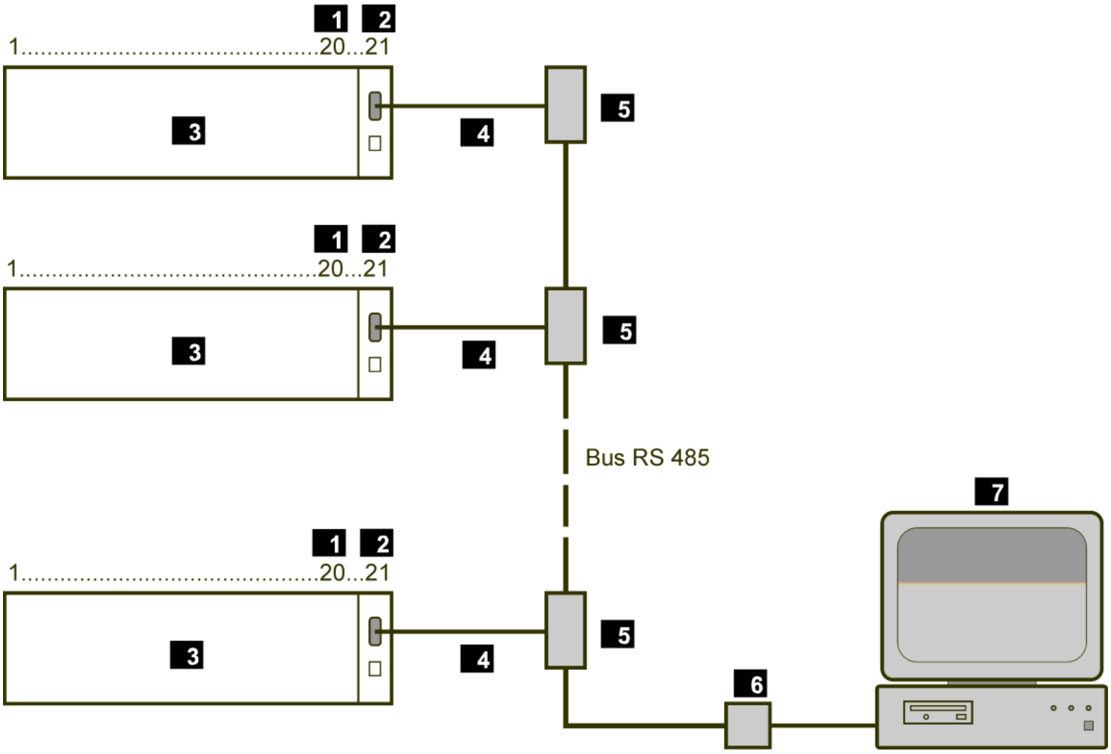
- Reading of variables such as inputs, outputs, actual values and thresholds
- Reading of events
- Time synchronization

Binary signal changes of inputs and outputs are recorded as events. Events recorded by the communication module in the same scanning cycle therefore have the same timestamp. The duration of the scanning cycle is 4 ms.

Events may be read (from the buffer memory of the communication module) using standard codes or special function codes that are not specified in the original Modbus protocol.

Each Modbus communication module in a Planar4 subrack is a slave in an RS485 network. The slave number is set via switches on the communication module, refer to the data sheet for details.

8.2 RS485 Bus System Structure



1 Module slots 1…20	5 H 7506 bus terminal
2 Communication module in slot 21	6 H 7505 interface converter
3 Subrack slave no. 1…n	7 Modbus master (control system)
4 BV 7040 data connection cable	

Figure 13: RS485 Bus System Structure

The number of slaves on one bus segment is limited to 31. Using repeaters, the system can be extended to four segments. In doing so, the number of addressable slaves is limited to a total of 124.

The Modbus master receives the required information from the Planar4 system modules via the slave numbers, function codes and addresses.

The RS485 bus system cannot be configured redundantly because each subrack may only include one communication module and this only has one interface.

8.3 Function Codes

The following function codes are implemented for the Planar4 system:

1	Reading the status of one or several binary values, e.g., scanning of a module state, input and output signals
3	Reading the status of one or several digital values, e.g., querying the module type, time-delay actual value, residual times, thresholds and actual values of limit indicators
6	Time synchronization
65 66 67	Event scanning: ▪ Binary signal change with timestamp ▪ (free codes in the original Modbus protocol)
70	Time synchronization

8.3.1 Addresses

The addresses depend on the module slot location in the subrack and on the requested information. 256 addresses are reserved for each module. Address A of a module's information is determined as follows:

$A = p * 256 + n$

p Slot in the subrack; for the first slot is p = 1

n Relative address of the information within a module, see the tables in the data sheets

8.3.2 Reading Data

The following function codes are implemented for reading data:

Code	Function
1	Reading the status of one or several binary signals (type: BOOL)
3	Reading the status of one or several digital signals (type: WORD)

Table 24: Reading Data

Function code 3 allows usage of a single telegram to transfer all the information about the modules within a subrack. For this purpose, 84 digital values (WORDS) must be requested, according to the 21 inputs of the communication module.

The type of starting addresses used (2000H, 3000H or 4000H) determines which data is requested. The data depends on the module type. 0 is transferred for unused module slots.

The master system must be able to interpret the received data, since it contains both binary and digital module values (types: BOOL and WORD).

8.3.3 Events

The communication module generates events from all binary input and output signals of the modules. The signal changes are recorded and an event number (depending on module slot and signal) with timestamp is stored in a buffer. Events recorded in the same scanning cycle have the same timestamp.

32 event numbers are reserved for each module. Event number E of a module's information is determined as follows:

$E = (p-1) * 32 + n$

p Slot in the subrack; for the first slot is p = 1

n Relative address of the event within a module, see the tables in the data sheets

A maximum of 1024 events can be stored. Two master systems can scan the events.

8.3.4 Reading of Events

The following function codes are implemented for reading events:

Code	Function
65	Reading of event values (event status without timestamp)
66	Reading of new events (address, status, time)
67	Request to repeat the last transmission

Table 25: Reading of Events

Reading with function code 65

Function code 65 is used to transfer the binary input and output signals of modules without timestamp. 0 is transferred for unused module slots.

Slave	Code	Bytes	Start address	Number of events	CRC
1 byte	1 byte	1 byte	2 bytes	2 bytes	2 bytes
		9	**Always 0**	**Always 640**	

Table 26: Function Code 65

Slave	Code	Bytes	Event values, module 1	…	Event values, module 20	CRC
1 byte	1 byte	1 byte	4 bytes	…	4 bytes	2 bytes

Table 27: Slave Response

Function code 66: Reading new events

A maximum of 8 events (64 bytes) is sent at once.

Slave	Code	CRC
1 byte	1 byte	2 bytes

Table 28: Function Code 66

Slave	Code	Number of bytes	CRC
1 byte	1 byte	1 byte (0)	2 bytes

Table 29: Slave Response, if no Events Exist

Slave	Code	Bytes	Event	Event	…	Event	CRC
1 byte	1 byte	1 byte	8 bytes	8 bytes	…	8 bytes	2 bytes

Table 30: Slave Response, if Events Exist

Event structure

Event no.	Event value	ms	DS	s	min	H
2 bytes	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte
	0 or 1	0…99	0…9	0…59	0…59	0…23

Table 31: Event Structure

Function code 67: Events sent last

Code 67 is only possible after code 66, if the master system has not received the correct response to code 66. It causes the slave system to repeat its last response.

Slave	Code	CRC
1 byte	1 byte	2 bytes

Table 32: Function Code 67

Response from the slave as with code 66, if code 66 was sent before, otherwise

Slave	Code	Error code	CRC
1 byte	1 byte	1 byte (0)	2 bytes
		1	

Table 33: Slave Response

Code 65 should be sent after a restart or buffer overflow of the slave system. During normal operation, code 66 or code 67 must be cyclically sent by the master.

Error messages after event scanning

Code	Description
1	Code 67 was not preceded by code 66.
2	Code 65 indicates that the start address is not equal to 0 or the number of events was not properly specified

Table 34: Error Messages After Event Scanning

8.3.5 Event Scanning with Standard Codes 1, 3

The requests implemented with the special codes 65, 66, and 67 can also be submitted with standard codes 1 and 3.

The events may be read out by 2 master systems that use different basic addresses during readout. The first master system uses start address 8960, the second the start address 9216. The events are read out from the same event buffer.

Event scanning with code 1

Function code 1 is used to transfer the binary input and output signals of modules without timestamp. 0 is transferred for unused module slots.

Slave	Code	Bytes	Start address	Number of events	CRC
1 byte	1 byte	1 byte	2 bytes	2 bytes	2 bytes
		9	**Always 8960**	**Always 640**	

Table 35: Function Code 1, First Master System

Slave	Code	Bytes	Start address	Number of events	CRC
1 byte	1 byte	1 byte	2 bytes	2 bytes	2 bytes
		9	**Always 9216**	**Always 640**	

Table 36: Function Code 1, Second Master System

Slave	Code	Bytes	Event values, module 1	…	Event values, module 20	CRC
1 byte	1 byte	1 byte	4 bytes	…	4 bytes	2 bytes

Table 37: Slave Response

Event scanning with code 3

If events are requested with code 3, the number of events read out from the event buffer (max. 31 events * 8 bytes) is identical to the number of events defined in the master system's request. Since one event consists of 8 bytes, 4 WORD variables must always be read together.

Error message during event scanning

Code	Description
2	Relative address or number of values does not correspond to the definition.

Table 38: Error Message during Event Scanning

Events released for overwriting

The events that were read out by a Modbus master and for which the receipt was acknowledged by the communication module, are released for being overwritten, but they are not erased.

If two masters are active, the events are released after readout by one of the two masters.

Events released for overwriting are erased in the following cases:

- Storage of new events in the event buffer
- Event buffer overflow

Event buffer overflow

If more events are received than can be stored, the *Buffer Overflow* event is stored in the communication module. In doing so, the Modbus master is informed that an overflow occurred and events were lost.

8.3.6 Time Synchronization

A master can synchronize the time and date of the controller via Modbus. To do so, code 70 is used.

If the slave address is 0x00, all the slaves are addressed (broadcast).

If only the time should be transmitted, d must be set to 0.

If only the date should be transmitted, ms must be set to 255.

Function code 70

Slave	Code	Number of bytes	Data								CRC
1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	2 bytes
0x00	0x46	0x08	ms 0…99	DS 0…9	s 0…59	min 0…59	H 0…23	d 0…31	m 1…12	A 0…99	

Table 39: Function Code 70

The time can also be set with function code 6. The telegram must include the number of milliseconds passed since the last full minute, i.e., the values are in the range 0…59999. With slave address 0, all the slaves are addressed by the master (broadcast). The address for time synchronization is 2048.

Function code 6

Slave	Code	Address	Data	CRC
1 byte	1 byte	2 bytes	2 bytes	2 bytes

Table 40: Function Code 6

8.4 Communication via PROFIBUS DP

PROFIBUS DP is a master-slave system for serial data transmission on a bus. The hardware structure is the same as for Modbus communication.

Data transferred in the Planar4 system via PROFIBUS DP can have a WORD or BYTE data type.

Events cannot be transferred.

Each PROFIBUS DP communication module in a Planar4 subrack is a slave in an RS485 network. The slave number is set via switches on the communication module, refer to the data sheet for details.

The number of slaves on one bus segment is limited to 31. Using repeaters, the system can be extended to four bus segments. In doing so, the number of addressable slaves is limited to a total of 124, see Chapter 8.1.

The RS485 bus system cannot be configured redundantly because each subrack may only include one communication module and this only has one interface. Only an overall controller can be structured redundantly.

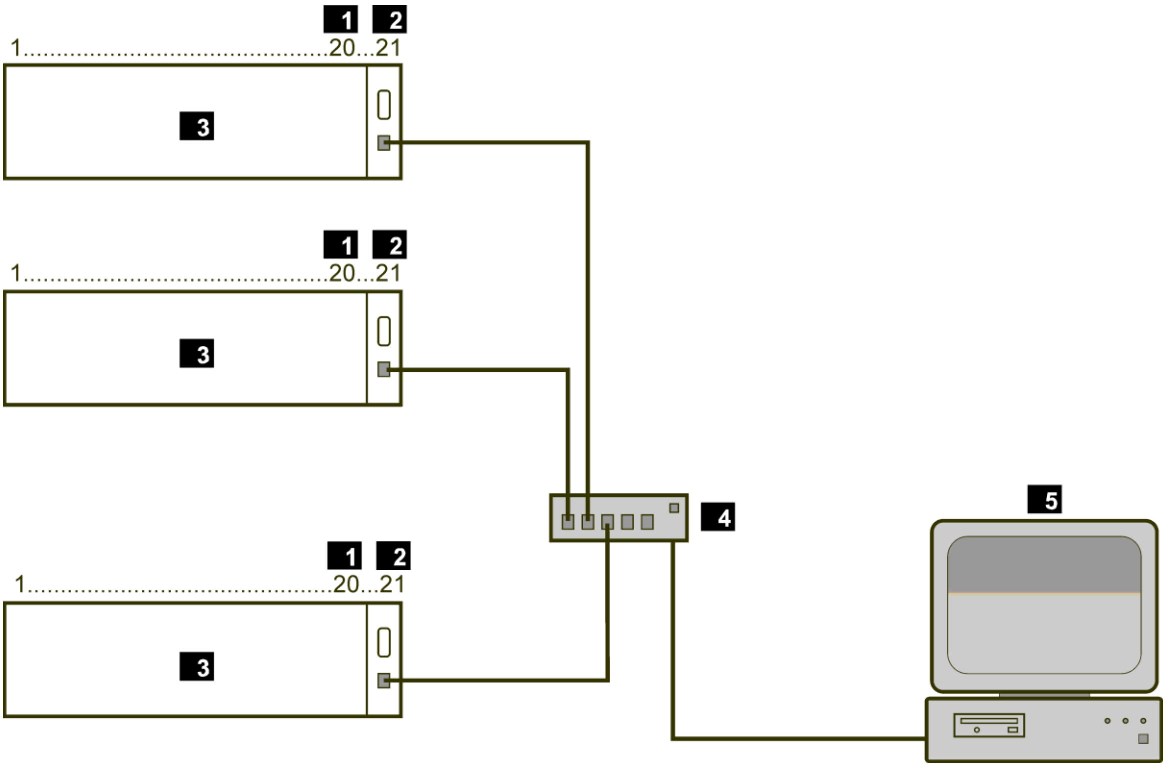
8.5 Communication via Ethernet (OPC Server)

The OPC Server is connected to the HIMA Planar4 system via a network. For this network, an Ethernet card configured according to TCP/IP is required in the PC. The HIMA OPC Server can use the addresses 192.168.0.215 up to 192.168.0.222.

Twisted pair cables are used to connect the Ethernet card interface of the OPC Server to a switch (RJ-45 connector), which is also connected to the communication modules of the individual Planar4 subracks.

Ethernet Network Structure

Twisted pair cables are used to connect the communication modules on the subracks via the RJ-45 connector (10Base-T) to an Ethernet switch, which is connected to the Ethernet card of the HIMA OPC Server.



1 Subrack slave no. 1
2 Module Slots 1…20
3 Communication modules on slot 21
Connection via RJ-45 (10BASE-T)
4 Switch
5 HIMA OPC Server

Figure 14: Ethernet Network Structure

Each communication module has its own ID number in the range 0…127. It is configured using switches on the module, refer to the data sheet for details.

The IP is determined as follows:

IP address = ID number * 2 + 1

The results are always odd IP addresses. They are in the range:

192.168.0.1…192.168.0.255.

The ID numbers must be entered in the configuration file of the HIMA OPC Server.

For further information, refer to the manual HIMA OPC Server 3.0 Rev. 2.

9 Safety, Availability and Requirements

9.1 Functional Principle of Safety-Related Modules

The term safety-related modules applies to individual units of modular systems, if they were subject to the relevant certification by a test authority (TÜV).

9.1.1 Module Safety Through Fail-Safe Principle

Safety-related modules are modules that, if a component fails, adopt the state defined as safe at the output. The safety function in the Planar4 system is based on the de-energize to trip principle, i.e., the safe state is the lowest energy state.

In contrast to non-safety-related modules, which process the signals in terms of DC voltage, the dynamic principle is applied to safety-related modules. The input and output signals are static DC signals, but they are internally processed via AC coupling. For a detailed description of the principle, refer to Chapter 3.1.

9.1.2 Module Safety Through Comparison Functions (Diagnostics)

The use of a two-channel operating computer structure and cycle self-tests ensure the module safety through comparison functions, e.g., 1oo2 microprocessor systems.

The self-test includes special measures such as testing of the input and output circuits. These measures are intended to detect all first faults that cannot be revealed by the system structure (two-channel) and may result in a dangerous operating state. This safety principle is applied, for instance, to time-delay function modules.

9.1.3 Process Safety Time

The process safety time is a property of the process and describes the time interval during which the process allows faulty signals to exist without a hazardous state occurring.

A safety-related response of the HIMA Planar4 system including all delays due to sensors, actuators, input and output modules must occur within the process safety time.

The response time of the Planar4 controllers must be viewed in accordance with the loops. The response time is the sum of all the switching and reset times of modules that are used in a loop.

9.2 Availability

The availability (A) is the probability that a system will be operational at any random time.

According to A. Birolini *Zuverlässigkeit von Geräten und Systemen (Reliability of devices and systems),* availability is calculated as follows:

$$A = \frac{MTTF}{MTTF + MTTR} \times 100\,\%$$

Overall operating time = MTTF + MTTR

MTTR = Mean time to repair

MTTR, also referred to as *mean time to repair* or *mean time to restoration*, is composed of the mean time to detect the fault and the mean time to restore the item.

The failure rates are calculated based on SN 29500.

The position of faulty modules can be determined by evaluating the data from the diagnostic and communication module (DCM).

Fault recovery is limited to the replacement of faulty modules.

Availability can be increased by arranging the modules in parallel.

$$MTTF\ red = \frac{MTTF\ mono^2}{2 \times MTTR}$$

9.3 Functional Safety Data

Functional safety data in accordance with IEC 61508 is available for the Planar4 system. The values for MTTF, PFH and PFD were calculated as a function of the required proof test in accordance with IEC 61508, see the corresponding manual (HI 804 001 E).

9.4 Safety Standards

All the safety-related modules of the HIMA Planar4 system are tested in accordance with the safety standards specified below.

The safety levels in the IEC 61508 standard are referred to as SIL 1 to SIL 4.

Standard	Title	Release
IEC 61508	Functional safety, safety systems	2010
IEC 62061	Safety of machinery - Functional safety of safety-related electrical/electronic and programmable electronic control systems	2012

Table 41: Safety Standards

9.5 Application Standards

During the application development, the applicable standards and legal regulations must be observed.

Standard	Title	Release
IEC 61508	Functional safety, safety systems	2010
IEC 61511	Functional safety - Safety instrumented systems for the process industry sector	2003
VDI/VDE 2180	Safeguarding of industrial process plants by means of process control engineering	2007

Table 42: Application Standards

10 Certification

The Planar4 system has been certified by the TÜV and is suitable for use in safety-related applications up to SIL 4.

10.1 Report to the Certificate

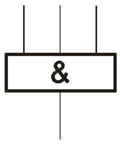
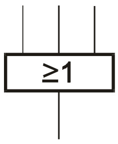
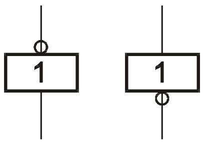
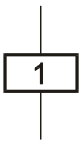
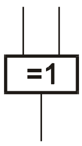
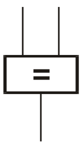
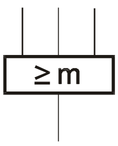
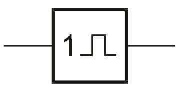
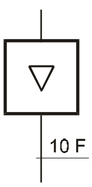
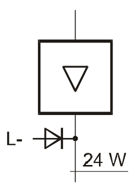
The report to the certificate of the Planar4 systems includes detailed information about test and certification standards, and a list of the tested modules. Additionally, it specifies the requirements such as the proof test that may be mandatory when operating the modules. The report to the certificate is available on request.

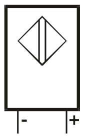
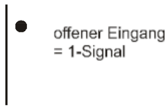
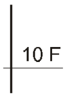
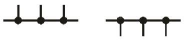
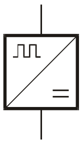
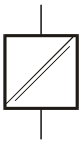
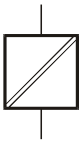
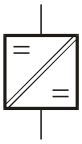
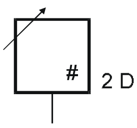
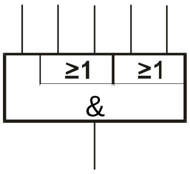
10.2 Planar4 Certificates

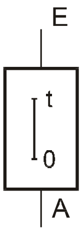
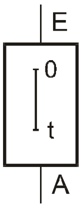
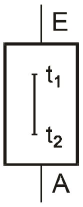
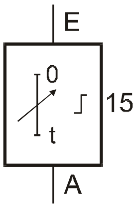
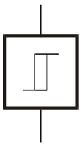
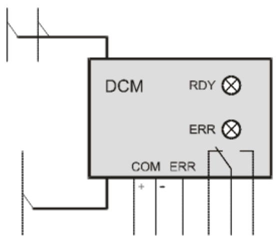
Planar4	
CE, EMC	IEC 61000-6-4 2007 IEC 61000-6-2 2005
TÜV	IEC 61508 1-7:2010, SIL 1 to SIL 4
Lloyd's Register	Shipping certification ENV1, ENV2 and ENV3: Test Specification Number 1-2002
ATEX, Ex (n)	EN 60079-0 EN 60079-15
IEC Ex, Ex (n)	IEC 60079-0 IEC 60079-15
ATEX, Ex (i)	EN 60079-0 EN 60079-11

Table 43: Certificates

11 Symbols Used in the Data Sheets

Representation	Function	Explanations
	AND function	1-signal at all the inputs causes 1-signal at the output
	OR function	1-signal at one or several inputs causes 1-signal at the output
	Negation (inverter)	The output signal is inverted with respect to the input signal
	1-signal transfer	For decoupling outputs
	Exclusive OR (exclusive disjunction)	1-signal is only issued if both input signals differ
	Equivalence	1-signal is only issued if both input signals are equal (1 or 0)
	Voting function (m out of n voting)	m out of n inputs with 1-signal cause 1-signal at the output
	Mono flop	Change to 1-signal at the input causes a temporary 1-signal at the output, irrespective of the input signal duration
	Amplifier	Amplifier with 10 F specified as the maximum output load capability
	Power amplifier	Amplifier with protective diode for switching of inductive loads and 24 W specified as the maximum output load

Representation	Function	Explanations
	Inductive proximity switch	Proximity sensor in accordance with DIN 19234 with polarity specification
	Marking of an input	1-signal if line is **open** 0-signal is achieved by activating L-
	Marking of an input or output	No input (output) for binary signal (no 1 signal)
	Load specifications	At the input: 10 F load capability At the output: 10 F load capability
	Rail	Input or output intended for rails
	Functional unit with signal conversion	Dynamic signal processing via function frequency
	Functional unit with galvanic separation	Galvanic separation of input and output circuits
	Functional unit with protective separation	Protective separation in accordance with DIN VDE 0106, Part 101/11.86
	DC/DC converter	Safe isolation of a DC voltage supply
	Digital selection	2-decade pre-selectors
	Combined AND/OR function	Two dual OR functions are connected to a triple AND function

Representation	Function	Explanations
	0-1 delay VESA = delayed ON, at once OFF	After activating the input E with 1-signal, the 1-signal appears at the output A after time t
	1-0 delay SEVA = at once ON, delayed OFF	After removing the 1 signal from the E input, the A output maintains the 1 signal for a duration t
	0-1 and 1-0 delay VEVA = delayed ON, delayed OFF	ON delay with time t1 and OFF delay with time t2
	1-0 delay, configurable in steps	Time-off delay, configurable in 15 regular steps
	Triggering level	If the input signal exceeds the switching threshold, the output carries a signal. If the input is less than the switching threshold, the output is switched off
	Limiter	Voltage or current values are limited to a specific value.
	Indicator lamps	Indicator lamps used on the modules are implemented as LEDs (light emitting diodes)
	Seven segment display	Display of values
	Diagnostic and communication module (DCM)	Signal recording and display (simplified representation with busbar) for diagnosis, error messages and for communication.

Abbreviations used in the data sheets

SFC	Hardware revision status
R	Reset
S	Set
SIL	Safety integrity level
U	Switching input

All the current manuals can be obtained upon request by sending an e-mail: documentation@hima.com. Registered customers can download the product documentation from the HIMA Extranet.

Chapter 4.6 provides the list of the available Planar4 modules.

12 Operation

The Planar4 system monitors itself autonomously.

12.1 Handling

Existing switches or fuses of the Planar4 system **must not** be operated under voltage, unless it is ensured that **no** explosive atmosphere is present.

Planar4 modules	Handling
22 120 22 121	The S switch is used for 2-pole shutdown of the output circuit during maintenance and repair works.
52 100	Buttons for configuration and ACK.
52 110	Four rotary switches for configuration.
62 100	Four buttons and two LDC displays for configuration and ACK.
80 1xx	Reset Key
90 300	Two switches for signal bridging during maintenance and repair works.

Table 44: Handling of Planar4 Modules

12.2 Diagnostics

A faulty module is reported through the red ERR LED on the module's front side or can be recognized when RDY is not displayed. To evaluate the error or fault, the error message can be sent to a suitable facility, e.g., the process control system, see Chapter 0 for further details.

If the input module is equipped with line monitoring, the sensors' supply lines are checked and external faults are reported via LEDs and additional signal outputs of the module. This also applies to output modules with fuse monitoring in the output circuit. In this case, the external line must be checked and the module must not be replaced.

12.3 Safety Lifecycle Services

HIMA provides support throughout all the phases of the plant's safety lifecycle, from planning and engineering through commissioning to maintenance of safety and security.

HIMA's technical support experts are available for providing information and answering questions about our products, functional safety and cyber security.

To achieve the qualification required by the safety standards, HIMA offers product or customer-specific seminars at HIMA's training center or on site at the customer's premises. The current seminar program for functional safety, cyber security and HIMA products can be found on HIMA's website.

Safety Lifecycle Services:	
Onsite+ / On-Site Engineering	In close cooperation with the customer, HIMA performs changes or extensions on site.
Startup+ / Preventive Maintenance	HIMA is responsible for planning and executing preventive maintenance measures. Maintenance actions are carried out in accordance with the manufacturer's specifications and are documented for the customer.
Lifecycle+ / Lifecycle Management	As part of its lifecycle management processes, HIMA analyzes the current status of all installed systems and develops specific recommendations for maintenance, upgrading and migration.
Hotline+ / 24 h hotline	HIMA's safety engineers are available by telephone around the clock to help solve problems.
Standby+ / 24 h call-out service	Faults that cannot be resolved over the phone are processed by HIMA's specialists within the time frame specified in the contract.
Logistic+/ 24 h spare parts service	HIMA maintains an inventory of necessary spare parts and guarantees quick, long-term availability.

Contact details:	
Safety Lifecycle Services	https://www.hima.com/en/about-hima/contacts-worldwide/
Technical Support	https://www.hima.com/en/products-services/support/
Seminar program	https://www.hima.com/en/products-services/seminars//

13 Decommissioning

The Planar4 system is decommissioned by removing the supply voltage.

14 Transport

To avoid mechanical damage, the components must be transported in packaging.

Always store the components in their original product packaging. This packaging also provides protection against electrostatic discharge (ESD). Note that the product packaging alone is not sufficient for transport.

15 Disposal

Industrial customers are responsible for correctly disposing of decommissioned hardware. Upon request, a disposal agreement can be arranged with HIMA.

All materials must be disposed of in an ecologically sound manner.

Appendix

Glossary

Term	Description
AI	Analog input
AO	Analog output
DI	Digital input
DO	Digital output
E/E/PE	Electrical / electronic / programmable electronic
EMC	Electromagnetic compatibility
EN	European standard
ESD	Electrostatic discharge
EUC	Equipment under control
FB	Fieldbus
HFT	Hardware fault tolerance
IEC	International electrotechnical commission
Interference-free	Supposing that two input circuits are connected to the same source (e.g., a transmitter). An input circuit is termed *interference-free* if it does not distort the signals of the other input circuit.
MAC Address	Media access control address, hardware address of one network connection
MTTF	Mean time to failure, mean time that an item is expected to operate
MTTR	Mean time to repair, mean time required to repair an item
PE	Protective ground
PELV	Protective extra low voltage
PES	Programmable electronic system
PFD	Probability of failure on demand, mean probability that an item operating in low demand mode will fail (a function is demanded once or twice a year)
PFH	Probability of failure per hour, mean probability that an item operating in high demand mode will fail (a function is demanded more than twice a year)
r_P	Peak value of a total AC component
SELV	Safety extra low voltage
SFF	Safe failure fraction, portion of faults that can be safely controlled
SIL	Safety integrity level (in accordance with IEC 61508)
SW	Software

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