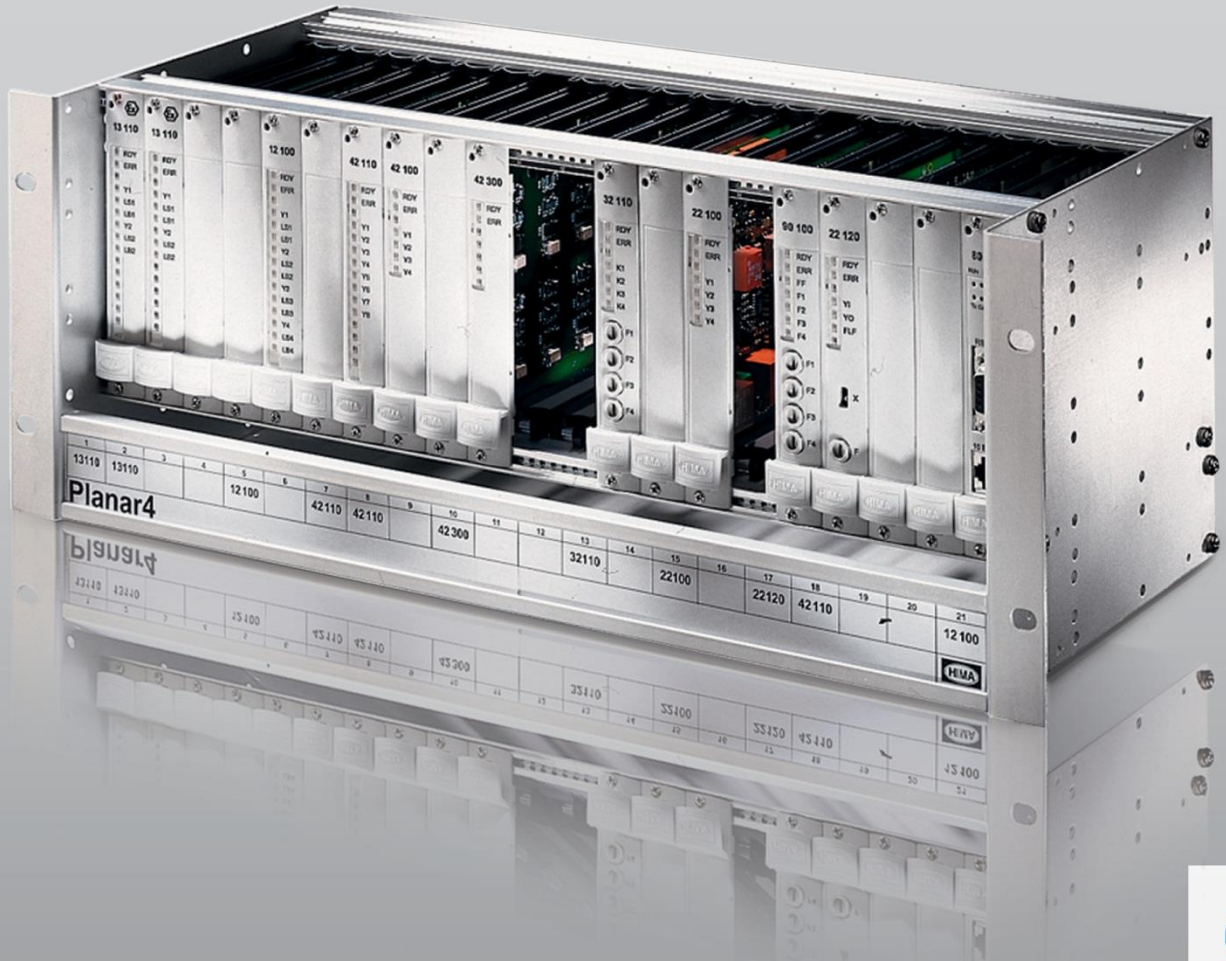
Planar4®

Electronic Systems
Operating Instructions for
Explosive Atmospheres

SAFETY
NONSTOP

HIMA



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For further information, refer to the HIMA DVD and our website at `http://www.hima.de` and `http://www.hima.com`.

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1 Introduction

This manual describes the Ex-relevant measures for starting up and operating the Planar4 system.

The HIMA Planar4 system is a modular, electronic circuit system with modules for assembling hard-wired, safety-related control and monitoring systems. 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 ensure data transfer to other systems.

The Planar4 system has been certified by the TÜV and may be used for safety-related applications up to SIL 4.

1.1 Structure and Use of this Manual

This manual is organized in the following main chapters:

- Use
- Installation
- Start-up
- Operation
- Decommissioning
- Transport
- Disposal
- HIMA service, training and hotline
- Appendix

1.2 Target Audience

This document addresses system planners, configuration engineers of automation devices and personnel authorized to implement, operate and maintain the devices and systems. 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 within automated systems, e.g., to prevent improper connections or faulty configuration.

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 Other Applicable Documents

Standard/Document	Description
EN 60079-0:2012 + A11:2013 IEC 60079-0:2011	Explosive atmospheres Part 0: Equipment – General requirements
EN 60079-15:2010 IEC 60079-15:2010	Explosive atmospheres - Part 15: Equipment protection by degree of protection 'n'
EN 60079-11:2012 IEC 60079-11:2011	Explosive Atmospheres - Part 11: Equipment protection by intrinsic safety 'i'
EN 60079-14:2008 IEC 60079-14:2007	Explosive atmospheres - Part 14: Electrical installations design, selection and erection
Safety and system manual	Planar4 safety and system manual
Planar4_12100_E	Input module 12 100, 4 channels Safety-related
Planar4_13110_E	Input module 13 110, 2 channels (Ex)i, safety-related
Planar4_22100_E	Output module 22 100, 4 channels Safety-related
Planar4_22120_E	Output module 22 120 Safety-related
Planar4_22121_E	Output module 22 121 Safety-related
Planar4_32100_E	Relay amplifier 32 100, 2 channels Safety-related
Planar4_32101_E	Relay amplifier 32 101, 2 channels Safety-related
Planar4_32102_E	Relay amplifier 32 102, 2 channels Safety-related
Planar4_32103_E	Relay amplifier 32 103, 2 channels Safety-related
Planar4_32110_E	Relay amplifier 32 110, 4 channels Safety-related
Planar4_42100_E	AND module 42 100, 4 AND functions Safety-related
Planar4_42110_E	AND module 42 110, 8 AND functions Safety-related
Planar4_42200_E	AND-OR module 42 200, 4 AND, 2 OR, 1 blocking function Safety-related
Planar4_42300_E	OR module 42 300, 8 OR functions Safety-related
Planar4_42400_E	Blocking module 42 400, 4 blocking functions Safety-related
Planar4_42500_E	2oo3 selection module 42 500, 4 2oo3 selection functions Safety-related
Planar4_52100_E	Time delay module 52 100 Safety-related
Planar4_52110_E	Time delay module 52 110, 4 SEVA functions Safety-related
Planar4_62100_E	Analog limit indicator 62 100, 2 channels Safety-related
Planar4_80105_E	Modbus communication module 80 105
Planar4_80106_E	PROFIBUS DP communication module 80 106
Planar4_80107_E	Ethernet communication module 80 107
Planar4_80110_E	Reset module 80 110

Planar4_90100_E	Fuse module 90 100, 4 fuses
Planar4_90300_E	Bypass module 90 300, 2 channels
Planar4_90900_E	Subrack with backplane, 19-inch, 4 RU, 32-pole female connector, solder terminal
Planar4_90901_E	Subrack with backplane, 19-inch, 4 RU, 28-pole female connector, solder terminal (Ex)i, including 20 wiring guards
Planar4_90902_E	Subrack with backplane, 19-inch, 4 RU, 32-pole female connector, termipoint 1.6 × 0.8 / wire wrap
Planar4_90910_E	Subrack with backplane, 19-inch, 4 RU, 32-pole female connector, solder terminal, separate power supply to each slot
Planar4_90911_E	Subrack with backplane, 19-inch, 4 RU, 28-pole female connector, solder terminal (Ex)i, including 20 wiring guards, separate power supply to each slot
Planar4_90912_E	Subrack with backplane, 19-inch, 4 RU, 32-pole female connector, termipoint 1.6 x 0.8, separate power supply to each slot

Table 1: Applicable Documentation

1.4 Standards

Planar4	
CE, EMC	EN 61000-6-4 2007 EN 61000-6-2 2005
TÜV	IEC 61508, Part 1-7:2010
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 2: Standards

2 Use

This chapter describes the use of Planar4 modules in accordance with the respective type of protection. To prevent ignition of the explosive atmosphere, different types of protection in accordance with IEC 60079-0 are applied to electrical equipment.

2.1 Use of Planar4 Module with Type of Protection 'n'

All the Planar4 module use type of protection 'n' for operation in Ex zone 2

Planar4	
Supply voltage	24 VDC, -15...+20 %, $r_p \leq 5$ %
Ambient temperature	-25...+70 °C
Humidity	max. 95 % relative humidity, non-condensing
Pollution	Pollution degree 2, in accordance with IEC 60664-1
Altitude	< 1000 m
Degree of protection	IP20

Table 3: Rating of Planar4 Modules

2.2 Use of Planar4 (Ex)i Modules

Modules with (Ex)i circuits are used in the Planar4 system. These modules must be classified as associated electrical equipment of zone 0.

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 not 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 equipment belongs to the associated electrical equipment that must be installed outside the area with explosive atmosphere.

Marking of the control circuit of an associated electrical equipment:

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

- II Area of application: Equipment-group
- (1)G Area of application: Equipment category
- [ ] Marking of an associated electrical equipment
- Ex 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 a EU-type examination certificate. Those certificates are part of the corresponding data sheet.

The certificate number provides the following details:

PTB 98 ATEX 2091 X (in accordance with European Directives)

PTB	Test institute
98	Year of issue
ATEX	Type examination complying with the relevant directive
2	Marking of the testing department
091	Consecutive number
X	Special conditions

The special conditions (X) are:

- Arrangement of the modules outside the area with explosive atmosphere.
- Interconnection of intrinsically safe circuits (the details specified in the certificate for parallel connection do not mean that proper operation of the 13 110 module is also ensured if the module is connected in parallel, see the Planar4 13 110 data sheet).
- Characteristics of wiring.

HIMA 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 IEC 60079-0, IEC 60079-11):

- 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 wires and insulated cables in light-blue color.
- Separation between intrinsically safe and not intrinsically safe wires and cables or supplementary insulation.
- Use of wiring guards or covering the female connectors with heat-shrinkable sleeves, including all connectors within a radius of 50 mm to the (Ex)i connectors.
- Use of power supply units with safe separation SELV or PELV
- Output voltage of the power supply units limited to ≤ 30 V.
  If a fault occurs, shutdown of power supply units at < 35 V.
- Protection against parasitic voltages in the system.

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 indication of the module type.

2.3 Marking

Ex marking of the Planar4 modules and subracks:

Subracks and modules with ⟨Ex⟩ II 3G Ex nA IIC T4 Gc			
80 105	90 900	90 910	
80 106	90 901	90 911	
80 107	90 902	90 912	
80 110	90 903		
Modules with ⟨Ex⟩ II 3G Ex nA nC IIC T4 Gc			
12 100	32 100	42 100	52 100
13 110	32 101	42 110	52 110
22 100	32 102	42 200	62 100
22 120	32 103	42 300	90 100
22 121	32 110	42 400	90 300
		42 500	

Table 4: Ex Marking

⟨Ex⟩	Explosion protection marking complying with the relevant directive.
II	Equipment group
3G	Equipment category
Ex	Equipment with type of protection in accordance with IEC 60079-0
nA	Non-sparking equipment
nC	Sparking equipment
IIC	Gas group hydrogen/ignition energy < 60 µJ
T4	Temperature class with a maximum surface temperature of 135 °C.
Gc	Equipment protection level (EPL)

3 Installation

This chapter discusses relevant aspects when installing and operating the Planar4 system in zone 2. The following standards must be taken into account:

- IEC 60079-15
- IEC 60079-14

3.1 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 in accordance with DIN 41494. For more mounting details, refer to the Planar4 safety and system manual (HI 804 003 E).

3.1.1 Conditions for Mounting in Zone 2

The Planar4 system may only be used in areas with maximum pollution degree 2 in accordance with IEC 60664-1.

The Planar4 system must be installed in an enclosure (control cabinet) that fulfils the requirements of the EN/IEC 60079-15 with degree of protection IP54 or better. The device must be provided with a warning:

WARNING Work is only permitted in the de-energized state

i Exception: If a potentially explosive atmosphere **has been precluded**, work can also be performed when the device is under voltage.

3.2 Earthing Concept

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

All Planar4 systems can be operated with earthed L- or unearthed.

3.2.1.1 Unearthed Operation

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

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

3.2.1.2 Earthed Operation

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

L- can only be earthed in one place within the system. L- is usually earthed directly behind the power supply unit (e.g., on the busbar). The earthing should be easily accessible and well separable. The earthing resistance must be ≤ 2 Ω.

3.2.1.3 Measures for Installing the Control Cabinet in Conformity with the CE Marking

All Planar4 system modules are labeled with the CE marking.

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

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

3.2.1.4 Earthing the HIMA Controllers

While also taking the EMC aspects into account, implement the following earthing 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 making. Stainless steel screws and flat washers must be used to prevent electrical corrosion.

3.3 Electrical Connections

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.

The power supply units used by HIMA, e.g., PS 1000, meet the CE requirements for electrical safety and the EMC requirements. With respect to safety during temporary voltage dropouts of up to 20 ms, these power supply units meet the requirements of NAMUR recommendation NE 21.

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.

3.3.1 Error Signal Contact Loop (EC)

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

3.3.2 Shielding within the Input and Output Areas

Lay field cables for sensors and actuators separately from the power supply lines and sufficiently distant from electromagnetic 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, additional measures must be taken to prevent compensation currents, e.g., capacitive connection of the shielding on the other end.

3.3.3 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 earth the system.

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

3.3.4 Cable Colors

The cable colors used for the Planar4 system comply with international standards.

Notwithstanding HIMA standard, other cable colors can be used for wiring due to national standard requirements. In such a case, document and verify the deviations.

3.3.5 Connecting the Supply Voltage

The Planar4 system is connected to 24 VDC. The clamp terminals are spring terminals marked by EL+ and L-.

3.4 Considerations about Heat

Considerations about heat must take every component within the enclosure (control cabinet) into account. This also applies to components that are not directly part of the Planar4 system! When mounting the Planar4 system, the permissible ambient temperature must be observed. Low ambient temperature increases the product life and the reliability of the electronic components within the system.

3.4.1 Overtemperature of Air within the Enclosure

The method used for determining the heating of the air within the enclosure is based on VDE 0660, Part 507 (HD 528 S2).

Size	Description	Unit
P_V	Power dissipation (heat capacity) of the electronic components within the device	W
ΔT	Overtemperature of air within the enclosure	K
b	Surface factor for determining the effective enclosure surface area	-
A	Effective enclosure surface area (see Chapter 3.4.1.2)	m²
B	Enclosure width	m
H	Enclosure height	m
D	Enclosure depth	m
k	Heat transmission coefficient of the enclosure	W/(m² K)
	For example: steel plate	approx. 5.5 W/(m² K)

Table 5: Definitions for Calculating the Overtemperature

3.4.1.1 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 IP54 enclosure (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 6: Power Dissipation of Planar4 Modules

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

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

Table 7: 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.

3.4.1.2 Heat Dissipation and Installation Type

A closed enclosure or a closed cabinet must be designed such that the heat generated inside can be dissipated through the surface.

Choose the installation type and position such that heat dissipation is ensured.

The effective enclosure surface area A is determined as a function of the installation type and the surface factor *b*, see VDE 0660 Part 507 (HD 528 S2) Table 3.

Example: Individual enclosure, free-standing on all sides

A = (front face + rear face) + (2*lateral face) + (top face)

A = 2*(0.9 * height * width) + 2*(0.9 * height * depth) + (1.4 * width * depth)

3.4.1.3 Natural Convection and Maximum Temperature Increase

It is assumed that heat load and unhindered natural convection are uniformly distributed. When the natural convection is not disturbed, the lost heat is dissipated through the enclosure walls and a uniform heat load is thus achieved. Requirement: The ambient temperature must be lower that the temperature within the enclosure and does not exceed 35 °C.

The maximum temperature increase (ΔT)max of all electronic devices within the enclosure is calculated as follows:

$$(\Delta T)_{max} = \frac{P_V}{k * A}$$

4 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. For more information, refer to the Planar4 safety and system manual (HI 804 003 E).

NOTICE

System damage possible!

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

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

4.1.1 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.

4.1.1.1 Testing all Inputs and Outputs

Impermissible parasitic voltages (in particular with 230 VAC against earth or L-) can be measured using an universal measuring instrument.

HIMA recommends testing every individual terminal for impermissible parasitic voltages.

When checking external cables for leakage resistance, potential short-circuits or breakage, the cables must not be connected on any end to prevent potential damage or destruction of modules caused by high voltages.

To check for earth faults, unplug the voltage connection plugs from the power distributor and disconnect the supply voltages for sensors and the negative pole of actuators.

If the negative pole is earthed during operation, the earth connection must be interrupted for the duration of the earth fault check. The same applies to the earth connection of earth fault measuring equipment, which may be connected to the system.
A megohmmeter or a special measuring facility must be used to check each connection against earth.

4.1.1.2 Voltage Connection

Requirement: ThePlanar4 modules are inserted and the corresponding cable are connected.
Check proper polarity, voltage and ripple prior to connecting the 24 VDC supply voltage.

In power installations, an insulation resistance test must be performed on site on the completely assembled system with mounted rack, see EN 50178, 9.4.5.4.

5 Operation

The Planar4 system monitors itself autonomously.

5.1 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.

5.2 Diagnosis

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.

6 Decommissioning

The Planar4 system is decommissioned by removing the supply voltage.

7 Transport

To avoid mechanical damage, the Planar4 components must be transported in packaging.

Always store the Planar4 components in their original product packaging. This packaging also provides protection against electrostatic discharge. Notice that the product packaging alone is not suitable for transport.

8 Disposal

Industrial customers are responsible for correctly disposing of decommissioned Planar4 hardware. Upon request, a disposal agreement can be arranged with HIMA.

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

9 HIMA Service, Training and Hotline

Deadlines and the extent of actions for commissioning, testing and modifying HIMA control cabinets can be agreed upon with HIMA's service department.

HIMA holds training course in accordance with the current seminar program for Planar4. The training courses are usually in-house at HIMA. Refer to the Internet page at www.hima.com or contact HIMA for details about the current seminar program and dates of the HIMA internal training.

Additionally, end customer training can be offered on-site. Special training can be tailored to customer-specific topics and provided upon request.

Important telephone numbers and e-mail addresses

HIMA Reception	Phone	+49 6202 709 - 0
	Fax	+49 6202 709 - 107
	E-mail	info@hima.com
HIMA Hotline	Phone	+49 6202 709 - 255 (or 258)
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	E-mail	hotline@hima.com

For questions about specific topics or to locate the appropriate HIMA contact person, use the contact form provided on our website *www.hima.com*.

Appendix

Glossary

Term	Description
AI	Analog input
AO	Analog output
ARP	Address resolution protocol, network protocol for assigning the network addresses to hardware addresses.
COM	Communication modules
DI	Digital input
DO	Digital output
EMC	Electromagnetic compatibility
EN	European norm
ESD	Electrostatic discharge
FB	Fieldbus
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
PE	Protective earth
PELV	Protective extra low voltage
PES	Programmable electronic system
R	Read: The system variable or signal provides value, e.g., to the user program
R/W	Read/Write (column title for system variable/signal type)
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)
TMO	Timeout

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