

SIEMENS

SIMATIC HMI

HMI device KP8, KP8F

Operating Instructions

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Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

⚠ DANGER
indicates that death or severe personal injury will result if proper precautions are not taken.
⚠ WARNING
indicates that death or severe personal injury may result if proper precautions are not taken.
⚠ CAUTION
with a safety alert symbol, indicates that minor personal injury can result if proper precautions are not taken.
CAUTION
without a safety alert symbol, indicates that property damage can result if proper precautions are not taken.
NOTICE
indicates that an unintended result or situation can occur if the corresponding information is not taken into account.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation for the specific task, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

Proper use of Siemens products

Note the following:

⚠ WARNING
Siemens products may only be used for the applications described in the catalog and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by Siemens. Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be adhered to. The information in the relevant documentation must be observed.

Trademarks

All names identified by ® are registered trademarks of the Siemens AG. The remaining trademarks in this publication may be trademarks whose use by third parties for their own purposes could violate the rights of the owner.

Disclaimer of Liability

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

Preface

Purpose of the operating instructions

This operating manual provides information for manuals derived from the requirements for mechanical engineering documentation according to DIN EN 62079. This information relates to the place of use, transport, storage, mounting, use and maintenance.

These operating instructions are intended for:

- Project planning engineers
- Users
- Commissioning engineers
- Maintenance personnel

Pay particular attention to the chapter "Safety Instructions (Page 19)".

Required knowledge

General knowledge of automation technology and process communication is needed to understand the operating instructions.

It is also assumed that those using the manual have experience in using personal computers and an understanding of Microsoft operating systems.

You must have knowledge about the STEP 7 software and about safety-related technology.

Scope

The operating instructions applies to the following HMI devices:

- KP8, order number 6AV3688-3AY36-0AX0
- KP8F, order number 6AV3688-3AF37-0AX0

Note

The manual is part of the HMI device and will be required for repeat commissioning. Retain all enclosed and additional documents for the entire service life of the HMI device.

You must pass on all these documents to future owners of the HMI device.

Registered trademarks

The following designations marked with the protective note ® are registered trademarks of the Siemens AG:

- HMI®
- SIMATIC®
- WinCC®

Notes on fail-safe operation

The following sections of these operating instructions contain important information about the fail-safe operation of the KP8F:

- Safety instructions and approvals (Page 19)
- Requirements for fail-safe operation (Page 36)
- Connecting the HMI device (Page 42)
- Setting KP8F - STEP 7 (Page 64)
- Operating KP8F in a fail-safe manner (Page 73)
- Sensor evaluation of the fail-safe channels (Page 93)

Documentation for fail-safe systems

- System description "Safety technology in SIMATIC S7"
 - Provides general information on the use, structure, and mode of operation of the fail-safe automation systems S7 Distributed Safety and S7 F/FH Systems
 - Contains detailed technical information which can be represented for the fail-safe technology both in S7-300 and S7-400.
 - Contains information about the calculation of monitoring and reaction times of the fail-safe systems "S7 Distributed Safety" and of "S7 F/FH Systems".
- "S7 Distributed Safety, Configuring and Programming" Manual and Online Help
Describes the configuration of the F-CPU and of the fail-safe I/O and the programming of the F-CPU in F-FBD or F-LAD
- "Automation System S7-1200, CPU Data" Reference Manual
Describes the standard functions of the CPU 1211C, CPU 1212C and CPU 1214C.
- "Automation System S7-400, CPU Data" Reference Manual
Describes the standard functions of CPU 416F-3 PN/DP, CPU 414-3 PN/DP and CPU 416-3 PN/DP
- "Automation System S7-300, CPU Data" Reference Manual
Describes the standard functions of CPU 315F-2 PN/DP, CPU 317F-2 PN/DP, CPU 315-2 PN/DP and CPU 317-2 PN/DP.

Style conventions

This manual uses the following style conventions:

Style Convention	Scope
"Add screen"	<ul style="list-style-type: none"> Terminology in the user interface, for example dialog names, tabs, buttons, menu commands Required input, for example, limits, tag values. Path information
"File > Edit"	Operational sequences, for example, shortcut menu commands
<F1>, <Alt+P>	Keyboard operation

Please observe notes labeled as follows:

Note

A note contains important information about the product described in the manual and its use, or a specific section of the manual to which you should pay particular attention.

Naming conventions

This manual uses the following naming conventions:

Naming convention	Applies to
Plant	<ul style="list-style-type: none"> System Machining center One or more machines
Actuate	<ul style="list-style-type: none"> By means of the touch screen on the HMI device By means of the button on the HMI device By operating a mouse on the HMI device
Switching cabinet	<ul style="list-style-type: none"> Mounting cabinet Switching cabinet Switchboard Console

Figures

This manual contains illustrations of the described devices. The illustrations can deviate from the details of the delivered device.

Technical Support

Technical support for the products covered in the manual is available in the Internet at:

- Technical Support (<http://support.automation.siemens.com/WW/view/en/4000024>)
- Support Request (<http://support.automation.siemens.com/WW/view/en/16605654>)
- Service (<http://support.automation.siemens.com/WW/view/en/16604318>)
- Contacts and office locations (<http://www.automation.siemens.com/mcms/aspa-db/en/Pages/default.aspx>)
- Training center (<http://sitrain.automation.siemens.com/sitrain/default.aspx?AppLang=en>)

Additional information on SIMATIC products is available in the Internet at:

- Industry Portal (http://www.automation.siemens.com/_en/portal/index.htm)
- Overall SIMATIC documentation (http://www.automation.siemens.com/simatic/portal/html_76/techdoku.htm)

Recycling and disposal

The products described in this manual are recyclable because of the low level of contaminants in their components. Contact a certified disposal service company for environmentally sound recycling and disposal of your old devices.

Used batteries and rechargeable batteries

Used batteries and lithium ion batteries are hazardous waste. Always dispose of used batteries and lithium ion batteries properly in accordance with the regulations in effect. Identify the container provided for this purpose with the label, "Used batteries and rechargeables".

Note

Batteries and rechargeables do not belong in the garbage. The user is legally obliged to return used batteries and rechargeable batteries. You can deposit used batteries and rechargeables at any public collection site and anywhere batteries or rechargeables of similar type are sold.

You can also send batteries and rechargeables to the following address:

Siemens AG
Industry Sector
Returns Center
Siemensstr. 2
90766 Fürth
Germany

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Overview

1.1 Product Overview

Application scenarios of the HMI device

The HMI device shows you operating states of a plant. You can actively control a running production process based on this information.

The HMI device is designed for mounting in control panels, and replaces keys and LEDs that are individually mounted. The HMI device is mounted in a mounting cut-out and connects to a SIMATIC controller via PROFINET. The HMI device can be set for immediate use. In comparison to conventional wiring, substantially less time is needed for commissioning and the device provides increase security against failure during runtime.

Fail-safe mode with KP8F

Thanks to the integrated PROFIsafe communication, the HMI device can be used in fail-safe mode for simple sensor applications. In regards to the safety-relevant signals, safety categories SIL3, Performance Level e and category 4 are reached.

The KP8 and the KP8F are intended for installation in the following extension units:

- Extension Unit 15", Order number 6AV7674-0KG00-0AA0
- Extension Unit 19" left, order number 6AV7674-0KH00-0AA0
- Extension Unit 19" right, order number 6AV7674-0KJ00-0AA0

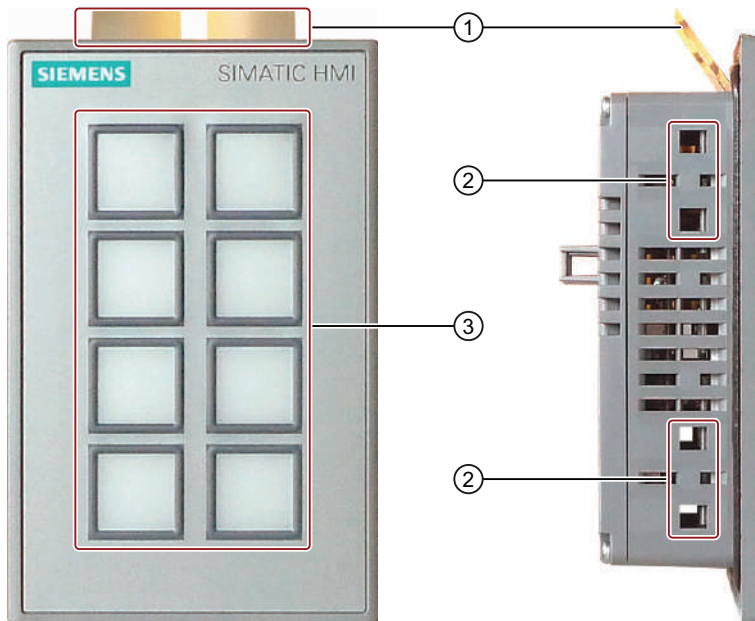
1.2 Scope of delivery

The scope of delivery includes:

- 1 KP8 or KP8F
- 1 accessory kit
- 1 data carrier with ATEX handbook

1.3 Design of KP8 and KP8F

Front view and side view

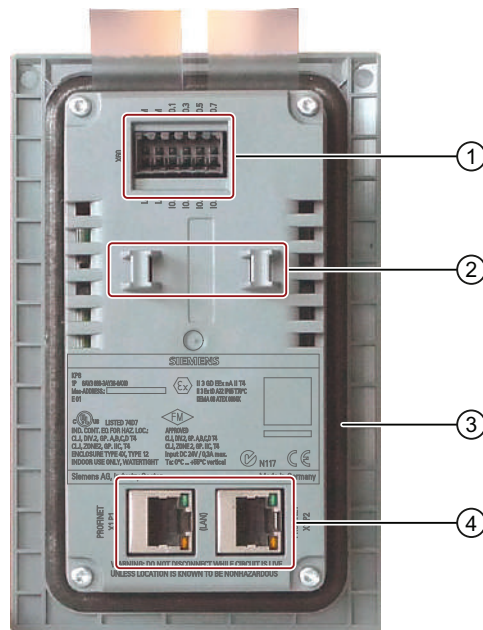


- ① Labeling strips
- ② Oblong holes for a mounting clamp
- ③ Keyboard

Plan view

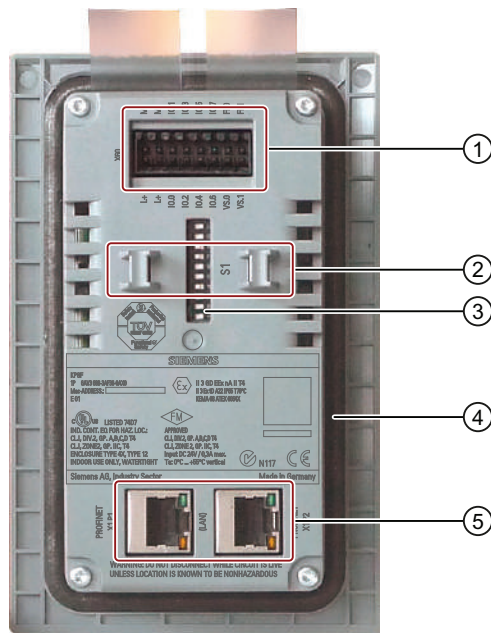


Rear view KP8



- ① Power supply connection and digital inputs and outputs
- ② Bar for strain relief
- ③ Seal
- ④ PROFINET interfaces

Rear view KP8F



- ① Power supply connection and digital inputs and outputs
- ② Bar for strain relief
- ③ DIP switch
- ④ Seal
- ⑤ PROFINET interfaces

1.4 Accessory kit

The accessory kit for the KP8 contains:

- A 12-pin plug connector
- Four mounting clamps for mounting the HMI device

The accessory kit for the KP8F contains the following:

- A 16-pin plug connector
- Four mounting clamps for mounting the HMI device

The accessory kit can include documents.

1.5 Service packages

KP8

This service pack contains:

1 set connector, 12-pin, order number 6AV6671-3XY39-4AX0

KP8F

This service pack contains:

1 set connector, 16-pin, order number 6AV6671-3XY49-4AX0

KP8, KP8F

This service pack contains:

1 set plastic mounting clamps, order number 6AV6671-8XK00-0AX2

1.6 Performance features

Performance features KP8

The HMI device offers a wide range of features that can be used without the need for programming:

- 8 short-stroke keys with integrated LEDs
The LEDs allow for the display of different colors. The colors red, yellow, blue, green and white are displayable.
- 8 clamps, rear
The clamps are used as digital inputs or outputs to the connection of external sensors.
- Integrated light and button tests - after turning on the HMI device
- Communication via PROFINET
- SIMATIC design

Through this, the HMI devices can be arranged closely next to each other.

Expansion with external input/output devices

The functionality of the HMI device can be extended using input and output devices, for example lamps or key switches.

Performance features KP8F

The KP8F has the following additional performance features compared to the KP8:

- Fail-safe digital inputs for:
 - An EMERGENCY STOP button or alternatively
 - Two single-channel evaluations

1.7 Communication and enabled PLCs

Enabled PLCs

The HMI device has been enabled for use with the following type of PLC:

- SIMATIC S7-1200
- SIMATIC S7-400, SIMATIC S7-400F
- SIMATIC S7-300, SIMATIC S7-300F
- WinAC and Embedded Controllers

NOTICE
Safety-related communication
A non fail-safe control does not provide any safety-directed communication.
A SIMATIC S7F PLC is required for fail-safe communication.

Released protocols

The HMI device uses the following protocols for communication with the controller:

- PROFINET IO for standard communication
- PROFIsafe Mode V2.0 for the fail-safe communication of the KP8F

1.8 Operating KP8F in a fail-safe manner

Configuring software

For fail-safe operation of the HMI device, the following software is required:

- STEP 7 V5.5
- SIMATIC S7 Distributed Safety, as of V5.4

Fail-safe automation system

Fail-safe automation system (F systems) are used in plants requiring higher levels of safety.

F systems control production processes in such a way that residual error probability is taken into consideration to achieve a safe operating state when a shutdown occurs. An immediate shutdown therefore does not pose a danger to people or the environment.

Operating KP8F in a fail-safe manner

The KP8F device is a PROFINET IO device on Industrial Ethernet.

In fail-safe mode the HMI device registers the signal states of compatible emergency stop buttons and transmits corresponding safety frames to the controller. The controller and the HMI device communicate with each other using the fail-safe protocol, PROFIsafe.

The HMI device can operate in fail-safe mode corresponding to SIL3, Performance Level e and category 4 if the safety functions are appropriately configured in STEP 7 with the "S7 Distributed Safety" add-on package.

Fail-safe mode of the HMI devices differs from standard mode essentially in that during communication, the signals are checked for being error-free (error-safe). In the event of a fault, the HMI device is placed in a safe state.

The fail-safe connection fulfills the following requirements:

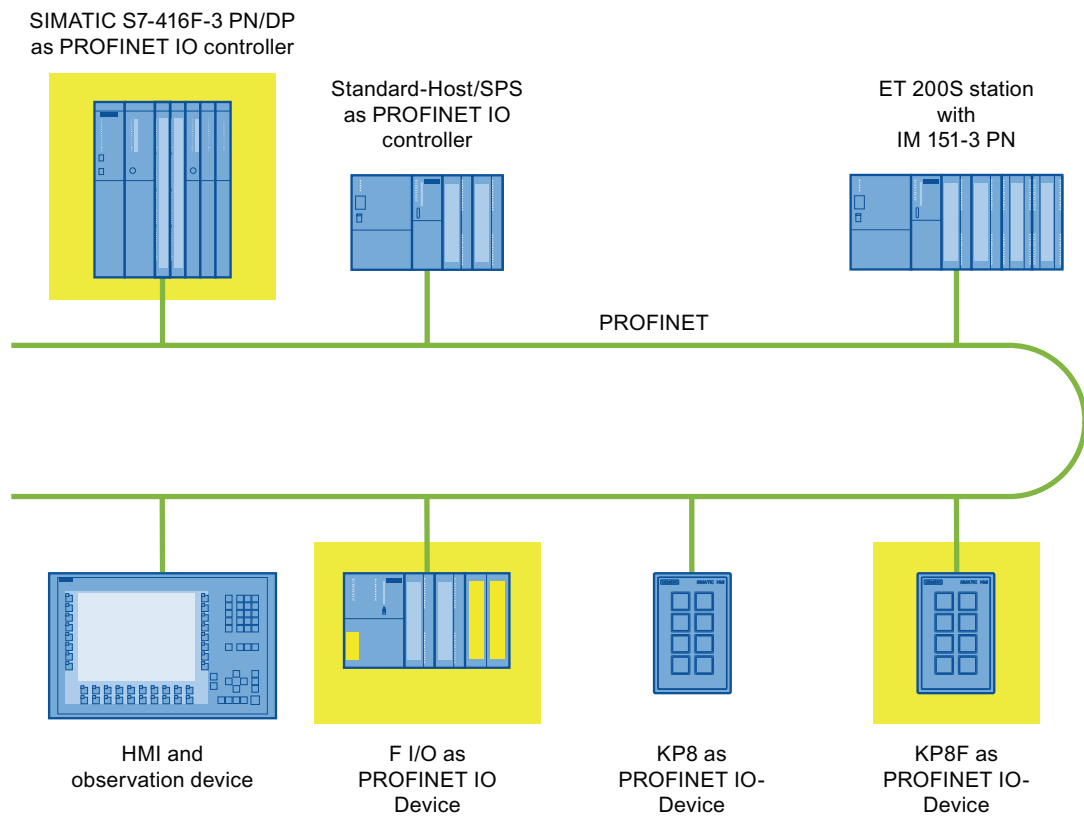
- Single-channel mode with 1oo1 parameterization
 - Safety category SIL2 corresponding to IEC 61508:2010
 - Safety category Performance Level d corresponding to IEC 13849:2006
 - Safety category category 3 corresponding to EN 954:1996
- Two-channel mode with 1oo2 parameterization
 - Safety category SIL3 corresponding to IEC 61508:2010
 - Safety category Performance Level e corresponding to IEC 13849:2006
 - Safety category category 4 corresponding to EN 954:1996

The HMI device can be operated simultaneously in standard mode and fail-safe mode.

Diagnostics function of KP8F

The fail-safe KP8F includes non-configurable diagnostic functions. The diagnostics functions are always active. The diagnostics result is automatically made available by the HMI device in STEP 7 and passed on to the fail-safe controller in the event of a fault.

Example configuration of a F-system with KP8F




The example shows the simultaneous operation of fail-safe and non fail-safe devices.

In the example, each PROFINET IO device communicates with just one PROFINET IO-controller. The PROFIsafe device communicates here exclusively with the F-PROFINET IO controller.

Safety instructions and approvals


2

2.1 Safety Instructions


 WARNING
Injury or material damage If you do not follow precisely the safety guidelines and manuals in this handbook, this may result in sources of danger and make safety functions ineffective. This can result in personal injuries or material damage. Follow the safety guidelines and instructions precisely.

Observe the safety and accident prevention instructions applicable to your application in addition to the safety instructions given in this manual.


Project security

 WARNING
Injury or material damage The configuration engineer for a system PLC must take precautions so that an interrupted program can be restarted normally after voltage dips or power failures. A dangerous operating state must not occur during the entire process of the control program, also during troubleshooting - also not in the short-run.

Safety during commissioning and operation

 WARNING
Installation according to the instructions Commissioning of the HMI device is forbidden until it has been absolutely ensured that the machine which is to be operated with the HMI device complies with Directive 2006/42/EC. Before commissioning, check to see if the regulations of the directive 2006/42/EC are fulfilled.
Open-type resource The HMI device is an open-type resource. This means that the HMI device may only be installed in cabinets that allow the device to be operated from the front side. Access to the control cabinet in which the HMI device is installed should only be possible by means of a key or tool and only for trained and authorized personnel.
Danger, high voltage Opening the cabinet will expose high voltage parts. Contact with these parts could be fatal. Switch off the power supply to the cabinet before opening it.

When operating the HMI device in hazardous areas the following warning applies.

 WARNING
Explosion Hazard Do not disconnect while circuit is live unless area is known to be non-hazardous. Substitution of components may impair suitability for Class I, Division 2 or Zone 2.

Safety during operation

Note

High frequency radiation, from mobile phones for example, can cause unintentional operating situations.

Recall

Note

If a safety case occurs for the KP8F, the customer of the KP8F will be immediately informed by the Siemens sales department they ordered from and told about suitable measures.

2.2 Approvals

Note

The following overview shows possible approvals for the HMI device.

The HMI device itself is certified as shown on the label on its rear panel.

CE mark



The HMI device meets the general and safety-related requirements of the following EU directives and conforms to the harmonized European standards for programmable logic controllers published in the official gazettes of the European Union:

- 2004/108/EC "Electromagnetic Compatibility" (EMC Directive)
- 2006/95/EC "Electrical Equipment Designed for Use within Certain Voltage Limits" (Low-voltage Directive)

EC Declaration of Conformity

The EC Declarations of Conformity are kept available for the responsible authorities at the following address:

Siemens AG
Industry Sector
I IA AS RD ST PLC
P.O. Box 1963
D-92209 Amberg, Germany

Explosion protection approval



For the HMI device

- EN 60079-0
- EN 60079-15
- EN 61241-0
- EN 61241-1

the following approvals are in place:

II 3 G	II 3 G Ex nA II T4
II 3 D	Ex tD A22 IP6X T xx °C
–	x ... Temperature values, see design examination certificate

The design examination certificate is available at the following Internet address:

Technical Support (<http://support.automation.siemens.com/WW/view/en/4000024>)

2.2 Approvals

FM approval



"Factory Mutual Research" approval in accordance with Approval Standard Class Number 3611, 3600, 3810

Approved for use in:

- Class I, Division 2, Group A, B, C, D Tx
- Class I, Zone 2, Group IIC Tx

UL approval



"Underwriters Laboratories Inc." approval in accordance with:

- UL 508 (Industrial Control Equipment)
- CSA C22.2 No. 142, (Process Control Equipment)

or



"Underwriters Laboratories Inc." approval in accordance with:

- UL 508 (Industrial Control Equipment)
- CSA C22.2 No. 142, (Process Control Equipment)
- UL 1604 (Hazardous Location)
- CSA-213 (Hazardous Location)

Approved for use in:

- Class I, Division 2, Group A, B, C, D or
- Class I, Zone 2, Group IIC or
- Non-hazardous locations

Approval for Australia



The HMI device fulfills the requirements of standard AS/NZS 2064 (Class A).

2.3 TÜV certificate

The HMI device is certified according to the following standards. The latest edition of the standard can be found in the report for the Technical Inspectorate Certificate.

Safety subject	Standard
Functional safety	IEC 61508:2010
	IEC 13849:2006
Basic safety	IEC 61131-2:2007
Machine Safety	EN 60204-1:2007
	NFPA 79:2007
	IEC 62061:2005
	IEC 61511:2003
	ISO 13850:2006

You can obtain a copy of certificates and reports from the Technical Inspectorate at the following address:

Siemens Aktiengesellschaft
 Industry Sector
 I IA AS RD ST
 P.O. Box 1963
 D-92209 Amberg

You can find the certificates from the Technical Inspectorate in the Internet at the following address:

"Technical Support (<http://support.automation.siemens.com/WW/view/en/4000024>)"

2.4 Notes about Usage

The HMI device is designed for industrial use, limit class A. The following standards are met:

- Requirements for emissions EN 61000-6-4:2007
- Requirements for interference immunity DIN EN 61000-6-2:2005

Note

The HMI device is not suitable for operation in residential areas: Operation of an HMI device in residential areas can have a negative impact on radio and TV reception.


If the HMI device is used in a residential area, you must take measures to achieve Limit Class B conforming to EN 55016 for RF interference.

Suitable measures to achieve Limit Class B for suppression of radio interference include:

- Installation of the HMI device in a grounded control cabinet
- Use of filters in electrical supply lines


Individual acceptance is required.

Operation in potentially explosive atmosphere, zone 2 and 22

 DANGER
<p>Degree of hazard</p> <p>There is an explosion hazard when operating an HMI device that does not have explosion protection.</p> <p>Operate the HMI device in potentially explosive zones 2 and 22 only if it has been approved and certified for such environments.</p>

If an HMI device is operated in potentially explosive atmospheres of zone 22, pay attention to the product information "Use in potentially explosive atmospheres of zones 2 and 22." The product information is available at the following Internet address:

Technical Support (<http://support.automation.siemens.com/WW/view/en/4000024>)

 WARNING
<p>Personal injury and damage to property</p> <p>Personal injury and property damage can occur in potentially explosive atmospheres if an electric connection is disconnected from the HMI device while the system is in operation.</p> <p>In potentially explosive atmospheres, always turn off power to the HMI device before disconnecting any electrical connections..</p>

Potentially explosive atmosphere zones 2 and 22

Areas subject to explosion hazard are divided into zones. The zones are differentiated according to the probability of the existence of an explosive atmosphere.

Zone	Degree of hazard	Example
2	Explosive gaseous atmosphere occurs only seldom and for a short period	Areas around flanged pipe joints with flat gaskets in closed rooms
22	Area in which a potentially explosive atmosphere in the form of a cloud in the air containing flammable dust does not usually occur or occurs only briefly during normal operation .	–
Safe zone	No	<ul style="list-style-type: none"> • Outside zone 2 • Outside zone 22 • Standard applications of distributed I/Os

Operating conditions for Zones 2 and 22

The following operating conditions apply for Zones 2 and 22:

- The HMI device must be installed in a control cabinet. The control cabinet must meet the following in accordance with EN 60529:
 - Protection type IP54 or higher for Zone 2
 - Protection type IP5x or higher for Zone 22 in case of **non** conductive dust
 - Protection type IP6x or higher for Zone 22 in case of conductive dust

You must install the HMI device so that you provide at least protection type IP54 or IP5x to EN 60529 on the front of the device. Consult the operating instructions of control cabinet and HMI device for this purpose.

Make allowances for the operating and ambient conditions under which you operate the HMI device. A manufacturer's declaration must be provided for the control cabinet in accordance with EC Directive 94/9, stating it is fit for purpose.

- The ambient temperature range is $0\text{ °C} \leq T \leq 50\text{ °C}$. Under these conditions, the HMI device will satisfy temperature class Tx for category 3G and support a maximum surface temperature of xx °C for category 3D. (x ... Temperature value, see design examination certificate).

Refer to the operating instructions for details of limitations resulting from the ambient temperature range.

- In situations where the temperature on the cable at the cable inlet of the control cabinet exceeds a temperature of 70 °C, or where the temperature on the wire branching point exceeds 80 °C under operating conditions, the temperature specifications of the cables must match the actually measured temperatures.
- Put measures in place to ensure the rated voltage is not exceeded.
 - Any transient interference voltages above the rated value must not exceed 40 %.
- Protect the HMI device from mechanical loads > 4 joule and the display from mechanical loads > 2 joule.
- Ensure that the atmosphere is not explosive during servicing.
 - Measures that impair or remove the protection type of the HMI device are not permitted while the system is in operation.
- If the HMI device was dismantled, check the mounting seal for damage before reassembling the HMI device. A damaged, porous or used mounting seal no longer meets the requirements of the protection type. In this case, the mounting seal must be replaced.
- Turn off the HMI device and the entire electrical installation in the control cabinet, if the film on the front of the HMI device or the glass of the display on the HMI device are damaged by a tear or hole or if the front film starts to peel off.

Replace the HMI device. Restart the system again after the device has been exchanged.

2.5 Electromagnetic compatibility

The HMI device fulfils, among other things, the requirements of the EMC laws pertaining to the European domestic market.

EMC-compliant installation of HMI devices

An EMC-compliant installation of the HMI device and the use of interference-proof cables form the basis of trouble-free operation. The following documentation applies to the mounting of the HMI device:

- Description "Directives for interference-free installation of PLCs" (<http://support.automation.siemens.com/WW/view/de/1064706>)
- The manual "PROFINET System Description"

Pulseshaped Interference

The following table shows the electromagnetic compatibility of modules compared to pulse-shaped interference. These specifications only apply when the HMI device meets the specifications and directives regarding electrical installation.

Pulse-shaped interference	Tested with	Corresponds to test intensity
Electrostatic discharge conforming to IEC 61000-4-2:2008	Air discharge: 8 kV Contact discharge: 6 kV	3
Bursts (high-speed transient interference) in accordance with IEC 61000-4-4:2004	2 kV power supply cable 2 kV signal cable, > 30 m 1 kV signal cable, < 30 m	3
High-power surge pulses in accordance with IEC 61000-4-5:2005, external protective circuit required (refer to manual S7-300 PLC, Installation, chapter "Lightning and overvoltage protection").		
Asymmetric coupling	2 kV power cable DC voltage with protective elements 2 kV signal/data cable, > 30 m, with protective elements as required	3
Symmetric coupling	1 kV power cable DC voltage with protective elements 1 kV signal cable, > 30 m, with protective elements as required	3

Sinusoidal interference

The table below shows the EMC properties of the modules with respect to sinusoidal interference. These specifications only apply when the HMI device meets the specifications and directives regarding electrical installation.

Sinusoidal interference	Test values	Corresponds to test intensity
HF radiation (in electromagnetic fields) in accordance with IEC 61000-4-3:2006	<ul style="list-style-type: none"> • 80% amplitude modulation at 1 kHz with 10 V/m in the range of 80 MHz to 1 GHz with 3 V/m in the range 1.4 GHz to 2 GHz with 1 V/m the range 2 GHz to 2.7 GHz • 10 V/m with 50 % pulse modulation at 900 MHz 10 V/m with 50 % pulse modulation at 1.89 GHz 	3
RF interference current on cables and cable shielding conforming to IEC 61000-4-6:2008	Test voltage 10 V at 80 % amplitude modulation of 1 kHz in the range from 9 kHz to 80 MHz	3

Emission of radio interference

The table below shows the emission values of electromagnetic interference conforming to 55011:2009, limit value class A, Group 1, measured at a distance of 10 m:

30 to 230 MHz	< 40 dB (V/m) quasi-peak
230 to 1000 MHz	< 47 dB (V/m) quasi-peak

Note

Before you connect the HMI device to the public power grid, ensure that it is compliant with Limit Class B in accordance with EN 55022:2006.

Planning the use

3.1 "Plan use" check list

Before deploying the HMI device, you should check that the planned application of the HMI device complies with the following test steps.

Test step	Information	Check
Check climatic and mechanical ambient conditions	Ambient conditions for storage and transport (Page 29)	
Set mounting position, installation location and mounting type of the HMI device	Mounting Positions and Type of Fixation (Page 32)	
Prepare installation cut-out	Preparing for Mounting (Page 34)	
Check insulation voltage, protection class and seal tightness	Insulation resistance, protection class and degree of protection (Page 36)	
Check compliance with the technical data		
Select sensors for fail-safe operation	Sensor for 1oo1 mode (Page 36)	

3.2 Ambient conditions for storage and transport

The shipping conditions of this HMI device exceed requirements in accordance with IEC 61131-2:2007. The following specifications apply to devices that are shipped and stored in the original packaging.

The climatic ambient conditions conform to the following standards:

- IEC 60721-3-3:1994, Class 3K7 for storage
- IEC 60721-3-2:1997, Class 2K4 for transportation

The mechanical ambient conditions are compliant with IEC 60721-3-2:1997, Class 2M2.

In the following table, the tests are contained that were checked on the HMI device in regards to the ambient conditions for transport and storage.

Test	Permitted range
Drop test, in transport package	≤ 1 m
Temperature	-40 to +70 °C
Air pressure acc. to IEC 60068-2-13:1983	1080 hPa to 660 hPa, corresponds to an elevation of -1000 to 3500 m
Switching frequency, max.	2 hPa, between front and rear
Humidity, relative	10% to 95 %, without condensation

3.3 Ambient conditions for operation

Test	Permitted range
Vibration, sinusoidal as per IEC 60068-2-6:2007 Test Fc	<ul style="list-style-type: none">• 5 to 8 Hz, 3.5 mm, 10 cycles per axis• 8 to 500 Hz, 9.8 m/s², 10 cycles per axis
Shock as per IEC 60068-2-27:2008 Test Ea	250 m/s ² , 6 ms, 1000 shocks

<p>NOTICE</p> <p>Equipment failure</p> <p>Moisture and condensation lead to malfunction. Moisture in the form of condensation on or in the device is formed:</p> <ul style="list-style-type: none">• When transporting a device at low temperatures• Under extreme temperature variations <p>Bring the device to room temperature before operating.</p> <p>Condensation</p> <p>When condensation is on the device, do not expose the HMI device to direct radiation from a heater.</p> <p>If condensation has developed, wait approximately 4 hours until the HMI device has dried completely before switching it on.</p>

The following points must be adhered to in order to ensure a fault-free and safe operation of the HMI device:

- Proper transportation and storage
- Proper installation and mounting
- Careful operation and maintenance

The warranty for the HMI device will be deemed void if these stipulations are not heeded.

3.3 Ambient conditions for operation

Mechanical and climatic ambient conditions

The HMI device is designed for use in a location protected from the effects of the weather. The ambient conditions meet the requirements for IEC 60721-3-3 Edition 2.2:2002:

- Mechanical requirements according to class 3M3
- Climatic requirements according to class 3K3

Use with additional protective measures

You may only use the HMI device at the following locations with additional protective measures:

- In locations with a high degree of ionizing radiation
- In locations with difficult operating conditions, for example due to:
 - Corrosive vapors, gases, oils or chemicals
 - Electrical or magnetic fields of high intensity
- In systems that require special monitoring, for example:
 - Elevators
 - Systems in especially hazardous rooms

Damping shock and vibration

If the HMI device is subjected to strong shocks or vibrations - as specified in the following table - you must take appropriate measures to reduce amplitudes or acceleration. In such situations, use vibration damping or vibration absorber systems for the HMI device and accessories.

Testing mechanical ambient conditions

In the following table contains tests that were checked on the HMI device in regards to the ambient conditions for operation.

Test	Physical variable	Value
Vibrations IEC 60068-2-6:2007 Test Fc	Vibration	1 octave/min 10 cycles per axis
	Frequency band	5 to 8.4 Hz: Deflection 3.5 mm
		8.4 to 150 Hz Vibration acceleration 9.8 m/s
Shock IEC 60068-2-27:2008 Test Ea	Shock form	Half sine
	Acceleration	150 ms ⁻²
	Duration	11 ms
	Number of shocks	3 per axis
Case DIN EN 60068-2-31:2009 Test Ec	Fall height	0.3 m, five times

Testing climatic ambient conditions

In the following table, contains the tests that were checked on the HMI device in regards to the climatic ambient conditions for operation.

Ambient condition	Permitted range	Comment
Operating temperature	See Mounting Positions and Type of Fixation (Page 32)	–
Humidity, relative IEC 61131-2:2007	< 95 %, No condensation	–
Humidity, absolute	1 to 25 g/m ³	–
Air pressure IEC 60068-2-13:1983	1080 to 795 hPa	Corresponds to an elevation of –1000 to 2000 m
Hazardous material concentration IEC 60721-3-3:1994	SO ₂ < 0.5 vpm, relative humidity < 60%, no condensation	Test: 10 cm ³ /m ³ ; 10 days
	H ₂ S < 0.1 vpm, relative humidity < 60%, no condensation	Test: 1 cm ³ /m ³ ; 10 days

3.4 Mounting Positions and Type of Fixation

Mounting position

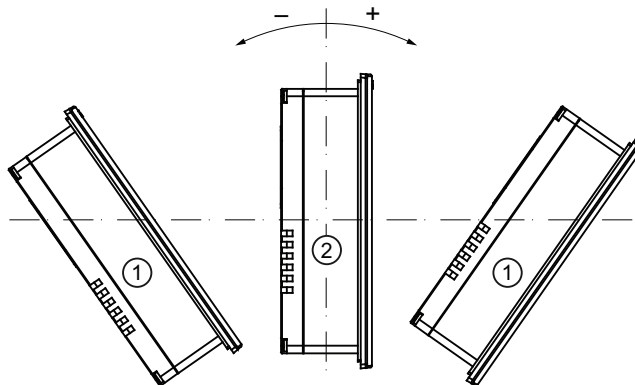
The HMI device is designed for mounting in:

- Racks
- Cabinets
- Control boards
- Consoles

In the following, all of these mounting options are referred to by the general term "cabinet".

The HMI device is self-ventilated and approved for vertical and inclined mounting in stationary cabinets.

The following mounting positions are permitted:



	Mounting position	Deviation from the vertical	operating temperature, permissible
①	Inclined	< 30°	0 to 45 °C
②	Vertical	0°	0 to 55 °C

CAUTION

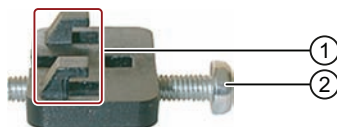
Impermissible ambient temperatures

Do not operate the HMI device without auxiliary ventilation. If the maximum permissible ambient temperature is exceeded, it may lead to damage. The approvals and warranties for the HMI device will become void!

If the maximum permissible ambient temperature is exceeded, only operate the HMI device with auxiliary ventilation.

Type of fixation

Mounting clamps are provided for mounting the device - see chapter "Accessory kit (Page 14)".



- ① Hooks
- ② Screws

The main dimensions of the HMI device are not exceeded by the installation of the mounting clamps.

3.5 Preparing for Mounting

Select the HMI device mounting location

Points to observe when selecting the mounting location:

- Position the HMI device so that it is not subjected to direct sunlight.
- Position the HMI device such that it is ergonomically accessible for the user.

Choose a suitable mounting height.

- Ensure that the air vents are not covered as a result of the mounting.
- Observe the permissible mounting positions for the HMI device.

Configuration of the mounting cut-out

In order to guarantee the protective type corresponding with chapter "Insulation resistance, protection class and degree of protection (Page 36)", the following must be complied with:

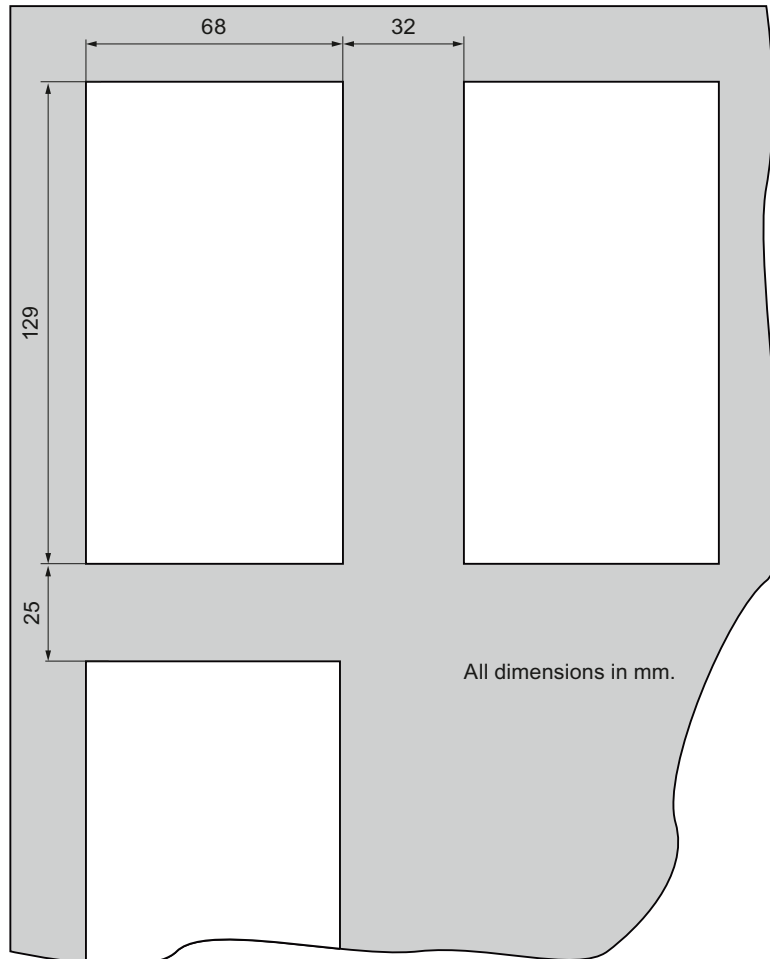
- The material at the mounting cut-out must be distortion-resistant.
- Thickness of material at the installation cut-out for protection class IP65: 2 mm up to 6 mm
- Permitted deviation from plane at the mounting cut-out: ≤ 0.5 mm

This condition must be fulfilled for the mounted HMI device.

- Permissible surface roughness in the area of the seal: ≤ 120 μm (R_z 120)

Dimensions of the mounting cut-out

Multiple HMI devices are installed directly next to or under each other. The following image shows the dimensions of the mounting cut-out and the required intervals.



Mounting Depth

The mounting depth for the HMI device depends on the type of construction of the PROFINET connector. With angled PROFINET connector, order number 6GK1901-1BB20-2AB0, the mounting depth is 65 mm.

The mounting depth does not match the external dimensions of the device. Plan for an adequate bending radius for the cables connected to the HMI device.

3.6 Insulation resistance, protection class and degree of protection

Insulation resistance of the HMI device

Proof of dielectric strength must be provided in the type test at a test voltage to IEC 61131-2:2007:

Circuits with a nominal voltage of U_n to other circuits or ground	Test voltage
< 50 V	500 VDC

Protection class of the HMI device



HMI device	Protection class according to IEC 60417-DB-HS:2008
Front and rear panel	Protection class III

Degree of protection of the HMI device

NOTICE
<p>Degree of protection IP65 for HMI device</p> <p>If the HMI device is not installed according to this manual, the HMI device does not comply with the specified protection type.</p> <p>Make sure the mounting is done properly.</p>

HMI device	Degree of protection IEC 60529:2000
Front	IP65
Rear	IP20

3.7 Requirements for fail-safe operation

3.7.1 Sensor for 1001 mode

The following safety categories can be achieved with the HMI device:

- SIL2 corresponding to IEC 61508:2010
- PL d corresponding to IEC 13849:2006
- Category 3 corresponding to EN 954:1996

Note

Have the fail-safe part of the system checked and accepted by a registered company in regards to the prescribed technical safety controls before commissioning the HMI device.

Sensor Requirements for Fail-Safe Sensors

NOTICE
Qualified sensor If you do not use any qualified, normed sensors, the safety categories SIL2, PL d and category 3 will not be reached. Only use qualified sensors corresponding with IEC 60947.

Note

Our electronics are equipped with such safety engineering features so that 98% of the maximum permissible probability of hazardous faults is due to all other components of the safety function. This corresponds to the recommended load division in safety engineering between sensing devices, actuating devices, and electronic switching for input, processing, and output.

The probability of hazardous faults and the rate of occurrence of hazardous faults of a safety function must comply with an upper limit determined by an SIL or PL. For a description of the HMI device, refer to chapter "Technical specifications (Page 84)".

Proof-test interval

Note the following:

- They have a considerable safety responsibility for the instrumentation with sensors.
- Sensors normally do not survive a proof-test interval of 10 years corresponding with IEC 61508.

The sensors clearly lose their safety.

Note

In order to reach the safety categories SIL2, PL d and category 3, high-quality sensors are required. The sensors used must fulfill the standards EN 60947-5-1:2004 and EN 60947-5-5:1997 (VDE 0660, section 200).

The contacts of the sensors must be weld-resistant in accordance with the standard IEC EN 60947-5. Ensure that the sensor connection is free of short-circuits.

Define an ideal proof-test interval for the used sensor.

Fault detection

Faults can be detected if the following connection errors are present:

- Short-circuit between two sensors
- Short-circuit to DC 24 V

Signal duration

In order to assure accurate detection of the sensor signal by the HMI device, you must ensure that the minimum duration for the sensor signal is adhered to. Refer to chapter "Technical specifications (Page 84)".

See also

Connect KP8F - fail-safe inputs (Page 46)

3.7.2 Sensor for 1oo2 mode

The following safety categories can be achieved with the HMI device:

- SIL3 corresponding to IEC 61508:2010
- PL e corresponding to IEC 13849:2006
- Category 4 corresponding to EN 954:1996

Note

Have the fail-safe part of the system checked and accepted by a registered company in regards to the prescribed technical safety controls before commissioning the HMI device.

Sensor Requirements for Fail-Safe Sensors

NOTICE
Qualified sensor If you do not use any qualified, normed sensors, the safety categories SIL3, PL e and category 4 will not be reached. Only use qualified sensors corresponding with IEC 60947.

Note

Our electronics are equipped with such safety engineering features so that 98% of the maximum permissible probability of hazardous faults is due to all other components of the safety function. This corresponds to the recommended load division in safety engineering between sensing devices, actuating devices, and electronic switching for input, processing, and output.

The probability of hazardous faults and the rate of occurrence of hazardous faults of a safety function must comply with an upper limit determined by an SIL or PL. For a description of the HMI device, refer to chapter "Technical specifications (Page 84)".

If you operate the HMI device with an EMERGENCY-STOP button, you must use a 2-channel equivalent sensor switching - see chapter "Connect KP8F - fail-safe inputs (Page 46)".

Proof-test interval

Note the following:

- They have a considerable safety responsibility for the instrumentation with sensors.
- Sensors normally do not survive a proof-test interval of 10 years corresponding with IEC 61508.

The sensors clearly lose their safety.

Note

In order to reach the safety categories SIL3, PL e and category 4, high-quality sensors are required. The sensors used must fulfill the standards IEC EN 60947-5-1:2004 and IEC EN 60947-5-5:1997 (VDE 0660, section 200).


The contacts of the sensors must be weld-resistant in accordance with the standard IEC EN 60947-5. Ensure the short-circuit-free connection of the emergency-stop button.

Define an ideal proof-test interval for the used sensor.

Fault detection

Faults can be detected if the following connection errors are present:

- When non-equivalent sensor signals are connected.
- When a single-channel sensor has a redundant connection.

 WARNING
No redundant connection of two single-channel break contacts
If sensor signals are connected redundantly (break contacts), a fault will only be recognized if one of the sensors is triggered.
Ascertain that under no circumstances are two single-channel break contacts redundantly connected as sensor signals.

Signal duration

In order to assure accurate detection of the sensor signal by the HMI device, you must ensure that the minimum duration for the sensor signal is adhered to. Refer to chapter "Technical specifications (Page 84)". The minimum duration is ensured by the usage of push-to-lock emergency stop buttons.

3.7.3 Cables

The cables used must meet the following requirements:

- The unique assignment of terminals to sensors must be ensured.
- Cables laid outside of the switching cabinet must be laid separately in accordance with the relevant standards.

Use stable pipes or cable channels in order to avoid short circuits and cross-circuits.

Note

With the connection of an emergency stop button to the fail-safe channels of the HMI device, the line lengths corresponding with chapter "Technical specifications (Page 84)" must be complied with.

Mount and connect KP8 and KP8F

4.1 "Mounting and connection of HMI device" checklist

The following steps must be taken when mounting and connecting the HMI device.

Test step	Check
Check the scope of delivery (Page 41)	
Mounting the HMI device (Page 41)	
Connecting the power supply (Page 44)	
Connect standard inputs/outputs (Page 45)	
Connect KP8F - fail-safe inputs (Page 46)	
Connecting the PLC (Page 48)	
Switching on and testing the HMI device (Page 50)	

4.2 Check the scope of delivery

Check the scope of delivery for completeness and visible signs of transport damage.

NOTICE
<p>Do not use damaged parts</p> <p>If you use defective parts from the items delivered, you may experience malfunctions.</p> <p>If you find defective parts in the item delivered, contact your Siemens partner. Only install undamaged parts.</p>

4.3 Mounting the HMI device

Requirement

- Four mounting clamps.
The mounting clamps are included in the accessory kit.
- The HMI device comes equipped with a mounting seal.
If the mounting seal is damaged, do not mount the HMI device.

4.4 Connecting the HMI device

Procedure

Note

Always mount the HMI device according to the operating instructions in this manual.
When mounting the HMI device, ensure that the labeling strips do not become jammed between the mounting cut-out and the HMI device.

1. Insert the HMI device into the mounting cut-out.
2. Insert a mounting clamp into a recess of the HMI device.
3. Fasten each mounting clamp by tightening its screws.
The permitted torque is 0.15 Nm.
4. Repeat step 2 and 3 for all mounting clamps until all required clamps are tightened.

4.4 Connecting the HMI device

4.4.1 Connection sequences and lines

Requirement

- The HMI device must be mounted according to the specifications of these operating instructions.
- Shielded standard cables
For additional information, refer to the Internet at:
Industry Mall (<http://mall.automation.siemens.com>)

Connection sequence

Note

Failure to do so may result in damage to the HMI device.

Connect the HMI device in the following sequence:

1. Power supply
2. Controller

Proceed in a reverse direction when disconnecting the connections.

Connecting the cables

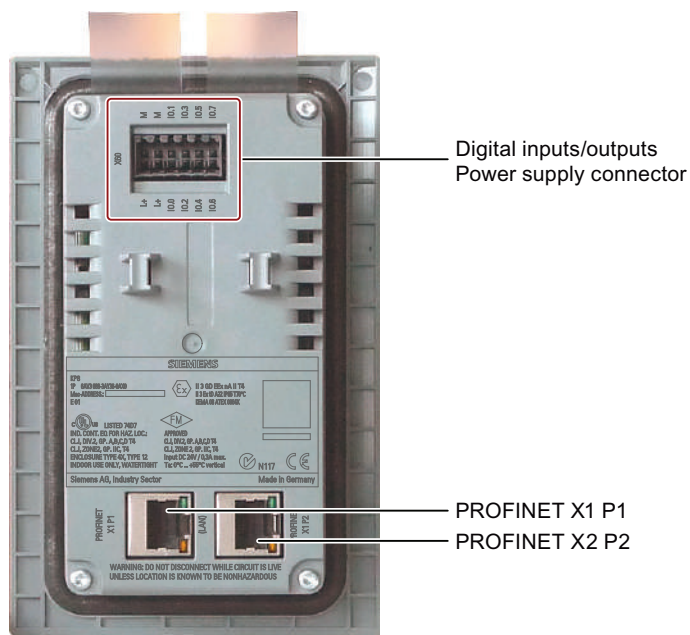
Pay attention to the following when connecting the lines:

- Do not bend contact pins
- The connector is coded to prevent faulty insertion

The setting of the interfaces is described in Chapter "Technical specifications (Page 83)".

4.4.2 Ports

The following figure below shows the interfaces of the KP8:

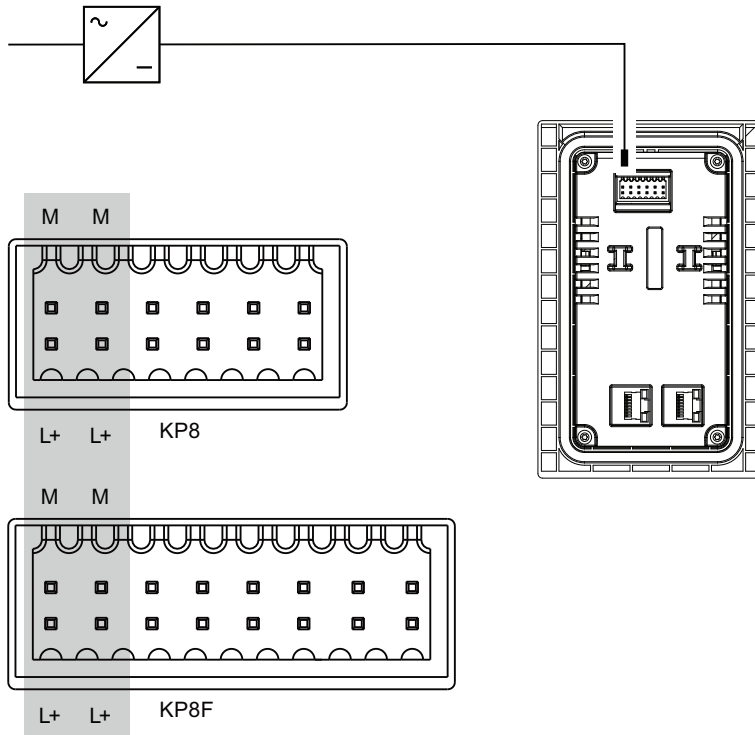


In contrast to the KP8, the KP8F has a 16-pin socket for the digital input/output and for connection to the power supply. For a description of the interfaces, refer to chapter "Interface description (Page 89)".

4.4.3 Connecting the power supply

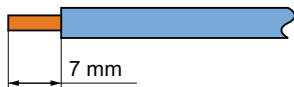
Configuration diagram

The figure below illustrates the connection between the power supply and the HMI device.



Connecting the connector

The plug-in connector for connecting the power supply is contained in the accessory kit and is designed for cables with a maximum cross-section of 1 mm². Note the following diagram when stripping the wire.



If you are using a stranded lead, use wire-end ferrules.

NOTICE
Damage possible
Do not connect the lines if the connector is in the HMI device. You may otherwise damage the mounting of the HMI device socket.
Always remove the connector to connect the wires.

To open the connectors, press in the opening provided with a screwdriver for slotted screws. Slide the cable into the connector enclosure and remove the screwdriver. The wire is fixed.

Do not confuse the wires. Refer to the label for the contact pins on the rear of the HMI device.

Note

The HMI device is equipped with a polarity reversal protection circuit.

Connecting the power supply

CAUTION

For the 24 VDC supply, use only power supply units with safety isolation complying with IEC 364-4-41 or HD 384.04.41 (VDE 0100, Part 410), for example according to the standards, SELV (Safety Extra Low Voltage) and PELV (Protective Extra Low Voltage).

The supply voltage must be within the specified voltage range. Any other voltage might lead to failure of the HMI device.

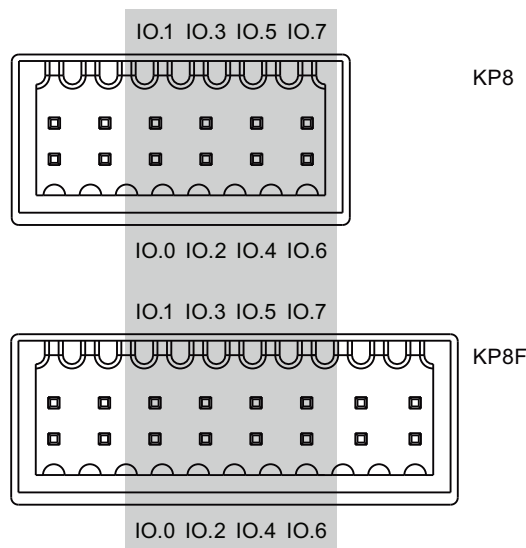
Applies to floating system design:

Connect the connection for GND 24 V from the 24 V power supply output to equipotential bonding for uniform reference potential. For this purpose, choose a connecting point that is as close as possible to the center.

4.4.4 Connect standard inputs/outputs

On the back of the HMI device you will find 8 digital inputs/outputs for **non** fail-safe input and output devices. Non-fail-safe inputs/outputs are shown in gray in the following illustration.

Unconnected inputs/outputs are automatically set to "0".



Procedure

Note

Follow the notes about connectors in chapter "Connecting the power supply (Page 44)".

1. Connect the wires on the connector corresponding with the setting of the socket on the rear of the HMI device.

4.4.5 Connect KP8F - fail-safe inputs

The KP8F is intended for the use of an emergency stop button and fail-safe sensor. Please observe the information in Section "Sensor for 1oo1 mode (Page 36)" and "Sensor for 1oo2 mode (Page 38)".

Note

For supplying the fail-safe inputs, only inputs labeled with VS may be used on the HMI device.

Only connect fail-safe inputs if these are also used. This also applies for disabled fail-safe inputs.

Follow the notes about connectors in chapter "Connecting the power supply (Page 44)".

Requirement - EMERGENCY STOP connection

- Connectors from the accessory kit
- EMERGENCY-STOP button

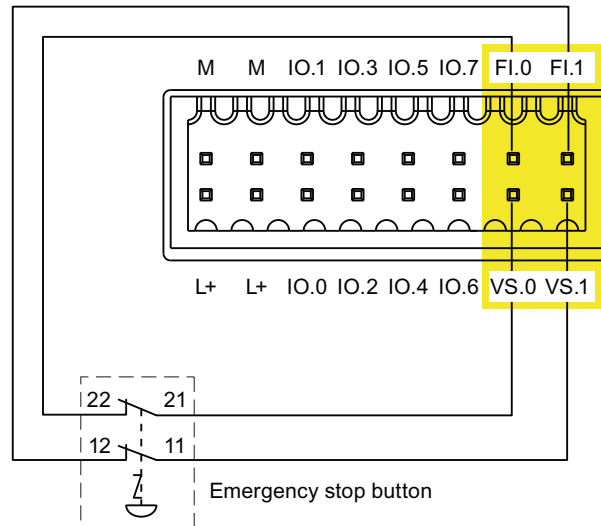
Note

If, in STEP 7 HW Config, you selected the option "No evaluation" for the KP8F in the "Evaluation of the sensor" parameter and no sensor is connected, the value 0 will be reported to the controller for the sensor values in the process illustration.

See section "Setting KP8F - STEP 7 (Page 64)" and "Bit assignment in the process image (Page 91)".

Procedure

1. Connect the EMERGENCY-STOP button as follows to the connector for the fail-safe digital inputs:
 - Sensor supply VS.0 for the FI.0 input
 - Sensor supply VS.1 for the FI.1 input



The EMERGENCY-STOP button must be connected as an equivalent break contact. Observe the affiliated setting for "Evaluation of the sensor" in the HW config - see chapter "Setting KP8F - STEP 7 (Page 64)".

Note

External power supply is not permissible for VS.0 and VS.1.

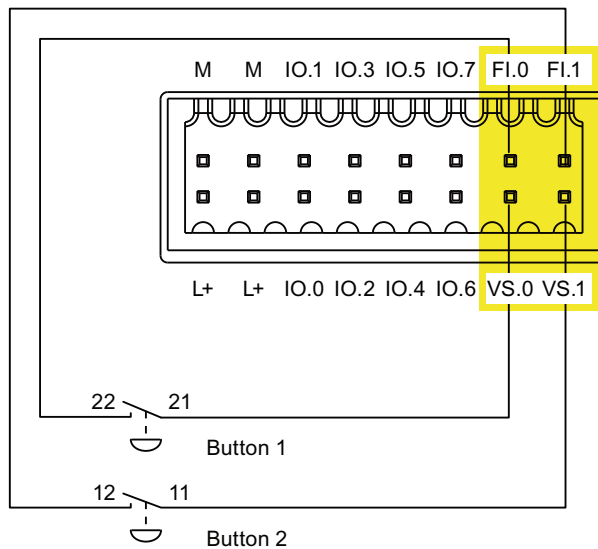
Requirement - sensor connection

- Connectors from the accessory kit
- Button as contact break or closer

Procedure

The following approach is an example.

1. Connect the button as follows to the connector for the fail-safe digital inputs:
 - Sensor supply VS.0 for the FI.0 input
 - Sensor supply VS.1 for the FI.1 input



Observe the affiliated setting for "Evaluation of the sensor" in the HW config - see chapter "Setting KP8F - STEP 7 (Page 64)".

Note

External power supply is not permissible for VS.0 and VS.1.

4.4.6 Connecting the PLC

The connection between the HMI device and controller depends on the topology of the PROFINET network.

- Line
All the communication nodes are connected in series as a bus. The series structure is implemented with switches that are integrated in the PROFINET devices.
- Star
The communication nodes are connected with a switch, from the Scalance X208 or X204 series for example.

You can find additional information on the topology of PROFINET networks in the system manual, "PROFINET System Description".

Note

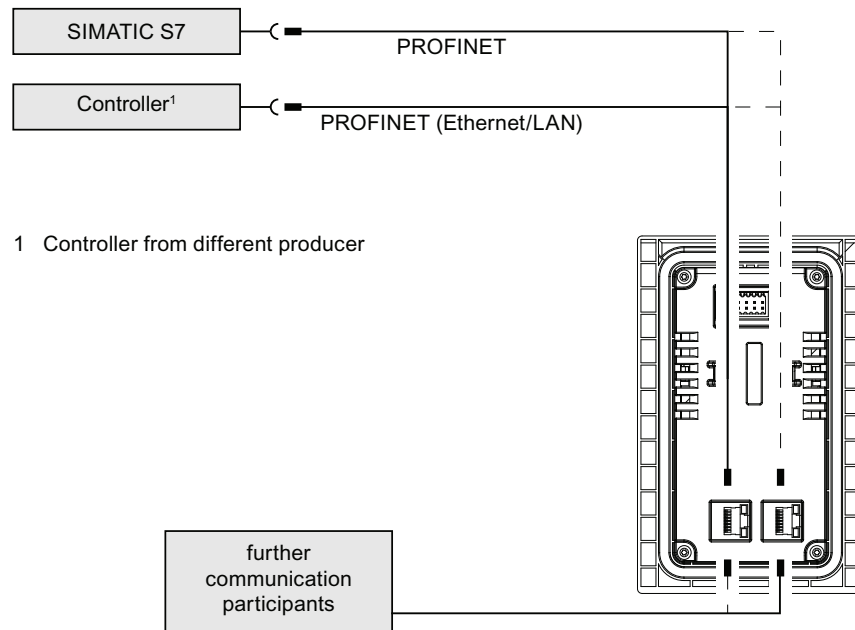
Always use only the approved cables to connect a SIMATIC S7 controller.

Standard cables are available for the connection. You will find more information in the SIMATIC NET-catalog IK PI or on the Internet at:

Industry Mall (<http://mall.automation.siemens.com>)

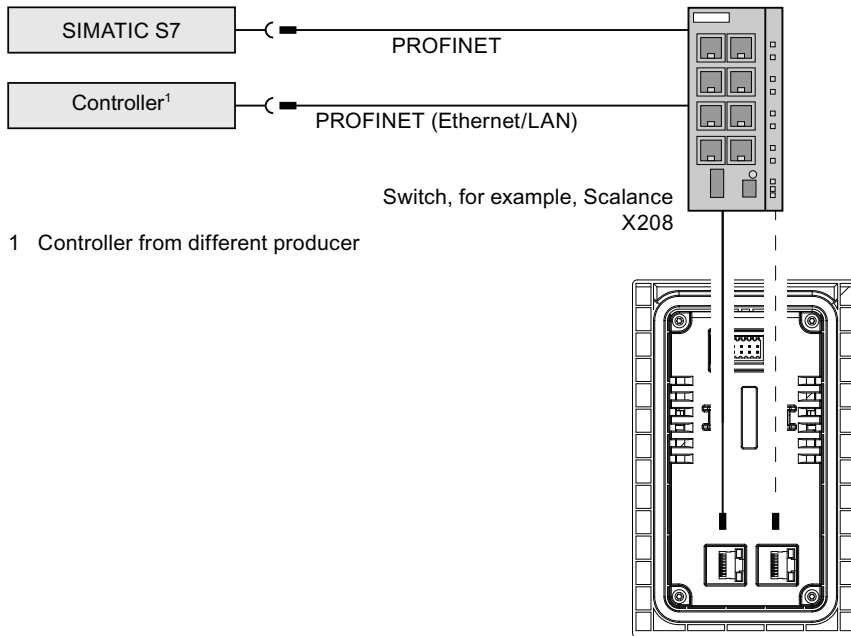
Configuration diagram for serial configuration

The figure below illustrates the connection between the HMI device and the controller with a serial configuration.



Configuration diagram for star configuration

The following figure shows the connection between the HMI device and the controller with a star configuration.



1 Controller from different producer

4.5 Switching on and testing the HMI device

Note

If the KP8F is operated with an EMERGENCY STOP button, check during the fail-safe operation of the KP8F before each commissioning to see if the required parameters are set in the HW config. Refer to chapter "Setting KP8F - STEP 7 (Page 64)".

Procedure

1. Connect the connector on the HMI device.
2. Switch on the power supply.

After starting the HMI device, all LEDs will illuminate corresponding to the setting. The default illumination time is 5 s.

Note

As long as the light test is executed, no keyboard entry will be transferred to the connected controller.

If the HMI device does not start, it is possible the wires on the connector have been crossed. Check the connected wires and change the connections if necessary.

3. Press each light button after one another.
The LED goes off after pressing light button.
4. Applies for the KP8F:
After connecting the EMERGENCY-STOP button or the buttons, execute a function test.
5. Execute a function test after connecting a sensor.

Switching off the HMI device

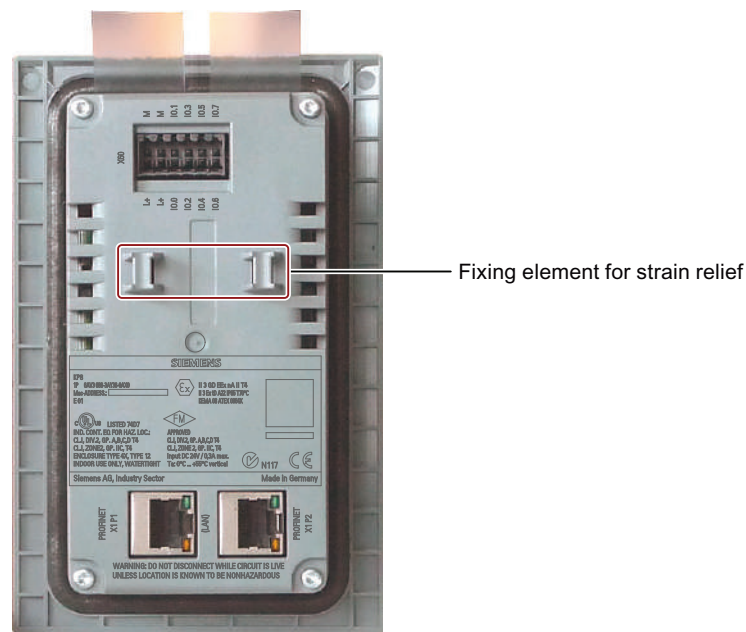
You have the following options for switching off the HMI device:

- Switch off the power supply.

In fail-safe mode of the PROFIsafe device, the system goes to a fail-safe state .

4.6 Securing the cables

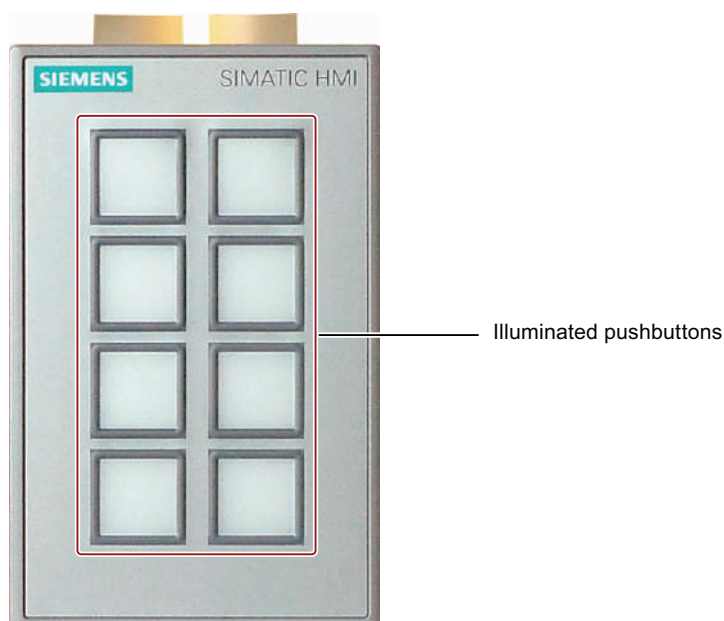
After the power-on test, use cable ties to secure the connected cables to the marked fixing elements to ensure strain relief.



Operator controls and displays

5.1 Front-sided control elements and displays

Controls



Display elements

There are 8 light buttons on the front of the HMI device. The corresponding bit in the controller is set as long as the key is pressed.

Surface LEDs are integrated in each key. They can be used to represent bit states of the connected controller. The LEDs can be displayed in red, green, yellow, blue and white.

The brightness of the LEDs can be set - see chapter "Setting controller - communication HMI device (Page 58)". The default setting is "normal".

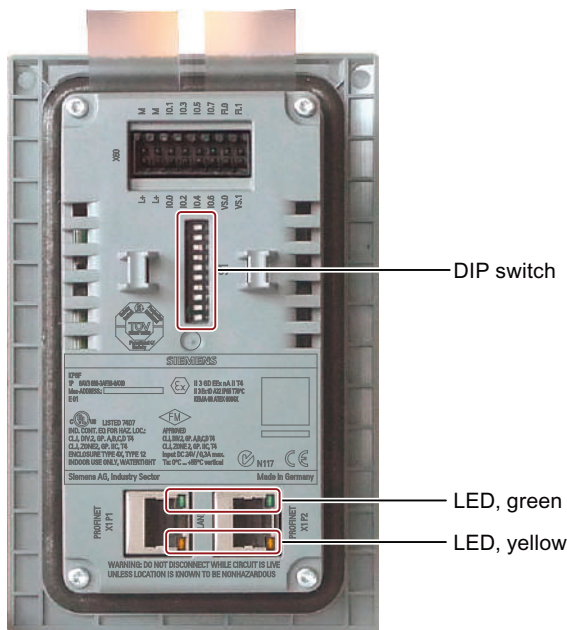
The following figure shows the numbering of the LEDs:



Utilization of the buttons occurs via the process image. Refer to chapter "Bit assignment in the process image (Page 91)".

5.2 Rear operator controls and displays

On the rear of the KP8 and the KP8F, you will find the following operator elements and displays. The DIP switch is only available on the KP8F.



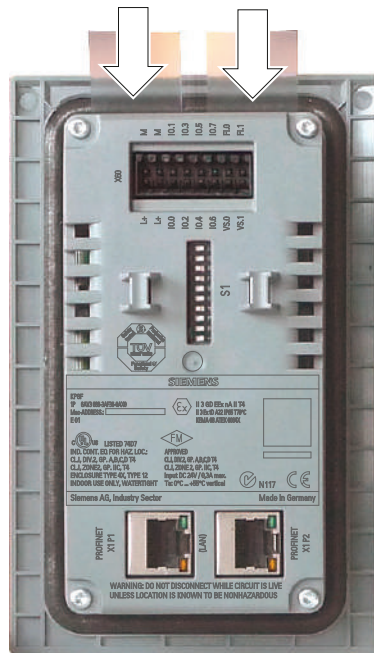
PROFINET interfaces

There are two LEDs on each PROFINET interface. These LEDs display the status of the PROFINET communication. The following table shows the meaning:

Green LED LINK	Yellow LED RX/TX	Meaning
OFF	OFF	No PROFINET connection
On	OFF	PROFINET communication possible
On	On	PROFINET communication runs

5.3 Labeling keys

You can label the keys as required for your project. Use the labeling strips for this purpose.



When installed, the labeling strips can be inserted if the mounting has a material thickness of < 3.5 mm. With larger material thicknesses, the disassembly of the HMI device is required if a labeling strip should be changed.

Note

Do not write on the keyboard to label the function keys.

Printing labeling strips

A template for the labeling strips is available as a Word file online under:

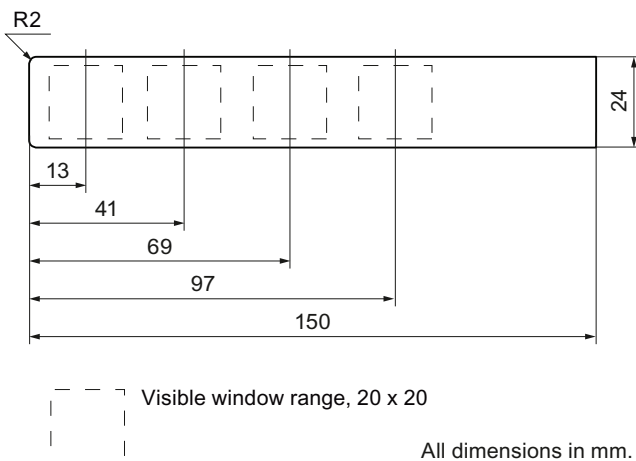
5.3 Labeling keys

"Technical Support

(<http://support.automation.siemens.com/WW/llisapi.dll?aktprim=99&lang=en&referer=%2fWW%2f&func=cslib.csinfo2&siteid=csius&extranet=standard&viewreg=WW>)"

Observe the information in this file.

The labeling strips have the following dimensions:



Procedure

1. Edit the template.
2. Print the template.

You can use printable labels and paper. Always ensure an adequate material stiffness during the selection. This is needed to insert the labeling strips. The maximum permitted thickness of the labeling strip is 0.15 mm.

Alternatively, you can also label the strips by hand.

Note

Wait for the printed labeling strips to dry before you insert them.

3. If you print the labeling strips on foil or paper, cut out the labeling strips.
Ensure that the corners are cut according to the corresponding diagram, as this makes it easier to slide them into the slot.
4. Remove any previously existing labeling strips.
5. Slide the new labeling strips into the guide up to the stop.
The labeling strip will protrude approximately 1 cm out of the guide. The template dimensions for the labeling strips are designed so that the labeling is correctly placed for the keys. An interlock is not required for the labeling strips.

Setting the KP8 and KP8F

6.1 "Setting the KP8 and KP8F" checklist

In order to operate the HMI device in a fail-safe manner, the set-up steps in STEP 7 and on the HMI device are required. Information, such as how to set the F-I/O in STEP 7, can be found in the Programming and operation manual "S7 Distributed Safety - Configuring and Programming" (<http://support.automation.siemens.com/WW/view/en/22099875>) and in the "Safety Technology in SIMATIC S7" system manual (<http://support.automation.siemens.com/WW/view/en/12490443>).

Test step	Information	Check
Setting slot 0 and 1	Setting controller - communication HMI device (Page 58)	
Setting slot 2 of the KP8F	Setting controller - communication HMI device (Page 58) Setting KP8F - STEP 7 (Page 64)	
Set PROFIsafe target addresses	Setting PROFIsafe address for KP8F (Page 67)	

6.2 Integrating GSD in STEP 7

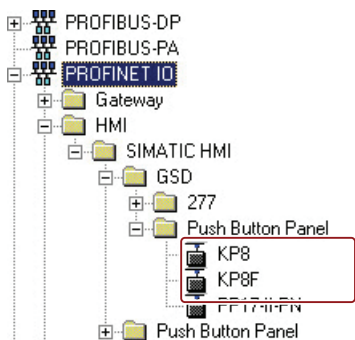
If the HMI device is not listed in the hardware catalog of HW Config, you need to integrate a valid GSD (device database) file for the HMI device in the STEP 7 database.

Requirement

- The GSD is installed.
Information on installing the GSD can be found online at:
Integrating a GSD File (<http://support.automation.siemens.com/WW/view/en/22817133>)
- STEP 7 applications, for example, the KOP/AWL/FUP editor or the icon table, are closed.
- HW Config opens.

Display catalog structure

KP8 and KP8F are displayed in the catalog structure of the HW config, "GSD" folder - see red labeling in the following image.



6.3 Setting controller - communication HMI device

HW Config of the STEP 7 project has to be configured and set to enable communication between HMI device and controller.

Note

The KP8F can only be configured with a – non fail-safe – standard controller if this standard controller supports Shared Device.

Set parameters for the slots as follows:

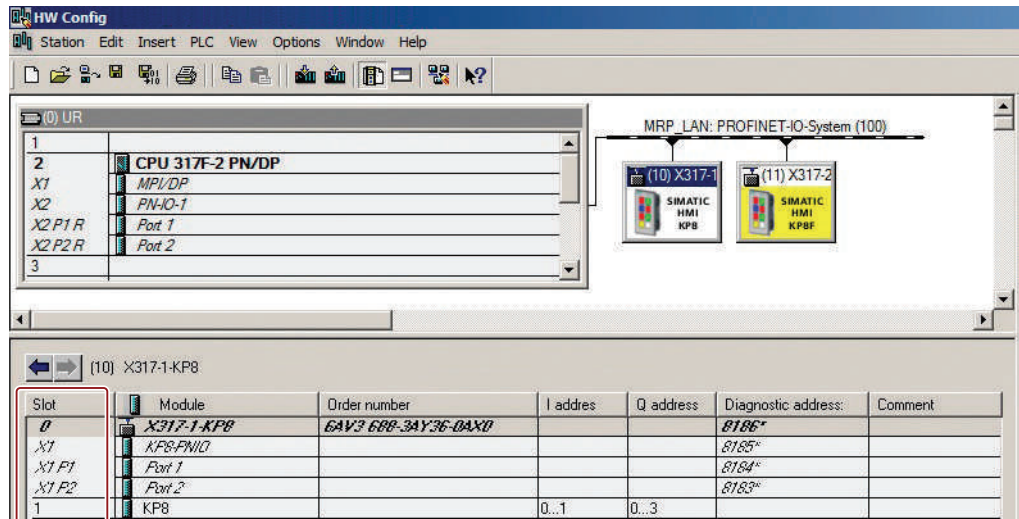
- For the KP8:
 - Slot 0
 - Slot 1
- For the KP8F:
 - Slot 0
 - Slot 1
 - Slot 2

The fail-safe mode is set with slot 2.

The setting of slots 0 and 1 is the same for the KP8 and KP8F.

Requirement

- The SIMATIC Manager opens in "HW Config".
In the following image, the slots that must be set are labeled in red.



The setting described in the following uses KP8 as an example and applies similarly for the KP8F.

Procedure – Setting slot 0

- Double click in the station window on the module.
The "Properties – [Name]" dialog box opens.
- Select the "General" tab.

Parameter	Meaning
Device name	The IO controller addresses the IO device by its device name. The device name must be unique within the network. The device name is connected with the IP-address, which is set for the HMI device.
Device number	You can identify an IO device in the user program with its device number. STEP 7 assigns the device number.

- Change the entries, if required.
- Click "OK".
The entries are saved. The dialog box closes.

You can find additional information about device names and numbers in the manual "PROFINET System Description".

Procedure – Setting slot 1

1. Double click in the properties window on slot 1.
The "Properties – KP8 inputs/outputs" dialog box opens.

2. Open the "Addresses" tab.

In the "Inputs" and "Outputs" groups, the start values of the address areas are set depending on the controller used.

Parameter	Meaning
Inputs > Start	Start of address range in which the PROFIsafe inputs/outputs for the fail-safe HMI device are mapped.
Inputs > Process Image	Process image to which the address range belongs. This parameter cannot be set with controllers of the SIMATIC CPU 300 type.
Outputs > Start	Start of address range in which the PROFIsafe inputs/outputs for the fail-safe HMI device are mapped.
Outputs > Process Image	Process image to which the address range belongs. This parameter cannot be set with controllers of the SIMATIC CPU 300 type.

3. Change the entries, if required.
4. Select the "Parameters" tab.
5. Open the "Parameters > Device-specific parameters" folder.

Parameter	Meaning
Duration of the light test	The value range from 0 to 60 s can be set. With the value "0", no light test is executed. Default setting is 5 s.
Brightness	Adjustable: very bright, bright, normal, dark or very dark Default setting is "normal".
Function of the clamp 0	Adjustable: Input or output, default setting is input
Function of the clamp 1	Adjustable: Input or output, default setting is input
Function of the clamp 2	Adjustable: Input or output, default setting is input
Function of the clamp 3	Adjustable: Input or output, default setting is input
Function of the clamp 4	Adjustable: Input or output, default setting is output
Function of the clamp 5	Adjustable: Input or output, default setting is output
Function of the clamp 6	Adjustable: Input or output, default setting is output
Function of the clamp 7	Adjustable: Input or output, default setting is output

6. Change the entries, if required.
 7. Click "OK".
- The entries are saved. The dialog box closes.

Result

The HMI device will now respond in operation according to the new setting. The switch states of the digital inputs/outputs of the HMI device are stored in the specified address area of the controller.

6.4 Configuring Media Redundancy Protocol

KP8 and KP8F are designed for MRP.

MRP allows compensation for individual failures in a simple ring topology. Meshed topology is not supported, MRP is deterministic.

MRP is based on a ring topology and guarantees recovery times between 200 ms and 500 ms. MRP uses a redundancy manager that closes the ring. In normal mode, the redundancy manager checks the continuity of the ring through test packets.

NOTICE

Response time

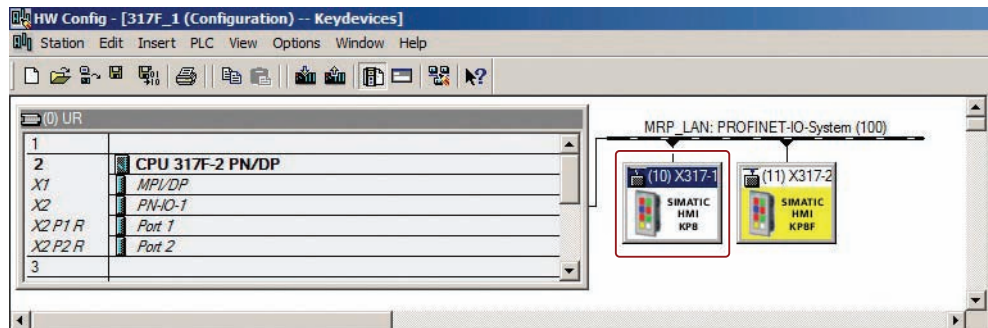
If the response monitoring time is less than the response time of the MRP, then MRP will not work with the KP8F. The controller will see the HMI device as "failed" in the short-term.

The response monitoring time must be greater than the response time of the MRP. Refer to chapter "Response times of the PROFIsafe devices (Page 78)".

Requirement

- "HW Config" is open in the SIMATIC Manager.

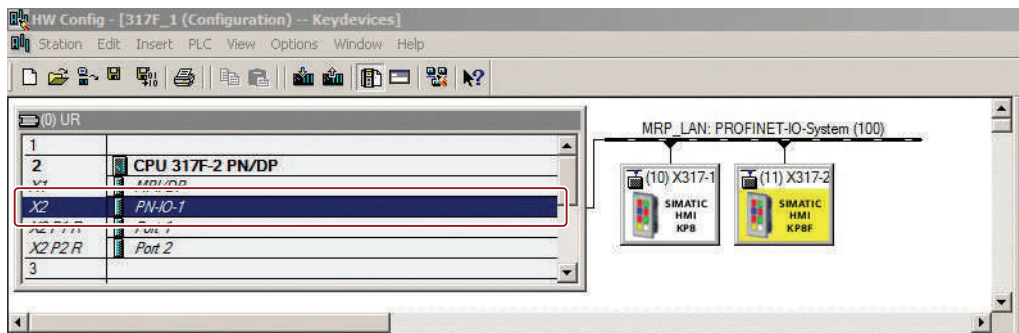
In the following image, the module to be configured is labeled in red.



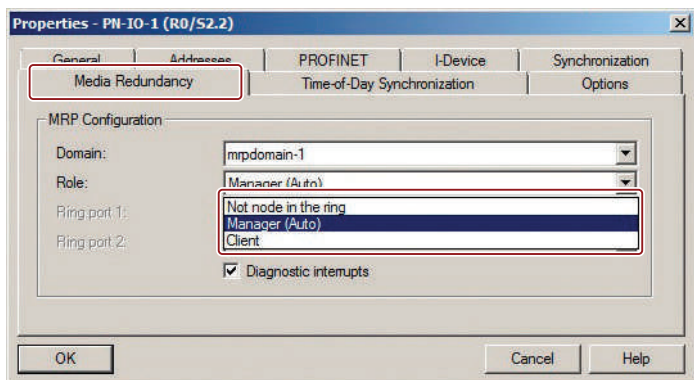
The following procedure is an example and also applies for the KP8F.

Procedure

1. Double-click the "X2" slot in the station window.



The following dialog appears.



2. Select the "Media Redundancy" tab.

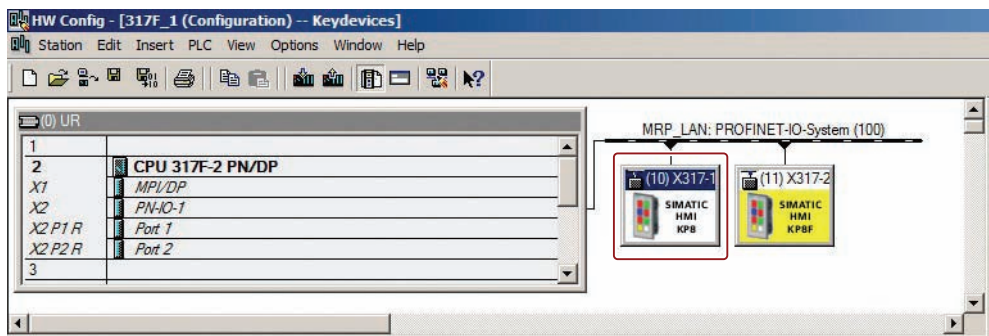
The "X317-2" controller can perform three different roles in MRP.

Parameter	Meaning
Not in the ring	The "X317-2" controller is not a node of the MRP
Manager (Auto)	The "X317-2" controller is the Manager of the MRP
Client	The "X317-2" controller is the Client of the MRP

3. Select "Manager (Auto)".
4. Click "OK".

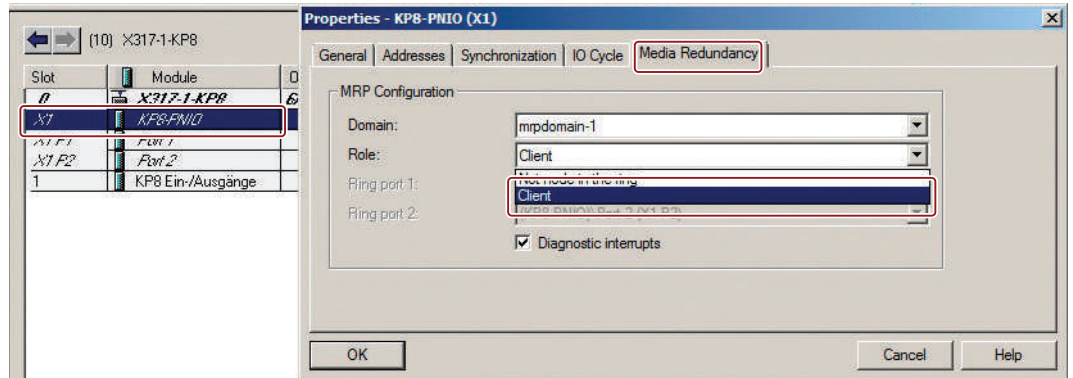
The entry is saved. The dialog box closes.

5. Select KP8 again in the station window.



- Double-click the "X1" slot in the station window.

The following dialog appears.



- Select the "Media Redundancy" tab.
- Select the marked entry from the "Role" list box.

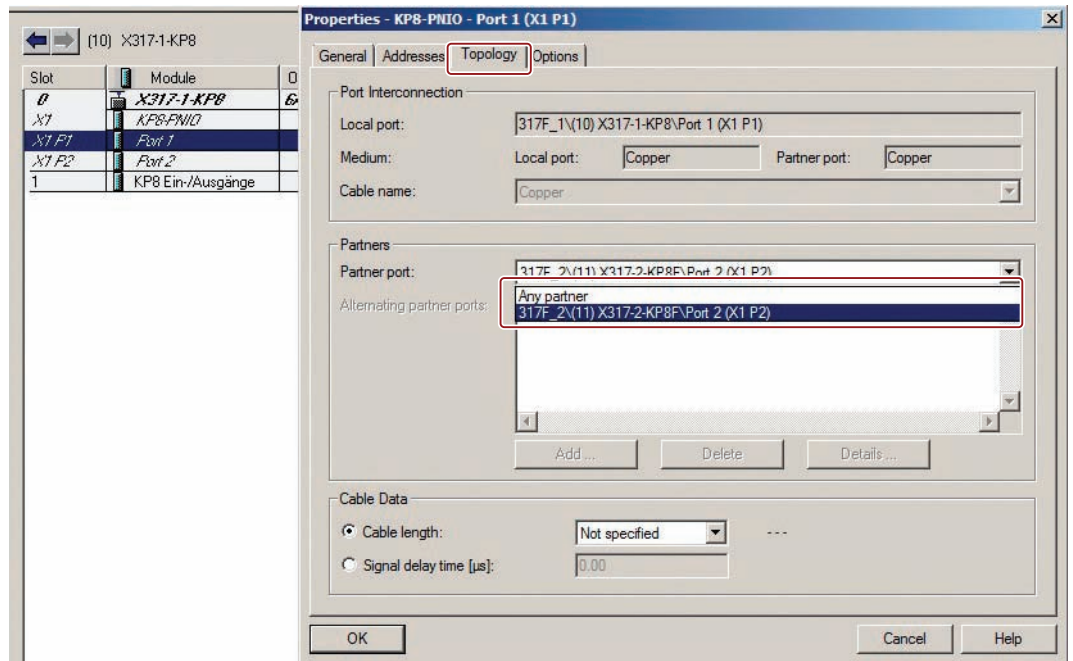
Parameter	Meaning
Not not in the ring	The KP8 is not a node of the MRP
Client	The KP8 is a client of the MRP

- Select "Client".
- Click "OK".

The entry is saved. The dialog box closes.

- Double-click the "X1 P1" slot in the station window.

The following dialog appears. The partner port entries are examples.



12. Select the required partner port from the "Partner port" list box.

The selected partner is therefore defined as the next partner of the MRP. If you select "Any partner", MRP will not work. A message is displayed.

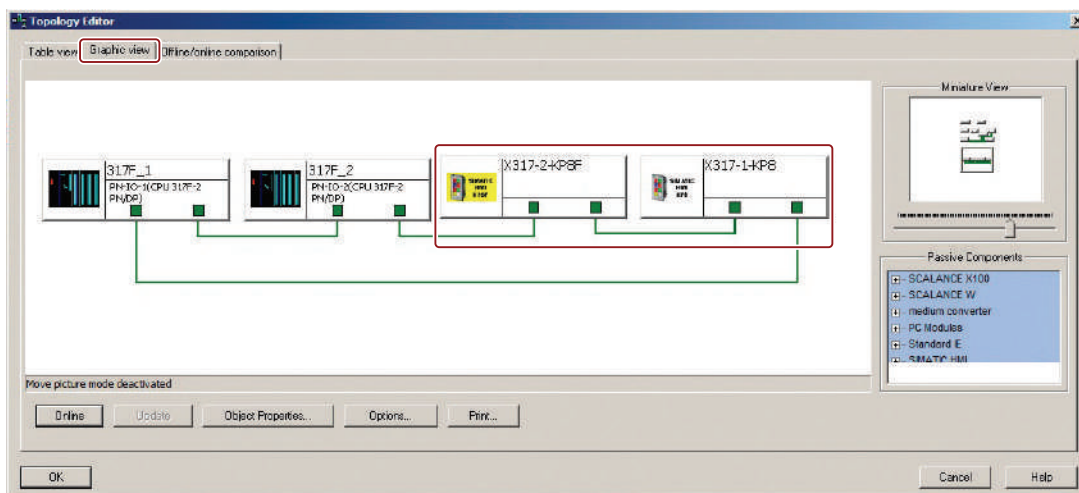
Parameter	Meaning
Any partner	Any device is partner of the MRP
317F_2\11) X317-2-KP8F	The device 317F_2\11) X317-2-KP8F\Port 2 (X1 P2) is the next partner of the MRP

13. Click "OK".

The entry is saved. The dialog box closes.

Result

The KP8 is configured for the MRP. This is illustrated by the following topology view with the Master CPU "KP8" and three Clients in a ring structure. The KP8F is a client in this case.



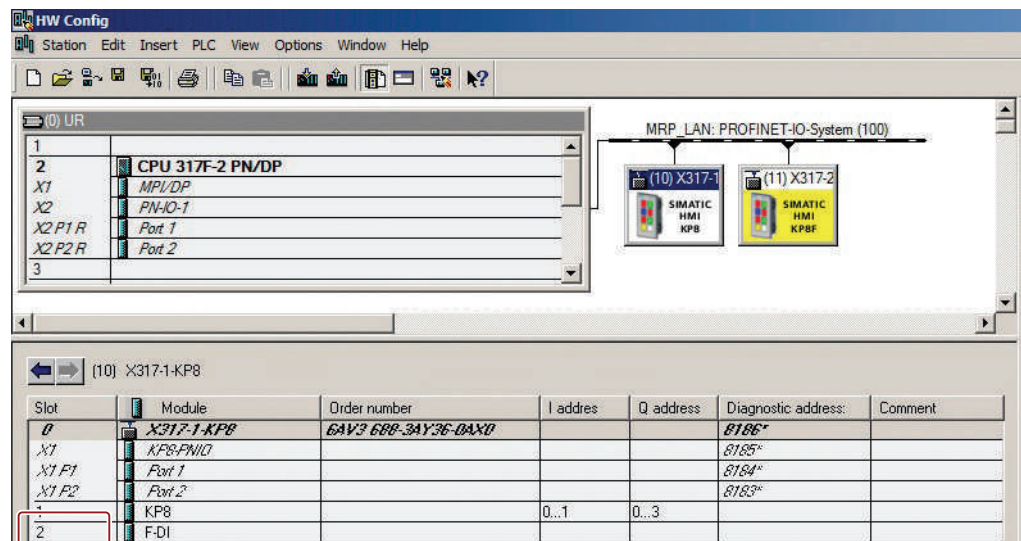
6.5 Setting KP8F - STEP 7

This chapter applies for the setting of the fail-safe slot 2 of the KP8F.

Requirement

- The password for the security program must be known.
- The SIMATIC Manager opens in "HW Config".

In the following image, the slot that must be set is labeled in red.



Procedure

1. Double click in the properties window on slot 2.

The "Properties – F-DI" dialog box opens.

2. Open the "Addresses" tab.

In the "Inputs" and "Outputs" groups, the start values of the address areas are set depending on the controller used. The signals of the F channels of the HMI device are mapped in these address ranges.

Parameter	Meaning
Inputs > Start	Start of address range in which the safety-relevant usage data of the HMI device are mapped.
Inputs > Process Image	Process image to which the address range belongs. This parameter cannot be entered with a controller of the SIMATIC CPU 300 type.
Outputs > Start	Start of address range in which the safety-relevant usage data of the HMI device are mapped.
Outputs > Process Image	Process image to which the address range belongs. This parameter cannot be entered with a controller of the SIMATIC CPU 300 type.

3. Check the default entry of the addresses for "Start".
If necessary, change the address range.
4. Select the "Parameters" tab.
5. Open the "Parameters > Device-specific Panels > Evaluation of the Sensor" directory.

6. In the list, select:
 - Not activated
"Not activated" is the default entry.
 - 1oo2 (2v2)-evaluation, EMERGENCY STOP
 - 1oo1 (1v1)-evaluation, single-channel

The selection is based on the connection corresponding with chapter "Connect KP8F - fail-safe inputs (Page 46)".

Note

Make sure that the sensor is monitored corresponding with its connection.

7. Click "OK".
The entries are saved. The dialog box closes.
8. Open the "PROFIsafe" tab.
If no access rights exist, the following dialog box will be shown.



9. Enter the password that was assigned when the safety program was created in Distributed Safety.
10. Click "OK".
The dialog box closes.
11. If necessary, change the "F_Dest_Add" parameter.
To do this, use the "Change value" button. Assign a network and station-wide unique address.
12. Change the monitoring time "F_WD_Time" if needed.
13. Click "OK".
The entries are saved. The dialog box closes.

Result

The HMI device will now respond in operation according to the new setting. The switch states of the digital inputs of the HMI device are stored in the specified address area of the controller.

6.6 Setting PROFIsafe address for KP8F

A PROFIsafe target address is assigned when you add the HMI device in the HW Config of the STEP 7 project. The PROFIsafe target address is the value of the "F_Dest_Add" parameter - see chapter "Setting KP8F - STEP 7 (Page 64)".

Then you must set the same PROFIsafe target address using the DIP switch on the back of the HMI device.

Note

Ensure that the HMI device is disconnected from the power before setting the PROFIsafe target address with the DIP switches.

Requirement

- The DIP switch of the HMI device is accessible.
- The value of the "F_Dest_Add" parameter is known.

Note

The PROFIsafe target address of the HMI device must be unique throughout the communication network and station. You can assign a maximum of 1022 PROFIsafe target addresses in a single system.

If you change the STEP 7 program in a way that changes the PROFIsafe target address, you need to change the switch settings on the HMI device's DIP switch accordingly.

Example

In the HW Config of the STEP 7 project, set the binary address for "383" as the PROFIsafe-target address:

Corresponding setting on the DIP switch: 0101111111

- 1 = switch setting "ON"
- 0 = switch setting "OFF".

Set the DIP switch on the back of the KP8F as follows:

OFF	ON	Switch	Bit number	Weighting	Address
<input type="checkbox"/>	<input checked="" type="checkbox"/>	1	0	1	1
<input type="checkbox"/>	<input checked="" type="checkbox"/>	2	1	2	2
<input type="checkbox"/>	<input checked="" type="checkbox"/>	3	2	4	4
<input type="checkbox"/>	<input checked="" type="checkbox"/>	4	3	8	8
<input type="checkbox"/>	<input checked="" type="checkbox"/>	5	4	16	16
<input type="checkbox"/>	<input checked="" type="checkbox"/>	6	5	32	32
<input type="checkbox"/>	<input checked="" type="checkbox"/>	7	6	64	64
<input checked="" type="checkbox"/>	<input type="checkbox"/>	8	7	128	0
<input type="checkbox"/>	<input checked="" type="checkbox"/>	9	8	256	256
<input checked="" type="checkbox"/>	<input type="checkbox"/>	10	9	512	0

383

The illustrated switch settings correspond with the binary address 383.

Result

The HMI device can be uniquely identified by the configured PROFIsafe target address.

6.7 KP8F – Configure Shared Device

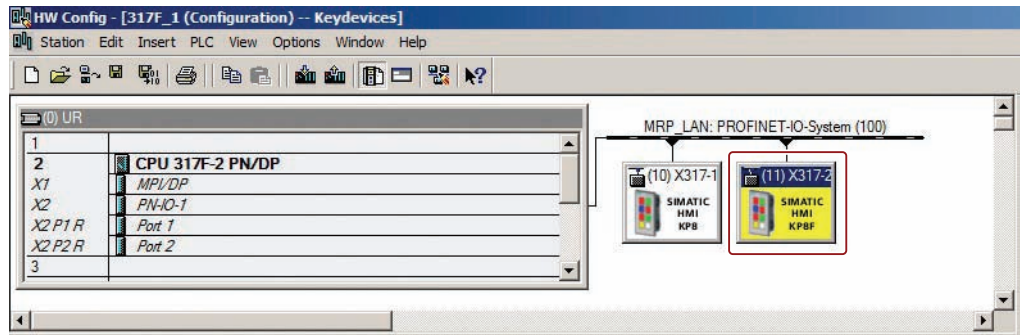
KP8F is designed for shared device.

Shared Device is the parallel and independent access from two different controllers to the same HMI device. A fixed assignment of the different modules that are used in an automation device must be configured to a select controller. The unique assignment of the module to the controller is always guaranteed and visible for the user.

Requirement

- A shared device is created in the project.
Information on the configuration of Shared Device can be found in the online help "STEP 7 Version 5.5".
- The Shared Device is now inserted in the PROFINET IO system.
Coupling with the controllers of the station is carried out automatically.
- "HW Config" is open in the SIMATIC Manager.

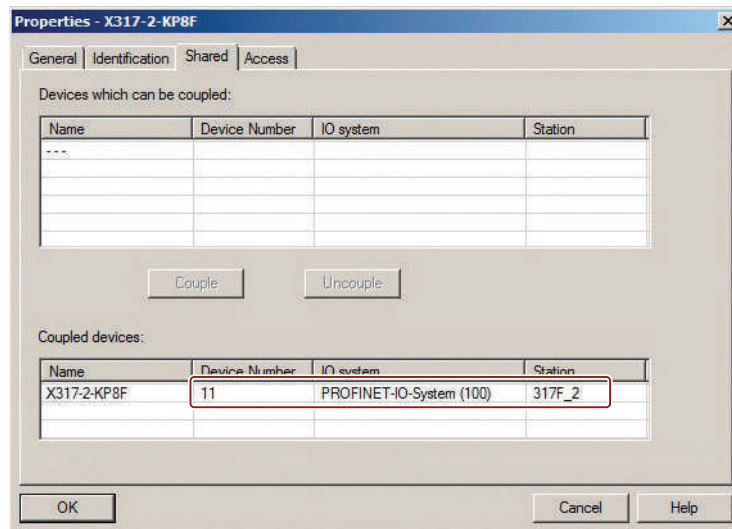
In the following image, the module to be configured is labeled in red.



Procedure

1. Double-click in the station window on the marked device.

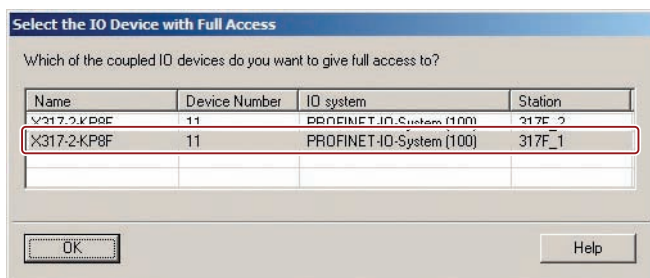
The following dialog appears.



2. Select the "Shared" tab.
The buttons are gray as long as no device is selected.
3. In the "Devices which can be coupled" group, select the device to be coupled to the KP8F.
4. Click "Couple".
The Shared Device connection is established. The coupled device is displayed in the "Coupled devices" group. See red marking.
5. If you want to decouple a Shared Device connection, select the device in question.
6. Click "Uncouple".
The Shared Device connection is terminated. The decoupled device is displayed in the "Devices which can be coupled" group.

- If there are several Shared Device connections, you must select a device for full access.

The following dialog appears:



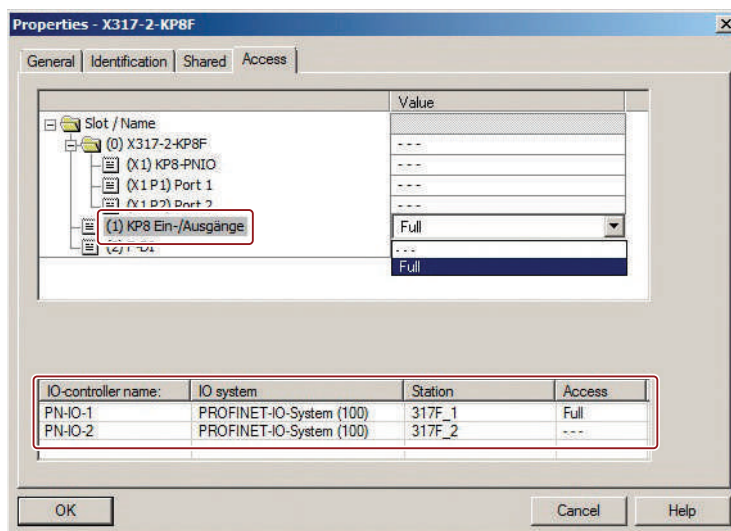
- Select the required device for the access type "Full".

- Click "OK".

The entry is saved. The dialog box closes.

- Select the "Access" tab.

The following dialog appears:



- Select the Shared Device connection for which you want to change the access.

Parameter	Meaning
Full	Read and write access by the controller
...	No access by the controller

- Select the required parameter.

- Click "OK".

The entry is saved. The dialog box closes.

Result

Shared Device is configured for the KP8F.

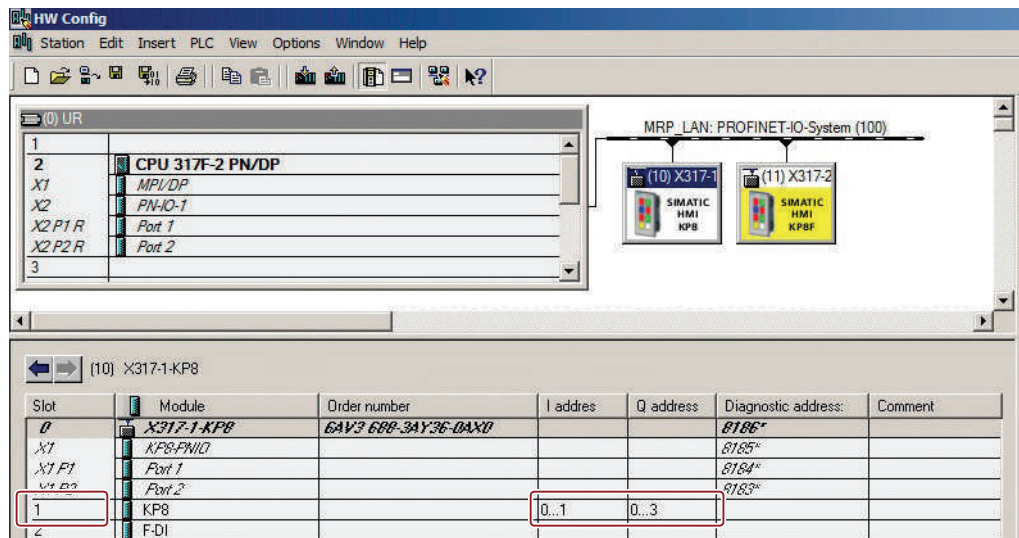
6.8 KP8F – Configure Shared Device for non fail-safe controller

You can also operate the KP8F with a non fail-safe controller. The non fail-safe controller must support Shared Device in this case.

Requirement

- "HW Config" is open in the SIMATIC Manager.

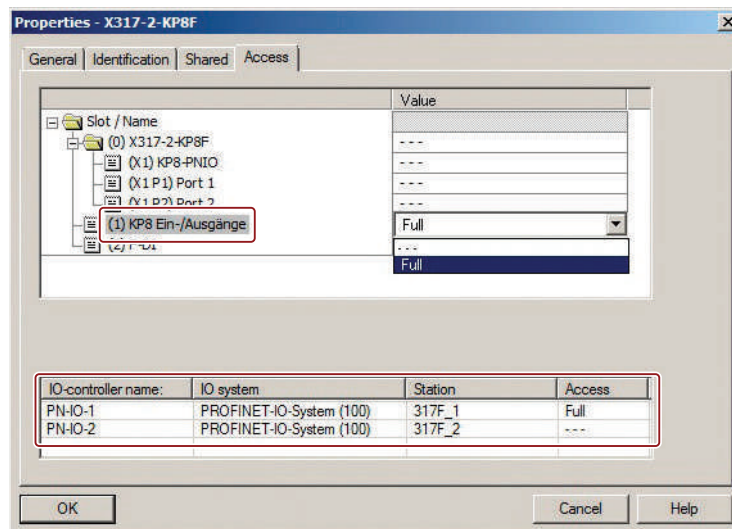
In the following image, the module to be configured is labeled in red.



Procedure

1. Perform steps 1 to 9 as described in section "KP8F – Configure Shared Device (Page 68)".
2. Select the "Access" tab.

The following dialog appears:



3. Select "." for the Shared Device connection.

The parameter indicates that there is no access by the controller.

4. Click "OK".

The entry is saved. The dialog box closes.

Result

Shared Device is configured for the KP8F and for a **non** fail-safe controller.

Operating KP8F in a fail-safe manner

7.1 Overview

Fail-safe mode

You can use the HMI device in standard mode and fail-safe mode simultaneously.

In fail-safe mode the HMI device recognizes signal states from suitable fail-safe sensors and sends corresponding safety telegrams to the fail-safe controller where the safety program runs. The fail-safe controller and the HMI device communicate with each other using the fail-safe protocol "PROFIsafe".

Safety functions

During fail-safe mode, safety functions are activated in both HMI and the fail-safe controller which recognize faults and react to them.

In the following cases, the fitting system unit must be run in a secure operating state:

- The EMERGENCY STOP button is pressed.
- A sensor was confirmed.
- A diagnosable error has occurred.

Reaction to pressed EMERGENCY STOP buttons or activation of sensor

If the EMERGENCY-STOP button was pressed or sensor was activated, the related BIT is sent to the controller in a safety-directed manner. The controller program analyzes if the EMERGENCY STOP button was pressed or sensor was activated.

Note

Which reactions this bit activates in the controller and thus, in the system, is the task of the user. Tasks include:

- Configuring required responses appropriate for the EMERGENCY STOP in the controller
- Setting measures to repair the cause of an EMERGENCY STOP
- Configuring the startup behavior after an EMERGENCY STOP

The response to an EMERGENCY STOP or activation of the sensor, measures and startup behavior must be described in the system documentation.

Responses to faults in the system

In the case of a failure, the F channels of the HMI device are passivated. This means "0" will be recognized at all fail-safe digital inputs.

The system must be configured so that the required safe operating mode can occur. Which measures must be implemented for failure analysis and repairs must be provided by the user.

Note

The HMI device may first be integrated into the control process after the causes for the failure have been repaired.

After integration, the process values for the digital fail-safe inputs are available again.

7.2 Passivate HMI device

Passivation

As soon as the HMI device recognizes a fault in fail-safe mode, all fail-safe channels are switched to the safe operating state. Through this, the fail-safe channels of this HMI device are passivated.

Note

If the HMI device is passivated, instead of the queued process values, the fail-safe value "0" is always assigned to all the fail-safe digital inputs. You cannot configure the fail-safe value.

Detected faults are entered in the diagnostic buffer of the fail-safe controller and reported to the safety program in the fail-safe controller.

The HMI device cannot permanently save the fault. When you switch off the HMI device and switch it on again, only one of the existing faults will continue to be detected after startup. If you want to save the faults, program your safety program accordingly.

The HMI device is passivated in the following situations:

- When the HMI device is started (startup)
- With a setting error
Errors in the PROFIsafe parameters, for example "F_WD_TIME" (F_monitoring time) too short.
- When an error occurs in the PROFIsafe communication between the fail-safe controller and HMI device
- With a hardware error
Error, for example, through wire break, short-circuit, discrepancy errors, internal errors of the HMI device.

Determining passivation

If you want to determine if the HMI device is passive or not, address the "PASS_OUT" variable of the F-I/O. The variable can be assigned the following values:

- 0 = HMI device not passive
- 1 = HMI device passive

Reintegrating KP8F

After passivation of the HMI device, the fault must be diagnosed and rectified. Afterwards, the HMI device can be reintegrated.

7.3 Error diagnostics

Diagnostic functions

Diagnostic functions, in other words displays and messages, are not critical to safety and therefore are not designed to be safety-related functions. They are therefore not tested internally.

Diagnostic function the HMI device

The fail-safe HMI device includes a non-configurable diagnostic function. The diagnostics are always activated and are automatically made available by the HMI device in STEP 7 and passed on to the controller in the event of a fault.

The diagnostics function passes the following diagnostics information to the controller:

- Communication error
The communication between the HMI device as the IO-device and the controller as the IO-controller is disrupted.
- Configuration error
Error in the PROFIsafe configuration

Reading diagnostic information

If you wish to locate the cause of an error, open the module diagnostics in STEP 7. You can find detailed information in the online help for STEP 7.

The following table shows the diagnostic functions of the HMI device. The diagnostic functions are assigned either to one channel or to the entire module.

7.4 Repair error and reintegrate

Diagnostics function	Error code	Scope of diagnostics functions
Short-circuit	0x01	Channel
Configuration error	0x10	Module
Communication error	0x13	Module
Discrepancy error	0x19	Channel
Non-permissible sensor evaluation	0x1C	Module
PROFIsafe address deviation	0x1D	Module
Serious error	0x1E	Module
Version conflict	0x1F	Module

You have the option of reading the diagnostics functions in the standard program by calling SFB 52 or SFB 54. For detailed information, refer to the "System and Standard Functions" reference manual.

Diagnostics of PROFIsafe errors

When diagnosing PROFIsafe errors, address the "DIAG" variable of the F-I/O DB. Detailed information about the F-I/O-DB can be found in the Programming and operation manual "S7 Distributed Safety - Configuring and Programming" (<http://support.automation.siemens.com/WW/view/en/22099875>).

HMI device with a serious error

If a serious error in the HMI device leads to its failure, the HMI device reacts as follows:

- The connection to PROFINET will be interrupted and the fail-safe channels will be rendered passive.
- No diagnosis will be transmitted from the HMI device.

In STEP 7 in module diagnostics, the standard diagnosis "Module interrupted" or "Module missing" will be reported.

7.4 Repair error and reintegrate

Remedy

The error correction of the HMI device should be undertaken depending on the type of error recognized:

Error	Possible causes of error	Remedy
Short-circuit	Short-circuit in the sensor	Eliminate the short-circuit.
	Cross-circuit in the sensor	Eliminate the cross-circuit.
	Internal error	Replace the HMI device.

Error	Possible causes of error	Remedy
Serious error	Internal error in the HMI device	Replace the HMI device.
Discrepancy error (1oo2 evaluation)	The process signal is faulty. The sensor is defective.	Check the process signal. Replace the sensor if needed.
	Short-circuit between the sensor line and the sensor voltage supply line.	Eliminate the short-circuit.
Configuration error	The HMI device does not match the configuration.	Correct the configuration. Check the communication paths.
	Configuration incorrect	Correct the configuration.
PROFIsafe address deviation	The PROFIsafe address on the HMI device is set incorrectly.	Set the same PROFIsafe address in the SIMATIC manager, HW config and on the device. This address must be unique. Refer to chapter "Setting PROFIsafe address for KP8F (Page 67)".
Communication error	The communication between the fail-safe controller and HMI device is interrupted, for example, due to a defective PROFINET connection or EMI.	Check the PROFINET cable.
	The PROFIsafe monitoring time set too low.	Increase the value of the "F_WD_Time" parameter in the SIMATIC Manager, HW Config.
	The configuration of the HMI device does not match the safety program.	Compile the safety program again. Then download the configuration and the safety program to the fail-safe controller.
Non-permissible sensor evaluation	An invalid value was transferred for the setting "Evaluation of the sensor".	Check the setting. Check the version of your GSDML-file. Load a new GSDML file.
Version conflict	The HMI device recognized an invalid combination of firmware.	Update the device firmware completely and bring it to the current state.

End passivation

When you have eliminated an error that lead to a passivation of the HMI device, you have to reintegrate the HMI device. A user acknowledgement in the safety program may be required for the reintegration of the HMI device. After reintegration, the pending process values at the HMI device's fail-safe channels are provided again for the safety program.

More information about the reintegration of F-I/O and for creating a user acknowledgement in the safety program can be found in the Programming and operation manual "S7 Distributed Safety - Configuring and Programming" (<http://support.automation.siemens.com/WW/view/en/22099875>).

7.5 Response times of the PROFIsafe devices

Response time of KP8F

The response time of the HMI device enters into the calculation of the response time of the F-system.

- Response times of the fail-safe channels

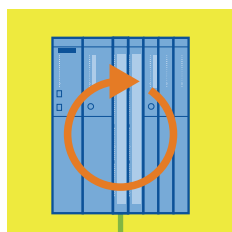
The response time is the time that is required between a signal change on the digital input and the safe loading of the safety message frame to PROFINET.

- Response time of the HMI device

The actual response time is somewhere between the shortest and longest response time. When planning a system, the longest response time must always be anticipated. Information about the response time can be found in the chapter "Technical specifications (Page 84)".

The following image shows where response times can be expected.

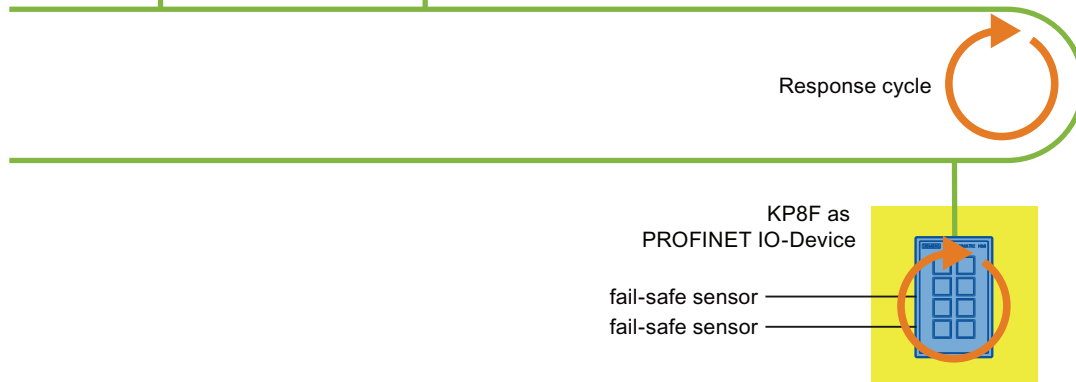
SIMATIC S7-416F-3 PN/DP
as PROFINET IO controller



ET 200S station
with
IM 151-3 PN



PROFINET



Response cycle

KP8F as
PROFINET IO-Device

fail-safe sensor
fail-safe sensor

Calculating response time

Information about the response times of the IO controller can be found in the manual of the IO controller used.

The "S7 Distributed Safety" add-on package contains an Excel file "s7fcotia.xls" for calculating maximum response times. You can find the current version of this table on the Internet at the following address:

"Support Request (<http://support.automation.siemens.com/WW/view/en/16605654>)", Entry - ID 19138505

Detailed information for the calculation of the response time of the F-system can be found in the "Safety Technology in SIMATIC S7" system manual (<http://support.automation.siemens.com/WW/view/en/12490443>).

Maintain and service KP8 and KP8F

8.1 Maintenance and care

Observe the safety instructions during maintenance and care found in chapter "Safety Instructions (Page 19)".

Scope of maintenance

The HMI device is designed for maintenance-free operation. Cyclic maintenance work is not required.

Scope of care

The scope of care includes:

- Cleaning keyboard overlay

Cleaning procedure

CAUTION
<p>Damage possible</p> <p>Using compressed air or steam cleaners, or aggressive solutions or scouring agents will damage the HMI device.</p> <p>Use a cleaning cloth dampened with a cleaning agent to clean the equipment. Only use water with a little liquid soap or a screen cleaning foam.</p>

Proceed as follows:

1. Switch off the HMI device.
2. Spray the cleaning solution onto a cleaning cloth.
Do not spray directly onto the HMI device.
3. Clean the HMI device.

8.2 Spare parts and repairs

If the unit needs to be repaired, ship the HMI device to the Return Center in Fürth.

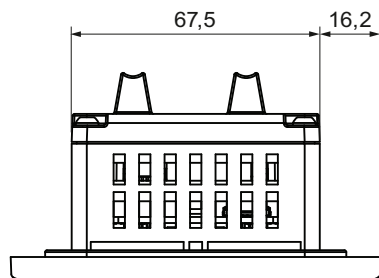
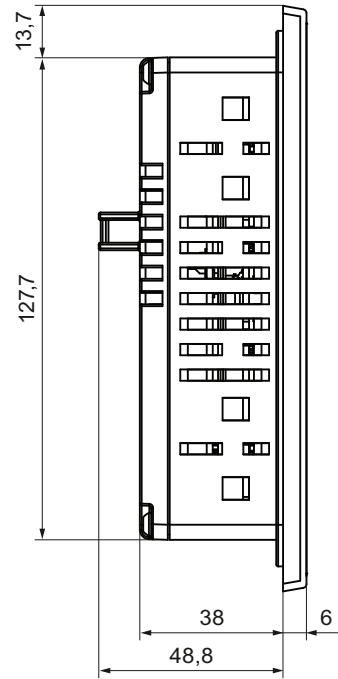
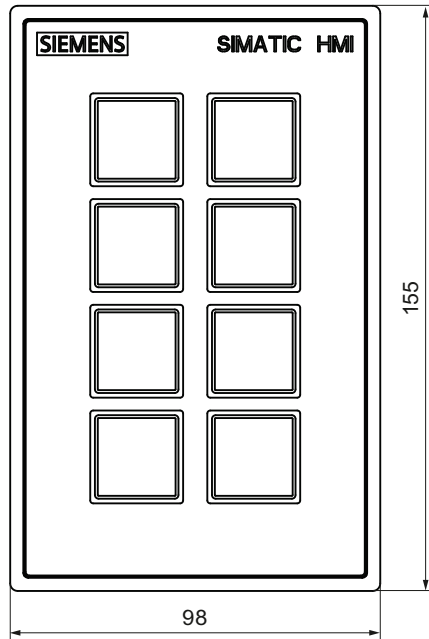
The address is:

Siemens AG
Industry Sector
Returns Center
Siemensstr. 2
90766 Fürth
Germany

You can find more detailed information on the Internet at Spare parts and repairs (<http://support.automation.siemens.com/WW/view/en/16611927>).

Technical specifications

9.1 Dimensional diagram



All dimensions in mm.

You can find more images on the Internet at:

Image database (<http://www.automation.siemens.com/bilddb>)

9.2 Technical specifications

Weight

KP8, including connector and mounting clamps, without packaging	270 g
KP8F, including connector and mounting clamps, without packaging	280 g

Power supply

Nominal value	+24 VDC
Range, permissible	+20,4 V ... +28,8 V (-15 %, +20 %)
Value for t < 0.5 s	35 V
Current consumption, maximum	0.3 A without load
Electrical isolation	No
Short-circuit protection	Yes
Transients, maximum permissible	35 V, 500 ms
Time between two transients, minimum	50 s
Fuse, internal	4 A

encoder

Signal duration, minimum	50 ms
--------------------------	-------

KP8 - digital inputs/outputs

Connectable	Keys, switches
Number of digital inputs/outputs, standard mode	8
Electrically isolated from internal logic	No
Input voltage <ul style="list-style-type: none"> • Nominal value • With "0" signal • With "1" signal 	<ul style="list-style-type: none"> • +24 VDC • 0 ... +5 V • 15 ... 30 V
Input current for signal "1"	Typically 5 mA for 24 V
Delay in the digital inputs/outputs	0.3 ms
Connection mechanical switches	Yes
Bounce time	≤ 10 ms
<ul style="list-style-type: none"> • Permitted resistive loads • Lamp load, permissible 	<ul style="list-style-type: none"> • 0,1 A • 2 W
Energy, inductive (max.)	200 mWs
Output voltage <ul style="list-style-type: none"> • With "0" signal • With "1" signal 	<ul style="list-style-type: none"> • Max. 2 V no load • Min. supply voltage -3 V
Output current <ul style="list-style-type: none"> • With "0" signal • With "1" signal 	<ul style="list-style-type: none"> • Max. 1 mA • Cumulative current for all outputs 800 mA
Switching frequency, max. at <ul style="list-style-type: none"> • Resistive load • Lamp load 	<ul style="list-style-type: none"> • 100 Hz • 8 Hz

KP8 - fail-safe digital inputs/outputs

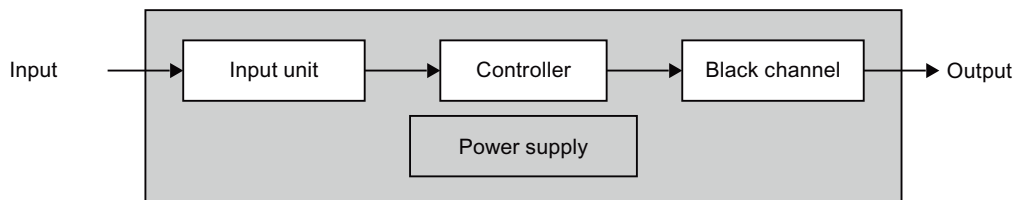
Additionally, with KP8F, the following applies for the fail-safe digital inputs:

Number of fail-safe digital inputs	2
Number of fail-safe outputs	Corresponding to PROFIsafe process values
Cable length <ul style="list-style-type: none"> • Unshielded cable, maximum • Shielded cable, maximum 	<ul style="list-style-type: none"> • 1 m • 3 m
Response time for 1oo1 and 1oo2 if there are no faults	6 to 22 ms
Response time for 1oo1 and 1oo2 in the event of a fault	10 to 27 ms
Acknowledgment time in safety mode	15 to 35 ms
Signal duration, minimum	22 ms

9.3 Fail-safe mode

KP8F internal

The block diagram of the KP8F:



The relevant values of the individual blocks are shown in the following.

Note

All values for the following data are based on the SN 29500:2005 and an ambient temperature of 60 °C.

Input unit – 1oo1 mode

Parameter	Value	Comment
Hardware Fault Tolerance	0	–
Classification	A	–
Architecture	1oo1D	–
Failure mode	Dangerous process value	Due to failures in the input circuit
• Detected	• 5.50 FIT	
• Undetected	• 0.34 FIT	
Failure Mode Diagnostic	No error signaling or no safe values	Calculation according IEC13849:2006 CAT4
• Detected	• 0 FIT	
• Undetected	• 0 FIT	
Diagnostic Coverage	94.15 %	–
Diagnostic test interval	15 ms	Errors detected in each firmware cycle
Safe Failure Fraction	99.19 %	–

Input unit – 1oo2 mode

Parameter	Value	Comment
Hardware Fault Tolerance	1	–
Classification	A	–
Architecture	1oo2D	1st detected failure leads to the safe state
Failure mode • Detected • Undetected	Dangerous process value • 5.78 FIT • 0.06 FIT	Due to failures in the input circuit One channel One channel
Failure Mode Diagnostic • Detected • Undetected	No error signaling or no safe values • 0 FIT • 0 FIT	Calculation according IEC13849:2006 CAT4
Diagnostic Coverage	99.00 %	–
Diagnostic test interval	15 ms	Errors detected in each firmware cycle
Safe Failure Fraction	99.86 %	–
Common Cause Factor	2 %	–

Controller

Parameter	Value	Comment
Hardware Fault Tolerance	1	–
Classification	B	–
Architecture	1oo2D	1st detected failure leads to the safe state
Failure mode • detected • undetected	Dangerous process value • 174,00 FIT • 1,68 FIT	Due to failures in the processing unit • One channel • One channel
Failure Mode Diagnostic • Detected • Undetected	No error signaling or no safe values • 0 FIT • 0 FIT	Calculation according IEC13849:2006 CAT4
Diagnostic Coverage	99.04 %	–
Diagnostic test interval	15 ms	Errors detected in each firmware cycle
Safe Failure Fraction	99.23 %	–
Common Cause Factor	2 %	–

Power supply

Parameter	Value	Comment
Hardware Fault Tolerance	0	–
Classification	A	–
Architecture	1oo1D	–
Failure mode • Detected • Undetected	Dangerous process value • 22.50 FIT • 0.22 FIT	Due to failures in the power supply
Failure Mode Diagnostic • Detected • Undetected	No error signaling or no safe values • 0 FIT • 0 FIT	Calculation according IEC13849:2006 CAT4
Diagnostic Coverage	99.03 %	–
Diagnostic test interval	< 10 ms	Voltage monitoring in hardware
Safe Failure Fraction	99.84 %	–

Fail-safe mode for 1oo1 evaluation

- In accordance with IEC 61508:2010

Systematic Capability	SIL3
Mode of operation	High and low demand mode
Meantime to Restoration (MTTR)	100 h
Probability of a dangerous failure per hour (PFH)	5.95×10^{-10} 1/h
Probability of a dangerous failure on demand (PFD)	2.61×10^{-5}
Safe Failure Fraction (SFF)	99.19 %
Diagnostic test interval	15 ms
Proof Test Interval	10 y
Lifetime	10 y

- In accordance with IEC 13849:2006

Meantime to Failure (MTTF _d)	560 y
Meantime to Restoration (MTTR)	100 h
Diagnostic Coverage (DC _{avg})	98.90 %
Performance Level	d
Category	3

- In accordance with EN 954-1:1996

Category	3
----------	---

Fail-safe mode for 1oo2 evaluation

- In accordance with IEC 61508:2010

Systematic Capability	SIL3
Mode of operation	High and low demand mode
Meantime to Restoration (MTTR)	100 h
Probability of a dangerous failure per hour (PFH)	2.55×10^{-10} 1/h
Probability of a dangerous failure on demand (PFD)	1.11×10^{-5}
Safe Failure Fraction (SFF)	99.23 %
Diagnostic test interval	15 ms
Proof Test Interval	10 y
Lifetime	10 y

- In accordance with IEC 13849:2006

Meantime to Failure (MTTF _d)	560 y
Meantime to Restoration (MTTR)	100 h
Diagnostic Coverage (DC _{avg})	99.04 %
Performance Level	e
Category	4

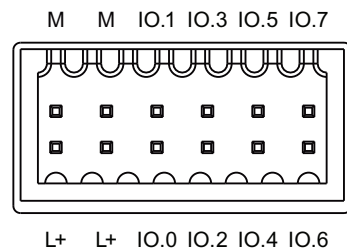
- In accordance with EN 954-1:1996

Category	4
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9.4 Interface description

9.4.1 Inputs and outputs KP8

X60, connector, 12-pin

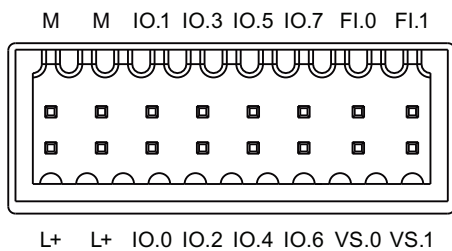


9.4 Interface description

PIN	Assignment
M	Ground
M	Ground
L+	+24 VDC
L+	+24 VDC
IO.0	digital input/output 0
IO.1	digital input/output 1
IO.2	digital input/output 2
IO.3	digital input/output 3
IO.4	digital input/output 4
IO.5	digital input/output 5
IO.6	digital input/output 6
IO.7	digital input/output 7

9.4.2 Inputs and outputs KP8F

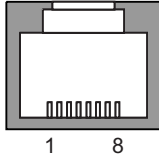
X60, connector, 16-pin



PIN	Assignment
M	Ground
M	Ground
L+	+24 VDC
L+	+24 VDC
IO.0	digital input/output 0
IO.1	digital input/output 1
IO.2	digital input/output 2
IO.3	digital input/output 3
IO.4	digital input/output 4
IO.5	digital input/output 5
IO.6	digital input/output 6
IO.7	digital input/output 7
FI.0	Fail-safe digital input 0
FI.1	Fail-safe digital input 1
VS.0	Sensor supply 1 for FI.0
VS.1	Sensor supply 2 for FI.1

9.4.3 PROFINET

RJ45 plug connector, 8-pin



PIN	Assignment	
1	RxP	Receive data +
2	RxN	Receive data -
3	TxP	Transmit data +
4	GND	n. c.
5	GND	n. c.
6	TxN	Transmit data -
7	GND	n. c.
8	GND	n. c.

9.5 Bit assignment in the process image

The signal states of HMI device digital inputs/outputs that are used in standard mode are saved in their own process images independently from the signal states of the fail-safe channels.

Input area of the controller

The keys and digital inputs of the HMI device are mapped to the bits in the input area of the controller as follows:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Description	Input byte
K 7	K 6	K 5	K 4	K 3	K 2	K 1	K 0	Keys 0 to 7	0
DI 7	DI 6	DI 5	DI 4	DI 3	DI 2	DI 1	DI 0	Digital inputs 0 to 7	1

K = Key

DI = Digital input

The numbering refers to the specifications in the chapter "Front-sided control elements and displays (Page 53)".

Output area of the controller

Each of the three questions has its own output byte. The LEDs are assigned to the bits in the output area of the controller as follows:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Description	Output byte
R 7	R 6	R 5	R 4	R 3	R 2	R 1	R 0	LEDs 0 to 7, red	0
G 7	G 6	G 5	G 4	G 3	G 2	G 1	G 0	LEDs 0 to 7, green	1
B 7	B 6	B 5	B 4	B 3	B 2	B 1	B 0	LEDs 0 to 7, blue	2
DO 7	DO 6	DO 5	DO 4	DO 3	DO 2	DO 1	DO 0	Digital outputs 0 to 7	3

- R = Red
- G = Green
- B = Blue
- DO = Digital output

For the output bytes 0 to 2, the bit combinations of the bit x are illustrated in the following table.

Bit R x (red, byte 0)	Bit G x (green, byte 1)	Bit B x (blue, byte 2)	LED
1	0	0	Red
0	1	0	Green
0	0	1	Blue
1	1	0	Yellow
1	1	1	White
0	0	0	OFF
1	0	1	OFF
0	1	1	OFF

9.6 Sensor evaluation of the fail-safe channels

Note

For digital inputs that are reserved with a fail-safe channel, the process image described in the chapter "Bit assignment in the process image (Page 91)" is **not** used.

The fail-safe channels occupy the following address areas in the process image of the fail-safe controller:

Input area	Output area
x + 0 to x + 4	x + 0 to x + 3

x The start address for the input and output range.

The address was entered on the "Addresses" tab in the HW Config in the object properties of the module "KP8F, Slot 2".

The first byte in the process image describes the switch state of the connected sensors or a connected EMERGENCY-OFF button. The setting is described in the section "Setting KP8F - STEP 7 (Page 64)".

Note

The unused bits in the byte 0 are always "0".

The following evaluations are possible:

- No evaluation

Slot 2 was not set. No evaluation occurs.

SIL2				SIL3			
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

First byte

- 1001 evaluation

The slot 2 was set with "1001 (1v1)-evaluation, one-channel". The connected sensor is evaluated.

SIL2				SIL3			
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

First byte

Bits 4 and 5 determine if the respective sensor contact is open or closed. The bits may take on the following values:

- 0 = Open sensor contact
- 1 = sensor contact closed

- 1oo2 evaluation

The slot 2 was set with "1oo2 (2v2)-evaluation, EMERGENCY STOP". The EMERGENCY STOP button is evaluated.

SIL2				SIL3				FI.0	First byte
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0		

Bit 0 determines whether or not the EMERGENCY STOP button was pressed. The bit can take on the following values:

- 0 = EMERGENCY STOP button pressed or error
- 1 = EMERGENCY STOP button **not** pressed

Appendix

A

A.1 ESD guideline

What does ESD mean?



An electronic module is equipped with highly integrated electronic components. Due to their design, electronic components are highly sensitive to overvoltage and thus to the discharge of static electricity. Such electronic components are labeled as electrostatic sensitive devices (ESD).

The following abbreviations are commonly used for electrostatic sensitive devices:

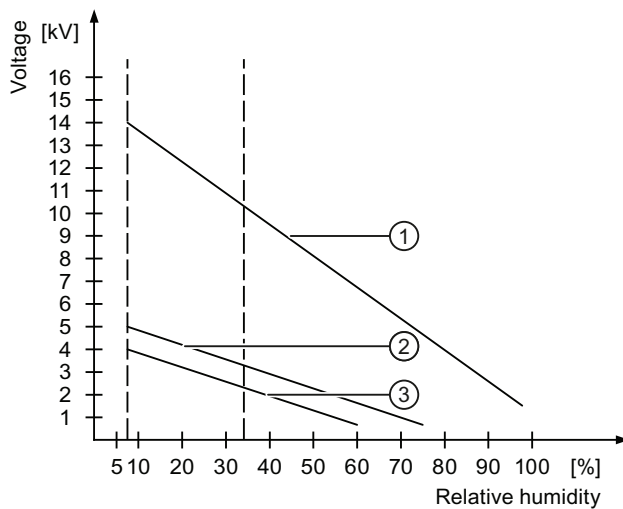
- ESD – Electrostatic Sensitive Device
- ESD – Electrostatic Sensitive Device (internationally recognized term)

Electrostatic charge

CAUTION
Electrostatic charge ESDs may be destroyed by voltages far below the level perceived by human beings. If you are not discharged electrostatically, the voltage that you transfer when touching a component or the contact points of a module can already cause damage. The damage to an ESD caused by overvoltage is usually not recognized immediately. The damage only becomes apparent after a long period of operation. Discharge any electrostatic charge of your body before you touch the ESD.

Anyone who is not connected conductively to their surroundings is subject to electrostatic charge.

The following diagram shows the maximum voltage values to which a person can be charged electrostatically. The values depend on the material and humidity. The shown values are in conformity with the specifications of EN 61000-4-2.



- ① Synthetic materials
- ② Wool
- ③ Antistatic materials such as wood or concrete

Protective measures against discharge of static electricity

CAUTION

Grounding measures

There is no equipotential bonding without grounding. An electrostatic charge is not discharged and may damage the ESD.

When working with electrostatic sensitive devices, make sure that the person and the workplace are properly grounded.

Note the following:

- Only touch the ESD if it is absolutely necessary.
- When you touch ESD modules, avoid touching the pins or the PCB tracks.
This precaution reduces the risk of damaging an ESD.
- Discharge electrostatic electricity from your body if you are performing measurements on an ESD.
To do so, touch a grounded metal object before you carry out the measurement.
- Always use grounded measuring instruments.

Abbreviations

CPU	Central Processing Unit
DC	Direct Current
DIL	Dual-in-Line
DP	Distributed I/O
ESD	Electrostatic Discharge, the components and modules endangered by such
EMC	Electromagnetic Compatibility
EN	European standard
ESD	Electrostatic Sensitive Device
F-CPU	Fail-safe Central Processing Unit
GND	Ground
GSD	Device master file
HF	High Frequency
HMI	Human Machine Interface
IEC	International Electrotechnical Commission
LED	Light Emitting Diode
MTTR	Meantime to Restoration
MRP	Media Redundancy Protocol
MS	Microsoft
PELV	Protective Extra Low Voltage
PFD	Probability of a dangerous Failure on Demand
PFH	Probability of a dangerous Failure per Hour
PL	Performance Level
RSTP	Rapid Spanning Tree Protocol
SELV	Safety Extra Low Voltage
SIL	Safety Integrity Level
TIA	Totally Integrated Automation
UL	Underwriter's Laboratory

Glossary

Automation system (AS)

is a controller of the SIMATIC S7 series such as a SIMATIC S7-1200.

Controller

General term for devices and systems with which the HMI device communicates, e.g. SIMATIC S7.

Diagnostics

Diagnostics enable you to determine if the signals are being correctly registered in the fail-safe HMI device.

EMC

Electromagnetic compatibility (EMC) refers to a state in which technical equipment does not disturb other equipment with unwanted electrical or electromagnetic effects. Electromagnetic compatibility deals with technical and regulatory questions of undesired, mutual influence in electrical engineering.

Failsafe

Capability of a technical system to remain in a safe state or switch to another safe state immediately in the event of a failure or fault.

Fail-safe system, F system

A fail-safe system is used to control production processes in which immediate shutdown results in a safe system status. This means that a fail-safe systems control processes that do not present a danger to people or the environment if a direct shutdown of the plant occurs.

Fail-safe systems are used in plants with high safety requirements.

GSD

The GSD file contains all the properties of a DP slave or IO device. STEP 7 requires a GSD file for each DP slave and for each IO device to allow the DP slave or IO device to be selected in the module catalog of HW Config.

Passivation

If the F-I/O detects a fault/error, it switches the affected channel or all its channels to the safe state. In other words, channels of this F-I/O are passivated. The F-I/O reports the detected error to CPU via the slave diagnostics. With an F-I/O with inputs, passivation is performed by the the F system by making available substitute values (0) to the safety program instead of the process values queued at the fail-safe inputs. With an F-I/O with outputs, passivation is performed by the the F system by sending substitute values (0) to the fail-safe outputs instead of the output values provided by from the safety program.

PROFINET

Within the framework of Totally Integrated Automation (TIA), PROFINET represents an enhancement of the following bus systems:

- PROFIBUS DP as well-established field bus
- Industrial Ethernet as the communication bus for the cell level

The experience gained from both systems has been and continues to be integrated in PROFINET. PROFINET as an Ethernet-based automation standard from PROFIBUS International (PROFIBUS Nutzerorganisation e.V.) defines a vendor-independent communication and engineering model.

PROFINET IO controller

Device used to address the connected IO devices. That is: The IO controller exchanges input and output signals with assigned field devices. The IO controller is often the controller on which the automation program runs.

PROFINET IO device

A PROFINET IO device is a decentralized field device that is assigned to one of the IO controllers (e.g., remote IO, valve terminals, frequency converters, switches)

PROFINET IO

As part of PROFINET, PROFINET IO is a communication concept that is used to implement modular, distributed applications.

PROFINET IO allows you to create automation solutions of the type with which you are familiar from PROFIBUS.

PROFINET IO is implemented by the PROFINET standard for automation devices on the one hand, and on the other hand by the STEP 7 engineering tool.

This means that you have the same application view in STEP 7 regardless of whether you configure PROFINET devices or PROFIBUS devices. Programming your user program is essentially the same for PROFINET IO and PROFIBUS DP if you use the extended blocks and system status lists for PROFINET IO.

PROFIsafe

Fail-safe bus profile of PROFINET for communication between the safety program and the F-I/O in an F system.

PROFIsafe address

Every F-I/O has a PROFIsafe address. This address is used to receive safety frames from the fail-safe CPU or send safety frames to the fail-safe CPU.

Proof-test interval

The proof-test interval is the time period after which a component must be put into fail-safe state. That is, it is replaced by an unused component or it is proven to be completely fault-free.

Reintegration

Once a fault/error has been eliminated, the F-I/O must be reintegrated (depassivated). Reintegration (switching from substitute values to process data) takes place either automatically or following user acknowledgment.

For an F-I/O module with inputs, the process data queued at the failsafe inputs are made available again to the safety program after reintegration. For an F-I/O module with outputs, the output values for fail-safe outputs are sent again by the system to the fail-safe outputs.

Safe state

State of a unit in which safety is assured. In other words, the risk is acceptably low because it has been established that safety-related malfunctions do not occur or because of the safety measures taken to prevent possible safety-related malfunctions.

The basic principle of the safety concept in a fail-safe system is the existence of a safe state for all process variables.

Safety class

Safety integrity level according to IEC 61508 and prEN 50129. The higher the safety integrity level, the sharper the measures taken to avoid systematic errors and to control systematic errors and random hardware failures.

Safety function

Safety function is a mechanism integrated in fail-safe CPUs and I/Os, enabling them to be used in fail-safe systems. According to IEC 61508: A safety function is implemented by a safety system to ensure that the system is kept in a safe state or brought into a safe state in the event of a particular fault (user safety function).

Safety mode

Operating mode of the HMI device in which safety-related communication can be performed via safety frames.

safety-related communication

Communication used to exchange fail-safe data.

Sensor evaluation

Two types of sensor evaluation:

- 1oo1 evaluation

Sensor signal is read once.

- 1oo2 evaluation

The sensor signal is read twice by the same F-I/O and compared internally.

Standard mode

Operating mode of an HMI device in which only standard communication is possible and safety-related communication cannot be performed via safety frames.

STEP 7

Programming software SIMATIC S7, SIMATIC C7 and SIMATIC WinAC controllers.

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