WAGO TECHDOCS

Manual

WAGO I/O System 750/753

750-662/000-004

8FDI 24V PROFIsafe

Safe 8-Channel Digital Input; 24 VDC; PROFIsafe

Version 1.1.0, valid from HW/SW Version 01/02

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Every conceivable measure has been taken to ensure the accuracy and completeness of this documentation. However, as errors can never be fully excluded, we always appreciate any information or suggestions for improving the documentation.

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We wish to point out that the software and hardware terms as well as the trademarks of companies used and/or mentioned in the present manual are generally protected by trademark or patent.

WAGO is a registered trademark of WAGO Verwaltungsgesellschaft mbH.

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1 Notes about this Documentation

Note

Always retain this documentation!
This documentation is part of the product. Therefore, retain the documentation during the entire service life of the product. Pass on the documentation to any subsequent user. In addition, ensure that any supplement to this documentation is included, if necessary.

Note

Technical Terms in this Documentation
The technical terms used in this documentation are available in the glossary at the end of the manual.

1.1 Validity of this Documentation

This documentation applies to: “8FDI 24V PROFIsafe” (750-662/000-004).

This documentation is only applicable from HW/SW Version 01/02.

The I/O module 750-662/000-004 shall only be installed and operated according to the instructions in this manual and in the manual for the used fieldbus coupler or controller.

NOTICE

Consider power layout of the WAGO I/O System 750!
In addition to these operating instructions, you will also need the manual for the used fieldbus coupler or controller, which can be downloaded at www.wago.com. There, you can obtain important information including information on electrical isolation, system power and supply specifications.

1.2 Copyright

1.3 Symbols

⚠ DANGER

Personal Injury!
Indicates a high-risk, imminently hazardous situation which, if not avoided, will result in death or serious injury.

⚠ DANGER

Personal Injury Caused by Electric Current!
Indicates a high-risk, imminently hazardous situation which, if not avoided, will result in death or serious injury.

⚠ WARNING

Personal Injury!
Indicates a moderate-risk, potentially hazardous situation which, if not avoided, could result in death or serious injury.

⚠ CAUTION

Personal Injury!
Indicates a low-risk, potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

NOTICE

Damage to Property!
Indicates a potentially hazardous situation which, if not avoided, may result in damage to property.

NOTICE

Damage to Property Caused by Electrostatic Discharge (ESD)!
Indicates a potentially hazardous situation which, if not avoided, may result in damage to property.

Note

Important Note!
Indicates a potential malfunction which, if not avoided, however, will not result in damage to property.

Information

Additional Information:
Refers to additional information which is not an integral part of this documentation (e.g., the Internet).

1.4 Number Notation

Table 1: Number Notation

Number Code	Example	Note
Decimal	100	Normal notation
Hexadecimal	0x64	C notation
Binary	'100' '0110.0100'	In quotation marks, nibble separated with dots (.)

1.5 Font Conventions

Table 2: Font Conventions

Font Type	Meaning
italic	Names of paths and files are shown in italics; e.g.: *C:\Programs\WAGO Software*
Menu	Menu options are shown in bold, e.g.: **Save**
>	A “greater than” symbol between two names denotes the selection of a menu option, e.g.: **File > New**
Input	Names of input fields and selection fields are shown in bold, e.g.: **Filter Time**
“Value”	Input or selection values are shown in quotation marks, e.g.: Enter the value “5 mA” under **Filter Time**.
[Button]	Button labels within the dialogs are shown in bold and enclosed in square brackets, e.g.: **[Input]**
[Key]	Key labels on the keyboard are shown in bold and enclosed in square brackets, e.g.: **[F5]**

2 Important Notes

This section includes an overall summary of the most important safety requirements and notes that are mentioned in each individual section. To protect your health and prevent damage to devices as well, it is imperative to read and carefully follow the safety guidelines.

2.1 Legal Bases

2.1.1 Subject to Changes

WAGO GmbH & Co. KG reserves the right to provide for any alterations or modifications. WAGO GmbH & Co. KG owns all rights arising from the granting of patents or from the legal protection of utility patents. Third-party products are always mentioned without any reference to patent rights. Thus, the existence of such rights cannot be excluded.

2.1.2 Personnel Qualifications

All sequences implemented on WAGO I/O System 750 devices may only be carried out by electrical specialists with sufficient knowledge in automation. The specialists must be familiar with the current norms and guidelines for the devices and automated environments.

All changes to the coupler or controller should always be carried out by qualified personnel with sufficient skills in PLC programming.

⚠ DANGER

Only personnel trained in safety-related procedures may perform the work!
Adding and commissioning F I/O modules may only be carried out by personnel trained in safety-related procedures!

2.1.3 Use of the 750 Series in Compliance with Underlying Provisions

Fieldbus couplers, controllers and I/O modules found in the modular WAGO I/O System 750 receive digital and analog signals from sensors and transmit them to actuators or higher-level control systems. Using controllers, the signals can also be (pre-) processed.

The devices fulfill the requirements of protection type IP20 and are designed for use in dry interior spaces. There is protection against finger injury and solid impurities ≥ 12.5 mm diameter is assured; protection against water damage is not ensured.
The devices represent open-type devices. They may only be installed in enclosures (tool-secured enclosures or operating rooms) which fulfil the listed requirements specified in the safety instructions in chapter “Safety Advice

(Precautions)". Use without additional protective measures in environments within which dust, corrosive fumes, gases or ionized radiation can occur is considered improper use.

Operating the WAGO I/O System 750 devices in home applications without further measures is only permitted if they meet the emission limits (emissions of interference) according to EN 61000-6-3. You will find the relevant information in the section "Device Description" > "Standards and Guidelines" in the manual for the used device.

Appropriate housing (per 2014/34/EU) is required when operating the WAGO I/O System 750 in hazardous environments. Please observe the installation regulations! Please note that a prototype test certificate must be obtained that confirms the correct installation of the system in a housing or switch cabinet.

The implementation of safety functions such as EMERGENCY STOP or safety door monitoring must only be performed by the F I/O modules within the modular WAGO I/O System 750. Only these safe F I/O modules ensure functional safety in accordance with the latest international standards. WAGO's interference-free output modules can be controlled by the safety function.

2.1.4 Technical Condition of Specified Devices

The devices to be supplied ex works are equipped with hardware and software configurations, which meet the individual application requirements. These modules contain no parts that can be serviced or repaired by the user. The following actions will result in the exclusion of liability on the part of WAGO GmbH & Co. KG:

- Repairs,
- Changes to the hardware or software that are not described in the operating instructions,
- Improper use of the components.

Further details are given in the contractual agreements. Please send your request for modified and new hardware or software configurations directly to WAGO GmbH & Co. KG.

2.2 Safety Advice (Precautions)

For installing and operating purposes of the relevant device to your system the following safety precautions shall be observed:

DANGER

Do not work on devices while energized!
All power sources to the device shall be switched off prior to performing any installation, repair or maintenance work.

DANGER

Install device in a suitable enclosure!
The device is an open system. Install the device in a suitable enclosure. This enclosure must:

- Guarantee that the max. permissible degree of pollution is not exceeded.
- Offer adequate protection against contact.
- Prevent fire from spreading outside of the enclosure.
- Offer adequate protection against UV irradiation.
- Guarantee mechanical stability
- Restrict access to authorized personnel and may only be opened with tools

DANGER

Ensure disconnect and overcurrent protection!
The device is intended for installation in automation technology systems. Disconnect protection is not integrated. Connected systems must be protected by a fuse.
Provide suitable disconnect and overcurrent protection on the system side!

DANGER

Ensure a standard connection!
To minimize any hazardous situations resulting in personal injury or to avoid failures in your system, the data and power supply lines shall be installed according to standards, with careful attention given to ensuring the correct terminal assignment. Always adhere to the EMC directives applicable to your application.

DANGER

Observe applicable standards!
In a safety-related application, both the control as well as the attached sensors and actuators must meet the applicable normative safety requirements. Ensure that switches, sensors and actuators comply with current applicable standards before use.

WARNING

Power from SELV/PELV power supply only!
All field signals and field supplies connected to this I/O module (750-662/000-004) must be powered from SELV/PELV power supply(s)!

CAUTION

Inadequate wire cross sections can cause temperature increases!
To avoid increasing thermal risks, only use conductor cross-sections sufficient for the required maximum load current. The conductor cross-sections specified in the technical data refer exclusively to the mechanical connection capacity of the clamping points.

NOTICE

Ensure proper contact with the DIN-rail!
Proper electrical contact between the DIN-rail and device is necessary to maintain the EMC characteristics and function of the device.

NOTICE

Replace defective or damaged devices!
Replace defective or damaged device/module (e.g., in the event of deformed contacts).

NOTICE

Protect the components against materials having seeping and insulating properties!
The components are not resistant to materials having seeping and insulating properties such as: aerosols, silicones and triglycerides (found in some hand creams). If you cannot exclude that such materials will appear in the component environment, then install the components in an enclosure being resistant to the above-mentioned materials. Clean tools and materials are imperative for handling devices/modules.

NOTICE

Clean only with permitted materials!
Clean housing and soiled contacts with propanol.

NOTICE

Do not use any contact spray!
Do not use any contact spray. The spray may impair contact area functionality in connection with contamination.

NOTICE

Do not reverse the polarity of connection lines!
Avoid reverse polarity of data and power supply lines, as this may damage the devices involved.

NOTICE

Avoid electrostatic discharge!
The devices are equipped with electronic components that may be destroyed by electrostatic discharge when touched. Please observe the safety precautions against electrostatic discharge per DIN EN 61340-5-1/-3. When handling the devices, please ensure that environmental factors (personnel, work space and packaging) are properly grounded.

NOTICE

Avoid conductive pollution!
Suitable measures must be taken to prevent conductive pollution to achieve Pollution Degree II in accordance with EN 61131-2. If you are unable to exclude that such materials will appear in the device environment, then install the devices in an enclosure that is resistant to the conductive materials. Clean tools and materials are imperative for handling devices.

NOTICE

System supply only with appropriate fuse protection!
Without overcurrent protection, the electronics can be damaged.
For 24 V system supply input voltage an external fuse, rated max. 2 A, slow acting, min. 30 VDC shall be used.

NOTICE

Field supply only with appropriate fuse protection!
Without overcurrent protection, the electronics can be damaged.
For 24V field supply input voltage an external fuse, rated max. 10 A, slow acting, min. 30 VDC shall be used.

NOTICE

Do not exceed maximum values via power contacts!
The maximum current that can flow through the power jumper contacts is 10 A. The power jumper contacts can be damaged and the permissible operating temperature can be exceeded by higher current values.

When configuring the system, do not exceed the permissible maximum current value. If there is a higher power requirement, you must use an additional supply module to provide the field voltage.

NOTICE

Do not exceed the maximum total current for I/O modules (5 VDC) via data contacts!
The maximum permissible total current for internal system supply of the I/O modules may not be exceeded. The permissible total current is specified in the technical data of the head station and power supply. The data contacts for internal system supply can be damaged and the permissible operating temperature can be exceeded by higher values.
When configuring the system, do not exceed the permissible total current. If there is a higher power requirement, you must use an additional supply to provide the system voltage (5 VDC)!

3 Device Description

The safe F I/O module is intended for functional safety[1] in the areas of industrial automation technology, building technology and process technology, in order to protect humans and machines according to Machinery Directive 2006/42/EC.

Connection to the safe PLC is established via the PROFINET IO fieldbus. The F I/O modules can be seamlessly integrated into the existing WAGO I/O System 750/753.

Expensive, inflexible cabling is replaced by flexible, configurable safety functions, thanks to secure PROFIsafe data transmission via the existing fieldbus system. That makes it possible to optimize the F I/O module for different safety applications.

The F I/O modules of the WAGO I/O System 750/753 can be used to implement safety applications in accordance with the standards listed in Section “Approvals” > “Applications”.

The following actuators and sensors can be operated at the inputs of the 750-662/000-004 F I/O module (see Section “Commissioning” > “Connection Examples”):

- Potential-free emergency-off switches with contacts
- Safety interlock switches
- Operating mode selector switches
- Safe sensors
- Semiconductor outputs, compatible with type 1 inputs per IEC 61131-2

The 750-662/000-004 F I/O module has the following features:

- Eight safety-oriented digital inputs I1 … I8
- To clock outputs T1 and T2
- Diagnostics via LED indicators and fieldbus protocol (per IEC 61784-1)
- iPar server support for saving and restoring iParameters
- Channel granular passivation of inputs
- Parameterizable channel and module properties

The inputs of the F I/O modules allow both single-channel and dual-channel operation:

- Single-channel input function: connection of a sensor to a terminal connection Ix
- Dual-channel input function: connection of a sensor to two terminal connections Ix and Ix+1

[1] Functional safety evaluations were carried out by TÜV Rheinland.

The assignment of the connections is described in the “Connectors” section.
Multicolor LEDs indicate input signal status, as well as the status and errors of the F I/O module.
The meaning of the LEDs is described in the “Display Elements” section.

The field voltage and the system voltage are electrically isolated from each other.

With consideration of the power jumper contacts, the individual modules can be arranged in any combination when configuring the fieldbus node.
An arrangement in groups within the group of potentials is not necessary.

The F I/O module 750-662/000-004 can be operated on the WAGO I/O System 750 fieldbus couplers specified in section “Technical Data” > … > “Communication”:

3.1 View

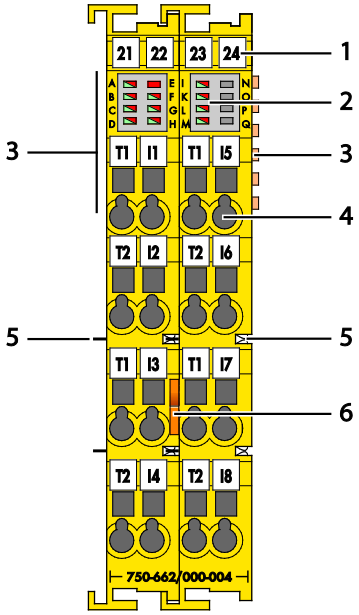


Figure 1: View

Table 3: Legend for Figure “View”

Pos.	Description	Details See Section
1	Marking possibility with Mini-WSB	---
2	Status LEDs	“Device Description” > “Display Elements”
3	Data contacts	“Device Description” > “Connectors”
4	CAGE CLAMP® connectors	“Device Description” > “Connectors”
5	Power jumper contacts	“Device Description” > “Connectors”
6	Release tab	“Mounting” > “Inserting and Removing Devices”

3.2 Connectors

3.2.1 Data Contacts/Local Bus

Communication between the fieldbus coupler/controller and the I/O modules as well as the system supply of the I/O modules is carried out via the local bus. The contacting for the local bus consists of 6 data contacts, which are available as self-cleaning gold spring contacts.

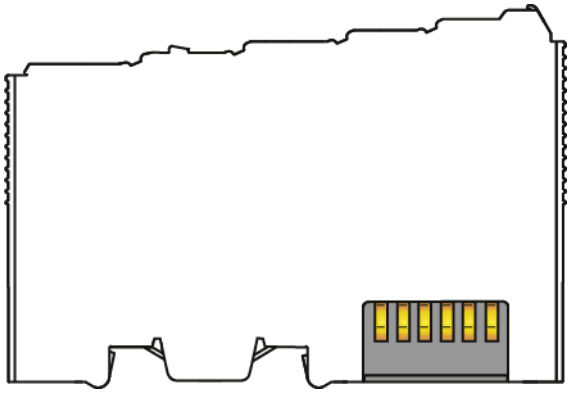


Figure 2: Data Contacts

NOTICE

Do not place the I/O modules on the gold spring contacts!
Do not place the I/O modules on the gold spring contacts in order to avoid soiling or scratching!

NOTICE

Pay attention to potential equalization from the environment!
The devices are equipped with electronic components that may be destroyed by electrostatic discharge. When handling the devices, please ensure that environmental factors (personnel, work space and packaging) are properly equalized. Do not touch any conducting parts, e.g., data contacts.

3.2.2 Power Jumper Contacts/Field Supply

⚠ CAUTION

Risk of injury due to sharp-edged blade contacts!
The blade contacts are sharp-edged. Handle the I/O module carefully to prevent injury. Do not touch the blade contacts.

The I/O module 750-662/000-004 has self-cleaning power jumper contacts that supply and transmit power for the field side. The contacts on the left side of the I/O module are designed as blade contacts and those on the right side as spring contacts.

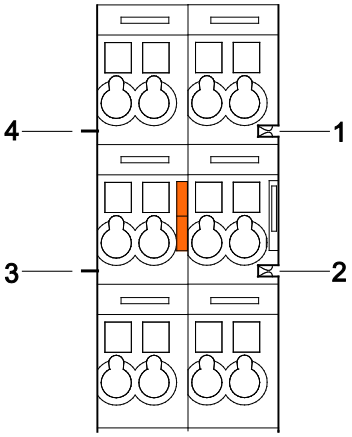


Figure 3: Power Jumper Contacts

Table 4: Legend for Figure “Power Jumper Contacts”

Contact	Type	Function
1	Spring contact	Potential transmission (U_V) for field supply
2	Spring contact	Potential transmission (0 V) for field supply
3	Blade contact	Potential feed-in (0 V) for field supply
4	Blade contact	Potential feed-in (U_V) for field supply

NOTICE

Do not exceed maximum values via power contacts!
The maximum current that can flow through the power jumper contacts is 10 A. The power jumper contacts can be damaged and the permissible operating temperature can be exceeded by higher current values.

When configuring the system, do not exceed the permissible maximum current value. If there is a higher power requirement, you must use an additional supply module to provide the field voltage.

Note

Use supply modules for ground (earth)!
The I/O module has no power jumper contacts for receiving and transmitting the earth potential. Use a supply module when an earth potential is needed for the subsequent I/O modules.

Note

Observe the information on the power supply concept!
Detailed information and examples for supplying F I/O modules is available in the section “Connect Devices” > … > “Power Supply Concept”.

3.2.3 CAGE CLAMP® Connectors

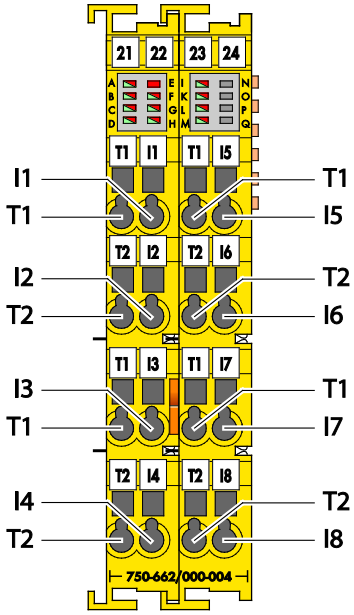


Figure 4: CAGE CLAMP® Connections

Table 5: Legend for figure “CAGE CLAMP® Connections”

Input Channel	Connection	Function
1	I1	Digital input I1
	T1	Clock output T1
2	I2	Digital input I2
	T2	Clock output T2
3	I3	Digital input I3
	T1	Clock output T1
4	I4	Digital input I4
	T2	Clock output T2
5	I5	Digital input I5
	T1	Clock output T1
6	I6	Digital input I6
	T2	Clock output T2
7	I7	Digital input I7
	T1	Clock output T1
8	I8	Digital input I8
	T2	Clock output T2

3.3 Display Elements

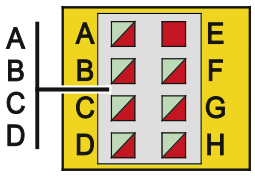


Figure 5: Indicators, Inputs 1 ... 4

Table 6: Legend for Figure “Indicators, Inputs 1 ... 4”

Input Channel	Designation	LED	Status	Function
1	Status I1	A	Off	Input I1: input voltage for logical 0 (false)
			Green	Input I1: input voltage for logical 1 (true)
			Red	Input I1: error
2	Status I2	B	Off	Input I2: input voltage for logical 0 (false)
			Green	Input I2: input voltage for logical 1 (true)
			Red	Input I2: error
3	Status I3	C	Off	Input I3: input voltage for logical 0 (false)
			Green	Input I3: input voltage for logical 1 (true)
			Red	Input I3: error
4	Status I4	D	Off	Input I4: input voltage for logical 0 (false)
			Green	Input I4: input voltage for logical 1 (true)
			Red	Input I4: error

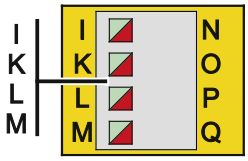


Figure 6: Indicators, Inputs 5 … 8

Table 7: Legend for Figure “Indicators, Inputs 5 ... 8”

Channel	Designation	LED	Status	Function
5	Status I5	I	Off	Input I5: input voltage for logical 0 (false)
			Green	Input I5: input voltage for logical 1 (true)
			Red	Input I5: error
6	Status I6	K	Off	Input I6: input voltage for logical 0 (false)
			Green	Input I6: input voltage for logical 1 (true)
			Red	Input I6: error
7	Status I7	L	Off	Input I7: input voltage for logical 0 (false)
			Green	Input I7: input voltage for logical 1 (true)
			Red	Input I7: error
8	Status I8	M	Off	Input I8: input voltage for logical 0 (false)
			Green	Input I8: input voltage for logical 1 (true)
			Red	Input I8: error

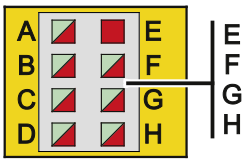


Figure 7: Communication/I/O Module Status Indicators

Table 8: Legend for Figure “Communication/I/O Module Status Indicators”

Designation	LED	Status	Function
Module error	E	Off	No error
		Red	Module or channel pair error (see section “Diagnostics” > … > “Error Diagnostics”)
		Red flashing 2 Hz	Internal safety-critical error (section “Diagnostics” > ... > “Module Error”)
Local bus communication	F	Green	Local bus communication active
		Red	Local bus communication, error
PROFIsafe status	G	Off	PROFIsafe data exchange inactive
		Green	PROFIsafe data exchange active
		Green flashing 0.5 Hz	Acknowledgment by operator required (Operator Acknowledge, OA)
		Red	No valid PROFIsafe F parameters available
		Red flashing 1 Hz	PROFIsafe communication error (CRC2 error), watchdog time (F_WD_Time) exceeded
Parameterization	H	Off	Parameterization OK
		Red	F I/O module selected via WAGO-I/O-CHECK
		Red flashing 1 Hz	iParameters invalid or F_iPar_CRC set to value not equal to iPar_CRC
		Red flashing 2 Hz	iParameters were transferred to the F I/O module, but not yet saved
		Green flashing 2 Hz	F I/O module is in PROFIsafe test mode.

The module error LED (LED E) may light up alone or in conjunction with other LEDs. Detailed information on module errors that have occurred can be found in section “Diagnostics.”

3.4 Operating Elements

You can use the coding switch located on the side of the F I/O module to set the PROFIsafe address.

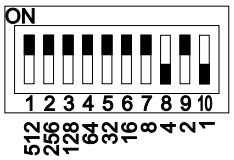


Figure 8: Coding Switch for the PROFIsafe Address (set to 1018)

Note

Coding switch is inaccessible when the I/O module is plugged in!
To set the PROFIsafe address on the coding switch, you must power down the fieldbus node and then unplug the I/O module from the fieldbus node.

Set the PROFIsafe address as described in the section "Setting the PROFIsafe Address".

3.5 Schematic Diagrams

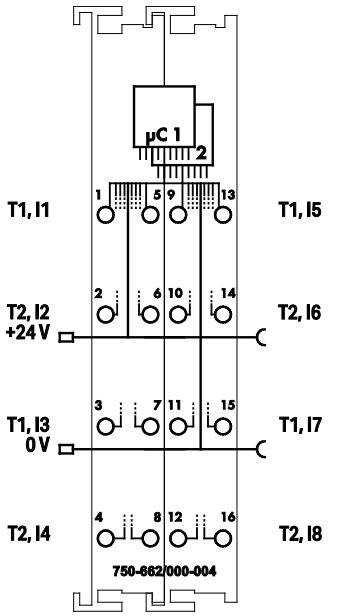


Figure 9: Schematic Circuit Diagram

3.5.1 Input Block Diagram

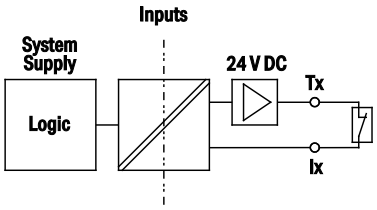


Figure 10: Input Block Diagram

3.6 Technical Data

3.6.1 Device Data

Table 9: Technical Data – Device

Width	24 mm
Depth (from upper-edge of DIN-rail)	64 mm
Height	100 mm
Weight	Approx. 100 g

3.6.2 Power Supply

Table 10: Technical Data – Power Supply via Local Bus

Nominal voltage	5 VDC from system power supply
Power consumption$_{max.}$	120 mA
Overvoltage category per IEC 61131-2 / UL 61010-2-201	II

Table 11: Technical Data – Power Supply via Power Jumper Contacts

Nominal voltage	24 VDC via power jumper contacts
Tolerance range	−25 % … +30 %
Current consumption$_{typ.}$	30 mA + load current
Current via power jumper contacts$_{max.}$	10 A
Overvoltage category per IEC 61131-2 / UL 61010-2-201	II
Reverse voltage protection for power jumper contacts	Yes
Isolation (peak value)	500 V system voltage/field level (power jumper contacts)

3.6.3 Communication

Table 12: Technical Data – Communication

Usable fieldbus couplers/controllers	750-333, SW 24 or higher
	750-375, SW 11 or higher
	750-377, SW 11 or higher
GSD specification	V2.4
Number of F I/O modules per node (fieldbus coupler/controller)$_{max.}$	See the information in the manual for the corresponding fieldbus coupler/ controller
Channel-granular passivation	Available

3.6.4 Digital Inputs

Table 13: Technical Data – Digital Inputs

Inputs	I1 … I8	8 inputs, type 1 per IEC 61131-2
Achievable safety classes		8 × Cat. 2/PL d per ISO 13849-1
		4 × Cat. 4/PL e per ISO 13849-1
		8 × SIL2 per IEC 62061
		4 × SIL3 per IEC 62061
		8 × SIL2 per IEC 61508
		4 × SIL3 per IEC 61508
Input filter time		Configurable between 0 ms and 200 ms in steps (see section “Commissioning” > … > “Input Filter Time Parameter”)
Signal voltage	0	–3 VDC … +5 VDC
	1	+15 V … +30 VDC
Input current$_{typ.}$		3.0 mA
Response times		See section “Technical Data” > … > “Response Times”
Minimum signal duration		= input filter time + test pulse duration + 2 ms

3.6.5 Digital Clock Outputs

Table 14: Technical Data – Digital Clock Outputs

Clock outputs	T1, T2	2 clock outputs
Test pulse duration	T1, T2	Between 0.5 ms and 200 ms, configurable in steps (see section “Commissioning” > … > “Test Pulse Duration Parameter”)
Nominal output current	T1, T2	100 mA
Output protection		Short circuit and overload protection
Cable length$_{max.}$	Unshielded	200 m
	Shielded	200 m

3.6.6 Safety Parameters

3.6.6.1 Single-Channel Safety Application, Duration of Use: 20 Years

Table 15: Safety Parameters for Single-Channel Safety Application – 20 Years

Maximum safety integrity level per IEC 62061		SIL 2
Maximum safety integrity level per IEC 61508		SIL 2
Maximum performance level per ISO 13849-1		Cat. 2/PL d
Duration of use		20 years
Probability of failure PFD,* duration of use: 20 years (low demand mode) (IEC 61508)	For 1 single-channel input (input to fieldbus)	3.85×10^{-5} (0.38 % of the total PFD of 10^{-2} at SIL2)
Probability of failure PFH,* duration of use: 20 years (high demand mode) (IEC 61508)	For 1 single-channel input (input to fieldbus)	4.41×10^{-10} (0.04 % of the total PFH of 10^{-6} at SIL2)
Hardware fault tolerance HFT with single-channel application (IEC 61508/ ISO 13849-1)		0 (1 error in the application can lead to a failure of the safety equipment)
DC_{AVG} (Diagnostic Coverage Level)		96 %
MTTFd (Mean Time To Dangerous Failure)		> 100 years

*) PFD: Probability of Failure on Demand
PFH: Probability of Dangerous Failure per Hour

3.6.6.2 Dual-Channel Safety Application, Duration of Use: 20 Years

Table 16: Safety Parameters for Dual-Channel Safety Application – 20 Years

Maximum safety integrity level per IEC 62061		SIL 3
Maximum safety integrity level per IEC 61508		SIL 3
Maximum performance level per ISO 13849-1		Cat. 4/PL e
Duration of use		20 years
Probability of failure PFD,* duration of use: 20 years (low demand mode) (IEC 61508)	for 1 dual-channel input (input to fieldbus)	2.29×10^{-5} (2.29 % of the total PFD of 10^{-3} at SIL3)
Probability of failure PFH,* duration of use: 20 years (high demand mode) (IEC 61508)	for 1 dual-channel input (input to fieldbus)	2.63×10^{-10} (0.26 % of the total PFH of 10^{-7} at SIL3)
Hardware fault tolerance HFT with dual-channel application (IEC 61508/ ISO 13849-1)		1 (1 error in the application does not yet lead to a failure of the safety equipment)
DC_{AVG} (Diagnostic Coverage Level)		96 %
MTTFd (Mean Time To Dangerous Failure)		> 100 years

*) PFD: Probability of Failure on Demand
PFH: Probability of Dangerous Failure per Hour

3.6.7 Connection Type

Table 17: Technical Data – Field Wiring

Connection technology	CAGE CLAMP®
Conductor cross-section	0.08 mm² … 2.5 mm², AWG 28 … 14
Strip length	8 mm … 9 mm / 0.33 in

Table 18: Technical Data – Power Jumper Contacts

Power jumper contacts	Blade/spring contact, self-cleaning

Table 19: Technical Data – Data Contacts

Data contacts	Slide contact, hard gold plated, self-cleaning

3.6.8 Climatic Environmental Conditions

Table 20: Technical Data – Climatic Environmental Conditions

Surrounding air temperature, operation	0 … 55 °C
Surrounding air temperature, storage	−40 … +85 °C
Relative humidity (without condensation)	Max. 95 %
Operating altitude	0 … 2000 m
Storage altitude	0 … 3000 m
Pollution degree	2
Protection class	III
Protection type	IP20
Resistance to harmful substances	Acc. to IEC 60068-2-42 and IEC 60068-2-43
Maximum pollutant concentration at relative humidity < 75 %	$SO_2 \leq 25$ ppm $H_2S \leq 10$ ppm

3.6.9 Safety Response Time

NOTICE

For the safety response time, take the execution times of the local bus and fieldbus and the cycle time of the safe PLC into account!
To determine the safety response time, always take the execution times of the local bus, fieldbus, sensors and actuators and the cycle time of the safe PLC into account when calculating the safety response time.

3.6.9.1 Safety Response Time of the Digital Inputs

The safety response time of the digital inputs specifies the time between when a signal change occurs at the digital input and the PROFIsafe telegram at the local bus is sent. It is part of the overall response time of a safety application.

3.6.9.1.1 Safety Response Time of the Digital Inputs for Single-Channel Applications

With single-channel use, the safety response time depends not only on the test pulse duration and input filter time of the input channel in question, but also on the input filter time of the other input channels. The dependency is illustrated in the following table:

Table 21: Safety Response Time of the Digital Inputs T(SR) in ms in Single-Channel Operation

Parameter		Short circuit test deacti-vated	Short circuit test activated									
			Test pulse duration in ms									
Input filter time of the channel in question in ms	Maximum Input filter time of all channels in ms		0.5	1	2	3	5	10	20	50	100	200
0	<5	9.2	12.8	18.3	29.3	40.3	62.3	117.4	227.5	557.8	1108.5	2209.6
0	5	10.0	12.8	18.3	29.3	40.3	62.3	117.4	227.5	557.8	1108.5	2209.6
0	10	15.0	16.2	18.3	29.3	40.3	62.3	117.4	227.5	557.8	1108.5	2209.6
0	20	25.0	26.2	27.2	29.3	40.3	62.3	117.4	227.5	557.8	1108.5	2209.6
0	50	55.0	56.2	57.2	59.2	61.2	65.2	117.4	227.5	557.8	1108.5	2209.6
0	100	105.3	106.5	107.5	109.5	111.5	115.5	125.5	227.5	557.8	1108.5	2209.6
0	200	205.6	206.8	207.8	209.8	211.8	215.8	225.8	245.8	557.8	1108.5	2209.6
0.2	<5	9.6	13.2	18.7	29.7	40.7	62.7	117.8	227.9	558.2	1108.9	2210.0
0.2	5	10.4	13.2	18.7	29.7	40.7	62.7	117.8	227.9	558.2	1108.9	2210.0
0.2	10	15.4	16.6	18.7	29.7	40.7	62.7	117.8	227.9	558.2	1108.9	2210.0
0.2	20	25.4	26.6	27.6	29.7	40.7	62.7	117.8	227.9	558.2	1108.9	2210.0
0.2	50	55.4	56.6	57.6	59.6	61.6	65.6	117.8	227.9	558.2	1108.9	2210.0
0.2	100	105.7	106.9	107.9	109.9	111.9	115.9	125.9	227.9	558.2	1108.9	2210.0
0.2	200	206.0	207.2	208.2	210.2	212.2	216.2	226.2	246.2	558.2	1108.9	2210.0

Table 24: Safety Response Time of the Digital Inputs T(SR) in ms in Single-Channel Operation

Parameter		Short circuit test deacti-vated	Short circuit test activated									
			Test pulse duration in in ms									
Input filter time of the channel in question in ms	Maximum Input filter time of all channels in ms		0.5	1	2	3	5	10	20	50	100	200
0.5	<5	9.9	13.5	19.0	30.0	41.0	63.0	118.1	228.2	558.5	1109.2	2210.3
0.5	5	10.7	13.5	19.0	30.0	41.0	63.0	118.1	228.2	558.5	1109.2	2210.3
0.5	10	15.7	16.9	19.0	30.0	41.0	63.0	118.1	228.2	558.5	1109.2	2210.3
0.5	20	25.7	26.9	27.9	30.0	41.0	63.0	118.1	228.2	558.5	1109.2	2210.3
0.5	50	55.7	56.9	57.9	59.9	61.9	65.9	118.1	228.2	558.5	1109.2	2210.3
0.5	100	106.0	107.2	108.2	110.2	112.2	116.2	126.2	228.2	558.5	1109.2	2210.3
0.5	200	206.3	207.5	208.5	210.5	212.5	216.5	226.5	246.5	558.5	1109.2	2210.3
1	<5	10.4	14.0	19.5	30.5	41.5	63.5	118.6	228.7	559.0	1109.7	2210.8
1	5	11.2	14.0	19.5	30.5	41.5	63.5	118.6	228.7	559.0	1109.7	2210.8
1	10	16.2	17.4	19.5	30.5	41.5	63.5	118.6	228.7	559.0	1109.7	2210.8
1	20	26.2	27.4	28.4	30.5	41.5	63.5	118.6	228.7	559.0	1109.7	2210.8
1	50	56.2	57.4	58.4	60.4	62.4	66.4	118.6	228.7	559.0	1109.7	2210.8
1	100	106.5	107.7	108.7	110.7	112.7	116.7	126.7	228.7	559.0	1109.7	2210.8
1	200	206.8	208.0	209.0	211.0	213.0	217.0	227.0	247.0	559.0	1109.7	2210.8
2	<5	11.4	15.0	20.5	31.5	42.5	64.5	119.6	229.7	560.0	1110.7	2211.8
2	5	12.2	15.0	20.5	31.5	42.5	64.5	119.6	229.7	560.0	1110.7	2211.8
2	10	17.2	18.4	20.5	31.5	42.5	64.5	119.6	229.7	560.0	1110.7	2211.8
2	20	27.2	28.4	29.4	31.5	42.5	64.5	119.6	229.7	560.0	1110.7	2211.8
2	50	57.2	58.4	59.4	61.4	63.4	67.4	119.6	229.7	560.0	1110.7	2211.8
2	100	107.5	108.7	109.7	111.7	113.7	117.7	127.7	229.7	560.0	1110.7	2211.8
2	200	207.8	209.0	210.0	212.0	214.0	218.0	228.0	248.0	560.0	1110.7	2211.8
3	<5	12.4	16.0	21.5	32.5	43.5	65.5	120.6	230.7	561.0	1111.7	2212.8
3	5	13.2	16.0	21.5	32.5	43.5	65.5	120.6	230.7	561.0	1111.7	2212.8
3	10	18.2	19.4	21.5	32.5	43.5	65.5	120.6	230.7	561.0	1111.7	2212.8
3	20	28.2	29.4	30.4	32.5	43.5	65.5	120.6	230.7	561.0	1111.7	2212.8
3	50	58.2	59.4	60.4	62.4	64.4	68.4	120.6	230.7	561.0	1111.7	2212.8
3	100	108.5	109.7	110.7	112.7	114.7	118.7	128.7	230.7	561.0	1111.7	2212.8
3	200	208.8	210.0	211.0	213.0	215.0	219.0	229.0	249.0	561.0	1111.7	2212.8
5	<10	15.2	18.0	23.5	34.5	45.5	67.5	122.6	232.7	563.0	1113.7	2214.8
5	10	20.2	21.4	23.5	34.5	45.5	67.5	122.6	232.7	563.0	1113.7	2214.8
5	20	30.2	31.4	32.4	34.5	45.5	67.5	122.6	232.7	563.0	1113.7	2214.8
5	50	60.2	61.4	62.4	64.4	66.4	70.4	122.6	232.7	563.0	1113.7	2214.8
5	100	110.5	111.7	112.7	114.7	116.7	120.7	130.7	232.7	563.0	1113.7	2214.8
5	200	210.8	212.0	213.0	215.0	217.0	221.0	231.0	251.0	563.0	1113.7	2214.8
10	<20	25.2	26.4	28.5	39.5	50.5	72.5	127.6	237.7	568.0	1118.7	2219.8
10	20	35.2	36.4	37.4	39.5	50.5	72.5	127.6	237.7	568.0	1118.7	2219.8
10	50	65.2	66.4	67.4	69.4	71.4	75.4	127.6	237.7	568.0	1118.7	2219.8
10	100	115.5	116.7	117.7	119.7	121.7	125.7	135.7	237.7	568.0	1118.7	2219.8
10	200	215.8	217.0	218.0	220.0	222.0	226.0	236.0	256.0	568.0	1118.7	2219.8
20	<50	45.2	46.4	47.4	49.5	60.5	82.5	137.6	247.7	578.0	1128.7	2229.8
20	50	75.2	76.4	77.4	79.4	81.4	85.4	137.6	247.7	578.0	1128.7	2229.8
20	100	125.5	126.7	127.7	129.7	131.7	135.7	145.7	247.7	578.0	1128.7	2229.8
20	200	225.8	227.0	228.0	230.0	232.0	236.0	246.0	266.0	578.0	1128.7	2229.8

Table 24: Safety Response Time of the Digital Inputs T(SR) in ms in Single-Channel Operation

Parameter		Short circuit test deacti-vated	Short circuit test activated									
			Test pulse duration in ms									
Input filter time of the channel in question in ms	Maximum Input filter time of all channels in ms		0.5	1	2	3	5	10	20	50	100	200
50	<100	105.2	106.4	107.4	109.4	111.4	115.4	167.6	277.7	608.1	1158.7	2259.8
50	100	155.5	156.7	157.7	159.7	161.7	165.7	175.7	277.7	608.1	1158.7	2259.8
50	200	255.8	257.0	258.0	260.0	262.0	266.0	276.0	296.0	608.1	1158.7	2259.8
100	<200	205.7	206.9	207.9	209.9	211.9	215.9	225.9	327.9	658.2	1208.9	2310.0
100	200	306.0	307.2	308.2	310.2	312.2	316.2	326.2	346.2	658.2	1208.9	2310.0
200	200	406.2	407.4	408.4	410.4	412.4	416.4	426.4	446.4	758.4	1309.1	2410.2

3.6.9.1.2 Safety Response Time of the Digital Inputs in Dual-Channel Applications

In dual-channel applications, the safety response time depends exclusively on the module-wide test pulse duration setting and the input filter time of the channel pair.

Table 22: Safety Response Time of the Digital Inputs T(SR) in ms in Dual-Channel Operation

Input filter time parameter in ms	Short circuit test deacti-vated	Short circuit test activated									
		Test pulse duration in ms									
		0,5	1	2	3	5	10	20	50	100	200
0	4.1	4.7	5.2	6.2	7.2	9.2	14.2	24.2	54.2	104.3	204.4
0,2	4.5	5.1	5.6	6.6	7.6	9.6	14.6	24.6	54.6	104.7	204.8
0,5	4.8	5.4	5.9	6.9	7.9	9.9	14.9	24.9	54.9	105.0	205.1
1	5.3	5.9	6.4	7.4	8.4	10.4	15.4	25.4	55.4	105.5	205.6
2	6.3	6.9	7.4	8.4	9.4	11.4	16.4	26.4	56.4	106.5	206.6
3	7.3	7.9	8.4	9.4	10.4	12.4	17.4	27.4	57.4	107.5	207.6
5	9.3	9.9	10.4	11.4	12.4	14.4	19.4	29.4	59.4	109.5	209.6
10	14.3	14.9	15.4	16.4	17.4	19.4	24.4	34.4	64.4	114.5	214.6
20	24.3	24.9	25.4	26.4	27.4	29.4	34.4	44.4	74.4	124.5	224.6
50	54.3	54.9	55.4	56.4	57.4	59.4	64.4	74.4	104.5	154.5	254.6
100	104.5	105.1	105.6	106.6	107.6	109.6	114.6	124.6	154.6	204.7	304.8
200	204.7	205.3	205.8	206.8	207.8	209.8	214.8	224.8	254.8	304.9	405.0

3.7 Approvals

For current approvals, please go to: www.wago.com/<Item number>.

Information

Functional safety evaluations by TÜV Rheinland
The module 750-662/000-004 has been evaluated by UL in accordance with the standards UL/CSA 61010-1, UL/CSA 61010-2-201 and UL 121201, CSA-C22.2 No. 213.

Functional safety evaluations according to the specified standards were carried out by TÜV Rheinland.

The following approvals have been granted to the F I/O module 750-662/000-004:

Conformity Marking

Ordinary Locations	UL 61010-1 UL 61010-2-201

TÜV Rheinland-certified according to the following standards

IEC 61508, parts 1-7:2010
EN ISO 13849-1:2015
EN ISO 13849-2:2012

The following Ex approvals have been granted to the F I/O module 750-662/000-004:

Hazardous Locations	UL 121201

Class I, Div2 ABCD T4

The following ship approvals have been granted to the F I/O module 750-662/000-004:

Federal Maritime and Hydrographic Agency

DNV
[Temperature: B, Humidity: B, Vibration: B, EMC: B, Enclosure: A]

3.7.1 Applications

The F I/O module can be used in the following applications:

- IEC 62061:2021 up to SIL 3
- EN 61511-1:2017 + A1:2017 up to SIL 3
- IEC 61511-1:2016 + COR1:2016 + A1:2017 up to SIL 3
- EN ISO 13849-1:2015 up to Cat. 4 PL e
- EN ISO 13849-2:2012

3.8 Standards and Guidelines

The F I/O module 750-662/000-004 meets the following standards and guidelines:

Safety of machinery – Functional safety of safety-related electrical / electronic / programmable electronic control systems	IEC 61508/EN 61508, Parts 1-7
Safety of machinery – Safety-related parts of controllers	EN ISO 13849, parts 1-2
Safety of machinery – Functional safety of safety-related electrical / electronic / programmable electronic control systems	IEC 62061
Functional safety – Safety instrumented systems for the process industry sector	IEC 61511, Parts 1-3
EU EMC Directive	2014/30/EU
EMC CE-Immunity to interference	IEC 61000-6-2
and	IEC 61131-2
EMC CE emission of interference	IEC 61000-6-3
and	IEC 61131-2
EMC requirements -	IEC 61000-6-7
and	IEC 61326-3-1

Electrical equipment for measurement, control and laboratory use - Immunity requirements for safety-related systems and for equipment intended to perform safety-related functions (functional safety) – General industrial applications

3.8.1 Transport and Storage Conditions

During transport and storage, the F I/O modules must be protected against undue stress such as mechanical loads, temperature, humidity and aggressive atmospheres.

The F I/O modules should be stored in the original packaging when possible, which offers optimal protection during transport.

When picking or unpacking, do not contaminate or damage the contacts. The F I/O modules must be stored and transported in suitable containers/packaging in compliance with the ESD instructions. The devices contain components sensitive to static discharge and can be damaged by improper handling.

Therefore, when transporting open modules, use statically shielded transport bags with metal coating to prevent contamination from amines, amides and silicones such as 3M 1900E.

In addition, take the required protective measures against electrostatic discharge (ESD) during commissioning and maintenance of the F I/O modules.

NOTICE

Ensure that the environment is well grounded!
The devices are equipped with electronic components that may be destroyed by electrostatic discharge. When handling the devices, ensure that the environment (persons, workplace and packing) is well grounded. Avoid touching conductive components, e.g. data contacts.

4 Process Image

The 750-662/000-004 F I/O module occupies 7 data bytes in the input process image and 5 data bytes in the output process image on the fieldbus. The secure PROFIsafe telegrams to send and receive are stored in input bytes 0 ... … 6 and in output bytes 0 … 4.

The process image contains different data depending on whether the F I/O module is operated in PROFIsafe Mode V2.4 or PROFIsafe Mode V2.6.

DANGER

Only use process values transmitted via PROFIsafe for safety-related applications
Process values received via communication paths other than the secure protocol must not be used for safety-related applications.

Note

The F parameters are used to set the PROFIsafe mode!
The F parameters are used to set the respective PROFIsafe mode (V2.4 or V2.6), see Section “Appendix” > … > “PROFIsafe F Parameters”.

4.1 PROFIsafe Mode V2.4

Table 23: Process Image PROFIsafe Mode V2.4

Input Data		Output Data	
Byte 0	Input process value	Byte 0	WAGO control byte
Byte 1	Input channel status byte	Byte 1	PROFIsafe control byte
Byte 2	WAGO status byte	Byte 2	PROFIsafe CRC
Byte 3	PROFIsafe status byte	Byte 3	PROFIsafe CRC
Byte 4	PROFIsafe CRC	Byte 4	PROFIsafe CRC
Byte 5	PROFIsafe CRC	Byte 5	–
Byte 6	PROFIsafe CRC	Byte 6	–

4.2 PROFIsafe-Modus V2.6

Note

The process image is structured according to RIOforFA
Since the process image is structured according to RIOforFA, the channel status byte contains the “RIOforFA Qualifier.”

Table 24: Process Image PROFIsafe Mode V2.6

Input Data		Output Data	
Byte 0	Input process value	Byte 0	PROFIsafe control byte
Byte 1	Input channel status byte	Byte 1	PROFIsafe CRC
Byte 2	PROFIsafe status byte	Byte 2	PROFIsafe CRC
Byte 3	PROFIsafe CRC	Byte 3	PROFIsafe CRC
Byte 4	PROFIsafe CRC	Byte 4	PROFIsafe CRC
Byte 5	PROFIsafe CRC	Byte 5	–
Byte 6	PROFIsafe CRC	Byte 6	–

4.3 Input process value

Table 25: Input Process Value

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
DI8	DI7	DI6	DI5	DI4	DI3	DI2	DI1

4.4 Input channel status byte

Table 26: Input Channel Status Byte

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Status DI8	Status DI7	Status DI6	Status DI5	Status DI4	Status DI3	Status DI2	Status DI1

4.5 WAGO status byte

Table 27: PROFIsafe Status Byte

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Res	Cons_nr_R	Toggle_d	FV_activated	WD_Timeout	CE_CRC	ChF_Ack_Req	iPar_OK

4.6 PROFIsafe status byte

Table 28: PROFIsafe Status Byte

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Res	Cons_nr_R	Toggle_d	FV_activated	WD_Timeout	CE_CRC	ChF_Ack_Req	iPar_OK

4.7 WAGO control byte

Table 29: WAGO Control Byte

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
ChF_Ack *	–	–	–	–	–	–	–

*) Use of “ChF_Ack” is described in Section “Diagnostics” > “Acknowledging Error Messages”.

4.8 PROFIsafe control byte

Table 30: PROFIsafe Control Byte

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Loopcheck	ChF_Ack	Toggle_h	activate_FV	Use_TO2	Cons_nr_R	OA_Req	iPar_EN

5 Mounting

DANGER

Do not work when devices are energized!
High voltage can cause electric shock or burns.
Switch off all power to the device prior to performing any installation, repair or maintenance work.

CAUTION

Risk of injury due to sharp-edged blade contacts!
The blade contacts are sharp-edged. Handle the I/O module carefully to prevent injury. Do not touch the blade contacts.

NOTICE

Do not contaminate contacts!
Contamination may negatively impact the functionality of data and power jumper contacts. Do not touch the contacts. Avoid contaminating the contacts.

NOTICE

Do not place the I/O modules on the gold spring contacts!
Do not place the I/O modules on the gold spring contacts in order to avoid soiling or scratching!

NOTICE

Pay attention to potential equalization from the environment!
The devices are equipped with electronic components that may be destroyed by electrostatic discharge. When handling the devices, please ensure that environmental factors (personnel, work space and packaging) are properly equalized. Do not touch any conducting parts, e.g., data contacts.

NOTICE

Follow the installation instructions!
Only install this device in dry, indoor rooms.
Do not install the device on or in the vicinity of easily flammable materials!

5.1 Mounting Sequence

Fieldbus couplers, controllers and I/O modules of the WAGO I/O System 750 are snapped directly on a carrier rail in accordance with the European standard EN 60175 (DIN 35).

The reliable positioning and connection is made using a tongue and groove system. Due to the automatic locking, the individual devices are securely seated on the rail after installation.

Starting with the fieldbus coupler or controller, the I/O modules are mounted adjacent to each other according to the project design. Errors in the design of the node in terms of the potential groups (connection via the power contacts) are recognized, as the I/O modules with power contacts (blade contacts) cannot be linked to I/O modules with fewer power contacts.

NOTICE

Insert I/O modules only from the proper direction!
All I/O modules feature grooves for power jumper contacts on the right side. For some I/O modules, the grooves are closed on the top. Therefore, I/O modules featuring a power jumper contact on the left side cannot be snapped from the top. This mechanical coding helps to avoid configuration errors, which may destroy the I/O modules. Therefore, insert I/O modules only from the right and from the top.

Note

Don't forget the bus end module!
Always plug a bus end module (e.g. 750-600) onto the end of the fieldbus node! You must always use a bus end module at all fieldbus nodes with WAGO I/O System 750 fieldbus couplers or controllers to guarantee proper data transfer.

5.2 Inserting and Removing Devices

5.2.1 Inserting the I/O Module

1. Position the I/O module in such a way that the groove and spring are connected to the preceding and following components.

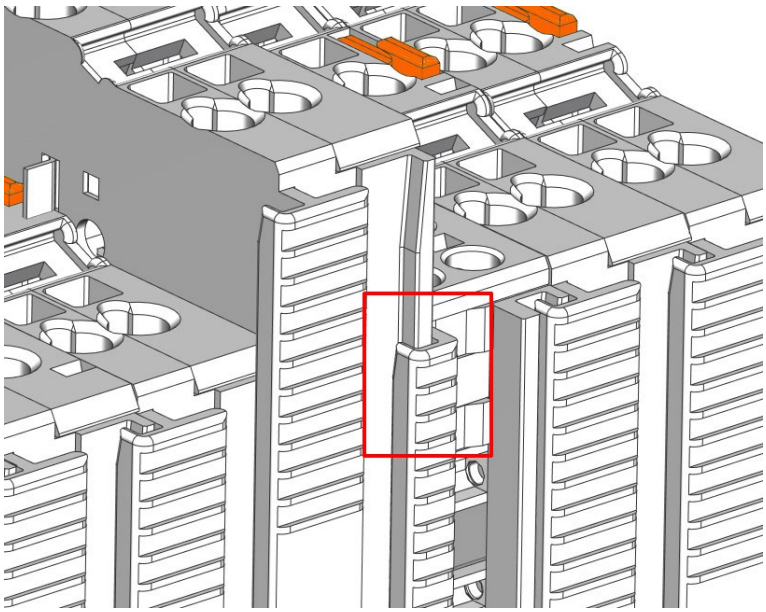


Figure 11: Inserting I/O Module (Example)

2. Press the I/O module into the assembly until the I/O module snaps into the carrier rail.

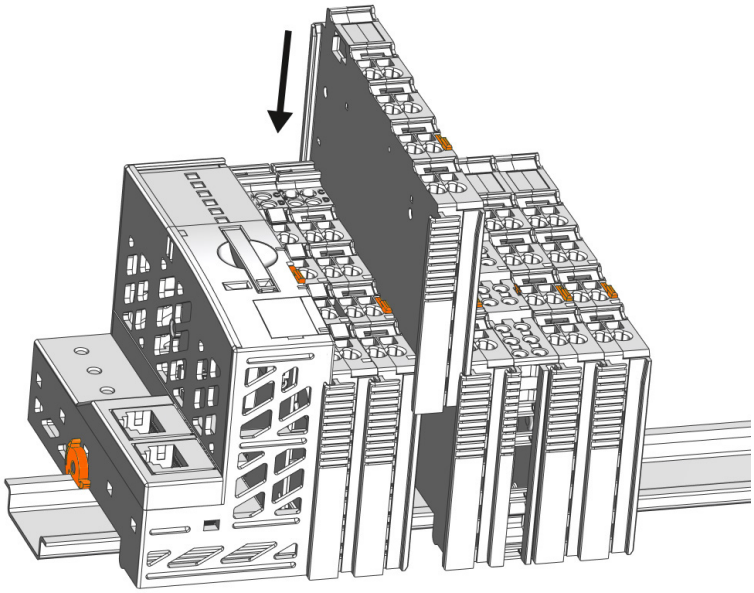


Figure 12: Snap the I/O Module into Place (Example)

3. Check that the I/O module is seated securely on the carrier rail and in the assembly. The I/O module must not be inserted crooked or askew.

Once the I/O module has snapped into place, the electrical connections for the data contacts and power contacts (if any) to the head station or to the preceding and, if applicable, following I/O module are established.

5.2.2 Removing the I/O Module

1. Remove the I/O module from the assembly by pulling the release tab.

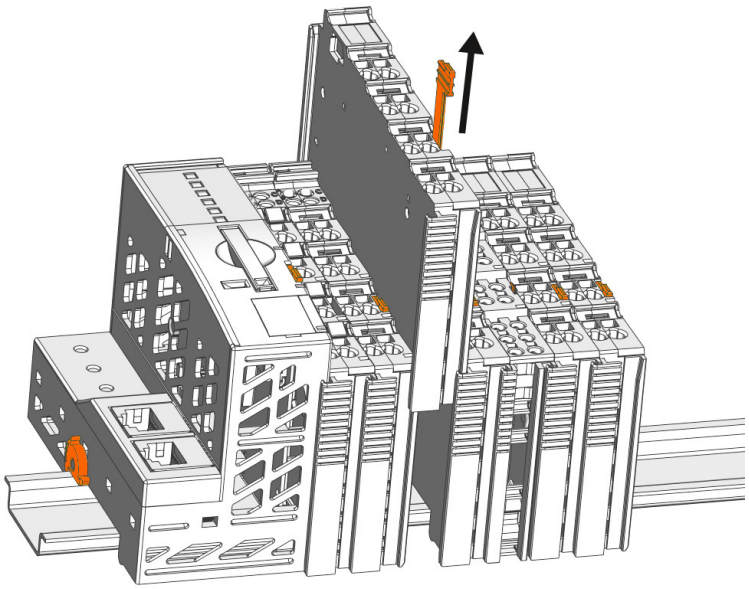


Figure 13: Removing the I/O Module (Example)

Electrical connections for data or power jumper contacts are disconnected when removing the I/O module.

6 Connect Devices

6.1 Connecting a Conductor to the CAGE CLAMP®

The WAGO CAGE CLAMP® connection is appropriate for solid, stranded and finely stranded conductors.

Note

Only connect one conductor to each CAGE CLAMP®!
Only one conductor may be connected to each CAGE CLAMP®.
Do not connect more than one conductor at one single connection!

If more than one conductor must be routed to one connection, these must be connected in an up-circuit wiring assembly, for example using WAGO feed-through terminals.

1. For opening the CAGE CLAMP® insert the actuating tool into the opening above the connection.
2. Insert the conductor into the corresponding connection opening.
3. For closing the CAGE CLAMP® simply remove the tool. The conductor is now clamped firmly in place.

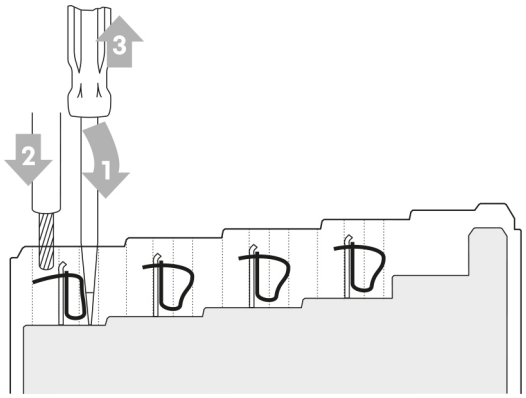


Figure 14: Connecting a Conductor to a CAGE CLAMP®

6.2 Additional Information on the Power Supply

NOTICE

Consider power layout of the WAGO I/O System 750

In addition to these operating instructions, you will also need the manual for the used fieldbus coupler or controller, which can be downloaded at www.wago.com. There, you can obtain important information including information on electrical isolation, system power and supply specifications.

⚠ WARNING

Avoid surge voltage

F I/O modules may only be supplied with power that does not have any surge voltages (burst and surge per IEC 61326-3-1 or IEC 61000-7). It may be necessary to install an external field supply filter or filter module.
You can use modules 750-624, 750-626, 750-626/020-000 and 750-626/020-002 for filtering.
Modules 750-626/020-000 and 750-626/020-002 are particularly suitable for systems monitored for ground faults (e.g., maritime applications).
Note that the cable length from the filter to the fieldbus node must be as short as possible.

6.2.1 Disturbances in the Supply Voltage

Voltage dips may occur when very high capacitive loads are switched. If the supply voltage falls below the permissible value, this can lead to passivation of the F I/O module. To prevent unwanted passivation, low-impedance supply lines and sufficient power supply units must be used. Alternatively in addition, a capacitor can be used to support the field supply voltage for the digital inputs. For the WAGO I/O System, a capacitive buffer module (e.g., Item No. 787-880) can be used to bridge short duration voltage drops or load fluctuations in the field supply voltage.

7 Commissioning

7.1 Commissioning and Maintenance Instructions

⚠ WARNING

Only qualified persons may perform the work!
Adding and commissioning F I/O modules may only be carried out by personnel trained in safety-related procedures!

⚠ WARNING

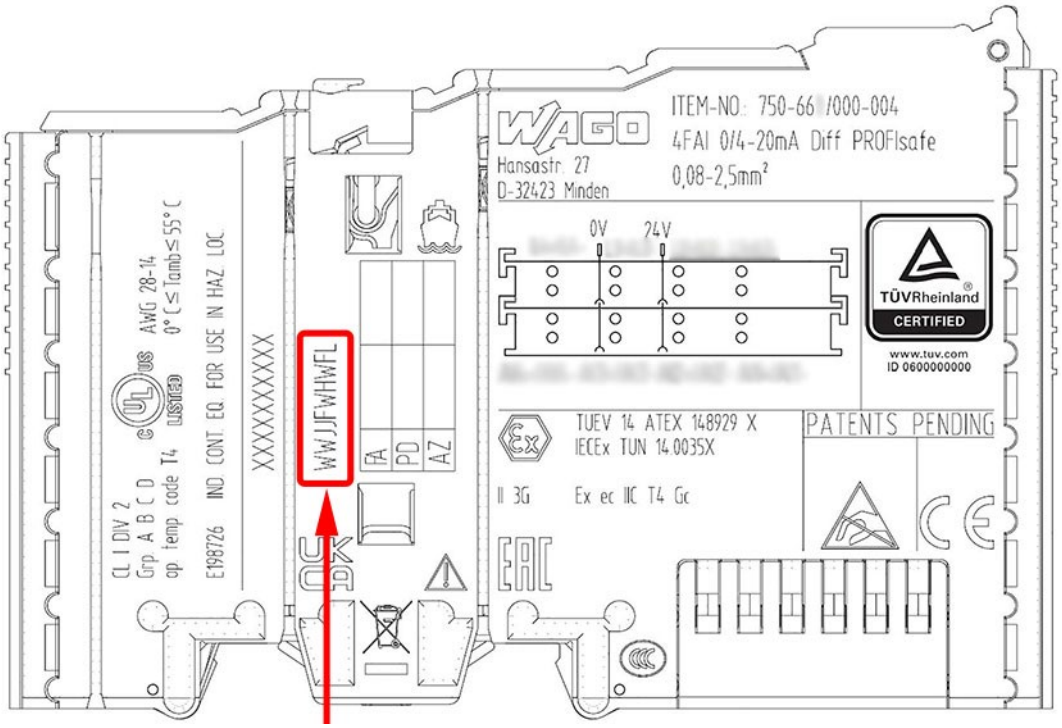
Check safety functions!
Before commissioning, all safety functions must be checked for their specified effectiveness!

⚠ WARNING

Protect against unauthorized modification of the iParameters!
As stated in ISO 13849-1, unauthorized modification of the iParameters must be prevented. This must be accomplished by secure protection of the F PLC or a secure application project.

7.1.1 Duration of Use

During the final production inspection of the F I/O modules, the serial number is affixed to the housing along with the date of manufacture.



Production number

WW	JJ	FW	HW	FL
Calendar week	Year	Software Version	Hardware Version	Firmware Loader Version

Figure 15: Example of a serial number

The serial number consists of the week and year of manufacture, firmware version (if available), hardware version, firmware loader version (if available) of the F I/O module.

The date of manufacture (calendar week/year) marks the beginning of the duration of usage.

The duration of use is specified in the technical data of the respective F I/O module.

When the duration of use ends, the F I/O module must be replaced.

7.1.2 Adding or Replacing Components

⚠ WARNING

Check safety functions!
If F I/O modules are added to a fieldbus node (see section “Mounting” > ... > “Inserting and Removing Devices”) or replaced (see section “Service” > ... > “Replacing an F I/O Module”), the associated safety function should undergo additional testing before commissioning the machine or system.

7.2 Setting the PROFIsafe Address in the F I/O Module

The PROFIsafe address can be set by the coding switch of the F I/O module, by the WAGO parameterization tool or by the engineering tool of the safe PLC.
The PROFIsafe address set on the coding switch of the F I/O module has priority over the PROFIsafe address set by the WAGO parameterization tool or by the engineering tool of the safe PLC.
Only when the address set on the coding switch equals 0 does the setting of the PROFIsafe address using the WAGO parameterization tool take effect.

Note

Default status address setting
In the default status, the address setting by the coding switch is active.

7.2.1 Setting the PROFIsafe Address using the Coding Switch

NOTICE

Disconnect the power from the node before making the settings!
Switch off the fieldbus node before you pull the F I/O module out of the fieldbus node to change the settings!

NOTICE

Use only appropriate tools to change the settings!
To set the switching elements of the coding switch, use only suitable objects.
Never exert pressure on the switching elements.

Note

Coding switch is inaccessible when the I/O module is plugged in!
To set the PROFIsafe address on the coding switch, the F I/O module must be pulled out of the fieldbus node.

Use the switching elements of the coding switch to set the PROFIsafe address to a value from 1 to 1023.

7.2.2 Setting the PROFIsafe Address using the WAGO Parameterization Tool

To configure the PROFIsafe address through storage in the iParameter set of the F I/O module, set the PROFIsafe address in the WAGO parameterization tool to the required value and save the current iParameter set to the F I/O module.

Configuring the F I/O module is described in the section “Parameteriziation of the F I/O module with the WAGO Parameterization Tool”.

7.2.3 Setting the PROFIsafe Address via the GSD

7.2.3.1 Initial Assignment of a PROFIsafe Address via the GSD

If a new PROFIsafe address is assigned to the F I/O module via the GSD, then the F I/O module issues a diagnostic message before the confirmation is completed and does not allow safe operation. The F I/O module reports diagnosis 0x0040 (different F_Dest_Add), because, although the new PROFIsafe address has not yet been applied, the F parameters have already been transferred to the F I/O module with the new value.

Note

Set PROFIsafe address to “0” when setting via coding switch
If the PROFIsafe address is set via the coding switch, then the PROFIsafe address in the GSD must be set to the value “0.”

The PROFIsafe address can be set via the GSD parameters of the F I/O module. Upon delivery, the value “0” is preset for the PROFIsafe address in the GSD. This value is invalid according to the PROFIsafe specification and must therefore be changed to a valid value via the GSD before the PROFIsafe address is used. To do so, a value between 1 and 65534 must be entered in the corresponding input field. In addition, the checksum must be calculated using the WAGO parameterization tool (see section “Offline Parameterization of the F I/O Module with the Engineering Tool of the Safe PLC”) and also entered in the corresponding input field.

If the PROFIsafe address set via the coding switch is used, the GSD parameter of the PROFIsafe address is ignored.

7.2.3.1.1 Checking the PROFIsafe Address Set via the GSD

The PROFIsafe address set via the GSD is saved together with the iParameters in the project of the engineering tool of the safe PLC. When the project is transferred to the controller and the controller is then started, the PROFIsafe address set via the GSD and the iParameters are transferred to the corresponding F I/O module simultaneously. The F I/O module automatically detects a new PROFIsafe address.

Before the new PROFIsafe address is taken over by the F I/O module, the PROFIsafe address must be checked manually and then confirmed. For this purpose, the F I/O module displays the value of the PROFIsafe address on LEDs A–H in three steps:

1. Display of the beginning of the representation sequence
   All the LEDs light up yellow/orange for two seconds.

2. Display of the lower eight bits of the PROFIsafe address
   All the LEDs light up red for two seconds according to the bit settings. LED A represents bit 1, and LED H represents bit 8.

3. Display of the upper eight bits of the PROFIsafe address
   All the LEDs light up green for two seconds according to the bit settings. LED A represents bit 9, and LED H represents bit 16.

These three steps are repeated consecutively until either the new PROFIsafe address is confirmed, a PROFIsafe address with the value “0” is set, or an interruption of the power supply causes the setting to be discarded.

Note

Read the value of the PROFIsafe address with the WAGO parameterization tool
The WAGO parameterization tool offers the option of displaying and printing the PROFIsafe address representation. It is advisable to visually compare the display on the LEDs to the printout or the display of the WAGO parameterization tool instead of reading the value of the PROFIsafe address from the LEDs.

The iParameters and the PROFIsafe address are not taken over by the F I/O module until the PROFIsafe address has been confirmed.

If the value “0” is set for the PROFIsafe address via the GSD, then the F I/O module takes over the setting immediately. Verification and confirmation of this PROFIsafe address are not required.

7.2.3.1.2 Confirmation of the PROFIsafe Address Set via the GSD

If the representation of the PROFIsafe address set via the GSD on the LEDs matches the expected value of the PROFIsafe address, confirmation of this PROFIsafe address must be transmitted to the F I/O module.

⚠ WARNING

Do not confirm if PROFIsafe address differs
If the representation of the PROFIsafe address differs from the expected value, the PROFIsafe address must not be confirmed. An incorrect address may have been set. In this case, correct the value of the PROFIsafe address in the engineering tool of the safe PLC.

For use of a Siemens S715xxF controller, WAGO provides a function block for confirming the PROFIsafe address that was set via the GSD. This function block is described in an application note. The procedure for confirmation when using a different controller is also described in an application note.

When the confirmation of the new PROFIsafe address is received, the F I/O module takes over the iParameters and the new PROFIsafe address. Display of the PROFIsafe address on the LEDs terminates.

7.2.3.2 Changing the PROFIsafe Address Set via the GSD

The F I/O module prevents assignment of a new PROFIsafe address via the engineering tool of the safe PLC if a value other than “0” is preset in the F I/O module. Therefore, if the PROFIsafe address needs to be changed via the engineering tool of the safe PLC, the value “0” must first be set for the PROFIsafe address and transferred to the F I/O module. The new PROFIsafe address can then be assigned as described in the previous section.

If a new PROFIsafe address is set for an F I/O module via the GSD and the PROFIsafe address currently stored in the F I/O module is not equal to “0,” then the F I/O module generates corresponding diagnostics. The iParameters and the PROFIsafe address that was set via the GSD are not taken over by the F I/O module.

7.3 Parameterization of the F I/O Module with the WAGO Parameterization Tool

⚠ WARNING

Check the iParameter settings!
After the parameterization of the F I/O module, the parameters read back from the F I/O module must be compared to the expected values and confirmed. The new parameters take effect after being confirmed.

Note

Verify that the parameterization LED is illuminated
After selecting the F I/O module, check that the F I/O module parameterization LED is illuminated! A detailed description of indicators is available in section “Device Description” > “Indicators.”

Depending on the call option, WAGO Safety Editor is started in either ONLINE or OFFLINE mode.

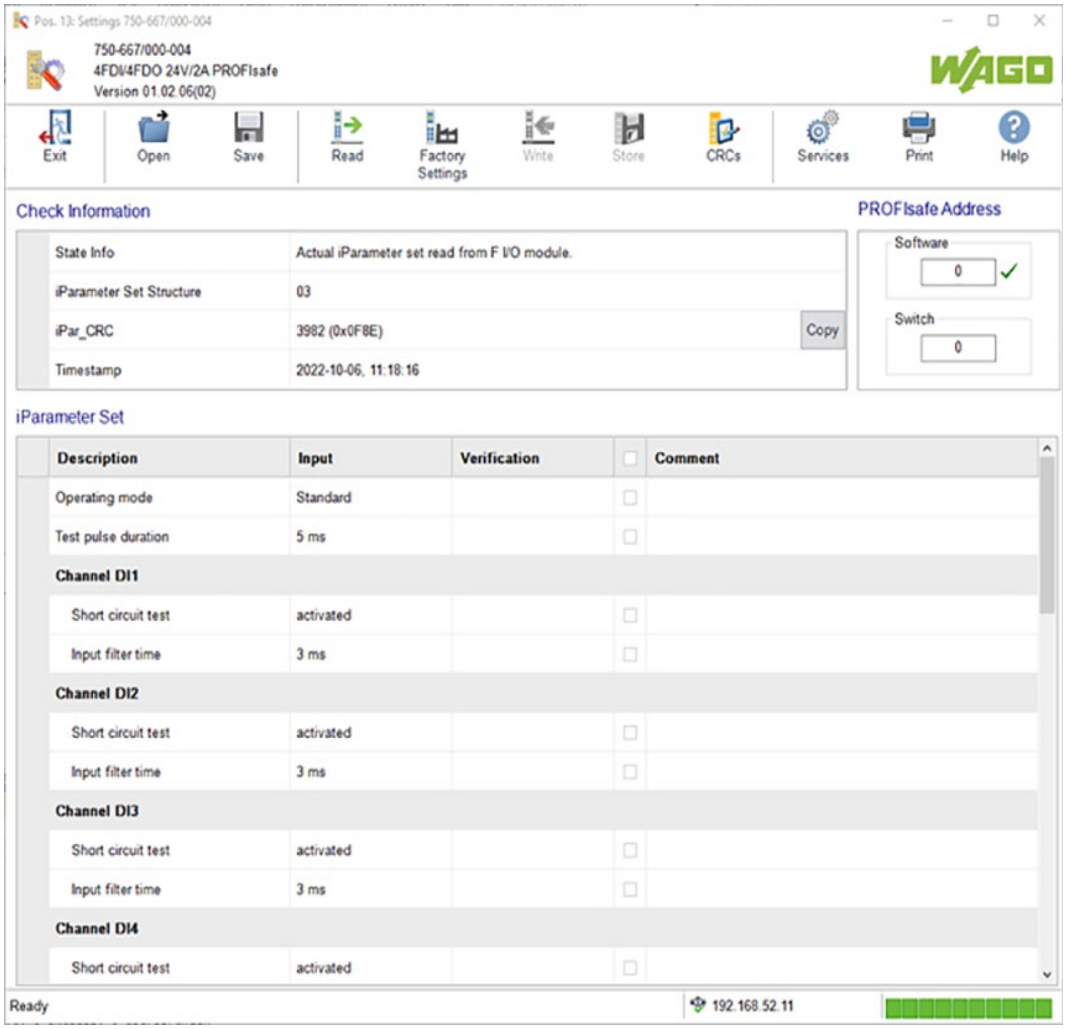


Figure 16: Start View of WAGO Safety Editor (Example)

7.3.1 ONLINE Mode

ONLINE mode is used to change the iParameter settings of an F I/O module directly.

7.3.1.1 Reading iParameters from the Module or Parameter File

When WAGO Safety Editor is launched, the current iParameter set of the F I/O module is read from permanent memory of the F I/O module and displayed in the **Input** column of the iParameter set table in the Safety Editor.

To access existing parameter files, click the **[Open]** button in the WAGO Safety Editor toolbar.

In the **Open WAGO iParameter Set** dialog, select the folder from which the file is to be loaded and enter a name for the parameter file. To load this file from the specified location, click the **[Open]** button.

Another **iParameter Set Description** dialog opens. In this dialog, check the information concerning the project, changes made and persons responsible and change the information if necessary. Click **[OK]** to confirm the information entered.

7.3.1.2 Writing iParameters to the Module or Parameter File

In the **Input** column of the iParameter set table, you can make the desired changes to the iParameter values.

After selecting an iParameter, you can select the iParameter values from a selection field or enter them directly.

If an iParameter value is changed, it is marked with a pencil icon that appears in the first column of the iParameter set table. Invalid values are marked in red and must be modified.

After changing the iParameter values, transfer them into the F I/O module. To do so, click the **[Write]** button in the WAGO Safety Editor toolbar.

If you have assigned a password for the F I/O module, you are then asked to enter it. After the password is entered, the parameter values are transferred and verified by the F I/O module.

The F I/O module performs an internal check of the transferred iParameter values. If the iParameter verification fails, an error message is output.

The verified iParameter values are then read out of the F I/O module and displayed in the **Verification** column of the iParameter set table of WAGO Safety Editor.

Now compare the iParameter values of the **Input** column to the values of the **Verification** column row by row. If the values are identical, mark the row as verified by checking the box to the right of the **Verification** column.

Once all rows have been verified (all boxes are checked), the box in the column header is checked automatically.

Now save the new iParameter values permanently in the F I/O module by clicking the **[Save]** button in the WAGO Safety Editor toolbar.

The F I/O module now permanently stores the iParameter values in the F I/O module. The values are then read out once again and displayed in the **Input** column of the iParameter set table for another check.

If all settings are correct, save the iParameter set in a parameter file. Click the **[Save]** button in the WAGO Safety Editor toolbar to save the iParameter set.

The **iParameter Set Description** dialog opens for a more detailed description of the parameter file. In this dialog, enter information about the project, the changes made and the persons responsible. Click **[OK]** to confirm the information entered.

Then the **Save WAGO iParameter Set** dialog opens. Enter a name for the parameter file and select the folder where the file is to be saved. Then click **[Save]** to save the file to the specified location.

To print the iParameter values and the information on the parameter file, click the **[Print]** button in the WAGO Safety Editor toolbar.

7.3.2 OFFLINE Mode

OFFLINE mode is used to create or change iParameter settings of an F I/O module in a parameter file.

7.3.2.1 Reading from a Parameter File

When WAGO Safety Editor is launched, specify whether you want to change a parameter file that is already saved on the computer or to create a new parameter file.

If you want to change a parameter file that saved on the computer, you are taken to the storage location of the last saved parameter file.

If you want to create a new parameter file, you are taken to the storage location of the default parameter files. Based on the names of these files, you can tell the type of the supported F I/O module.

In the **Open WAGO iParameter Set** dialog, enter the name of the parameter file to load. Then click the **[Open]** button to load the selected file.

Another **iParameter Set Description** dialog opens. In this dialog, check the information concerning the project, changes made and persons responsible and change the information if necessary. Click **[OK]** to confirm the information entered.

7.3.2.2 Writing to a Parameter File

In the **Input** column of the iParameter set table of WAGO Safety Editor, you can make the desired changes to the iParameter values.

After selecting an iParameter, you can select the parameter values from a selection field or enter them directly.

If all settings are correct, save the iParameter set in a parameter file. Click the **[Save]** button in the WAGO Safety Editor toolbar.

The **iParameter Set Description** dialog opens for a more detailed description of the parameter file. In this dialog, enter information about the project, the changes made and the persons responsible. Click the **[OK]** button to confirm the information you entered.

Then the **Save WAGO iParameter Set** dialog opens. Enter a name for the parameter file and select the folder where the file is to be saved. Then click **[Save]** to save the file to the specified location.

To print the iParameter values and the information on the parameter file, click the **[Print]** button in the WAGO Safety Editor toolbar.

7.3.3 Other Services for OFFLINE and ONLINE Mode

7.3.3.1 Comparing iParameter Sets

WAGO Safety Editor provides additional services. Click the **[Services]** button in the WAGO Safety Editor toolbar. A selection menu appears with the **Compare** menu item.

Note

Comparison of iParameter settings
This function can only be used to compare iParameter settings with the same F I/O module type and iParameter set format.

To compare two iParameter sets with each other, select the **Compare** menu item. The **Comparison of iParameter Sets** dialog opens.

To load a parameter file saved on the computer for comparison, click the **[Open]** button and specify whether the iParameter set should appear in the “Reference” or “Comparison” column.

To load the iParameter settings from the F I/O module that is currently connected for comparison in ONLINE mode, click the **[Read]** button and specify whether the iParameter set should appear in the “Reference” or “Comparison” column.

To reset the comparison dialog to its original state, click the **[Delete]** button.

To print the results of the comparison between to iParameter sets, click the **[Print]** button.

To exit the WAGO Safety Editor comparison dialog, click the **[Close]** button.

To close WAGO Safety Editor, click the **[Exit]** button in the WAGO Safety Editor toolbar.

7.3.3.2 Change Password

Note

Changing the password
Use this function to reset the current password of an F I/O module.

To change the password, select the **Password** menu item.

If you have not assigned a password to the selected F I/O module, you can specify a password in the **Change F I/O Module Password** dialog.

If you have already assigned a password, then you have to enter the current password and the new password.

If you do not know the current password, you can use the master password to assign a new one. The master password is 16 characters long and is)[4~>#%qM}x=,:$~.

To close WAGO Safety Editor, click the **[Exit]** button in the WAGO Safety Editor toolbar.

7.3.4 Description of the Call Options

WAGO Safety Editor can be started with various call options. Depending on the call option, WAGO Safety Editor is started in either ONLINE or OFFLINE mode.

In ONLINE mode, different communication media are available (serial connection, TCP/IP connection, fieldbus connection).

Note

Do not change the selected F I/O module or communication connection if an application is open!
Changing the F I/O module to be parameterized or the communication connection is not possible while WAGO Safety Editor is running. If you want to parameterize a different F I/O module, or you want to change the communication connection, close the WAGO Safety Editor, select another module and restart WAGO Safety Editor.

Note

Safety Editor instances
In ONLINE mode, only one instance of WAGO Safety Editor can be open. In OFFLINE mode, as many instances of WAGO Safety Editor as you want can be open.

7.3.4.1 Indirect Start via WAGO-I/O-*CHECK* from the Operating System

Launch WAGO-I/O-*CHECK*.

Select an F I/O module for parameterization from the displayed fieldbus node configuration. Execute the **Settings** command in WAGO-I/O-*CHECK* in the context menu of the F I/O module (node view or navigation). WAGO-I/O-*CHECK* then starts WAGO Safety Editor 75x with the current language and communication settings. WAGO Safety Editor starts in ONLINE mode.

Communication is performed over the serial connection or ETHERNET TCP/IP, depending on the current communication setting in WAGO-I/O-*CHECK*.

7.3.4.2 Direct Start from the Operating System

Launch WAGO Safety Editor.

WAGO Safety Editor starts in OFFLINE mode.

7.3.4.3 Indirect Start via WAGO-I/O-*CHECK* from the Engineering Tool of the Safe PLC (Device Level TCI Conformance Class 2)

In the engineering tool of the safe PLC, select a device (fieldbus coupler) and launch WAGO-I/O-*CHECK* via the “WAGO-I/O-*CHECK* 3” TCI link. The engineering tool of the safe PLC passes the current language and communication setting to WAGO-I/O-*CHECK*.

Select an F I/O module for parameterization from the fieldbus node configuration displayed in WAGO-I/O-*CHECK*. WAGO-I/O-*CHECK* then starts WAGO Safety Editor 75x with the current language and communication settings. WAGO Safety Editor starts in ONLINE mode.
The communication is performed via ETHERNET TCP/IP.

If you exit the configuration of the F I/O module and close Safety Editor, WAGO-I/O-*CHECK* also closes.

7.3.4.4 Indirect Start via WAGO-I/O-*CHECK* from the Engineering Tool of the Safe PLC (Module Level TCI Conformance Class 2)

In the engineering tool of the safe PLC, select an F I/O module and launch WAGO-I/O-*CHECK* via the “WAGO-I/O-*CHECK* 3” TCI link. The engineering tool of the safe PLC passes the current language and communication setting to WAGO-I/O-*CHECK*. WAGO-I/O-*CHECK* then starts WAGO Safety Editor 75x

with the current language and communication settings. WAGO Safety Editor starts in ONLINE mode.
The communication is performed via ETHERNET TCP/IP.

If you exit the configuration of the F I/O module and close WAGO Safety Editor, WAGO-I/O-*CHECK* remains open.

7.3.4.5 Direct Start from the Engineering Tool of the Safe PLC (Module Level TCI Conformance Class 3 ONLINE)

In the engineering tool of the safe PLC, select an F I/O module and launch WAGO Safety Editor 75x via the “WAGO Safety-Editor 75x” TCI link. The engineering tool of the safe PLC passes the current language and communication setting to WAGO Safety Editor. WAGO Safety Editor starts in ONLINE mode.
Communication is performed via PROFINET.

7.3.4.6 Direct Start from the Engineering Tool of the Safe PLC (Device Level TCI OFFLINE)

In the engineering tool of the safe PLC, select a device (fieldbus coupler) and launch WAGO Safety Editor 75x via the “WAGO Safety-Editor 75x” TCI link (offline). The engineering tool of the safe PLC passes the current language setting to WAGO Safety Editor. WAGO Safety Editor starts in OFFLINE mode.

7.3.4.7 Direct Start from the Engineering Tool of the Safe PLC (Module Level TCI OFFLINE)

In the engineering tool of the safe PLC, select an F I/O module and launch WAGO Safety Editor 75x via the “WAGO Safety-Editor 75x” TCI link. The engineering tool of the safe PLC passes the current language setting to WAGO Safety Editor. WAGO Safety Editor starts in OFFLINE mode.

7.3.5 Adjustable Parameters for Digital Inputs

The following parameters can be adjusted on the digital inputs.

Table 31: Adjustable Parameters for Digital Inputs

Parameter Name	Value Range
Input filter time	0 ms (deactivated)
	0.2 ms
	0.5 ms
	1 ms
	2 ms
	3 ms *)
	5 ms
	10 ms
	20 ms
	50 ms
	100 ms
	200 ms
Short circuit test	activated *) / deactivated
Test pulse duration	0.5 ms
	1 ms
	2 ms
	3 ms
	5 ms *)
	10 ms
	20 ms
	50 ms
	100 ms
	200 ms
Pre-evaluation	single-channel *) / equivalent / antivalent
Discrepancy time	5 ... 100 *) … 65000 ms
Restart interlock	activated / deactivated *)
Operating mode	Standard *) / Rotary table

*) Default setting

7.3.5.1 Input Filter Time Parameter

⚠ DANGER

Configuring the input filter time changes the safety response time
If you change the **Input Filter Time** parameter, then the safety response time also changes. You can read more about this in section “Safety Response Time.”

The input filter time is used to suppress interference on the input signal.

The **Input Filter Time** parameter sets the filter time for all channels of the F I/O module’s digital inputs. Setting the input filter time to “0 ms” deactivates the input filter.

Note that the minimum signal duration on a digital input depends on the input filter time setting.

The input filter causes the F I/O module's detection of signal changes at a digital input to be delayed by the duration of the input filter time. For example, if the signal voltage on the digital input switches from "1" to "0" (1-0 signal change) for a safety request (e.g., emergency stop request), the signal voltage "0" must be present for this minimum signal duration.

If the signal voltage is present on the digital input for less than the minimum signal duration, the signal change is not detected by the F I/O module. The cycle time of the safe communication must also be taken into account. If it is too large, it may not be possible to transmit the request to the safe controller.

Note

Measures to take in case of interference on signal lines
If interference can occur on the signal lines, use shielded signal lines, or increase the input filter time and the test pulse duration to avoid possible passivation of the input channels of the F I/O module or incorrect requests for the safety functions.

7.3.5.2 Short Circuit Test Ix Parameter

⚠ WARNING

Protected installation of signal lines required
When connecting signal lines to the digital inputs of the F I/O module, it is essential to ensure that signals are transmitted within a cable or non-metallic sheathed cable only if their short circuit does not lead to a dangerous failure of the safety function, or if they are signals supplied by different clock outputs.

Therefore, make sure that the signal lines are installed in accordance with IEC 60204-1 or ISO 13849-2 (e.g., as separate sheathed lines or in separate cable ducts).

The digital inputs are tested cyclically by the F I/O module. If the **Short Circuit Test** parameter is set to the value "Deactivated," then the F I/O module only tests the input circuit for internal errors. You can set the **Short Circuit Test** parameter to "Deactivated" if, for example, you connect the OSSD semiconductor output of a sensor (such as light arrays, light barriers, etc.) to the digital input of the F I/O module.

If you set the **Short Circuit Test** parameter to the value "Activated," you must connect the digital input to the associated clock output via a switching element. This ensures that the F I/O module tests the signal line for short circuits against external voltages. If the short circuit test detects an external voltage at the digital input, the input signal is passivated and the "Short Circuit" diagnostic message is output to the secure PLC.

Table 32: Assignment of Inputs to Clock Outputs

Inputs	Associated clock output (when short circuit test activated)	
	“Standard” Operating Mode	“Rotary Table” Operating Mode
I1, I3, I5, I7	T1	T1
I2, I4, I6, I8	T2	T1

Using the cyclical tests of the digital inputs, the F I/O module detects the following errors at the digital inputs:

Table 33: Error Detection

Error (x = 1 ... 8, m = 1,2)	Operating Mode			
	Standard		Standard	
	Short Circuit Test			
	Deactivated	Deactivated	Deactivated	Deactivated
Short circuit Ix / Ix+1	No	Yes	Invalid parameter combination	No
Short circuit I3 / I4	No	Yes		No
Short circuit I5 / I6	No	Yes		No
Short circuit I7 / I8	No	Yes		No
Short circuit Ix / +24 V	No	Yes		Yes
Short circuit Ix / GND	No	No		No
Short circuit Tm / +24 V	No	Yes *)		Yes *)
Short circuit Tm / GND	No	Yes		Yes
Short circuit T1 / T2	No	Yes *)		No
Internal error in input circuit	Yes	Yes		Yes
No supply voltage	Yes	Yes		Yes

*) Only if the clock outputs are connected to the digital input

Note

Behavior of the F I/O module in the event of an error

If an overload is detected by the F I/O module at a clock output, then the clock output is switched off, and the associated inputs are passivated by setting the process image of the inputs to the value “0.” For all other errors, only the relevant input is passivated.

You can find detailed information in section “Diagnostics.”

7.3.5.3 Test Pulse Duration Parameter

DANGER

Configuring the test pulse duration changes the safety response time
If you change the **Test Pulse Duration** parameter, then the safety response time also changes. You can read more about this in section “Safety Response Time.”

The **Test Pulse Duration** parameter is used to set the duration of the test pulses for the short circuit test.

The test pulse duration applies equally to the test pulses at clock outputs T1 and T2. However, if the short circuit test of all input channels assigned to a clock output is deactivated, then the clock output in question is switched off (see sections “Commissioning” > ... > “Short Circuit Test Ix Parameter” and “Emergency Stop Connection, Single-Channel”). In this case, the **Test Pulse Duration** parameter has no effect on the clock output in question, and the parameterized value is irrelevant.

The correct test pulse duration setting depends on the capacitance of the input wiring, which is influenced by the type of sensor connected and the cable length. A higher capacitance of the wiring requires a longer test pulse duration. If the wiring is fault-free but the F I/O module detects a short circuit of an input to an external voltage, then the test pulse duration setting is not sufficient, and a larger value must be selected.

7.3.5.4 Pre-Evaluation Parameter

The **Pre-Evaluation** parameter is used to switch dual-channel pre-evaluation of the digital inputs on and off. You can set the parameter to the values “Single-channel,” “Equivalent” or “Antivalent.”

With the “Single-Channel” setting, dual-channel pre-evaluation is deactivated.

With the “Equivalent” or “Antivalent” setting, the F I/O module combines the corresponding digital inputs Ix and Ix+1 into one channel pair. Each channel pair determines a logical channel pair value from its two physical channel values. The signal states of the digital inputs are analyzed based on the rule setting using the **Pre-Evaluation** parameter and applied to the process image as a logical channel pair value as a 0-signal or 1-signal.

Depending on the value of the **Pre-Evaluation** parameter, the signal states of the Ix and Ix+1 inputs are analyzed, reproduced in the process image and transferred to the safe PLC differently.

If the **Pre-Evaluation** parameter is set to the “Equivalent” or “Antivalent” value, then the same process value is transmitted to the safe controller for both channels of the channel pair according to the pre-evaluation.

The F I/O module can be used to create four channel pairs from the eight digital inputs:

- Channel pair 1: digital inputs I1 and I2
- Channel pair 2: digital inputs I3 and I4
- Channel pair 3: digital inputs I5 and I6
- Channel pair 4: digital inputs I7 and I8

You can set the value of the **Pre-Evaluation** parameter separately for each channel pair.

Note

With the “Equivalent” or “Antivalent” setting, the Short Circuit Test and Input Filter Time parameters must be set to the same value
If you have set the **Pre-Evaluation** parameter to “Equivalent” or “Antivalent” for two digital inputs, you must set the value of the **Short Circuit Test** and **Input Filter Time** parameters to the same value for both digital inputs in question.

If you have set the **Pre-Evaluation** parameter to “Equivalent,” the F I/O module behaves as follows:

The F I/O module compares the signal states of the digital inputs in question to the same values. The following table shows the possible signal states for equivalent pre-evaluation:

Table 34: Equivalent Pre-Evaluation

Inputs		Process Image		Signal Status
Ix+1	Ix	Ix+1	Ix	
0	0	0	0	0-signal
0	1	0	0	Invalid
1	0	0	0	Invalid
1	1	1	1	1-signal

After the amount of time specified in the Discrepancy Time setting has elapsed, an invalid signal state causes a discrepancy error to be detected, which in turn causes the channel pair in question to be passivated and the “Discrepancy Time Exceeded” diagnostic message to be output; see section “Commissioning” > … > “Discrepancy Time Ix and Ix+1 Parameter.”

If you have set the **Pre-Evaluation** parameter to “Antivalent,” the F I/O module behaves as follows:
The F I/O module compares the signal states of the digital inputs to the opposite values. The following table shows the possible signal states for antivalent pre-evaluation:

Table 35: Antivalent Pre-Evaluation

Inputs		Process Image		Signal Status
Ix+1	Ix	Ix+1	Ix	
0	0	0	0	Invalid
0	1	1	1	1-signal
1	0	0	0	0-signal
1	1	0	0	Invalid

After the amount of time specified in the Discrepancy Time setting has elapsed, an invalid signal state causes a discrepancy error to be detected, which in turn causes the channel pair in question to be passivated and the “Discrepancy Time Exceeded” diagnostic message to be output; see section “Commissioning” > … > “Discrepancy Time Ix and Ix+1 Parameter.”

If you have set the value of the **Operating Mode** parameter to “Rotary Table,” you must set the **Pre-Evaluation** parameter to “Single-Channel.”

Note

Input signal changes caused by interference
Input signal changes caused by interference can cause the F I/O module to transmit the value “0” to the safe PLC in the process image for the channel pair in question, detect a discrepancy error after the discrepancy time has elapsed and output the diagnostic message “Discrepancy time exceeded.” Possible causes may include:

- Cross circuit, short circuit and cable break (user error, wiring error)
- Stuck normally open contacts of a safe sensor
- Insufficient filtering of the test signals of a safe sensor

7.3.5.5 Discrepancy Time Ix and Ix+1 Parameter

The **Discrepancy time** parameter is used for dual-channel pre-evaluation of two digital inputs Ix and Ix+1. The discrepancy time is then only used by the F I/O module when the **Operating mode** parameter is set to “Standard” and the **Pre-evaluation** parameter is set to a value of “equivalent” or “antivalent.”

The discrepancy analysis is only performed if both channels of a channel pair have no channel error.

The signal states of the channel pair in question are evaluated according to a parameterizable valence rule. The valence rule (equivalence, antivalence) depends on the value of the **Pre-evaluation** parameter (see section “Commissioning” > ... > “Pre-Evaluation Parameter”).

The F I/O module checks whether the valence rule violation has ceased after the amount of time corresponding to the Discrepancy Time setting has elapsed. If it has not, a discrepancy error is present. The channel pair is passivated, and the diagnostic message “Discrepancy time exceeded” is output to the safe PLC.

You can use the value of the parameter to specify the maximum permissible time for a deviation (invalid signal state) of the two input signal states of the valence rule.

The F I/O module begins discrepancy monitoring as soon as a deviation of the input signal states from the valence rule is detected.

Discrepancy time monitoring is terminated when a valid signal status is achieved (0-signal or 1-signal; see section “Commissioning” > ... > “Pre-Evaluation Parameter”), depending on the signal status that was present at the digital inputs prior to the beginning of discrepancy monitoring.

You can set the discrepancy time for each channel pair separately in the value range from 5 ... 65000 ms in 25 steps.

The discrepancy time must be greater than the sum of the test pulse duration and input filter time.

Discrepancy Time Monitoring and Discrepancy Time

The discrepancy time monitoring feature checks whether there are unacceptable delays between the signals of the two input channels. For example, this can be used to detect mechanical or electro-mechanical deviations from the nominal state of simultaneity.

Discrepancy time monitoring of the dual-channel pre-evaluation is used to deduce the existence of sensor errors based on the chronological progression of the signal states. Discrepancy time monitoring is activated if the signal states deviate from the valence rule.

Note

Discrepancy time monitoring activated only after the amount of time corresponding to the Input Filter Time setting has elapsed
Discrepancy time monitoring not activated until the input filter time has elapsed.

During error-free operation, the input signals will take on acceptable signal states within the discrepancy time period. Discrepancy time monitoring is started and ends before the discrepancy time elapses.

Set the value of the **Discrepancy time** parameter high enough that both digital inputs can complete the change of signal voltage before the discrepancy time has elapsed.

Behavior of the F I/O Module during Discrepancy Time Monitoring

If the process image of the F I/O module transfers a 1-signal due to the input signal states, and a deviation of the input signal states from the valence rule is then detected, discrepancy time monitoring starts. Discrepancy time monitoring is not terminated until a 0-signal is detected.

If the process image of the F I/O module transfers a 0-signal due to the input signal states, and a deviation of the input signal states from the valence rule is then detected, discrepancy time monitoring starts. Discrepancy time monitoring is not terminated until a 0-signal or 1-signal is detected.

While discrepancy time monitoring progresses in the F I/O module, the “0” value is output from the channel pair in question to the safe PLC as a safe process value.

Behavior of the F I/O Module after the Discrepancy Time Elapses

If the invalid input signal status is detected by the F I/O module for longer than the discrepancy time setting, a discrepancy error occurs. The channel pair is passivated, and the diagnostic message “Discrepancy time exceeded” is output. The discrepancy error can be caused, for example, by a wire break in a signal line, a sensor error etc.

NOTICE

Behavior of the F I/O module in the event of discrepancy errors
If the F I/O module detects a discrepancy error, the channel pair is passivated by the process values and by the channel statuses of the corresponding digital inputs being set in the process image to the value “0.” You can acknowledge the reported error(s) after the cause of the error has been eliminated (see section “Commissioning” > ... > “Restart Inhibit Ix and Ix+1 Parameter”).

Maximum Duration of a Deviation from the Valence Rule to Avoid Unwanted Discrepancy Errors

To avoid unwanted discrepancy errors and the resulting passivation of the channel pair during error-free operation, it is necessary to ensure that the maximum duration of the deviation from the valence rule is smaller than that specified in the following formula.

$$\Delta t_{nD} < (\Delta \mathrm{t}_{\mathrm{Discrepancy}} + 1\ \mathrm{ms}) \times 0.99913 + \Delta \mathrm{t}_{nDOffset}$$

Δt_{nD}: Duration of the deviation from the valence rule
$\Delta t_{Discrepancy}$: Discrepancy Time setting in ms
$\Delta t_{nDOffset}$: maximum duration in ms determined by test pulses and hardware and software delays from the following table

Table 36: Maximum Duration of a Deviation from the Valence Rule to Avoid Unwanted Discrepancy Errors

$\Delta t_{nDOffset}$ Filter Time in ms	Short Circuit Test Deactivated	Short Circuit Test Activated									
		Test pulse duration in ms									
		0.5	1	2	3	5	10	20	50	100	200
0	−1.5	−2.1	−2.6	−3.6	−4.6	−6.6	−11.6	−21.6	−51.6	−101.7	−201.8
0.2	−1.5	−2.1	−2.6	−3.6	−4.6	−6.6	−11.6	−21.6	−51.6	−101.7	−201.8
0.5	−1.5	−2.1	−2.6	−3.6	−4.6	−6.6	−11.6	−21.6	−51.6	−101.7	−201.8
1	−1.5	−2.1	−2.6	−3.6	−4.6	−6.6	−11.6	−21.6	−51.6	−101.7	−201.8
2	−1.5	−2.1	−2.6	−3.6	−4.6	−6.6	−11.6	−21.6	−51.6	−101.7	−201.8
3	−1.5	−2.1	−2.6	−3.6	−4.6	−6.6	−11.6	−21.6	−51.6	−101.7	−201.8
5	−1.5	−2.1	−2.6	−3.6	−4.6	−6.6	−11.6	−21.6	−51.6	−101.7	−201.8
10	−1.5	−2.1	−2.6	−3.6	−4.6	−6.6	−11.6	−21.6	−51.6	−101.7	−201.8
20	−1.5	−2.1	−2.6	−3.6	−4.6	−6.6	−11.6	−21.6	−51.7	−101.7	−201.8
50	−1.6	−2.2	−2.7	−3.7	−4.7	−6.7	−11.7	−21.7	−51.7	−101.8	−201.9
100	−1.7	−2.3	−2.8	−3.8	−4.8	−6.8	−11.8	−21.8	−51.8	−101.9	−202.0
200	−1.9	−2.5	−3.0	−4.0	−5.0	−7.0	−12.0	−22.0	−52.1	−102.1	−202.2

Minimum Duration of a Deviation from the Valence Rule to Detect a Discrepancy Error

A discrepancy error can be detected as soon as the deviation from the valence rule is greater than the value determined in section “Maximum Duration of a Deviation from the Valence Rule to Avoid Unwanted Discrepancy Errors.” However, detection of a discrepancy error is only ensured if the deviation of the input values from the valence rule lasts longer than the value determined by the following formula.

$$\Delta t_D \geq (\Delta t_{\text{Discrepancy}} + 1\ \text{ms}) \times 1.00087 + \Delta t_{DOffset}$$

Δt_D: Duration of the deviation from the valence rule
$\Delta t_{Discrepancy}$: Discrepancy Time setting in ms
$\Delta t_{DOffset}$: maximum duration in ms determined by test pulses and hardware and software delays from the following table

Table 37: Minimum Duration of a Deviation from the Valence Rule to Detect a Discrepancy Error

$\Delta t_{DOffset}$ Filter time in ms	Short circuit test deactivated	Short circuit test activated									
		Test pulse duration in ms									
		0.5	1	2	3	5	10	20	50	100	200
0	1.6	2.2	2.7	3.7	4.7	6.7	11.7	21.7	51.7	101.8	201.9
0.2	1.6	2.2	2.7	3.7	4.7	6.7	11.7	21.7	51.7	101.8	201.9
0.5	1.6	2.2	2.7	3.7	4.7	6.7	11.7	21.7	51.7	101.8	201.9
1	1.6	2.2	2.7	3.7	4.7	6.7	11.7	21.7	51.7	101.8	201.9
2	1.6	2.2	2.7	3.7	4.7	6.7	11.7	21.7	51.7	101.8	201.9
3	1.6	2.2	2.7	3.7	4.7	6.7	11.7	21.7	51.7	101.8	201.9
5	1.6	2.2	2.7	3.7	4.7	6.7	11.7	21.7	51.7	101.8	201.9
10	1.6	2.2	2.7	3.7	4.7	6.7	11.7	21.7	51.7	101.8	201.9
20	1.6	2.2	2.7	3.7	4.7	6.7	11.7	21.7	51.8	101.8	201.9
50	1.7	2.3	2.8	3.8	4.8	6.8	11.8	21.8	51.8	101.9	202.0
100	1.8	2.4	2.9	3.9	4.9	6.9	11.9	21.9	51.9	102.0	202.1
200	2.0	2.6	3.1	4.1	5.1	7.1	12.1	22.1	52.2	102.2	202.3

7.3.5.6 Restart Inhibit Ix and Ix+1 Parameter

⚠ WARNING

Measures required if the Restart Inhibit parameter is set to “Deactivated”
If you have set the **Restart Inhibit** parameter to “Deactivated” and the F I/O module outputs the diagnostic message “Discrepancy time exceeded,” you must ensure that all necessary repair steps are taken immediately, because subsequent faults could be dangerous.

The **Restart Inhibit** parameter is used to set the reintegration behavior of the F I/O module after a discrepancy error between the digital inputs.

The **Restart Inhibit** parameter is used for dual-channel pre-evaluation of two digital inputs. Restart Inhibit is then only used by the F I/O module if the **Operating Mode** parameter is set to the value “Standard” and the value of the **Pre-Evaluation** parameter is set to “Equivalent” or “Antivalent.”

Restart Inhibit is only evaluated if both channels of a channel pair have no channel error.

If you have set the **Restart Inhibit** parameter to “Activated,” then the F I/O module behaves as follows:

A discrepancy error that has been eliminated can only be acknowledged if the input signals have taken on the values listed in the following table.

Table 38: Required Signal States to Allow Acknowledgement When Restart Inhibit Is Activated

Channel Pair	Digital Inputs		Valence Analysis
	I2	I1	
I1 and I2	“1”	“0”	“Antivalent”
	“0”	“0”	“Equivalent”
	I4	I3	
I3 and I4	“1”	“0”	“Antivalent”
	“0”	“0”	“Equivalent”
	I5	I6	
I5 and I6	“1”	“0”	“Antivalent”
	“0”	“0”	“Equivalent”
	I7	I8	
I7 and I8	“1”	“0”	“Antivalent”
	“0”	“0”	“Equivalent”

7.3.5.7 Operating Mode Parameter

⚠ WARNING

Evaluation of input signal states in “Rotary table” operating mode:
If you have set the **Operating mode** to the “Rotary table” value, the temporal logic evaluation of the signal state must be performed by a suitable function block in the safe PLC.

You can use the **Operating mode** parameter to choose between safe standard evaluation of the digital inputs (single-channel, dual-channel) and the specific “Rotary table” operating mode.

For single-channel or dual-channel use of the digital inputs, you must set the **Operating mode** parameter to the value “Standard.”

The choice of operating mode only affects the digital inputs and clock outputs of the F I/O module.

To connect the cam switch on a rotary table or one or more mode selectors to the digital inputs of the F I/O module, set the parameter to the value “Rotary table.”

If you set the **Operating mode** parameter to the value “Rotary table,” the F I/O module behaves as follows:

- The F I/O module only accepts the **Pre-evaluation** parameter with the value “Single-Channel.”
- The F I/O module only accepts the **Short circuit test** parameter with the value “Activated.”
- All inputs are sensitive to clock output T1 and are tested for short circuit to any 24 V signal source.
- Clock output T2 is switched off.
- The signal states on the digital inputs are not pre-analyzed the F I/O module. A separate function block is required.

7.4 Offline Parameterization of the F I/O Module with the Engineering Tool of the Safe PLC

The F I/O module supports offline parameterization directly via the GSD. If offline parameterization is used, the iParameters are configured in the engineering tool of the safe PLC and saved together with the device application in the safe controller. As a result, when the safe controller is switched on, the iParameters are transferred from the safe controller to the F I/O modules.

If offline parameterization is used, no direct communication is required between the engineering tool of the safe PLC and the F I/O modules. The possible iParameters are communicated to the engineering tool of the safe PLC through the GSD. After maintenance or replacement of the F I/O module, manual reparameterization is not required.

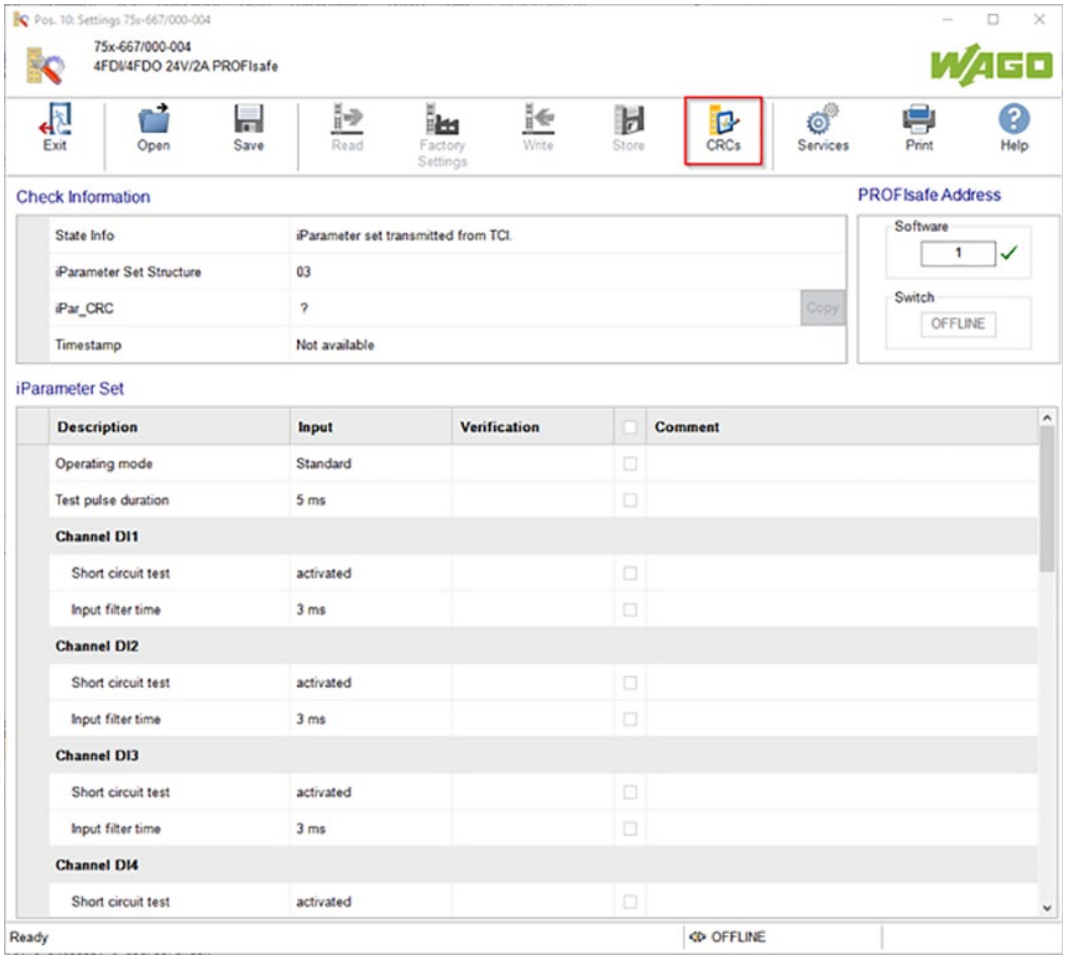


Figure 17: Offline Parameterization – WAGO Safety Editor Start Screen

For offline parameterization, proceed as follows:

1. In the engineering tool of the safe PLC, select the submodule named ".... iPar by GSD..." for the F I/O module.
   This enables the configuration of the iParameters in the engineering tool of the safe PLC.

2. To calculate the CRCs with the WAGO Safety Editor, select the F I/O module in the engineering tool of the safe PLC.

3. Start the WAGO Safety Editor via the TCI link "Calculate CRC."
   The engineering tool of the safe PLC then transfers the iParameters that have been set to the WAGO Safety Editor and starts the WAGO Safety Editor in offline operating mode.
   Alternatively, the WAGO Safety Editor can be started directly in offline mode. In this case, however, the iParameter set must be set manually in the WAGO Safety Editor according to the parameterization in the engineering tool of the safe PLC.
   The WAGO Safety Editor displays the iParameters transferred from the engineering tool of the safe PLC and performs a plausibility check on the iParameters. If errors are found due to parameter dependencies, these are indicated.

4. If errors exist, correct them in the engineering tool of the safe PLC.

5. Relaunch the WAGO Safety Editor.

6. If no errors exist, click the "CRCs" button to start the verification of the iPar CRC and Com CRC.

7. In the "CRCs" dialog that opens, all the iParameters appear again. Compare the values of the displayed iParameters in the WAGO Safety Editor line by line to the values set in the engineering tool of the safe PLC.

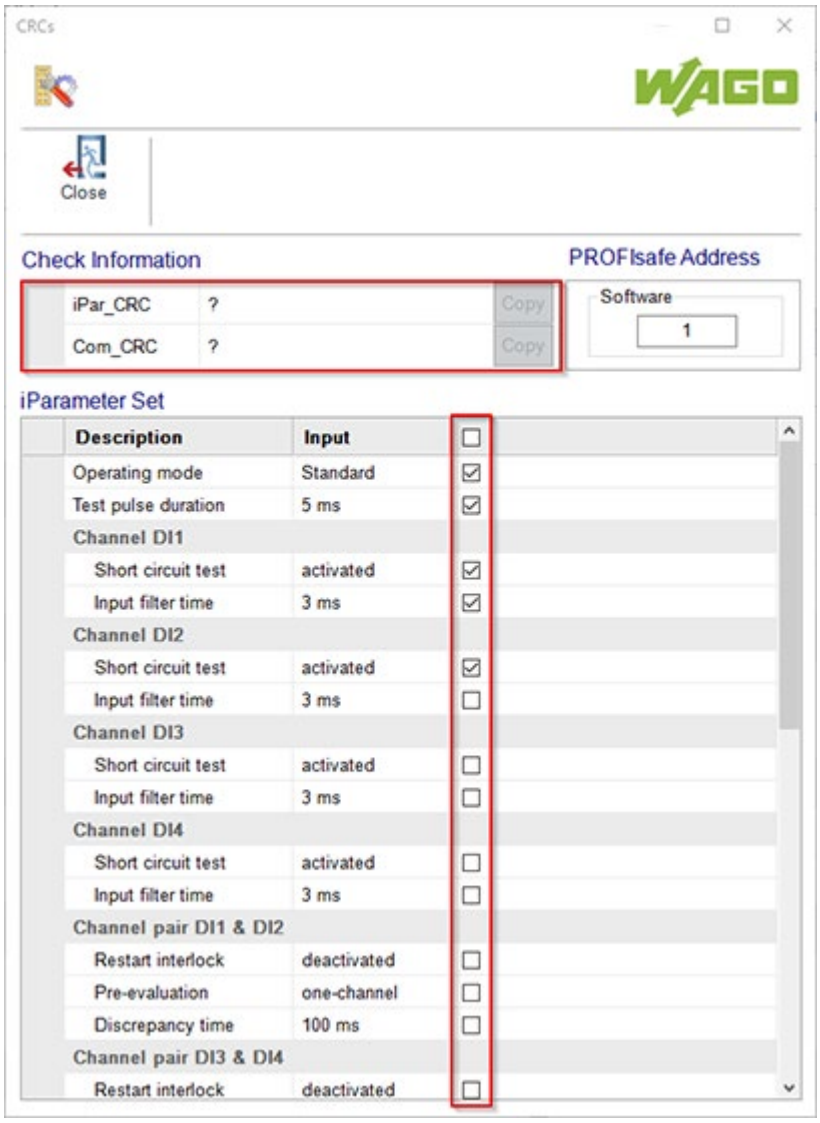


Figure 18: Offline Parameterization – “CRCs” Dialog in the WAGO Safety Editor

If the values match, confirm that the corresponding parameter is verified by checking the box to the right of the iParameter value.
This ensures that the iParameters set in the engineering tool of the safe PLC match the iParameters displayed in the WAGO Safety Editor and that no error has occurred during transmission.
If all iParameters have been marked as verified, the entire iParameter set is also considered verified, and the iPar CRC and the Com CRC are automatically calculated and displayed.

8. Transfer the iPar CRC and Com CRC to the engineering tool of the safe PLC. To do so, you can copy the calculated CRCs to the clipboard, for example.

7.5 Programming the Safe PLC

The following requirements must be met for programming the safe PLC using the F I/O module 750-662/000-004:

- Use of a suitable safe PLC
- Use of a suitable programming and configuration environment
- Selection of an appropriate WAGO fieldbus coupler (PROFINET)
- Use of the valid WAGO device description file (GSD)

After selecting a suitable safe PLC, add the bus system (PROFIBUS or PROFINET) to the hardware configuration environment and configure it accordingly (fieldbus parameters, addresses, names etc.).

Then select a PROFINET fieldbus coupler from the device catalog and connect it to the bus system.

Note

Observe the manufacturer's documentation for the safe PLC!
The exact programming procedure can be found in the manufacturer's documentation for the safe PLC.

Note

Use the application notes from WAGO!
An overview for using the F I/O module in combination with a safe PLC is described in an application note. This application note is available on the Internet at www.wago.com under "Downloads > Application Notes ..."

Note

Pay attention to dependencies!
When creating safety programs, take the dependencies between the PLC cycle time, the call interval of the safety program, the expected response times of the safety program and the adjustable monitoring times into account. Details can be found in the corresponding manufacturer's documentation.

PROFIBUS

To use the F I/O module with PROFIsafe Mode V2.4 and PROFIBUS, the F I/O module with designation "75x-662 8FDI 24V 4th Gen. iPar" must be selected from the device catalog and added to the fieldbus node.

PROFINET

To use the F I/O module with PROFIsafe Mode V2.6 and PROFINET, the F I/O module with designation “„75x-662/000-004 8FDI/24V” must be selected from the device catalog and added to the fieldbus node.

Either the submodule with designation “8FDI iPar, iPar-Server, PROFIsafe V2.4” or the submodule with designation “8FDI iPar, iPar by GSD, PROFIsafe V2.4” must also be used for PROFIsafe Mode V2.4.
Either the submodule with designation “8FDI iPar, iPar-Server, PROFIsafe V2.6” or the submodule with designation “8FDI iPar, iPar by GSD, PROFIsafe V2.6” must also be used for PROFIsafe Mode V2.6.

After you have configured the F I/O module, create the required call structure for the safety program. The required system calls and system settings to activate the safety program are added to the project.

Then parameterize the F I/O module either with the WAGO parameterization tool using a submodule named “...iPar server...,” or with the engineering tool of the safe PLC using a submodule named “...iPar by GSD...” (see section “Offline Parameterization of the F I/O Module with the Engineering Tool of the Safe PLC” or “Parameterization of the F I/O Module with the WAGO Parameterization Tool”).

If you parameterize the I/O module via the engineering tool of the safe PLC and do not want to set the PROFIsafe address via the coding switch, then set the PROFIsafe address as described in section “Setting the PROFIsafe Address via the GSD.”

Then adjust the F parameters of the F I/O module by setting the F_iPar_CRC and the F_Dest_add in the hardware configuration environment (see Appendix > “PROFIsafe” > “Overview of PROFIsafe F Parameters”). F_Dest_Add must be set to the value of the PROFIsafe address used (coding switch, WAGO parameterization tool or GSD).

Note

Using the default iParameter set
You can use the default iParameter set of the F I/O module without changing the iParameter settings. Apply the value of the F_iPar_CRC parameter specified in the Appendix in section “Overview of PROFIsafe F Parameters” by setting F_iPar_CRC to this value in the hardware configuration environment.

Note

Behavior of the F I/O module when discrepancies occur between F_iPar_CRC and iPar_CRC
If the F I/O module detects a discrepancy between F_iPar_CRC and iPar_CRC, safe communication is not established.

If F_iPar_CRC has been set correctly, a match with the iPar_CRC is permanently stored in the F I/O module.

Next, compile the hardware configuration and safety program and check the assignment of the PROFIsafe subscribers to the respective run-time group. Then transfer the entire project to the safe PLC.

Observe the required workflows given in the respective manufacturer's documentation and check and document all safety functions.

7.5.1 F I/O Module with iPar Server

The F I/O module provides functions for realizing iPar server functionality according to the system manual of the PROFIsafe specification. With an iPar server, I/O module replacement for maintenance is possible without reparameterization.

To implement iPar server functionality, refer to the respective manufacture's documentation and the PROFIsafe documentation.

7.5.2 F I/O Module with iPar Functionality from WAGO

The iPar server option is described in a WAGO application note and contains all the descriptions, libraries and sample projects necessary for implementing an iPar server.

If the F I/O module is operated in conjunction with the iPar server from WAGO, I/O module replacement for maintenance is possible without manual reparameterization.

7.5.3 F I/O Module without iPar Server

When operating the F I/O module without an iPar server, set F_iPar_CRC according to the iPar_CRC value; see Section "Programming the Safe PLC."

If the F I/O module is operated without an iPar server, manual reparameterization may be necessary when replacing the I/O module for maintenance if the default settings are not used.

Note that the F I/O module cannot be automatically reparameterized when a module is replaced.

Note

Diagnostic message when there is a difference between F_iPar_CRC and iPar_CRC

When there is a difference between F_iPar_CRC and iPar_CRC, note that the diagnostic message “Inconsistent F_iPar_CRC” appears first. This diagnostic message is replaced by the diagnostic message “Error downloading the iParameters” after about 4.5 minutes. To fix this, adjust the iParameters of the F I/O module using the WAGO parameterization tool.

Observe the required workflows given in the respective manufacturer’s documentation and check and document all safety functions.

7.6 Connection Examples

⚠ WARNING

Warning against personal and property damage!
The use of the connection examples described in this section alone is not enough to execute the safety function according to the SIL, Cat./PL determined from the risk analysis. In connection with safe devices, sensors and actuators, additional measures may be necessary to ensure the safety function.
This includes, for example, the appropriate wiring and parameterization of digital inputs and outputs, as well as measures to exclude unforeseeable errors.
More information is available in the user manuals of the safe devices used.

This section generally describes possible applications, in which the functions of the F I/O module for implementation of a safety function are used.

For the digital inputs of the F I/O module, you can use the WAGO parameterization tool during individual parameterization to select the "Standard" or "Rotary table" operating mode. For more information, read the section “Commissioning” > … > "Parameterization of the F I/O module with the WAGO Parameterization Tool".

Note

Use application notes from WAGO
An overview for using F I/O module in combination with a safe PLC is summarized in an application note. This application note is available on the Internet at www.wago.com in the download area.

7.6.1 Connection Examples for Digital Inputs

If you have set the **Operating Mode** parameter of the F I/O module to "Standard" using the WAGO parameterization tool, you can operate the inputs of the F I/O module single- or two-channel.

Connection examples are further examined below.

⚠ WARNING

Ensure protected installation of signal lines when Short circuit test is set to “deactivated”!
If you have set the **Short circuit test** parameter of an input to “deactivated,” the signal lines must be installed with protection between the lines themselves and between the sensors and inputs according to IEC 60204-1 or ISO 13849-2 (e.g., as separate sheathed lines or in separate cable ducts), since external short circuits cannot be detected.

⚠ WARNING

Ensure protected installation when the short circuit test is activated!
With the two clock outputs T1 and T2, you can install the signal lines of at most two contiguous input channels in one common cable. Otherwise, the F I/O module cannot detect short circuits between signal lines of the inputs that are tested with the same clock output. Make sure that the signal lines that belong to the same clock output T1 or T2 are installed with protection against each other according to IEC 60204-1 or ISO 13849-2 (e.g., as separate sheathed lines or in separate cable ducts).

You can take alternative measures (e.g., antivalent evaluation) for fault detection to achieve the required risk reduction for your application (e.g., SIL3/Cat.4/PL e). The safety parameters of the F I/O module do not change.

7.6.1.1 Emergency Off Connection, Single-channel

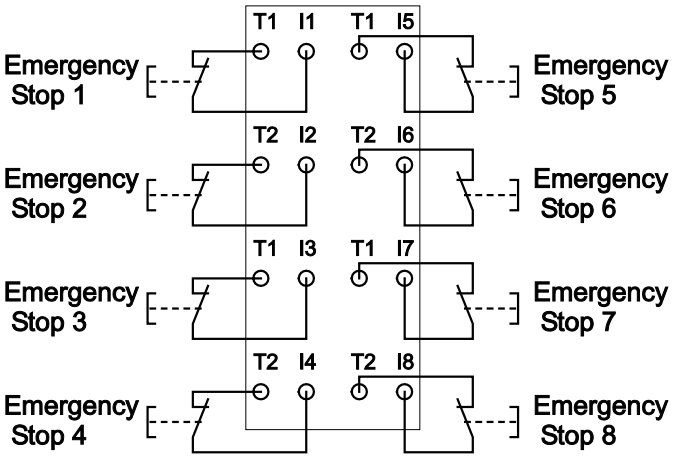


Figure 19: Connection 8 × Emergency Off, Single-Channel, Short Circuit Test Activated

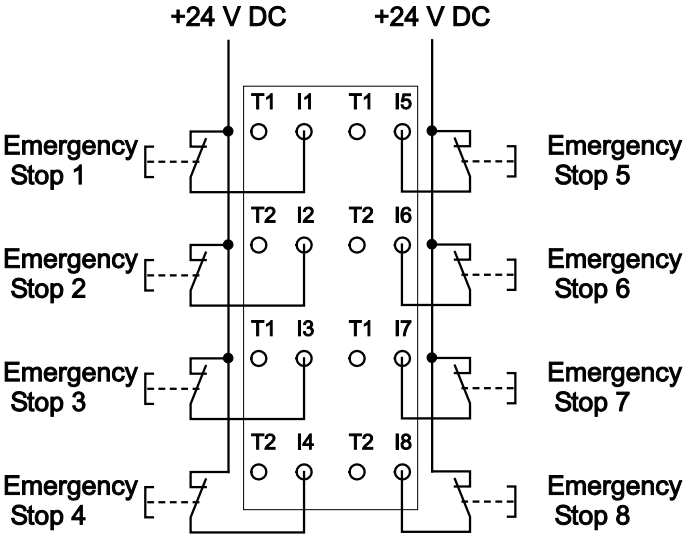


Figure 20: Connection 8 × Emergency Off, Single-Channel, Short Circuit Test Deactivated

For simple emergency stop applications without single fault security, you can use a digital input for your safety function.

You can connect the digital input via a switching element (e.g., an emergency stop switch) either to the associated clock output or directly to the +24 V field supply voltage. Alternatively, you can connect the semiconductor output of a sensor to the digital input directly. For single-channel use of a digital input, you must set the **Pre-evaluation** parameter to “single-channel.”

If you do not connect the digital input via a switching element to the associated clock output (e.g., OSSD semiconductor output), set the **Short circuit test** parameter to “deactivated.” Otherwise, the F I/O module detects a short circuit on the input and outputs the diagnostic message “Short circuit.”

If you connect the digital input via the switching element to the associated clock output, and the F I/O module should monitor the signal line for short circuits, you must set the **Short circuit test** parameter to “deactivated.”

Mixed operation of inputs with the short circuit test activated and inputs with the short circuit test deactivated is possible. If the short circuit test is deactivated for all channels of a test phase, the associated clock output is switched off permanently.

With this wiring, you can achieve a risk reduction of SIL2/Cat.2/PL d.

7.6.1.2 Emergency Stop Connection, Dual-Channel, Equivalent Pre-Evaluation

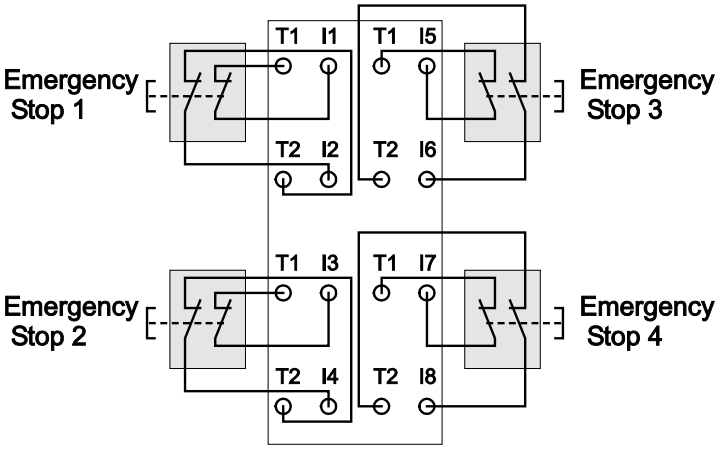


Figure 21: Connection 4 × Emergency-Off Switch, Dual Channel, Equivalent Pre-Evaluation

For applications that require single fault security, e.g., emergency off and emergency stop, you can connect two digital inputs via two switching elements of safe sensors to the F I/O module.

Use the WAGO parameterization tool to set the parameters.

Set the **Pre-evaluation** parameter for the digital inputs used to “equivalent.” In addition, set the **Discrepancy time** parameter to the discrepancy time required for the two switching elements.

You can set the **Short circuit test** parameter of both inputs used to “activated” or “deactivated.” Note that the **Short circuit test** parameter must have the same setting for both digital inputs.

With this wiring, you can achieve a risk reduction of SIL3/Cat.4/PL e.

If you connect the digital inputs via the switching elements directly to the field voltage of +24 V or to two semiconductor outputs of a sensor, then you have to set the **Short circuit test** parameter to "deactivated" because otherwise the F I/O module detects a short circuit and outputs the "Short circuit" diagnostic message.

7.6.1.3 Protective Door Monitoring Connection, Dual-Channel, Antivalent Pre-Evaluation

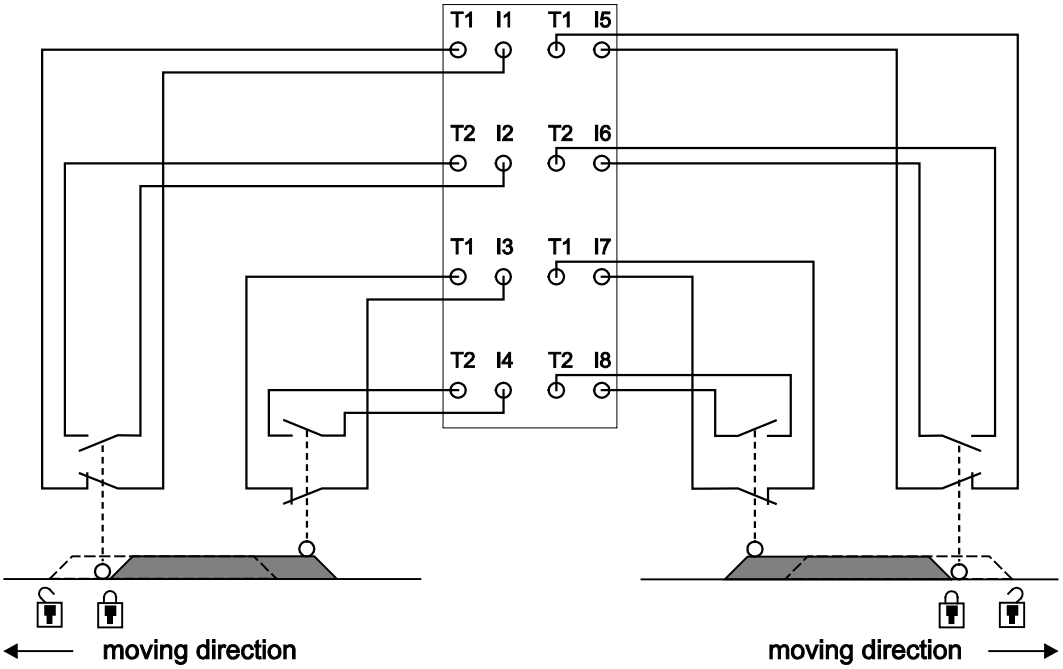


Figure 22: Connection 2 × Interlock Monitoring, Dual Channel, Antivalent Pre-Evaluation

To monitor protective door devices, you can connect the normally open contacts of a safety interlock switch to four digital inputs of the F I/O module.[2]

Use the WAGO parameterization tool to set the parameters.

Set the **Pre-evaluation** parameter for the digital inputs used to “antivalent.” To have the signal lines of the digital inputs of the F I/O module monitored for short circuits, set the **Short circuit test** parameter for all inputs to “activated.” In addition, set the **Discrepancy time** parameter to the discrepancy time required for the normally open contact of the safety interlock switch.

With this wiring, you can achieve a risk reduction of SIL3/Cat.4/PL e.

[2] Functional safety evaluations were carried out by TÜV Rheinland.

7.6.1.4 Connection Example for Digital Inputs in “Rotary Table” Operating Mode (1 of N)

⚠ WARNING

Use of “Rotary Table” operating mode
If you have set the **Operating Mode** parameter to the value “Rotary Table” (1 of N), the temporal logic evaluation of the input bits must be performed by a suitable function block in the safe PLC.

⚠ WARNING

No detection of cross circuits between digital inputs
In “Rotary Table” operating mode, cross circuits between the digital inputs cannot be detected, since all inputs are tested with the same clock output.
If a cross circuit can lead to a hazardous state, make sure that the signal lines are installed with protection between the lines themselves and between the sensors and inputs per IEC 60204-1 or ISO 13849-2 (e.g., as separate sheathed lines or in separate cable ducts).

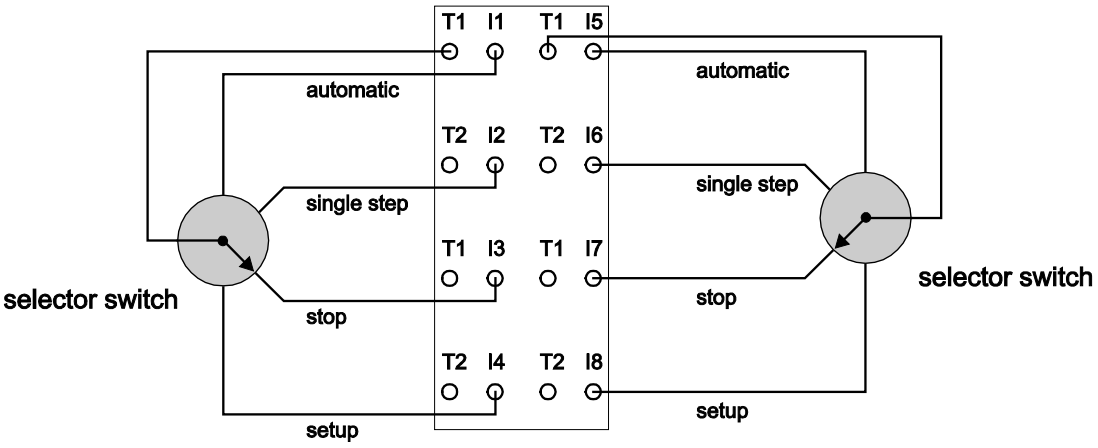


Figure 23: Connection 2 × Mode Selector Switch

If you have set the **Operating mode** parameter to the value “Rotary table” using the WAGO parameterization tool, you can connect the normally open contacts of a mode selector switch or several rotary table sensors to the digital inputs of the F I/O module.

Set the **Short circuit test** parameter for all digital inputs to “activated” and the **Pre-evaluation** parameter to “single-channel.”

Then connect the normally open contacts of the mode selector switch to the digital inputs and the common clock line of the mode selector switch to clock output T1. The process image of the digital inputs now contains the switch setting of the mode selector switch.

With this wiring, you can achieve SIL2/Cat.2/PL d.

8 Diagnostics

8.1 Error Detection

Internal and external errors are detected and diagnosed in the F I/O module through continuous self-testing. The F I/O module also generates warnings that warn of potential errors. An overview of all detectable and diagnosed errors and warnings can be found in section “Diagnostics” > ... > “Error Diagnostics.”

The following information is described in the specified sections:

- The behavior of the F I/O module in case of error depends on the type of error; see section “Diagnostics” > ... > “Behavior in Case of Error.”

- Diagnostics are assigned to the individual errors; see section “Diagnostics” > ... > “Error Diagnostics.”

- Acknowledging error messages; see section “Diagnostics” > ... > “Acknowledging Error Messages.”

Note

Internal and external errors caused by strong EMC events
Both internal and external errors can be caused by strong EMC events. This can cause a safety-related shutdown of the F I/O module. The user cannot acknowledge a safety-related shutdown.

To check whether the cause of a safety-related shutdown was a temporary EMC event, you can switch the entire fieldbus node off and then on again in an attempt to reactivate the F I/O module.

If the safety-related shutdown occurs multiple times, the F I/O module must be replaced. In such cases, return the defective F I/O module to WAGO GmbH & Co. KG for fault analysis.

8.2 Errors and Error Types

Table 39: Errors and Error Types

Error	Error Type	Coding
Safe Inputs		
Internal channel error	Channel error	0x0280
Short circuit	Channel error	0x0201
Overload clock output	Channel error	0x0286
Discrepancy time exceeded	Channel pair error	0x021E
General		
Safety shutdown (internal error)	Module error	0x0219
Firmware update required	Module error	0x0231
Invalid iParameters	Module error	0x0200
Overtemperature error	Module error	0x0205
Undervoltage field supply	Module error	0x0202
Overvoltage field supply	Module error	0x0230
Overtemperature warning	Module error	0x0232
F_Dest_Add mismatch	Configuration error	0x0040
Invalid F_Dest_Add	Configuration error	0x0041
Invalid F_Source_Add	Configuration error	0x0042
Invalid F_WD_Time	Configuration error	0x0043
Non-supported F_SIL	Configuration error	0x0044
Incorrect F_CRC_Length	Configuration error	0x0045
Incorrect F_Par_Version	Configuration error	0x0046
Invalid F_CRC1	Configuration error	0x0047
Inconsistent F_iPar_CRC	Configuration error	0x004B
Non-supported F_Block_ID	Configuration error	0x004C
Invalid F parameters	Configuration error	0x0048
Error uploading iParameters	Configuration error	0x0049
Error downloading iParameters	Configuration error	0x004A
PROFIsafe CRC2 error	Communication error	0x004D
F_WD_Time expired	Communication error	0x004E
Acknowledgement required	–	0x004F

8.3 Behavior in Case of Error

The behavior of the F I/O module in case of error depends on the type of error and is described below:

- Channel error
- Channel pair error
- Module error
- Configuration/communication error

8.3.1 Channel Errors

In case of channel error, the corresponding bit in the channel status byte is set to the value “Bad” (0). A safe substitute value (0) for the faulty passivated input channel in the process image is transferred to the safe PLC.

The channel status LED shines red continuously. A diagnostic message corresponding to the error appears (see section “Diagnostics” > ... > “Error Diagnostics”). With dual-channel pre-evaluation, the channel status of the second channel is also set to the value “Bad” (0), which leads to passivation of both channels of the channel pair.

8.3.2 Channel Pair Errors

In the event of a channel pair error, the respective bits of the channel pair in the channel status byte are set to “Bad.” Safe substitute values (0) are transferred to the safe PLC for the faulty passivated channel pair in the process image.

The module error LED shines red continuously. A diagnostic message corresponding to the error appears (see section “Diagnostics” > ... > “Error Diagnostics”).

8.3.3 Module Errors

In case of a module error, all bits in the channel status byte are set to “bad”. For all module errors requiring confirmation, safes substitute values in the process image are transmitted to the safe PLC for all channels or channel pairs.

All other module errors lead to shutdown of the safe communication. All channel status LEDs of the module are switched off permanently.

The module error LED shines red continuously or blinks red at a frequency of 2 Hz. A diagnostic message corresponding to the error appears (see section “Diagnostics” > ... > “Error Diagnostics”).

The clock outputs are switched off.

Note

Behavior when module error LED flashing
A flashing module error LED (LED E) indicates that the F I/O module has detected an internal safety-critical error. The cause can be a defect in the F I/O module or an environmental EMC error. In this case, switch off the F I/O module completely and then switch it back on. Defective firmware is detected via the corresponding diagnostics (see section “Diagnostics” > “Error Diagnostics”).

If the problem occurs repeatedly, this indicates a defect in the F I/O module. In this case, return the F I/O module to WAGO GmbH & Co. KG for fault analysis. Observe the notes in Section “Firmware Update.”

8.3.4 Configuration/Communication Errors

In the event of a configuration or communication error, safe communication between the F I/O module and the safe PLC is not possible.

The safe PLC sets all process values to substitute values for all input channels or channel pairs.

The PROFIsafe status LED, local bus communication LED and parameterization status LED assume states corresponding to the error.
The module error LED shines red continuously. A diagnostic message corresponding to the error appears (see section “Diagnostics” > ... > “Error Diagnostics”).

The F I/O module 750-662/000-004 can be operated on the WAGO I/O System 750 fieldbus couplers specified in section “Technical Data” > … > “Communication”:

8.4 Error Diagnostics

⚠ WARNING

Diagnostic signaling of the F I/O module not a safety-related feature
Diagnostic signaling of the F I/O module cannot be part of the safety function under any circumstances.

After detecting internal or external errors, the F I/O module outputs diagnostic messages to the safe PLC via the fieldbus. Errors can be identified by the diagnostic messages, and appropriate troubleshooting measures can be taken. The F I/O module provides diagnostic messages via the indicators and the diagnostic services of the PROFINET fieldbus system.

All diagnostic messages that the F I/O module makes available are listed below in alphabetical order. The structure of the diagnostic messages is described in the fieldbus coupler manuals.

The F I/O module 750-662/000-004 can be operated on the WAGO I/O System 750 fieldbus couplers specified in section “Technical Data” > … > “Communication”:

Table 40: Diagnostic Messages

Message	Description	
Acknowledge-ment required	**Diagnostic type**	Module diagnostic
	Coding	0x004F
	LED indicator	PROFIsafe status: green, flashing at 0.5 Hz
	Description/ remedy	Acknowledgement required to reactivate the channel(s) after error correction. This diagnostic is only output in PROFIsafe V2.6 mode.
	Classification	Error
Discrepancy time exceeded	**Diagnostic type**	Channel diagnostics
	Coding	0x021E
	LED indicator	Module error: red, channel status according to input value
	Description/ remedy	For two-channel analysis of the input pair, the F I/O module has determined that the discrepancy time set has been exceeded. Check the safety function. Adjust the discrepancy time setting if necessary.
	Classification	Error

Table 40: Diagnostic Messages

Message	Description	
Error downloading iParameters	**Diagnostic type**	Module diagnostic
	Coding	0x004A
	LED indicator	No indicator
	Description/ remedy	Timeout when writing (downloading) the iParameters from the iPar server. Check whether an iPar server instance was created for the F I/O module and whether an appropriate data set exists.
	Classification	Error
Error uploading iParameters	**Diagnostic type**	Module diagnostic
	Coding	0x0049
	LED indicator	No indicator
	Description/ remedy	Timeout when saving (uploading) the iParameters to the iPar server. Check whether an iPar server instance was created for the F I/O module.
	Classification	Error
F_Dest_Add mismatch	**Diagnostic type**	Module diagnostic
	Coding	0x0040
	LED indicator	Module error: red PROFIsafe status: red
	Description/ remedy	The PROFIsafe address assigned as part of the F parameterization differs from the one set on the F I/O module. Check the DIP switch setting or PROFIsafe address set using the safety editor (SEDI).
	Classification	Error
F_WD_Time expired	**Diagnostic type**	Module diagnostic
	Coding	0x004E
	LED indicator	Module error: red PROFIsafe status: red, flashing at 1 Hz
	Description/ remedy	The time between two data packets from the safe PLC was greater than the time set in F_WD_Time. Check the F_WD_Time parameter and increase the value if necessary.
	Classification	Error

Table 40: Diagnostic Messages

Message	Description	
Firmware update required	**Diagnostic type**	Module diagnostic
	Coding	0x0231
	LED indicator	Module error: red, flashing at 2 Hz
	Description/ remedy	Checking the firmware image has resulted in an inconsistent state. Update the device firmware. **Note:** Observe the safety advices in Section “Firmware-Update.”
	Classification	Error
Inconsistent F_iPar_CRC	**Diagnostic type**	Module diagnostic
	Coding	0x004B
	LED indicator	Module error: red PROFIsafe status: red Parameterization status: red, flashing at 1 Hz
	Description/ remedy	The iPar_CRC of the module is not identical to the CRC for the iParameter set transmitted in the F parameter set. Generate a consistent combination from the iParameter set and F parameter set. Check the iParameter set of the iPar server if necessary.
	Classification	Error
Incorrect F_CRC_Length	**Diagnostic type**	Module diagnostic
	Coding	0x0045
	LED indicator	Module error: red PROFIsafe status: red
	Description/ remedy	The configured F_CRC length setting is not possible in the current operating mode. Observe the dependency between F_Par_Version and F_CRC_Length and select a valid combination.
	Classification	Error

Table 40: Diagnostic Messages

Message	Description	
Incorrect F_Par_Version	**Diagnostic type**	Module diagnostic
	Coding	0x0046
	LED indicator	Module error: red PROFIsafe status: red
	Description/ remedy	The set version of F parameter set is incorrect. Observe the dependency between F_Par_Version and F_CRC_Length and select a valid combination.
	Classification	Error
Internal channel error	**Diagnostic type**	Channel diagnostics
	Coding	0x0280
	LED indicator	Channel status: red
	Description/ remedy	The internal hardware test of the F I/O module failed. If the error occurs repeatedly after restart, immediately replace the F I/O module and send it to WAGO for error analysis.
	Classification	Error
Invalid F_CRC1	**Diagnostic type**	Module diagnostic
	Coding	0x0047
	LED indicator	Module error: red PROFIsafe status: red
	Description/ remedy	The F_CRC1 formed via the F parameter set is invalid. Create a consistent F parameter set.
	Classification	Error
Invalid F_Dest_Add	**Diagnostic type**	Module diagnostic
	Coding	0x0041
	LED indicator	Module error: red PROFIsafe status: red
	Description/ remedy	The PROFIsafe address of the F I/O module must be in the range of 1 … 65534. Correct the F parameterization.
	Classification	Error
Invalid F parameters	**Diagnostic type**	Module diagnostic
	Coding	0x0048
	LED indicator	Module error: red PROFIsafe status: red
	Description/ remedy	The combination of F parameters is invalid. Correct the F parameterization.
	Classification	Error

Table 40: Diagnostic Messages

Message	Description	
Invalid F_Source_Add	**Diagnostic type**	Module diagnostic
	Coding	0x0042
	LED indicator	Module error: red PROFIsafe status: red
	Description/ remedy	The PROFIsafe address of the safe controller must be in the range of 1 … 65534. Correct the F parameterization.
	Classification	Error
Invalid F_WD_Time	**Diagnostic type**	Module diagnostic
	Coding	0x0043
	LED indicator	Module error: red PROFIsafe status: red
	Description/ remedy	The monitoring time for fail-safe data exchange must be set to a value greater than “0 ms.” Correct the F parameterization.
	Classification	Error
Invalid iParameters	**Diagnostic type**	Module diagnostic
	Coding	0x0200
	LED indicator	Module error: red, Parameterization: red, flashing at 1 Hz
	Description/ remedy	The iParameter set for the F I/O module is invalid. Correct the parameterization, taking dependencies between individual settings into account.
	Classification	Error
Non-supported F_Block_ID	**Diagnostic type**	Module diagnostic
	Coding	0x004C
	LED indicator	Module error: red PROFIsafe status: red
	Description/ remedy	The F parameter block specified by the F_Block_ID is not supported by the F I/O module. Use an F parameter block supported by the F I/O module.
	Classification	Error
Non-supported F_SIL	**Diagnostic type**	Module diagnostic
	Coding	0x0044
	LED indicator	Module error: red PROFIsafe status: red
	Description/ remedy	The F I/O module cannot be operated in the configured safety integrity level (SIL). Correct the F parameterization.
	Classification	Error

Table 40: Diagnostic Messages

Message	Description	
Overload clock output	**Diagnostic type**	Channel diagnostics
	Coding	0x0286
	LED indicator	Channel status: red
	Description/ remedy	Clock output of the F I/O module is overloaded. Check the clock output's wiring.
	Classification	Error
Overtemperature error	**Diagnostic type**	Module diagnostic
	Coding	0x0205
	LED indicator	Module error: red
	Description/ remedy	The permissible internal temperature of the enclosure was exceeded, which results in module-wide passivation of the F I/O module. Make sure that the surrounding air temperature is within the specified range.
	Classification	Error
Overtemperature warning	**Diagnostic type**	Module diagnostic
	Coding	0x0232
	LED indicator	No indicator
	Description/ remedy	A defined internal enclosure temperature was exceeded, which does not result in module-wide passivation of the F I/O module. Make sure that the surrounding air temperature is within the specified range.
	Classification	Warning
Overvoltage field supply	**Diagnostic type**	Module diagnostic
	Coding	0x0230
	LED indicator	Module error: red
	Description/ remedy	The 24 V field supply of the F I/O module is above the specified tolerance. Correct the power supply responsible.
	Classification	Error
PROFIsafe CRC2 error	**Diagnostic type**	Module diagnostic
	Coding	0x004D
	LED indicator	Module error: red PROFIsafe status: red, flashing at 1 Hz
	Description/ remedy	A CRC2 error occurred during safe communication. Check the communication connection and acknowledge the error message.
	Classification	Error

Table 40: Diagnostic Messages

Message	Description	
Safety shutdown (internal error)	**Diagnostic type**	Module diagnostic
	Coding	0x0219
	LED indicator	Module error: red, flashing at 2 Hz
	Description/ remedy	The F I/O module has entered the safe state and switched off the outputs. If the error occurs repeatedly after restart, immediately replace the F I/O module and send it to WAGO for error analysis.
	Classification	Error
Short circuit	**Diagnostic type**	Channel diagnostics
	Coding	0x0201
	LED indicator	Channel status: red
	Description/ remedy	The input of the F I/O module is not powered by the associated clock output or is connected to a +24 V field supply directly. Check the input wiring.
	Classification	Error
Undervoltage field supply	**Diagnostic type**	Module diagnostic
	Coding	0x0202
	LED indicator	Module error: red
	Description/ remedy	The 24 V field supply of the F I/O module is below the specified tolerance. Correct the power supply responsible.
	Classification	Error

8.5 Acknowledging Error Messages

Once they have been corrected, errors can be acknowledged by the controller via the PROFIsafe protocol.

8.5.1 Error Acknowledgment PROFIsafe V2.4

The module supports channel granular passivation in PROFIsafe Mode V2.4. Acknowledgement is performed via the WAGO status byte and the WAGO control byte.

The acknowledgment request for a corrected error is displayed on the F I/O module via the PROFIsafe status LED. The acknowledgement is also indicated in the F periphery data block (on the F PLC) via the ACK_REQ bit and in the WAGO status byte via the ChF_Ack_Req bit.

Errors are manually acknowledged with a rising edge on the “ACK_REI” variable of the F periphery data block. In addition, a high signal for at least two PROFIsafe telegram cycles must be applied to the ChF_Ack bit in the WAGO control byte.

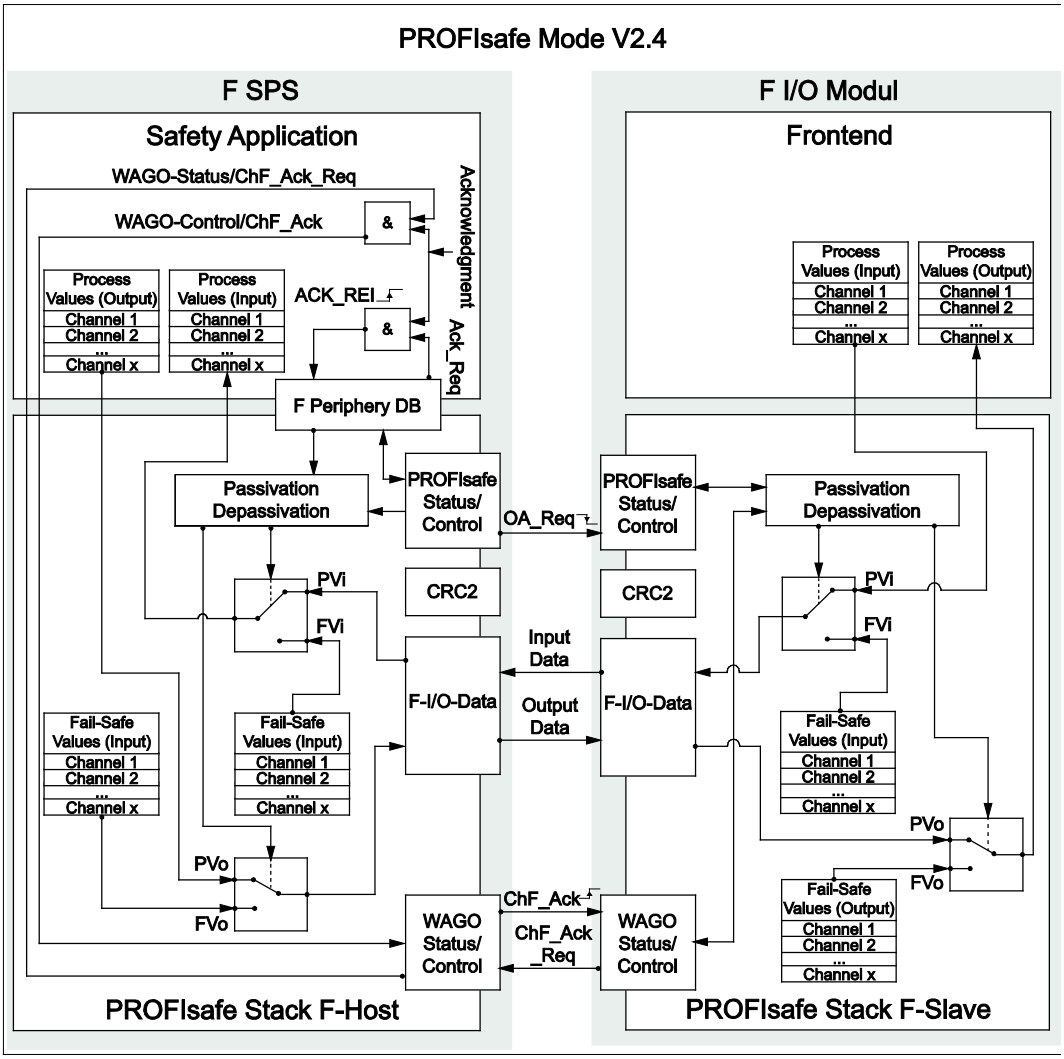


Figure 24: Schematic Representation of Acknowledgement in PROFIsafe mode V2.4

8.5.2 Error Acknowledgment PROFIsafe V2.6

In PROFIsafe mode V2.6, the module supports channel granular passivation. Acknowledgement is performed in accordance with the RIOforFA specifications.

The acknowledgment request for a corrected error is displayed on the F I/O module via the safe status LED (green, flashing at 0.5 Hz); see section “Indicators.” The acknowledgement is also indicated in the F periphery database (on the PLC) via the ACK_REQ bit.

Errors are manually acknowledged with a rising edge of the “ACK_REI” bit of the F periphery database.

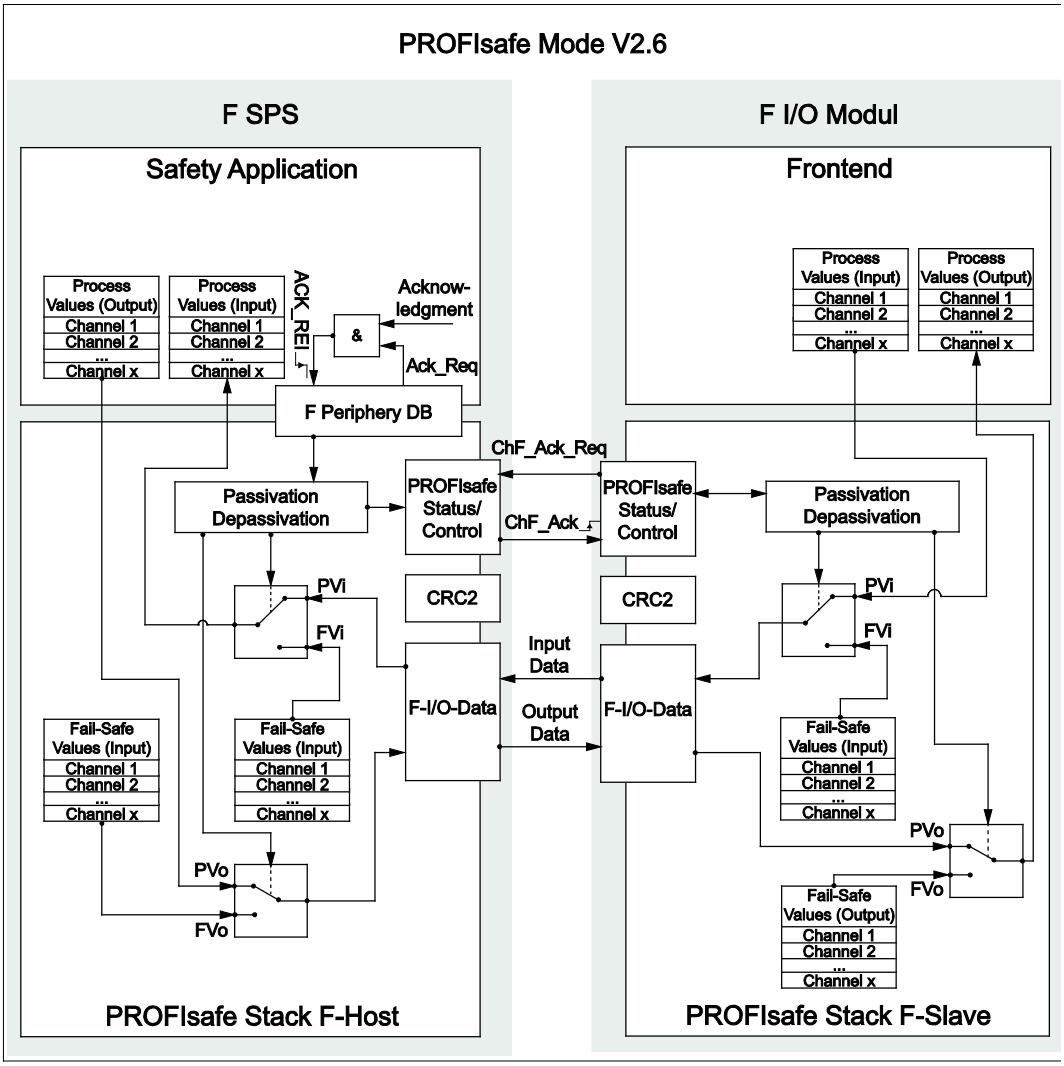


Figure 25: Schematic Representation of Acknowledgement in PROFIsafe mode V2.6

Note

Note manufacturer's documentation
Follow the required procedures listed in the respective controller manufacturer's documentation. Check and document all safety functions.

Only corrected errors are acknowledged with error acknowledgment. Pending errors can only be acknowledged after the error has been corrected.

8.5.3 Signal Sequence Diagrams

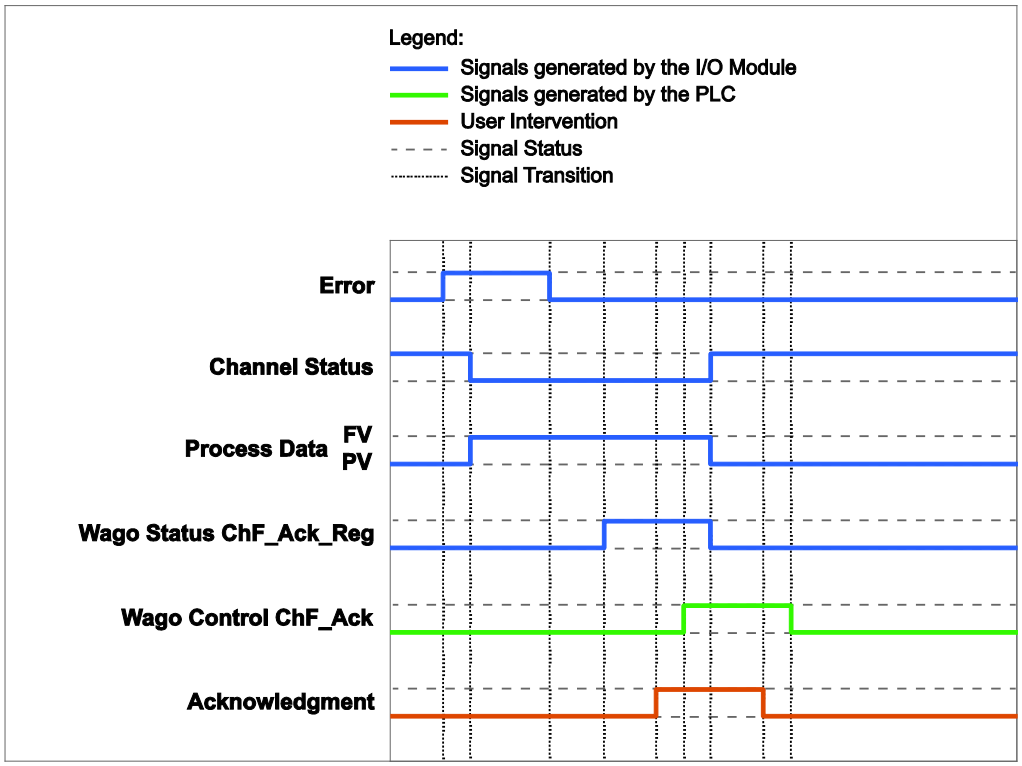


Figure26: PROFIsafe Mode V2.4 – Channel-granular passivation

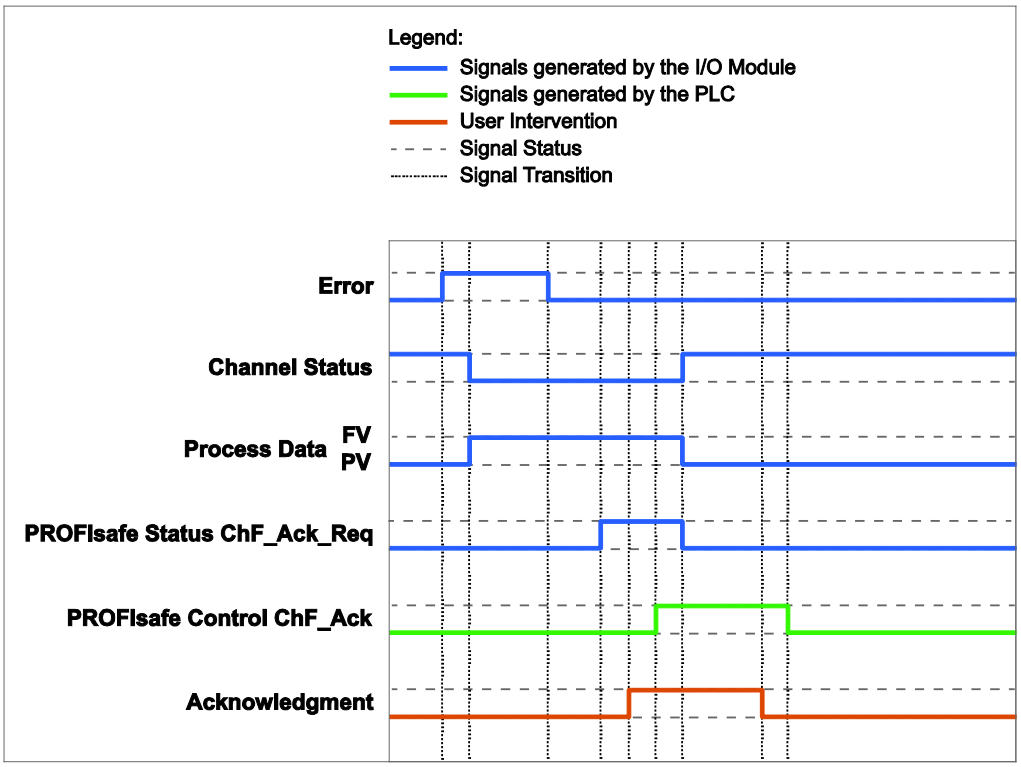


Figure 27: PROFIsafe-Modus V2.6 – Signal Sequence: User Acknowledgement of Channel Error

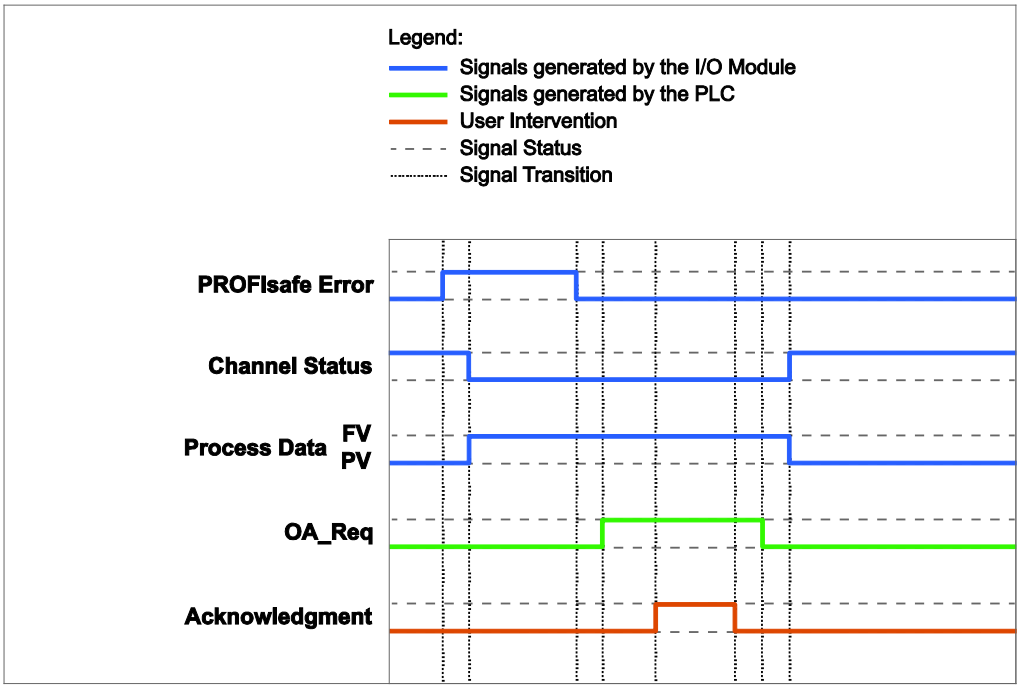


Figure 28: PROFIsafe-Modus V2.4 and V2.6 – Signal Sequence: Communication Error

9 Service

9.1 Replacing the F I/O Module

The process of replacing an F I/O module with an F I/O module of the same type is described below.

⚠ DANGER

Only replace modules when the system is in a safe state!
Modules must only be replaced when the system is in a safe state.

The process of replacing an F I/O module with an F I/O module of a different type is always associated with a new project configuration (see Section “Commissioning” > … > “Programming the Safe PLC”).

9.1.1 Procedure

When replacing an F I/O module, first perform the following steps:

- Switch off the supply voltage of the fieldbus node containing the F I/O module to be replaced.
- Pull the F I/O module to be replaced out of the fieldbus node (see Section “Assembly” > … > “Inserting and Removing Devices”).
- Read the PROFIsafe address on the coding switch of the F I/O module to be replaced and use this setting for the replacement module.
- Plug the replacement module into the fieldbus node in the position of the F I/O module to be replaced.
- Switch the power to the fieldbus node in question back on.

Then perform the one of the following steps, depending on your system configuration:

- If the coding switch setting of the F I/O module to be replaced has a value other than 0 and this F I/O module is operated with iPar server functionality, read section “Service” > “Replacing the F I/O Module” > “F I/O Module with iPar Server Functionality” > “PROFIsafe Address Set Using the Coding Switch.”
- If the coding switch setting of the F I/O module to be replaced has a value of 0, and this F I/O module is operated with iPar server functionality, read section “Service” > “Replacing the F I/O Module” > “F I/O Module with iPar Server Functionality” > “PROFIsafe Address Set Using the Parameterization Tool.”

- If the coding switch setting of the F I/O module to be replaced has a value other than 0 and this F I/O module is operated without iPar server functionality, read section “Service” > “Replacing the F I/O Module” > “F I/O Module without iPar Server Functionality” > “PROFIsafe Address Set Using the Coding Switch.”

- If the coding switch setting of the F I/O module to be replaced has a value of 0 and this F I/O module is operated without iPar server functionality, read section “Service” > “Replacing the F I/O Module” > “F I/O Module without iPar Server Functionality” > “PROFIsafe Address Set Using the Parameterization Tool.”

9.1.2 F I/O Module with iPar Server Functionality

9.1.2.1 PROFIsafe Address Set Using the Coding Switch

If the PROFIsafe address of the F I/O module to be replaced is set using the coding switch on the side, i.e., the switch setting does not equal 0, proceed as follows afterwith replacing the F I/O module:

After start-up, the replacement module automatically requests its individual parameters from the iPar server. The safety-related verification of these parameters occurs in the F I/O module. If the verification step is unsuccessful, the replacement module sends a second request to the iPar server. If the process cannot be completed successfully, the replacement module remains in its initial state and must be configured using the WAGO parameterization tool (see Section “Service” > “Replacing the F I/O Module” > “F I/O Module without iPar Server Functionality” > “PROFIsafe Address Set Using the Coding Switch”).

When using the WAGO iPar server functionality, follow the procedure found in the corresponding application note.

9.1.2.2 PROFIsafe Address Set Using the Parameterization Tool

If the coding switch of the F I/O module to be replaced is set to 0, the PROFIsafe address of the replacement module must be set through the parameterization tool (see section “Commissioning” > … > “Parameterization of the F I/O Module with the WAGO Parameterization Tool”). The PROFIsafe address must be set to the value of the previous module. You can find the correct address in the system documentation. After successfully setting the PROFIsafe address, proceed as follows:

After start-up, the replacement module automatically requests its individual parameters from the iPar server. The safety-related verification of these parameters occurs in the F I/O module. If the verification step is unsuccessful, the replacement module sends a second request to the iPar server. If the process cannot be completed successfully, the replacement module remains in its initial state and must be configured using the WAGO parameterization tool (see section “Service” > “Replacing the F I/O Module” > “F I/O Module without iPar Server Functionality” > “PROFIsafe Address Set Using the Parameterization Tool”).

When using the WAGO iPar server functionality, follow the procedure found in the corresponding application note.

9.1.3 F I/O Module without iPar Server Functionality

9.1.3.1 PROFIsafe Address Set Using the Coding Switch

If the PROFIsafe address of the F I/O module to be replaced is set using the coding switch on the side, i.e., the switch setting does not equal 0, set the replacement module identically to the F I/O module that was replaced. Then set the parameters for the replacement I/O module using the WAGO parameterization tool (see section “Commissioning” > “Parameterization of the F I/O Module with the WAGO Parameterization Tool”).

9.1.3.2 PROFIsafe Address Set Using the Parameterization Tool

If the coding switch of the F I/O module to be replaced is set to 0, the PROFIsafe address of the replacement module must be set through the WAGO parameterization tool. After setting the PROFIsafe address, set the parameters for the replacement I/O module using the WAGO parameterization tool (see section “Commissioning” > “Parameterization of the F I/O Module with the WAGO Parameterization Tool”).

Note

Determine the PROFIsafe address if the coding switch is set to “0”
You can find the PROFIsafe address of the F I/O module to be replaced in the system documentation.

9.2 Firmware Update

DANGER

Only update firmware when the system is in a safe state!
Firmware updates must only be done when the system is in a safe state.

DANGER

The system must be checked after a firmware update!
Before commissioning, the safety functions of the automation system must be checked after changes have been made to the firmware. These tests are a requirement for occupational safety!

DANGER

Replace module if firmware defective!
If the module issues the diagnostic message “Firmware update required,” updating the firmware again is only permissible if this message was issued due to a previously aborted firmware update.
If the module reports this diagnostic after having functioned without errors, it must be replaced.

NOTICE

Note firmware version!
Only firmware intended for the F I/O module can be loaded.

You can update firmware on the Series 750 I/O Modules with the software “WAGO I/O-Update 750.” The I/O modules can be updated via the service interface or, for ETHERNET-based fieldbuses, via the fieldbus connection on the fieldbus coupler/controller.

Observe the following information:

NOTICE

Do Not Switch Off the I/O Module!
Interrupting the update process can damage the I/O module.
Do not remove the I/O module during the update process. Do not interrupt the power supply!

- Ensure that communication with the fieldbus coupler/controller is not interrupted during the update process.
- Any PLC application running on the controller must be stopped before the update process.

- Before an update via the service interface, disconnect the fieldbus cable from the fieldbus coupler/controller.
- Do not close the software during the update.
- Only run the software from a local hard disk.

Note

Additional Information from WAGO Support!
Additional information about the software “WAGO I/O-Update 750” is available through WAGO Support.

10 Use in Hazardous Environments

The **WAGO I/O System 750** (electrical equipment) is designed for use in Zone 2 hazardous areas and shall be used in accordance with the marking and installation regulations.

The following sections include both the general identification of components (devices) and the installation regulations to be observed. The individual subsections of the “Installation Regulations” section must be taken into account if the I/O module has the required approval or is subject to the range of application of the ATEX directive.

10.1 Marking Configuration Examples

10.1.1 Marking for Europe According to ATEX and IECEx

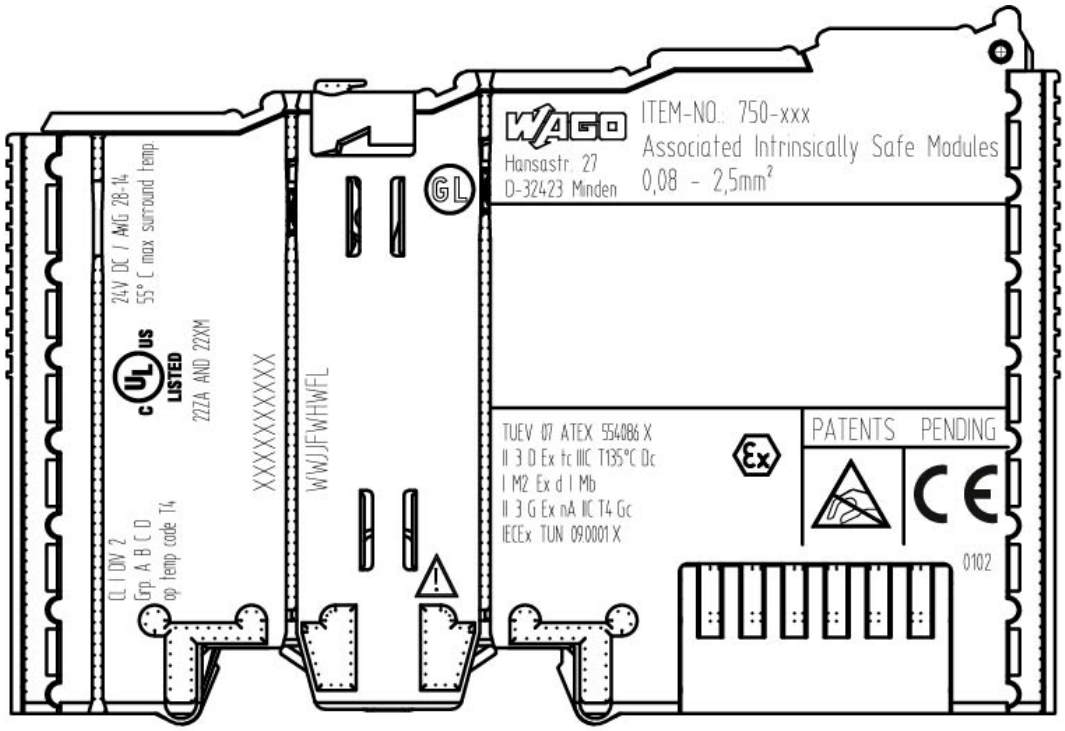


Figure 29: Marking Example per ATEX and IECEx

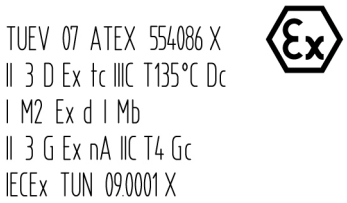


Figure 30: Text Detail – Marking Example per ATEX and IECEx

Table 41: Description of the Marking Example per ATEX and IECEx

Marking Text	Description
TUEV 07 ATEX 554086 X IECEx TUN 09.0001 X	Approving authority or certificate numbers
Dust	
II	Device group: All except mining
3 D	Device category 3 (Zone 22)
Ex	Explosion protection mark
tc	Protection type: Protection by enclosure
IIIC	Dust group: Explosive dust atmosphere
T135°C	Maximum surface temperature of the enclosure (no dust bin)
Dc	Level of equipment protection (EPL)
Mining	
I	Device group: Mining
M2	Device category: High degree of safety
Ex	Explosion protection mark
d	Protection type: Pressure-tight encapsulation
I	Electrical devices in potentially explosive mines
Mb	Level of equipment protection (EPL)
Gases	
II	Device group: All except mining
3 G	Device category 3 (Zone 2)
Ex	Explosion protection mark
nA	Protection type: Non-sparking equipment
IIC	Gas group: Explosive gas atmosphere
T4	Temperature class: Max. surface temperature 135 °C
Gc	Level of equipment protection (EPL)

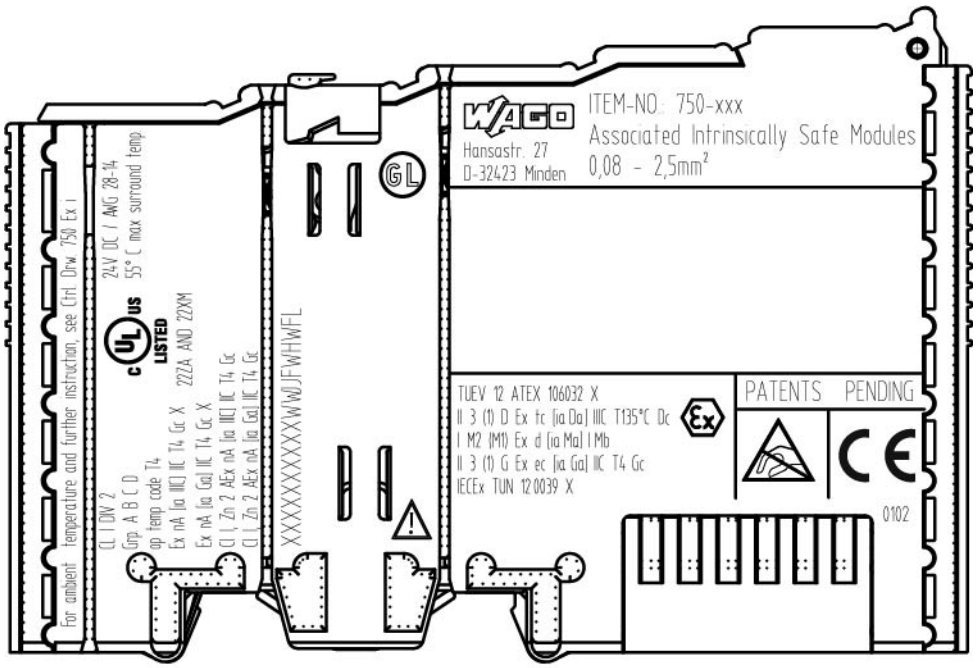


Figure 31: Marking Example of an Approved I/O Module Ex i per ATEX and IECEx

TUEV 12 ATEX 106032 X
II 3 (1) D Ex tc [ia Da] IIIC T135°C Dc
I M2 (M1) Ex d [ia Ma] I Mb
II 3 (1) G Ex ec [ia Ga] IIC T4 Gc
IECEx TUN 12 0039 X

Figure 32: Text Detail – Marking Example of an Approved I/O Module Ex i per ATEX and IECEx

Table 42: Description of the Marking Example of an Approved I/O Module Ex i per ATEX and IECEx

Marking Text	Description
TUEV 12 ATEX 106032 X IECEx TUN 12 0039 X	Approving authority or certificate numbers
Dust	
II	Device group: All except mining
3 (1) D	Device category 3 (Zone 22) that contain safety devices for Category 1 (Zone 20) devices
Ex	Explosion protection mark
tc	Protection type: Protection by enclosure
[ia Da]	Protection type and equipment protection level (EPL): Associated equipment with intrinsically safe circuits for Zone 20
IIIC	Dust group: Explosive dust atmosphere
T135°C	Max. surface temperature of the enclosure (no dust bin)
Dc	Level of equipment protection (EPL)
Mining	
I	Device group: Mining
M2 (M1)	Device category: High level of safety with circuits that offer a very high level of safety
Ex	Explosion protection mark
d	Protection type: Pressure-tight encapsulation
[ia Ma]	Protection type and equipment protection level (EPL): Associated equipment with intrinsically safe circuits
I	Electrical devices in potentially explosive mines
Mb	Level of equipment protection (EPL)
Gases	
II	Device group: All except mining
3 (1) G	Device category 3 (Zone 2) that contain safety devices for Category 1 (Zone 0) devices
Ex	Explosion protection mark
ec	Protection type: Increased safety
[ia Ga]	Protection type and equipment protection level (EPL): Associated equipment with intrinsically safe circuits for Zone 0
IIC	Gas group: Explosive gas atmosphere
T4	Temperature class: Max. surface temperature 135 °C
Gc	Level of equipment protection (EPL)

10.1.2 Marking for the United States of America (NEC) and Canada (CEC)

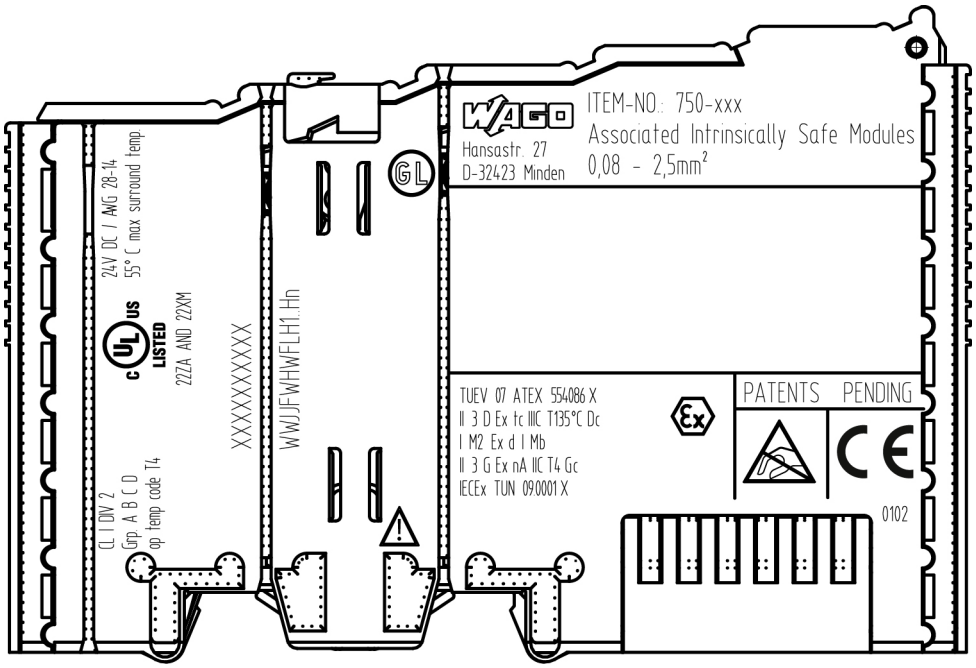


Figure 33: Marking Example According to NEC

CL I DIV 2
Grp. A B C D
op temp code T4

Figure 34: Text Detail – Marking Example According to NEC 500

Table 43: Description of Marking Example According to NEC 500

Marking	Description
CL I	Explosion protection (gas group)
DIV 2	Area of application
Grp. A B C D	Explosion group (gas group)
op temp code T4	Temperature class

Figure 35: Text Detail – Marking Example for Approved I/O Module Ex i According to NEC 505

Table 44: Description of Marking Example for Approved I/O Module Ex i According to NEC 505

Marking	Description
Cl I,	Explosion protection group
Zn 2	Area of application
AEx	Explosion protection mark
nA	Type of protection
[ia Ga]	Type of protection and equipment protection level (EPL): Associated apparatus with intrinsic safety circuits for use in Zone 20
IIC	Group
T4	Temperature class
Gc	Equipment protection level (EPL)

Figure 36: Text Detail – Marking Example for Approved I/O Module Ex i According to NEC 506

Table 45: Description of Marking Example for Approved I/O Module Ex i According to NEC 506

Marking	Description
Cl I,	Explosion protection group
Zn 2	Area of application
AEx	Explosion protection mark
nA	Type of protection
[ia IIIC]	Type of protection and equipment protection level (EPL): Associated apparatus with intrinsic safety circuits for use in Zone 20
IIC	Group
T4	Temperature class
Gc	Equipment protection level (EPL)

Ex nA [ia IIIC] IIC T4 Gc X
Ex nA [ia Ga] IIC T4 Gc X

Figure 37: Text Detail – Marking Example for Approved I/O Module Ex i According to CEC 18 attachment J

Table 46: Description of Marking Example for Approved I/O Module Ex i According to CEC 18 attachment J

Marking	Description
Dust	
Ex	Explosion protection mark
nA	Type of protection
[ia IIIC]	Type of protection and equipment protection level (EPL): Associated apparatus with intrinsic safety circuits for use in Zone 20
IIC	Group
T4	Temperature class
Gc	Equipment protection level (EPL)
X	Symbol used to denote specific conditions of use
Gases	
Ex	Explosion protection mark
nA	Type of protection
[ia Ga]	Type of protection and equipment protection level (EPL): Associated apparatus with intrinsic safety circuits for use in Zone 0
IIC	Group
T4	Temperature class
Gc	Equipment protection level (EPL)
X	Symbol used to denote specific conditions of use

10.2 Installation Regulations

For the installation and operation of electrical equipment in hazardous areas, the valid national and international rules and regulations which are applicable at the installation location must be carefully followed.

10.2.1 Special Notes including Explosion Protection

The following warning notices are to be posted in the immediately proximity of the WAGO I/O System 750 (hereinafter “product”):

WARNING – DO NOT REMOVE OR REPLACE FUSED WHILE ENERGIZED!

WARNING – DO NOT DISCONNECT WHILE ENERGIZED!

WARNING – ONLY DISCONNECT IN A NON-HAZARDOUS AREA!

Before using the components, check whether the intended application is permitted in accordance with the respective printing. Pay attention to any changes to the printing when replacing components.

The product is an open system. As such, the product must only be installed in appropriate enclosures or electrical operation rooms to which the following applies:

- Can only be opened using a tool or key
- Inside pollution degree 1 or 2
- In operation, internal air temperature within the range of 0 °C ≤ Ta ≤ +55 °C or −20 °C ≤ Ta ≤ +60 °C for components with extension number …/025-xxx or −40 °C ≤ Ta ≤ +70 °C for components with extension number …/040-xxx
- Minimum degree of protection: min. IP54 (acc. to EN/IEC 60529)
- For use in Zone 2 (Gc), compliance with the applicable requirements of the standards EN/IEC/ABNT NBR IEC 60079-0, -7, -11, -15
- For use in Zone 22 (Dc), compliance with the applicable requirements of the standards EN/IEC/ABNT NBR IEC 60079-0, -7, -11, -15 and -31
- For use in mining (Mb), minimum degree of protection IP64 (acc. EN/IEC 60529) and adequate protection acc. EN/IEC/ABNT NBR IEC 60079-0 and -1
- Depending on zoning and device category, correct installation and compliance with requirements must be assessed and certified by a “Notified Body” (ExNB) if necessary!

Explosive atmosphere occurring simultaneously with assembly, installation or repair work must be ruled out. Among other things, these include the following activities

- Insertion and removal of components
- Connecting or disconnecting from fieldbus, antenna, D-Sub, ETHERNET or USB connections, DVI ports, memory cards, configuration and programming interfaces in general and service interface in particular:
  - Operating DIP switches, coding switches or potentiometers
  - Replacing fuses

Wiring (connecting or disconnecting) of non-intrinsically safe circuits is only permitted in the following cases

- The circuit is disconnected from the power supply.
- The area is known to be non-hazardous.

Outside the device, suitable measures must be taken so that the rated voltage is not exceeded by more than 40 % due to transient faults (e.g., when powering the field supply).

Product components intended for intrinsically safe applications may only be powered by 750-606 or 750-625/000-001 bus supply modules.

Only field devices whose power supply corresponds to overvoltage category I or II may be connected to these components.

10.2.2 Special Notes Regarding UL Hazardous Location

For UL Hazardous Location acc. to UL File E198726, the following additional requirements apply:

- Use in Class I, Division 2, Group A, B, C, D or non-hazardous areas only
- ETHERNET connections are used exclusively for connecting to computer networks (LANs) and may not be connected to telephone networks or telecommunication cables
- **WARNING** – The radio receiver module 750-642 may only be used to connect to external antenna 758-910!
- **WARNING** – Product components with fuses must not be fitted into circuits subject to overloads!
  These include, e.g., motor circuits.
- **WARNING** – When installing I/O module 750-538, “Control Drawing No. 750538” in the manual must be strictly observed!

Information

Additional Information
Proof of certification is available on request.
Also take note of the information given on the operating and assembly instructions.
The manual, containing these special conditions for safe use, must be readily available to the user.

11 Appendix

11.1 PROFIsafe

PROFIsafe is a protocol for secure communication that is certified in accordance with IEC 61784-3-3.

I/O modules equipped with safety-related inputs and outputs (so-called F I/O modules) have been developed for the WAGO I/O System 750/753 without radical changes to the existing 750 Series system. This allows mixed operation of safety-related and non-safety-related I/O modules.

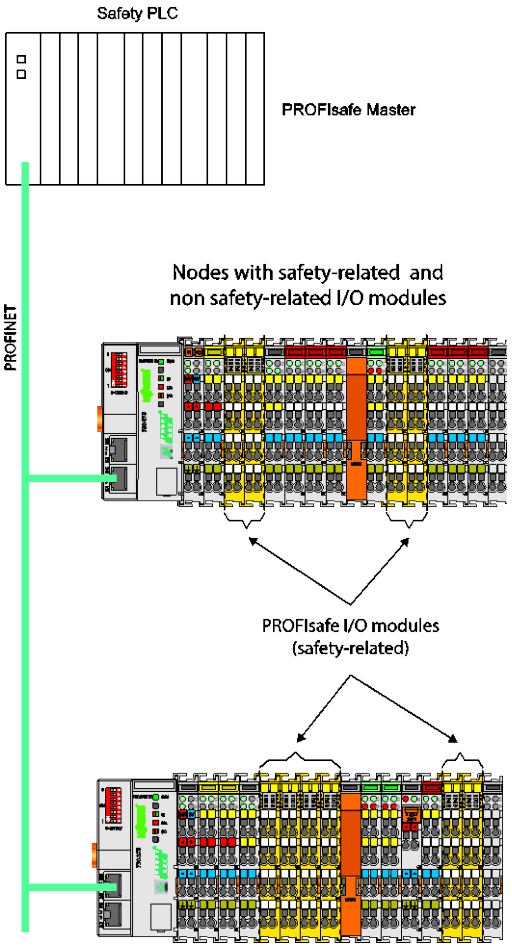


Figure 38: Mixed Operation of Safety-Related and Non-Safety-Related I/O Modules

A safe PLC (PROFIsafe and PROFINET host) with a PROFINET interface is used as the controller.

Data is exchanged between the safe F I/O modules and the safe PLC via PROFINET as the basis. Data is exchanged in the form of PROFIsafe telegrams that correspond to the PROFIsafe protocol profile IEC 61784-3-3.

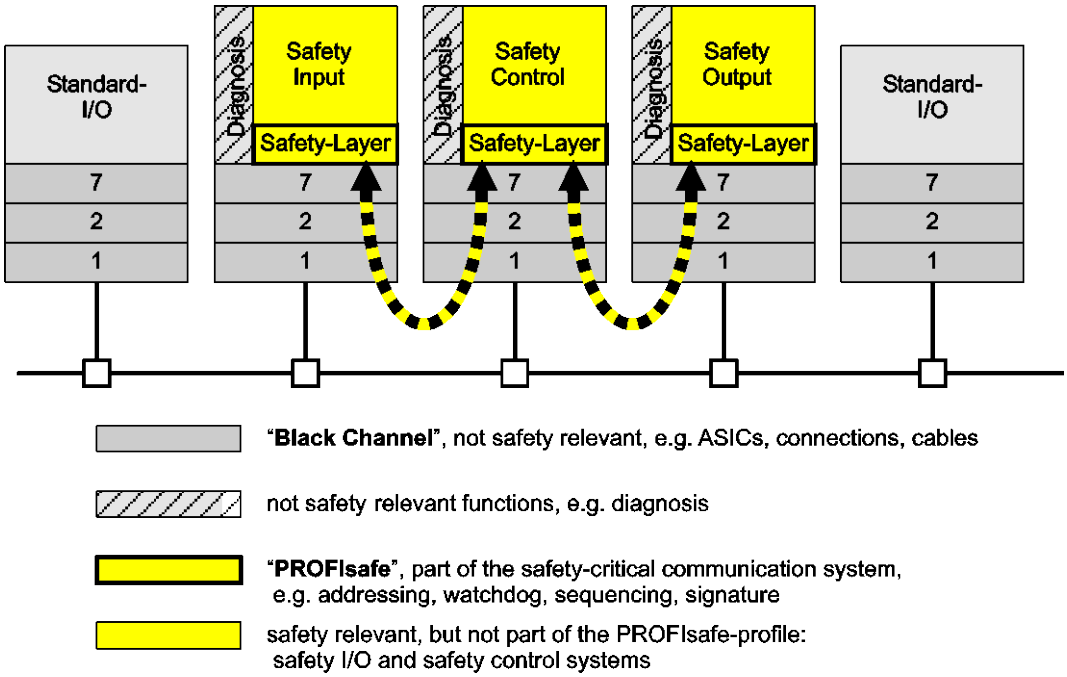


Figure 39: PROFIsafe Layer Model

The PROFIsafe telegrams are transferred between the safe PLC and the F I/O module via the so-called “black channel.” The “black channel” extends from the PROFINET connection of the PLC, to the fieldbus coupler/controller, the local bus in the node, to the F I/O module. The PROFIsafe telegrams are only evaluated in the safe PLC and in the F I/O module.

If communication errors are detected, the F I/O modules are passivated by all safe outputs being switched off and the safe substitute values being transferred to the safe PLC as an input process image.

The evaluation of the input process image and the output of the output process image via the F I/O module with digital outputs are performed by the safe PLC.

Note

Note the following guidelines and information when setting up PROFIsafe applications:

- PROFIsafe Guidelines – Requirements for Installation, Immunity and Electrical Safety (PROFIsafe Environmental Requirements, current version)
- Installation recommendations (PROFIBUS Installation Guidelines, current version)

These documents are available on the Internet at http://www.profibus.com/.

11.1.1 iParameters (Individual Parameters)

The iParameters are used to configure device functions of a safe device such as the F I/O modules of the WAGO I/O System 750. The “WAGO Safety Editor 75x” parameterization tool (SEDI) can be used to set the iParameters of WAGO F I/O modules. SEDI is the CPD tool for WAGO F I/O modules.

It is often required during a repair to quickly replace a device without using additional manufacturer tools for parameterization of the device functions.

To meet this requirement, the iPar server is used that offers appropriate services for saving and restoring iParameters. The “iPar Server” is available as a function block or as a system function within the non-safety related part of the safe PLC.

Further details about using the iPar server in conjunction with the WAGO F I/O modules are available in an application note.

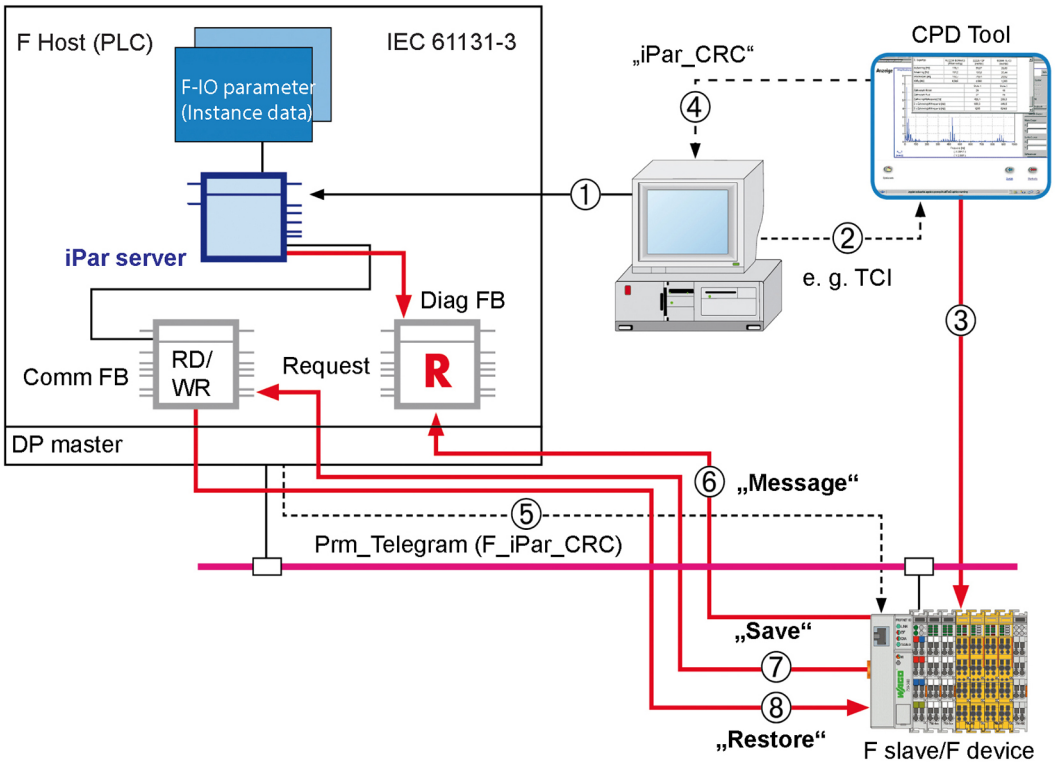


Figure 40: iPar Server

Table 47: Legend for the iPar Server Figure

No.	Explanation
1	Instantiation of the iPar Server function
2	CPD Tool Start and parameter transfer (e.g., node address)
3	Parameterization of iParameters of a F I/O module and commissioning
4	Transfer of iPar signature (CRC over the iParameters) to the F-Host
5	During startup, transfer of the iPar signature to F-device (Prm_Telegram)
6	Message to iPar server via diagnostic agent (alarm/status)
7	iPar server polls Diag FB and starts “Save” if required
8	iPar server polls Diag FB and starts “Restore” if required

Note

Use application notes from WAGO
An overview for using F I/O module in combination with a safe PLC is summarized in an application note. This application note is available on the Internet at www.wago.com in the download area.

11.2 Overview of PROFIsafe F Parameters

Table 48: PROFIsafe F Parameters

F parameters	Default Value	Explanation	
F_Check_SeqNr	No Check	The F I/O module only supports **PROFIsafe mode V2**. The parameter is not evaluated and must be set to “No Check.”	
F_Check_iPar	No Check	For the F I/O module, this value must always be set to “No Check.”	
F_SIL	SIL 3	The **F_SIL** parameter specifies the required safety integrity level of the F I/O module. The F I/O module supports SIL3. This value is specified by the WAGO device description file (GSD/GSDML).	
F_CRC_Length	3-byte CRC	The **F_CRC_Length** parameter specifies the length of the CRC 2 key to be used in the PROFIsafe telegram. The required length depends on the length of the user data to be transferred. Valid combinations are:	
		F_CRC_Seed, F_Passivation	F_CRC_Length
		0, 0 (PROFIsafe V2.4)	3-byte CRC
		1, 1 (PROFISafe V2.6)	4-byte CRC

Table 48: PROFIsafe F Parameters

<table>
<tr><th>F parameters</th><th>Default Value</th><th>Explanation</th></tr>
<tr><td>F_CRC_Seed</td><td>0</td><td>The F_CRC_Seed parameter defines the calculation type of the CRC2. The value of the parameter must exactly match the value of the F_Passivation parameter.
If the F I/O module is to be operated in PROFIsafe Mode V2.4, both parameters must be set to “0”.
If PROFIsafe Mode V2.6 is to be used, both parameters must be set to “1”.
Valid combinations are:
<table>
<tr><td>F_Passivation</td><td>F_CRC_Seed</td></tr>
<tr><td>0
(PROFIsafe V2.4)</td><td>0</td></tr>
<tr><td>1
(PROFIsafe V2.6)</td><td>1</td></tr>
</table></td></tr>
<tr><td>F_Passivation</td><td>0</td><td>The F_Passivation parameter sets the passivation mode of the F I/O module.
If PROFIsafe Mode V2.4 is to be used, this parameter and the F_CRC_Seed parameter must be set to “0”.
If PROFIsafe Mode V2.6 is to be used, this parameter and the F_CRC_Seed parameter must be set to “1”. In this case, the F I/O module uses channel-granular passivation per RIOforFA.
Valid combinations are:
<table>
<tr><td>F_CRC_Seed</td><td>F_Passivation</td></tr>
<tr><td>0
(PROFIsafe V2.4)</td><td>0
(PROFIsafe V2.4 passivation mode parameter is used)</td></tr>
<tr><td>1
(PROFIsafe V2.6)</td><td>1
(channel-granular RIOforFA passivation)</td></tr>
</table></td></tr>
<tr><td>F_Block_ID</td><td>1</td><td>The F_Block_ID parameter specifies the format of the F parameter set. The F I/O module only supports the value “1.”</td></tr>
<tr><td>F_Par_Version</td><td>V2 mode</td><td>The F_Par_Version parameter specifies the PROFIsafe version to be used for communication. The F I/O module only supports PROFIsafe Mode V2.</td></tr>
</table>

Table 48: PROFIsafe F Parameters

F parameters	Default Value	Explanation
F_Source_Add	–	The **F_Source_Add** parameter specifies the PROFIsafe source address. To prevent incorrect parameterization, the address of the configuration tool is assigned automatically and cannot be changed. The parameter can take values from 1 to 65534. The F I/O module only supports PROFIsafe address type 1 and does not check the F source address.
F_Dest_Add	–	The **F_Dest_Add** parameter specifies the PROFIsafe destination address of the F I/O module. For F_Dest_Add, values from 1 to 65534 can be selected. Each address value is only allowed to appear in the system once. This is checked by the configuration tool of the **safe PLC**. For PROFIsafe communication, the parameter value must match the PROFIsafe address of the F I/O module. The F I/O module only supports PROFIsafe address type 1.
F_WD_Time	150 ms	The **F_WD_Time** parameter determines the monitoring time for PROFIsafe communication between the safe PLC and F I/O module. At least one valid PROFIsafe telegram must be exchanged between the safe PLC and the F I/O module within the monitoring time. If this condition is not met, the safe PLC or F I/O module initiates a safe state. The monitoring time must be selected in such a way that the telegram execution times are tolerated, but an interruption in the connection is still detected quickly enough. The monitoring time can be specified in increments of 1 ms. The possible value range (50 ... 10000 ms) is specified by the WAGO device description file (GSD/GDML).

Table 48: PROFIsafe F Parameters

F parameters	Default Value	Explanation
F_iPar_CRC	48024 (0xBB98)	The **F_iPar_CRC** parameter specifies a comparison value for the CRC value via the **iParameters** (iPar_CRC). The PROFIsafe data exchange only starts when the values for F_iPar_CRC and iPar_CRC match. If they differ, the F I/O module requests a restore of the iParameter from the **iPar server**. The “F_iPar_CRC” value “0” is a special case. This value switches the F I/O module into test mode. The CRC value (iPar_CRC) is displayed by the WAGO parameterization tool and must be transferred with the configuration tool of the safe PLC to the **F parameters** of the F I/O module.

12 Glossary

A

Actuator
Final controlling element, valve, signal lamps, relays, motor contactor with force-guided contacts (see also “Force-Guided Contacts, Positively Driven Relays”)

Antivalence
Two different input signals, e.g., open and closed contacts on two inputs of the F I/O module.

C

CAGE CLAMP®
CAGE CLAMP® is a registered trademark of WAGO GmbH & CO. KG.

Cat. (category)
The categories (Cat.) of ISO 13849-1 (B, 1, 2, 3 and 4) specify the required behavior of a safe device in terms of its resistance to errors based on its design.

Channel Pair
A channel pair is used for dual-channel applications and consists of two inputs. Either inputs AI1 and AI2 or AI3 and AI4 must be used for a channel pair.

CPD Tool (Configuration, Parametrization and Diagnosis Tool)
The CPD tool can be used to parameterize, configure and diagnose device functions of safe field devices (see also “WAGO Parameterization Tool” and “WAGO Safety Editor”).

CRC (Cyclic Redundancy Check)
The cyclic redundancy check is a procedure for determining a test value for data in order to detect errors during transmission or storage.

Cross Circuit
A conductive connection between two live electrical lines with almost no resistance (see also “Short Circuit”).

Cross Circuit Test
The cross circuit test is used to discover a short circuit between two live lines (see also “Short Circuit Test”).

D

Dangerous Failure
Termination of the capacity of a unit to perform the required function (see also “Failure”).

DC (Diagnostic Coverage)
Diagnostic coverage is the decrease in probability of dangerous hardware failures that result from executing automatic diagnostics tests.

DC13 (Utilization Category)
Utilization category DC13 of IEC 60947-5-1 describes the making and breaking capacity for switching elements to switch an electromagnetic load.

Default Setting
A default setting is a preset value of a parameter that is used if the user does not make any other settings (see also “Default iParameter Set”).

Default iParameter Set
A data set persistently stored in the F I/O module with default values that correspond to the iParameter set in the F I/O module when delivered.

Diagnostic Coverage Level
See “DC (Diagnostic Coverage)”

Discrepancy Error
A discrepancy error is reported if the discrepancy time is exceeded during dual-channel pre-evaluation. The module outputs the diagnostic message “Discrepancy time exceeded.”

Discrepancy Time
The discrepancy time specifies the maximum permissible duration of unequal states of two signals.

Discrepancy Time Monitoring
The F I/O module performs discrepancy time monitoring when dual-channel pre-evaluation is used by comparing the signal states of two digital inputs against the valence rule. If the inputs signals deviate from the valence rule, discrepancy time monitoring is activated (see also “Discrepancy Time”).

E

Engineering Tool of the Safe PLC
The engineering tool of the safe PLC is used to configure hardware and to create the safety program of the safe PLC.

Equivalence
Two identical input signals, e.g., two open contacts on two inputs of the F I/O module

F

Failure
Termination of the capacity of a unit to perform the required function (see also “Dangerous Failure”).

FG (Functional Ground)
Function ground (FG) is not the same as protective earth (PE) according to VDE 0100 and is only used as an EMC ground connector.

F Parameters
Parameters for configuring data communication between the safe PLC and the F I/O module

Force-Guided Contacts, Positively Driven Relays
Force-guided contacts or positively driven operation refers to a contact system where break contacts and make contacts can never be opened or closed at the same time. It must be ensured that a contact gap of min. 0.5 mm is present throughout the service life and in the faulted state (contact welding). Relays with force-guiced/positively driving contacts are elementary relays governed by standard according to IEC EN 61810-1 with special additional properties based on the contact set, whose requirements are formulated in EN 50205 (see also “Actuator”).

Function Block
Software block executed in a unit that performs a sub-function

FVi
Failsafe Values Input

FVo
Failsafe Values Output

H

Hardware Fault Tolerance
Capacity of a safety-oriented unit, subsystem or subsystem element to continue executing a required safety function even when an error exists

Hazardous Situation
Circumstance in which a person is exposed to at least one hazard. This situation leads to injury immediately or over a period of time.

I

Individual Parameters (iPar)
Individual or device-specific parameters of a safe unit or safe device.

iParameters
See “Individual Parameters.”

iPar Server
Standardized mechanism for saving and restoring iParameters (iPar) in the non-safe part of a control unit.

M

Minimum Signal Duration
Minimum duration of a signal voltage “0” (e.g., open input) on the input of the F I/O module

Mini-WSB
Mini-WSB marking accessories are a quick marking system (item no. 247-xxx) for WAGO connectors and WAGO modules.

$MTTF_D$ (Mean Time To Failure Dangerous)
The $MTTF_D$ value specifies the mean time to a dangerous failure of a safe unit or sub-unit.

O

Operator Acknowledge (OA)
See “User Acknowledgement (Operator Acknowledge (OA))”

Overvoltage Category
The overvoltage category is a metrica for overvoltages that can occur at the place if installation due to lightning or switching operations, for example.

P

Passivate, Passivation
Passivation of safe digital inputs is performed automatically by the F I/O module after activation or detection of errors. Operator acknowledgment is required after passivation in order for the F I/O module to start.

PE (Protective Earth)
Protective earth (PE) is connected to the ground connector according to EN 60204-1 and serves as basic protection against electric shock in the event of indirect touching. It is also used to reduce the effect of electrical interference on electrical equipment that affects operation of a machine or system.

PFD (Probability of Failure on Demand)
The safety parameter PFD specifies the probability of a dangerous failure.

PFH (Probability of Dangerous Failure per Hour)
The safety parameter PFH specifies the probability of a dangerous failure within one hour.

PL (Performance Level)
The performance level (PL) specifies the capacity of safety devices to execute a safety function under foreseeable conditions.

PLC
A PLC (Programmable Logic Controller) is a device used to control a machine or system and is programmed on a digital basis.

PROFIsafe
PROFIsafe Version 2.6 is used per PROFIsafe – Profile for Safety Technology on PROFIBUS and PROFINET Profile part, related to IEC 61784-3-3 Technical Specification Version 2.6 MU1.

PROFIsafe Address
Address that must be assigned to a safe device with PROFIsafe data communication in order for data communication to be established between an F host and F device.

Protected Installation
The goal of the protected installation of lines is, for example, operational reliability and protection against stray voltages at different voltages in a cable or equipment. Among other means, this is achieved by the necessary insulation between two lines of different potentials.

PVi
Process Values Input

PVo
Process Values Output

R

Request
Event that causes the F I/O module to execute its safety function.

Response Time
See “Safety Response Time.”

Restart Inhibit
A restart inhibit is a means of preventing hazardous machine operation from starting automatically after one or more of the following events:
- A safety function is triggered
- The operating mode of the machine changes
- The means for staring the machine changes

RIOforFA
Remote IO for Factory Automation Common Profile Specification for PROFINET and PROFIBUS Version 1.10

Risk Reduction
The required risk reduction is the result of a risk assessment on the basis of which measures are taken to lower the risk of a safety system to an acceptable residual risk.

S

Safe PLC
A safe PLC (Programmable Logic Controller) is a safety-oriented PLC that controls safe devices, e.g., F I/O modules.

Safety Function
Function of a machine whose failure can lead to an immediate increase in the risk(s).

Safety Response Time
The safety response time is the time between a safety request (on an input/channel pair or in the output process values) and the response to the safety request (in the input process values). This time is observed even in the presence of an error. In the process image, if an error is present, the channel status bit of the input channel in the input process image changes from status 1 to status 0 (T(SR)).

Sensor
A sensor is used for recording physical quantities (e.g., switch settings, temperature, pressure etc.) and can be connected (if compatible) to the digital inputs of the F I/O module.

Severity Level of Diagnostics
The severity levels of diagnostics are derived from the PROFINET system description, according to which “Severity Level” stands for “Error” corresponding to “Fault” and “Maintenance Demanded” corresponding to “Warning.”

SIL (Safety Integrity Level)
The Safety Integrity Level (SIL) is used to assess electrical/electronic/programmable electronic (E/E/PE) systems in terms of reliability of safety functions. There are four levels for specifying the requirement for the safety integrity of safety functions, where “Safety Integrity Level 4” is the highest level of safety integrity and “Safety Integrity Level 1” is the lowest.

Single Fault Security
Even after one error occurs, the required safety function is still ensured. In other words, one error does not lead to the loss of the safety function.

Short Circuit
A conductive connection between two live electrical lines with almost no resistance (see also “Cross Circuit”).

Short Circuit Test
The short circuit test is used to detect a short circuit between two live lines. See also “Cross Circuit Test.”

T

T(SR) (Safety Response Time)
Symbol for the safety response time in case of error (see also “Safety Response Time”).

TCI (Tool Calling Interface)
TCI (Tool Calling Interface) is an interface specified by the PROFIBUS User Organization (PNO), which defines how device-specific or manufacturer-specific parameterization tools are called from a configuration environment. The features of the interface are described in conformance classes. Generally, the communication options of the specific software tools are determined with the devices.

Test Mode
The test mode is intended for commissioning and configuring the F I/O module with the iPar server and is initiated by the F I/O module upon receiving the F parameter F_iPar_CRC = 0. This eliminates the check of F_iPar_CRC against iPar_CRC. All digital inputs are passivated the test mode. According to the PROFIsafe specification, test mode is indicated visually by the parameterization LED (LED H) on the F I/O module flashing green at 2 Hz.

Test Pulse Duration
The duration of the test pulse for the short circuit test is set with the **Test Pulse Duration** parameter; the correct test pulse duration setting depends on the capacitance of the input circuitry, which is influenced by the type of sensor connected and the cable length.

U

User Acknowledgement (Operator Acknowledge (OA))
Prompt for user acknowledgment (operator acknowledgment) that causes start-up of a machine or system. User acknowledgment is necessary for the F I/O module – for example after errors are detected by the F I/O module and eliminated by maintenance personnel – and is initiated from the control level.

V

Valence Analysis
The valence analysis is the analysis of two input signals according to either the equivalence rule (equality) or the antivalence rule (difference).

W

WAGO-I/O-*CHECK*
WAGO-I/O-*CHECK* is a manufacturer tool used to configure WAGO I/O modules. To parameterize the F I/O modules, WAGO-I/O-*CHECK* and WAGO Safety Editor are required (see also “WAGO Parameterization Tool”).

WAGO Parameterization Tool
The WAGO parameterization tool is required for configuring the F I/O modules. This consists of the two manufacturer tools WAGO-I/O-*CHECK* and WAGO Safety Editor (see also “WAGO-I/O-*CHECK*”).

WAGO Safety Editor
WAGO Safety Editor (abbreviated SEDI) is required together with WAGO-I/O-CHECK 3.x for configuring the F I/O modules. SEDI is the CPD tool for WAGO F I/O Modules (see also “CPD Tool (Configuration, Parametrization and Diagnosis Tool)”).

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