TECHDOCS

Manual

WAGO I/O System 750

750-667/000-003

4FDI/4FDO 24V/2A PROFIsafe V2 iPar

Fail-safe 4/4 channel digital input/output; 24 VDC; 2 A; PROFIsafe V2.0 iPar

Version 1.5.0, 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: “4FDI/4FDO 24V/2A PROFIsafe V2 iPar” (750-667/000-003).

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

The I/O module 750-667/000-003 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.

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”.

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	Indicates
italic	Names of paths and data files are marked in italic-type. e.g.: *C:\Program Files\WAGO Software*
Menu	Menu items are marked in bold letters. e.g.: **Save**
>	A greater-than sign between two names means the selection of a menu item from a menu. e.g.: **File** > **New**
Input	Designation of input or optional fields are marked in bold letters, e.g.: **Start of measurement range**
“Value”	Input or selective values are marked in inverted commas. e.g.: Enter the value “4 mA” under **Start of measurement range**.
[Button]	Pushbuttons in dialog boxes are marked with bold letters in square brackets. e.g.: **[Input]**
[Key]	Keys are marked with bold letters 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 Kontakttechnik GmbH & Co. KG reserves the right to provide for any alterations or modifications. WAGO Kontakttechnik 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, exchanging 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 up to 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 Kontakttechnik 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 Kontakttechnik 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 only one 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.

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 EN61131-2. 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.

3 PROFIsafe

PROFIsafe is a protocol for safe communication, and is certified in accordance with IEC 61784-3-3.

For the WAGO I/O System 750, I/O modules were developed with safety-related inputs and outputs (F I/O modules) without any drastic changes to the existing series 750 system, making mixed operation of safety-related and non-safety-related I/O modules possible.

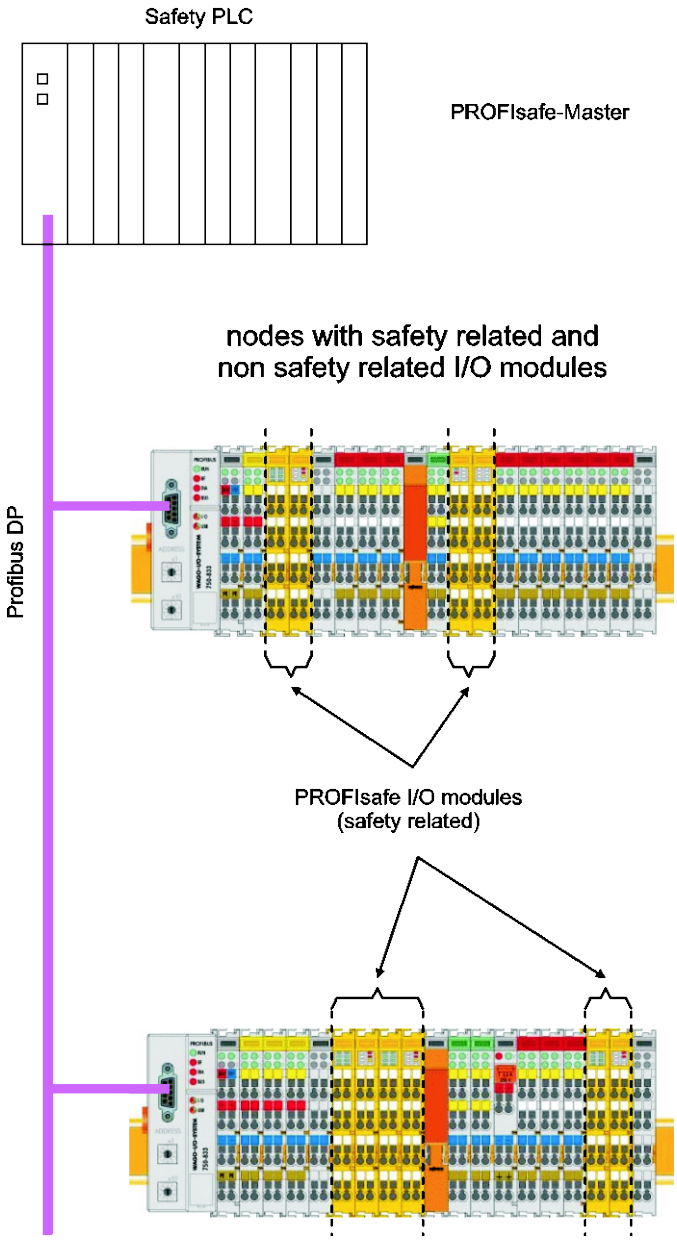


Figure 1: Mixed Operation of Safety-Related and Non-Safety-Related I/O Modules

A safe PLC (PROFIsafe and PROFIBUS or PROFINET master) is used with PROFIBUS or PROFINET interface as the controller.

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

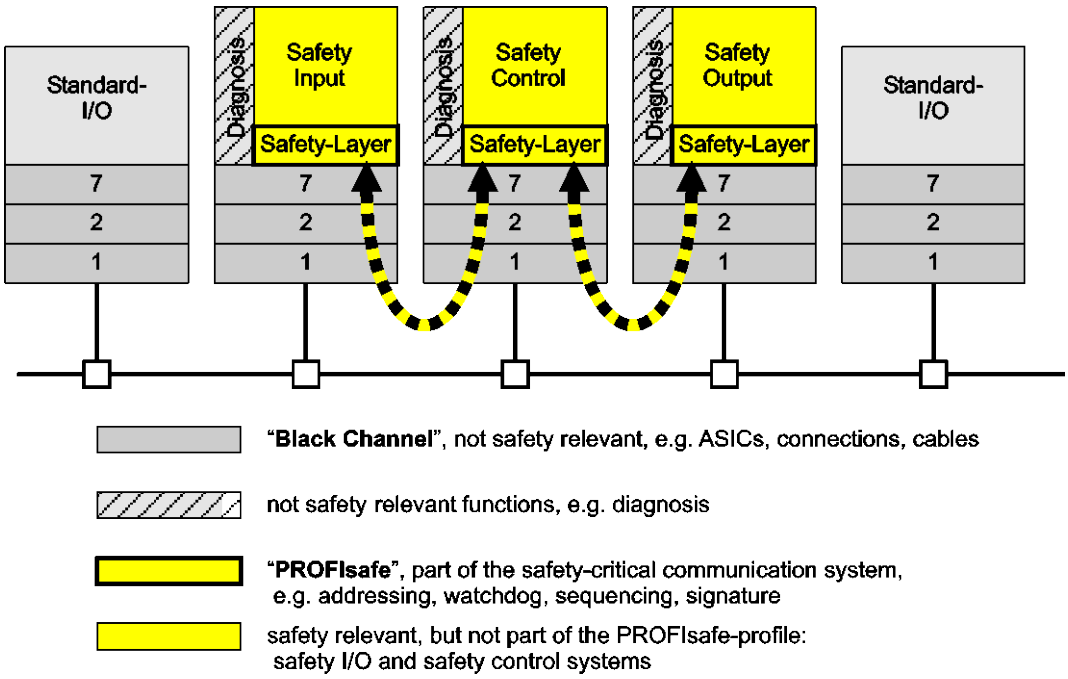


Figure 2: PROFIsafe Layer Model

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

When detecting communication errors, the F I/O modules are passivated in that all safe outputs are switched off and the substitute values are transferred to the safe PLC as an input process image.

Evaluation of the input process image and output of the output process image via the F I/O modules with digital outputs are controlled by the safe PLC.

Note

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

- Guideline PROFIsafe - Requirements for Installation, Immunity and electrical Safety (PROFsafe Environmental Requirements, current version)
- Installation recommendations (PROFIBUS Installation Guidelines, current version)

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

3.1 Individual Parameters (iParameters)

The individual parameters 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 individual parameters 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.

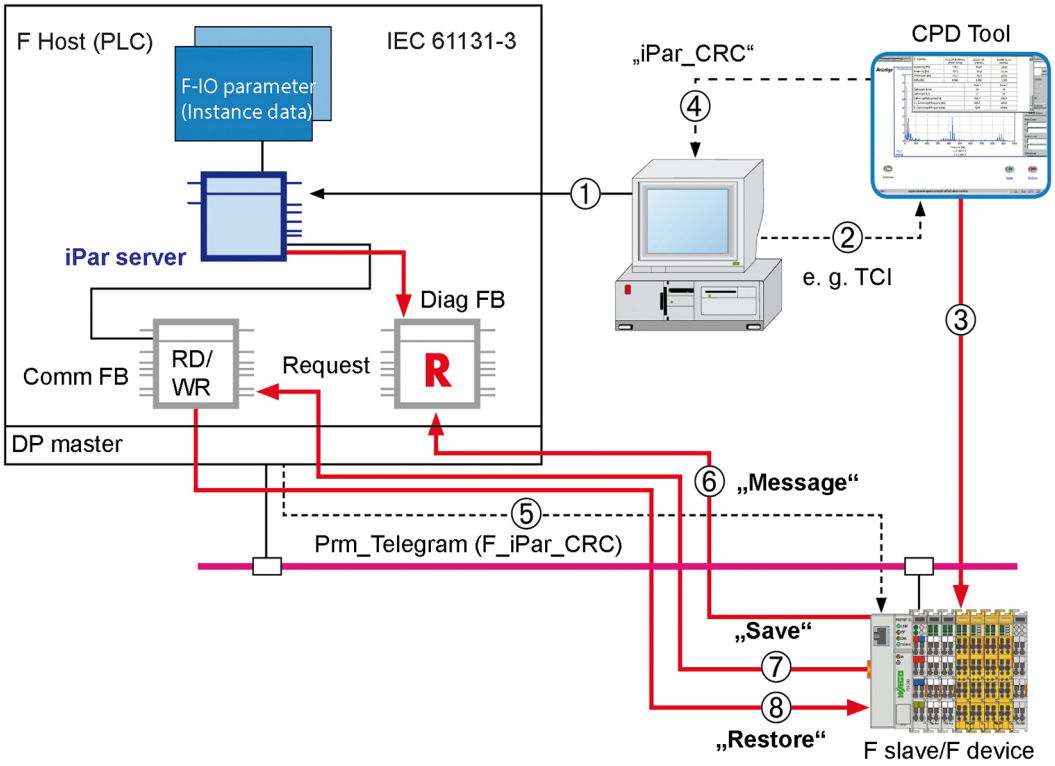


Figure 3: iPar Server

Table 3: 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-slave (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 the application notes from WAGO!
An overview for using the 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 under “Service > Downloads > Application Notes ...”.

4 Device Description

The safe F I/O modules are intended for functional safety in the area of industrial automation technology, building technology and process technology to protect man and machine according to Machinery Directive 2006/42/EC.

The PROFIBUS DP and PROFINET IO fieldbus can be used to connect to the safe PLC. The F I/O modules can be seamlessly integrated into the existing WAGO I/O System 750.

Expensive and inflexible cabling are replaced by flexible configurable safety functions by secure PROFIsafe data transmission via the existing fieldbus system. It is then possible to optimize the F I/O module to different safety applications.

The F I/O modules of the WAGO I/O System 750 can be used to implement safety applications in accordance with the following standards:

- DIN EN 61508, Part 1 – 7, up to SIL3
- EN ISO 13849, Part 1 – 2 + AC, up to Cat.4/PL e
- DIN EN 62061, up to SIL3
- DIN EN 61511, up to SIL3

The following actuators and sensors can be operated at the inputs of the F I/O module 750-667/000-003 (see section “Connect Devices” > … > “Connection Examples”):

- Potential-free emergency OFF switches with contacts
- Protective door switches
- Mode selector switches
- Safe sensors
- Semiconductor outputs, compatible with type 1 inputs according to EN 61131-2

The following loads can be operated at the outputs of the F I/O module 750-667/000-003 (see section “Connect Devices” > … > “Connection Examples”):

- Resistive loads
- Inductive loads after DC13 acc. EN 60947-5-1

The F I/O module 750-667/000-003 has the following properties:

- Four safety-oriented digital inputs I1 … I4
- To clock outputs T1 and T2
- Clock outputs T1 and T2 can be used to power semiconductor sensors.
- Four safety-oriented digital power outputs O1 … O4, plus/minus switching, output nominal current per 2 A
- Diagnosis via the LED display elements and the fieldbus protocol acc. IEC 61784-1
- iPar server support for saving and restoring individual parameters

- Module-wide passivation of the digital inputs and power outputs in case of error
- Short circuit test for digital inputs I1 … I4 can be activated/deactivated
- Configurable filter time for digital inputs I1 … I4
- Configurable two-channel analysis of the input signals
- Configurable discrepancy monitoring for the two-channel analysis of the digital inputs
- Restart barrier for the two-channel analysis can be activated/deactivated
- Rotary table / mode selector switch operating mode for digital inputs I1 … I4
- Configurable test pulse durations for digital power outputs O1 … O4
- Configurable line break monitoring for digital power outputs O1 … O4

The assignment of the connections is described in the “Connectors” section. Connection examples are shown in section “Connect Devices” > … > “Connection Example(s)”.

Multicolor LEDs indicate the signal states of the inputs and outputs, as well as the status and errors of the PROFIsafe I/O module.
The meaning of the LEDs is described in the “Display Elements” section.

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”.

The I/O module 750-667/000-003 (4FDI/4FDO 24V/2A PROFIsafe V2 iPar) receives the 24 V voltage supply for the field level from an upstream I/O module or from the fieldbus coupler/controller via blade-formed power jumper contacts. It then provides these potentials to subsequent I/O modules via spring-formed power jumper contacts.

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 750-667/000-003 can be operated on the WAGO I/O System 750 fieldbus couplers specified in section “Technical Data” > … > “Communication”:

4.1 View

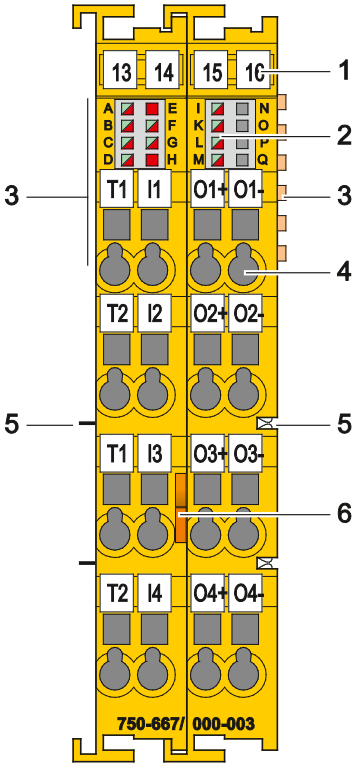


Figure 4: View

Table 4: 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”

4.2 Connectors

4.2.1 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.

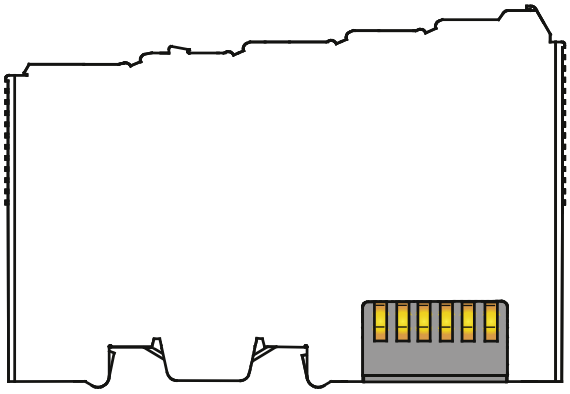


Figure 5: Data Contacts

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.

4.2.2 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 750-667/000-003 has 2 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.

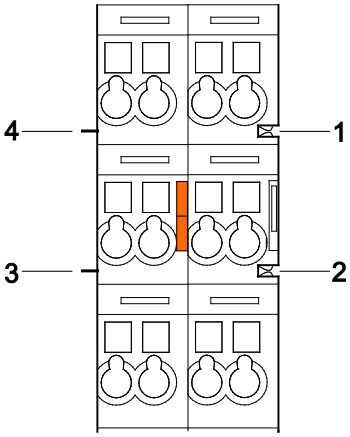


Figure 6: Power Jumper Contacts

Table 5: 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”.

4.2.3 CAGE CLAMP® Connectors

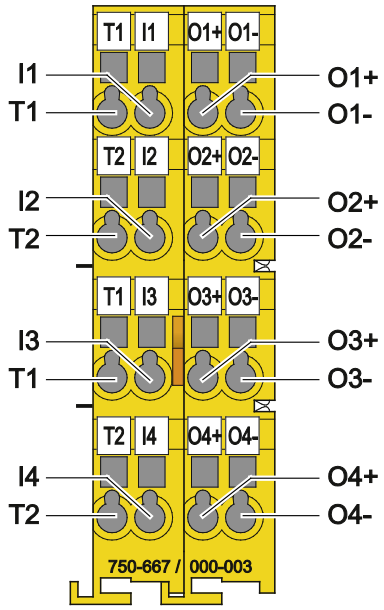


Figure 7: CAGE CLAMP® Connectors

Table 6: Legend for Figure “CAGE CLAMP® Connectors”

Channel	Designation	Connector	Function
1	Clock output T1	1	Input I1: Clock output
	Input I1	5	Input I1: Signal voltage
	Output O1+	9	Output O1: Signal voltage +
	Output O1−	13	Output O1: Signal voltage −
2	Clock output T2	2	Input I2: Clock output
	Input I2	6	Input I2: Signal voltage
	Output O2+	10	Output O2: Signal voltage +
	Output O2−	14	Output O2: Signal voltage −
3	Clock output T1	3	Input I3: Clock output
	Input I3	7	Input I3: Signal voltage
	Output O3+	11	Output O3: Signal voltage +
	Output O3−	15	Output O3: Signal voltage −
4	Clock output T2	4	Input I4: Clock output
	Input I4	8	Input I4: Signal voltage
	Output O4+	12	Output O4: Signal voltage +
	Output O4−	16	Output O4: Signal voltage −

4.3 Display Elements

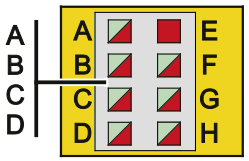


Figure 8: Display Elements, Inputs 1 ... 4

Table 7: Legend for Figure “Display Elements, Inputs 1 ... 4”

Channel	Designation	LED	Status	Function
1	Status I1	A	Off	Input I1: Signal voltage (0)
			Green	Input I1: Signal voltage (1)
			Red	Input I1: Error
2	Status I2	B	Off	Input I2: Signal voltage (0)
			Green	Input I2: Signal voltage (1)
			Red	Input I2: Error
3	Status I3	C	Off	Input I3: Signal voltage (0)
			Green	Input I3: Signal voltage (1)
			Red	Input I3: Error
4	Status I4	D	Off	Input I4: Signal voltage (0)
			Green	Input I4: Signal voltage (1)
			Red	Input I4: Error

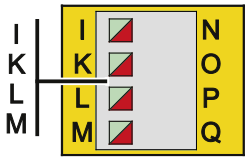


Figure 9: Display Elements, Outputs 1 ... 4

Table 8: Legend for Figure “Display Elements, Outputs 1 ... 4”

Channel	Designation	LED	Status	Function
1	Status O1	I	Off	Output O1: Signal voltage (0)
			Green	Output O1: Signal voltage (1)
			Red	Output O1: Error
2	Status O2	K	Off	Output O2: Signal voltage (0)
			Green	Output O2: Signal voltage (1)
			Red	Output O2: Error
3	Status O3	L	Off	Output O3: Signal voltage (0)
			Green	Output O3: Signal voltage (1)
			Red	Output O3: Error
4	Status O4	M	Off	Output O4: Signal voltage (0)
			Green	Output O4: Signal voltage (1)
			Red	Output O4: Error

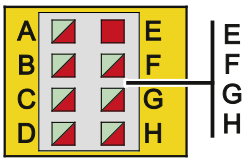


Figure 10: Display Elements, Communication/ I/O Module Status

Table 9: Legend for Figure “Display Elements, Communication / I/O Module Status”

Designation	LED	Status	Function
Group error	E	Off	No error
		Red	Group error, illuminates when • Overtemperature • Undervoltage of the field supply voltage • Error on clock output T1 or T2 • Internal error • I/O error • Incorrect F parameters • Invalid individual parameter
		Red 2 Hz flashing	Internal safety critical error
Local bus communication	F	Green	Local bus communication active
		Red	Local bus communication error
PROFIsafe status	G	Off	PROFIsafe data exchange not active
		Green	PROFIsafe data exchange active
		Green 0.5 Hz flashing	Acknowledgement by operator required (Operator acknowledge, OA)
		Red	No valid PROFIsafe F parameters available
		Red 1 Hz flashing	Watchdog time (F_WD_Time) exceeded
Parameter Setting	H	Off	Parameterization OK
		Red	F I/O module selected by WAGO-I/O-*CHECK*
		Red 1 Hz flashing	Individual parameter invalid
		Red 2 Hz flashing	Configuration running and not yet completed
		Green 2 Hz flashing	F I/O module is it PROFIsafe test mode

The group error LED (LED E) can illuminate alone or in conjunction with other LEDs. Detailed information about the occurred group error is available in the section "Diagnostics".

Note

Behavior when group error LED (LED E) is flashing
A flashing group 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 the switch it back on.
If the problem occurs several times, it points to a defect in the F I/O module. In this case, return the F I/O module to WAGO Kontakttechnik GmbH & Co. KG for fault analysis.

4.4 Operating Elements

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

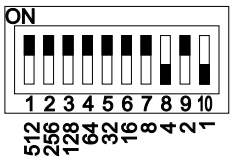


Figure 11: Coding Switch for the PROFIsafe Address (set to 1018)

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".

4.5 Schematic Diagrams

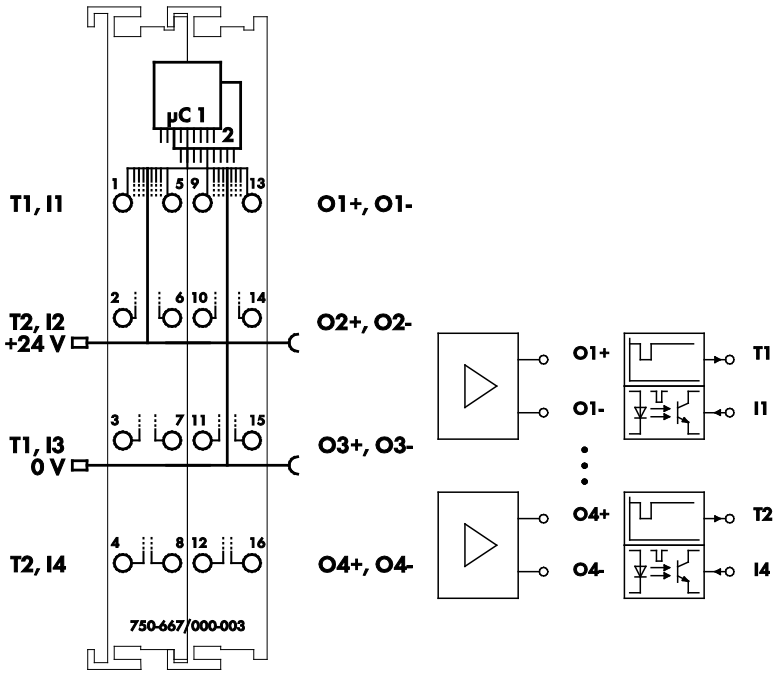


Figure 12: Schematic Diagram

4.5.1 Input Block Diagram

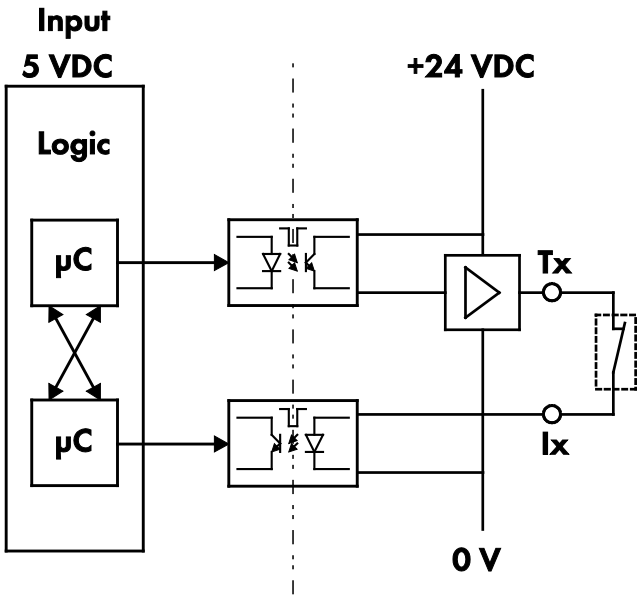


Figure 13: Input Block Diagram

4.5.2 Output Block Diagram

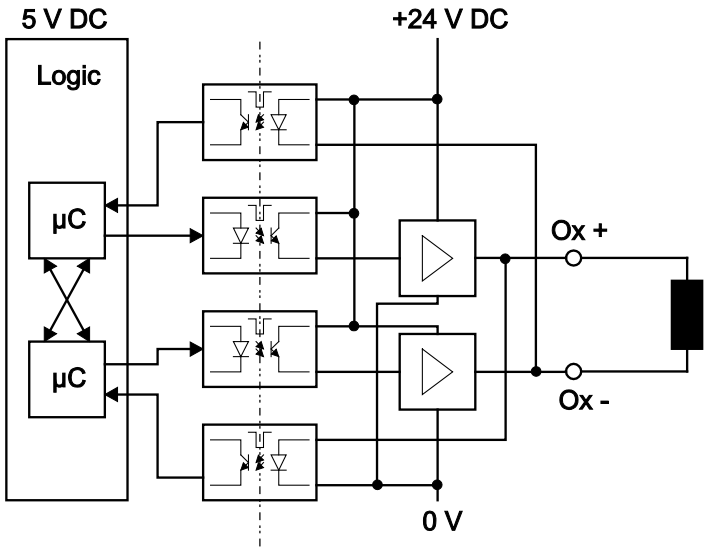


Figure 14: Output Block Diagram

4.6 Technical Data

4.6.1 Device Data

Table 10: Technical Data — Device

Width	24 mm
Depth (from upper edge of DIN-35 rail)	64 mm
Height	100 mm
Weight	Approx. 100 g

4.6.2 Power Supply

Table 11: Technical Data – Power Supply

Voltage supply	Via system voltage local bus (5 VDC) and power jumper contacts (24 VDC)
Overvoltage category acc. EN 61131-2	II
Current consumption, system voltage$_{typ.}$ (5 VDC)	180 mA
Current consumption, power jumper contacts$_{typ.}$ (24 VDC)	20 mA + clock outputs + load current
Nominal voltage via power jumper contacts (tolerance range)	24 VDC (20.4 V … 28.8 V)
Current via power jumper contacts	10 A
Reverse voltage protection for power jumper contacts	Yes
Isolation (peak value)	500 V system voltage / field level (power jumper contacts)

4.6.3 Communication

Table 12: Technical Data – Communication

Usable fieldbus couplers / controllers		750-333 SW 14, HW 16 or higher
		750-370 SW 02, HW 01 or higher
		750-375 SW 02, HW 01 or higher
		750-377 SW 02, HW 01 or higher
GSD specification		V5
No. of PROFIsafe I/O modules per node (fieldbus couplers / controllers)$_{max.}$		See information in manual about the respective fieldbus coupler/controller
PROFIsafe F Parameter	F_Check_SeqNr	No Check/Check (depending on PLC)
	F_iPar_CRC	0 … 65535
	F_Block_ID	0 / 1 for 750-333 and 750-370
		1 for 750-375 and 750-377
	F_SIL	SIL3
	F_CRC_Length	2 bytes (PROFIsafe V1) / 3 bytes (PROFIsafe V2)
	F_Par_Version	PROFIsafe V1 / PROFIsafe V2
	F_Dest_Addr	1 … 65534
	F_WD_Time	50 ms … 10000 ms
Channel diagnostic messages		Can be switched on/off for entire PROFIsafe I/O module
Acknowledgement path F_Ack		Available in software version 08 and higher

4.6.4 Digital Inputs

Table 13: Technical Data – Digital Inputs

Inputs	I1 … I4	4 inputs type 1 acc. EN 61131-2
Achievable safety classes		4 × Cat. 2/PL d acc. EN ISO 13849-1
		2 × Cat. 4/PL e acc. EN ISO 13849-1
		4 × SIL2 acc. EN 62061
		2 × SIL3 acc. EN 62061
		4 × SIL2 acc. IEC 61508
		2 × SIL3 acc. IEC 61508
Input filter time		Configurable between 0 ms and 200 ms in steps (see section “Startup” > … > “Input Filter Time Parameter”)
Signal voltage	0	–3 VDC … +5 VDC
	1	+15 V … +30 VDC
Input current$_{typ.}$		2.2 mA
Response times		See section “Technical Data” > … > “Response Times”
Input frequency$_{max.}$		50 Hz (depending on filter time)
Input pulse duration$_{min.}$		See section “Startup” > … > “Input Filter Time Parameter”

4.6.5 Digital Clock Outputs

Table 14: Technical Data – Digital Clock Outputs

Clock outputs	T1, T2	2 clock outputs
Output nominal current		0.5 A
Output protection		Short circuit and overload
Cable length$_{max.}$	unshielded	200 m (at 120 nF/km)
	shielded	200 m (at 120 nF/km)

Table 15: Technical Data – Clock Pulse Duration at Input Filter Time

Input filter time 0 ms	Clock pulse duration 5 ms
Input filter time 0.5 ms	Clock pulse duration 5 ms
Input filter time 1 ms	Clock pulse duration 5 ms
Input filter time 2 ms	Clock pulse duration 5 ms
Input filter time 3 ms	Clock pulse duration 5 ms
Input filter time 5 ms	Clock pulse duration 7 ms
Input filter time 10 ms	Clock pulse duration 12 ms
Input filter time 20 ms	Clock pulse duration 22 ms
Input filter time 50 ms	Clock pulse duration 50 ms
Input filter time 100 ms	Clock pulse duration 102 ms
Input filter time 200 ms	Clock pulse duration 202 ms

4.6.6 Digital Power Outputs

Table 16: Technical Data – Digital Power Outputs

Power outputs	O1 … O4	4 outputs for actuators
Achievable safety classes		8 × Cat. 2/PL d acc. EN ISO 13849-1
		4 × Cat. 4/PL e acc. EN ISO 13849-1
		8 × SIL2 acc. EN 62061
		4 × SIL3 acc. EN 62061
		8 × SIL2 acc. IEC 61508
		4 × SIL3 acc. IEC 61508
Output nominal current	O1 … O4	2 A
Output current, permissible range	O1 … O4	20 mA … 2.4 A
Total output current $_{max.}$		8 A at 55 °C ambient temperature
Output current for UL and ATEX		24 VDC, 2 A per channel, 4 A total
Output residual current at signal "0"	O1+ … O4+	Max. 1.2 mA
	O1- … O4-	Max. 600 µA
Load resistance range		12 Ω … 1.2 kΩ
Output protection	O1 … O4	Short-circuit-protected
Response threshold output protection	Min.	2.4 A
	Typ.	3.5 A
	Max.	5.5 A
Limitation of the inductive transient voltage		See section “Connect Devices” > … > “Switching Inductive Loads”
Response threshold line break detection	Min.	66 µA
	Max.	130 µA
Parallel connection of outputs		Not possible
Controlling outputs		See section “Connection Examples” > … > “Connecting the Digital Power Outputs to Digital Inputs”
Response times		See section “Technical Data” > … > “Response Times”
Switching frequency$_{max.}$	Resistive load	50 Hz
	Inductive load DC13 acc. to IEC 60947-5-1	0.1 Hz (see section “Connect Devices” > … > “Switching Inductive Loads”)
Capacitive load per output $C_{L\ max.}$		2.2 µF
Cable length $_{max.}$	unshielded	200 m
	shielded	200 m
Test pulse duration		0 ms … 500 ms, configurable in steps (see section “Startup” > … > “Test Pulse Duration Parameters”)

Table 16: Technical Data – Digital Power Outputs

Response threshold Output monitoring O1+ … O4+	Min.	6 V
	Typ.	9 V
	Max.	11 V

4.6.7 Safety Parameters

4.6.7.1 Two-channel Safety Application, Proof Test Interval 10 Years

Table 17: Safety Parameters for 2-Channel Safety Applications – 10 Years

Maximum safety integrity level acc. EN 62061		SIL3
Maximum safety integrity level acc. IEC 61508		SIL3
Maximum performance level acc. EN ISO 13849-1		Cat. 4/PL e
Proof test interval/usage duration		10 years
Probability of failure PFD*), Proof test interval 10 years (low demand mode) (IEC 61508)	for 1 2-channel output (fieldbus to output)	8.30×10^{-5} (8.30 % of all PFD from 10^{-3} at SIL3)
	for 1 input pair (input to fieldbus)	7.49×10^{-5} (7.49 % of all PFD from 10^{-3} at SIL3)
	for 2 input pares and 4 2-channel outputs (input to fieldbus and fieldbus to output)	8.55×10^{-5} (8.55 % of all PFD from 10^{-3} at SIL3)
Probability of failure PFH*), Proof test interval 10 years (high demand mode) (IEC 61508)	for 1 2-channel output (fieldbus to output)	1.91×10^{-9} (1.91 % of all PFH from 10^{-7} at SIL3)
	for 1 input pair (input to fieldbus)	1.71×10^{-9} (1.71 % of all PFH from 10^{-7} at SIL3)
	for 2 input pares and 4 2-channel outputs (input to fieldbus and fieldbus to output)	2.02×10^{-9} (2.02 % of all PFH from 10^{-7} at SIL3)
Hardware fault tolerance HFT with two-channel application (IEC 61508 / EN ISO 13849-1)		1 (1 error in the application does not yet lead to a failure of the safety equipment)
DC (diagnostic coverage level)		96 %
$MTTF_d$ (Mean Time To Failure dangerous)		> 100 years

*) PFD: Probability of a dangerous failure on demand
PFH: Probability of a dangerous failure per hour

4.6.7.2 Two-channel Safety Application, Proof Test Interval 20 Years

Table 18: Safety Parameters for 2-Channel Safety Applications – 20 Years

Maximum safety integrity level acc. EN 62061		SIL3
Maximum safety integrity level acc. IEC 61508		SIL3
Maximum performance level acc. EN ISO 13849-1		Cat. 4/PL e
Proof test interval/usage duration		20 years
Probability of failure PFD*), Proof test interval 20 years (low demand mode) (IEC 61508)	for 1 2-channel output (fieldbus to output)	1.66×10^{-4} (16.6 % of all PFD from 10^{-3} at SIL3)
	for 1 input pair (input to fieldbus)	1.50×10^{-4} (15.0 % of all PFD from 10^{-3} at SIL3)
	for 2 input pares and 4 2-channel outputs (input to fieldbus and fieldbus to output)	1.71×10^{-4} (17.1 % of all PFD from 10^{-3} at SIL3)
Probability of failure PFH*), Proof test interval 20 years (high demand mode) (IEC 61508)	for 1 2-channel output (fieldbus to output)	1.92×10^{-9} (1.92 % of all PFH from 10^{-7} at SIL3)
	for 1 input pair (input to fieldbus)	1.72×10^{-9} (1.72 % of all PFH from 10^{-7} at SIL3)
	for 2 input pares and 4 2-channel outputs (input to fieldbus and fieldbus to output)	2.02×10^{-9} (2.02 % of all PFH from 10^{-7} at SIL3)
Hardware fault tolerance HFT with two-channel application (IEC 61508 / EN ISO 13849-1)		1 (1 error in the application does not yet lead to a failure of the safety equipment)
DC (diagnostic coverage level)		96 %
$MTTF_d$ (Mean Time To Failure dangerous)		> 100 years

*) PFD: Probability of a dangerous failure on demand
PFH: Probability of a dangerous failure per hour

4.6.7.3 Single-channel Safety Application, Proof Test Interval 10 Years

Table 19: Safety Parameters for Single-Channel Safety Application – 10 Years

Maximum safety integrity level acc. EN 62061		SIL2
Maximum safety integrity level acc. IEC 61508		SIL2
Maximum performance level acc. EN ISO 13849-1		Cat. 2/PL d
Proof test interval/usage duration		10 years
Probability of failure PFD*), Proof test interval 10 years (low demand mode) (IEC 61508)	for 1 input (input to fieldbus)	8.13×10^{-5} (0.81 % of all PFD from 10^{-2} at SIL2)
	for 1 input and 1 single-channel output (input to fieldbus and fieldbus to output)	1.25×10^{-4} (1.25 % of all PFD from 10^{-2} at SIL2)
	for 4 inputs and 4 single-channel outputs (inputs to fieldbus and fieldbus to outputs)	2.54×10^{-4} (2.54 % of all PFD from 10^{-2} at SIL2)
Probability of failure PFH*), Proof test interval 10 years (high demand mode) (IEC 61508)	for 1 input (input to fieldbus)	1.86×10^{-9} (0.19 % of all PFH from 10^{-6} at SIL2)
	for 1 input and 1 single-channel output (input to fieldbus and fieldbus to output)	2.86×10^{-9} (0.29 % of all PFH from 10^{-6} at SIL2)
	for 4 inputs and 4 single-channel outputs (inputs to fieldbus and fieldbus to outputs)	5.80×10^{-9} (0.58 % of all PFH from 10^{-6} at SIL2)
Hardware fault tolerance HFT with single-channel application (IEC 61508 / EN ISO 13849-1)		0 (1 error in the application can lead to a failure of the safety equipment)
DC (diagnostic coverage level)		96 %
$MTTF_d$ (Mean Time To Failure dangerous)		> 100 years

*) PFD: Probability of a dangerous failure on demand
PFH: Probability of a dangerous failure per hour

4.6.7.4 Single-channel Safety Application, Proof Test Interval 20 Years

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

Maximum safety integrity level acc. EN 62061		SIL2
Maximum safety integrity level acc. IEC 61508		SIL2
Maximum performance level acc. EN ISO 13849-1		Cat. 2/PL d
Proof test interval/usage duration		20 years
Probability of failure PFD*), Proof test interval 20 years (low demand mode) (IEC 61508)	for 1 input (input to fieldbus)	1,63 × 10^{-4} (1,63 % of all PFD from 10^{-2} at SIL2)
	for 1 input and 1 single-channel output (input to fieldbus and fieldbus to output)	2,51 × 10^{-4} (2,51 % of all PFD from 10^{-2} at SIL2)
	for 4 inputs and 4 single-channel outputs (inputs to fieldbus and fieldbus to outputs)	5,08 × 10^{-4} (5,08 % of all PFD from 10^{-2} at SIL2)
Probability of failure PFH*), Proof test interval 20 years (high demand mode) (IEC 61508)	for 1 input (input to fieldbus)	1,86 × 10^{-9} (0,19 % of all PFH from 10^{-6} at SIL2)
	for 1 input and 1 single-channel output (input to fieldbus and fieldbus to output)	2,86 × 10^{-9} (0,29 % of all PFH from 10^{-6} at SIL2)
	for 4 inputs and 4 single-channel outputs (inputs to fieldbus and fieldbus to outputs)	5,80 × 10^{-9} (0,58 % of all PFD from 10^{-2} at SIL2)
Hardware fault tolerance HFT with single-channel application (IEC 61508 / EN ISO 13849-1)		0 (1 error in the application can lead to a failure of the safety equipment)
DC (diagnostic coverage level)		96 %
$MTTF_d$ (Mean Time To Failure dangerous)		> 100 years

*) PFD: Probability of a dangerous failure on demand
PFH: Probability of a dangerous failure per hour

4.6.8 Connection Type

Table 21: 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 22: Technical Data – Power Jumper Contacts

Power jumper contacts	Blade/spring contact, self-cleaning

Table 23: Technical Data – Data Contacts

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

4.6.9 Climatic Environmental Conditions

Table 24: 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
Overvoltage category	II
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
Special conditions	Ensure that additional measures for components are taken, which are used in an environment involving: – dust, caustic vapors or gases – ionizing radiation

4.6.10 Response Times

4.6.10.1 Safe Response Time of Digital Inputs in the Event of a Failure

⚠ WARNING

Only use response times in the event of a failure for the safety response time!
To prevent any personal injury or property damage, only use the values of the safe response time for errors for defining the safety response time.

⚠ WARNING

For the safety response time, take into account the execution times of the local bus, fieldbus and cycle time of the safe PLC!
To prevent any personal injury or property damage, always take the execution times of the local bus and of the fieldbus and the cycle time of the safe PLC into account when calculating the safety response time.

The safe response time of the digital inputs indicates the maximum time from a signal change on one single-channel input or two two-channel digital inputs to preparation of the PROFIsafe telegram on the local bus. It is part of the safety response time of a safety application.

Therefore, take into account the execution times or response times of the safe sensors and actuators used, local bus, fieldbus, as well as the cycle time of the safe PLC when designing the safety response time.

The safe response time of the digital inputs significantly depends on the configured input filter time. Changing the input filter time changes the safe response time of the digital inputs.

The safe response time can differ depending on the device configuration for each digital input or for the individual input pars (for dual channel evaluation). You can, for example, set the **Dual channel evaluation** parameter to "**yes**" and the value of the **Valence evaluation** to "**Equivalent**". In this case, the affected input pair has a quicker safe response time than, for example, a single-channel digital input used or if you have set the **Valence evaluation** parameter to "**Antivalent**". The safe response times listed in the following table refer to an individual digital input or an individual input par that is analyzed two-channel.

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

The following table lists the safe response times in the event of failure that result from the input filter time set.

Table 25: Safe Response Time of the Digital Inputs in the Event of Failure

Input Filter Time	Standard Operating Mode			Rotary Table Operating Mode
	Single-Channel Analysis	Valence Evaluation Equivalent	Valence Evaluation Antivalent	
0 ms	35 ms	35 ms	19 ms	35 ms
0.5 ms	36 ms	36 ms	20 ms	36 ms
1 ms	38 ms	38 ms	21 ms	38 ms
2 ms	42 ms	42 ms	24 ms	42 ms
3 ms	47 ms	47 ms	28 ms	47 ms
5 ms	59 ms	59 ms	36 ms	59 ms
10 ms	89 ms	89 ms	56 ms	89 ms
20 ms	150 ms	150 ms	96 ms	150 ms
50 ms	331 ms	331 ms	217 ms	331 ms
100 ms	633 ms	633 ms	419 ms	633 ms
200 ms	1237 ms	1237 ms	821 ms	1237 ms

4.6.10.2 Typical Response Time of the Digital Inputs in an Error-free Case

⚠ WARNING

Only use response times in the event of a failure for the safety response time!

To prevent any personal injury or property damage, only use the values of the safe response time for errors for defining the safety response time (see Section "Safe Response Time of Digital Inputs in the Event of a Failure"). Under no circumstances may you use the response times for the digital inputs during error-free operation for the design!

The following table lists the typical response times for the digital inputs in error-free operation.

Table 26: Safe Response Time of the Digital Inputs in the Error-Free Operation

	Standard Operating Mode						Rotary Table Operating Mode	
	Single-Channel Analysis		Valence Evaluation Equivalent		Valence Evaluation Antivalent			
Signal change	0 → 1	1 → 0	0 → 1	1 → 0	0 → 1	1 → 0	0 → 1	1 → 0
Input filter time								
0 ms	15 ms	15 ms	15 ms	9 ms	15 ms	9 ms	15 ms	15 ms
0.5 ms	17 ms	17 ms	17 ms	9.5 ms	17 ms	9.5 ms	17 ms	17 ms
1 ms	19 ms	19 ms	19 ms	10 ms	19 ms	10 ms	19 ms	19 ms
2 ms	21 ms	21 ms	21 ms	11 ms	21 ms	11 ms	21 ms	21 ms
3 ms	25 ms	25 ms	25 ms	12 ms	25 ms	12 ms	25 ms	25 ms
5 ms	33 ms	33 ms	33 ms	13 ms	33 ms	13 ms	33 ms	33 ms
10 ms	53 ms	53 ms	53 ms	19 ms	53 ms	19 ms	53 ms	53 ms
20 ms	93 ms	93 ms	93 ms	29 ms	93 ms	29 ms	93 ms	93 ms
50 ms	211 ms	211 ms	211 ms	59 ms	211 ms	59 ms	211 ms	211 ms
100 ms	411 ms	411 ms	411 ms	109 ms	411 ms	109 ms	411 ms	411 ms
200 ms	808 ms	808 ms	808 ms	209 ms	808 ms	209 ms	808 ms	808 ms

4.6.10.3 Safe Response Time of Digital Power Outputs

⚠ WARNING

For the safety response time, take into account the execution times of the local bus, fieldbus and cycle time of the safe PLC!
To prevent personal and property damage, take into account the execution times of the local bus, fieldbus and cycle time of the safe PLC in calculating the safety response time.

The safe response time of the digital power outputs indicates the time from an incoming PROFIsafe telegram to the local bus to the signal change on the digital power output. It is part of the overall response time of a safety application.

The safe response time of the digital power outputs depends on the protective circuit used and the test pulse length configured. You can set the Test pulse parameter in stages using the WAGO parameterization tool. For more information, read the section “Parameterization of the F I/O module with the WAGO Parameterization Tool”.

The following table lists the safe response times for the digital power outputs based on the test pulse length and the protective circuit used.

4.6.10.4 Response Time of the Digital Power Outputs for a Load between Ox+ and Ox− in the Event of Failure

⚠ WARNING

For the safety response time, take into account the execution times of the local bus, fieldbus and cycle time of the safe PLC!
To prevent personal and property damage, take into account the execution times of the local bus, fieldbus and cycle time of the safe PLC in calculating the safety response time.

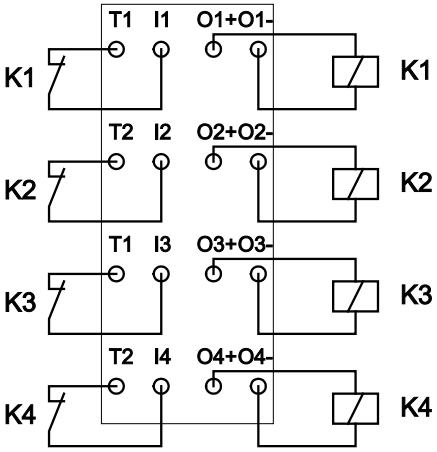


Figure 15: Load Between Ox+ and Ox−

The safe response times for the protective wiring depicted above in the figure are represented in the following table:

Table 27: Response Time of the Digital Power Outputs for a Load between Ox+ and Ox− in the Event of Failure

Test pulse length	Safe response time
0 ms	18 ms
1 ms	18 ms
2 ms	18 ms
5 ms	18 ms
10 ms	18 ms
20 ms	18 ms
50 ms	18 ms
100 ms	18 ms
200 ms	18 ms
500 ms	18 ms

4.6.10.5 Response Time of the Digital Power Outputs for a Load between Ox+ and 0 V in the Event of Failure

⚠ WARNING

For the safety response time, take into account the execution times of the local bus, fieldbus and cycle time of the safe PLC!
To prevent personal and property damage, take into account the execution times of the local bus, fieldbus and cycle time of the safe PLC in calculating the safety response time.

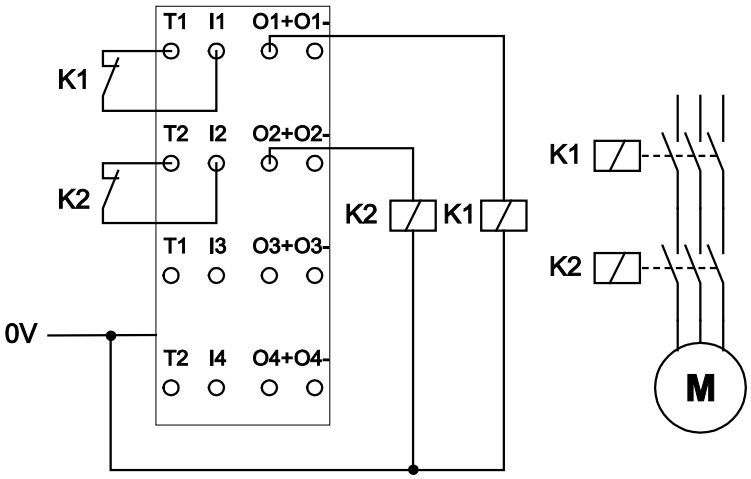


Figure 16: Load Bbtween Ox+ and 0 V

The safe response times for the protective wiring depicted above in the figure are represented in the following table:

Table 28: Response Time of the Digital Power Outputs for a Load between Ox+ and 0 V in the Event of Failure

Test pulse length	Safe response time
0 ms	46 ms
1 ms	46 ms
2 ms	46 ms
5 ms	46 ms
10 ms	46 ms
20 ms	46 ms
50 ms	66 ms
100 ms	116 ms
200 ms	216 ms
500 ms	516 ms

4.6.10.6 Response Time of the Digital Power Outputs for a Load between 24 V and Ox−

⚠ WARNING

For the safety response time, take into account the execution times of the local bus, fieldbus and cycle time of the safe PLC!
To prevent personal and property damage, take into account the execution times of the local bus, fieldbus and cycle time of the safe PLC in calculating the safety response time.

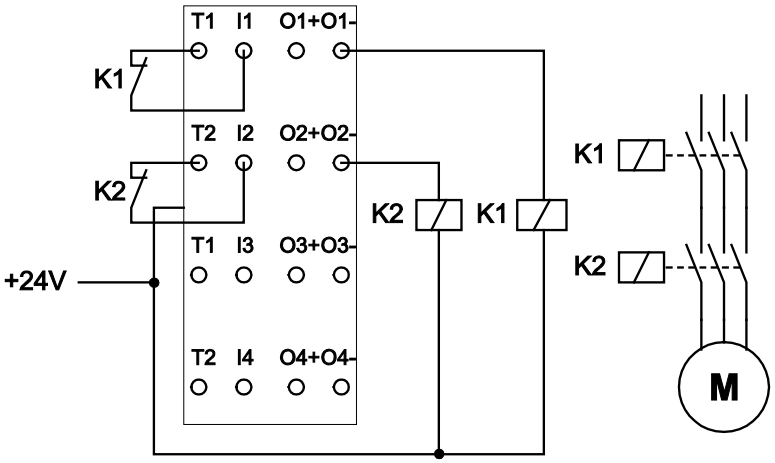


Figure 17: Load between 24 V and Ox−

The safe response times for the protective wiring depicted above in the figure are represented in the following table:

Table 29: Response Time of the Digital Power Outputs for a Load between 24 V and Ox−

Test pulse length	Safe response time
0 ms	46 ms
1 ms	46 ms
2 ms	46 ms
5 ms	46 ms
10 ms	46 ms
20 ms	46 ms
50 ms	66 ms
100 ms	116 ms
200 ms	216 ms
500 ms	516 ms

4.6.10.7 Response Time of the Digital Power Outputs for a Load between Ox+ and 0 V, as well as 24 V and Ox−

⚠ WARNING

For the safety response time, take into account the execution times of the local bus, fieldbus and cycle time of the safe PLC!
To prevent personal and property damage, take into account the execution times of the local bus, fieldbus and cycle time of the safe PLC in calculating the safety response time.

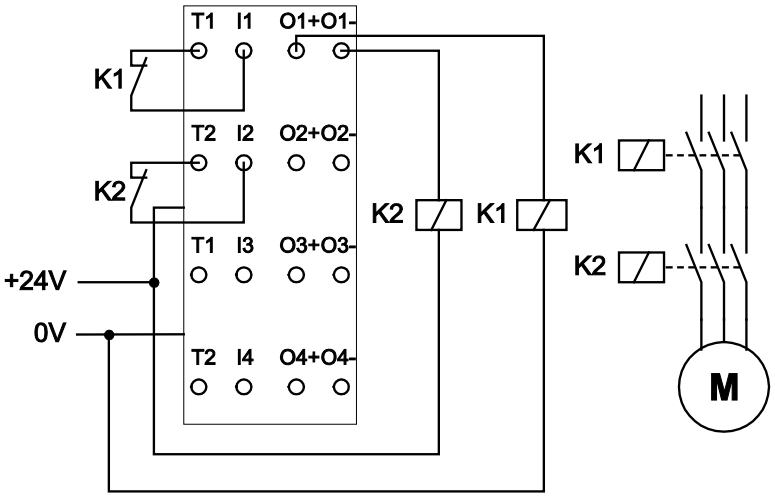


Figure 18: Load between Ox+ and 0 V, as well as 24 V and Ox−

The safe response times for the protective wiring depicted above in the figure are represented in the following table:

Table 30: Response Time of the Digital Power Output for a Load between Ox+ and 0 V, as well as 24 V and Ox−

Test pulse length	Safe response time
0 ms	18 ms
1 ms	18 ms
2 ms	18 ms
5 ms	18 ms
10 ms	18 ms
20 ms	18 ms
50 ms	18 ms
100 ms	18 ms
200 ms	18 ms
500 ms	18 ms

4.7 Approvals

Information

More information about approvals.
Detailed references to the approvals are listed in the document “**Overview on WAGO I/O System 750 approvals**”, which you can find via the internet under: www.wago.com → DOWNLOADS → Documentation → System Description.

The following approvals have been granted to the F I/O module 750-667/000-003:

Conformity Marking

UL508

Korea Certification MSIP-REM-W43-DIO750

TÜV certified for safety operation

IEC 61508, parts 1-7, Edition 2: 2010
EN ISO 13849, parts 1-2: 2008 + AC: 2009-1
EN 62061: 2005
EN 61511, parts 1-3: 2004

The following Ex approvals have been granted to the F I/O module 750-667/000-003:

TÜV 07 ATEX 554086 X

I M2 Ex d I Mb
II 3 G Ex nA IIC T4 Gc
II 3 D Ex tc IIIC T135°C Dc

IECEx TUN 09.0001 X

Ex d I Mb
Ex nA IIC T4 Gc
Ex tc IIIC T135°C Dc

cULus ANSI/ISA 12.12.01

Class I, Div2 ABCD T4

The following ship approvals have been granted to the F I/O module 750-667/000-003:

Federal Maritime and Hydrographic Agency

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

4.8 Standards and Guidelines

The F I/O module 750-667/000-003 meets the following standards and guidelines:

Safety of machinery Functional safety of electrical/ electronic/ programmable electronic safety-related systems	IEC 61508, parts 1-7
Safety of machinery – Safety-related parts of controllers	EN ISO 13849, parts 1-2 + AC
Safety of machinery – Functional safety of safety-related electrical/ electronic/ programmable electronic control systems	EN 62061
Functional safety Safety instrumented systems for the process industry sector	EN 61511, parts 1-3
EU EMC Directive	2014/30/EU
EMC CE-Immunity to interference	EN 61000-6-2 and to EN 61131-2
EMC CE-Emission of interference	EN 61000-6-4 and to EN 61131-2
EMC requirements - 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	EN 61326-3-1

4.8.1 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.

5 Process Image

The F I/O module 750-667/000-003 occupies five data bytes in the input and output process image in the higher-level secure PLC. The secure PROFIsafe telegrams to send and receive are stored in input and output bytes 0 … 4.

The process image received different data depending on whether the module is operated in PROFIsafe V1 or PROFIsafe V2 mode.

5.1 PROFIsafe V1 Mode

Table 31: Process Image PROFIsafe V1 Mode

Input data		Output data	
Byte 0	Inputs	Byte 0	Outputs
Byte 1	Status byte	Byte 1	Control byte
Byte 2	Serial No.	Byte 2	Serial No.
Byte 3	CRC16 high byte	Byte 3	CRC16 high byte
Byte 4	CRC16 low byte	Byte 4	CRC16 low byte
Byte 0 … byte 4	Secure process data (PROFIsafe telegram)		

Table 32: PROFIsafe Inputs, V1 Mode

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
X	X	X	X	I4	I3	I2	I1

I1	Signal state I1 – Digital input channel 1
I2	Signal state I2 – Digital input channel 2
I3	Signal state I3 – Digital input channel 3
I4	Signal state I4 – Digital input channel 4
X	Reserved

Table 33: PROFIsafe Outputs, V1 Mode

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
F_Ack	0	0	0	O4	O3	O2	O1

O1	Signal state O 1 – Digital output channel 1
O2	Signal state O 2 – Digital output channel 2
O3	Signal state O 3 – Digital output channel 3
O4	Signal state O 4 – Digital output channel 4
0	Reserved
F_Ack	User acknowledgement for diagnosed failure (Failure Acknowledgement)

5.2 PROFIsafe V2 Mode

Table 34: Process Image PROFIsafe V2 Mode

Input data		Output data	
Byte 0	Inputs	Byte 0	Outputs
Byte 1	Status byte	Byte 1	Control byte
Byte 2	CRC2 byte 2	Byte 2	CRC2 byte 2
Byte 3	CRC2 byte 1	Byte 3	CRC2 byte 1
Byte 4	CRC2 byte 0	Byte 4	CRC2 byte 0
Byte 0 … byte 4	Secure process data (PROFIsafe telegram)		

Table 35: PROFIsafe Inputs, V2 Mode

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
X	X	X	X	I4	I3	I2	I1

I1	Signal state I1 – Digital input channel 1
I2	Signal state I2 – Digital input channel 2
I3	Signal state I3 – Digital input channel 3
I4	Signal state I4 – Digital input channel 4
X	Reserved

Table 36: PROFIsafe Outputs, V2 Mode

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
F_Ack	0	0	0	O4	O3	O2	O1

O1	Signal state O 1 – Digital output channel 1
O2	Signal state O 2 – Digital output channel 2
O3	Signal state O 3 – Digital output channel 3
O4	Signal state O 4 – Digital output channel 4
0	Reserved
F_Ack	User acknowledgement for diagnosed failure (Failure Acknowledgement)

6 Mounting

6.1 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.

⚠ 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

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!

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.

6.2 Inserting and Removing Devices

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.

6.2.1 Inserting the I/O Module

1. Position the I/O module so that the tongue and groove joints to the fieldbus coupler or controller or to the previous or possibly subsequent I/O module are
engaged.

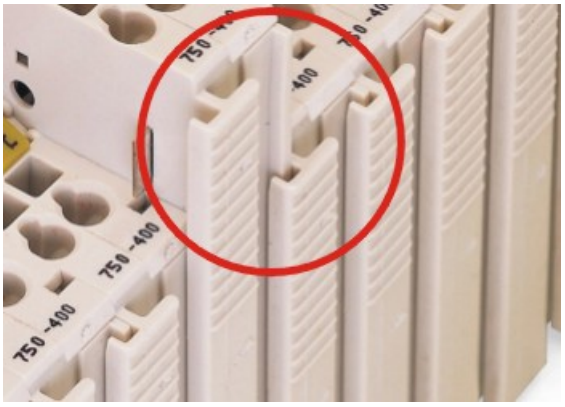


Figure 19: Insert I/O Module (Example)

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

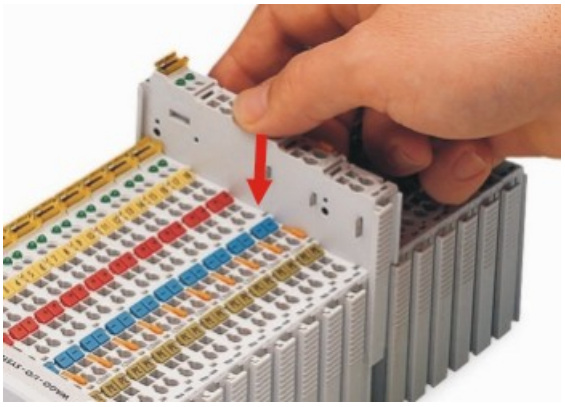


Figure 20: Snap the I/O Module into Place (Example)

With the I/O module snapped in place, the electrical connections for the data contacts and power jumper contacts (if any) to the fieldbus coupler or controller or to the previous or possibly subsequent I/O module are established.

6.2.2 Removing the I/O Module

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

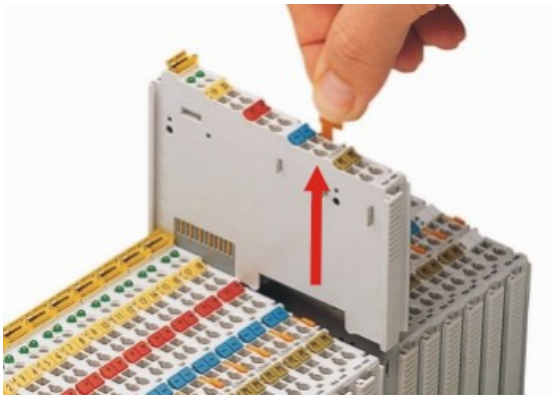


Figure 21: Removing the I/O Module (Example)

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

7 Connect Devices

7.1 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.

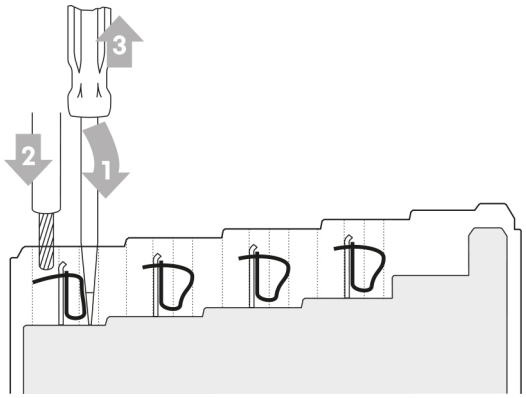


Figure 22: Connecting a Conductor to a CAGE CLAMP®

7.2 Power Supply Concept

The F I/O module receives the field supply voltage via the power jumper contacts listed as knife blade contacts from an upstream I/O module, the fieldbus coupler/controller or an internal system power supply and makes this potential available via the power jumper contacts listed as spring contacts for downstream I/O modules.

⚠ WARNING

Only operate F I/O modules with safe extra low voltage!
When using F I/O modules, only use power supplies with extra-low voltage (PELV/SELV) for the 24 VDC power supply acc. EN 50178 or EN 60950-1.
In addition, note that only a maximum voltage of $U_{max.}$ can act on these I/O modules even in the event of failure.

The following applies to all F I/O modules:
$U_{max.} < 35$ V.

⚠ WARNING

Only operate sensors and actuators with a safe extra low voltage!
All sensors and actuators with field supply connected to the F I/O modules also have to be supplied from a safe extra low voltage (SELV/PELV). In the case of error, only the maximum voltage $U_{max.}$ can be applied to the inputs and outputs of a F I/O module.

The following applies to the maximum voltage $U_{max.}$:
$U_{max.} < 35$ V.

⚠ WARNING

Only supply PROFIsafe modules with filtered voltages

Only power a fieldbus node that contains F I/O modules with a voltage filtered against surges (burst and surge) per EN 61326-3-1. You may need to install an external field-side power supply filter or power supply filter.

You can use the modules 750-624, 750-626, 750-626/020-000 and 750-626/020-002 for filtering. The modules 750-626/020-000 and 750-626/020-002 are particularly suitable for systems monitored for ground faults (e.g., shipping). Be sure to keep the cable length from the filter to the fieldbus node as short as possible.

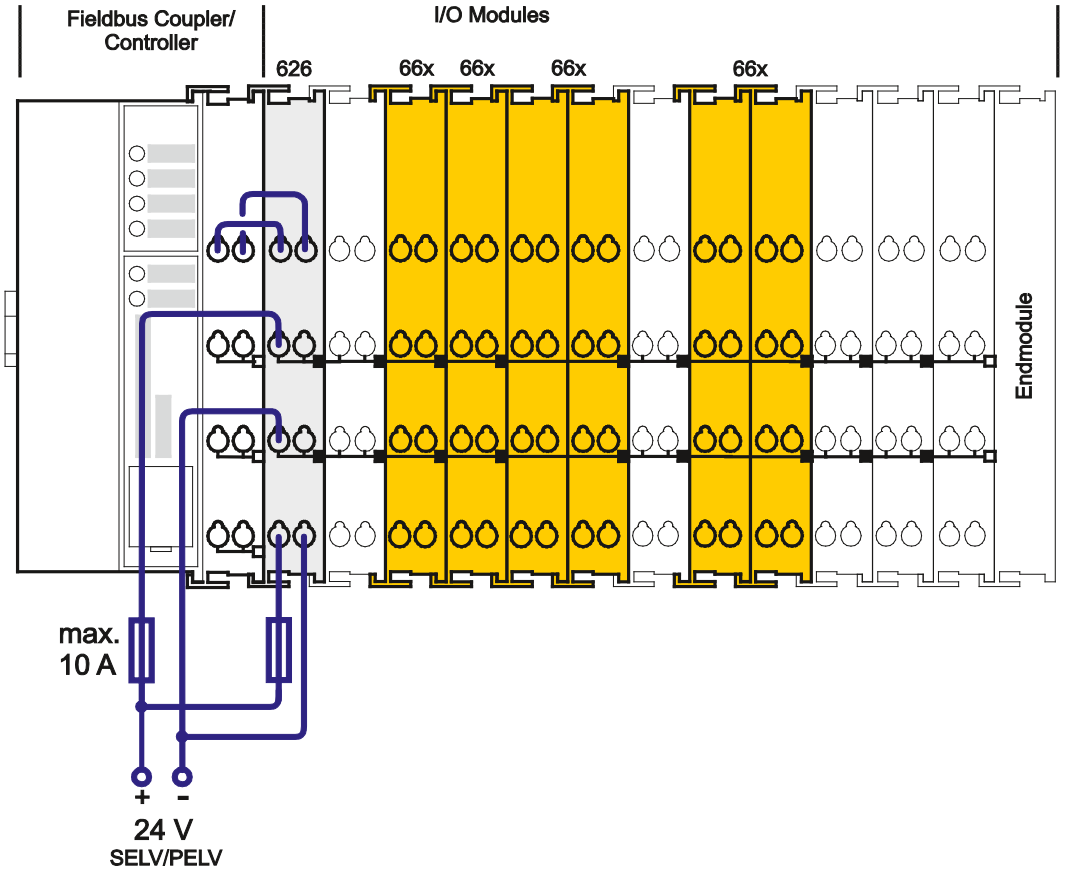


Figure 23: Infeed for F I/O Modules 750-66x and 753-66x

NOTICE

Do not exceed maximum current via power contacts!

The maximum current that can flow through the power jumper contacts is 10 A. The power jumper contacts can be damaged when the maximum is exceeded. When configuring the system, do not exceed this current. If that is the case, you must use an additional power supply.

7.2.1 Using a Backup Capaciter in Case of Interruptions in the Power Supply

Brief voltage dips in the field power supply below permissible values (e.g., when switching capacitive loads) also leads to passivation of the PROFIsafe I/O module. To prevent unintended passivations, 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. To this effect, you can use a backup capacitor module for the WAGO I/O System 750 with a capacity of 10000 µF (item No. 288-824). The back-up capacitor module (item No. 288-824) has a maximum current carrying capacity of 1 A and cannot be used to support the 24V field supply voltage for digital power outputs with higher power requirements.

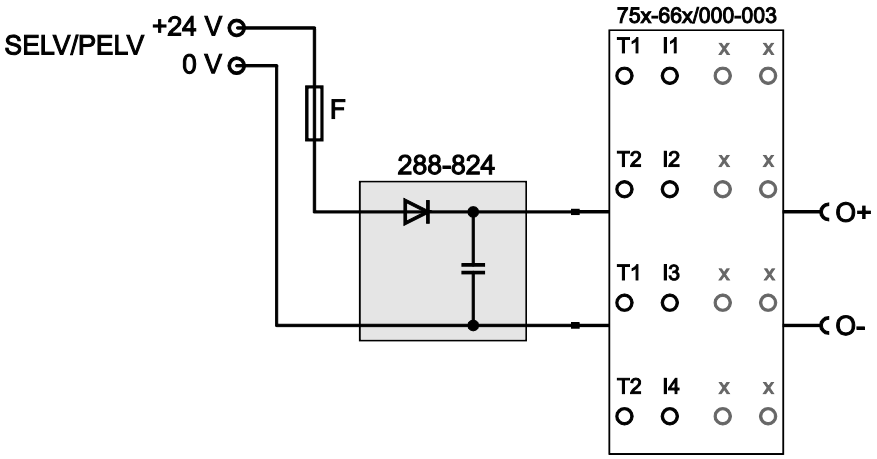


Figure 24: Infeed for PROFIsafe I/O Modules 75x-66x with Backup Capacitor Module 288-824

7.2.2 Using 230 VAC I/O Modules

If 230 VAC I/O modules are used together with F I/O modules in one fieldbus node, there are two options:

7.2.2.1 230 VAC Modules are Used in Another Fieldbus Node that Contains no F I/O Modules

You have to use a separate 24 VDC power supply unit (SELV/PELV) for a fieldbus node that contains F I/O modules. You have to use a PELV or FELV power supply unit with protective grounding for a fieldbus node without F I/O modules.

⚠ WARNING

Avoid unacceptably high body voltages!
All 230 V AC voltages applied to the nodes must also be protected by a 30 mA residual current circuit breaker.

In the simplest case, place the residual current operated circuit-breaker just behind the junction of the supply network. Doing so allows you to fuse all paths.

⚠ WARNING

Avoid vagabond voltages!
Never use a power supply unit to power fieldbus nodes with F I/O modules and fieldbus nodes with 230 V I/O modules.

7.2.2.2 230 VAC I/O Modules and F I/O Modules are Used Together in one Fieldbus Node

An isolation transformer (basic insulation) must be used to supply the voltage for the 230 VAC I/O modules. Between adjoining 230 VAC and 24 VDC I/O modules, you have to take into account the double basic insulation and if necessary, use separation modules 750-616/030-000.

7.3 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.

The section “Connect Devices” > … > "Connection Examples" 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".

Depending on the operating mode of the F I/O module selected, you can operate the following sensors on the digital inputs:

7.3.1 Connection Examples for Digital Inputs in the "Standard" Operating Mode

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 for the "Standard" operating mode are further examined below.

7.3.1.1 Emergency Off Connection, Single-channel

⚠ WARNING

Achievable risk reduction (SIL/Cat./PL) for single-channel use of the digital inputs!
The achievable risk reduction (SIL/Cat./PL) depends on the quality of the safe sensors. Depending on the risk reduction, this must meet the requirements according to EN 60947-5-1 /-5 or EN 61496-3.

⚠ WARNING

Pay attention to the protected installation of signal lines during short circuit test "inactive"!
If you have set the **Short circuit test** parameter of an input to "inactive", the signal lines must be installed protected among each other and between the sensors and inputs according to EN 60204-1 or EN ISO 13849-2 (e.g., as separate sheathed lines or in separate cable ducts).

⚠ WARNING

Alternative measures for fault detection!
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.

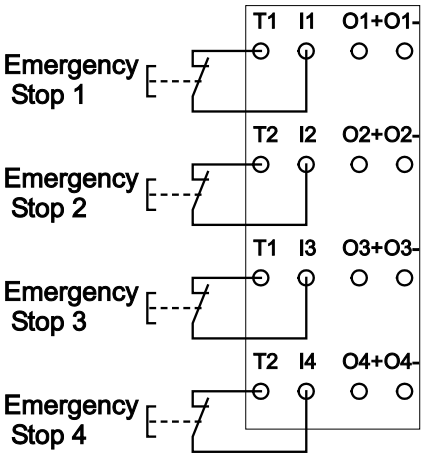


Figure 25: Connection 4 x Emergency-Off, Single-Channel, Short-Circuit Test Active

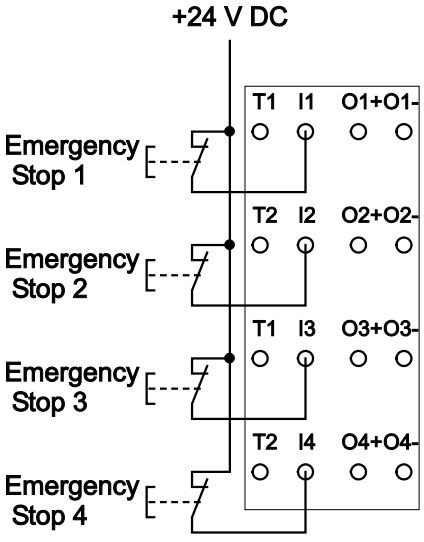


Figure 26: Connection 4 x Emergency-Off, Single-Channel, Short-Circuit Test Not Active

For simple emergency off applications without signal 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 off switch) either to the associated clock output or to the +24V field supply voltage directly. Alternatively, you can connect the semiconductor output of a sensor to the digital input directly. For the single-channel use if a digital input, you must set the **Dual channel evaluation** parameter to “no”.
For more information about configuring the F I/O module, read section “Commissioning” > … > “Parameterization of the F I/O modules with the WAGO Parameterization Tool”.

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

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 have to set the **Short circuit test** to “active”.

If you connect a safe sensor without single fault security to a digital input, SIL2, Cat. 2/PL d is achieved with these connections.
The $B10_d$ values and the $MTTF_d$ for the safe sensor must also be taken into account for this.

7.3.1.2 Emergency Off Connection, Dual Channel, Equivalent Evaluation

⚠ WARNING

Pay attention to the protected installation of signal lines during short circuit test "inactive"!
If you have set the **Short circuit test** parameter of an input to "inactive", the signal lines must be installed protected among each other and between the sensors and inputs according to EN 60204-1 or EN ISO 13849-2 (e.g., as separate sheathed lines or in separate cable ducts).

⚠ WARNING

Pay attention to the protected installation when the short circuit test is activated!
With the two clock outputs T1 and T2, you must install the signal lines from maximum 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 protected against each other and between the safe sensors according to EN 60204-1 or EN ISO 13849-2 (e.g., as separate sheathed lines or in separate cable ducts).

⚠ WARNING

Alternative measures for fault detection!
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.

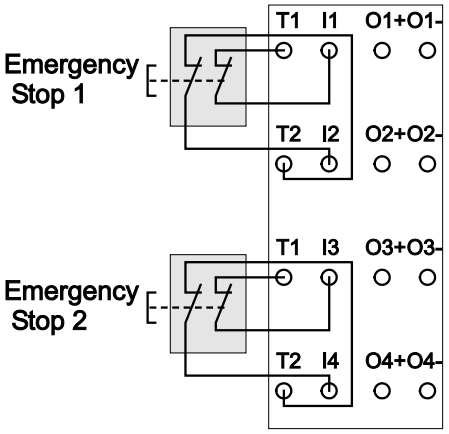


Figure 27: Connection 2 x Emergency-Off Switch, Dual Channel, Equivalent Evaluation

For emergency off applications that require single fault security, you can connect two digital inputs via two switching elements (two-channel emergency off switches with two break contacts) to the F I/O module.

Use the WAGO parameterization tool to set the parameters. For more information about configuring the F I/O module, read section "Parameterization of the F I/O module with the WAGO Parameterization Tool".

Set the **Dual channel evaluation** parameter to "yes" for the digital inputs used and the **Valence evaluation** parameter 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 "active" or "not active". Please note that the **Short circuit test** parameter must be set the same for both digital inputs.

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 "not active" because otherwise the F I/O module detects a short circuit and outputs the "Short circuit" diagnostic message.

7.3.1.3 Protective Door Monitoring Connection, Dual Channel, Antivalent Evaluation

⚠ WARNING

Pay attention to the protected installation when the short circuit test is activated!
With the two clock outputs T1 and T2, you must install the signal lines from maximum 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 protected against each other and between the safe sensors according to EN 60204-1 or EN ISO 13849-2 (e.g., as separate sheathed lines or in separate cable ducts).

⚠ WARNING

Alternative measures for fault detection!
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.

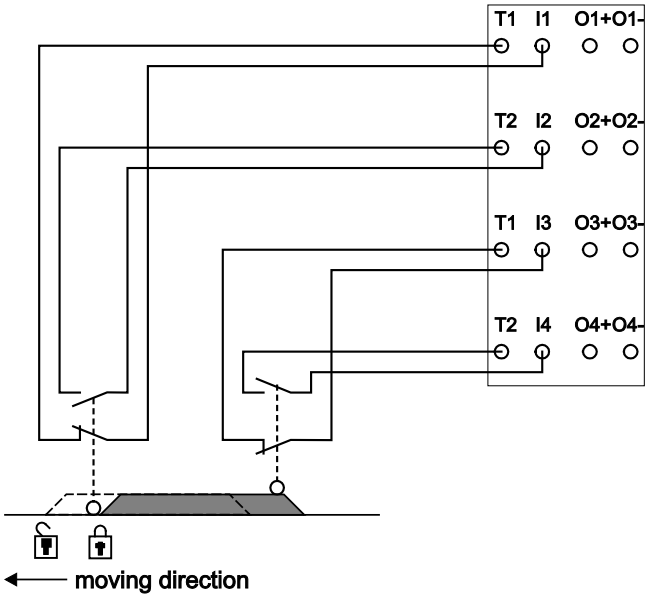


Figure 28: Connection 1 x Interlock Monitoring, Dual Channel, Antivalent Evaluation

To monitor protective devices, you can connect the normally open contact of a protective door switch to four digital inputs of the F I/O module.

For more information about configuring the F I/O module, read section "Parameterization of the F I/O module with the WAGO Parameterization Tool".

Set the **Dual channel evaluation** parameter for the digital inputs used to "yes". So that the signal lines of the digital inputs of the F I/O module are monitored for

short circuits, set the **Short circuit test** parameter for all inputs to "active". You must set the **Valence evaluation** parameter to "Antivalent". In addition, set the **Discrepancy time** parameter to the discrepancy time required for the normally open contact of the protective door switch.

You can achieve SIL3, Cat. 4/PL e with this switching.

7.3.2 Connection Example for Digital Inputs in Rotary Table Operating Mode (1 of N)

⚠ WARNING

Use of the Rotary Table Operating Mode
If you have set the **Operating Mode** to the "Rotary Table" value (1 of N), the temporal logic evaluation of the input bits must be performed by a suitable function block in the safe PLC. Do not use the process image of the digital inputs in the safe PLC without the suitable function blocks.

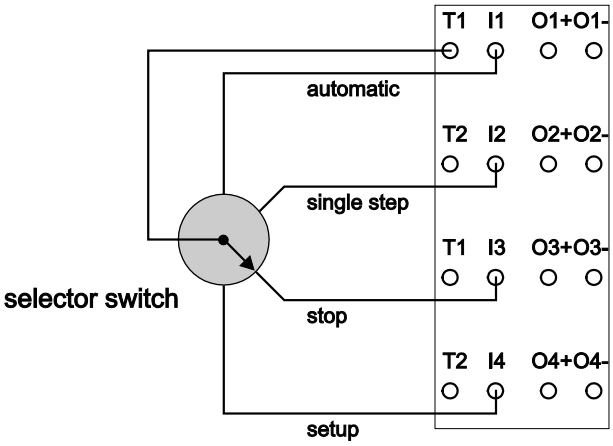


Figure 29: Connection 1 x Mode Selector Switch

If you have set the **Operating mode** parameter to "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. For more information on configuring the F I/O module, read section “Parameterization of F I/O module with WAGO Parameterization Tool”

By setting the **Operating mode** parameter to Rotary table, clock output T2 is switched off by the F I/O module module permanently.

Set the **Short circuit test** parameter for all digital inputs to "active" and the **Two-channel analysis** parameter to "no".

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.

A suitable module must be used in the safety application of the safe PLC to analyze the input bits.

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 area "Service > Documentation > Application Notes..."

7.3.3 Connection Examples for Digital Power Outputs

On the F I/O module, the following loads can be operated on the digital power outputs:

- Resistive loads
- Inductive loads after DC13 acc. EN 60947-5-1

7.3.3.1 Switching Grounded Loads

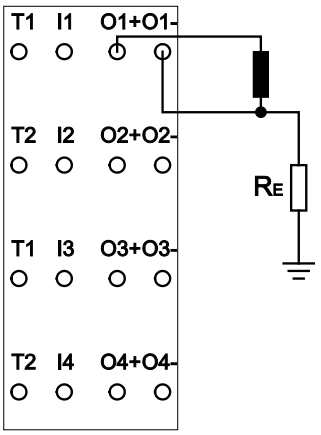


Figure 1: Grounded Load Connection

When switching loads that are connected between the digital power output and the Ox- (O1- … O4-) ground connection (e.g., to improve EMC properties) from the F-I/O module and when the attached power supply is connected between the common (ground) connection of the field supply voltage and the ground connection, then this type of circuit leads to detection of a short circuit and to the "Short circuit to GND" diagnostic message.

This happens because the connection bridges the digital power output Ox-. As a remedy, the connection between the ground connection and the common (ground) connection of the field supply voltage must have a total resistance RE (see figure) of at least 32 kΩ.

You can accomplish this by placing an additional resistor between the common (ground) connection of the field supply voltage and the ground connection.

7.3.3.2 Switching Inductive Loads

⚠ WARNING

Defect by thermal overheating if the switching frequency is too high!
If the inductivity and load current you have selected is too high for the selected switching frequency, it can lead to thermal destruction of the digital power output.

Destruction of the digital power output can cause the safety function to fail.

You can operate inductive loads on the digital power outputs of the F-I/O module by using the internal recovery circuit. Depending on the size of the inductance of the load and the value of the load current, the switching frequency specified in the technical data may be maximum 0.1 Hz higher.

The following figure represents the maximum permissible inductance of the load based on the load current and switching frequency.

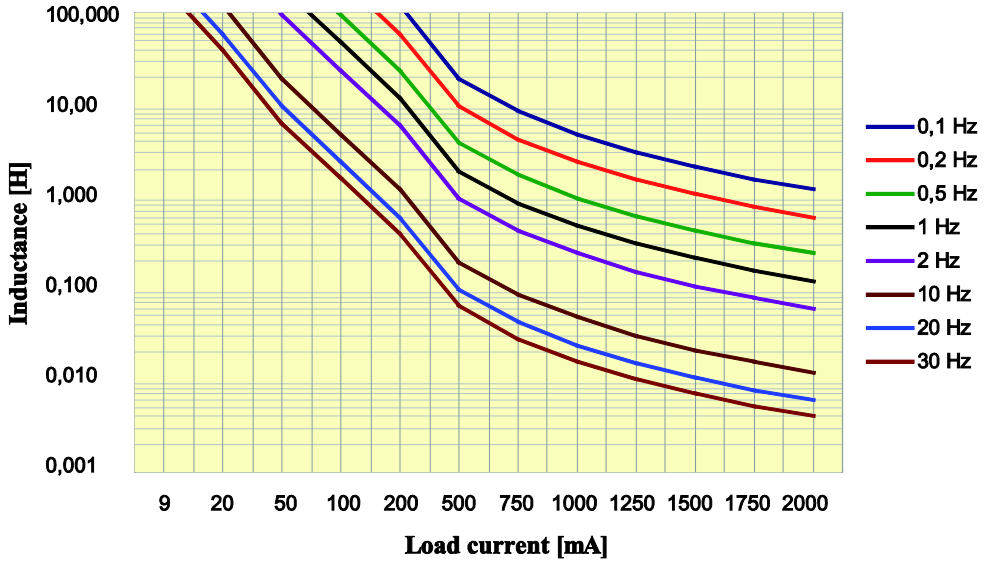


Figure 2: Switching Frequency Based on the Inductance and Load Current

7.3.3.2.1 Selecting an External Diode Recovery Circuit

NOTICE

Pay attention to heat loss from the external diode recovery circuit!
If you use a suitable external diode recovery circuit, then the magnetic energy when shutting down the inductive load is not converted in the F I/O module, but on the external diode recovery circuit.
The external diode recovery circuit must be designed for the resulting heat loss.

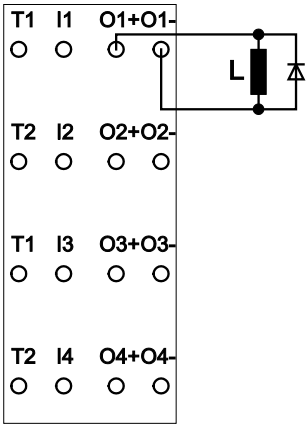


Figure 3: Connection Variant with Diode Recovery Circuit

When shutting down an inductive load, the magnetic energy stored in the inductive load must be dissipated. This magnetic energy converted by a diode recovery circuit into heat. You can convert the magnetic energy into heat with the F I/O module or with a suitable external diode recovery circuit.

The diode recovery circuit integrated in the F I/O module has a different limitation of negative voltage depending on the connection variant and the value of the field voltage.

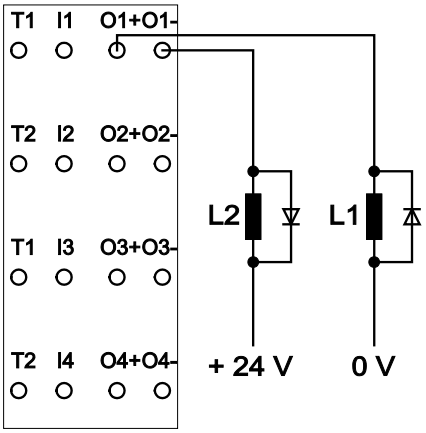


Figure 4: Connection Variant with 2 Diode Recovery Circuits

If you connect the inductive load to the Ox+ and Ox- connections, you have to make sure when selecting the external diode recovery circuit that the negative voltage is limited to a value less than -60 V. Otherwise, the magnetic energy is converted by the F-I/O module into heat.

You can connect an inductive load between the digital power output Ox+ and the common (ground) connection of the field supply voltage 0 V and/or a second inductive load between the digital power output Ox- and the positive connection of the field supply voltage U_V.

In this case, pay attention to the voltage values listed in the table when selecting the external diode recovery circuit.

Table 1: Maximum Negative Voltage of the Diode Recovery Circuit, Connection Variant 2

Field Voltage	U_{L1} (Output Ox+)	U_{L2} (Output Ox-)
+19.2 V DC	-30 V DC	-20 V DC
+24.0 V DC	-26 V DC	-15 V DC
+26.4 V DC	-23 V DC	-12 V DC
+28.8 V DC	-21 V DC	-11 V DC

7.3.3.3 Switching Electronic Loads

Note

Switching electronic loads

When switching electronic loads, increased inrush currents that significantly exceed the rated current can be caused by internal capacities in the electronic loads. This can lead to passivation of the F I/O module with the "Overload" diagnostic message. You can remedy this by limiting the inrush current, e.g., by placing an additional series resistor between the digital power output and the electronic load.

You can switch electronic loads (e.g., electronically controlled door locking device) using the F I/O module.

7.3.3.4 Connecting a Load between Ox+ and Ox-

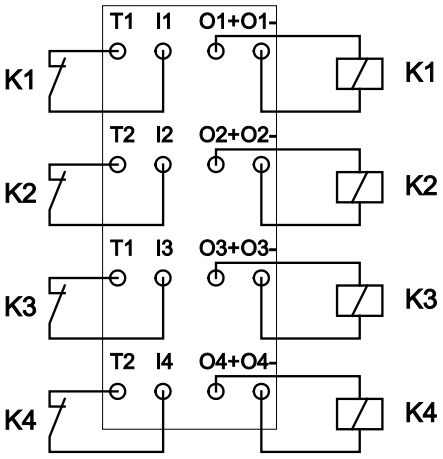


Figure 5: Connecting One Load to Each Digital Power Output

You can connect a load between the digital power outputs Ox+ and Ox-. If you want to deactivate open load detection for the load, set the **Open load detection** parameter to "not active". Otherwise, set the **Open load detection** parameter to "active" so that the F I/O module performs the open load detection task once per minute.

For more information about configuring the F I/O module, read section "Parameterization of the F I/O module with the WAGO Parameterization Tool".

Note

Open load detection on the digital outputs
To monitor line interruptions between the digital power outputs Ox+ or Ox− and the connected load, you can set the line break detection parameter for each digital power output separately.

Open load detection is not safety related and cannot be part of the safety function under any circumstances.

7.3.3.5 Connecting Loads from Ox+ and Ox− to 0 V and 24 V

⚠ WARNING

When installing the lines, protect against loads!
When a short circuit occurs between the digital power outputs Ox+ and Ox-, the controlled load is no longer switched off.
Therefore, protect the lines against the loads during installation according to EN 60204-1 or EN ISO 13849-2 (e.g., installed as separate shielded lines or in separate cable ducts).

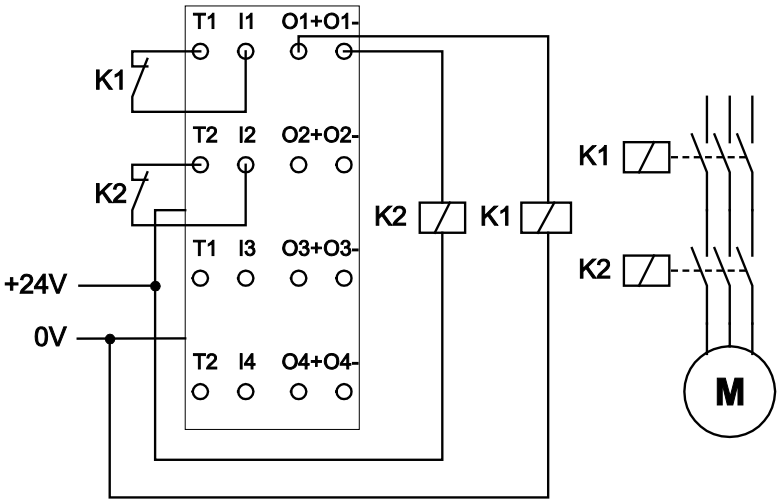


Figure 30: Connecting Loads from Ox+ and Ox- to 0 V and 24 V

You can switch ON two loads (e.g., two relays) two-channel with one digital power output. Connect a load between the digital power output Ox+ and the ground connection of the field supply voltage 0 V, and the second load between the digital power output Ox- and the positive field voltage connection +24 V.

Please also observe the following conditions:

- You must connect the voltage supply +24 V and 0 V of the relay to the field supply voltage U_v and 0 V of the F I/O module (same reference potential is necessary).
- You must connect the normally open contacts (K1 and K2, see figure) of both relays in series to the load to be switched.

- Open load detection is only possible on digital output Ox-.

The figure shows an example for connection two loads to digital power output O1.

With this connection, you can achieve SIL3/Cat. 4/PL e by re-reading the relay states.

Note

Open load detection is only possible on digital output Ox-
When connecting two loads to a digital power output (see figure), open load detection is only possible on output Ox- (not on output Ox+).
Open load detection is not safety related and cannot be part of the safety function under any circumstances.

7.3.3.6 Connecting Two Parallel Loads to a Digital Power Output

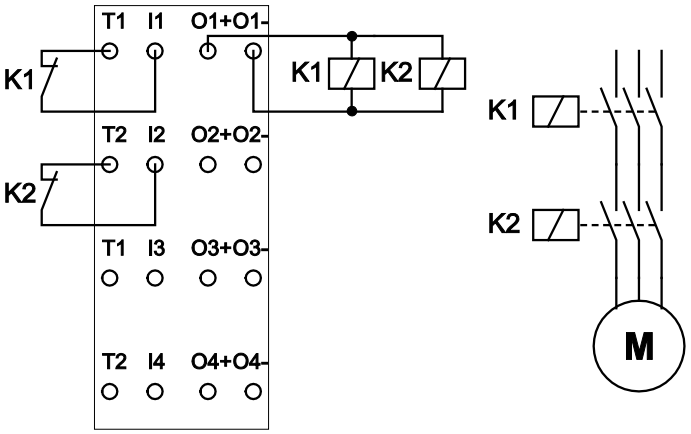


Figure 31: Connecting Two Parallel Loads to a Digital Power Output

You can connect two loads parallel to one digital power output.

If you want to deactivate open load detection for the supply lines to the loads, set the **Open load detection** parameter to "not active". Otherwise, set the **Open load detection** parameter to "active" so that the F-I/O module performs the open load detection task once per minute.

For more information about configuring the F-I/O module, read section "Parameterization of the F-I/O module with the WAGO Parameterization Tool".

With this connection, you can achieve SIL3/Cat. 4/PL e by re-reading the relay states.

Note

Open load detection for supply lines to the loads only!
If you connect two loads parallel to a digital power output (as depicted in the figure), the F I/O module only detects open loads on the supply lines.

Open load detection is not safety related and cannot be part of the safety function under any circumstances.

7.3.3.7 Connecting Loads between Ox+ to the Ground Connection 0 V

⚠ WARNING

Important note about single fault security
If single fault security is required for the safety function, you must use at least two positive digital power outputs Ox+ to connect two loads (e.g., two relays) because each positive digital power output uses only one semiconductor switch for switching.

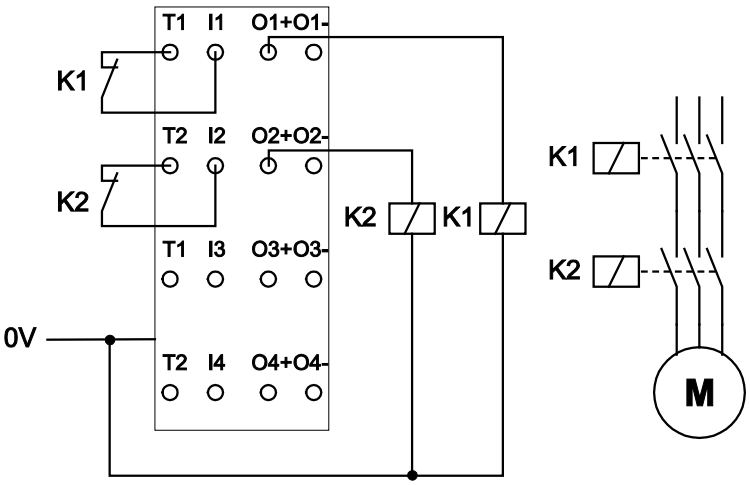


Figure 32: Connecting Loads from Ox+ to Ground Connection 0 V

You can connect a load (e.g., a relay) between a positive digital power output Ox+ and the ground connection of the field supply voltage O v (common ground). The digital power output Ox- can remain open.

Please observe the following conditions:

- You must connect the voltage supply +24 V and 0 V of the relay to the field supply voltage U_v and 0 V of the F I/O module (same reference potential is necessary).
- For single fault security, you need at least two positive digital power outputs Ox+ and two relays.
- You must connect the normally open contacts (K1 and K2, see figure) of two relays in series to the load to be switched.

With this connection, you can achieve SIL3/Cat. 4/PL e by re-reading the relay states.

Note

Open load detection not possible!
When connecting a load from positive digital power output Ox+ to the ground connection 0 V (common ground), open load detection is not possible for digital power output Ox+. Set the **Open load detection** parameter to "not active" because otherwise the F I/O module is passivated and the "Open load" diagnostic message is output.

7.3.3.8 Connecting the Digital Power Outputs to Digital Inputs

⚠ WARNING

Pay attention to the protected installation of signal lines during short circuit test "inactive"!
If you have set the **Short circuit test** parameter of an input to "inactive", the signal lines must be installed protected among each other and between the sensors and inputs according to EN 60204-1 or EN ISO 13849-2 (e.g., as separate sheathed lines or in separate cable ducts).

⚠ WARNING

Alternative measures for fault detection!
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.

You can connect the digital power outputs Ox+ to the digital inputs of the same or another F I/O module. You then have to set the **Short circuit test** parameter to "not active" for the digital input used because otherwise the F I/O module detects a short circuit and the "Short circuit" diagnostic message is output.

You have to set the filter time of the digital input to double the value of the test pulse length of the digital power output to adequately filter the test pulse of the digital power outputs.

Also observe the minimum load of the digital power output.
For more information about configuring the F I/O module, read section "Parameterization of the F I/O module with the WAGO Parameterization Tool".

Note

Open load detection not possible!
When connecting a digital power output to a digital input directly, open load detection is not possible for this power output Ox+. Set the **Open load detection** parameter to "not active" because otherwise the F I/O module is passivated and the "Open load" diagnostic message is output.
Open load detection is not safety related and cannot be part of the safety function under any circumstances.

Note

Note about the Short circuit parameter
If you connect a digital power output Ox+ to a digital input, you have to set the **Short circuit** parameter to "not active". Otherwise, the F I/O module is passivated and the "Short circuit" diagnostic message is output.

7.3.3.9 4 x Motor Connection, Single-channel with Feedback (1 Contactor per Motor)

⚠ WARNING

Important information about single-channel use!
The single-channel use of an output for a safety function is only permitted if 1-fault safety is not required! With single-channel use, shutdown must be ensured by the standard control in the event of an error. This can be achieved by integrating a 2nd disconnection faculty (e.g., a line contactor K0) in the safety application.

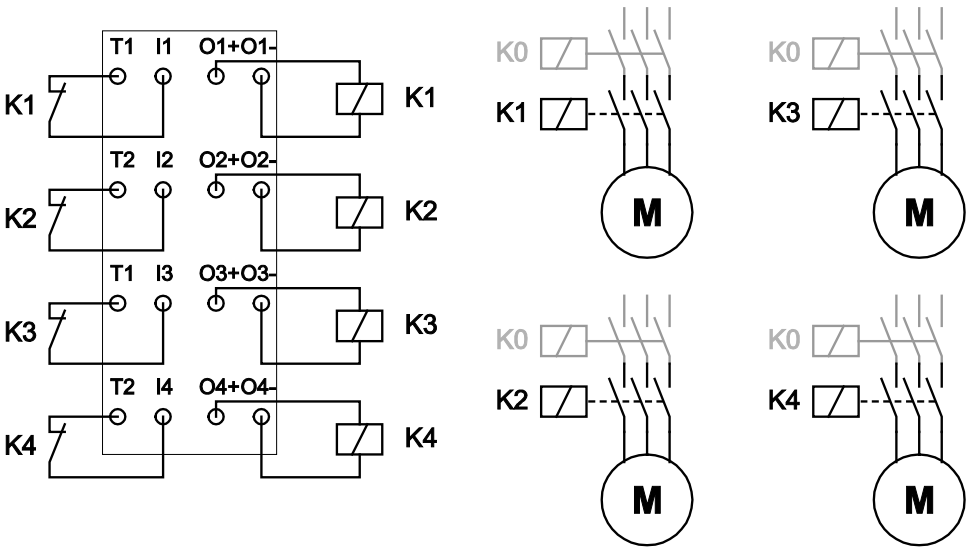


Figure 33: 4 x Motor Connection, Single-Channel with Feedback

You can connect a contactor to a digital power output and connect a motor single-channel using normally open contacts of the contactor. Connection is

possible to each of the four digital power outputs. You must observe the warning messages for single-channel use.

If you want to deactivate open load detection for the contactor, set the **Open load detection** parameter to "not active". Otherwise, set the **Open load detection** parameter to "active" so that the F I/O module performs the open load detection task once per minute.
For more information about configuring the F I/O module, read section "Parameterization of the F I/O module with the WAGO Parameterization Tool".

Please note that open load detection may not be part of the safety function under any circumstances.

With this connection, you can achieve SIL2/Cat. 2/PL d by re-reading the relay states.
Please note that according to EN ISO 13849-1, the demand rate of the safety function must be ≤1/100 of the test rate.

Note

Open load detection on the digital outputs
To monitor line interruptions between the digital power outputs Ox+ or Ox− and the connected load, you can set the line break detection parameter for each digital power output separately.

Open load detection is not safety related and cannot be part of the safety function under any circumstances.

7.3.3.10 Connecting 2 Motors, Two-channel with Feedback (2 Actors per Motor)

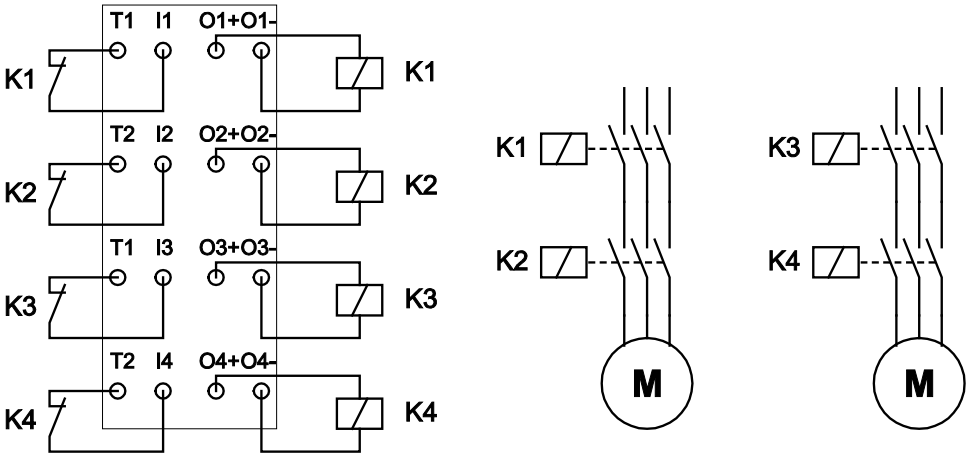


Figure 34: 2 x Motor Connection, Two-Channel with Feedback

To achieve signal fault security, we recommend the use of two positively driven normally open contacts of a contactor in series to the motor to be connected. These can originate from one contactor or from two different contactors. Connect the contactors between the digital power outputs Ox+ and Ox-.

You can also connect two contactors parallel to one digital power output and connect the normally open contacts of the contactor in series to the more to be connected.

If you want to deactivate open load detection for the contactors, set the **Open load detection** parameter to "not active". Otherwise, set the **Open load detection** parameter to "active" so that the F I/O module performs the open load detection task once per minute.
For more information about configuring the F I/O module, read section "Parameterization of the F I/O module with the WAGO Parameterization Tool".

Please note that open load detection may not be part of the safety function under any circumstances.

With this connection, you can achieve SIL3/Cat. 4/PL e by re-reading the relay states.

Note

Open load detection on the digital outputs
To monitor line interruptions between the digital power outputs Ox+ or Ox− and the connected load, you can set the line break detection parameter for each digital power output separately.

Open load detection is not safety related and cannot be part of the safety function under any circumstances.

7.3.3.11 Connecting 4 DC Motors

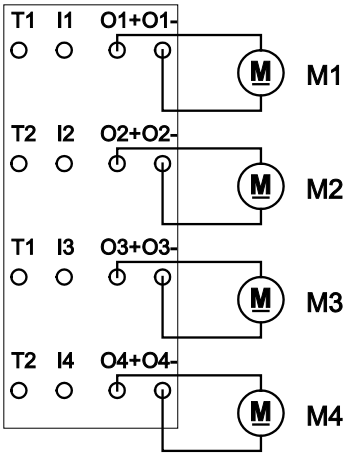


Figure 35: 4 x DC Motor Connection

You can operate a DC motor on each digital power output. Connect the DC motor between the digital power output Ox+ and Ox−.

If you want to deactivate open load detection for the motors, set the **Open load detection** parameter to "not active". Otherwise, set the **Open load detection** parameter to "active" so that the F I/O module performs the open load detection task once per minute.
For more information about configuring the F I/O module, read section “Commissioning” > … > “Parameterization of the F I/O modules with the WAGO Parameterization Tool”.

Please note that open load detection may not be part of the safety function under any circumstances.

You can achieve SIL3/Cat. 4/PL e with this switching.

Note

Open load detection on the digital output
To monitor line interruptions between the digital power outputs Ox+ or Ox- to the connected DC motor, you can set the **Open load detection** parameter for each digital power output separately.

Open load detection is not safety related and cannot be part of the safety function under any circumstances.

8 Commissioning

8.1 Commissioning and Maintenance Instructions

⚠ WARNING

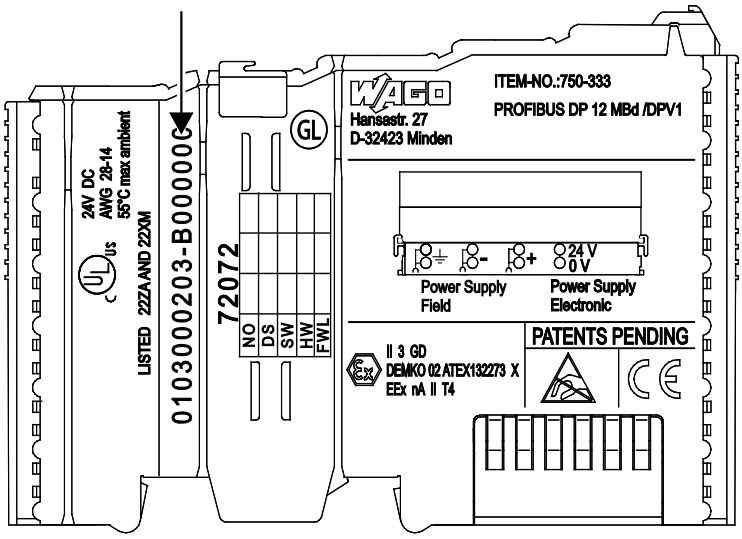
Only qualified persons may perform the work!
Adding, exchanging and commissioning F I/O modules may only be carried out by personnel trained in safety-related procedures!

⚠ WARNING

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

8.1.1 Proof Test Interval/Usage Duration

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



Serial number

01	03	00	02	03	-	B000000
Calendar week	Year	Software version	Hardware version	Firmware loader version		Internal number

Figure 36: Example of a Serial Number

The serial number consists of the week and year of manufacture, software version (if available), hardware version, firmware loader version (if available) and other internal information from WAGO Kontakttechnik GmbH & Co. KG.

The date of manufacture (calendar week/year) marks the beginning of the proof test interval.

The proof test interval is specified in the technical data of the respective F I/O module.

At the end of the proof test interval, the usage duration of the F I/O module is also reached. The F I/O module must then be replaced. An explicit proof test is not provided.

8.1.2 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.

8.2 Setting the PROFIsafe Address

The PROFIsafe address can be set by the coding switch of the F I/O module or by the WAGO parameterization tool.
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.
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.

8.2.1 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 (e.g., test prod or watchmakers screwdriver). 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.

8.2.2 Setting the PROFIsafe Address using the WAGO Parameterization Tool

Note

Effectiveness using the WAGO Parameterization Tool
The PROFIsafe address set using the WAGO parameterization tool only takes effect when the address set on the coding switch of the F I/O module equals 0.

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”.

8.3 Parameteriziation of the F I/O Module with the WAGO Parameterization Tool

⚠ WARNING

Only qualified persons may perform these tasks!
Adding, exchanging and starting up F I/O modules may only be carried out by personnel trained in safety-related procedures!

⚠ WARNING

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

⚠ WARNING

Only operate F I/O modules with active password protection!
Without using the iPar functionality, F I/O modules may only be operated in safety-related applications with active password protection.
F I/O modules may be operated in safety-related applications without active password protection if the F I/O module is operated with iPar functionality (see section “Commissioning” > … > ”F I/O Module with iPar Functionality without iPar Server”).

The 75x 2.x WAGO Safety Editor can be started with various call versions. Depending on the call option, the Safety Editor is started in either ONLINE or OFFLINE mode.

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

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

8.3.1 ONLINE Mode

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

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

In the **Open WAGO safety parameter set** dialog, enter a name for the parameter file and select the directory from which the file is to be loaded. Then click on the **[Open]** button to load the selected file from the specified location.

Another **iParameter set description** dialog opens. In this dialog, verify the information given on the project, on the changes made, and on the personnel in charge and change the information if need be. Click **[OK]** to confirm.

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

If you click on a parameter value with the left mouse button, depending on the parameter you have selected, either a selection list of the possible settings for this parameter will be displayed or you can enter the desired value directly.

Any parameter value changed is marked with a pen symbol, displayed in the first column of the parameter table.

After changing the parameter values, transfer them into the I/O module. To do so, click on **[WRITE]** in the Safety Editor toolbar.

If you have assigned a password for the I/O module, you will now be asked to enter it. After entering the password, the parameter values are transmitted and verified by the I/O module.

The verified parameter values are then read out of the I/O module and displayed in the **Verification** column of the parameter table.

Now compare the parameter values of the **"Input"** column with the values of the **"Verification"** column line by line. If the values are identical, mark the line as verified by activating the checkbox on the right side next to the **Verification** column.

As soon as all lines have been verified (all checkboxes are activated), the checkbox in the headline of the column is activated automatically.

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

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

If all settings are correct, save the parameter set in a parameter file. To do so, click **[Save]** in the Safety Editor toolbar.

The **iParameter set description** dialog opens for the detailed description of the parameter file. In this dialog, enter information about the project, the changes made, and the person responsible. Confirm your entries by clicking **[OK]**.

Then the **Save WAGO safety parameter set** dialog opens. Enter a name for the parameter file and select the directory in which the file is to be saved. Then click on **[Save]** in order save the file to the hard disk.

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

The Safety Editor provides additional services. Click the **[Services]** button on the System Editor toolbar. A selection menu appears with the **Compare** and **Password** menu items.

Note

Comparison of parameter data!
With this function, only parameter data of the same I/O module type and iParameter set format can be compared.

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 PC for comparison, click the **[Open]** button and select whether the data set should appear in the Reference or Comparison column.

To load the iParameter data from the I/O module currently connected for comparison, click the **[Read]** button and select whether the data set should appear in the Reference or Comparison column.

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

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

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

Note

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

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

If you have not assigned a password for the selected I/O module, then do so in the **Change PROFIsafe 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 the Safety Editor, click on **[Exit]** in the Safety Editor toolbar.

8.3.2 OFFLINE Mode

When opening the Safety Editor, select whether you want to change a parameter file already stored on the PC or whether you want to create a new parameter file.

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

If you want to create a new parameter file, you are directed to the storage location of the default parameter files. From the names of these files, you can draw conclusions about the type of the supported I/O module and the language support.

In the **Open WAGO Safety Parameter Set** dialog, enter the name of the parameter file that should be loaded. Then click on the **[Open]** button to load the selected file.

Another **iParameter set description** dialog opens. In this dialog, verify the information given on the project, on the changes made, and on the personnel in charge and change the information if need be. Click **[OK]** to confirm.

In the **Input** column of the parameter table of the Safety Editor, you can now make the desired changes to the parameter values.

If you click on a parameter value with the left mouse button, depending on the parameter you have selected, either a selection list of the possible settings for this parameter appears or you can enter one of the possible parameter values directly.

If all settings are correct, save the parameter set in a parameter file. To do so, click **[Save]** in the Safety Editor toolbar.

The **iParameter set description** dialog opens for the detailed description of the parameter file. In this dialog, enter information about the project, the changes made, and the person responsible. Confirm your entries by clicking **[OK]**.

Then the **Save WAGO safety parameter set** dialog opens. Enter a name for the parameter file and select the directory in which the file is to be saved. Then click on **[Save]** in order save the file to the hard disk.

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

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

Note

Comparison of parameter data!
With this function, only parameter data of the same I/O module type and iParameter set format can be compared!

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 PC for comparison, click the **[Open]** button and select whether the data set should appear in the “Reference” or “Comparison” column”.

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

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

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

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

8.3.3 Description of the Call Options

The WAGO Safety Editor can be started with various call versions. Depending on the call option, the 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 communication connection is currently not possible at runtime of the WAGO Safety Editor. If you want to parameterize a different F I/O module or you want to change the communication connection, close and restart the WAGO Safety Editor.

Note

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

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

In the Windows Start menu, select the entry **Programs** → **WAGO Software** → **WAGO-I/O-*CHECK*** → **WAGO-I/O-*CHECK* 3**.

Select an F I/O module for parameterization from the displayed fieldbus node configuration. Execute the **Settings** command in the 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. The WAGO Safety Editor is started in ONLINE mode.

Communication occurs over the serial connection for a PROFIBUS fieldbus coupler and over the serial connection or ETHERNET for a PROFINET fieldbus coupler depending on the current communication setting in WAGO-I/O-*CHECK*.

8.3.3.2 Direct Start from the Operating System

In the Windows Start menu, select the entry **Programs → WAGO Software → WAGO-I/O-*CHECK* 3 → WAGO Safety Editor 75x**.

The WAGO Safety Editor is started in OFFLINE mode.

8.3.3.3 Indirect Start via WAGO-I/O-*CHECK* from the Configuration Program (Device Level TCI Conformance Class 2)

In the configuration program of the safe PLC, select a device (fieldbus coupler) and launch “WAGO-I/O-*CHECK* 3” from the TCI link. The configuration program 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. The Safety Editor is started in ONLINE mode.
Communication occurs over the serial connection for a PROFIBUS fieldbus coupler and over ETHERNET for a PROFINET fieldbus coupler.

If you want to exit the configuration of the F I/O module and to close the Safety Editor, then WAGO-I/O-*CHECK* is also closed.

8.3.3.4 Indirect Start via WAGO-I/O-*CHECK* from the Configuration Program (Module Level TCI Conformance Class 2)

In the configuration program, select an F I/O module and from the TCI link “WAGO-I/O-*CHECK* 3”, start the WAGO-I/O-*CHECK*. The configuration program 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. The Safety Editor is started in ONLINE mode.
Communication occurs over the serial connecting cable for a PROFIBUS fieldbus coupler and via the TCP/IP connection for a PROFINET fieldbus coupler.

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

8.3.3.5 Direct Start from the Configuration Program (Device Level TCI Conformance Class 3)

This option is not supported. Since no F I/O module can be selected for parameterization, the WAGO Safety Editor is automatically closed after selecting a device (fieldbus coupler) in the configuration program of the safe PLC and launching the WAGO Safety Editor via the TCI link “WAGO Safety Editor 75x”.

8.3.3.6 Direct Start from the Configuration Program (Module Level TCI Conformance Class 3)

In the configuration program of the safe PLC, select an F I/O module and from the TCI link ”WAGO Safety Editor 75x”, start the WAGO Safety Editor 75x. The

configuration program passes the current language and communication setting to the WAGO Safety Editor. The WAGO Safety Editor is started in ONLINE mode. Communication occurs over the PROFIBUS fieldbus for a PROFIBUS fieldbus coupler.

8.3.3.7 Direct Start from the Configuration Program (Device Level TCI Conformance Class 3 OFFLINE)

In the configuration program of the safe PLC, select a device (fieldbus coupler) and from the TCI link “WAGO Safety Editor 75x” (offline), start the WAGO Safety Editor 75x. The configuration program passes the current language setting to the WAGO Safety Editor. The WAGO Safety Editor is started in OFFLINE mode.

8.3.3.8 Direct Start from the Configuration Program (Module Level TCI Conformance Class 3 OFFLINE

In the configuration program of the safe PLC, select an F I/O module and from the TCI link “WAGO Safety Editor 75x” (offline), start the WAGO Safety Editor 75x. The configuration program passes the current language setting to the Safety Editor. The WAGO Safety Editor is started in OFFLINE mode.

8.3.4 Adjustable Parameters

Table 37: Adjustable Parameters

Parameter	Value Range
Input filter time [ms]	0 (off) / 0.2 / 0.5 / 1 / 2 / 3* / 5 / 10 / 20 / 50 / 100 / 200
Short circuit test I1	not active / active*
Short circuit test I2	not active / active*
Short circuit test I3	not active / active*
Short circuit test I4	not active / active*
Dual channel evaluation I1 & I2	yes/no*
Dual channel evaluation I3 & I4	yes/no*
Discrepancy time I1 & I2 [ms]	10 ... 100* ... 65535
Discrepancy time I3 & I4 [ms]	10 ... 100* ... 65535
Valence evaluation I1 & I2	equivalent* / antivalent
Valence evaluation I3 & I4	equivalent* / antivalent
Restart inhibit I1 & I2	yes* / no
Restart inhibit I3 & I4	yes* / no
Operating mode	Standard* / Rotary table, i.e. all safe inputs I1 ... I4 are sensitive to T1
Open load detection O1	not active* / active
Open load detection O2	not active* / active
Open load detection O3	not active* / active
Open load detection O4	not active* / active
Test pulse length O1 [ms]	0 (off) / 1 / 2 / 5* / 10 / 20 / 50 / 100 / 200 / 500
Test pulse length O2 [ms]	0 (off) / 1 / 2 / 5* / 10 / 20 / 50 / 100 / 200 / 500
Test pulse length O3 [ms]	0 (off) / 1 / 2 / 5* / 10 / 20 / 50 / 100 / 200 / 500
Test pulse length O4 [ms]	0 (off) / 1 / 2 / 5* / 10 / 20 / 50 / 100 / 200 / 500

* Standard setting

8.3.4.1 Parameter Input Filter Time

DANGER

Configuring the input filter time changes the safe response time!
If you change the Input Filter Time parameter, then the safe response time is also changed. See "Response Time" section.

The **Input Filter Time** parameter is used to set the filter time for all digital inputs of the F I/O module. Setting the filter time to "0 ms" disables the input filter.

Note that the minimum signal duration on a digital input depends on the filter time set.
With the input filter, signal changes to a digital input are detected by the F I/O module delayed by the duration of the filter time.

If the signal voltage on the digital input switches from "1" to "0" (signal change 1-0) for a safety requirement (e.g., emergency off requirement), for example, signal voltage "0" must be present for this input pulse duration.
If the signal voltage is present shorter than the input pulse duration on the digital input, the signal change is may not be detected by the F I/O module. The following table indicates input pulse durations depending on the input filter time set:

Table 38: Input Pulse Durations Depending on the Input Filter Time

Input filter time [ms]	0	0.5	1	2	3	5	10	20	50	100	200
Input pulse duration [ms]	19	20	21	24	28	36	56	96	216	418	816

Note

Use shielded cables for input filter times under 3 ms!
If you have set input filter times less than 3 ms, you have to use shielded cables if there is risk of interference (e.g., overvoltage) on the signal lines to prevent possible passivation of the F I/O module.

8.3.4.2 Parameter Short-Circuit Test Ix

⚠ WARNING

Protect signal lines when installing!
When connecting signal lines to the digital inputs of the F I/O module, make sure that only the following signals are transmitted within a cable or non-metallic sheathed cable:

- Those whose short-circuit does not lead to a dangerous failure of the safety function
- Those supplied by different clock outputs

Therefore, please make sure that the signal lines are installed in accordance with EN 60204-1 or EN 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 "not active" value, then the F I/O module only tests the input circuit for internal errors. You have to set the **Short-circuit test** parameter to "not active" if, for example, you connect the 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 "active" value, then you have to connect the digital input to the associated clock output via a switching element (e.g., break contact). By doing so, the F I/O module tests the signal line for short circuits against external voltages. If the short circuit test detects an external voltage on the digital input, the F I/O module is passivated and the "Short circuit" diagnostic message is output to the safe PLC.

Table 39: Input /Clock Output Assignment

Inputs	Associated Clock Output (for Activated Short-Circuit Test)
I1, I3	T1
I2, I4	T2

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

Table 40: Error Detection

Error, Example (x = 1 ... 4, m = 1.2)	Error Detection	
	Short-Circuit Test "Active"	Short-Circuit Test "Not Active"
Short circuit I1 / I2	Yes	No
Short circuit I3 / I4	Yes	No
Short circuit Ix / +24 V	Yes	No
Short circuit Ix / GND	No	No
Short circuit Tm / +24 V	Yes*	No
Short circuit Tm / GND	Yes	Yes
Short circuit T1 / T2	Yes*	No
Internal error in input circuit	Yes	Yes
No supply voltage	Yes	Yes

* Only if the clock outputs are connected to the digital inputs.

Note

Behavior of the F I/O module in the event of a failure

If an error is detected on a digital input or power output by the F I/O module, the entire F I/O module is passivated by the process image of all digital inputs being set to "0" and all digital power outputs being switched off.

For detailed information, read the section "Diagnostics".

8.3.4.3 Parameter Two-Channel Analysis Ix & Ix+1

The **Two-channel analysis** parameter is used to switch the two-channel analysis of the digital inputs on or off. The value of the parameter can be set to “yes” or “no”. You can set the Restart barrier parameter to “yes” or “no”. If you have set the value of the operating mode parameter to “Rotary table”, you must set the **Two-channel analysis** parameter to “no”.

Depending on the value of the **Two-channel analysis** parameter, the signal states of the Ix and Ix+1 inputs are analyzed differently (normal, two-channel), reproduced in the process image and transferred to the safe PLC.

If you have set the **Two-channel analysis** parameter to “no”, then the signal states of the digital inputs are transmitted independently, i.e., single-channel without analysis to the safe PLC (see Process Image section).

If have you set the **Two-channel analysis** parameter to "yes", the respective digital inputs Ix and Ix+1 are combined into an input pair by the F I/O module. The signal states of the digital inputs are analyzed based on the rule set using the **Valence analysis** parameter and applied to the process image as 0 signal or 1 signal (see Valance Analysis Parameter section).

The F I/O module can be used to create two input pairs from the four digital inputs.

- Input pair 1: digital input I1 & I2
- Input pair 2: digital input I3 & I4

You can set the value of the **two-channel analysis** parameter for each input pair separately.

Note

If the two-channel analysis is set to "yes", then the Short circuit test parameter must be the same!
If you have set the **Two-channel analysis** parameter to "yes" for two digital inputs, then you have to set the value of the **Short circuit test** parameter to the same for both digital inputs concerned. The F I/O module checks your setting after transferring to the I/O module and makes automatic corrections if necessary by setting the value to “active” for both digital inputs. The automatic correction is displayed in the WAGO parameterization tool. You can set the values of both digital inputs to the same value after the correction is made.

8.3.4.4 Discrepancy Time Ix & Ix+1 Parameter

⚠ WARNING

Do not use discrepancy time monitoring as part of the safety function!
You can only use discrepancy monitoring for safety applications where monitoring of both contacts does not represent its own safety function such as emergency stop and the opposite, two-hand control!

The **discrepancy time** parameter is used for two-channel analysis of two digital inputs Ix & Ix+1. The discrepancy time is then only used by the F I/O module when the **operating mode** is set to "Standard" and the value of the **two-channel analysis** parameter is set to "yes".

If you have set the **Two-channel analysis** parameter is set to "yes", the signal states of the affected input pair are evaluated based on an adjustable valence rule. The valence rule (antivalence, equivalence) depends on the value of the **Valence analysis** parameter (see section “Commissioning” > … > “Parameter Valence Evaluation Ix & Ix+1”).

The F I/O module checks whether the difference from the valence rule has disappeared after the configured discrepancy time has elapsed. If not, a discrepancy error is present. The F I/O module is passivated and the "Discrepancy time exceeded" diagnostic message is output to the safe PLC.

Use the value of the parameter to specify the maximum permissible time for a deviation (illegal signal state) of both 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” > … > “Parameter Valence Evaluation Ix & Ix+1”), 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 in a value range from 10 ms to 65535 ms for each input pair separately.

Discrepancy Time Monitoring and Discrepancy Time

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

Discrepancy time monitoring of the two-channel analysis is used to determine 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 when:

- No equivalent (same) states are detected with equivalent valence rule
- No antivalent (opposing) states are detected with antivalent valence rule

Note

Activate discrepancy time monitoring only after the set input filter time has elapsed!
Discrepancy time monitoring is only activated if the input filter time has expired.

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

Set the value of the **discrepancy time** parameter such 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 is started. 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 is started. Discrepancy time monitoring is not terminated until either a 0-signal or a 1-signal is detected.

As discrepancy time monitoring progresses in the F I/O module, the "0" value is output from the affected input pair to the safe PLC as a safe process image.

Behavior of the F I/O module after expiration of the discrepancy time

If the invalid input signal status is detected by the F I/O module longer than the configured discrepancy time, there is a discrepancy error, the F I/O module is passivated and the "Discrepancy time exceeded" diagnostic message it output to the safe PLC. The discrepancy error can be caused, for example, by a wire discontinuity in a signal line, a sensor error, etc.

Note

Behavior of the F I/O module during discrepancy time errors
If the a discrepancy error is detected by the F I/O module, all digital inputs and power outputs are passivated by the F I/O module. Depending on the **Restart inhibit** parameter setting, you can acknowledge the reported error(s) with or without eliminating the cause of the error (see section "Commissioning" > "Parameter Restart Inhibit Ix & Ix+1").

8.3.4.5 Parameter Valence Evaluation Ix & Ix+1

The **Valence evaluation** parameter is used for the dual channel evaluation of two digital inputs Ix & Ix+1. The valence evaluation is then only used by the F I/O module if you have set the value of the **Operating mode** parameter to "Standard" and the value of the **Dual channel evaluation** parameter to "yes".

The **Valence evaluation** parameter is used to set the valence rule of the dual channel evaluation to be used for an input pair. You can set the parameter to "Antivalent" or "Equivalent". The valence evaluation can be set separately for each input pair.

Note

Changing input signals caused by interference
Changing input signals 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 input pair affected, a discrepancy error to be detected after the discrepancy time has elapsed and the "Discrepancy time exceeded" diagnostic message to be output.

Possible causes may be:
- Cross circuit, short circuit and broken cable (user error, wiring error)
- Sticky normally open contacts of a reliable sensor
- Inadequate filtering of the test signals of a reliable sensor

If you have set the **Valence evaluation** parameter to "Antivalent", then the F I/O module behaves as follows:

The F I/O module compares the signal states of the digital inputs affected to the opposing values. The following table shows the possible signal states for the antivalent evaluation:

Table 41: Antivalent Evaluation

Inputs		Process Image		
I2 I4	I1 I3	Bit 1 Bit 3	Bit 0 Bit 2	**Signal State**
0	0	0	0	Illegal
0	1	0	1	1 Signal
1	0	0	0	0 Signal
1	1	0	0	Illegal

After the set discrepancy time has elapsed, an illegal signal state leads to the detection of a discrepancy error by which the F I/O module is passivated and the "Discrepancy time exceeded" diagnostic message is output.

If you have set the **Valence evaluation** parameter to "Equivalent", then the F I/O module behaves as follows:

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

Table 42: Equivalent Evaluation

Inputs		Process Image		
I2 I4	I1 I3	Bit 1 Bit 3	Bit 0 Bit 2	**Signal State**
0	0	0	0	0 Signal
0	1	0	0	Illegal
1	0	0	0	Illegal
1	1	1	1	1 Signal

After the set discrepancy time has elapsed, an illegal signal state leads to the detection of a discrepancy error by which the F I/O module is passivated and the "Discrepancy time exceeded" diagnostic message is output.

8.3.4.6 Parameter Restart Inhibit Ix & Ix+1

⚠ WARNING

Measures required if the Restart inhibit parameter is set to "no"!
If you have set the **Restart inhibit** parameter to "No", then if the F I/O module outputs the "Discrepancy time exceeded" diagnostic message to the secure PLC, you must independently ensure that all necessary repair measures are implemented immediately because the following errors 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 the dual channel evaluation of two digital inputs. The restart inhibit is then only used by the F I/O module if you have set the value of the **Operating mode** parameter to "Standard" and the value of the **Dual channel evaluation** parameter to "yes".

You can set the **Restart inhibit** parameter to "Yes" or "No".

If you have set the **Restart inhibit** parameter to "Yes", then the F I/O module behaves as follows:

A fixed discrepancy error can only be acknowledged if the input signals have taken the values listed in the following table.

Table 43: Necessary Signal States for Acknowledgement if the Restart Inhibit is Set to "yes"

Input Pair	Digital Inputs		Valence Evaluation
	I2	I1	
I1 & I2	"1"	"0"	"Antivalent"
	"0"	"0"	"Equivalent"
	I4	I3	
I3 & I4	"1"	"0"	"Antivalent"
	"0"	"0"	"Equivalent"

If you have set the **Restart inhibit** parameter to "No" acknowledgement of a discrepancy error is successful once the deviation from the valence rule on the digital inputs concerned no longer exists. You can set the value of the **Restart inhibit** parameter for each input pair separately.

8.3.4.7 Operating Mode Parameter

⚠ WARNING

Evaluation of the input signal state in the "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. Under certain circumstances, you can use the process image of the digital inputs without the suitable function blocks.

An overview for using F-I/ O modules 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 area "Service > Documentation > Application Notes..." .

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

If you want to use the digital inputs single-channel or two-channel, you must set the **Operating mode** parameter to the "Standard" value.

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 indexing table or one or more mode selectors to the digital inputs of the F-I/ O module, set the parameter to the “indexing table” value.

If you set the **Operating mode** parameter to "Round table", the F-I/ O module behaves as follows:

- The **two-channel** parameter is only accepted by the F-I/ O module with the "no" value.

- The **Short circuit test** parameter is only accepted by the F-I/ O module with the "active" value.
- All inputs are sensitive to clock output T1 and are tested for short circuit on any 24 V signal source.
- Clock output T2 is switched off.
- The signal states on the digital inputs are not analyzed in advance by the F-I/ O module. A separate function block is required.

8.3.4.8 Parameter Open Load Detection

The **Open load detection** parameter is used to separately activate or deactivate open load detection for each individual power output.

Open load detection is only possible on digital output Ox. Therefore, we recommend that you wire the load to be switched between the Ox+ and Ox- connections.

If you have set the **Open load detection** parameter to "active", the supply lines from the digital power outputs to the loads to be switched are monitored for open loads.

If you have set the **Open load detection** parameter to "not active", then the supply lines are not monitored for open loads by the F I/O module.

Note

Open load diagnostics are performed just once per minute!
Open load monitoring is performed once per minute.

Open load detection is not safety related and cannot be part of the safety function under any circumstances.

Note

Open load detection is only possible if the test pulse length is set to > 0 ms!
Open load detection is only possible if the test pulse of the digital power output affected is set to > 0 ms.

Open load detection is not safety related and cannot be part of the safety function under any circumstances.

8.3.4.9 Test Pulse Duration Parameter

⚠ WARNING

No test pulses when test pulse duration = 0 ms!

If you have set the test pulse duration of a digital power output (1 or 2-channel) to the value “0 ms (off)”, the F I/O module does not perform a cyclic diagnostic test of the digital power output. However, to achieve a risk reduction to SIL3 acc. to EN 62061 or PL e acc. to EN ISO 13849-1, the diagnostic test must be triggered automatically by the safe controller. The time interval for repeating the diagnostic test may not exceed 24 hours.
Possible variants:

a) Protected cable routing
   1. The F I/O module executes the diagnostic test to check the digital power outputs if all outputs with a test pulse duration of “0 ms (off)” are switched off. The shutdown must last for 500 ms.

b) Unprotected cable routing
   1. The F I/O module executes the diagnostic test to check the digital power outputs if all outputs with a test pulse duration of “0 ms (off)” are switched off. The shutdown must last for 500 ms.
   2. To make sure that short circuits between outputs are also detected by the diagnostic test in unprotected cable routes, the outputs must be switched off sequentially. An interval of 500 ms must be maintained between each output that is switched off.
      The diagnostic test is successfully concluded when all outputs are switched off at the same time.

⚠ WARNING

Safe response time depends on the test pulse duration!

If you connect the load from the digital power output Ox+ to a common reference potential (e.g., B. 0 V) and you change the test pulse duration, the response time of the digital power output is extended. See section “Technical Data” > … > “Response Times”.

The digital power outputs are tested each minute using test pulses. The **Test Pulse Duration** parameter is used to set the duration of the test pulse for one digital power output. If the test pulse duration is set to “0 ms”, the test pulse for the respective digital power output is deactivated. The test pulse duration must be adjusted if you, for example, when you connect a capacitive load to the digital power output.

Each digital power output is switched off in the cycle of one minute for the duration of the test pulse duration set. The F I/O module tests whether the digital outputs can be switched off and whether there are short circuits to external voltages on the output cable.

Note

Internal test pulse also when test pulse duration = 0 ms!
(applies to SW version 06)
Please note that the F I/O module up to software version 06 also performs an internal test pulse expressed by briefly switching off all digital power outputs when the test pulse duration is set to 0 ms. This is necessary to achieve the high diagnostic coverage level and typically lies at well under 1 ms. You have to take this into account when laying out your connected actuators and sensors.

Note

Behavior of the F I/O module in the event of a failure
If an error is detected on a digital input or digital power output by the F I/O module, the entire F I/O module is passivated by the process image of all digital inputs being set to “0” and all digital power outputs being switched off. For detailed information, read the section “Diagnostics”.

8.4 Programming the Safe PLC

The following requirements must be met to configure the safe PLC using the F I/O module **750-667/000-003**:

- Use of a suitable safe PLC
- Use of a suitable programming and configuration environment
- Selection of a WAGO fieldbus coupler (PROFIBUS, PROFINET)
- Use of the current WAGO device description file (GSD, GSDML)

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

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

The F I/O module can be operated with or without iPar server functionality.

Note

Observe the manufacturer's documentation for the safe PLC!
The exact programming procedure is available in the manufacturer documentation of the safe PLC.

Note

Use the application notes from WAGO!
An overview for using F I/O modules 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 area “Service > Documentation > Application Notes...” .

Note

Observe dependencies!
When creating safety programs, take into account the dependencies between PLC cycle time, call interval of the safety program, expected response times of the safety program and adjustable monitoring times. Details are available in the respective manufacturer documentation.

8.4.1 F I/O Module without iPar Functionality

To use the F I/O module without iPar server functional, select the F I/O module “75x-667 4FDI/4FDO 24V/2.0A DC” from the device catalog and add it to the fieldbus node. Then set the F parameters of the F I/O module in the hardware

configuration environment. Then recompile the configuration and transfer it so the safe PLC.

Then configure the F I/O module using the WAGO parameterization tool as described in the section “Start Up” > … > “Parameterization of the F I/O module with the WAGO Parameterization Tool”.

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.

Based on your requirements, then create the safety program that contains the basic functions for PROFIsafe subscribers (e.g., reintegration).

After compiling the safety program, you have to check the assignment of PROFIsafe subscribers to the respective run-time group. Then transfer the entire project to the safe PLC.

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

8.4.2 F I/O Module with iPar Functionality and iPar Server

Note

Use the application notes from WAGO!
The use of the F I/O modules with iPar functionality is described in application note “A114802”. This application note is available on the Internet at www.wago.com in the area “Service > Documentation > Application Notes ...” .

To use the F I/O module with iPar server functional, select the I/O module with the “75x-667 4FDI/4FDO iPar-Server” designation from the device catalog and add it to the fieldbus node. You must first set the F_iPar_CRC in the F parameters to 0 in the hardware configuration environment, so that the F I/O module switches to test mode. Then recompile the configuration and transfer it so the safe PLC.

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. It is important that the data block for storing the individual parameters (iPar server) is added for each iPar server-capable I/O module.

After compiling the safety program, you have to check the assignment of PROFIsafe subscribers to the respective run-time group. Then transfer the entire project to the safe PLC.

After the safe PLC starts, the F I/O module switches to test mode. In this mode, the safety-related functions of the F I/O module are passivated. Then configure the F I/O module using the WAGO parameterization tool. For more information, read the section “Start Up” > … > “Parameterization of the F I/O module with the

WAGO Parameterization Tool”. The WAGO parameterization tool displays the iPar_CRC. Note this for the next step (e.g., copy to clipboard).

Then adjust the F parameters of the F I/O module by setting the F_iPar_CRC in the hardware configuration environment to the value from the WAGO parameterization tool. You have to recompile the hardware configuration and the safety program and transfer it to the safe PLC.

If the F_iPar_CRC was set correctly in the previous step, a match with the iPar_CRC is permanently stored in the F I/O module. The current individual parameters of the F I/O module are then transferred to the safe PLC and permanently stored, so that an I/O module can be replaced, for example, in case of service without new parameterization.

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

8.4.3 F I/O Module with iPar Functionality without iPar Server

To use the F I/O module with iPar server functional but without using the iPar server, select the I/O module with the “75x-667 4FDI/4FDO iPar-Server” designation from the device catalog and add it to the fieldbus node. Without using the iPar server, the F_iPar_CRC is only checked against the iPar-CRC by the F I/O module. Thus, it is permissible to operate the F I/O module without password protection for the individual parameters.

Note

Behavior of the F I/O module when discrepancies occur between F_iPar_CRC and iPar-CRC!
If the F I/O module identifies a discrepancy between the F_iPar_CRC and the iPar-CRC, substitute values (failsafe values) are output instead of actual process values by the F I/O module.

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 configure the F I/O module using the WAGO parameterization tool (see the section “Start Up” > … > "Parameterization of the F I/O module with the WAGO Parameterization Tool"). The WAGO parameterization tool displays the iPar_CRC. Note this for the next step (e.g., copy to clipboard).

Then adjust the F parameters of the F I/O module by setting the F_iPar_CRC in the hardware configuration environment to the value from the WAGO parameterization tool.

Note

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

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

Then 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.

Note when replacing an I/O module (e.g., in case of maintenance), note that the F I/O module cannot be automatically reparameterized.

Note

Diagnostic message when there is a difference between the F_iPar_CRC and iPar-CRC!
When there is a difference between the F_iPar_CRC and iPar-CRC, note that the “Error when downloading individual parameters” diagnostic message first appears after about 4.5 minutes. As a remedy, adjust the individual parameters of the F I/O module using the WAGO parameterization tool.

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

9 Diagnostics

9.1 Behavior in the Event of an Error

The F I/O module detects internal and external errors. Internal errors are detected by continuous self testing. Depending on the configuration, external errors are detected and diagnosed by testing the external circuits to the extent possible. When detecting an external error, a diagnostic message is output to the safe PLC. The diagnostic messages for external errors are described in the section “Diagnostics” > … > “Diagnosis of Errors”.

In the event of an error, all digital inputs and power outputs of the F I/O module are passivated by outputting the substitute values (failsafe values) instead of actual process values. For the digital inputs, the substitute values "0" for the process image are transferred to the safe PLC. The digital power outputs are switched off.

The external errors can be eliminated by maintenance personnel and must then be acknowledged by the operator triggering an acknowledgement (operator acknowledgement).

Both internal and external errors can be evoked by strong EMC events. If an internal error is diagnosed, the F I/O module switches off for safety. In this case, acknowledgement by the operator remains ineffective.

To check whether the cause of an internal error was a temporary EMC event and thus caused the safety-oriented shutdown, switching the entire fieldbus node off and then on again can be performed in an attempt to activate the F I/O module again.

If shutdowns occur frequently due to internal errors, the F I/O module should be replaced.

In this case, return the defective F I/O module to WAGO Kontakttechnik GmbH & Co. KG for fault analysis.

9.2 Diagnosis of Errors

⚠ WARNING

he diagnosis of the F I/O module is not safety related!
The diagnosis of the F I/O module is not safety related and 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. Diagnostic messages help you identify errors and implement appropriate measures for error correction.

The F I/O module provides you with diagnostic messages about the display elements and the diagnostic services of the respective fieldbus system (PROFIBUS or PROFINET). The presentation of diagnostic information via the LEDs is available in the section “Display Elements”.

All diagnostic messages transferred to and displayed on the safe PLC are listed below in alphabetical order. Information about error correction and resolutions for each diagnostic message can also be displayed on the safe PLC for released channel and module diagnostics. The configuration tool of your safe PLC can be used to set the release of the channel and module diagnostics.

The structure of the diagnostic messages is described in the fieldbus coupler manuals.

The F I/O module 750-667/000-003 can be operated on the WAGO I/O System 750 fieldbus couplers specified in section “Technical Data” > … > “Communication”:

Table 44: Diagnostic Messages

Alarm	Description	
Differing F_Dest_Add	**Diagnostic type**	Module diagnostics
	Coding	0x0040
	LED indication:	Group error (E) red PROFIsafe (G) red
	Remedy	The PROFIsafe address assigned as part of the F parameterization differs from that set on the F I/O module. Check the DIP switch setting or PROFIsafe address set using the safety editor (SEDI).
Discrepancy time exceeded	**Diagnostic type**	Channel diagnostics
	Coding	0x021E
	LED indication:	Status In (A, B, C or D) red, group error (E) red
	Remedy	For 2-channel analysis of the input pair, the F I/O module has determined that the discrepancy time set has been exceeded. Check the connected contacts. Adjust the discrepancy time setting if necessary.
Incorrect F_CRC_Length	**Diagnostic type**	Module diagnostics
	Coding	0x0045
	LED indication:	Group error (E) red PROFIsafe (G) red
	Remedy	The configured F_CRC length is not possible in the current operating mode. Observe the dependency between F_Par_Version and F_CRC_Length and select a valid combination.
Incorrect F_Par_Version	**Diagnostic type**	Module diagnostics
	Coding	0x0046
	LED indication:	Group error (E) red PROFIsafe (G) red
	Remedy	The set version of the F parameter set is incorrect. Observe the dependency between F_Par_Version and F_CRC_Length and select a valid combination.

Table 44: Diagnostic Messages

Alarm	Description	
Error when downloading the individual parameters	**Diagnostic type**	Module diagnostics
	Coding	0x004A
	LED indication:	No indicator
	Remedy	Timeout when writing (downloading) the individual parameters 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.
Error when uploading the individual parameters	**Diagnostic type**	Module diagnostics
	Coding	0x0049
	LED indication:	No indicator
	Remedy	Timeout when saving (uploading) the individual parameters to the iPar server. Check whether an iPar server instance was created for the F I/O module.
Internal error	**Diagnostic type**	Module diagnostics
	Coding	0x0209
	LED indication:	Group error (E) red
	Remedy	The internal hardware test of the F I/O module failed or the operating program is no longer running properly. Immediately replace the F I/O module and return it to WAGO Kontakttechnik GmbH & Co. KG for fault analysis.
Short Circuit	**Diagnostic type**	Channel diagnostics
	Coding	0x0201
	LED indication:	Status In (A, B, C or D) red, group error (E) red
	Remedy	The input of the F I/O module is not supplied by the associated clock output or is connected to a +24V field supply directly. Check the input wiring.

Table 44: Diagnostic Messages

Alarm	Description	
Short circuit on T1	**Diagnostic type**	Module diagnostics
	Coding	0x020B
	LED indication:	Group error (E) red
	Remedy	Clock output T1 of the F I/O module has short-circuited with the 0V potential of the field supply. Check the clock output wiring.
Short circuit on T2	**Diagnostic type**	Module diagnostics
	Coding	0x020C
	LED indication:	Group error (E) red
	Remedy	Clock output T2 of the F I/O module has short-circuited with the 0V potential of the field supply. Check the clock output wiring.
Short circuit acc. to GND	**Diagnostic type**	Channel diagnostics
	Coding	0x021C
	LED indication:	Status On (I, K, L or M) red, group error (E) red
	Remedy	The - connection of the output has short-circuited with the 0V potential of the field supply. Check the output wiring. The output may be defective.
Short circuit acc. to VCC	**Diagnostic type**	Channel diagnostics
	Coding	0x021B
	LED indication:	Status On (I, K, L or M) red, group error (E) red
	Remedy	The + connection of the output has short-circuited with the +24V potential of the field supply. Check the output wiring. The output may be defective.
Line break	**Diagnostic type**	Channel diagnostics
	Coding	0x0206
	LED indication:	Status On (I, K, L or M) red, group error (E) red
	Remedy	The connection between the output of the F I/O module and the connected load has been interrupted. Check the output wiring.

Table 44: Diagnostic Messages

Alarm	Description	
Non-supported F_Block_ID	**Diagnostic type**	Module diagnostics
	Coding	0x004C
	LED indication:	Group error (E) red PROFIsafe (G) red
	Remedy	The F parameter block signaled 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.
Non-supported F_SIL	**Diagnostic type**	Module diagnostics
	Coding	0x0044
	LED indication:	Group error (E) red PROFIsafe (G) red
	Remedy	The F I/O module cannot be operated in the configured SIL. Correct the F parameterization.
Safety-oriented shutdown	**Diagnostic type**	Module diagnostics
	Coding	0x0219
	LED indication:	Group error (E) red, 2 Hz flashing
	Remedy	The F I/O module has taken the safe state and switched off the outputs. Immediately replace the F I/O module and return it to WAGO Kontakttechnik GmbH & Co. KG for fault analysis.
Overload	**Diagnostic type**	Channel diagnostics
	Coding	0x0204
	LED indication:	Status On (I, K, L or M) red, group error (E) red
	Remedy	The maximum permissible load current on the output of the F I/O module has been exceeded or the + and - connections have been short circuited. Check the load and the output wiring.

Table 44: Diagnostic Messages

Alarm	Description	
Over temperature	**Diagnostic type**	Module diagnostics
	Coding	0x0205
	LED indication:	Group error (E) red
	Remedy	The permissible operating temperature of the semiconductor in the F I/O module has been exceeded. Make sure that the ambient temperature is within the specified range.
Invalid individual parameters	**Diagnostic type**	Module diagnostics
	Coding	0x0200
	LED indication:	Group error (E) red, parameterization (H) red, 1 Hz flashing
	Remedy	The individual parameter set for the F I/O module is inconsistent. Correct the parameterization taking into account dependencies between individual settings.
Invalid Individual Parameters from the iPar Server	**Diagnostic type**	Module diagnostics
	Coding	0x004B
	LED indication:	Group error (E) red, parameterization (H) red, 1 Hz flashing
	Remedy	The individual parameter set for the F I/O module provided by the iPar server are inconsistent. Make sure that a valid individual parameter set exists on the iPar server. If necessary, check the fieldbus transmission.
Invalid F_CRC1	**Diagnostic type**	Module diagnostics
	Coding	0x0047
	LED indication:	Group error (E) red PROFIsafe (G) red
	Remedy	The F_CRC1 form from the F parameter set is invalid. Create a consistent F parameter set.

Table 44: Diagnostic Messages

Alarm	Description	
Invalid F_Dest_Add	**Diagnostic type**	Module diagnostics
	Coding	0x0041
	LED indication:	Group error (E) red
	Remedy	The PROFIsafe address of the F I/O module must lie within the range of 1 to 65534. Correct the F parameterization.
Invalid F_Source_Add	**Diagnostic type**	Module diagnostics
	Coding	0x0042
	LED indication:	Group error (E) red PROFIsafe (G) red
	Remedy	The PROFIsafe address of the F host must lie within the range of 1 to 65534. Correct the F parameterization.
Invalid F_WD_Time	**Diagnostic type**	Module diagnostics
	Coding	0x0043
	LED indication:	Group error (E) red PROFIsafe (G) red
	Remedy	The monitoring time for fail-safe data exchange must be set to a value greater than 0 ms. Correct the F parameterization.
Undervoltage	**Diagnostic type**	Module diagnostics
	Coding	0x0202
	LED indication:	Group error (E) red
	Remedy	The 24V field supply of the F I/O module is below the specified tolerance. Correct the power supply responsible.

9.3 Acknowledging Error Messages

When detecting an error, a message is sent by the PROFIBUS I/O module to the safe PLC. More information about error detection by the F I/O module is available in the section “Diagnosis” > … > “Behavior in the Event of an Error” and in the section “Diagnostics” > … > “Diagnosis of Errors”.

In the F I/O module, passivation of the process data is automatic in the event of error detection. During this process, all digital inputs and outputs of the F I/O module are passivated by outputting the substitute values (failsafe values) instead of actual process values.

To reset the passivation, acknowledgement is required by the user. A call for depassivation of the process data in the F I/O module is displayed by the F-Host with the “Acknowledgement Request” signal. The actual signal designation for the acknowledgement request depends on the manufacturer of the controller.

Two variants are available to carry out the depassivation:

9.3.1 Variant 1: User Acknowledgement via “OA_Req”

For safe PLCs that offer access to the “OA_Req” bit in the PROFIsafe control byte, the “OA_Req” bit can be used by the safe PLC. The acknowledgement request from the error is signaled by the PROFIsafe status display element to the F I/O module. The “OA_Req” bit can be used to reset passivations caused by PROFIsafe communication errors or other errors. The “F_Ack” bit in the output process data should not be used for this variant and should be set to 0 by the safe application. This variant is not supported by all F I/O modules. The figure below provides a schematic representation of this variant for user acknowledgement.

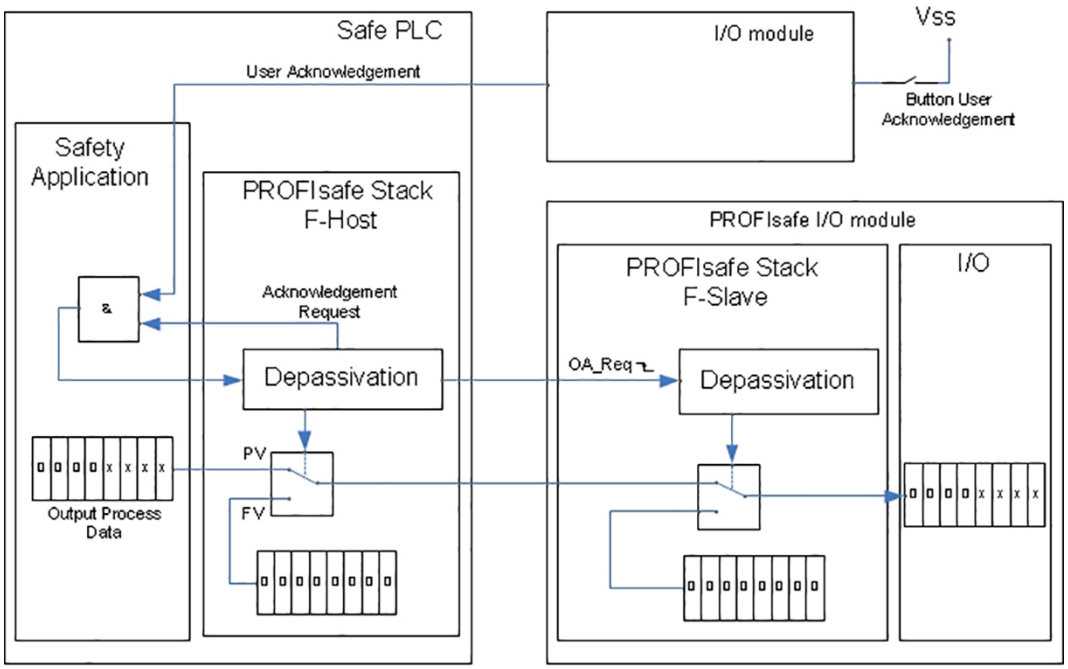


Figure 37: Schematic Representation for User Acknowledgement via “OA_Req”

9.3.2 Variant 2: User Acknowledgement via “OA_Req” and “F_Ack”

For safe PLCs that offer the safe application no access to the “OA_Req”, only PROFIsafe communication errors can be acknowledged via the “OA_Req” bit in the PROFIsafe control byte. To acknowledge other errors, the F I/O module provides an acknowledgement via the “F_Ack” in the output process data.

For this variant, the acknowledgement request is only displayed for PROFIsafe communication errors by the PROFIsafe status display element to the F I/O module. For other errors, the acknowledgement request is not displayed by the PROFIsafe status display element. The acknowledgement request for these errors is only displayed by the group error display element (red) and channel status (red) of the F I/O module.

To acknowledge both PROFIsafe communication errors and other errors with one button, the “User Acknowledgement” signal must affect the “OA_Req” and “F_Ack” bits. The figure below provides a schematic representation of this variant for user acknowledgement.

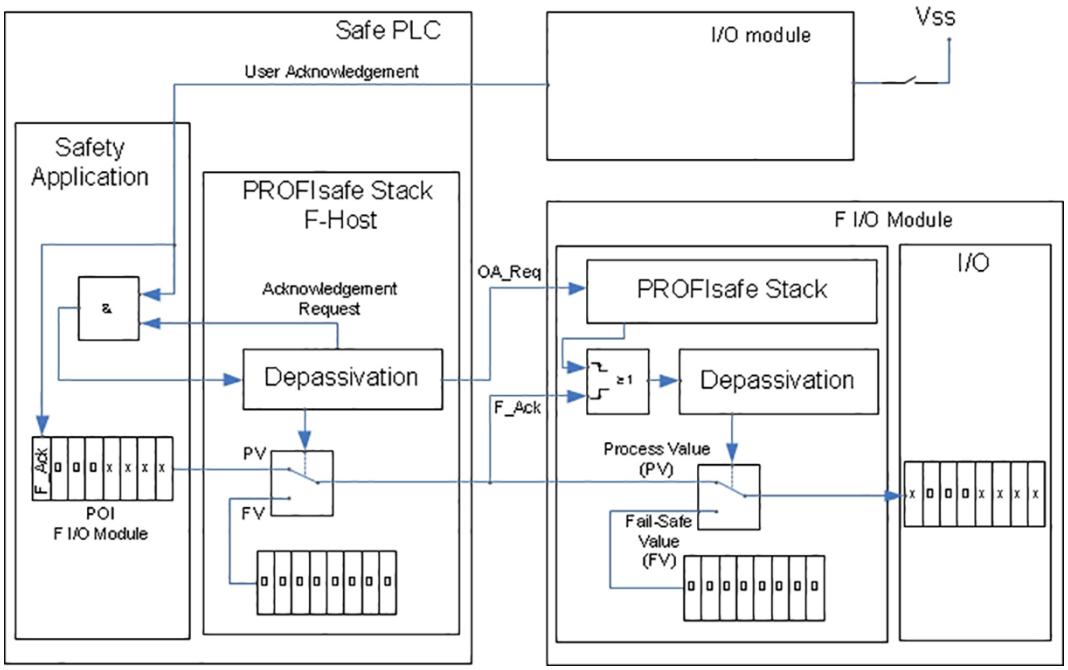


Figure 38: Schematic Representation for User Acknowledgement via “OA_Req” and “F_Ack”

10 Service

10.1 Replacing the F I/O Module

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.

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

10.1.1 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 enter this setting on the replacement module.
- Plug the replacement module into the position of the F I/O module to be replaced in the fieldbus node.
- Switch the power to the affected fieldbus node back on.

Then perform one of the following steps based 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 it is operated with iPar server functionality, continue reading in Section “Service” > … > “PROFIsafe Address Set Using the Coding Switch.”
- If the coding switch of the F I/O module to be replaced is set to 0 and it is operated with iPar server functionality, continue reading in Section “Service” > … > “PROFIsafe Address Set Using the Parameterization Tool.”
- If the coding switch of the F I/O module to be replaced is set to a value other than 0 and it is operated without iPar server functionality, continue reading in Section “Service” > … > “PROFIsafe Address Set Using the Coding Switch.”

- If the coding switch of the F I/O module to be replaced is set to 0 and it is operated without iPar server functionality, continue reading in Section “Service” > … > “PROFIsafe Address Set Using the Parameterization Tool.”

10.1.2 F I/O Module with iPar Server Functionality

10.1.2.1 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 with replacing the F I/O module as follows:

After start-up, the replacement module automatically requests its iParameters 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 “Commissioning” > … > “Parameterization of the F I/O Module with the WAGO Parameterization Tool”).

10.1.2.2 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"). After successfully setting the PROFIsafe address, proceed as follows:

After start-up, the replacement module automatically requests its iParameters 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 “Commissioning” > … > “Parameterization of the F I/O Module with the WAGO Parameterization Tool”).

10.1.3 F I/O Module without iPar Server Functionality

10.1.3.1 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").

10.1.3.2 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 (see Section “Commissioning” > … > “Parameterization of the F I/O Module with 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

Determining the PROFIsafe address when the coding switch is set to "0"!
The PROFIsafe address of the F I/O module to be replaced must be entered in the system documentation.

11 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.

11.1 Marking Configuration Examples

11.1.1 Marking for Europe According to ATEX and IECEx

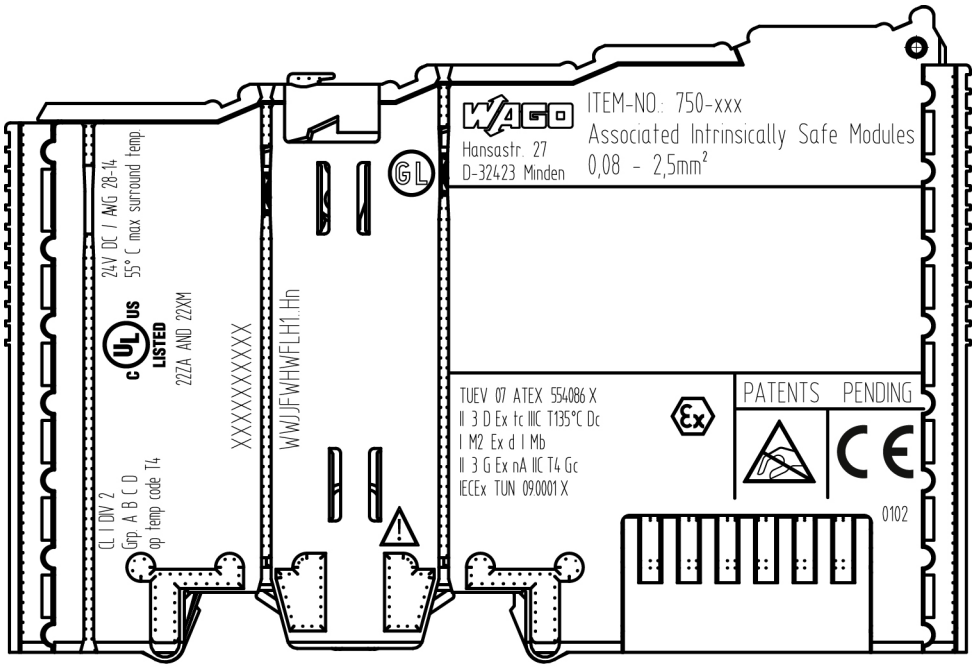


Figure 39: Marking Example According to ATEX and IECEx

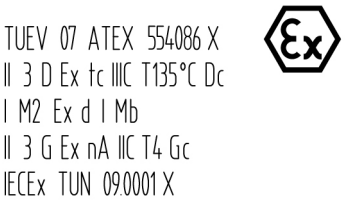


Figure 40: Text Detail – Marking Example According to ATEX and IECEx

Table 45: Description of Marking Example According to ATEX and IECEx

Marking	Description
TUEV 07 ATEX 554086 X IECEx TUN 09.0001 X	Approving authority resp. certificate numbers
Dust	
II	Equipment group: All except mining
3 D	Category 3 (Zone 22)
Ex	Explosion protection mark
tc	Type of protection: Protection by enclosure
IIIC	Explosion group of dust
T135°C	Max. surface temperature of the enclosure (without a dust layer)
Dc	Equipment protection level (EPL)
Mining	
I	Equipment group: Mining
M2	Category: High level of protection
Ex	Explosion protection mark
d	Type of protection: Flameproof enclosure
I	Explosion group for electrical equipment for mines susceptible to firedamp
Mb	Equipment protection level (EPL)
Gases	
II	Equipment group: All except mining
3 G	Category 3 (Zone 2)
Ex	Explosion protection mark
nA	Type of protection: Non-sparking equipment
IIC	Explosion group of gas and vapours
T4	Temperature class: Max. surface temperature 135 °C
Gc	Equipment protection level (EPL)

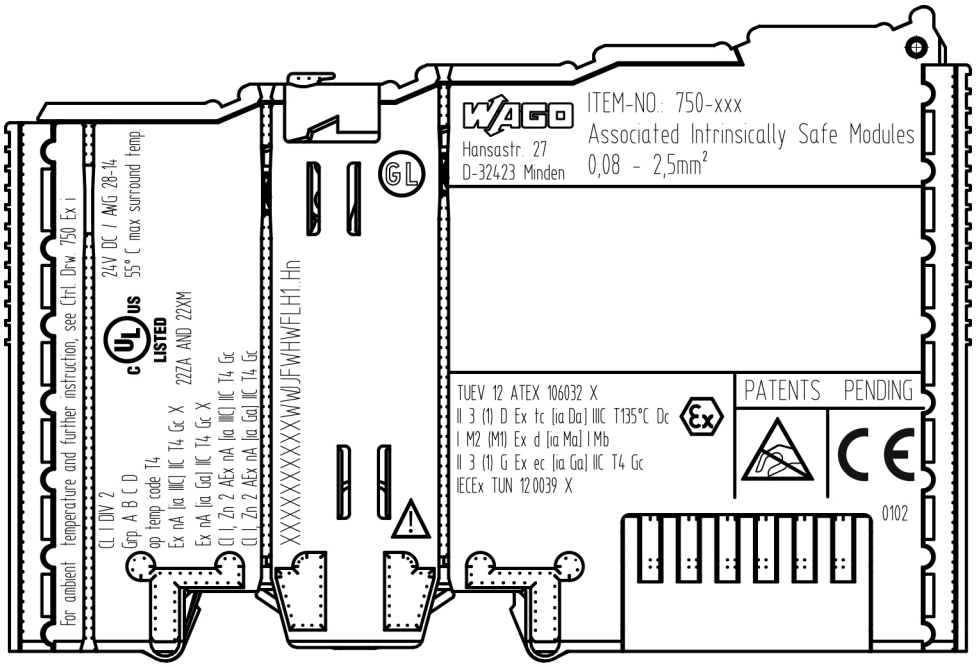


Figure 41: Marking Example for Approved I/O Module Ex i According to ATEX and IECEx

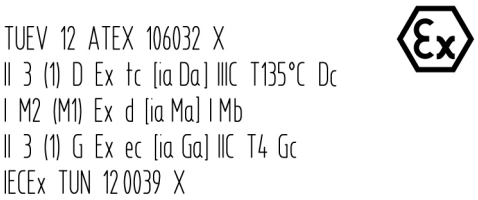


Figure 42: Text Detail – Marking Example for Approved I/O ModuleEx i According to ATEX and IECEx

Table 46: Description of Marking Example for Approved I/O Module Ex I According to ATEX and IECEx

Marking	Description
TUEV 12 ATEX 106032 X IECEx TUN 12 0039 X	Approving authority resp. certificate numbers
Dust	
II	Equipment group: All except mining
3 (1) D	Category 3 (Zone 22) equipment containing a safety device for a category 1 (Zone 20) equipment
Ex	Explosion protection mark
tc	Type of protection: Protection by enclosure
[ia Da]	Type of protection and equipment protection level (EPL): Associated apparatus with intrinsic safety circuits for use in Zone 20
IIIC	Explosion group of dust
T135°C	Max. surface temperature of the enclosure (without a dust layer)
Dc	Equipment protection level (EPL)
Mining	
I	Equipment Group: Mining
M2 (M1)	Category: High level of protection with electrical circuits which present a very high level of protection
Ex	Explosion protection mark
d	Type of protection: Flameproof enclosure
[ia Ma]	Type of protection and equipment protection level (EPL): Associated apparatus with intrinsic safety electrical circuits
I	Explosion group for electrical equipment for mines susceptible to firedamp
Mb	Equipment protection level (EPL)
Gases	
II	Equipment group: All except mining
3 (1) G	Category 3 (Zone 2) equipment containing a safety device for a category 1 (Zone 0) equipment
Ex	Explosion protection mark
ec	Equipment protection by increased safety “e”
[ia Ga]	Type of protection and equipment protection level (EPL): Associated apparatus with intrinsic safety circuits for use in Zone 0
IIC	Explosion group of gas and vapours
T4	Temperature class: Max. surface temperature 135 °C
Gc	Equipment protection level (EPL)

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

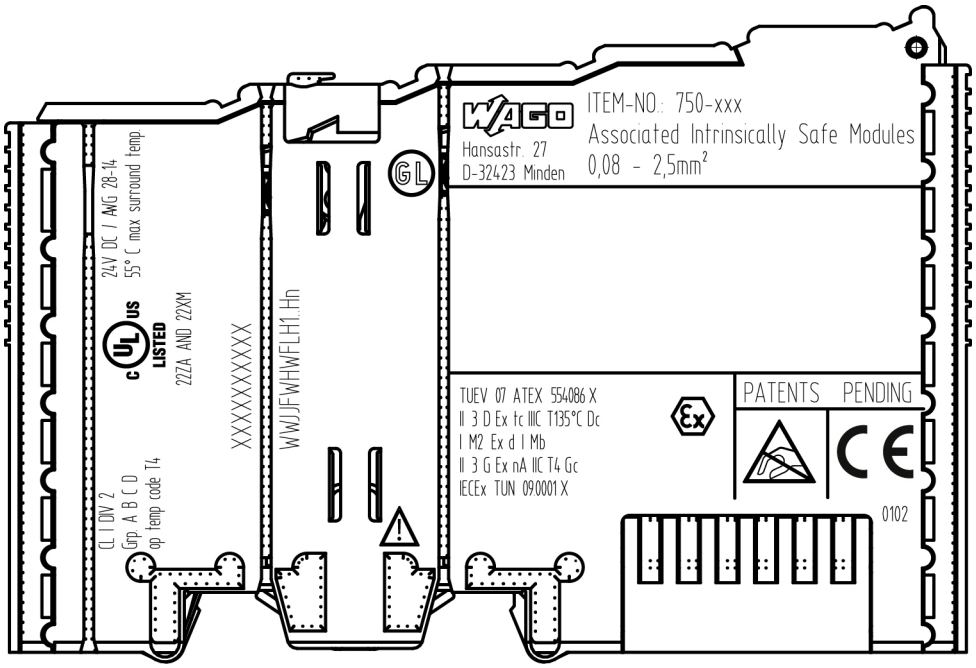


Figure 43: Marking Example According to NEC

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

Figure 44: Text Detail – Marking Example According to NEC 500

Table 47: 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 45: Text Detail – Marking Example for Approved I/O Module Ex i According to NEC 505

Table 48: 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 46: Text Detail – Marking Example for Approved I/O Module Ex i According to NEC 506

Table 49: 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 47: Text Detail – Marking Example for Approved I/O Module Ex i According to CEC 18 attachment J

Table 50: 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

11.2 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.

11.2.1 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.

11.2.2 Special Notes Regarding ANSI/ISA Ex

For ANSI/ISA Ex 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.

12 Appendix

12.1 Overview of PROFIsafe F Parameters

Table 51: PROFIsafe F Parameters

F Parameters	Default Value	Description	
F_Check_SeqNr	No Check	When in PROFIsafe V1 mode, the **F_Check_SeqNr** parameter determines whether the consecutive number of the PROFIsafe telegrams should be included in the consistency check (CRC 2 calculation) of the PROFIsafe telegram. Because the available safe PLC controllers only support “No Check”, this parameter must be set accordingly. When in PROFIsafe V2 mode, the parameter has no effect.	
F_Check_iPar	NoCheck	When in PROFIsafe V1 mode, this parameter only determines whether the CRC 3 should go into calculating CRC 1 as the starting value. CRC 1 is the CRC above the F parameter. CRC 3 is the CRC above the individual Parameter. When in PROFIsafe V2 mode, the meaning of this parameter changes and has a manufacturer-specific meaning. For the F I/O-Module, this value is always set to “NoCheck”.	
F_SIL	SIL3	The **F_SIL** parameter specifies the required safety integrity class of the F I/O-Module. The F I/O-Module support 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_Par_Version	F_CRC_Length
		PROFIsafe V1 mode	2-byte CRC
		PROFIsafe V2 mode	3-byte CRC

Table 51: PROFIsafe F Parameters

F Parameters	Default Value	Description	
F_Block_ID	0 / 1	The **F_Block_ID** parameter specifies the format of the F parameter set. If F_Block_ID has the value “0”, the F_iPar_CRC parameter is not included in the F parameters and the iPar server is not used. If F_BLOCK_ID has the value “1”, the F_iPar_CRC parameter is included in the F parameters and the F I/O-module can use the iPar server. The F I/O-module supports both formats. To set this parameter, the correct F I/O-module must be selected for device configuration with the configuration tool of the safe PLC:	
		F_Block_ID	Module designation
		0	75x-667 4FDI/4FDO 24V/2.0A DC
		1	75x-667 4FDI/4FDO iPar-Server
F_Par_Version	V2 mode	The **F_Par_Version** parameter specifies the PROFIsafe version to be used communication. The F I/O-module supports PROFIsafe V1 mode and PROFIsafe V2 mode and use the version specified with this parameter:	
		F_Par_Version	Version
		V1 mode	PROFIsafe V1 mode
		V2 mode	PROFIsafe V2 mode
F_Source_Add	– *)	The **F_Source_Add** parameter specifies the PROFIsafe source address. To prevent incorrect parameterization, the address of the configuration tool is automatically assigned and cannot be changed. The parameter can accept values from 1 … 65534.	

Table 51: PROFIsafe F Parameters

F Parameters	Default Value	Description
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 … 65534 can be selected. Each address value may appear in the system only once. This is checked by the configuration tool of the safe PLC. For PROFIsafe communication to begin, the parameter value must match the PROFIsafe address of the F I/O-module.
F_WD_Time	150	The **F_WD_Time** parameter determines the monitoring time for PROFIsafe communication between F controller and PROFIbus 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, so that telegram execution times are tolerated, but an interruption in the connection is detected quickly enough. The monitoring time can be specified in steps of 1 ms. The possible value range (50 … 10000 ms) is specified by the WAGO device description file (GSD/GDML).

Table 51: PROFIsafe F Parameters

F Parameters	Default Value	Description
F_iPar_CRC	12668 (0x317C)	The **F_iPar_CRC** is only available when F_Block_ID = 1 and specifies a comparison value for the CRC value via the individual Parameter (iPar_CRC). The PROFIsafe data exchange only starts when the values for F_iPar_CRC and der iPar_CRC match. If they differ, the F I/O-module makes a restore request of the individual Parameter from the iPar server. The F_iPar_CRC value “0” holds special standing. This value switches the PROFIbus 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 parameter of the F I/O-module.

*) is assigned by the configuration tool

12.2 PROFIsafe Certificates

Information

PROFIsafe Certificates
A list of PROFIsafe certificates and PDFs of the certificates are available on the "AUTOMATION Tools and Docs" DVD-ROM (Art. No.: 0888-0412) or on the Internet at: http://www.wago.com.

13 Glossary

A

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

Actuator
Final controlling element, valve, signal lamps, relays, motor contactor with positively driven contacts (see also “Positively Driven 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 Kontakttechnik GmbH & CO. KG.

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

Configuration Program
The configuration program is used to configure hardware and to create the safety program of the safe PLC.

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 75x 2.x”.

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

Cross Circuit
A practically unopposed conductive connection between two live electrical lines (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 complete the required function (see also “Failure”).

DC (Diagnostic Coverage)
The 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 EN 60947-5-1 describes the making and breaking capacity for switching elements to apply an electromagnetic load.

Default Individual Parameter Set
A data set persistently stored in the F I/O module with default values that correspond to the individual parameter set in the delivery condition of the F I/O module

Diagnostic Coverage Level
See “DC (Diagnostic Coverage)”

Discrepancy Time
The discrepancy time specifies the maximum permissible duration of unequal states of two signals.
See also “Discrepancy Time Monitoring”

Discrepancy Time Monitoring
Discrepancy time monitoring is performed by the F I/O module when using the two-channel analysis 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

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

F

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

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

FE (functional earth)
The FE functional earth is not the same as protective earth (PE) according to VDE 0100 and is only used as an EMC ground connector.

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

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 directly or over a period of time.

I

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

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

M

Miniature WSB
The miniature WSB marking accessories is a quick marking system (item No. 247-xxx) for WAGO connectors and I/O 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))”

Output monitoring
The F I/O module checks the voltage on the output signal line against an expected value.

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

P

Passivate, passivation
Passivation of safe digital inputs or power outputs is performed automatically by the F I/O module after activation or detection of errors. Operator acknowledgement is required after passivation, so that the F I/O module can start.

PE (Protective Earth)
The PE is connected to the ground connector according to EN 60204-1 and is used as fundamental protection against electric shock when touched indirectly. It is also used to reduce the effect of electrical interference on electrical equipment that affect 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 error.

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

Positively driven contacts, positively driven relays
Positively driven contacts or positively driven operation means that break contacts and make contacts can never be opened or closed at the same time in a contact system. 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 positively driving contacts are normative elementary relays 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”).

PROFIsafe
Safety-oriented data communication via the standard PROFIBUS or PROFINET (black channel). A distinction is made between V1 mode and V2 mode.

PROFIsafe V1 Mode acc. IEC 61784-3-3
PROFIsafe V1 Mode – Services and protocols of the safety-oriented PROFIsafe communication profile according to PROFIBUS Guideline: PROFIsafe – Profile for Safety Technology, V1.30, June 2004.

PROFIsafe V2 Mode acc. IEC 61784-3-3
PROFIsafe V2 Mode – Services and protocols of the safety-oriented PROFIsafe communication profile according to PROFIBUS Guideline: PROFIsafe – Profile for Safety Technology, 2.4, March 2007.

PROFIsafe Address
Address that must be assigned to a safe device with PROFIsafe data communication, so that data communication can be established between a PROFIsafe master and a PROFIsafe slave.

Proof Test
Proof test or recurring test that is performed to discover failures in a safety-related system, so that the system can be brought to a "like-new state" or as close as possible to this state from a practical perspective.

Proof Test Interval
The proof test interval is the time until testing the safety function / safety device is required.

Protected Installation
The goal of the protected installation of lines is, for example, operational reliability and protection against vagabond 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.

R

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

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

Restart Barrier
A restart barrier is a means of preventing hazardous machine operation from starting automatically after one or more of the following events:
- Triggering of a safety function
- Changing of the operating mode of the machine
- Changing of the means for staring the machine

Risk Reduction
The required risk reduction is the result of a risk assessment that is used to take measures to lower the risk of a security system to an acceptable residual risk.

S

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

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

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

Short Circuit
A practically unopposed conductive connection between two live electrical lines (see also “Cross Circuit”).

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

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 an error occurs, the required safety function is still ensured. In other words, an error does not lead to the loss of the safety function.

T

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 starting up 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 and power outputs are passivated during test mode and the F I/O module outputs the substitute values (failsafe values) instead of actual process values to the controller. According to the PROFIsafe specification, the test mode is indicated visually by 2 Hz flashing of the parameterization LED (LED H) in green on the F I/O module.

U

User acknowledgement (Operator Acknowledge (OA))
Prompt for user acknowledgement (operator acknowledgement) that evokes start-up of a machine or system.. User acknowledgement is necessary for the F I/O module, for example, after detecting errors by the F I/O module and their resolution by maintenance personnel and is initiated from the control level.

V

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

W

WAGO Parameterization Tool
The WAGO parameterization tool is required to configure the F I/O module. This refers to the WAGO-I/O-*CHECK* 3.x and WAGO Safety Editor 75x 2.x manufacturer tools (see also “WAGO-I/O-*CHECK*”).

WAGO Safety Editor 75x 2.x
The WAGO Safety Editor (SEDI) 75x 2.x is required together with the WAGO-I/O-*CHECK* 3.x to configure the F I/O module. SEDI is the CPD tool for WAGO F I/O modules (see also “CPD Tool (Configuration Parametrization and Diagnosis Tool)”).

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* 3.x and WAGO Safety Editor 75x 2.x are required (see also “WAGO Parameterization Tool”).

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