

**WAGO → I/O → SYSTEM 750**

**Safety I/O Modules PROFIsafe**

**8FDI 24V DC PROFIsafe  
750-660/000-001**



**Manual**

Version 1.0.0

Valid from SW / HW Version XXXX0101... and up

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Every conceivable measure has been taken to ensure the correctness and completeness of this documentation. However, as errors can never be fully excluded, we would appreciate any information or ideas at any time.

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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 trademark or patent protected.

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# 1 Important Comments

To ensure fast installation and start-up of the units described in this manual, we strongly recommend that the following information and explanations are carefully read and abided by.

## 1.1 Legal Principles

### 1.1.1 Copyright

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### 1.1.2 Personnel Qualification

The use of the product detailed in this manual is exclusively geared to specialists having qualifications in PLC programming, electrical specialists or persons instructed by electrical specialists who are also familiar with the valid standards.



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#### Caution

Adding, exchanging and starting-up PROFIsafe modules shall only be carried out by personnel trained in safety-related procedures!

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WAGO Kontakttechnik GmbH & Co. KG declines all liability resulting from improper action and damage to WAGO products and third party products due to non-observance of the information contained in this manual.

### 1.1.3 Intended Use

For each individual application, the components supplied are to work with a dedicated hardware and software configuration. Modifications are only permitted within the framework of the possibilities documented in the manuals. All other changes to the hardware and/or software and the non-conforming use of the components entail the exclusion of liability on part of WAGO Kontakttechnik GmbH & Co. KG.

Please direct any requirements pertaining to a modified and/or new hardware or software configuration directly to WAGO Kontakttechnik GmbH & Co. KG.

## 1.2 Symbols



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**Danger**

Always abide by this information to protect persons from injury.

---



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**Warning**

Always abide by this information to prevent damage to the device.

---



---

**Attention**

Marginal conditions must always be observed to ensure smooth operation.

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**ESD (Electrostatic Discharge)**

Warning of damage to the components by electrostatic discharge. Observe the precautionary measure for handling components at risk.

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**Note**

Routines or advice for efficient use of the device and software optimization.

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**More information**

References on additional literature, manuals, data sheets and INTERNET pages

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## 1.3 Number Notation

Number Code	Example	Note
Decimal	100	normal notation
Hexadecimal	0x64	C notation
Binary	'100' '0110.0100'	Within ' Nibble separated with dots

## 1.4 Safety Notes



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### Attention

Switch off the system prior to working on bus modules!

In the event of deformed contacts, the module in question is to be replaced, as its functionality can no longer be ensured on a long-term basis.

The components are not resistant against materials having seeping and insulating properties. Belonging to this group of materials is: e.g. aerosols, silicones, triglycerides (found in some hand creams).

If it cannot be ruled out that these materials appear in the component environment, then additional measures are to be taken:

- installation of the components into an appropriate enclosure
  - handling of the components only with clean tools and materials.
- 



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### Attention

Cleaning of soiled contacts may only be done with ethyl alcohol and leather cloths. Thereby, the ESD information is to be regarded.

Do not use any contact spray. The spray may impair the functioning of the contact area.

The WAGO-I/O-SYSTEM 750 and its components are an open system. It must only be assembled in housings, cabinets or in electrical operation rooms. Access must only be given via a key or tool to authorized qualified personnel.

The relevant valid and applicable standards and guidelines concerning the installation of switch boxes are to be observed.

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### ESD (Electrostatic Discharge)

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

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## 1.5 Scope

This manual describes the Special Module 750-660/000-001 8FDI 24V DC PROFIsafe of the modular WAGO-I/O-SYSTEM 750.

Handling, assembly and start-up are described in the manual of the Fieldbus Coupler. Therefore this documentation is valid only in the connection with the appropriate manual.

## 2 PROFIsafe

Modules equipped with safety related inputs and outputs have been developed for the WAGO-I/O-SYSTEM 750, without radical changes to the existing 750 Series system. This way, mixed operation of safety related and non safety related modules is made possible.

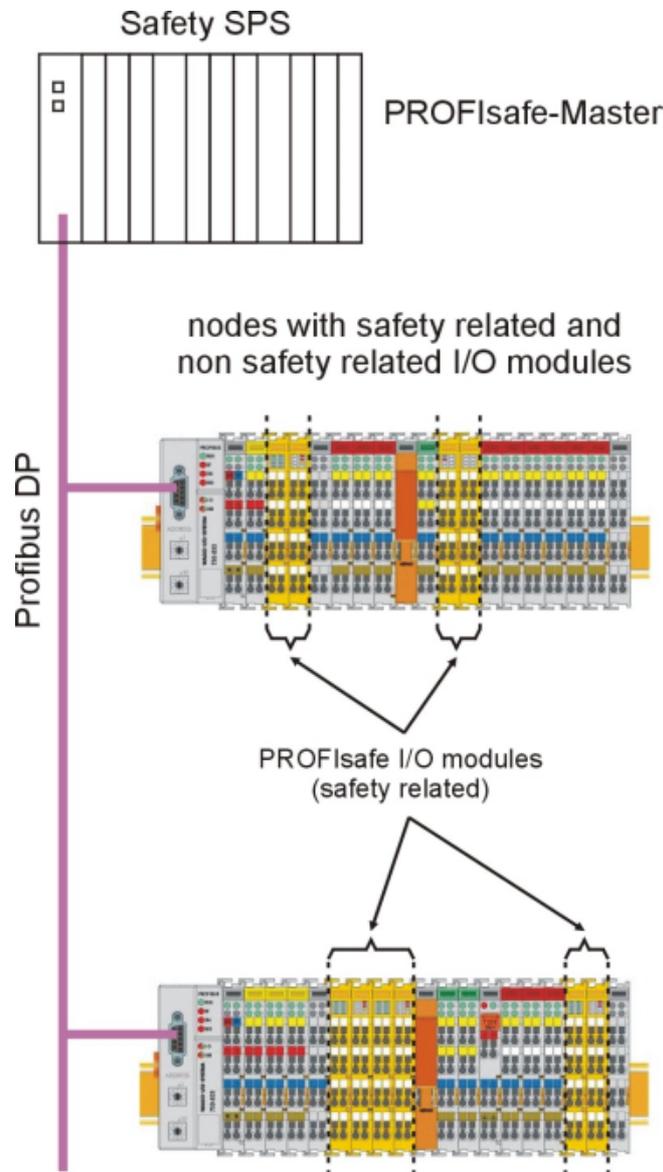


Fig. 2-1: Mixed operation of safety related and non safety related modules

g066014e

A fail-safe PLC (PROFIsafe master) with PROFIBUS interface is used as control unit. Data exchange between the safety input and output modules as well as the control unit is done via PROFIBUS as a physical basis and the PROFIsafe protocol.

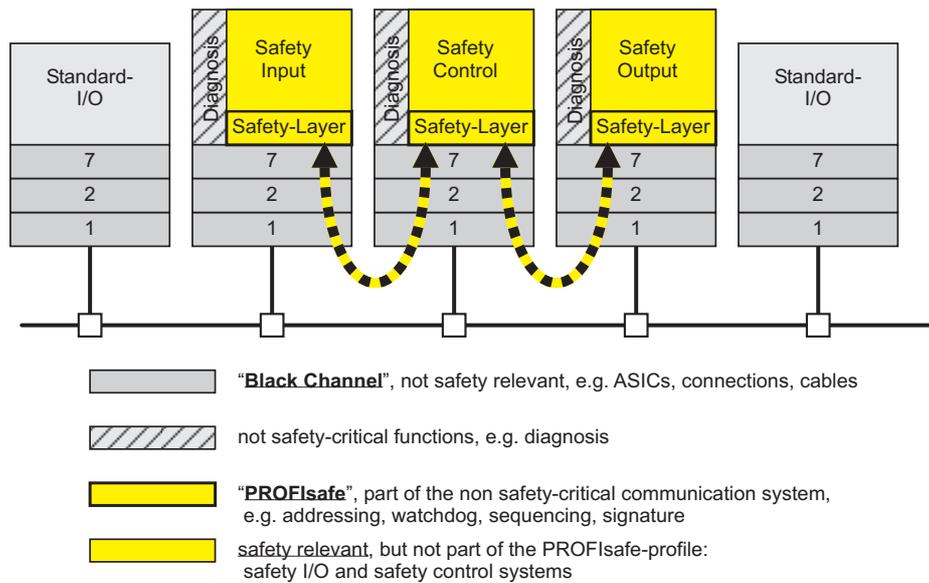


Fig. 2-2: PROFIsafe layer model

g066013e

The safety protocol is sent through the so called "black channel" from the safety PLC to the safety input or output modules. The "black channel" extends from the PROFIBUS connection of the PLC through the coupler / controller, the K-Bus in the node up to the I/O module where the protocol is then unpacked.

When communication errors are detected, the safety I/O modules go into the fail-safe mode, i.e. the outputs are turned off and the input bits are set to "0".

The analysis of the input information as well as the output of safe information via the output modules is governed by the control layer.

The configuration of the modules is done via the GSD file according to the V4 GSD specification.

The PROFIsafe address of a safety I/O module is defined by the configuration tool of the safety control unit and can be changed if required. This address must then be set using the address switch of the appropriate I/O module.



**Note**

The following regulations and notes must be observed when realizing PROFIsafe applications:

**Guideline PROFIsafe - Requirements for Installation, Immunity and electrical Safety, Version 1.1, June 2004, Order No: 2.232**

[http://www.profibus.com/imperia/md/content/pisc/documentationfree/PROFIsafe-Environments\\_2.232\\_v11\\_Jun04.pdf](http://www.profibus.com/imperia/md/content/pisc/documentationfree/PROFIsafe-Environments_2.232_v11_Jun04.pdf)

**Recommendation for Cabling and Assembly, Version 1.0.2, June 2005, Order No: 8.022**

[http://www.profibus.com/imperia/md/content/pisc/documentationfree/Recommendation\\_Assembling\\_8022\\_V102\\_Jun05\\_72DPI.pdf](http://www.profibus.com/imperia/md/content/pisc/documentationfree/Recommendation_Assembling_8022_V102_Jun05_72DPI.pdf)

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## 3 I/O Modules

### 3.1 Safety I/O Modules PROFIsafe

#### 3.1.1 750-660/000-001 [8FDI 24V DC PROFIsafe]

8-channel digital input PROFIsafe module

##### 3.1.1.1 View

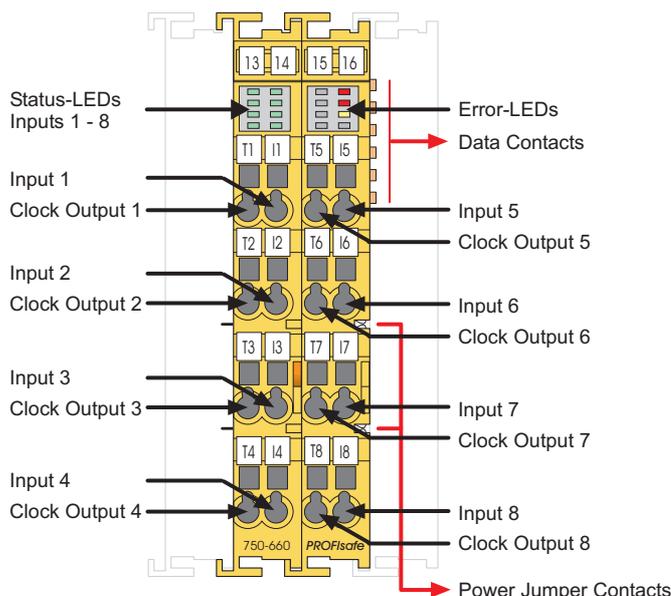


Fig. 3.1.1-1: View

g066000e

##### 3.1.1.2 Description

Using the PROFIsafe modules from the WAGO-I/O-SYSTEM 750, safety applications are possible up to CAT. 4 acc. to EN 954-1 or SIL 3 acc. to the IEC 61508 base standard.

Safety-related potential-free emergency stop buttons, safety interlock switches, operating mode switches, and other safety sensors with contacts can be operated with the PROFIsafe input module 750-660/000-001 (cf. section 3.1.1.8, "Connection Examples").

The modules have 8 clock sensitive inputs (I1 ... I8) that are fed by 8 differently clocked outputs (T1 ... T8).

The inputs are directly assigned to the clock outputs (I1 – T1, ... , I8 – T8). The clocks of the clock outputs differ in phase. This way, several sensors can be wired in the same cable.

The inputs are continually monitored. The following failures may be identified for the inputs I1 ... I8:

- Crossed connection (e.g. T2 is connected to I3)
- Short circuit of an input to +24 V DC

A short circuit of an input to 0 V will be identified as open input ("0").

The clock outputs are short circuit proof.

The signal states of the input channels as well as the errors are indicated via LEDs. The meaning of the LEDs is described in section 3.1.1.3, "Indicators".

The PROFIsafe address can be set using the code switch located on the side.

Field and system levels are electrically isolated.

The individual output modules can be arranged in any combination when configuring the fieldbus node. An arrangement in groups is not necessary.



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**Attention**

A node containing PROFIsafe components shall only be supplied using a filtered voltage. Make sure that the cable length between the filter module with surge suppression and the node is kept as short as possible. Only power supplies with protective extra-low voltage (PELV/SELV) shall be used for the 24 V DC power supply. You will find information on voltage and power supply in section 3.1.2.1, „Power Supply Concept“.

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The input module receives the 24 V DC supply voltage for the field level via an upstream I/O module or a supply module. Power connections are made automatically from module to module via the internal power jumper contacts when snapped onto the DIN rail.



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**Caution**

The maximum current that is permitted to flow through the power jumper contacts is 10 A. When configuring the system, the total current shall not be exceeded. If this should happen, an additional supply module has to be used.

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The module 750-660/000-001 can be operated with the PROFIBUS coupler 750-333, the PROFIBUS-ECO coupler 750-343 as well as with the PROFIBUS controller 750-833 from the WAGO-I/O-SYSTEM 750.

This description is valid from the hardware and software version XXXX0101... and up. The version is specified in the manufacturing number, which is part of the lateral marking on the module.

3.1.1.3 Indicators

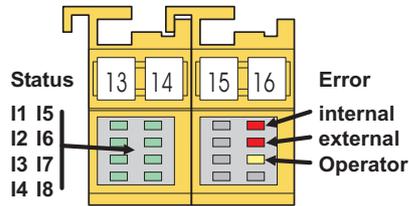


Fig. 3.1.1-2: Indicators g066002e

LED	Name	State	Function
green	Status I1	off	Input I1: signal voltage (0)
		on	Input I1: signal voltage (1)
green	Status I2	off	Input I2: signal voltage (0)
		on	Input I2: signal voltage (1)
green	Status I3	off	Input I3: signal voltage (0)
		on	Input I3: signal voltage (1)
green	Status I4	off	Input I4: signal voltage (0)
		on	Input I4: signal voltage (1)
green	Status I5	off	Input I5: signal voltage (0)
		on	Input I5: signal voltage (1)
green	Status I6	off	Input I6: signal voltage (0)
		on	Input I6: signal voltage (1)
green	Status I7	off	Input I7: signal voltage (0)
		on	Input I7: signal voltage (1)
green	Status I8	off	Input I8: signal voltage (0)
		on	Input I8: signal voltage (1)
red	Internal error	off	No error
		on	Internal error (FAILSAFE)
red	External error	off	No error
		on	Fieldside short circuit to +24 V, 0 V or crossed connection
		blinking	PROFIsafe data error
yellow	Operator error (not used)	off	No error
		on	Operator error

### 3.1.1.4 Operating Elements

The PROFIsafe address (cf. section 2, „PROFIsafe“) can be set using the code switch located on the side. This way, the module is clearly identified as PROFIsafe and can be configured using the PROFIsafe software of the higher level control system.

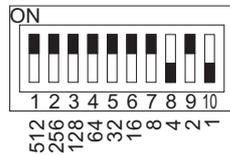


Fig. 3.1.1-3: Code switch PROFIsafe address (set to 1018)

g066016x



#### Attention

The code switch shall only be operated using a suitable device (contact point or watchmaker's screwdriver). In no case, pressure shall be exerted on a switch element by using a blunt tool, for example.

### 3.1.1.5 Schematic Diagrams

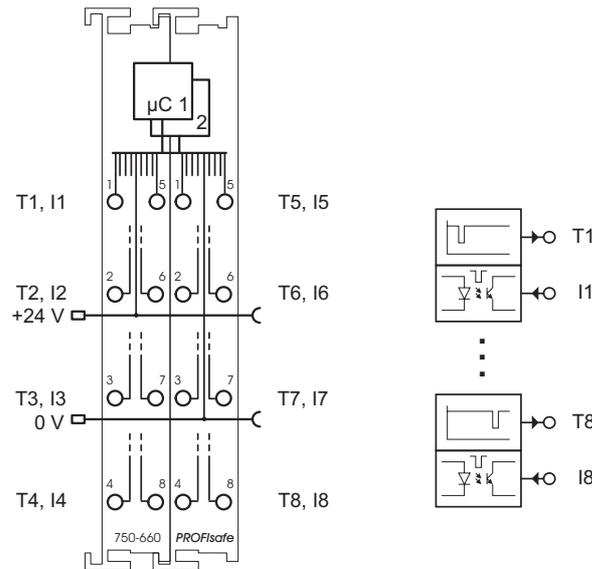


Fig. 3.1.1-4: Schematic Diagram

g066001e

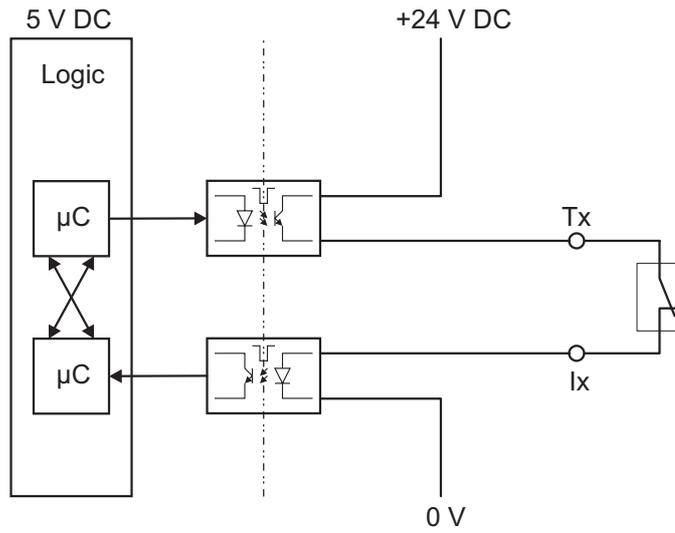


Fig. 3.1.1-5: Input block diagram

g066003e

3.1.1.6 Technical Data

Inputs		
Sensor inputs	I1 ... I8	8 inputs, clock sensitive to T1 ... T8
Achievable safety classes		8 x Cat. 2 or 4 x Cat. 4 acc. to EN 954-1, SIL3 acc. to IEC61508
Input current <sub>min.</sub>		2 mA
Input current <sub>typ.</sub>		2.2 mA
Response times <sub>min. ... max.</sub>	t <sub>on</sub> (L->H) t <sub>off</sub> (H->L)	13 ... 71 ms 13 ... 26 ms plus 2 x internal bus runtime plus 2 x fieldbus runtime plus PLC runtime
Input frequency <sub>max.</sub>		10 Hz
Input pulse length <sub>min.</sub>	Input = H Input = L	71 ms 26 ms
Clock outputs	T1 ... T8	8 outputs, short-circuit protected
Module Specific Data		
Voltage supply		via system voltage internal bus (5 V DC) and power jumper contacts (24 V DC)
Current consumption (system voltage 5 V DC) <sub>approx.</sub>		40 mA
Current consumption (power jumper contacts 24 V DC) <sub>typ.</sub>		20 mA
Voltage via power jumper contacts		24 V DC (20.4 V ... 28.8 V, -15 % ... +20 %)
Current via power jumper contacts <sub>max.</sub>		10 A
Isolation		500 V system voltage / field level (power jumper contacts)
PROFIBUS couplers / controllers that can be used		750-333 from HW 12 and SW 08 750-343 from HW 07 and SW 03 750-833 from HW 12 and SW 08
Number of PROFIsafe modules per node (fieldbus coupler or controller) <sub>max.</sub>		12
PROFIsafe parameters F_Check_SeqNr F_Sil F_WD_Time <sub>min.</sub>		No check / check (depending on PLC) SIL2 / SIL3 150 ms (Values range = 150 ms ... 10000 ms)
Channel diagnostic messages		can be switched on/off for the whole module
Failure probability PFD (low demand mode) (IEC 61508) for one input channel (input up to PROFIBUS) for two input channels (input up to PROFIBUS) for the whole module (8E) (input up to PROFIBUS)		1.38 * 10 <sup>-5</sup> (1.38 % of the whole PFD of 10 <sup>-3</sup> for SIL3) 1.90 * 10 <sup>-5</sup> (1.90 % of the whole PFD of 10 <sup>-3</sup> for SIL3) 5.02 * 10 <sup>-5</sup> (5.02 % of the whole PFD of 10 <sup>-3</sup> for SIL3)

Failure probability PFH (high demand mode) (IEC 61508) for one input channel (input up to PROFIBUS) for two input channels (input up to PROFIBUS) for the whole module (8E) (input up to PROFIBUS)	6.40 * 10 <sup>-10</sup> (0.64 % of the whole PFH of 10 <sup>-7</sup> for SIL3) 7,60 * 10 <sup>-10</sup> (0.76 % of the whole PFH of 10 <sup>-7</sup> for SIL3) 1.47 * 10 <sup>-9</sup> (1.47 % of the whole PFH of 10 <sup>-7</sup> for SIL3)
Hardware fault tolerance (IEC 61508) HFT for single channel application  HFT for two-channel application	0 (an application error may lead to a safety system failure)  1 (an application error does not lead to a safety system failure yet)
Proof test interval	10 years
Dimensions W x H* x D (* from upper edge of DIN 35 rail)	24 mm x 64 mm x 100 mm
Weight	approx. 45 g
<b>Standards and directives (see section 2.2 in manual on coupler / controller)</b>	
Safety application standards	IEC 61508, EN 954-1
<b>Approvals (see section 2.2 in manual on coupler / controller)</b>	
	cUL <sub>US</sub> (UL508)
	TÜV certified for safety operation  up to safety class SIL3 (Safety Integrity Level) acc. to IEC 61508 Category 4 acc. to EN 951-1
	Conformity marking



### Further information

Please refer to the "Overview on WAGO-I/O-SYSTEM 750 approvals" documentation for detailed information on approvals.

You will find it on the CD ROM ELECTRONICC Tools and Docs (Item-No.: 0888-0412/...) or on the Internet under:

[www.wago.com](http://www.wago.com) -> Service / Downloads / Documentation / WAGO-I/O-SYSTEM 750 / System Description /.

### 3.1.1.7 Process Image

The I/O module 750-660/000-001 provides the fieldbus coupler / controller with an 8-byte input and output process image via one logical channel. The safe data will be stored into the 5 input and output bytes (D0 ... D4). One control byte (C) and 1 status byte (S) as well as the register data R0 and R1 are used for diagnostic purposes (see section 3.1.4, „Diagnostics“).



**Note**

Mapping the process data of some I/O modules or their variations into the process image is specific for the fieldbus coupler/controller used. You will find both this information and the specific configuration of the relevant control/status bytes in the section on "Fieldbus Specific Configuration of Process Data" which describes the process image of the particular coupler/controller.

Only the safe data D0 – D4 are transmitted via the fieldbus. The status byte S and the control byte C as well as the register data R0 and R1 are not be transmitted.



**Note**

Only the PROFIBUS coupler 750-333, the PROFIBUS-ECO coupler 750-343 and the programmable PROFIBUS controller 750-833 process the status byte cyclically and generate a diagnostic message to the higher level control system if necessary (see 3.1.4.1, „Diagnostic Signalisation“).

The PROFIBUS coupler 750-333 and the programmable PROFIBUS controller 750-833 can access to the status and control byte as well as to the register data via the acyclical PROFIBUS DPV1 channels (MSAC1/2) and read detailed diagnostic information.

Input data		Output data	
S	Status byte	S	Status byte
R0	Register data (WR) High Byte	R0	Register data (WR) High Byte
R1	Register data (WR) Low Byte	R1	Register data (WR) Low Byte
D0	PROFIsafe inputs	D0	PROFIsafe inputs
D1	PROFIsafe status	D1	PROFIsafe status
D2	PROFIsafe consecutive No.	D2	PROFIsafe consecutive No.
D3	PROFIsafe CRC16 High Byte	D3	PROFIsafe CRC16 High Byte
D4	PROFIsafe CRC16 Low Byte	D4	PROFIsafe CRC16 Low Byte
S, C, R0, R1	Non safe process data (diagnostics, register communication), are not transmitted to the fieldbus		
D0 – D4	Safe process data ( <i>PROFIsafe</i> profile)		

### PROFIsafe Inputs

$2^7$	$2^6$	$2^5$	$2^4$	$2^3$	$2^2$	$2^1$	$2^0$
I8	I7	I6	I5	I4	I3	I2	I1

### PROFIsafe Outputs

$2^7$	$2^6$	$2^5$	$2^4$	$2^3$	$2^2$	$2^1$	$2^0$
unused							

3.1.1.8 Connection Examples

3.1.1.8.1 8 x Emergency Stop, Single Channel, Safety Operation SIL2 / Cat.2

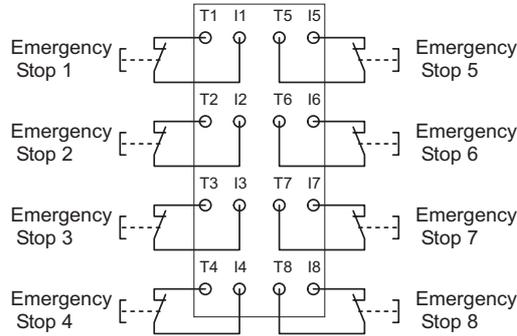


Fig. 3.1.1-6: Connecting 8 x emergency stop, single channel

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3.1.1.8.2 4 x Emergency Stop, Two-Channel, Safety Operation SIL3 / Cat.4

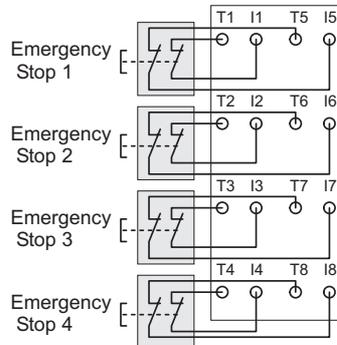


Fig. 3.1.1-7: Connecting 4 x emergency stop, two-channel

g066005e

3.1.1.8.3 2 x ( 4 x ) Interlock Monitoring / Antivalence, Safety Operation SIL3 / Cat.4

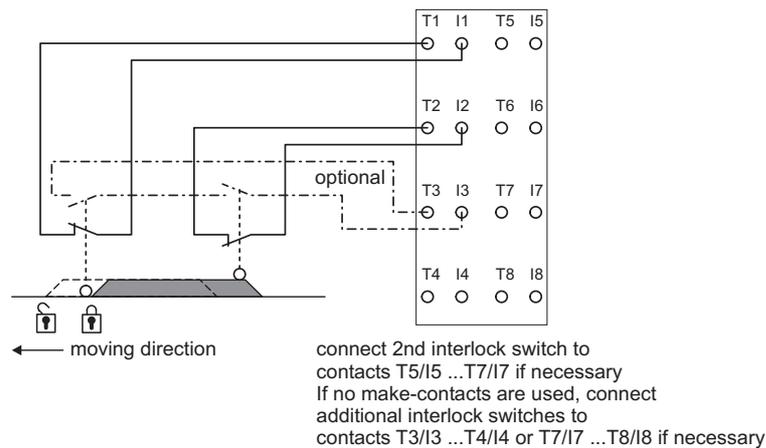
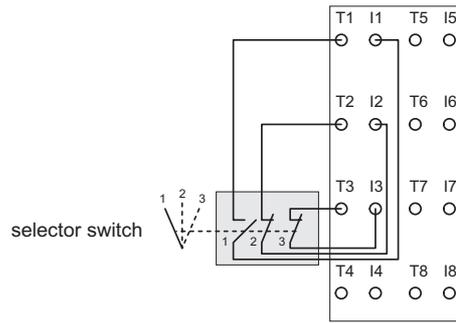


Fig. 3.1.1-8: Connecting interlock monitoring / antivalence

g066006e

### 3.1.1.8.4 2 x 3-Way Selector Switch



connect 2nd selection switch to contacts T5/I5 ... T7/I7 if necessary

Fig. 3.1.1-9: Connecting 3-way selector switch

g066007e

## 3.1.2 Node Configuration

### 3.1.2.1 Power Supply Concept

When using PROFIsafe modules, only power supplies with protective extra-low voltage (PELV/SELV) shall be used for the 24 V DC power supply. This is also valid for the system supply terminations of the coupler / controller. Furthermore, the supply voltage must be performed via a 750-626 Series filter module equipped with surge suppression.



#### Attention

A node containing PROFIsafe components shall only be supplied using a filtered voltage. Make sure that the cable length between the filter module with surge suppression and the node is kept as short as possible.

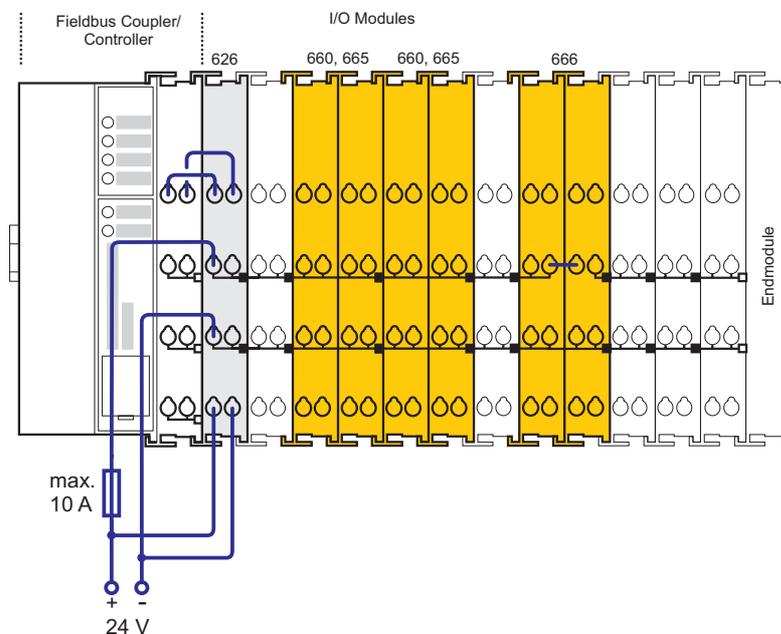


Fig. 3.1.2-1: Power supply for PROFIsafe modules 750-660, -665 and -666 g066010e

The PROFIsafe modules 750-660/000-001, 750-665/000-001 and 750-666/000-001 can be supplied via the power jumper contacts from the 24 V DC field supply of the node, if the power required by the I/O modules via the power jumper contacts of the filter module 750-626 is smaller than 10 A.

If the power required exceeds 10 A, an additional power supply must be provided. This can be realized using the supply modules 750-601 or -610 (with fuse max. 6.3 A).

If a current of more than 6.3 A (maximum 10 A) is required to supply the modules 750-660/000-001, 750-665/000-001 and 750-666/000-001 as well as the upstream output modules, the power supply can be performed via the 750-602 module using an external fuse of max. 10 A.



**Attention**

A 750-624 filter module must be used between the supply module and the PROFIsafe modules to filter the supply voltage.

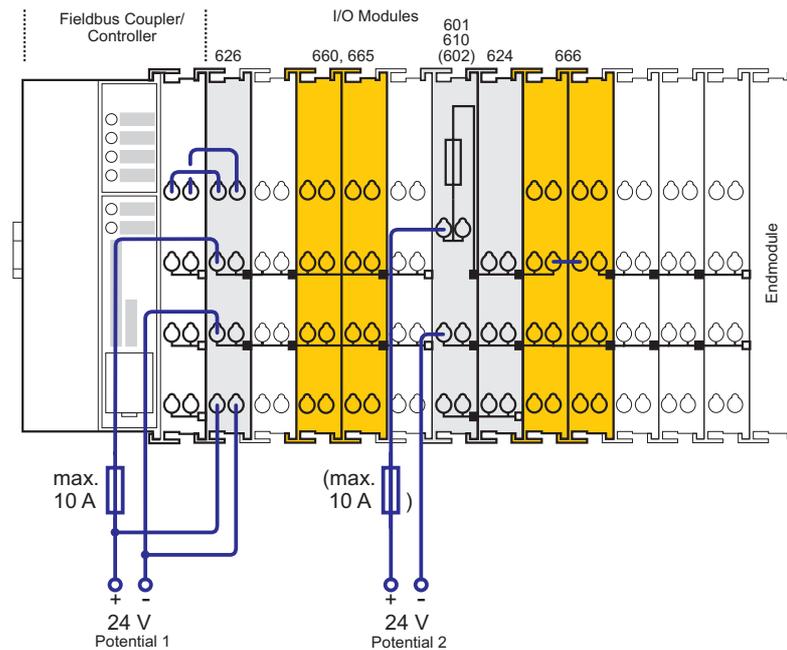


Fig. 3.1.2-2: Additional power supply for the PROFIsafe modules

g066011e



**Attention**

If both filter modules 750-626 and 750-624 are not required, the node must be supplied via an external surge filter with upstream fuse of maximum 10 A.

Each node within the PROFIBUS network, even if it has no PROFIsafe module, must be supplied with a PELV/SELV power supply unit. The whole field wiring of the node must meet the PELV/SELV directives.

If unregulated power supply units for the 24 V DC voltage supply of the WAGO-I/O-SYSTEM are used or if the 24 V DC power supply falls below 20 V for more than 1ms, the modules will surely be switched off. In these cases, the supply voltage must be supported by a capacitor (200 µF per 1 A of load current). To this effect, a back-up capacitor module has been developed for the WAGO-I/O-SYSTEM with a capacity of 10000 µF (Item No. 288-824).

The two following options are available when 230 V AC modules are used together with PROFIsafe modules within a PROFIBUS network:

**1. The 230VAC modules are used in another node that contains no PROFIsafe module:**

Nodes that contain PROFIsafe modules must be supplied using a separate 24 V DC power supply unit with protective extra-low voltage (PELV/SELV). Nodes without PROFIsafe modules must be supplied either with a PELV or a FELV power supply unit with protective earthing.



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**Warning**

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

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The easiest thing to do is to place the fuse directly after the branch supplying the power so that all paths are protected.



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**Caution**

In no case, the PROFIsafe nodes and 230 V AC nodes shall be supplied from one power supply unit.

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**2. Both 230 V AC modules and PROFIsafe modules can be mixed on the same node:**

The voltage for the 230 V AC modules must be supplied using an isolation transformer (basic isolation). -Double basic isolation must absolutely be considered between adjacent 230 V AC and 24 V DC modules (separation modules must be used if required).

### 3.1.3 Start-Up and Service Notes



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#### Caution

Adding, exchanging and starting-up PROFIsafe modules shall only be carried out by personnel trained in safety-related procedures!

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#### 3.1.3.1 Proof Test

After final testing has been performed by the manufacturer, the date that the final test was carried out is applied to each PROFIsafe module. From that point on, a proof test must be performed before expiry of the proof test interval. The proof test interval is indicated in the technical data of the relevant module.

The proof test must at least fulfil the following requirements:

- all inputs and outputs must be tested
- the related LEDs must be tested
- dynamic test must be performed, so that at least one change of state must be observed

#### 3.1.3.2 Adding or Exchanging Components

When PROFIsafe modules are added to a fieldbus node or exchanged, an additional test must be performed before the safety function can be started up.

## 3.1.4 Diagnostics

### 3.1.4.1 Diagnostic Signalisation

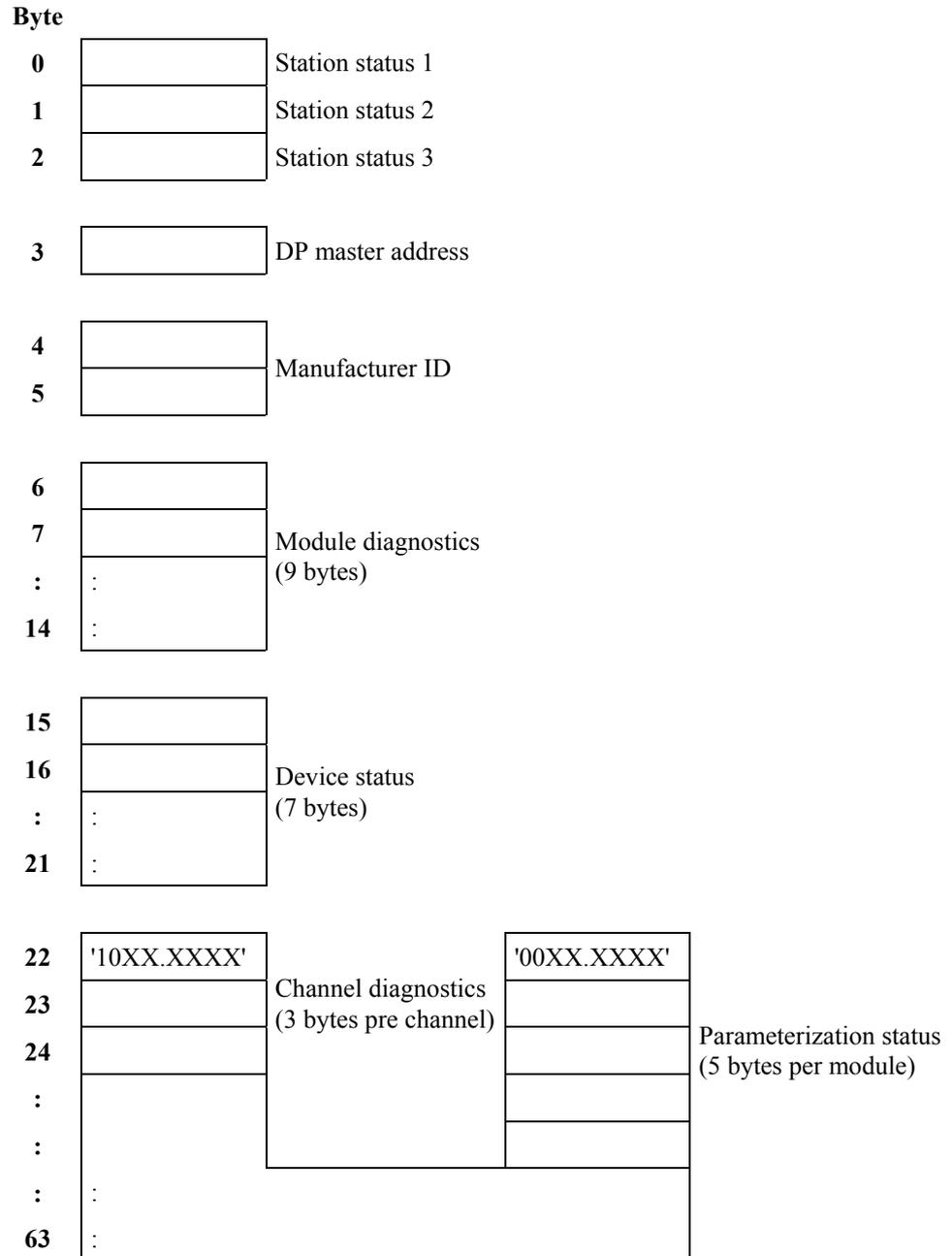
In the cyclical data exchange of the PROFIsafe I/O modules, the K-bus status byte is used to indicate diagnostic events, for example.

The status information, which is not visible to the control system, is analysed internally by the 750-333 PROFIBUS coupler, 750-343 PROFIBUS-ECO coupler and 750-833 programmable PROFIBUS controller 750-833 on a cyclical basis. Once the diagnostic release on the module parameterization has been performed, a diagnostic message is generated by these components to the higher-level control system in the event of failure. The diagnostic message is generated both for incoming and outgoing failure events and contains a module and channel specific entry for the PROFIsafe I/O modules. The channel specific message provides both information on the type of failure (module or channel related failure) and on the signal channel affected by a channel related failure. A differentiation between different channel failures is not possible via the channel specific diagnostic procedure.

However, with 750-333 and 750-833 DPV1 devices, reference can be made via the type of signal and the signal channel to a data set containing detailed information on the failure. Access to the relevant data set is done via an acyclical read access (MSAC1/2-Read) by stating the appropriate data set number.

### 3.1.4.2 Diagnostic Structure

The diagnostic structure according to DP/DPV1 is divided into a static and a variable part. The static part consists of a 6-byte standard diagnostic, a 9-byte module diagnostic (identifier or slot related diagnostic), and 7-byte device status (status according to DPV1 extensions). The static part is followed by a variable part, which can contain 3-byte channel based diagnostic messages as well as 5-byte parameterization stati (status messages according to DPV1 extensions). The whole diagnostic block has a variable length of minimum 22 bytes and maximum 64 bytes.



If other diagnostic events are pending that cannot be entered due to the maximum buffer size of 64 bytes, the PROFIBUS coupler/controller will indicate this state by setting the flag to "diagnose overflow", which is part of the 6-byte standard diagnostic (see manual 750-333/833).

### 3.1.4.2.1 Module Diagnostics

The way the detail diagnostic of a module is arranged (channel based or parameterization status) depends on its position within the I/O module assembly or within the configuration list. The information whether a module provides detail diagnostic or not, is provided from the slot-related diagnostic field (module diagnostic). Depending on the configuration module, a flag is available in the diagnostic field that indicates the pending of a diagnostic event in set state (TRUE, 1) and the presence of at least one detail diagnostic entry in the variable diagnostic area (byte 22 – byte 63) for the appropriate module.

Byte	Information								Signification
6	0	1	0	0	1	0	0	1	Header byte (9-byte module-related diagnostic incl. header)
7	8	7	6	5	4	3	2	1	Module diagnostic assignment: I/O coupler (bit 2 <sup>0</sup> ) I/O modules (bit 2 <sup>n</sup> , n ∈ {1, 2, ... 64 })
8	16	15	14	13	12	11	10	9	
9	24	23	22	21	20	19	18	17	
10	32	31	30	29	28	27	26	25	
11	40	39	38	37	36	35	34	33	
12	48	47	46	45	44	43	42	41	
13	56	55	54	53	52	51	50	49	
14	64	63	62	61	60	59	58	57	

### 3.1.4.2.2 Parameterization Status and Channel Diagnostics

If an event is pending for a module located in the slot-related diagnostic field and provided the module is a PROFIsafe I/O module, then either a parameterization status message or a channel based diagnostic will be available in the detail diagnostic. The bits  $2^6$  and  $2^7$  within byte 22 indicate the different events.

#### 3.1.4.2.2.1 Parameterization Status

The indication of a defective PROFIsafe parameterization only appears when the station (coupler/controller) is running up and has the following data structure:

Byte	Information								Signification
	$2^7$	$2^6$	$2^5$	$2^4$	$2^3$	$2^2$	$2^1$	$2^0$	
22	0	0	0	0	0	1	0	1	Header byte (5-byte status information incl. header)
23	1	0	0	0	0	0	0	1	Type of status = Status indication
24	Position								Position of the PROFIsafe I/O module (values range 2 ... 64)
25	0	0	0	0	0	0	0	0	Status differentiation = none
26	Error number								PROFIsafe status indication (values range 64 ... 71)

The following parameterization errors can be diagnosed:

<b>PROFIsafe diagnostic (register 53)</b>				
<b>Error number</b>		<b>Signification</b>	<b>LED</b>	<b>Remedy</b>
<b>Hex.</b>	<b>Dec.</b>			
0x0040	64	The preset PROFIsafe address does not match the parameterized F_DESTINATION_ADDR address	External error, blinking	Restart the coupler / controller after changing parameters
0x0041	65	Invalid parameterization of F_DESTINATION_ADDR. The 0x0000 and 0xFFFF addresses are not permitted	External error, blinking	Restart the coupler / controller after changing parameters
0x0042	66	Invalid parameterization of F_SOURCE_ADDR. The 0x0000 and 0xFFFF addresses are not permitted	External error, blinking	Restart the coupler / controller after changing parameters
0x0043	67	Invalid parameterization of F_WDG_TIME. A watchdog time of 0 ms is not permitted	External error, blinking	Restart the coupler / controller after changing parameters
0x0044	68	Invalid parameterization of F_SIL. The required SIL class cannot be supported by the F module.	External error, blinking	Restart the coupler / controller after changing parameters
0x0045	69	Invalid parameterization of F_CRC_LENGTH. The required CRC length does not match the one generated by the F module.	External error, blinking	Check parameter telegram
0x0046	70	Version of F_parameter set is invalid. The required version does not match the F module version.	External error, blinking	Check parameter telegram
0x0047	71	The CRC, which was determined by the F module via the PROFIsafe parameters (CRC1), varies from the CRC1 transmitted in the parameterization telegram.	External error, blinking	Check communication line, module is waiting for valid telegrams
0x0048	72	Reserved error numbers that shall not be used or analysed.	---	---
0x0049	73			

### 3.1.4.2.2.2 Channel Diagnostics

A diagnostic event of the PROFIsafe modules in operating mode always results in a channel related diagnostic and, in any case, in the initiation of the FAILSAFE state.

The channel related diagnostic message of a PROFIsafe I/O module indicates both the defective signal channel and its type of signal, and has the following structure:

Byte	Information								Signification
	2 <sup>7</sup>	2 <sup>6</sup>	2 <sup>5</sup>	2 <sup>4</sup>	2 <sup>3</sup>	2 <sup>2</sup>	2 <sup>1</sup>	2 <sup>0</sup>	
22 + n	1	0	Slot						
			Slot 2 ... 64						
			1						Slot 2
			2						Slot 3
			...						
			63						Slot 64
Header channel related diagnostic									
23 + n	Type of signal		Signal channel						
			Signal channel 1 ... 8						
			0						Signal channel 1
			1						Signal channel 2
			...						
			7						Signal channel 8
			Type of signal						
			0	1					Input
			1	0					Output
		1	1					Input/Output	
24 + n	Type of channel		Error number						
			1	1	0	0	0	24 (0x18)	
			0	0	0				No assignment
			0	0	1				1 Bit

n : Offset of the diagnostic message in diagnostic buffer

The error number within the channel related diagnostic structure is always coded with the value 24 (0x18, "The register of the I/O module, which is referenced by both types of signal and channel, contains a diagnostic message"). This way, the number of the appropriate register, which contains a detailed error description, can be determined from the type of signal and the signal channel. The assignment between the type of signal and the signal channel (byte (23 + n)) on the one hand, and the register number on the other hand, is as follows:

Byte (23 + n)								Diagnostic source	Register	
2 <sup>7</sup>	2 <sup>6</sup>	2 <sup>5</sup>	2 <sup>4</sup>	2 <sup>3</sup>	2 <sup>2</sup>	2 <sup>1</sup>	2 <sup>0</sup>		Hex.	Dec.
0	1	X	X	X	0	0	0	Input channel 1	0x0024	36
0	1	X	X	X	0	0	1	Input channel 2	0x0025	37
0	1	X	X	X	0	1	0	Input channel 3	0x0026	38
0	1	X	X	X	0	1	1	Input channel 4	0x0027	39
0	1	X	X	X	1	0	0	Input channel 5	0x0028	40
0	1	X	X	X	1	0	1	Input channel 6	0x0029	41
0	1	X	X	X	1	1	0	Input channel 7	0x002A	42
0	1	X	X	X	1	1	1	Input channel 8	0x002B	43
1	0	X	X	X	0	0	0	Output channel 1	0x002C	44
1	0	X	X	X	0	0	1	Output channel 2	0x002D	45
1	0	X	X	X	0	1	0	Output channel 3	0x002E	46
1	0	X	X	X	0	1	1	Output channel 4	0x002F	47
1	0	X	X	X	1	0	0	Output channel 5	0x0030	48
1	0	X	X	X	1	0	1	Output channel 6	0x0031	49
1	0	X	X	X	1	1	0	Output channel 7	0x0032	50
1	0	X	X	X	1	1	1	Output channel 8	0x0033	51
1	1	X	X	X	0	0	1	I/O module	0x0034	52

The following error messages are possible for the individual diagnostic sources:

Diagnostic input channel (register 36...43)				
Error number		Signification	LED	Remedy
Hex.	Dec.			
0x0012	18	Cross circuit to another input channel	External error	Restart the coupler / controller after error correction
0x0014	20	Short circuit against VCC	External error	Restart the coupler / controller after error correction
0xXX16	22	Cross circuit to one or several input channels (see table for coding XX in the error number)	External error	Restart the coupler / controller after error correction

Diagnostic output channel (register 44...51)				
Error number		Signification	LED	Remedy
Hex.	Dec.			
0x0012	18	Cross circuit to another output channel	External error	Restart the coupler / controller after error correction
0x0013	19	Short circuit against GND or field voltage not available	External error	Restart the coupler / controller after error correction
0xXX16	22	Cross circuit to one or several output channels (see table for coding XX in the error number)	External error	Restart the coupler / controller after error correction

If the input or output channel diagnostic is dealing with error 22 (cross circuit to one or several channels), the affected channels will be indicated in the high byte of the error number:

Extended cross circuit diagnostic (Register 36 ... 51.HB)							
$2^7$	$2^6$	$2^5$	$2^4$	$2^3$	$2^2$	$2^1$	$2^0$
Channel 8	Channel 7	Channel 6	Channel 5	Channel 4	Channel 3	Channel 2	Channel 1

If the diagnostic is not a channel diagnostic but an I/O module diagnostic (register 52), the following error messages are possible:

Diagnostic I/O module (register 52)				
Error number		Signification	LED	Remedy
Hex.	Dec.			
0x0001	1	CPU command test is incorrect	Internal error	Restart the coupler / controller or exchange module
0x0002	2	ROM memory test is incorrect	Internal error	Restart the coupler / controller or exchange module
0x0003	3	RAM memory test is incorrect	Internal error	Restart the coupler / controller or exchange module
0x0004	4	CPU cross communication is defective	Internal error	Restart the coupler / controller or exchange module
0x0005	5	Field voltage not available or internal error	Internal / external error	Restart the coupler / controller after error correction
0x0006	6	Internal I/O test is incorrect	Internal / external error	Restart the coupler / controller
0x0010	16	Field voltage not available	External error	Restart the coupler / controller after error correction
0x0011	17	External wiring is incorrect	External error	Restart the coupler / controller after error correction
0x0012	18	only Power module: overcurrent detection at O1 or O2	External error	Restart the coupler / controller after error correction
0x0020	32	CRC2 from F Host to F Slave invalid	External error, blinking	None, module continues to operate, as soon as valid telegrams are available
0x0021	33	Consecutive number from F host to F slave is incorrect	External error, blinking	None, module continues to operate, as soon as valid telegrams are available
0x0022	34	F communication monitoring time of the F slave is over	External error, blinking	None, module continues to operate, as soon as valid telegrams are available

### 3.1.5 Programming the Safety PLC



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**Note**

Please refer to the manufacturer's documentation for detailed instructions on programming the safety PLC.

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The following steps must be performed when programming a safety program in the safety PLC:

#### 1. Creating Hardware Configuration

Setting up the access protection through password assignment.

Defining the cycle time for calling the safety program.



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**Note**

The cycle time for calling the safety program must be shorter than the monitoring time of the PROFIsafe modules!

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Setting up the PROFIsafe addresses on the modules according to the configuration requirements or adjusting the configuration to the PROFIsafe addresses of the modules.

#### 2. Designing

Designing the modules of the safety program.

#### 3. Defining module assignment and monitoring

Defining the monitoring time of the PROFIsafe modules.



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**Note**

The cycle time for calling the safety program must be shorter than the monitoring time of the PROFIsafe modules!

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#### 4. Creating the safety program

#### 5. Defining the call of the safety program

#### 6. Loading safety program into PLC

### 3.1.6 Appendix

#### 3.1.6.1 Overview on F Parameters

F parameter	Default value	Description
F_Check_SeqNr	No Check	<p>The 'F_Check_SeqNr' parameter specifies whether the sequence number will be included in the consistency check (CRC calculation) of the F-user data telegram.</p> <p>The parameter must be set to "No Check". Only fail-safe standard DP slaves that act according to this setting are supported.</p>
F_SIL	SIL 3	<p>The 'F_SIL ist' parameter depends on the device and indicates the safety class of the fail-safe standard DPslave.</p> <p>Depending on the GSD file, the parameter can be set between "SIL 1" and max. "SIL 3".</p>
F_CRC_Length	2 Byte CRC	<p>The 'F_CRC_Length' parameter communicates the expected length of the CRC2 key to the F-CPU in the safety telegram.</p> <p>Depending on the length of the F user data (process values) and the safety classes, a 2 or 4 Byte long CRC test value is required. With a user data length of up to 12 bytes, the "F_CRC_Length" parameter must be set to "2 Byte CRC", with a user data length of 13 bytes up to 122 bytes it must be set to "4 Byte CRC".</p> <p>At the moment, only "2 Byte CRC" is supported and the fail-safe standard DP slave must act accordingly.</p>
F_Par_Version	0	<p>The 'F_Par_Version' parameter identifies the implemented PROFIsafe version. Starting from 0, the parameter is counted up (+1) with every version.</p> <p>This parameter cannot be changed.</p>
F_Source_Add	2011	<p>The 'F_Source_Add' parameter clearly identifies the PROFIsafe source node address. In order to prevent false parameterization, this address is assigned automatically.</p> <p>The parameter can take a value from 1 to 65534. This parameter cannot be changed.</p>
F_Dest_Add	1021	<p>The 'F_Dest_Add' parameter clearly identifies the PROFIsafe destination node address. In order to prevent false parameterization, this address is assigned automatically.</p> <p>The parameter can take a value from 1 to 1022. The value can be changed, if required.</p> <p>Set the address switch of the PROFIsafe module to the destination node address.</p>

F parameter	Default value	Description
F_WD_Time	150	<p>The 'F_WD_Time' parameter determines the monitoring time in the fail-safe standard DP slave.</p> <p>A currently valid safety telegram must arrive from the F-CPU within the monitoring time. Otherwise, the fail-safe standard DP slave will switch to safe state.</p> <p>The monitoring time should be so long that, on the one hand, telegram delays through communication are tolerated, but, on the other hand, the response in the event of failure (e.g. interruption of the communication connection) will be quick enough.</p> <p>The parameter value can be adjusted in steps of 1 ms. The possible range of values depends on the GSD file.</p>

3.1.6.2 Certificates

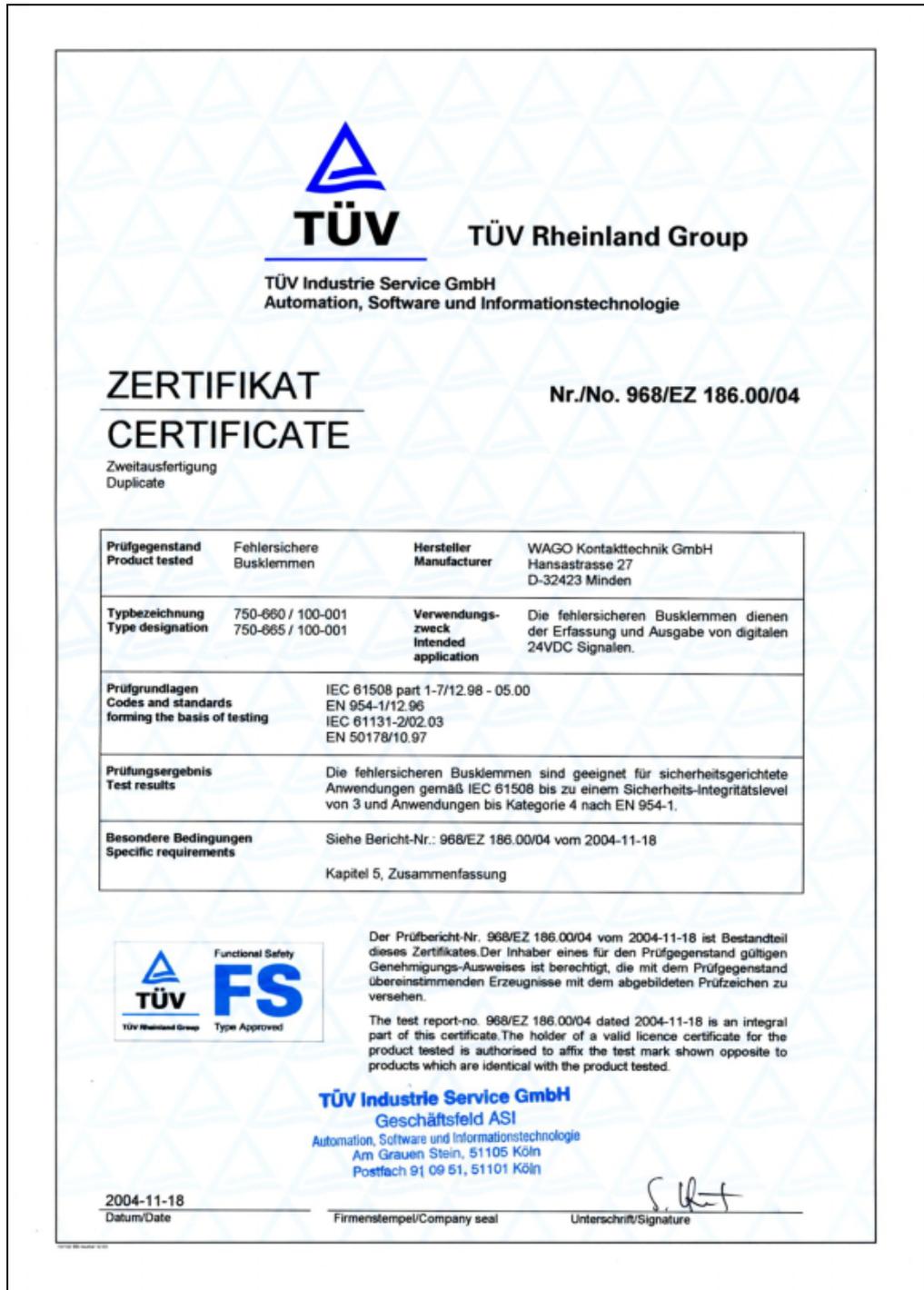


Fig. 3.1.6-1: TÜV-Certificate 968/EZ 186.00/04

p066x02x



Fig. 3.1.6-2: TÜV-Certificate 968/EL 219.02/05

p066x03x



Fig. 3.1.6-3: PROFIBUS-Certificate Z01062

p066x04x



Fig. 3.1.6-4: PROFIBUS-Certificate Z01061

p066x05x



Fig. 3.1.6-5: PROFIBUS-Certificate Z01077

p066x06x





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