ifm electronic

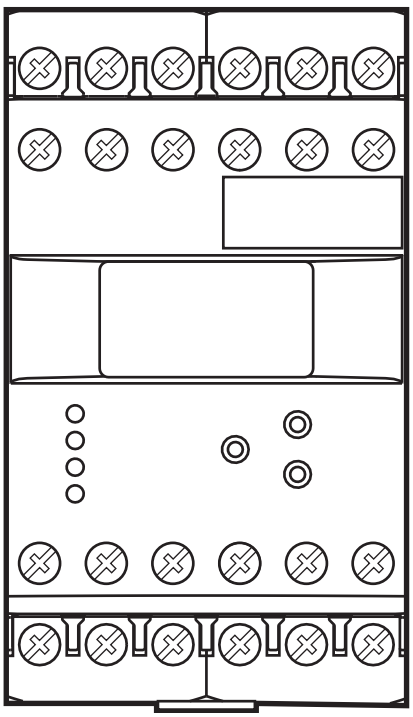
CE

Operating instructions

ecomat200®

UK

Monitor
FS-3



7390960 / 00 01 / 2013

Contents

This document is the original instructions.

1 Preliminary note

This document is part of the device and contains information about the correct handling of the product.

This document is intended for specialists. These specialists are people who are qualified by their training and their experience to see risks and to avoid possible hazards that may be caused during operation or maintenance of the device.

Read this document before use to familiarise yourself with operating conditions, installation and operation. Keep this document during the entire duration of use of the device.

Adhere to the warning notes and safety instructions.

1.1 Symbols used

▶ Instructions

> Reaction, result

[…] Designation of pushbuttons, buttons or indications

→ Cross-reference

Important note
Non-compliance can result in malfunction or interference.

Information
Supplementary note.

1.2 Warning signs used

⚠ WARNING

Warning of serious personal injury.
Death or serious irreversible injuries may result.

⚠ CAUTION

Warning of personal injury.
Slight reversible injuries may result.

NOTE

Warning of damage to property.

2 Safety instructions

2.1 General

Follow the operating instructions. Non-observance of the instructions, operation which is not in accordance with use as prescribed below, wrong installation or incorrect handling can affect the safety of operators and machinery.

The installation and connection must comply with the applicable national and international standards. Responsibility lies with the person installing the device.

2.2 Target group

The device must only be installed, connected and put into operation by a qualified electrician.

2.3 Electrical connection

Disconnect the unit externally before handling it. Also disconnect any independently supplied relay load circuits.

Make sure that the external voltage is generated and supplied according to the requirements for safe extra-low voltage (SELV) since this voltage is supplied without further measures near the operating elements and at the terminals for the supply of connected sensors.

The wiring of all signals in connection with the SELV circuit of the device must also comply with the SELV criteria (safety extra-low voltage, safe electrical isolation from other electric circuits).

If the externally supplied or internally generated SELV voltage is externally grounded, the responsibility lies with the user in accordance with the applicable national installation regulations. All statements in this manual refer to the unit the SELV voltage of which is not grounded.

It is not allowed to supply external voltage to the terminals for the pulse pick-up supply. The consumption of current which exceeds the value given in the technical data is not allowed.

An external main switch must be installed for the unit which can switch off the unit and all related circuits. This main switch must be clearly assigned to the unit.

2.4 Operation

Be careful when handling the unit once power is applied. This is only allowed by qualified personnel due to the protection rating IP 20.

The design of the unit corresponds to the protection class II except for the terminal blocks. Protection against accidental contact (finger protection to IP 20) for qualified personnel is only guaranteed if the terminal screw has been completely screwed in.

2.5 Location

For the correct operation the unit must be mounted in a housing (protection rating IP 40 or higher) which can only be opened using a tool or in a locked control cabinet.

The device has been tested for an impact energy of 1 joule according to EN61010.

2.6 Housing temperature

As described in the technical specifications below the device can be operated in a wide ambient temperature range. Because of the additional internal heating the operating elements and the housing walls can have high perceptible temperatures when touched in hot environments.

2.7 Tampering with the device

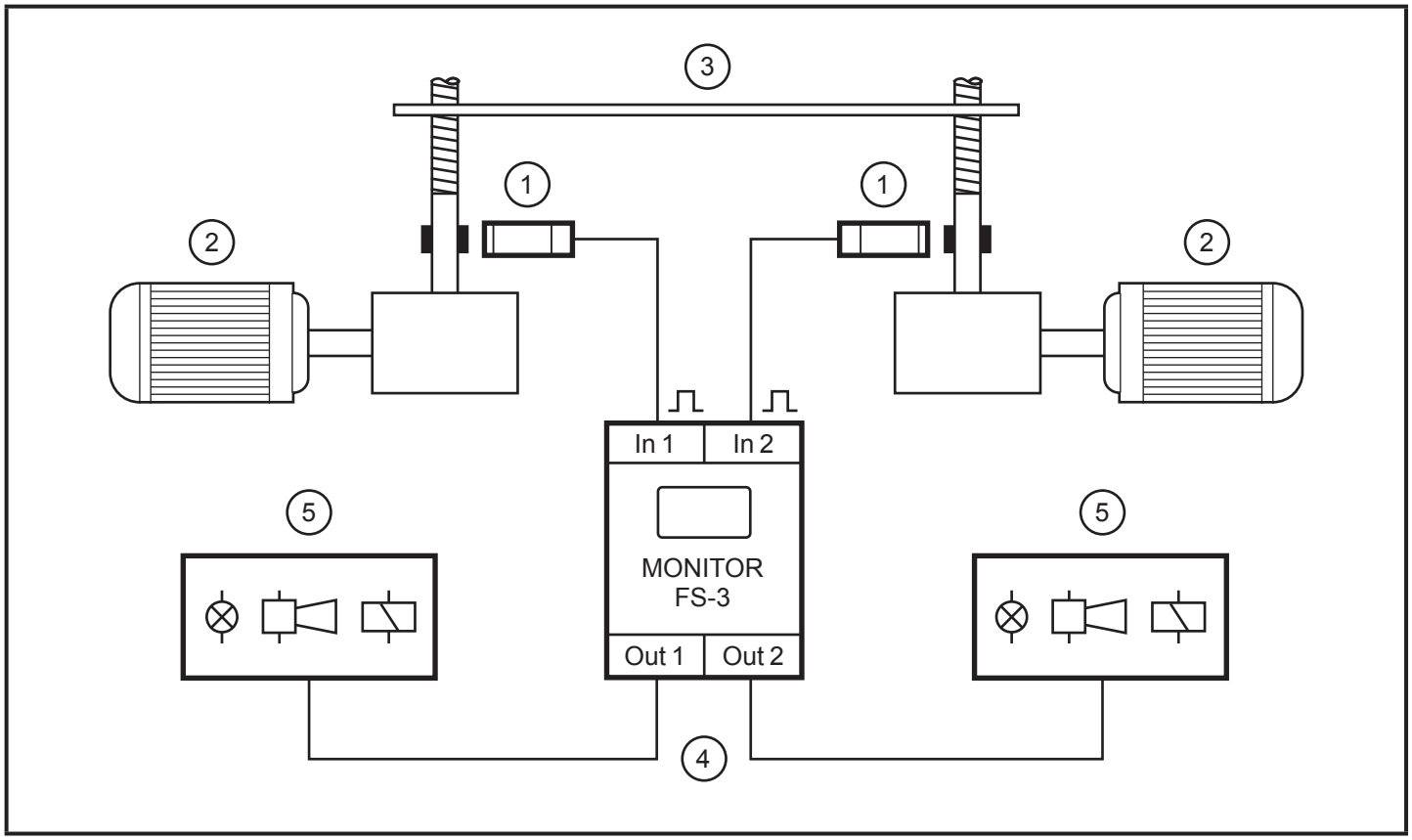
In case of malfunction of the unit or queries please contact the manufacturer. Any tampering with the device can seriously affect the safety of operators and machinery. This is not permitted and leads to the exclusion of any liability and warranty claims.

3 Functions and features

The monitor FS-3 is a pulse evaluation system. It is especially used for skew monitoring on lifting systems with screw or chain drive, rotating scraper bridges in sewage systems or for monitoring shaft break or torsional strain of drive shafts on crane or lifting systems.

It takes the pulse sequences from the driven shafts or screw jacks at 2 separate inputs, supplies them to two internal counters and monitors the difference between the two counter values.

The monitor switches when the set number of differential pulses is reached.



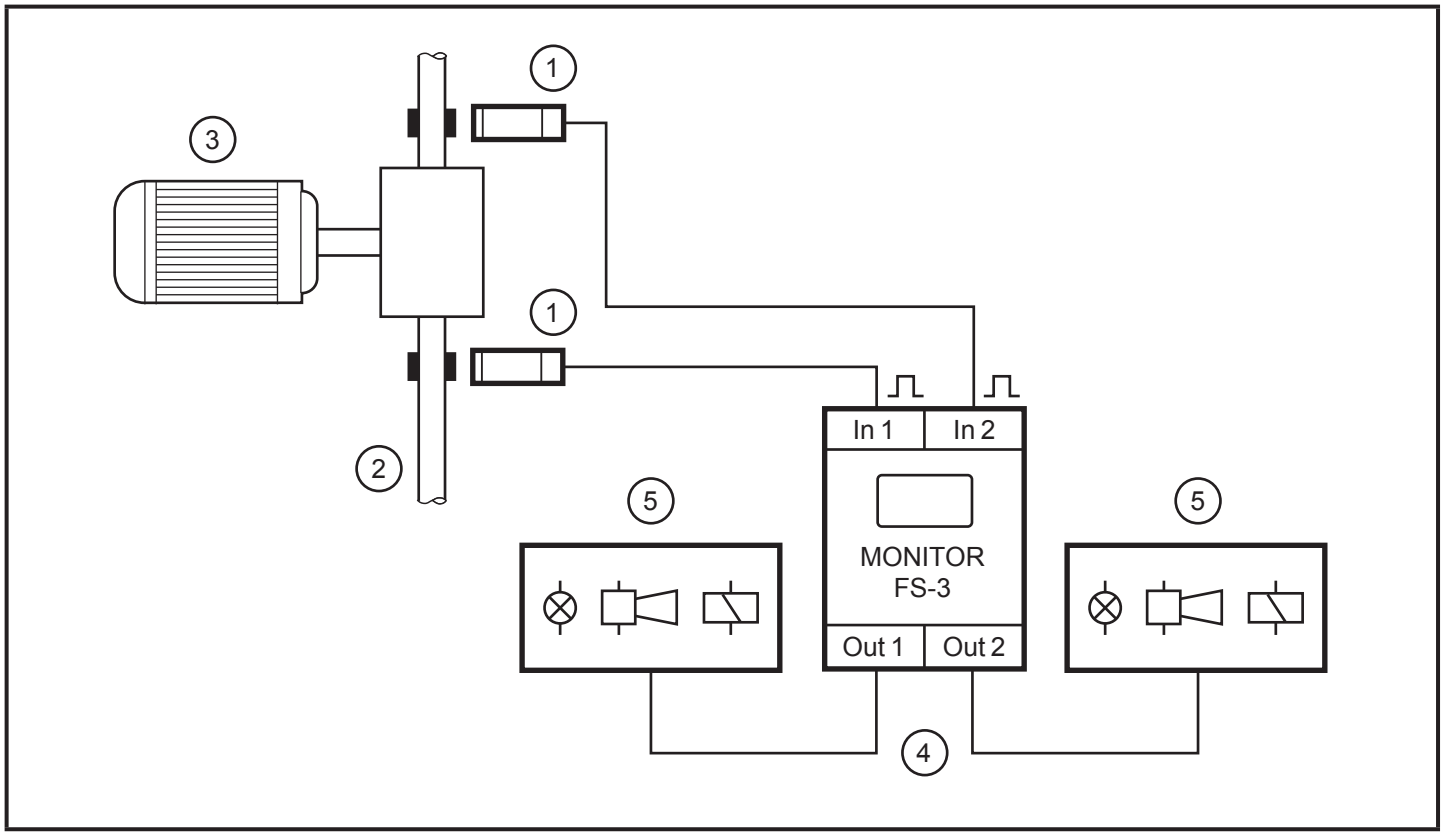
Example 1: skew monitoring on a screw jack lifting table (→ 8.3.1)

1: pulse pick-ups
2: drives
3: screw jack lifting table
4: switching outputs
5: signals depending on the selected switching functions

The pulses can be freely assigned to the input channels.
The rotational speed difference between the monitored shafts or screw jacks is the measure of the skew, torsion or shaft break.
The monitor determines the number of the differential pulses from the rotational speed difference and compares them with the set switch points.

⚠ WARNING

The device is not approved for safety-related tasks in the field of operator protection.
Using an electrical connection of the outputs from two or more units to achieve a redundant circuit, they can also be used for safety-related tasks. All applicable technical standards must be followed.



Example 2: monitoring of shaft break or torsional strain (→ 8.3.2)

1: pulse pick-up or encoder
2: shaft
3: drive
4: switching outputs
5: signals depending on the selected switching functions

3.1 Operating principle

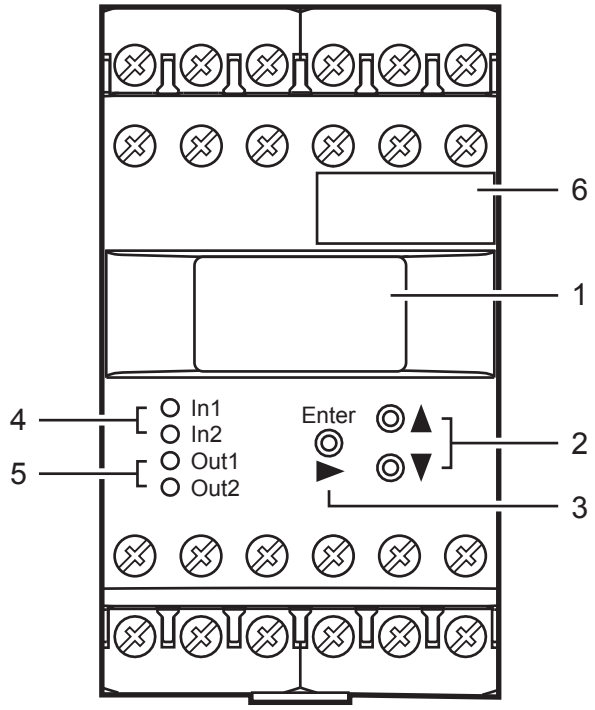
During the pulse evaluation the monitor differentiates at which input fewer pulses are counted.
The evaluation of the differential pulses depending on the sign allows the assignment of the monitor outputs to a shaft or a jack. It is detected at which side more pulses are counted and if the other side has become slower or if it is blocked.

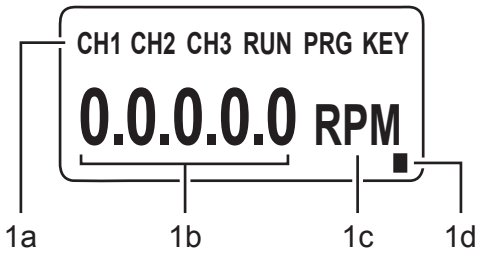
In case of a fault the drives are normally switched off and the monitor is set to restart disable (latching function active).

The monitor works without cyclic reset of the differential counter.

The differential pulse counter counts to +1 or -1 when detecting the first pulse and back to zero with the next pulse.
Thus the counter changes continuously between ±1 and 0 during normal operation.

4 Operating and display elements





UK

1	OLED display	
1a	Indicators for input channels and operating modes	
	CH...	Input channels
	RUN	Run mode (normal operating mode)
	PRG	Programming mode (setting of the parameter values)
	KEY	Locking
1b	Actual values and parameter values (5-digit, numerical)	
	Rotational speed	0...60,000 RPM
	Pulses	0.1...1,000.0 Hz
	Differential pulses	0...999
	Outside the value ranges the display shows "----".	
1c	Parameter abbreviation and units (3-digit, alphanumeric)	
1d	Display is in stand-by mode, no values visible (→ 4.1)	
2	[▲] and [▼] buttons	
	Selection of the actual value display, parameter selection, setting of the parameter values	
3	[Enter/►] button	
	Selection of the operating mode, acknowledgement of the parameter value, front reset	

4	LEDs In1/2 (yellow)	Input pulses
5	LEDs Out1/2 (green)	Switching status of the outputs 1 and 2
	Off	Output is not switched. (relay de-energised, transistor blocked)
	on	Output is switched. (relay energised, transistor switched)
	Flashing quickly	Output is kept latched. (parameter SOx, Store Output)
	Flashing slowly	The delay time has an effect on the output. The output switches when the delay time has elapsed and the trigger event is still present (parameter DTx, Delay Time).
6	Panel for labelling	

4.1 Display stand-by mode

If no button is pressed for more than 10 minutes, the device changes to the stand-by mode. Values and units are no longer visible.
The stand-by mode can be identified by a flashing rectangle.

Even if no values and units are visible, the device continues its monitoring function on the basis of the set parameters and switches the relay and transistor outputs accordingly.

Press any button to switch the display on again.

5 Installation

5.1 Installation of the device

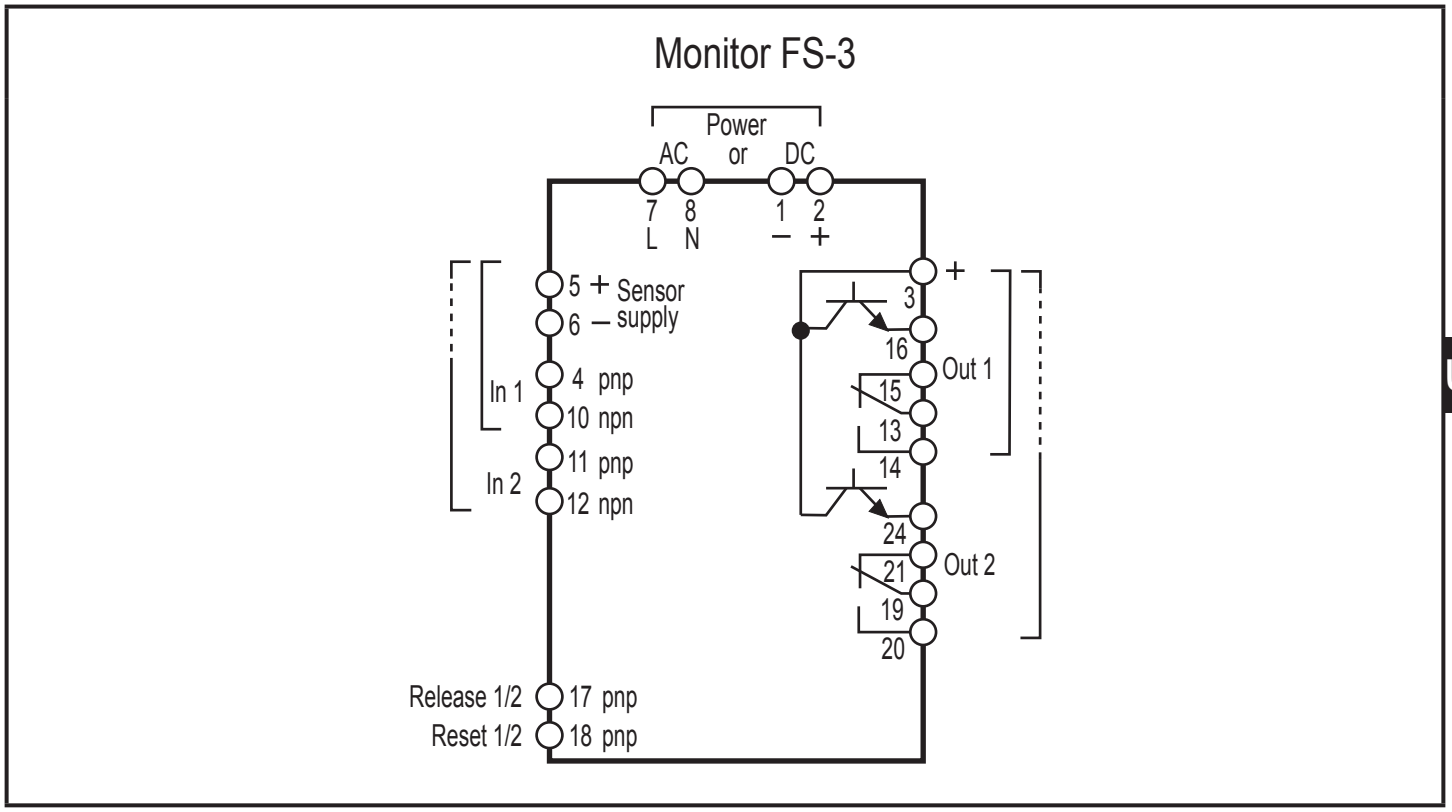
- ▶ Install the device on a 35 mm DIN rail.
- ▶ Leave enough space between the unit and the top and bottom of the control cabinet to enable air circulation and to avoid excessive heating.
- ▶ Take into account the internal heating of all units when mounting several units side by side. The environmental conditions must be observed for every unit.

5.2 Mounting of the sensors

- ▶ Follow the manufacturer's installation instructions.

6 Electrical connection

6.1 Terminal connection



Terminal connection

⚠ WARNING

Do not use unconnected terminals such as terminal 9 as support point terminal.

6.2 Voltage supply (power)

- ▶ Voltage supply see type label.
- ▶ The device may only be operated using one of the possible voltage connections, i.e. either terminals 7/8 (AC) or terminals 1/2 (24 V DC).
- ▶ All supply and signal cables must be laid separately. Use a screened cable if required in the application.

6.2.1 AC supply

- ▶ The AC supply cable must be protected according to the cross-section used (max. 16 A).

If the unit is supplied on AC, the low voltage provided for the sensor supply meets the SELV criteria according to EN 61010, overvoltage category II, soiling degree 2.

6.2.2 DC supply

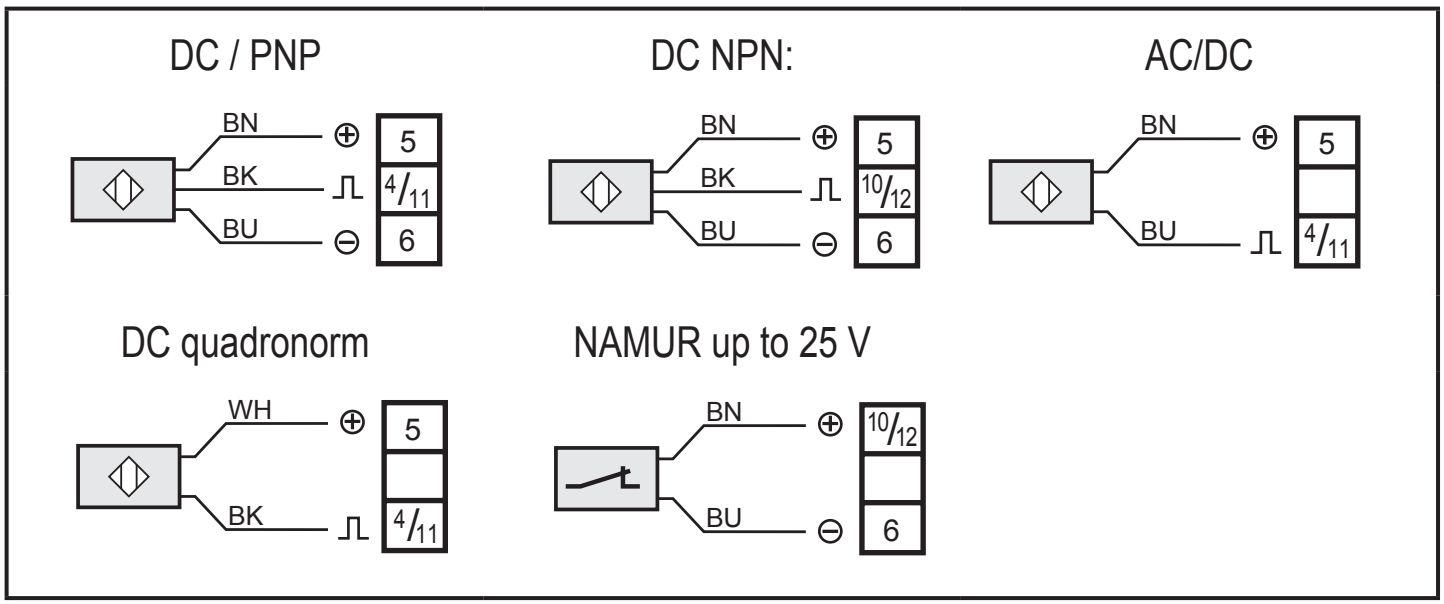
- ▶ The SELV criteria (safety extra-low voltage) must be met for the DC supply.

▶ The DC supply cable L+ (terminal 2) must be protected externally with a 315 mA T fuse (5 x 20 mm or similar).

The DC supply terminals are directly connected to the sensor supply terminals.

6.3 Inputs

6.3.1 Connection of the sensors (In1, 2)



Connection of the sensors

The connection of mechanical switch contacts is not recommended since they tend to bounce and produce faulty pulses.

The terminals 5/6 can be used for the sensor supply or for the release/reset inputs.

6.3.2 Release input (release 1 and 2)

By means of the release input (terminal 17), a preset start-up delay can be started.

▶ The internal +24 V DC voltage (terminal 5) or an external +24 V DC voltage is connected with terminal 17 via a closing contact.

▶ If an external voltage is used, the negative reference point of this voltage must be connected to terminal 1 of the monitor.

When the contact is opened (+24 V DC no longer applied), the set start-up delay starts for both outputs.

In case of a stored fault the +24 V DC signal on terminal 17 is only effective after a reset has been made.
A +24 V DC continuous signal on terminal 17 keeps outputs 1 and 2 in the same state as with the active start-up delay.

6.3.3 Reset input (reset 1 and 2)

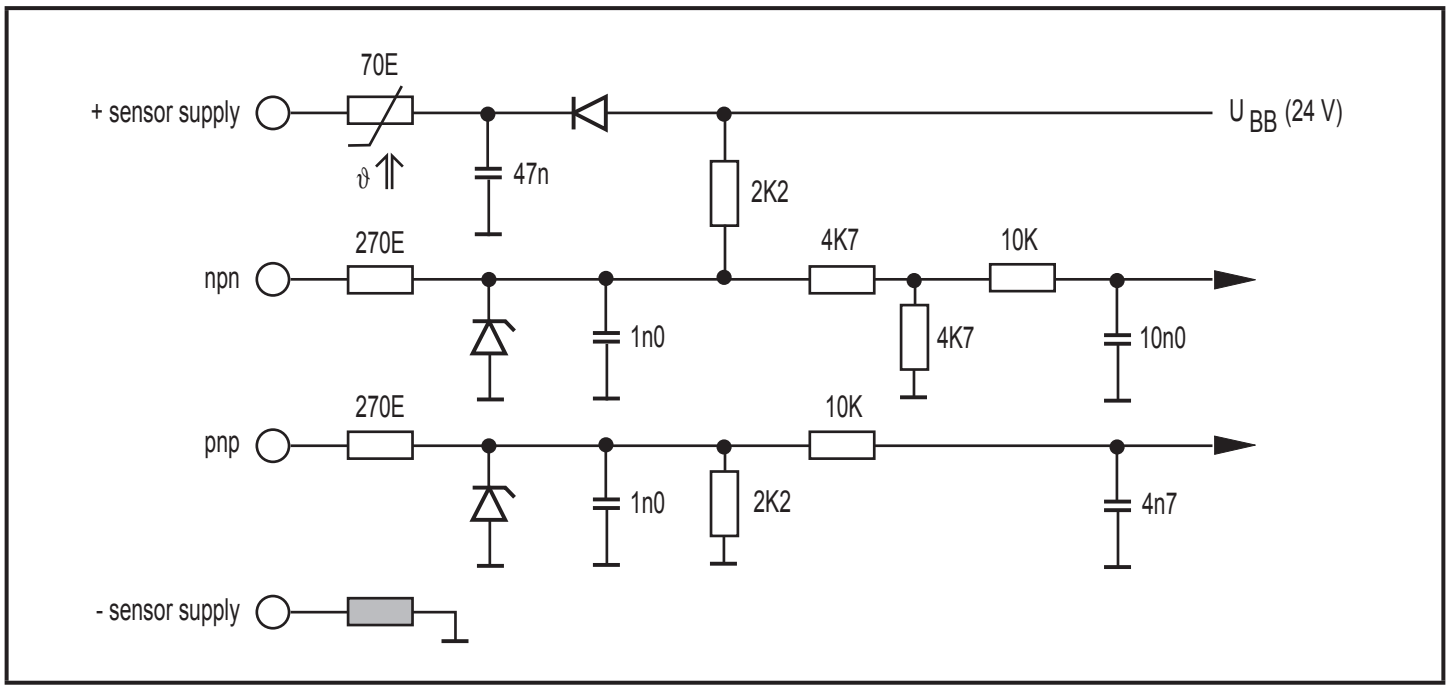
A saved error can be reset via the reset input (terminal 18).

- ▶ The internal +24 V DC voltage (terminal 5) or an external +24 V DC voltage is connected with terminal 18 via a closing contact.
  Reset for output 1 and 2 = terminal 18
- ▶ If an external voltage is used, the negative reference point of this voltage must be connected to terminal 1 of the monitor.

When the contact is opened (+24 V DC no longer applied), the memory of both outputs is reset.

A +24 V DC continuous signal has no effect on the monitoring function.

6.3.4 Typical input circuit F...-x



6.4 Outputs

6.4.1 Relay outputs (Out1, 2)

▶ To prevent excessive wear and to comply with the EMC standards, interference suppression of the contacts is required for switching inductive loads.

⚠ WARNING

If the device is operated on an AC supply (terminals 7/8) this must use the same supply cable as the voltage supply to switch an AC voltage via the relay outputs.

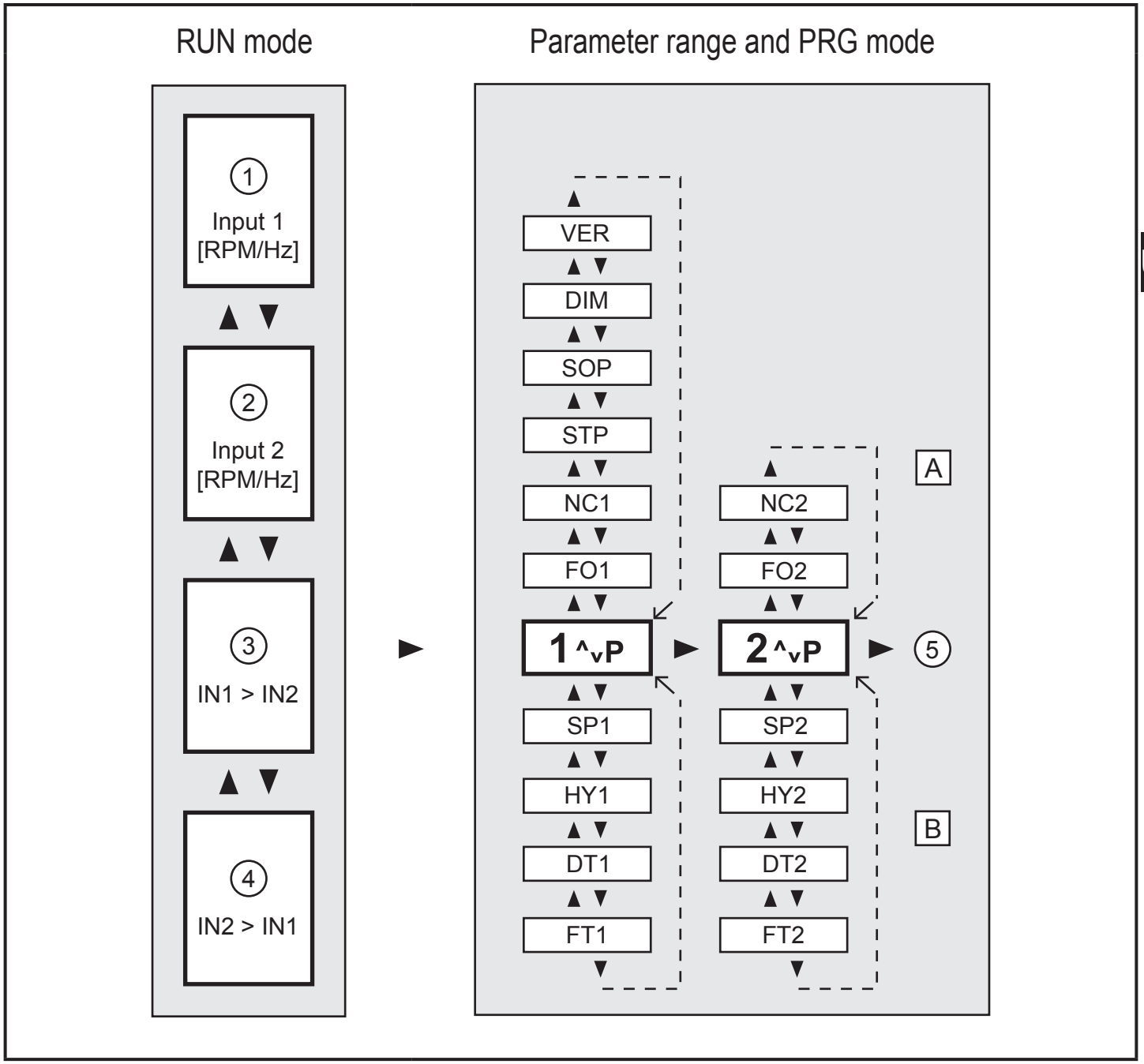
If the relay outputs are used for switching very small currents (e.g. PLC inputs), considerable contact resistance can arise. In this case use the transistor outputs.

6.4.2 Transistor outputs (Out1, 2)

▶ The transistor outputs need an external voltage of +24 V DC on terminal 3.
▶ Connect the reference point (GND) of the external power supply to terminal 1 of the monitor. Otherwise no switching operation is possible.
▶ The SELV criteria (safety extra-low voltage) must be met for the DC supply of the transistor outputs.
▶ The DC supply cable L+ (terminal 3) must be protected externally with a 315 mA T fuse (5 x 20 mm or similar).

7 Navigation and parameter overview

The pushbuttons [▲] / [▼] and [Enter/►] are used for the navigation, entry of values and acknowledgement within the parameters arranged in columns.



1: Display: actual value input 1
2: Display: actual value input 2
3: Display: differential pulses IN1 > IN2
4: Display: differential pulses IN2 > IN1
5: Back to the RUN mode

A: System parameters
B: Application parameters

7.1 System parameters

7.1.1 FOx

Function Output (switching function of the outputs 1/2)

1	The relay is de-energised in case of slip and during the start-up delay STP. (+24 V DC signal on terminal 17 = relay energised)
2	The relay is energised in case of slip and during the start-up delay STP. (+24 V DC signal on terminal 17 = relay de-energised)
3	The relay is de-energised in case of synchronous running and during the start-up delay STP. (+24 V DC signal on terminal 17 = relay de-energised)
4	The relay is energised when number of differential pulses < SPx and during STP. The relay is de-energised when number of differential pulses = SPx. (+24 V DC signal on terminal 17 = both relays energised) Switching function of the outputs: - Relay 1 is de-energised when input 1 counts more pulses than input 2, i.e. when the pulse sequence on input 2 becomes "slower" and the number of differential pulses SP1 is reached. Display: 1 > 2 - Relay 2 is de-energised when input 2 counts more pulses than input 1, i.e. when the pulse sequence on input 1 becomes "slower" and the number of differential pulses SP2 is reached. Display: 2 > 1
Values	1...4
Default values	4

4 = recommended setting for synchronous monitoring

7.1.2 NCx

Number of Cams (on inputs 1/2)

Allows the indication of the rotational speed in RPM if there is more than one switching cam per revolution. It is also possible to compensate for a different number of cams of the jacks or shafts.	
Values	1...999
Default values	1

1 = most sensitive setting and setting with the fastest reaction with the same number of cams.
Displayed value shows pulses/min. instead of RPM or Hz.

7.1.3 STP

Start-up Delay Time Parallel (start-up delay outputs 1/2)

The parameter can be used to compensate for a slipping start of the plant until synchronous running is achieved. The parameter applies to both outputs. Normally the output relays are energised after power on of the monitor until the drive is switched on. The outputs then switch depending on the switching function and state of the plant. Monitoring starts on the first pulse edge after this time has elapsed. The start-up delay can also be released externally while the monitor remains connected. (→ 6.3.2).	
Values	0.0...1000.0 s (min. setting = 0.1 s)
Default value	0.0

7.1.4 SOP

Store Output Parallel (latching function outputs 1/2)

If the parameter is active, the outputs do not switch back automatically in case of a fault. They must be reset internally or externally. The function is simultaneously activated for both outputs. The reset function is also effective for both outputs.	
Values	0 = inactive
	1 = active front reset
	2 = front reset and external reset
Default value	0 = (inactive)

7.1.5 DIM

Dimension (display format)

Indication in Hz or RPM (revolutions per minute). When a new unit is selected, the monitor converts all existing values into the new unit!	
Values	0 = RPM
	1 = Hz
Default value	0 = RPM

7.1.6 VER

Software version

The installed software version is displayed (5-digit number with abbreviation VCO).

7.2 Application parameters

7.2.1 SPx

Switch Point (max. number of differential pulses)

Number of differential pulses at which the respective output switches (e.g. SPx = 5, the relay de-energises when the 5th differential pulse is reached).	
Values	1...999
Default values	1

7.2.2 HYx

Hysteresis (number of hysteresis pulses)

The hysteresis value determines the distance between the switch-off point and the switch point SPx. It must be set to a value < SPx. Switch-off point = SPx − HYx. With the hysteresis value the drives can be influenced by means of the switching outputs while the latching function is inactive, thus enabling to restore synchronous running.	
Values	1...99
Default values	1

7.2.3 DTx

Delay Time (for output 1/2)

Enables a delayed switching of the outputs 1/2. In case of a value greater than 0.0 the outputs only switch if the state of being above or below the switch point is longer than the time set. If e.g. for DTx = 5 s the allowed number of differential pulses is exceeded but is already below this value after 3 s, the output does not switch.	
Values	0.0...1000.0 s (only effective if SOP inactive, 0)
Default values	0.0 (no delay time)

7.2.4 FTx

Fleeting Time (for outputs 1/2)

If an event occurs, the output changes its state during the set time and then switches back to the initial state.	
Values	0.0...1000.0 s
Default values	0.0 (fleeting time not active)

8 Programming

⚠ WARNING

If programming takes place during operation, dangerous contact voltage may occur. Therefore ensure that programming is done by a qualified electrician.

Parameter changes during operation, especially changes to the switching function and the switch points can lead to malfunction in the plant. Therefore disconnect it during the change and then check the function.

Programming consists of 6 steps:	
1. Change from the RUN mode to the parameter range 1 or 2	[Enter/►]
2. Selection of the requested parameter (FOx, NCx, etc.)	[▲] / [▼]
3. Change to the PRG mode	[Enter/►]
4. Setting or changing the parameter value	[▲] / [▼]
5. Acknowledgement of the set parameter value	[Enter/►] > 3 s
6. Return to the RUN mode	[Enter/►] > 3 s

8.1 Programming example DT1 (Delay Time, output 1)

Operation	Display
Change from the RUN mode to the parameter range (here 1)	
► Briefly press [Enter/►] once. > The 1st parameter range is displayed.	
Selection of the requested parameter (here DT1)	
► Press the [▼] button until the parameter DT1 is displayed with the currently set value (here default value 0.0).	
Change to the PRG mode	
► Briefly press [Enter/►] once. > The unit is in the programming mode. > PRG indicator visible, parameter abbreviation flashes.	

Setting or changing the parameter value	
▶ Press [▲] / [▼] until the requested parameter value is displayed (→ 8.2.3 Numerical entries).	
Acknowledgement of the set parameter value	
▶ Press [Enter/▶] until the parameter abbreviation no longer flashes and the indicator PRG has disappeared. > The new parameter value is indicated and effective.	
Return to the RUN mode	
▶ Press [Enter/▶] for about 3 s or wait for the time-out function (approx. 15 s). > The unit is again in the RUN mode, the current value is indicated.	

8.2 Notes on programming

8.2.1 RUN mode

During programming the unit internally remains in the RUN mode (RUN indicator visible).
This means that until a new value is acknowledged with [Enter/▶], the unit carries out its monitoring function on the basis of the previously set parameters and switches the relay and transistor outputs accordingly.

The monitoring function of the monitor is deactivated by continuously pressing [Enter/▶] in the RUN mode. The deactivation is effective as long as the button is pressed.

8.2.2 Time Out function

If during programming no pushbutton is pressed for approx. 15 s, this is seen as a cancellation.
Parameter changes which are not acknowledged with [Enter/▶] are rejected. The previously set parameter value is restored and remains effective for the monitoring functions.

8.2.3 Numerical entries

▶ Press [▲] or [▼] and hold it.

The smallest decade becomes active and is counted up or down depending on the selected pushbutton (e.g. 1, 2, 3,...0). Then comes the next decade, etc.

As soon as the pushbutton is released, the active decade flashes. It is set by pressing [▲] or [▼] several times. The preceding decade then flashes and can be set.

8.2.4 Factory Reset

The factory default values can be restored by pressing [▲] and [▼] simultaneously during power on. All previously entered parameter values are lost.

8.2.5 KEY function (locking)

The unit can be locked to prevent incorrect entries.
After locking, only the actual value indication can be switched with the [▲] and [▼] buttons. Parameter range and PRG mode can no longer be selected.

Locking	Unlocking
▶ Press [▲] and [▼] simultaneously and hold them pressed. > The KEY indicator flashes. ▶ Release the pushbuttons when the KEY indicator is continuously indicated.	▶ Press [▲] and [▼] simultaneously and hold them pressed. > The KEY indicator flashes. ▶ Release the pushbuttons when the KEY indicator is no longer indicated.

8.3 Setting examples

8.3.1 Skew monitoring on a screw jack lifting table

See example 1 (→ 3 Functions and features)

Task

In case of a skew (difference in height) of 200 mm the switching outputs are to switch. When the difference in height is evened out by controlling the drives accordingly the switching outputs are to switch off automatically.

System parameters			
Assignment screw jack 1		input 1 (In1)	
Assignment screw jack 2		input 2 (IN2)	
Switching cams per jack		2 per revolution	
Stroke per jack rotation		100 mm	
Rotational speed of the jack		60 = RPM	
Parameter values			
FO1/2	Switching function	4	= default value
NC1/2	Switching cams	2	= difference in height 50 mm per pulse
SP1/2	Differential pulses	4	= 4 x 50 mm = 200 mm difference in height
HY1/2	Hysteresis pulses	3	= switch-off point at 1
SOP	Latching function	0	= inactive

General

In this case the number of differential pulses is a measure of the skew of the lifting system. For monitoring the screw jack speed is not relevant. It only indicates the shortest time in which the skew is reached.

Switching operation

If e.g. jack 2 runs faster than jack 1, there will be a difference in height.
If a difference in height of 200 mm is reached (= 4 differential pulses), output 2 will switch. According to the switching function the relay de-energises.
Jack 2 can run slower if the drive is controlled accordingly. The difference in height is reduced and thus the number of differential pulses. Output 2 switches back when ±1 differential pulses are reached. According to the switching function the relay energises again.
The inactive latching function enables output 2 to switch back automatically.

8.3.2 Monitoring of shaft break or torsional strain

See example 2 (→ 3 Functions and features)

Task

In case of a shaft break or a shaft misalignment >=30° the switching outputs are to switch and remain in this switching state up to the reset.

System parameters			
Assignment shaft 1		input 1 (In1)	
Assignment shaft 2		input 2 (In2)	
Switching cams per shaft		36 per revolution (e.g. shaft encoder)	
Shaft speed		600 = RPM	
Parameter values			
FO1/2	Switching function	4	= default value
NC1/2	Switching cams	36	= resolution 10°
SP1/2	Differential pulses	3	= 3 x 10° = 30° shaft misalignment
HY1/2	Hysteresis pulses	1	= switch-off point at 2
SOP	Latching function	2	= front reset and external reset

General

In this case the number of differential pulses is a measure of the torsion of the shafts in relation to each other. The rotational speed of the shafts is important for the monitoring because it determines how fast a fault can be signalled. Furthermore the number of pulses per revolution is also decisive for the response time. The following response time per differential pulse results from the above-mentioned system parameters: 36 switching cams x 600 RPM = 21600 pulses/min = 360 pulses/s

This results in: pulse interval = 0.0028 s = approx. 3 ms.

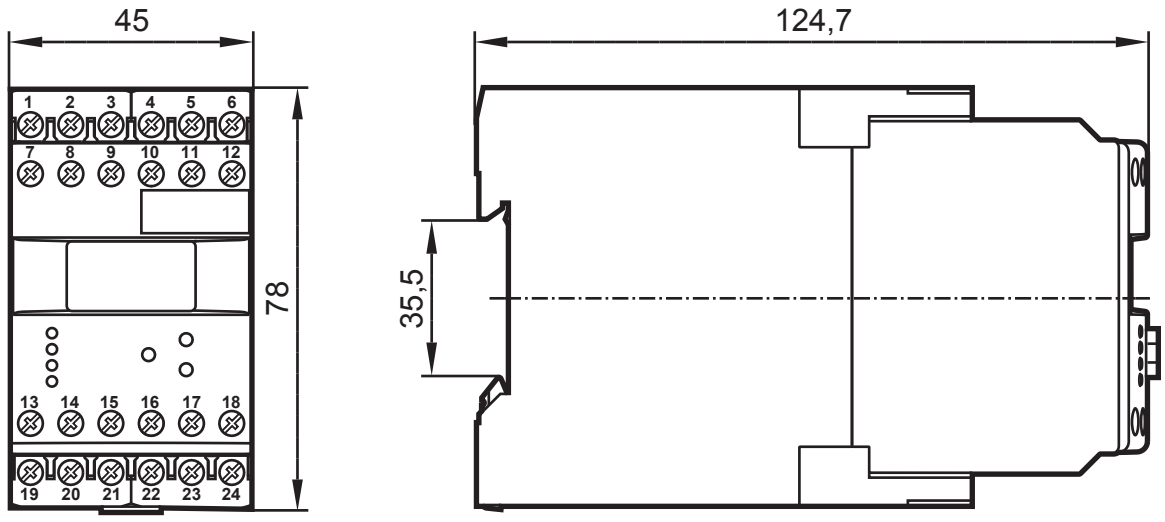
Switching operation

If e.g. there is more strain on shaft 2 output 1 switches in case of a shaft misalignment ≥ 30° (= 3 differential pulses). According to the switching function the relay de-energises.

If shaft 2 is blocked input 1 counts 3 pulses more than input 2 within approx. 9 ms; the output relay 1 switches. According to the switching function the relay de-energises.

The activated latching function SOP maintains the output in the fault state up to the reset.

9 Scale drawing



10 Technical data

10.1 Overview

Art. no.	DS2506
Monitor type	FS-3
Supply voltage Frequency range Power consumption	see type label
Sensor types	PNP/NPN; NAMUR
Sensor supply	24 V DC
Input frequency	≤ 5 kHz
relay outputs	2 changeover contacts; potential free
Switching current	≤ 6 A
Switching voltage	≤ 250 V AC; B300, R300
Transistor outputs	PNP switched; externally supplied
Switching current	≤ 15 mA; short-circuit proof
Switching voltage	24 V DC (± 20 %)
Protection housing / terminals	IP 50 / IP 20
Ambient temperature	-40...60 °C
Storage temperature	-40...85 °C
Max. relative air humidity	80 % (31 °C) linearly decreasing to 50 % (40 °C)

Art. no.	DS2506
Maximum operating altitude	2000 m above sea level
Connection	21 dual-chamber terminals; 2 x 2.5 mm² (AWG 14)
cULus test conditions	housing dimensions for temperature rise test: 200 x 200 x 150 mm

Data sheets can be found at:
www.ifm.com → Data sheet search→ article number

10.2 Approvals / standards

EC declarations of conformity, approvals etc. can be downloaded at:
www.ifm.com → Data sheet search → Article number → More information

11 Maintenance, repair, disposal

The device is maintenance-free.

- ▶ Do not open the housing as the device does not contain any components which can be repaired by the user. The device must only be repaired by the manufacturer.
- ▶ Dispose of the device in accordance with the national environmental regulations.