ifm electronic

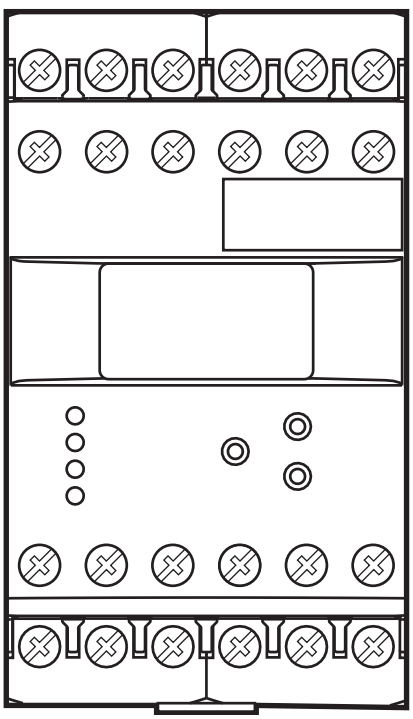
CE

Operating instructions

ecomat200®

UK

Monitor
FS-1 / FS-1N



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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

▶ Instruction

> 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 Installation 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.

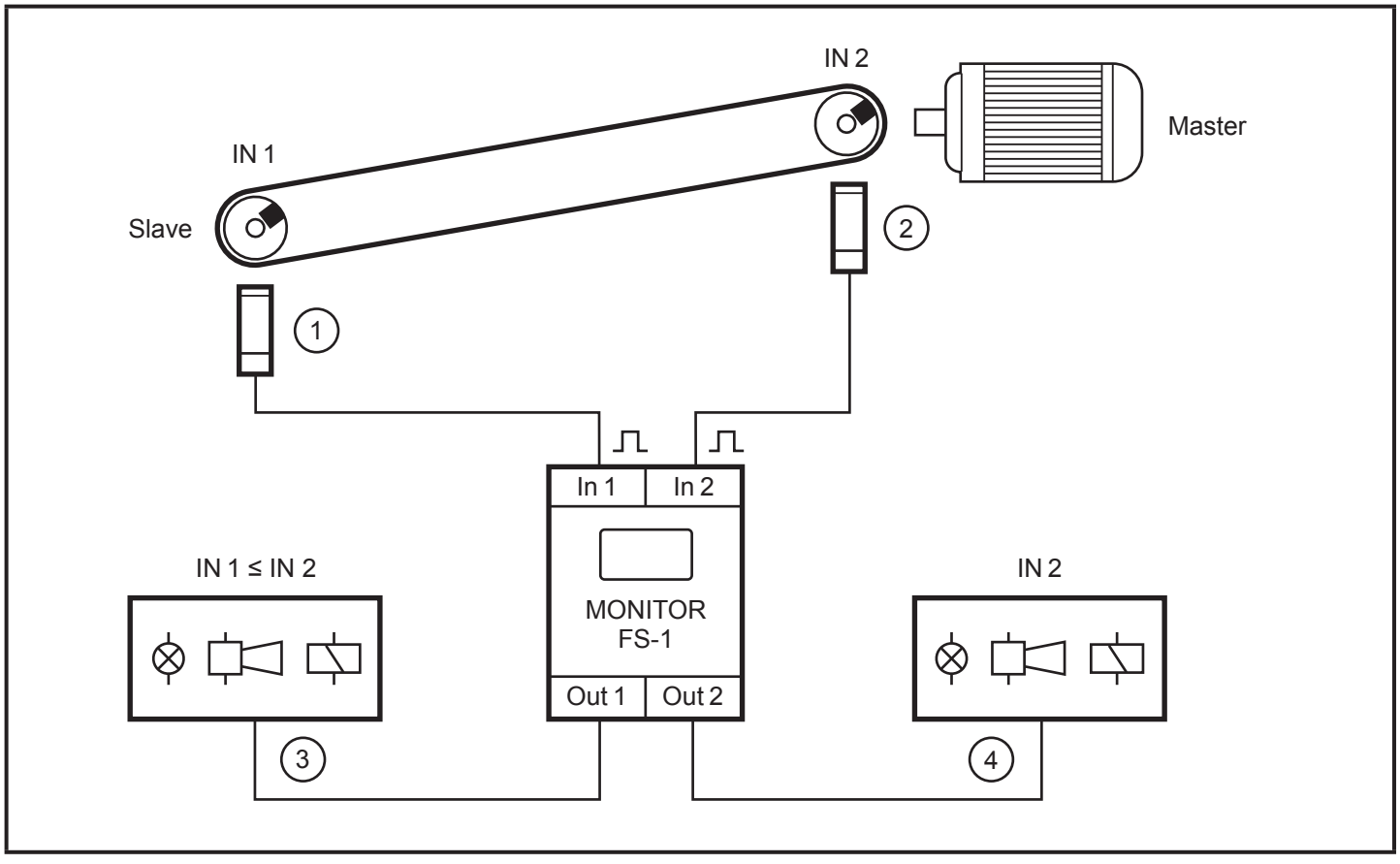
3 Functions and features

The monitor FS-1 / FS-1N is a programmable pulse evaluation system for slip/ synchronous monitoring. It monitors the rotational speed ratio between drive (master) and power take-off (slave).

It receives the pulses from 2 external sensors on 2 separate input channels, measures the pulse interval and calculates the input frequency.

The device determines for example the deviation in percent between the input frequencies, compares them with the set switch point [slip in %] and switches output 1 according to the selected switching function.

slip = $(f_{IN2} - f_{IN1}) \div f_{IN2} \times 100$ [%]



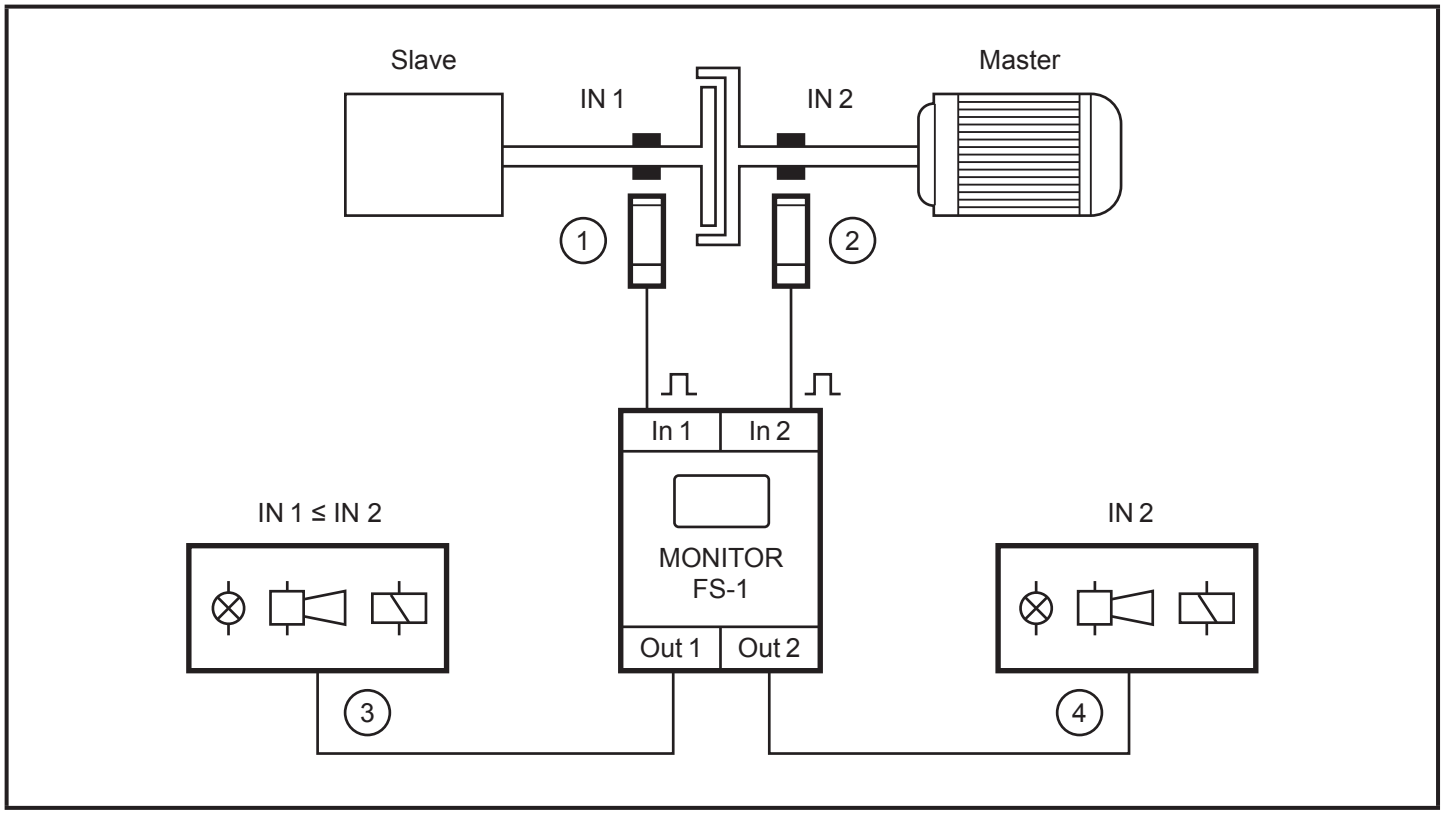
Example 1: Slip/synchronous monitoring of a conveyor system

1: Pulse pick-up power take-off (slave)
2: Pulse pick-up drive (master)
3: Switching output 1, message slip or synchronous movement (IN 1 ≤ IN 2)
4: Switching output 2, message rotational speed not reached/exceeded or acceptable range (IN 2)

In addition to the speed monitor function for the drive the device also provides monitoring of

- rotational speed exceeded/not reached, blocking, overload or jam,
- maximum or minimum rotational speeds,
- defined slip, synchronous movement and frequency ranges.

The assignment of the pulses to the input channels is predetermined.
IN 1 = power take-off (slave)
IN 2 = drive (master)
The frequency ratio IN 1 ≤ IN 2 is evaluated.
The frequency ratio IN 1 > IN 2 cannot be evaluated.



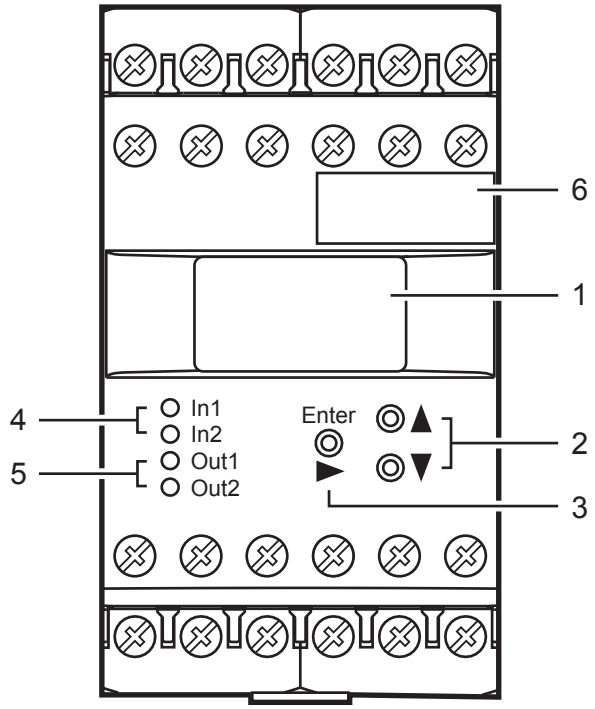
Example 2: Slip/synchronous monitoring of a slipping clutch

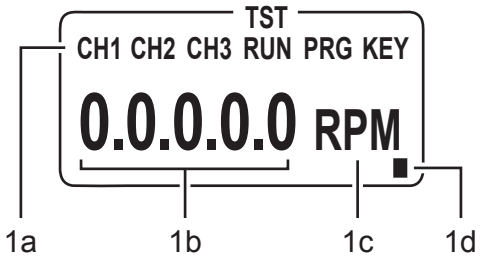
1: Pulse pick-up power take-off (slave)
2: Pulse pick-up drive (master)
3: Switching output 1, message slip or synchronous movement (IN 1 ≤ IN 2)
4: Switching output 2, message rotational speed not reached/exceeded or acceptable range (IN 2)

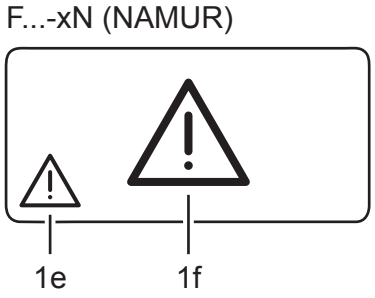
⚠ WARNING

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.

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)
	TST	Test mode (check of the switching characteristics without pulse pick-up connected)
	PRG	Programming mode (setting of the parameter values)
	KEY	Locking
1b	Actual values and parameter values (5-digit, numerical)	
	Slip	0.1...99.9 %
	Rotational speed	0...60,000 RPM
	Pulses	0.1...1,000.0 Hz
	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)	
1e	Display in display mode Symbol for wire break/ short circuit on the cable of the pulse pick-up (only F...-xN)	
1f	Display in standby mode Symbol for wire break/ short circuit on the cable of the pulse pick-up (only F...-xN)	

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 pulse
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	

F...-xN = device with NAMUR input

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

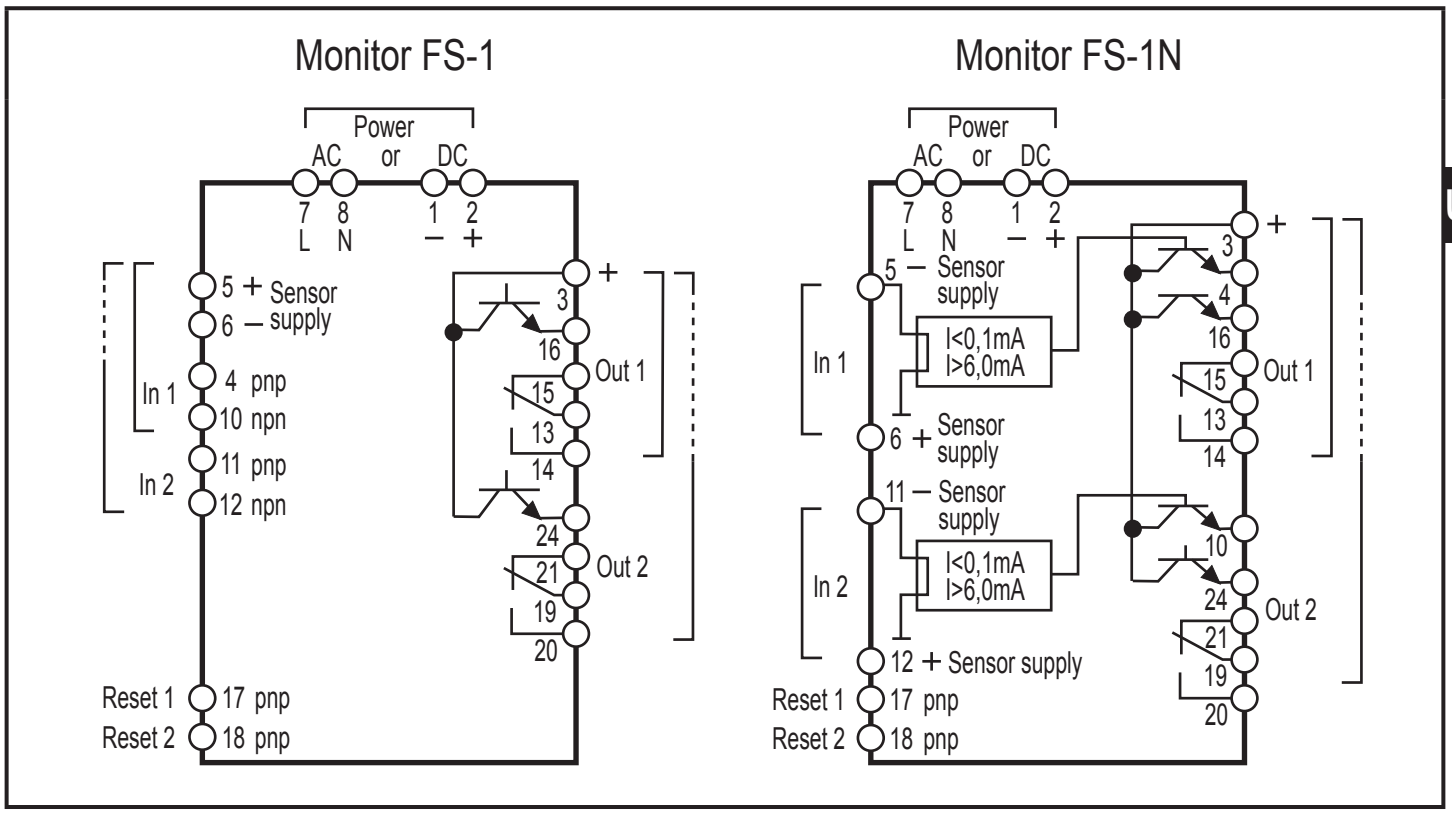
- ▶ Install the device on a 35 mm DIN rail.
- ▶ Leave enough space between the unit and the top and bottom of the control cabinet to enable air circulation and to avoid excessive heating.
- ▶ Take into account the internal heating of all units when mounting several units side by side. The environmental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

5.2 Installation 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 supplies

▶ 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.

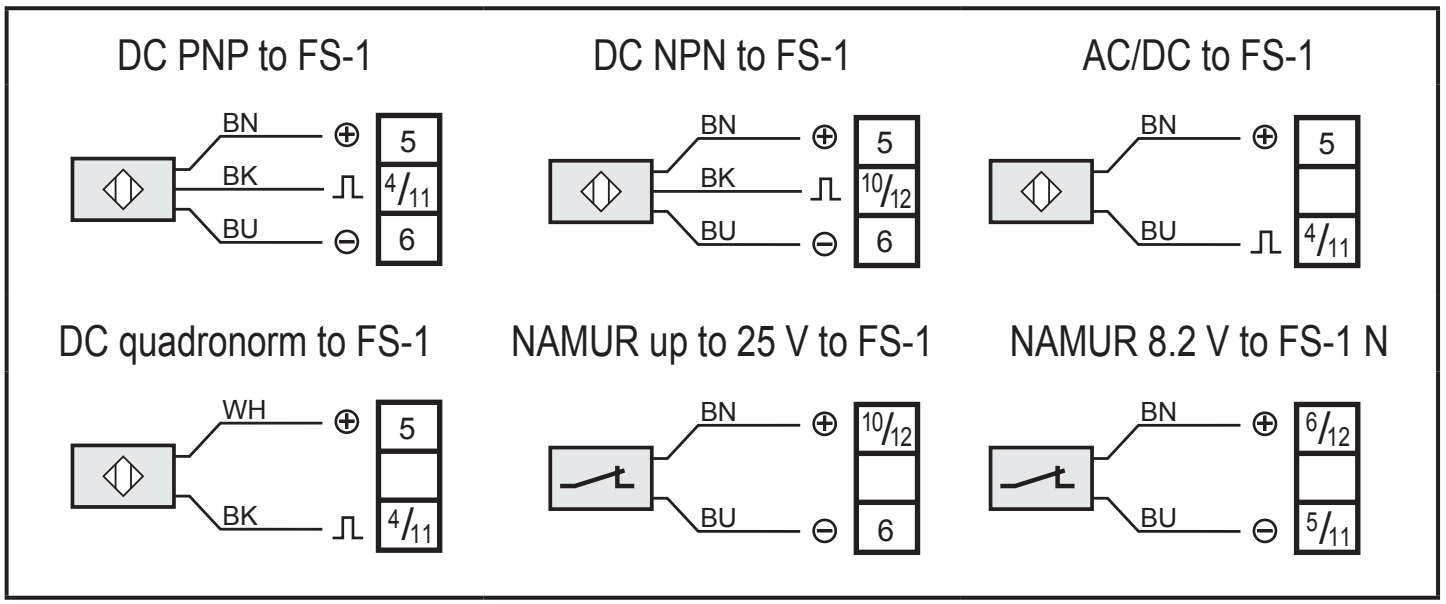
6.2.2 DC supplies

- ▶ 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 reset inputs (only F...-x).

6.3.2 Reset inputs (reset 1 and 2)

The start-up delay can be started or a saved error can be reset via the reset inputs (terminals 17/18).

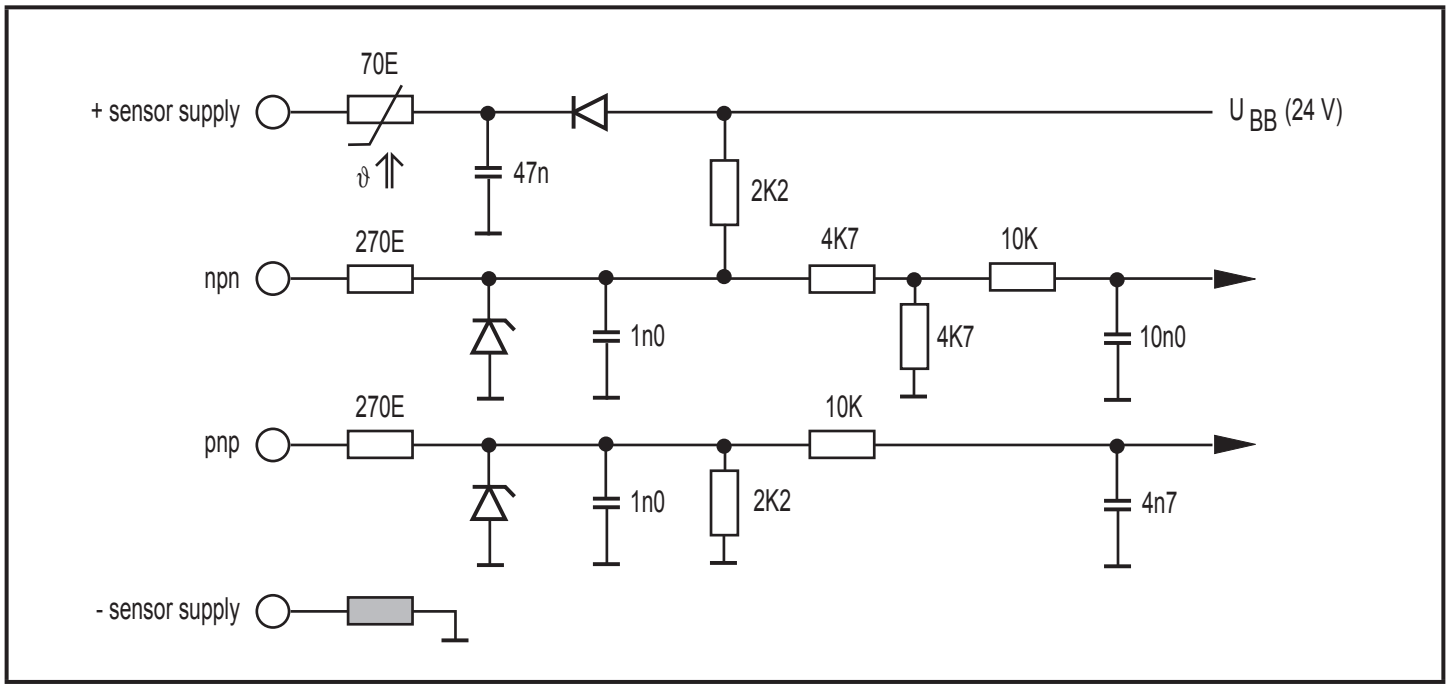
- ▶ The internal +24 V DC voltage (terminal 5) or an external +24 V DC voltage is connected with terminal 17 or 18 via a closing contact.
  Reset for output 1 = terminal 17
  Reset for output 2 = terminal 18
- ▶ If an external voltage is used, the negative reference point of this voltage must be connected to terminal 1 of the monitor.

When the contact is opened (+24 V DC no longer applied), the start-up delay or the memory reset starts.

A +24 V DC continuous signal leads to a permanent bridging of the monitoring, i.e. the same state as during the start-up delay is indicated. When the voltage is no longer applied and the set start-up delay has elapsed, monitoring starts.

Note on F...-xN:
The +24 V DC signal voltage required for the reset inputs is not available to the F...-xN. This must be taken from an external voltage source. The reference point (GND) of the external power supply must be connected to terminal 1 of the monitor; otherwise no switching operation is possible.

6.3.3 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).

6.5 Additional outputs for NAMUR devices (F...-xN)

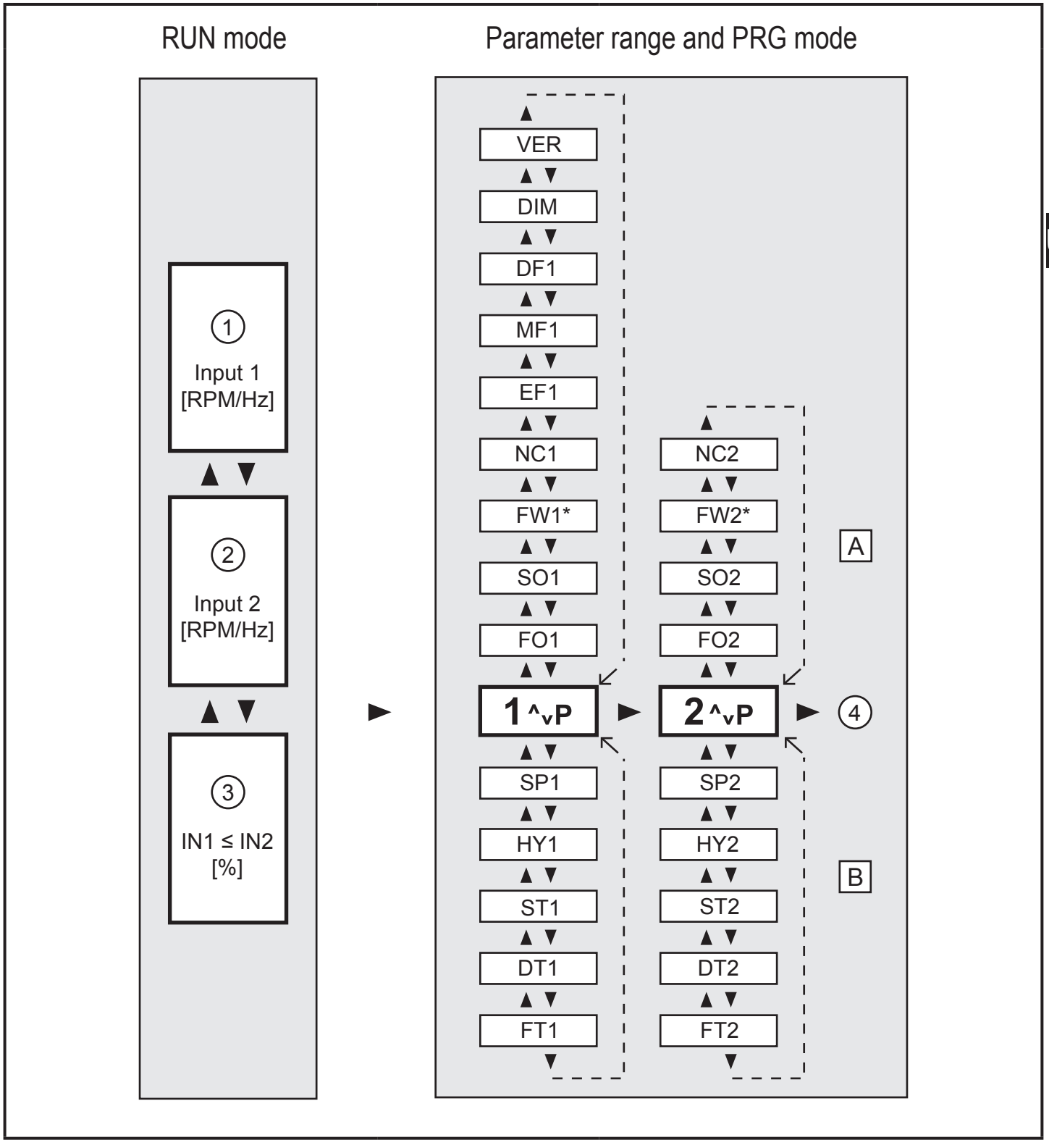
6.5.1 Fault outputs

The fault outputs (terminals 4/10) indicate a wire fault between the monitor and the respective pulse pick-up (wire break/short circuit). In case of a fault the respective output is blocked.

Wire fault input 1 = terminal 4
Wire fault input 2 = terminal 10

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: Indication: actual value input 1 (slave)
2: Indication: actual value input 2 (master)
3: Indication: slip
4: Back to the RUN mode

A: System parameters
B: Application parameters

*) only F...-xN

7.1 System parameters

7.1.1 FOx

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

1	Relay energised (transistor switched) when the current value is below the switch point SPx (= signalled state OUT1 "synchronous movement"; OUT2 "drive below preset value")
2	Relay de-energised (transistor blocked) when the current value is below the switch point SPx (= error message OUT2 "drive underspeed"; not useful for OUT1)
3	Relay energised (transistor switched) when the current value is above the switch point SPx (= signalled state OUT2 "drive speed reached"; not useful for OUT1)
4	Relay de-energised (transistor blocked) when the current value is above the switch point SPx (= error message OUT1 "slip"; OUT2 "drive overspeed")
5	Relay is energised (transistor switched) within a frequency range (acceptable range)
6	Relay is de-energised (transistor output blocked) within a frequency range. With the functions 5 and 6 a frequency range above and below the switch point SPx is defined in connection with the parameter HYx (hysteresis). Functions 5 and 6 are not useful for output 1 (FO1)!
Values	1...6
Default settings	FO1 = 4 (output 1; error message "slip"; recommended)
	FO2 = 2 (output 2; error message "drive underspeed")

7.1.2 SOx

Store Output (latching function outputs 1/2)

When this parameter is active, the respective output does not switch back automatically but must be reset.	
Values	0 = inactive
	1 = front reset ([Enter/▶] > 3 s)
	2 = front reset and external reset
Default settings	0 (inactive)

7.1.3 FWx

Function Wire Break Monitoring (only F...-xN)

Relay characteristics for wire fault or short circuit, i.e. input frequency = 0		
Output 1 (slip/synchronous monitoring)		
if	FW1 = inactive (0)	FW1 = active (1)
slip > switch point SPx		
for switching functions 1 and 4	relay de-energised	relay remains de-energised
slip < switch point SPx		
for switching functions 1 and 4	relay remains energised	relay de-energised
Output 2 (drive: frequency, rotational speed)		
if	FW2 = inactive (0)	FW2 = active (1)
frequency > switch point SPx		
for switching functions 1 and 4	relay energised	relay remains de-energised
for switching functions 2 and 3	relay de-energised	relay de-energised
frequency < switch point SPx		
for switching functions 1 and 4	relay remains energised	relay de-energised
for switching functions 2 and 3	relay de-energised	relay remains de-energised
frequency in the window range		
for switching function 5	relay de-energised	relay de-energised
for switching function 6	relay energised	relay de-energised
Values	0 = inactive	
	1 = active	
Default settings	0	

7.1.4 NCx

Number of Cams (on inputs 1/2)

Number of cams detected per revolution. On the basis of this value the monitor calculates the rotational speed (measured frequency ÷ NCx = displayed speed in RPM). For frequency measurements NCx = 1 should remain set.	
Values	1...999
Default settings	1

7.1.5 EF1

Enable Frequency (slip monitoring becomes active above EF1)

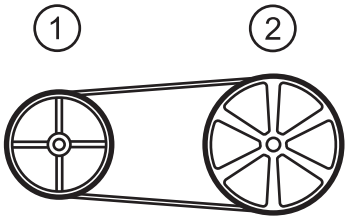
This function is used as time-independent start-up delay (cf. STx). For applications where the driven side could become jammed during start-up (e.g. grinding gear). Output 1 (slip monitoring) is maintained in the "good" state until the drive has reached the set value EF1.	
Values	0.1...1000.0 Hz or 1...60,000 RPM (Note parameter DIM!)
Default value	1 (RPM)

7.1.6 MF1

Multiplication Factor (multiplier)

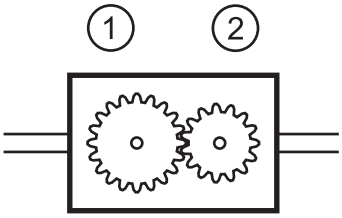
By means of the parametres MF1 and DF1 the transmission ratio or the gear reduction ratio is calculated. They enable a conversion of the power take-off side to the rotational speed level of the drive.	
Values	1...10,000 (only whole numbers)
Default value	1
Rotational speed power take-off x (MF1 ÷ DF1) = rotational speed drive	
Example transmission by means of V-belt:	

1: Power take-off	2: Drive
1800 RPM	1500 RPM
DF1 = 1800	MF1 = 1500



Example gear reduction:

1: Power take-off	2: Drive
800 RPM	1000 RPM
DF1 = 800	MF1 = 1000



7.1.7 DF1

Division Factor (divisor)

see MF1	
Values	1...10,000 (only whole numbers)
Default value	1

7.1.8 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

7.1.9 VER

Software version

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

7.2 Application parameters

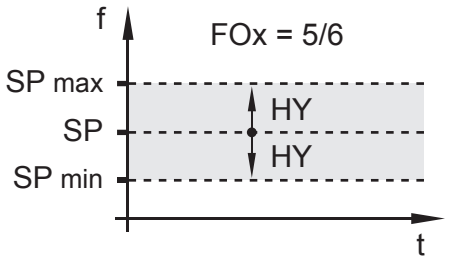
7.2.1 SPx

Switch Point (outputs 1/2)

Value at which the output changes its switching status. SP1 = switch point output 1 (slip/synchronous monitoring) SP2 = switch point output 2 (monitoring of the rotational speed of the drive) The outputs switch independent of each other.	
Values	SP1: 0.1...99.9% (slip)
	SP2: 1...1000.0 Hz or 1...60,000 RPM (Note parameter DIM!)
Default settings	SP1 = 5 [%]
	SP2 = 500 [RPM]

7.2.2 HYx

Hysteresis (hysteresis for switching outputs 1/ 2)

The hysteresis value determines the distance of the reset point to the switch point SPx and prevents a possible chattering of the corresponding switching output. In connection with switching functions 5 and 6 (FOx) an acceptable range or an error range can be defined for output 2. (Not useful for output 1.) The window range in which the hysteresis is effective in both directions is set by means of a "ficticious" switch point SP.	
$SP = (SP_{max} + SP_{min}) \div 2$ $HY = (SP - SP_{min}) \div SP) \times 100$ [%]	
Values	0.0...1000.0 % of the value for SPx
Default settings	HY1 = 10.0
	HY2 = 5.0

7.2.3 STx

Start-Up Delay Time (for outputs 1/2)

Enables the suppression of error messages when a plant is started. When the device is switched on or when the 24 V signal is removed from the reset input, the respective output for the time set here is in the "good" state (= no fault).	
Values	0.0...1000.0 s
Default settings	0.0 (no start-up delay)

7.2.4 DTx

Delay Time (for outputs 1/2)

Enables a delayed switching of the outputs 1/2. The respective output switches only if the current value is above or below the switch point for more than the time set here.	
Values	0.0...1000.0 s
Default settings	0.0 (no delay time)

7.2.5 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 settings	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, SOx, 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.

9 Test mode

In the test mode the switching behaviour of the monitor can be checked, set and stored without any connected pulse pick-up. The monitor runs through a freely definable frequency range and switches the outputs according to the selected switching function and switch points.

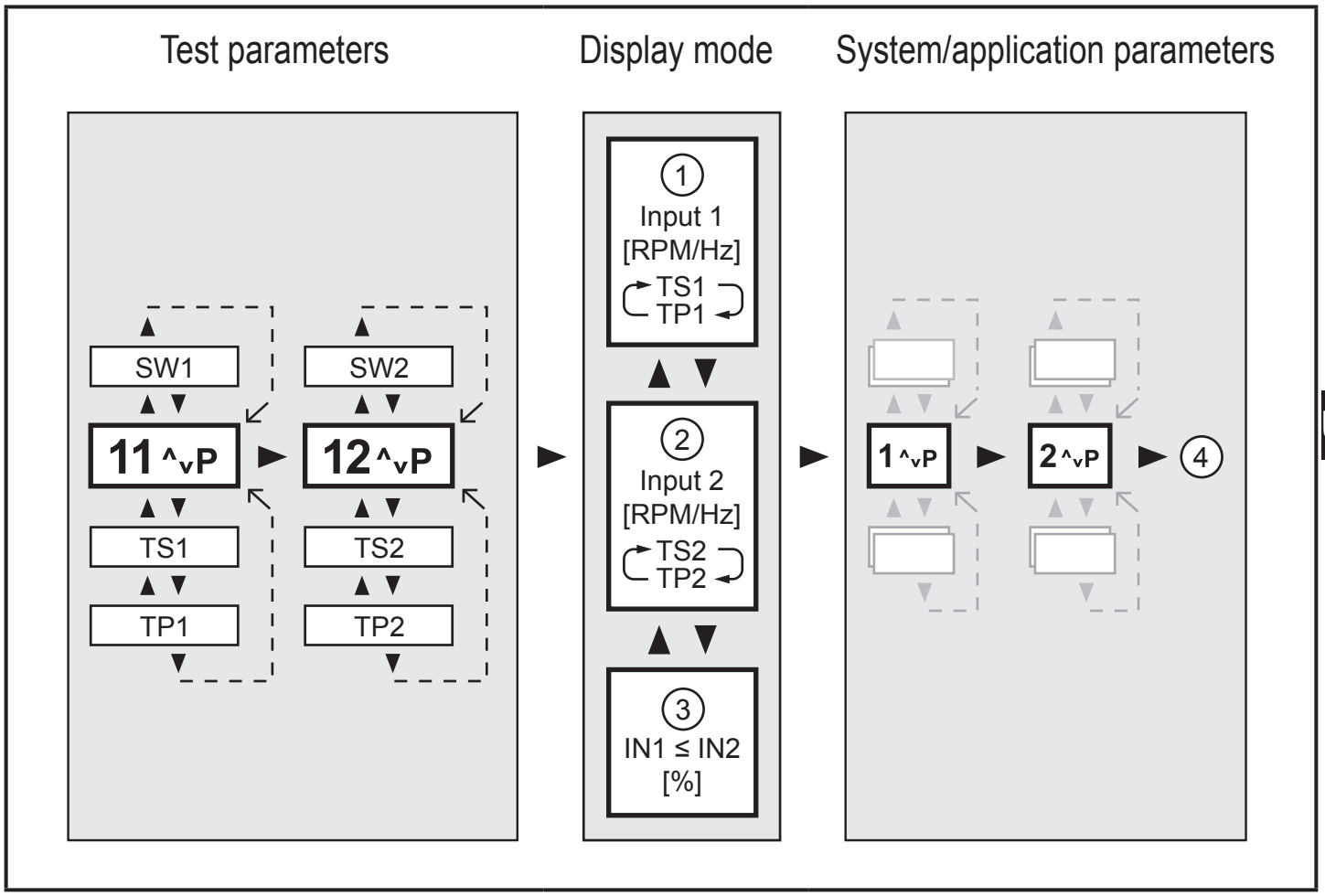
9.1 Activate the test mode

▶ Apply the operating voltage and press [Enter/▶] simultaneously.
> The display indicates the parameter range 11 and "TST".
> In addition to the system and application parameters, the parameters for the test frequency are available.

9.2 Terminate the test mode

▶ Switch off the unit.

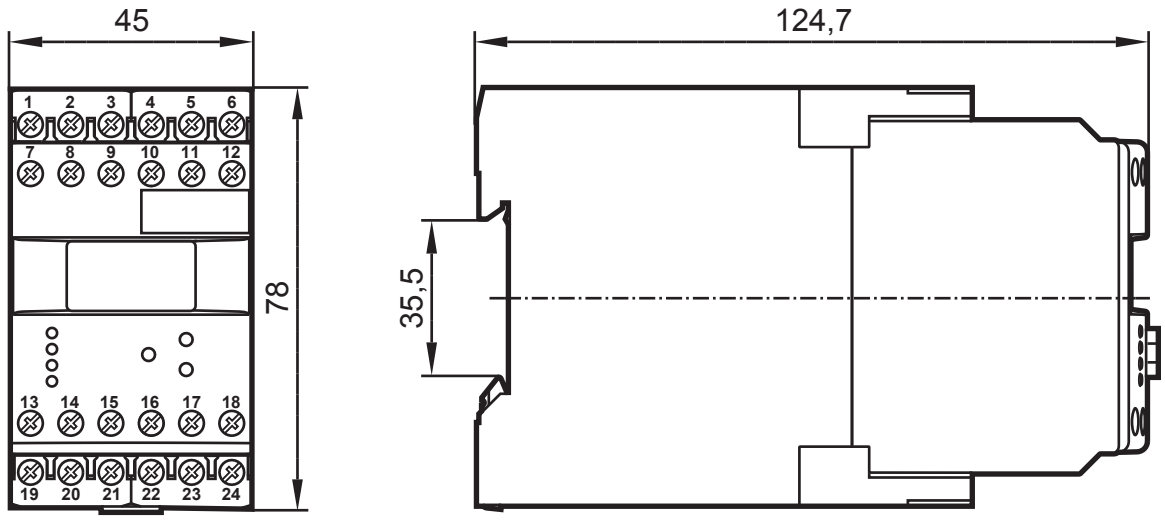
9.3 Test parameters



1: Test frequency input 1 (slave)
2: Test frequency input 2 (master)
3: Slip
4: Back to the test parameters

SWx	Sweep on input 1/2	
	Change of speed of the test frequency	
	Values	1...5 (1 = fast, 5 = slow)
	Default settings	1
TSx	Test Start on input 1/2	
	Initial value of the test frequency	
	Values	1...60,000 RPM or 0.1...1000.0 Hz
	Default settings	TS1 = 500 RPM
		TS2 = 1000 RPM
TPx	Test Stop on input 1/2	
	Final value of the test frequency	
	Values	1...60,000 RPM or 0.1...1000.0 Hz
	Default settings	TP1 = 1500 RPM
		TP2 = 1000 RPM

10 Scale drawing



11 Technical data

11.1 Overview

Art. no.	DS2503	DS2603
Monitor type	FS-1	FS-1N
Supply voltage Frequency range Power consumption	see type label	
Sensor types	PNP/NPN: NAMUR	NAMUR (to EN 50227)
Sensor supply	24 V DC	8.2 V DC
Input frequency	≤ 5 kHz	≤ 5 kHz
Relay outputs	2 changeover contacts; potential free	
Switching current	≤ 6 A	≤ 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	-40...60 °C
Storage temperature	-40...85° C	-40...85° C

Art. no.	DS2503	DS2603
Max. relative air humidity	80 % (31 °C) linearly decreasing to 50 % (40 °C)	
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.

11.2 Approvals/standards

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

12 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.