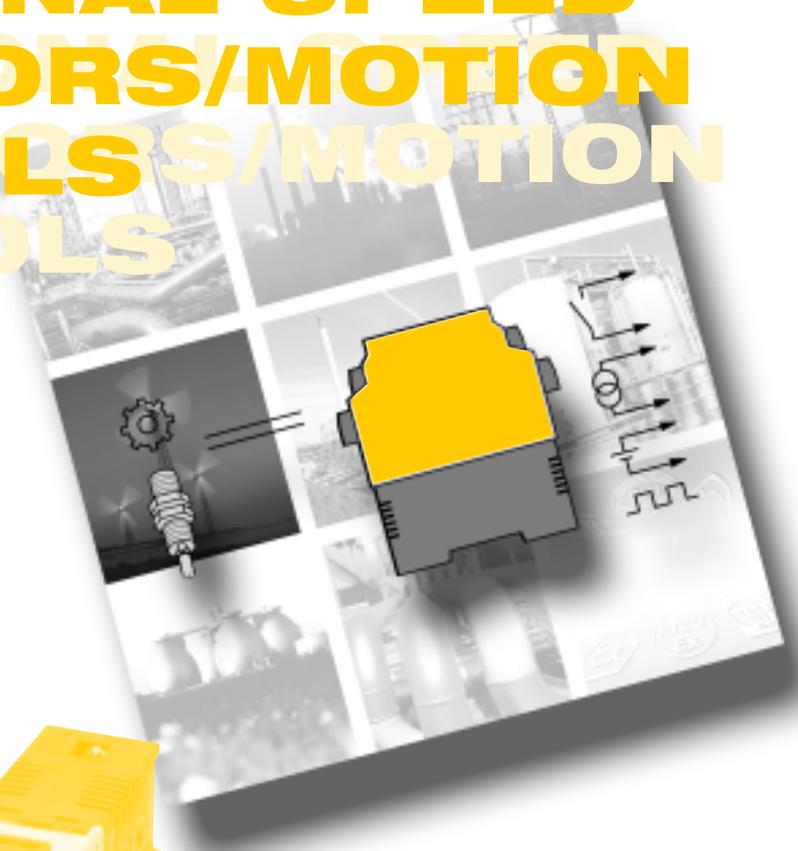


ROTATIONAL SPEED MONITORS/MOTION CONTROLS/MOTION CONTROLS



Rotational Speed Monitors and Motion Controls Selection Guide

Housing Style
multimodul
multisafe®
multicart®

	Housing																
	<i>interface modul</i>			<i>multi modul</i>			<i>multisafe®</i>						<i>multi cart®</i>				
Type	IM21-14-CDTRI	IM21-14Ex-CDTRI		MK26-22-R			MS21-12Ex0-R	MS22-Ri	MS23-R	MS23-22Ex0-R	MS24-R	MS24-112-R	MS25-Ui	MS27-R	MS28-R	MC25-144Ex0-LRP	MC25-144-LRP
Functions																	
Rotational speed meter	•	•														•	•
Rotational speed monitor	•	•					•	•			•	•		•	•	•	•
Slip monitor				•													
Direction discriminator									•	•							
Rotational speed monitor with pulse scaler																•	•
PC interface card																•	•
Operating mode																	
Analogue																	
Digital	•	•		•			•	•	•	•	•	•	•	•	•	•	•
Function																	
Underspeed	•	•					•	•	•		•	•		•	•	•	•
Overspeed	•	•					•	•			•	•				•	•
Under- and overspeed	•	•													•	•	•
Speed range																	
1:5 ... 3 000 min ⁻¹												•					
1:5 ... 10 000 min ⁻¹														•	•		
5 ... 25 000 min ⁻¹							•										
0.06 ... 100 000 min ⁻¹																	
0.6 ... 100 000 min ⁻¹								•			•		•				
0.06 ... 120 000 min ⁻¹									•								
0.06 ... 150 000 min ⁻¹									•								
0.06 ... 600 000 min ⁻¹	•	•														•	•
Galvanic isolation																	
Input to output																	
Output to supply																	
Input to supply																	
Full galvanic isolation	•	•		•			•	•	•	•	•	•	•	•	•	•	•
Input circuit																	
Intrinsically safe according to DIN 50020		•					•	•	•	•	•	•	•	•	•	•	•
NAMUR sensors (EN 60947-5-6)	•	•					•			•						•	•
24 VDC, pnp (non-intrinsically safe)	•	•						•	•		•	•	•	•	•	•	•
Sensor input	•	•						•	•		•	•	•	•	•	•	•
Input circuit monitoring	•	•		•				•	•	•	•	•	•	•	•	•	•
Output Circuit																	
Relay, SPDT per channel	2	2		2			2	1	2	2	1	1		2	2	2	2
Transistor, pnp	1	1														2	2
Pulse output, pnp	•	•									•		•	•		•	•
Alarm output											•					•	•
Current output 0/4...20 mA	•	•											•			•	•
Voltage output 0...10 V													•			•	•
Supply voltage																	
24 VDC				•												•	•
115 VAC				•													
230 VAC				•													
Universal power supply	•	•					•	•	•	•	•	•	•	•	•		
(20...250 VUC)	•	•						•	•	•	•	•	•	•	•		
(20...250 VAC/20...125 VDC)							•			•							
Approved for installation in zone 2		•															
Data sheet – see page	7	9		11			13	15	17	19	21	23	25	27	29		
																	Catalogue multicart®

Applications

In the process control industry there are many applications requiring measurement of rotation and oscillating movements. From simple functions such as monitoring speed of rotating shafts and gears, or sensing of turbine rotors, to entire production lines, rotational speed and motion controls provide the answer.

A wide range of devices with various functions are used to cover the complexity of rotational speed and motion control:

- rotational speed meters (conversion of rotational speed values into proportional current or voltage signals)
- rotational speed monitors (overspeed and underspeed detection)
- combined devices (rotational speed monitors with analogue output for automatic control and indicator functions)
- direction discriminators (detection of motion direction)
- slip monitors (monitoring of two shafts for synchronous operation)

Rotational speed monitors are available in modular housings type *interfacemodul*, *multisafe*® or *multicart*®. Several devices with intrinsically safe input circuits are available for use in hazardous areas.

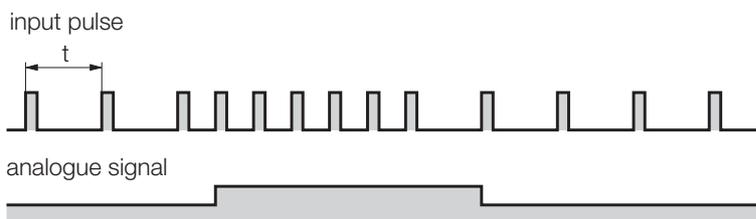


Fig. 1 Pulse-width measurement

Principle of operation

Overspeed and underspeed monitors operate on a **pulse-width measurement**. The digital system measures the time between two consecutive pulses and compares it to a defined setpoint (reference value). This enables the device to detect a deviation and activate the output after two pulse indication.

The response of devices based upon the digital pulse principle is inherently very fast. An increase in the number of pulses per revolution (more targets) allows for a quicker response, because the preset (pulses per minute) can be increased.

In devices with analogue output, the calculated time between two pulse indication is directly converted into an analogue signal. This method provides very fast response times. If only the shaft key is monitored and the rotation is slow but varies, the resulting analogue signal can have sudden changes. TURCK's rotational speed monitors use an arithmetic signal steadying method to reduce this effect.

The digital pulse-width measurement is not suited for monitoring input frequencies which are close to zero speed. Nevertheless, the digital pulse-width measurement is the only monitoring principle which provides acceptable response times in applications with low speeds.

Input sources

Non-contact proximity sensors are the most commonly used input source for devices in this field. It is also possible to use 3-wire pnp sensors. Mechanical contacts should not be used due to contact bounce and wear.

NAMUR proximity sensors (EN 60947-5-6) feature a rugged and simple 2-wire design with speeds up to 5 kHz. They are very reliable and have an excellent price-performance ratio. NAMUR sensors may also be installed in hazardous areas when used with an approved amplifier.

Unlike tacho-generators and conventional rotational pulse generators, non-contact sensors require no physical connection to the driving element in order to perform motion detection. In most cases, the speed of a rotating machine part (i.e. shafts, gears, or cams) is monitored directly so that special or additional control elements or relays are not necessary.

Response time

The response time of rotational speed monitors operating on the pulse principle is an inherent delay time, which consists of the internal processing time of the device and the pulse period duration. Devices with relay output have a typical response time of 20 ms to detect a speed deviation and activate the output. Devices with analogue output have a typical response time of 100 ms to detect a speed deviation and provide the output signal if no steadying method is used. The pulse period duration of two Pulse indication has to be added to the a.m. time value to obtain the total response time.

If the number of targets is increased, the pulse period duration (measuring time) is shortened and thus it is possible to achieve relatively short response times in applications with low speed.

Rotational Speed Meters/ Rotational Speed Monitors

Operation modes

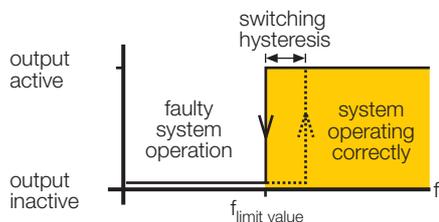
If the rotational speed is within the permissible speed range, the output is activated (relay energised, transistor conducting). If an unacceptable deviation occurs, the output de-activates (relay de-energised, transistor disabled). An input fault (detected by the input circuit monitoring function) and missing supply voltage also lead to a shut down of the output.

The rotational speed monitors provide two monitoring modes: *underspeed* and *overspeed* monitoring. The respective mode is either fixed or jumper programmable or can be adjusted when assigning the device's parameters.

A limit value ($f_{\text{limit value}}$) must be defined and set to distinguish between admissible and unacceptable speeds. A switching hysteresis is needed to cause the rotational speed monitor to switch exactly at the defined speed. Setting of the limit value and of the switching hysteresis differs between the three different basic designs and can be taken from the respective data sheets. The following settings are available: speed limit value with a fixed switching hysteresis, speed limit value and switching hysteresis (as a percentage of the limit value), switch-on and switch-off time of the output at a defined speed.

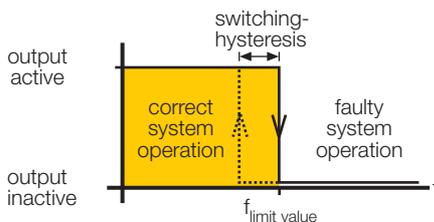
Underspeed monitoring

If the input frequency exceeds the limit value the system is operating correctly.



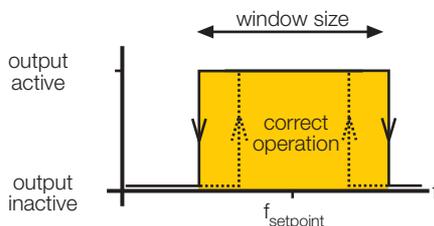
Overspeed monitoring

If the input frequency is below the preset limit value, the system is operating correctly.



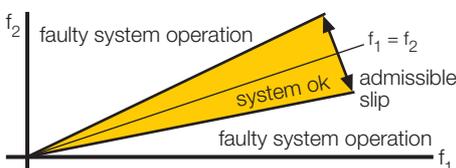
Underspeed and overspeed detection (window function)

This mode is a combination of underspeed and overspeed monitoring. If the input frequency is within the defined range (window) of the setpoint, the system is operating correctly. This mode enables selection of several parameters which are explained in the respective data sheets.



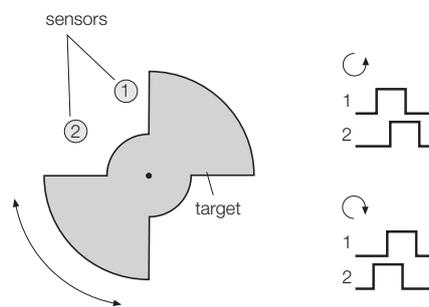
Slip monitoring

These devices are designed to compare two pulse sequences (e.g. from two rotating parts on motors, gears, turbines etc.) for slip/synchronous operation of belt-driven systems by means of sensors on both shafts. Slip monitors evaluate the deviation (in percent) of both rotational speeds. If the deviation (slip) exceeds the defined limit value, the output changes state.

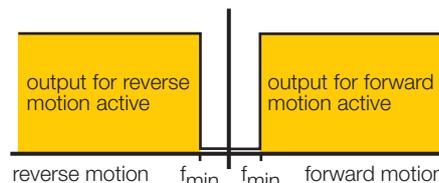


Direction discriminators

Direction discriminators are used to detect forward or reverse motion of a shaft. For this two sensors are needed which have to be attenuated in a pre-defined order: first one of the sensors is damped, then both are damped simultaneously for at least 1 ms and finally the remaining sensor is attenuated.

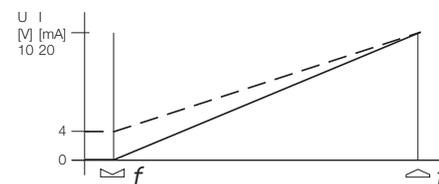


This can be achieved by an especially shaped target. If the motion direction is detected, the respective relay is energised. Further specifications can be taken from the data sheets.



Rotational speed meters

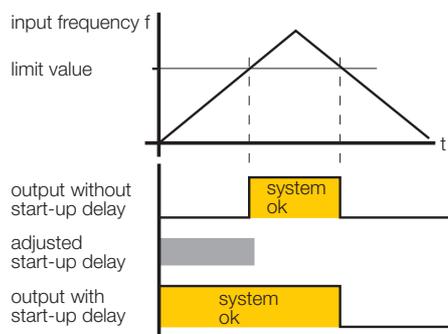
Rotational speed meters convert the measured speed value into a proportional and standardised analogue current or voltage value of 0/4...20 mA or 0...10 V.



Start-up delay

In units designed for *underspeed monitoring*, it is possible to adjust a start-up delay time during which the output relays are forced to remain energised. This prevents underspeed indications and system shut-down during the start-up phase.

The start-up time delay is triggered by a potential-free contact (auxiliary contact of the motor starter) or by applying power to the device.



Start-up alarm

A start-up alarm is required in drive systems where an increase in speed could cause a faulty operation (e.g. variable frequency based motors and D.C. drives).

In units designed for *underspeed monitoring*, it is not critical if input signals are not transmitted due to faulty control elements (wire-break, short-circuit or incorrectly aligned sensors etc.). In this case the output relays automatically de-energise.

In units designed for *overspeed monitoring*, the alarm will not be activated if the pulse indication are missing. This is especially critical in cases of missing pulse indication as the monitoring device is not able to react and this condition would remain undetected for some time.

For *overspeed monitoring* the start-up time delay is not required. Therefore, the start-up time delay function of the MS24-R device has been designed as a start-up alarm. This alarm is activated by means of an auxiliary contact on the motor starter; it monitors the pulse indication and activates the alarm relay when no pulse indication are detected.

Overrange protection

Speed monitors for overrange indication have an integrating filter incorporated into the input circuitry to protect against signal interference. Any input frequencies in excess of the upper threshold cannot be processed by the speed monitoring device and the device indicates faulty system operation.

Input frequencies which exceed the operation range but are below the threshold frequency do not generate an error indication. Input rates in excess of the threshold value are not detected.

For safety reasons a speed monitor should only be operated within the specified operation range.

Signal attenuation factor (AVR)

For overspeed monitoring, some speed monitors can be pre-programmed to steady the signal by forming a floating average from a preset adjustment factor. The floating average is formed over the adjusted number of pulses and used to calculate the rotational speed.

This signal steadying function is especially useful when operating devices with analogue output (current or voltage). The adjusted factor should match the number of targets per rotation.

Input circuit monitoring

Many rotational speed monitors feature input circuit monitoring. If a short-circuit or wire-break condition occurs in the sensor line of the connected NAMUR sensor, the relay output of the device de-energises and thus generates an error indication. If a 3-wire sensor is connected, it is only possible to monitor the current consumption of the sensor. If this value drops below 0.2 mA, the relay is de-energised.

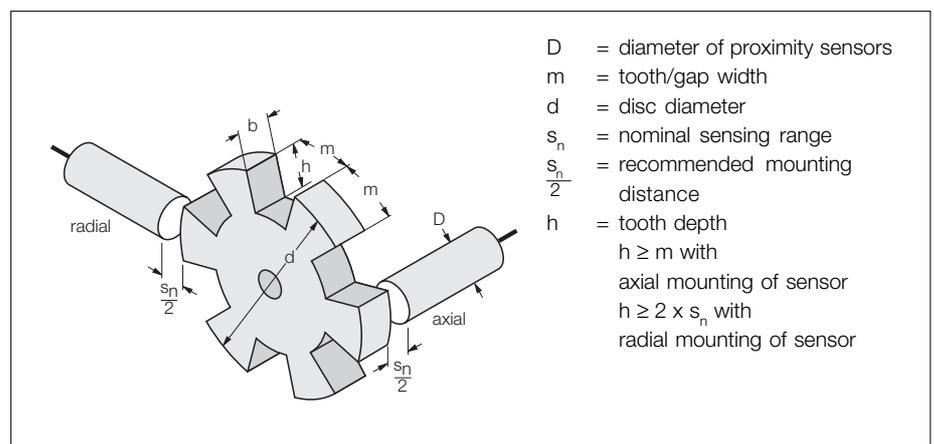


Fig. 3 Radial and axial mounting of a sensor

Rotational Speed Meters Rotational Speed Monitors

Modification of rotational speed monitors according to customer applications

To achieve fast response times of the monitoring devices usually several pulses per shaft revolution are transferred to the device. This method is not compatible with devices equipped with a display for actual speed indications. There are several possibilities to achieve accordance by setting a certain factor in the *multimodul* and *multicart*® devices. Indication and adjustment of limit values will then correspond to the number of revolutions per shaft. When using *multisafe*® devices the user must set the number of revolutions multiplied by the number of pulses per rotation.

Quite often display and measuring units other than Hz are required (e.g. min^{-1} , a converted speed value or l/h) when using a flow rate monitor. *multimodul* and *multicart*® devices with display enable programming of a conversion factor. Thus the display and settings can be adapted perfectly to the application.

Guidelines for rotational speed monitoring via inductive sensors

When inductive proximity sensors are used as input devices, the following points should be observed (contact TURCK for more specific examples):

- When using mild steel targets, the sensors must be positioned at half of the nominal sensing range.
- The correction factors for non-ferrous targets must also be considered (see sensors catalogue).
- The target surface and the distance between two surfaces should not be smaller than the sensor diameter.
- In high speed applications, it is advisable to use a larger target and to increase the distance between the targets (see EN 50010). The closer the sensor operates to its limit frequency, the larger the safety distance between the targets and the larger the target should be.

- Flush and non-flush mounted sensors require different targets due to their differing oscillating fields. Non embeddable (unshielded) units require larger metal-free areas around the sensing face (see sensors catalogue).
- The targets should be positioned symmetrically to enable the speed meter to provide a steady output signal. Subsequent signal steadying may reduce sudden signal variations of the analogue output, but cannot compensate this effect completely.
- Despite the shaft's bearing it can happen that shaft play impairs rotational speed monitoring. Therefore it is necessary to consider shaft play when mounting the sensors in their two different positions. (see page 2-5, fig. 3)
- In case of axial play in conjunction with an axially mounted sensor, it must be ensured that the shaft cannot damage the sensor. On the other hand care must be taken not to increase the distance between sensor and shaft to such an extent that detection is impossible. When using a radially mounted sensor it must be ensured that the target is broad enough to attenuate the sensor sufficiently in spite of axial play. In case of radial play the same considerations should be taken into account, even though radial play is lesser than axial play.

- When installing inductive sensors, care must be taken that metal parts, which are not part of the target, do not reach into the detection range. Different mounting distances for radially and axially mounted sensors must be observed.

Installation guidelines

The sensor-specific installation requirements are listed in the according sensor catalogues (switching distance, ambient conditions etc). It is essential to meet these requirements to ensure correct operation.

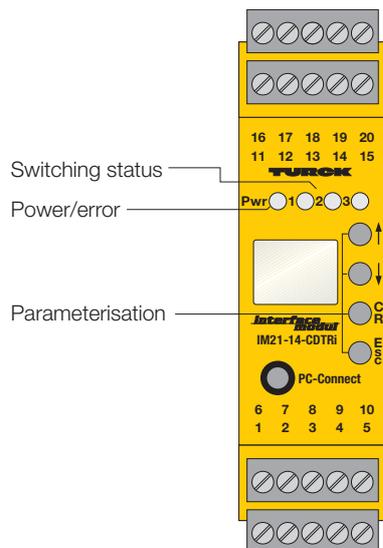
When laying sensor cables, it is requested to observe the following guidelines:

- the sensor cable should be routed separately from the power cable
- prevent electro-magnetic interferences
- if long cables are needed, it is recommended to use shielded and earthed cables
- the line resistance may not exceed 50 Ω (EN 60947-5-6); the maximum cable length is determined by the cable's cross-section:

$$l = \frac{R \times S}{\delta}$$

R = line resistance [Ω]
 S = cable cross-section [mm^2]
 δ = resistivity [$\Omega \times \text{mm}^2/\text{m}$]
 l = cable length [m]

Rotational Speed Monitor IM21-14-CDTRi 1-channel



- **1-channel rotational speed monitor**
- **Frequency to current converter**
- **Overspeed and underspeed detection plus window function**
- **Detection range 1 mHz...10 kHz (0.06...600 000 pulses/min⁻¹)**
- **For use with sensors according to EN 60947-5-6 (NAMUR)**
- **Connection of three-wire sensors and external signal sources 5...30 VDC**
- **2 Relay and 1 transistor output which can be configured as**
 - alarm output
 - two-point controllers (switch on/off point)
 - four point controllers (window function)
 - pulse divider (transistor only)
- **Current output 0/4...20 mA (invertible)**
- **Pulse output**
- **Programmable behaviour of the analogue output with faults in the input circuit**
- **Simple parameterisation and measured value detection via**
 - four panel push buttons
 - FDT/DTM and PACTware™ interface
 - current interface with HART® protocol
- **Ring buffer for storing the measured values**
- **Read access to diagnostic bits via FDT/DTM**
- **Universal operating voltage (20...250 VAC/20...250 VDC)**

The IM21-14-CDTRi is a rotational speed monitor designed to monitor pulse sequences from rotating shafts on motors, gears, turbines etc., for overspeed and underspeed conditions. A display located on the front cover indicates the actual value.

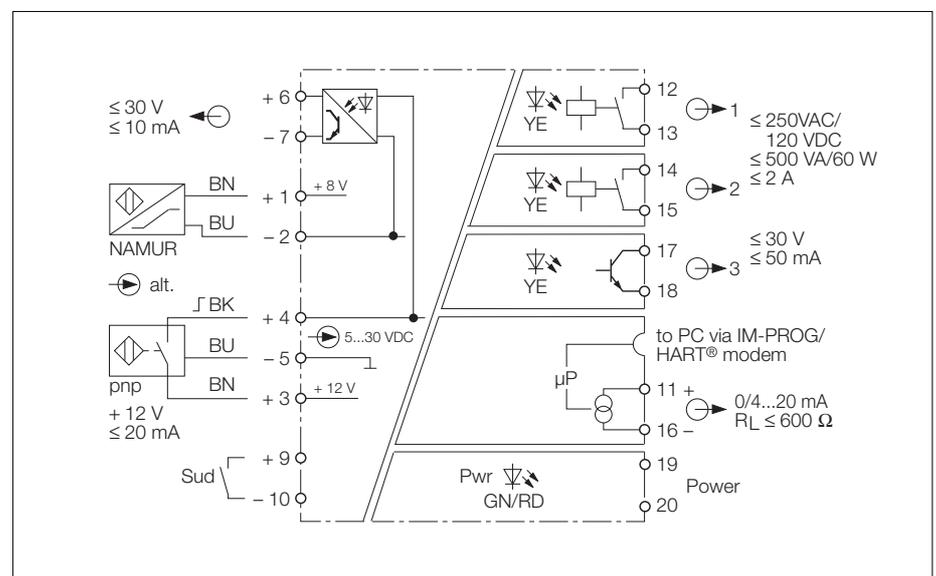
The switching status of the correspondent output relay i.e. transistor is indicated by a yellow LED; operational readiness is indicated by a green LED. The input pulse is indicated on the display.

Sensors per EN 60947-5-6 (NAMUR), 3-wire sensors or external signal sources (5...30 VDC) may be used for signal detection. When using NAMUR sensors, line monitoring for short-circuit and/or wire-break conditions may be adjusted.

In case of input-circuit errors the relays are de-energised, the transistor is blocked and the Power-LED (Pwr) changes to red. 3-wire pnp sensors can be powered with 12 V (≤ 20 mA) by the rotational speed monitor.

External signal sources must have a signal range from 5...30 VDC. The potential-free pulse output provides the input signal for additional processors.

To provide fast response times for applications with relatively low speed, the device operates on a digital pulse principle. High speed monitoring is based on a time window. In low-speed applications, the response time depends on the pulse period.



Rotational Speed Monitor IM21-14-CDTRi

The menu-assisted parameterisation is implemented with four push buttons. The settings are shown on the display.

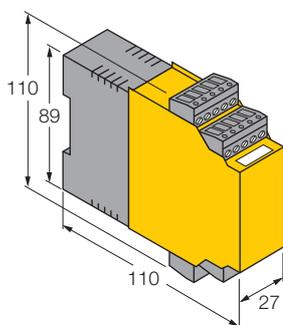
All outputs can be programmed separately for either overspeed or underspeed detection. The both relay outputs can be programmed as a window function – a combination of both. The transistor output can also be used as a pulse divider.

The measured value is written permanently into a ring buffer with 8000 measuring points. A predefined trigger event is necessary to stop the write procedure, e.g. when a limit value is exceeded. The recorded behaviour of the signal can be read out afterwards.

The switching hysteresis is defined by the adjustable switch ON and OFF points. Further it is possible to adjust a separate switch-off time for each output to prevent the device from shutting down due to sudden short-term changes of the frequency. An adjustable latching function prevents the output relay from re-energizing.

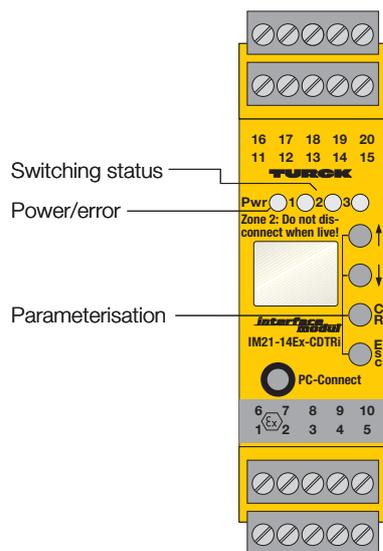
The outputs operate in the normally open mode; i.e. the output is switch-on if the speed is within the acceptable range.

The actual speed and the limit value settings are displayed in Hz. By adjusting a time basis and programming the number of pulses per rotation, it is possible to adjust all settings and the display to the required measuring unit. Suppose, the display should be in min^{-1} instead of Hz, the time-based factor adjustment would be 60.



Type	IM21-14-CDTRi
Ident-no.	7505650
Supply voltage U_B	20...250 VAC/20...250 VDC
Line frequency (AC)	40...70 Hz
Current consumption	≤ 3 W (unipolar)
Galvanic isolation	between input circuit and output circuit and supply voltage for 250 V _{rms} test voltage 2,5 kV _{rms}
Rotational speed monitoring	underspeed/overspeed
Monitoring range/adjustable range	0.06...600000 min^{-1} (digitally adjustable)
– Input frequency	≤ 1200000 min^{-1} (20 kHz)
Pulse duration	≥ 0.02 ms
Pulse pause	≥ 0.02 ms
Start-up time delay	0...1000 s (adjustable)
Input circuits	
NAMUR input	acc. to EN 60947-5-6, (NAMUR)
– Operating values	$U_0 = 8.2$ V; $I_k = 8.2$ mA
– Switching threshold	1.55 mA
– Switching hysteresis	0.2 mA
– Wire-break threshold	≤ 0.1 mA
– Short-circuit threshold	≥ 6 mA
3-wire sensor	
– voltage	12 V
– current (no-load current)	≤ 20 mA
External signal source	
– 0-signal	0...3 V
– 1-signal	5...30 V
– Input resistance	26 k Ω
Output circuits	
Relay output	two relays / one transistor 2 change-over contacts
– Switching voltage	≤ 250 V
– Switching current	≤ 2 A
– Switching capacity	≤ 500 VA/60 W
– Switching frequency	≤ 5 Hz
– Contact material	Ag-alloy + 3 μm Au
Pulse output	
– External voltage	< 30 V
– Current	≤ 10 mA
Transistor output	potential-free, short-circuit protected
– Switching voltage	≤ 30 VDC
– Switching current per output	≤ 50 mA
– Switching frequency	≤ 10 kHz
– Voltage drop	$\leq 1,3$ V
Current output	0/4...20 mA (invertible)
Measured value memory	
Number of measuring points	8000
Measurement interval and trigger event	adjustable via DTM
Pre-trigger/post-trigger length, minimum...maximum (increment size):	1st range: 0 s...600 s (1 s), 2nd range: 10 min...600 min (1 min) 3rd range: 10 h...600 h (1 h)
LED indications	
Power/Error	green/red (two-colour LED)
Switching status	3 x yellow
Display	LCD
Pulse indication	on display
Housing	20 poles, 27 mm wide, Polycarbonat/ABS, flammability class V-0 per UL94
Mounting	snap-on hat rail (DIN 50022) or panel screw mounting
Connection	removable terminal blocks, polarity protected screw connection, self-lifting
Connection profile	$\leq 1 \times 2.5$ mm ² , 2×1.5 mm ² or 2×1.0 mm ² with wire sleeves
Degree of protection (IEC 60529/EN 60529)	IP20
Operating temperature	-25...+70 °C

Rotational Speed Monitor IM21-14Ex-CDTRi 1-channel



- **1-channel rotational speed monitor**
- **Intrinsically safe input circuit EEx ia**
- **Area of application according to ATEX: II (1) GD, II 3 G**
- **Approved for installation in zone 2, however the device must be installed in a housing which complies with the requirements of EN 60079-15 with a minimum protection degree of IP54**
- **Frequency to current converter**
- **Overspeed and underspeed detection plus window function**
- **Detection range 1 mHz...10 kHz (0.06...600 000 pulses/min⁻¹)**
- **For use with sensors according to EN 60947-5-6 (NAMUR)**
- **2 Relay and 1 transistor output which can be configured as**
 - alarm output
 - two-point controllers (switch on/off point)
 - four point controllers (window function)
 - pulse divider (transistor only)
- **Current output 0/4...20 mA (invertible)**
- **Pulse output**
- **Programmable behaviour of the analogue output with faults in the input circuit**
- **Simple parameterisation and measured value detection via**
 - four panel push buttons
 - FDT/DTM and PACTware™ interface
 - current interface with HART® protocol
- **Ring buffer for storing the measured values**
- **Read access to diagnostic bits via FDT/DTM**
- **Universal operating voltage (20...250 VAC/20...250 VDC)**

The IM21-14Ex-CDTRi is a rotational speed monitor designed to monitor pulse sequences from rotating shafts on motors, gears, turbines etc., for overspeed and underspeed conditions. A display located on the front cover indicates the actual value.

The switching status of the correspondent output relay i.e. transistor is indicated by a yellow LED; operational readiness is indicated by a green LED. The input pulse is indicated on the display.

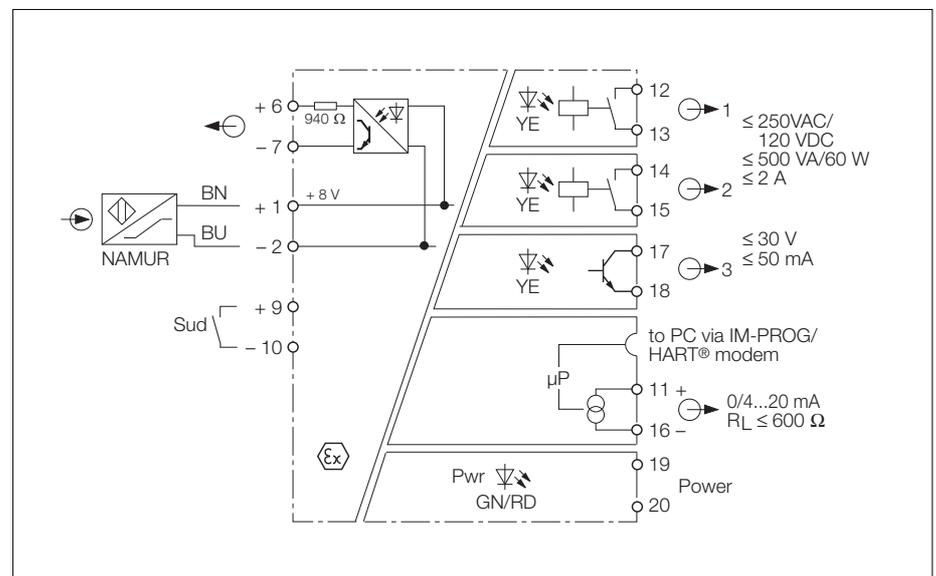
Intrinsically safe sensors per EN 60947-5-6 (NAMUR), may be used for signal detection. Line monitoring for short-circuit and/or wire-break conditions may be adjusted.

In case of input-circuit errors the relays are de-energised, the transistor is blocked and the Power-LED (Pwr) changes to red.

The potential-free pulse output provides the input signal for additional processors.

To provide fast response times for applications with relatively low speed, the device operates on a digital pulse principle. High speed monitoring is based on a time window. In low-speed applications, the response time depends on the pulse period.

The menu-assisted parameterisation is implemented with four push buttons. The settings are shown on the display.



Rotational Speed Monitor IM21-14Ex-CDTRi

All outputs can be programmed separately for either overspeed or underspeed detection. The both relay outputs can be programmed as a window function – a combination of both. The transistor output can also be used as a pulse divider.

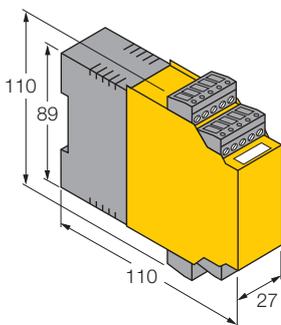
The measured value is written permanently into a ring buffer with 8000 measuring points. A predefined trigger event is necessary to stop the write procedure, e.g. when a limit value is exceeded. The recorded behaviour of the signal can be read out afterwards.

The switching hysteresis is defined by the adjustable switch ON and OFF points. Further it is possible to adjust a separate switch-off time for each output to prevent the device from shutting down due to sudden short-term changes of the frequency.

An adjustable latching function prevents the output relay from re-energizing.

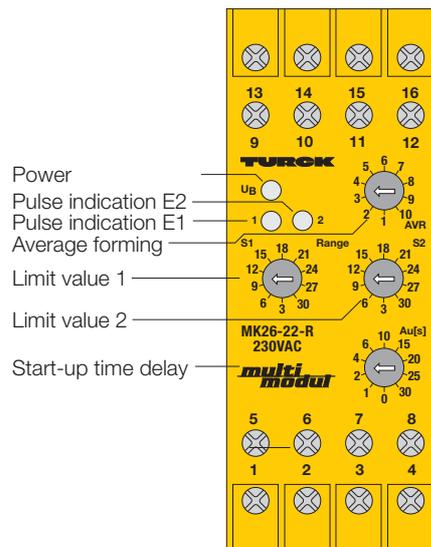
The outputs operate in the normally open mode; i.e. the output is switch-on if the speed is within the acceptable range.

The actual speed and the limit value settings are displayed in Hz. By adjusting a time basis and programming the number of pulses per rotation, it is possible to adjust all settings and the display to the required measuring unit. Suppose, the display should be in min^{-1} instead of Hz, the time-based factor adjustment would be 60.



Type Ident-no.	IM21-14Ex-CDTRi 7505651
Supply voltage U_B Line frequency (AC) Current consumption Galvanic isolation	20...250 VAC/20...250 VDC 40...70 Hz ≤ 3 W (unipolar) between input circuit an output circuit and supply voltage for 250 V_{rms} , test voltage 2,5 kV_{rms}
Rotational speed monitoring Monitoring range/adjustable range – Input frequency Pulse duration Pulse pause Start-up time delay	underspeed/overspeed 0.06...600000 min^{-1} (digitally adjustable) ≤ 1200000 min^{-1} (20 kHz) ≥ 0.02 ms ≥ 0.02 ms 0...1000 s (adjustable)
Input circuits NAMUR input – Operating values – Switching threshold – Switching hysteresis – Wire-break threshold – Short-circuit threshold	intrinsically safe acc. to EN 60079-11 acc. to EN 60947-5-6, (NAMUR) $U_0 = 8.2$ V; $I_k = 8.2$ mA 1.55 mA 0.2 mA ≤ 0.1 mA ≥ 6 mA
Output circuits Relay output – Switching voltage – Switching current – Switching capacity – Switching frequency – Contact material Pulse output – External voltage – Current Transistor output – Switching voltage – Switching current per output – Switching frequency – Voltage drop Current output	two relays / one transistor 2 change-over contacts ≤ 250 V ≤ 2 A ≤ 500 VA/60 W ≤ 5 Hz Ag-alloy + 3 μm Au < 30 V ≤ 10 mA potential-free, short-circuit protected ≤ 30 VDC ≤ 50 mA ≤ 10 kHz $\leq 1,3$ V 0/4...20 mA (invertible)
Ex-Approval acc. to certificate of conformity Maximum nominal values – No load voltage U_0 – Short-circuit current I_0 – Power P_0 Maximum external inductances/capacitances – [Ex ia] IIC – [Ex ia] IIB – Ex nL IIC – Ex nL IIB Marking of device	IBEXU 07 ATEX 1132/IBEXU 07 ATEX B 010 X ≤ 9.6 V $\leq 10,7$ mA ≤ 25 mW 100/5/1 mH/10 μH / 510/840 nF/1,2/3,6 μF 100/5/1 mH/10 μH / 2,7/4,4/6,3/26 μF 100/5/1 mH/10 μH / 765 nF/1,2/1,8/5,4 μF 100/5/1 mH/10 μH / 4,0/6,6/9,4/39 μF Ⓔ II (1) GD [Ex ia] IIC/IIB II 3 G Ex nA nC [nL] IIC/IIB T4
Measured value memory Number of measuring points Measurement interval and trigger event Pre-trigger/post-trigger length, minimum...maximum (increment size):	8000 adjustable via DTM 1st range: 0 s...600 s (1 s), 2nd range: 10 min...600 min (1 min) 3rd range: 10 h...600 h (1 h)
LED indications Power/Error Switching status Display Pulse indication	green/red (two-colour LED) 3 x yellow LCD on display
Housing Mounting Connection Connection profile Degree of protection (IEC 60529/EN 60529) Operating temperature	20 poles, 27 mm wide, Polycarbonat/ABS, flammability class V-0 per UL94 snap-on hat rail (DIN 50022) or panel screw mounting removable terminal blocks, polarity protected screw connection, self-lifting $\leq 1 \times 2.5$ mm ² , 2×1.5 mm ² or 2×1.0 mm ² with wire sleeves IP20 -25...+70 °C

Slip Monitor MK26-22-R/24VDC MK26-22-R/230VAC 1-channel



- **1-channel slip monitor**
- **Rotational speed monitoring of two rotating parts for slip/synchronous operation**
- **For use with sensors according to EN 60947-5-6 (NAMUR)**
- **Operating range up to 150 000 min⁻¹**
- **Detection range 3...30 % slip**
- **Simple parameterisation:**
 - **Two independent switch points (limit values)**
 - **Setting of limit values in %**
 - **Selectable NO/NC relay output functions**
 - **Start-up time delay**
 - **Signal steadying (average forming)**
- **Galvanic isolation between input circuit, output circuit and supply voltage**
- **2 relay outputs, each with one SPDT contact**

The MK26-22-R is a rotational speed monitor designed to compare two pulse sequences (e.g. from two rotating parts on motors, gears, turbines etc.) and to monitor these sequences for slip/synchronous operation. This makes the device especially suitable for belt-drive and conveyor belt monitoring.

To monitor slip, i.e the difference between the two rotational speeds, two independen-

dent limit values can be adjusted. Thus one relay output can be used for alarm indications and the other relay output for shut-down functions.

Each limit value can be adjusted separately via a rotary switch in a range of 3...30 % in ten steps.

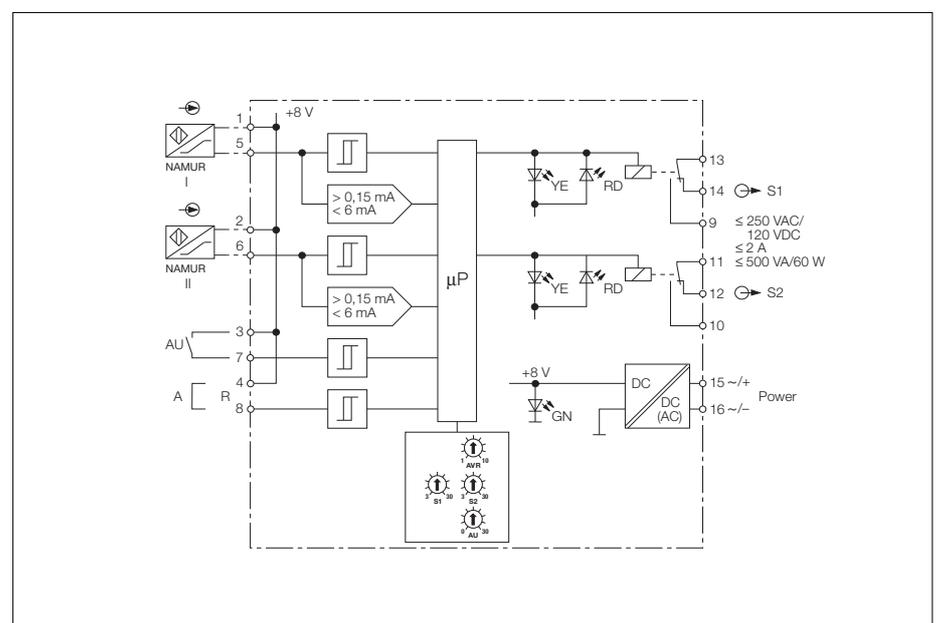
The device provides selectable output functions of the limit value relays to match the individual application. The limit value relays can be programmed for normally open mode (system working correctly: relays de-energised) or for normally closed mode (system working correctly: relays energised). Linking terminals 4/8 selects the NO mode while leaving them open provides the NC mode. The green LED indicates that the devices are powered.

Both limit value relays S1 and S2 are monitored by a separate dual colour LED.

An illuminated yellow LED indicates that the respective relay is energised.

The two NAMUR inputs are monitored for wire-break and short-circuit. If the NC mode has been selected and a fault in the input circuit occurs, both limit value relays de-energise; in the NO mode both relays energise for approx. 20 ms. Insufficient supply voltage during operation is also indicated by a short activation of the relays for 20 ms.

A fault in the input circuit (I) is indicated by the illuminated red LED of limit value relay S1; a fault in the input circuit (II) by the red LED of relay S2.



Slip Monitor MK26-22-R

A green LED indicates that the device is powered.

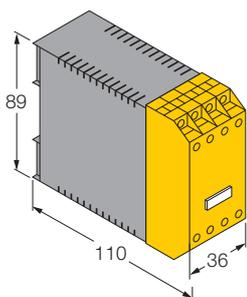
A floating average can be formed to steady the input signals of both inputs. This is especially important if more than one target per revolution is to be monitored. Via the rotary switch AVR up to ten cycles can be adjusted to form the average.

For the start-up phase of the drive a start-up time delay between 0.3...30 s can be selected in ten steps using the according rotary switch. In the NC mode the output relays are energised during the selected start-up delay time to prevent system shut-down due to an underspeed indication.

The start-up time delay can be activated by a potential-free NO contact or by applying supply voltage (terminals 3 and 7 linked).

In the NO mode, the relays remain de-energised during system start-up.

During normal operation, the frequency of the pulse sequences of the sensors must be identical. If shafts with different rotational speeds are monitored, it is required to use an appropriate number of targets to generate an identical frequency.



Slip monitoring

Monitoring range	0.06...150 000 min ⁻¹
– Input frequency	≤ 300 000 min ⁻¹ (5 kHz)
Pause duration	≥ 0.1 ms
Pulse duration	≥ 0.1 ms
Start-up time delay	0.1...30 s (adjustable)

Input circuits

NAMUR input	according to EN 60947-5-6, terminals 5/6
– Operating characteristics	$U_0 = 8.2 \text{ V}; I_k = 8.2 \text{ mA}$
– Switching threshold	1.55 mA
– Switching hysteresis	0.2 mA
– Wire-break trip point	≤ 0.1 mA
– Short-circuit trip point	≥ 6 mA

Galvanic isolation

between input circuit, output circuit and supply voltage for 250 V_{rms}, test voltage 2.5 kV_{rms}

Output circuits

Relay output	2 SPDT contacts
– Switching voltage	≤ 250 V
– Switching current	≤ 2 A
– Switching capacity	≤ 500 VA/60 W
– Contact material	silver-alloy + 3 μm Au

LED indications

– Power	green
– Status indication/fault indication	yellow/red (two 2-colour LEDs)

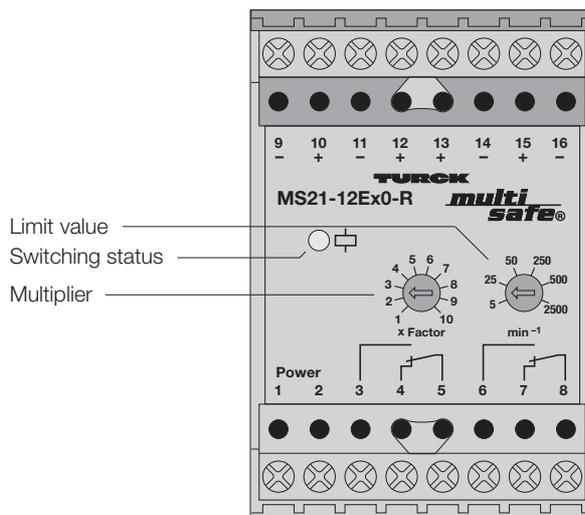
Housing

Mounting	16-pole, 36 mm wide, Polycarbonate/ABS flammability class V-0 per UL 94 panel mounting or snap-on clamps for top-hat rail (DIN 50022)
Connection	screw terminals with self-lifting pressure plates
Connection profile	≤ 2 x 2.5 mm ² or 2 x 1.5 mm ² with wire sleeves
Degree of protection (IEC 60529/EN 60529)	IP20
Operating temperature	-25...+60 °C

multimodul Slip Monitor MK26-22-R

Type	Ident-no.	Supply voltage U_B	Line frequency	Ripple W_{pp}	Power consumption
MK26-22-R/230VAC	7543501	184 ... 264 VAC	48...62 Hz	–	≤ 5 VA
MK26-22-R/24VDC	7543503	19.2 ... 28.8 VDC	–	≤ 10 %	≤ 5 W

Rotational Speed Monitor MS21-12Ex0-R 1-channel



- **1-channel rotational speed monitor**
- **Overspeed or underspeed detection**
- **Intrinsically safe input circuit EEx ia**
- **Area of application according to ATEX: II (1) GD, I (M1)**
- **For use with NAMUR sensors (EN 60947-5-6)**
- **Detection range from 5...25 000 min⁻¹ (six overlapping ranges)**
- **Adjustable start-up time delay**
- **Overrange of up to 60 000 min⁻¹**
- **Galvanic isolation between input circuit, output circuit and power supply**
- **Relay output with two SPDT contacts**
- **Universal supply voltage (20...250 VAC/20...125 VDC)**

The MS21-12Ex0-R is a single channel rotational speed monitor with an intrinsically safe input circuit. It has one relay output with two SPDT contacts.

The device monitors for overspeed when terminals 11 and 12 are jumpered; it monitors for underspeed when terminals 11 and 12 are open.

The device has six overlapping measuring ranges. The range selection is the product of the front panel switch and potentiometer settings.

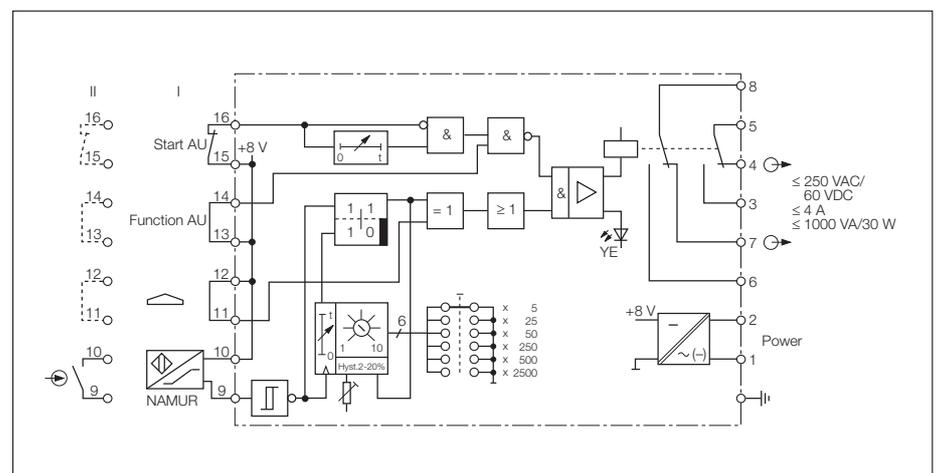
The unit operates on the digital pulse principle. This method provides a fast response and is ideal for applications with relatively low speed. A yellow LED indicates the status of the output relay.

Start-up time delay (AU time) from 0...60 seconds may be adjusted via a potentiometer which is accessible after removing the black front cover. The time delay inhibits speed monitoring and alarm indications during system start-up. The start-up time delay is enabled under two conditions:

- when using a potential-free N.C. contact between terminals 15 and 16.
- if terminals 15 and 16 are open when power is applied to terminals 1 and 2.

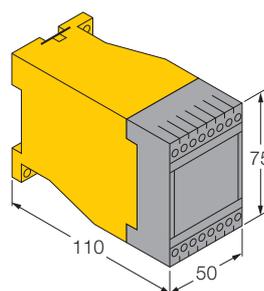
During the start-up time delay, the output relays will be energised if terminals 13/14 are open and de-energised if they are linked.

The switching hysteresis and the start-up time delay are adjusted by means of a potentiometer inside the device which is accessed by removal of the front cover.

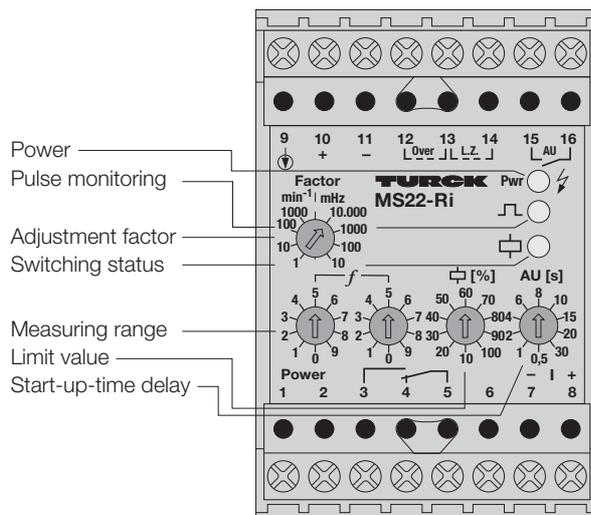


Rotational Speed Monitor MS21-12Ex0-R

Type	MS21-12Ex0-R
Ident-no.	5341106
Supply voltage U_B	20...250 VAC/20...125 VDC
Line frequency (AC)	40...70 Hz
Power consumption	≤ 3 W
Galvanic isolation	between input circuit, output circuit and supply voltage for 250 V _{rms} test voltage 2.5 kV _{rms}
Function	overspeed/underspeed
Speed range	5...25 000 pulses/min ⁻¹ (6 subranges)
– Range 1	5...50 pulses/min ⁻¹
– Range 2	25...250 pulses/min ⁻¹
– Range 3	50...500 pulses/min ⁻¹
– Range 4	250...2 500 pulses/min ⁻¹
– Range 5	500...5 000 pulses/min ⁻¹
– Range 6	2 500...25 000 pulses/min ⁻¹
Minimum pulse duration	≥ 0.5 ms
Minimum pause duration	≥ 0.5 ms
Hysteresis	2...20 % (adjustable, preset at 5 %)
Start-up time delay	0...60 s (adjustable, preset at 15 s)
Repeatability	≤ 1 % (T _a constant temperature)
Input circuits	EN 60947-5-6 (NAMUR), intrinsically safe according EN 50020
Operating characteristics	
– Voltage	8 V
– Current	8 mA
Switching threshold	1.55 mA
Output circuits	relay output
Number of contacts	2 SPDT contacts, AgCdO
Switching voltage	≤ 250 VAC/60 VDC
Switching current	≤ 4 A
Switching capacity	≤ 1000 VA/30 W
Ex-Approval acc. to certificate of conformity	DMT 01 ATEX E 119
Maximum nominal values	
– No load voltage U_0	11.0 V
– Short-circuit current I_0	55 mA
– Power P_0	150 mW
– Safety voltage U_m	250 VAC/125VDC
Max. external inductances/capacitances L_0/C_0	
– [EEx ia] IIC	1 mH/500 nF
– [EEx ia] IIB	3 mH/2500 nF
– [EEx ia] I	10 mH/10 μF
Marking of device	Ⓔ II (1) GD [EEx ia] IIC I (M1) [EEx ia] I
LED indications	
– Switching status	yellow
Housing	50 mm wide, Polycarbonate/ABS
Mounting	panel mounting or snap-on clamps for top-hat rail (DIN 50022)
Connection	2 x 8 self-lifting pressure plates
Connection profile	≤ 2 x 2.5 mm ² or 2 x 1.5 mm ² with wire sleeves
Protection type (IEC 529/DIN 40050-9)	IP 20
Operating temperature	-25...+60 °C

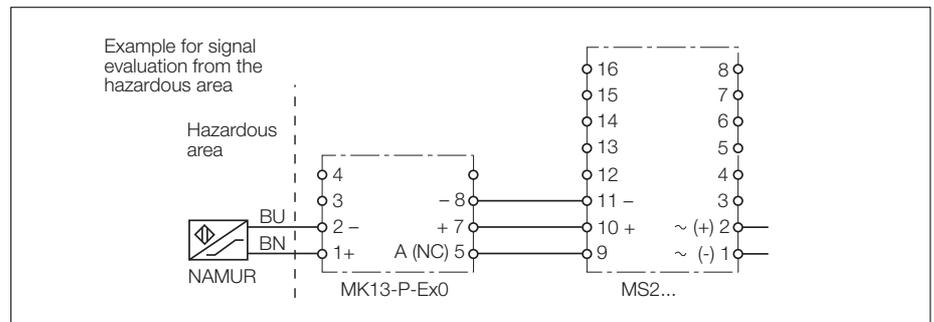


Rotational Speed Monitor MS22-Ri with Analogue Output 1-channel



2

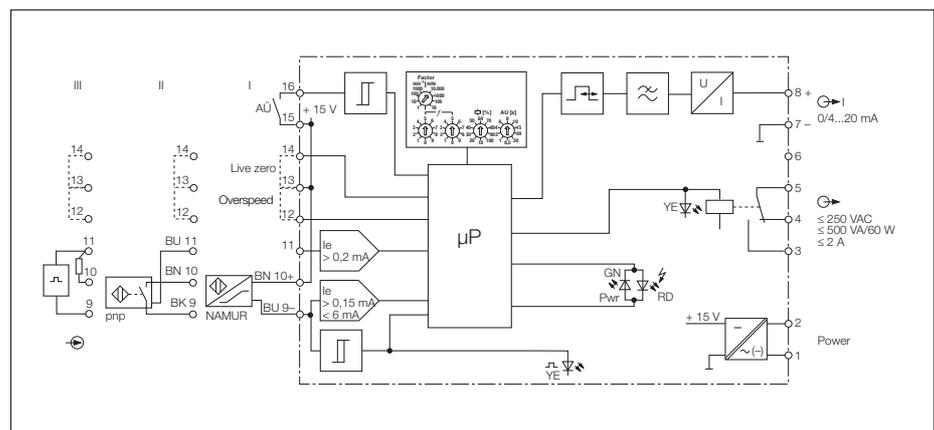
- 1-channel rotational speed monitor with analogue output
- Overspeed or underspeed detection
- For use with sensors conforming to EN 60947-5-6 (NAMUR) with input circuit monitoring, 3-wire pnp sensors and signal sources with pulse levels from 10...30 VDC
- Additional analogue output 0...20 mA or 4...20 mA
- Detection range from 0.01...1 660 Hz (0.6...100 000 pulses/min⁻¹)
- Digitally adjustable setpoints in Hz or pulses/min⁻¹
- Excellent temperature stability and linearity
- Optional start-up time delay
- Relay output with one SPDT contact
- Sealed relay with hard gold-plated contacts
- Universal supply voltage (20...250 VAC/20...125 VDC)



In addition to the relay output, the rotational speed monitor MS22-Ri features an analogue output of 0/4 to 20 mA. 3-wire pnp sensors, sensors according to EN 60947-5-6 or signals between 10 and 30 VDC may be connected. If connected to NAMUR sensors, the input control circuit is monitored for both wire-break and short-circuit conditions. When a fault occurs, the dual colour LED, indicating operational readiness, changes from green to red and the output relay de-energises independently of the programmed monitoring mode.

The yellow input LED enables distinction between wire-break and short-circuit (wire-break: LED off). In case of an error, the output current will go to 0. Thus fault conditions can be detected in subsequent processing or display devices.

If 3-wire sensors are used, wire-break detection applies only to the supply line. Wire-break or short-circuit on the output line of the sensor are not detected. If external sources are connected, terminals 11 and 9 should be used. Suppression of fault signals can be



Rotational Speed Monitor MS22-Ri

accomplished with a 1...10 k Ω resistor between terminals 10 and 11.

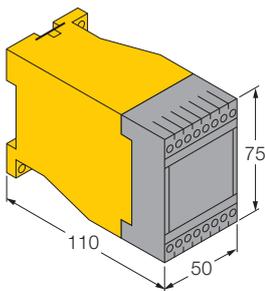
Leaving terminals 12/13 open activates the underspeed monitoring mode: when the limit value is underranged, the relay de-energises.

Linking terminals 12/13 selects the *overspeed* monitoring mode; when the limit value is exceeded the relay de-energises.

The device operates on the digital pulse method which shortens reaction times in applications where pulses occur infrequently. A standard analogue output signal, which is proportional to the measured rotational speed, is provided additionally for control and monitoring purposes. By linking terminals 13/14, the analogue signal can be changed from 0...20 mA to 4...20 mA.

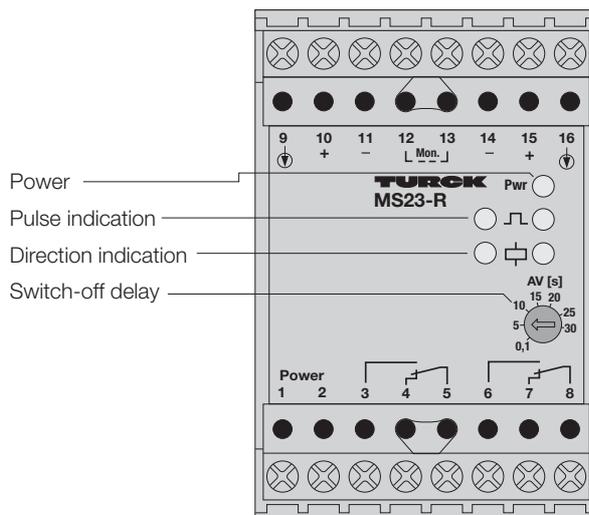
The upper end value of the measuring range is adjusted digitally using three rotary switches on the device front and assigned to an analogue output value of 20 mA. Below 0.6 min⁻¹ the output current adopts the value 0/4 mA. Within the selected measuring range, the switch point is adjustable as a percentage between 10 and 100 % of the upper end value by means of an additional rotary switch. The output relay status is indicated by a yellow LED.

In the *underspeed* monitoring mode, a fixed start-up time delay (AU-time) of 15 s is provided. The output relay is energised during the start-up time delay. Consequently underspeed indications are inhibited during system start-up. The time delay is activated by a potential-free contact between terminals 15/16 when the device is on, or by linking terminals 15/16 and then applying power to the device.



Type	MS22-Ri
Ident-no.	0508010
Supply voltage U_B	20...250 VUC
Line frequency (AC)	40...70 Hz
Power consumption	≤ 3 W
Galvanic isolation	input circuit to output circuit and supply voltage for 250 V _{rms} test voltage 2,5 kV _{rms}
Rotational speed monitoring	overspeed/underspeed
Measuring range	0.01...1660 Hz or 0.6...100 000 min ⁻¹
Switch point adjustment range	10...100 %
Input frequency	≤ 150 000 min ⁻¹
Pause duration	≥ 0.2 ms
Pulse duration	≥ 0.2 ms
Hysteresis	approx. 10 %
Start-up time delay	0.5...30 s (adjustable, 10 positions)
Temperature drift frequency	≤ 0.005 %/K
Temperature drift analogue output	≤ 0.005 %/K
Linearity error	≤ 0.1 % v.E.
Clearences and creepage distances	
- Input and output circuit to power supply	≥ 4 mm
- Input circuit to power supply	≥ 4 mm
Input circuits	NAMUR/3-wire, pnp
NAMUR input	according to EN 60947-5-6, terminals 9/10
- Operating characteristics	$U_0 = 8.2$ V; $I_k = 8.2$ mA
- Switching thresholds	1.4 mA $\leq I_e \leq 1.8$ mA
- Wire-break trip point	≤ 0.15 mA
- Short-circuit trip point	≥ 6 mA
3-wire input	pnp, terminals 9...11
- Operating characteristics	$U \leq 15$ V; $I \leq 30$ mA
- "OFF" signal	0...5 VDC
- "ON" signal	10...30 VDC
Output circuits	1 relay output and 1 analogue output
Relay output	1 SPDT contact
- Switching voltage	≤ 250 V
- Switching current	≤ 2 A
- Switching capacity	≤ 500 VA/60 W
- Contact material	silver-alloy + 3 μ m Au
Analogue output	
- Current source	0/4...20 mA (load ≤ 600 Ω)
LED indications	
- Power/Fault indication	green/red (2-colour LED)
- Switching status	yellow
- Pulse monitoring	yellow
Housing	50 mm wide, Polycarbonate/ABS
Mounting	panel mounting or snap-on clamps for top-hat rail (DIN 50022)
Connection	2 x 8 self-lifting pressure plates
Connection profile	≤ 2 x 2.5 mm ² or 2 x 1.5 mm ² with wire sleeves
Degree of protection (IEC 60529/EN 60529)	IP20
Operating temperature	-25...+60 °C

Direction Discriminator MS23-R 1-channel



2

- **1-channel direction discriminator**
- **Underspeed monitoring**
- **For use with sensors conforming to EN 60947-5-6 (NAMUR), 3-wire pnp sensors and signal sources with pulse levels from 10...30 VDC**
- **Adjustable switch-off delay**
- **2 relay outputs, each with one SPDT contact**
- **2 sealed relays with hard gold plated contacts**
- **Universal supply voltage (20...250 VUC)**

The direction of rotation is obtained by evaluating the attenuation sequence and the overlap from the two sensor signals. The target used must be suitable for simultaneous damping of both sensors for a period of at least 1 ms.

One output relay with SPDT contacts will energise in the forward direction; the other relay will energise in the reverse direction. Each output has a yellow LED for status indications.

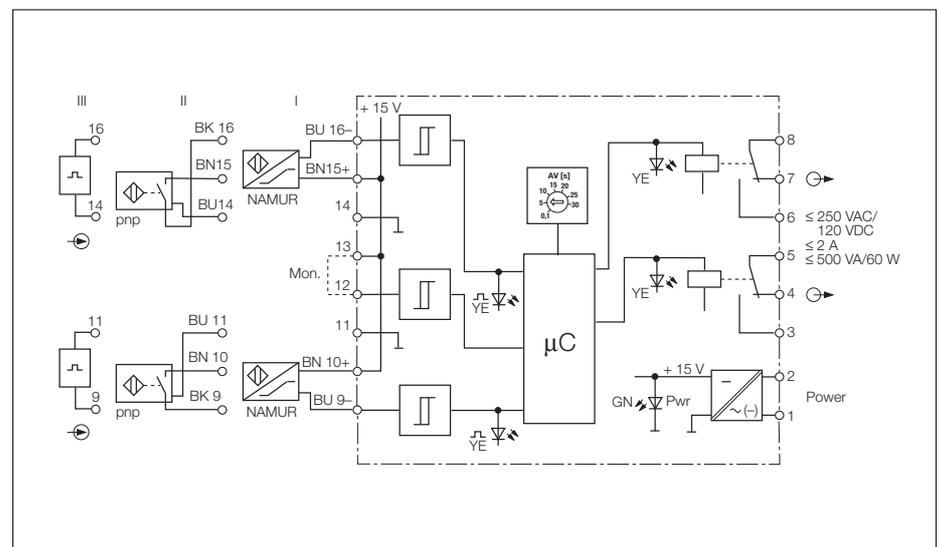
Leaving terminals 12/13 (Mem.) open activates the switch-off delay. The adjustable switch off delay function enables monitoring of the time interval between the pulse indication and detection of an underspeed condition.

A potentiometer (AV) located on the front cover of the housing serves to adjust the switch-off time delay (0.1...30 s). The output relay energised last will stay permanently energised during the adjusted time delay. If the pulse indication ceases, the relays will de-energise after the time delay. The adjustable switch off delay also allows to blank out short periods of suddenly missing Pulse indication.

If terminals 12/13 are linked (Mem.), the switch-off delay is disabled. In this mode, the relays retain their switching status until the direction of rotation changes.

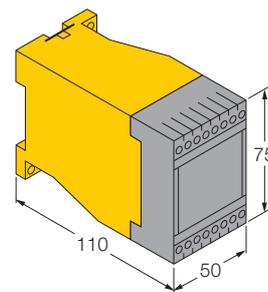
This device should *not* be used in safety applications where accurate zero speed detection is required.

The MS23-R direction discriminators accommodates NAMUR sensors according to EN 60947-5-6, 3-wire pnp sensors or other voltage sources with pulse levels between 10 and 30 VDC. The device is used to determine forward or reverse rotation of a system.

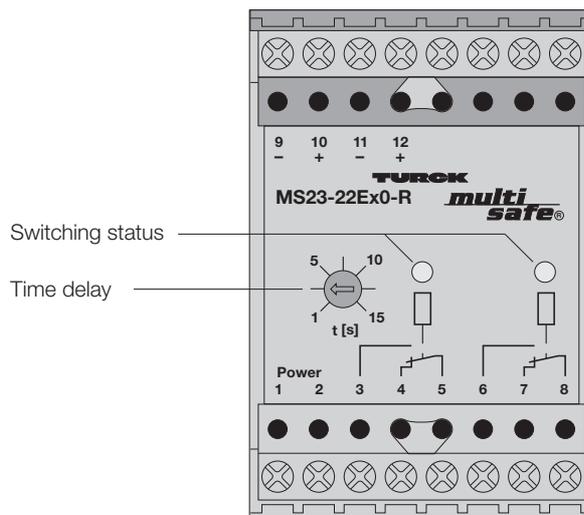


Direction Discriminator MS23-R

Type	MS23-R
Ident-no.	0508112
Supply voltage U_B	20...250 VUC
Line frequency (AC)	40...70 Hz
Power consumption	≤ 3 W
Galvanic isolation	between input circuit, output circuit and supply voltage for 250 V _{rms} test voltage 2.5 kV _{rms}
Clearences and creepage distances	
- Input circuit to output circuit	≥ 4 mm
- Input circuit to power supply	≥ 4 mm
Rotational speed monitoring	
	forward and reverse directions, underspeed
Input frequency	≤ 150 000 min ⁻¹
Pause duration	≥ 0.2 ms
Pulse duration	≥ 0.2 ms
Hysteresis	approx. 10 %
Switch off delay	0.1...30 s (adjustable)
Repeat accuracy	± 0.5 %
Temperature drift	≤ 0.020 %/K
Input circuits	
NAMUR input	NAMUR/3-wire, pnp according to EN 60947-5-6, terminals 9/10; 15/16
- Operating characteristics	
Voltage	8.2 V
Current	8.2 mA
- Switching threshold	1.4 mA ≤ I ₀ ≤ 1.8 mA
3-wire input	pnp, terminals 9...11;14...16
- Operating characteristics	
Voltage	15 VDC
Current	≤ 15 mA
- "ON" signal	0...5 VDC
- "OFF" signal	10...30 VDC
Output circuits	
	2 relay outputs
Relay output	
- Number of contacts	1 SPDT contact, silver-alloy + 3 μm Au
- Switching voltage	≤ 250 V
- Switching current	≤ 2 A
- Switching capacity	≤ 500 VA/60 W
LED indications	
- Power	green
- Direction indication (forward or reverse motion)	yellow
- Pulse indication	yellow
Housing	
Mounting	50 mm wide, Polycarbonate/ABS panel mounting or snap-on clamps for top-hat rail (DIN 50022)
Connection	2 x 8 self-lifting pressure plates
Connection profile	≤ 2 x 2.5 mm ² or 2 x 1.5 mm ² with wire sleeves
Degree of protection (IEC 60529/EN 60529)	IP20
Operating temperature	-25...+60 °C



Direction Discriminator MS23-22Ex0-R 1-channel



- **1-channel direction discriminator**
- **Intrinsically-safe input circuit EEx ia**
- **Area of application according to ATEX: II (1) GD, I (M1)**
- **For use with sensors conforming to EN 60947-5-6 (NAMUR)**
- **Galvanic isolation between input circuit, output circuit and supply voltage**
- **Direction detection in either direction**
- **Input circuit monitoring for wire-break and short-circuit**
- **2 relay outputs, each with one SPDT contact**
- **Universal supply voltage (20...250 VAC/20...125 VDC)**

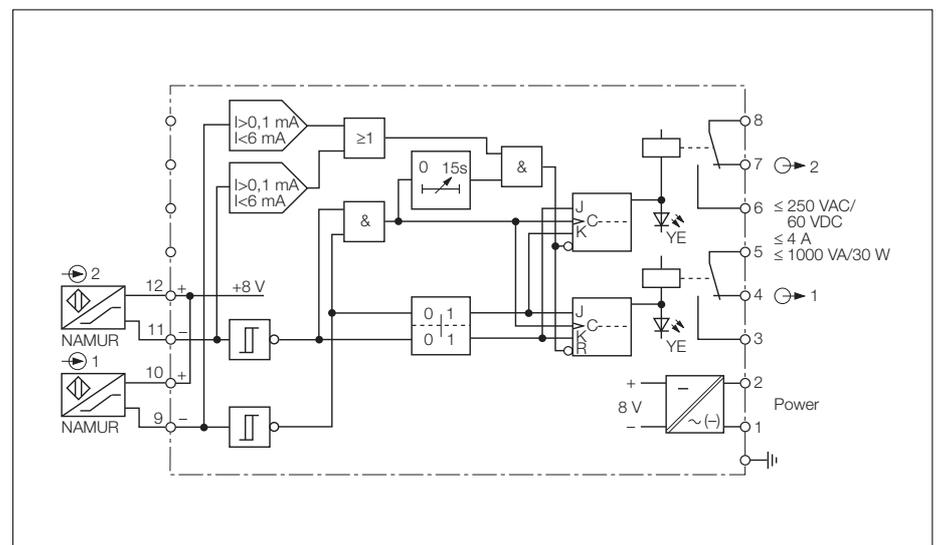
The MS23-22Ex0-R direction discriminator features an intrinsically safe input circuit. It provides two relay outputs, each with one SPDT contact.

The MS23-22Ex0-R uses two sensors to determine forward or reverse direction of a system. One output relay will energize in the forward direction; the other relay will energize in the reverse direction. Each output has a yellow LED that turns on when the output is energized. At zero speed both relays are de-energised.

The direction discriminator receives input pulses from sensors according to EN 60947-5-6 (NAMUR). Both input circuits are monitored for wire-break and short-circuit. In case of a fault condition, both output relays de-energize automatically.

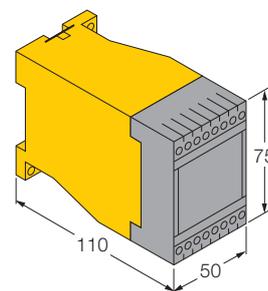
The direction of rotation is obtained by evaluating the sequence and the overlap from the two sensor signals. The target used must be suitable for simultaneous damping of both sensors for a period of at least 1 ms.

A potentiometer located on the front cover of the housing serves to adjust the time delay (1...15 s) between consecutive inputs pulse sequences.

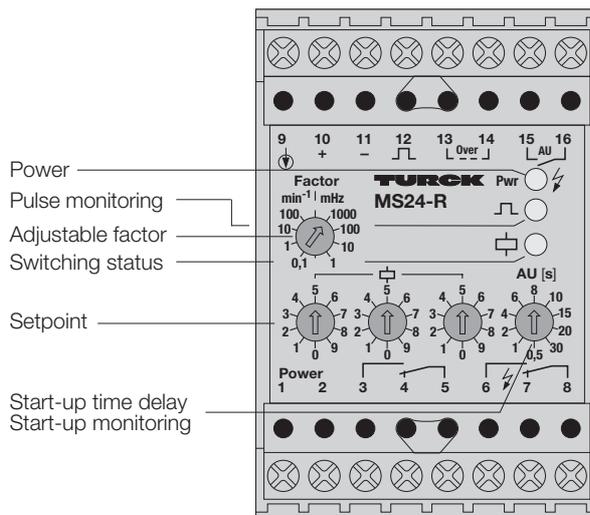


Direction Discriminator MS23-22Ex0-R

Type	MS23-22Ex0-R
Ident-no.	5341107
Supply voltage U_B	20...250 VAC/20...125 VDC
Line frequency (AC)	40...70 Hz
Power consumption	≤ 3 W
Galvanic isolation	between input circuit, output circuit and supply voltage for 250 V _{rms} test voltage 2.5 kV _{rms}
Direction discrimination	both directions
Input pulse overlap	≥ 1 ms
Time limit for input pulse sequence	1...15 s (adjustable)
Input circuits	accor. to EN 60947-5-6 (NAMUR), intrinsically safe per EN 50020
Operating characteristics	
– Voltage	8 V
– Current	8 mA
Switching threshold	1,55 mA
Hysteresis	0,2 mA
Output circuits	2 relais outputs
Number of contacts	1 SPDT contact, AgCdO
Switching voltage	≤ 250 VAC/60 VDC
Switching current	≤ 4 A
Switching caoacity	≤ 1000 VA/30 W
Ex-Approval acc. to certificate of conformity	DMT 01 ATEX E 119
Maximum nominal values	
– No load voltage U_0	11.0 V
– Short-circuit current I_0	55 mA
– Power P_0	150 mW
– Safety voltage U_m	250 VAC/125VDC
Max. external inductances/capacitances L_0/C_0	
– [EEx ia] IIC	1 mH/500 nF
– [EEx ia] IIB	3 mH/2500 nF
– [EEx ia] I	10 mH/10 μF
Marking of device	Ⓔ II (1) GD [EEx ia] IIC I (M1) [EEx ia] I
LED indications	
– Switching status	yellow
Housing	50 mm wide, Polycarbonate/ABS
Mounting	panel mounting or snap-on clamps for top-hat rail (DIN 50022)
Connection	2 x 8 self-lifting pressure plates
Connection profile	≤ 2 x 2.5 mm ² or 2 x 1.5 mm ² with wire sleeves
Protection type (IEC 60529/EN 60529)	IP20
Operating temperature	-25...+60 °C

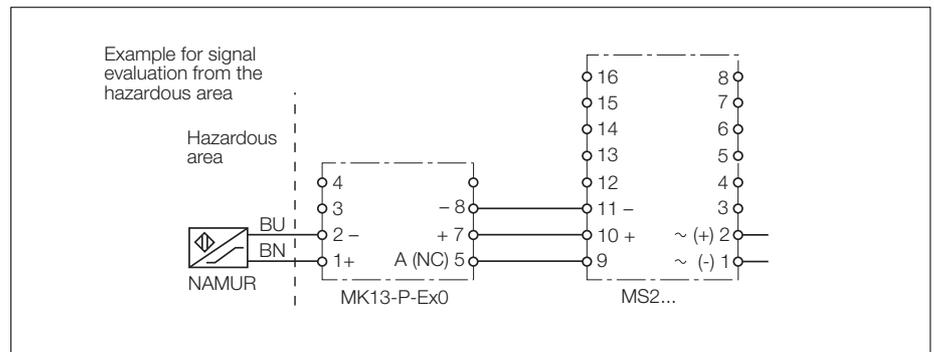


Rotational Speed Monitor MS24-R 1-channel



- 1-channel rotational speed monitor
- Overspeed or underspeed detection
- For use with sensors conforming to EN 60947-5-6 (NAMUR) with input circuit monitoring, 3-wire pnp sensors and signal sources with pulse levels from 10...30 VDC
- Detection range from 0.01...1 660 Hz or 0.6...100 000 min⁻¹
- Digital adjustment of setpoints in Hz or min⁻¹
- Excellent temperature stability and linearity
- Adjustable start-up time delay in the underspeed monitoring mode
- Optional dynamic input alarm in the overspeed monitoring mode
- 1 setpoint relay, 1 alarm relay
- Sealed relays with hard gold plated contacts
- Universal supply voltage (20...250 VUC)

The MS24-R are rotational underspeed/overspeed monitors designed to monitor pulse sequences for *overspeed* and *underspeed*. Limit value adjustments are

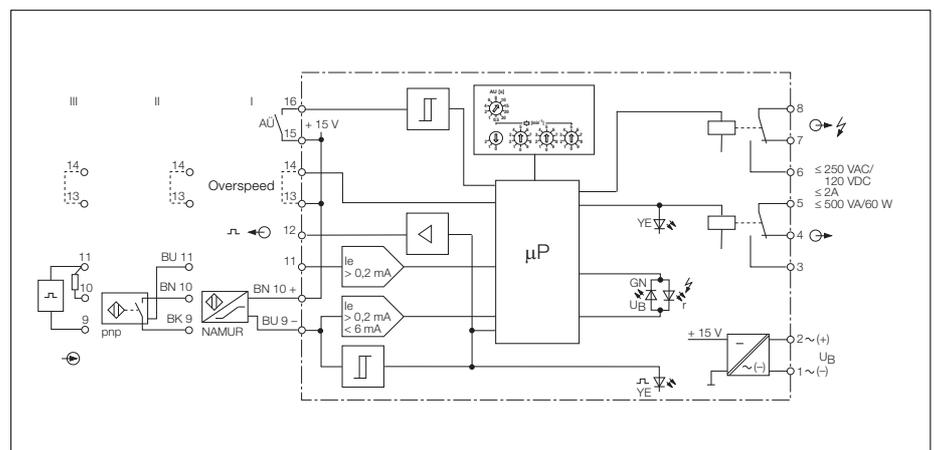


determined via four rotary switches on the front of the device. To provide optimum response times for applications with relatively low speeds the device operates on the digital pulse principle.

The device accommodates NAMUR sensors according to EN 60947-5-6, 3-wire pnp sensors or other voltage sources with pulse levels between 10 and 30 VDC. If connected to NAMUR (I) sensors, the input circuit is monitored for wire-break and

short-circuit conditions. During a malfunction the dual colour „Power“ LED changes from green to red and the output relay (3...5) as well as the limit value relay (6...8) de-energise independently of the selected monitoring mode.

The yellow LED for the Pulse indication enables distinction between a wire-break and a short-circuit condition (wire-break: LED turns off).



Rotational Speed Monitor MS24-R

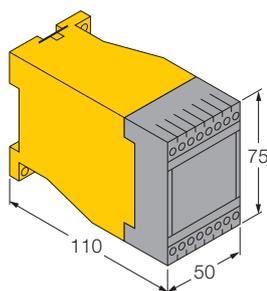
With 3-wire sensors as input devices, the power supply lines are monitored for wire-break only. Wire-break or short-circuit conditions on the output of the sensor are not detected.

Terminals 11 and 9 are the inputs for external signal sources (III). A 1...10 k Ω resistor must be connected between terminals 10 and 11 to disable wire-break monitoring.

Overspeed detection is selected when terminals 13/14 are linked. If the speed is below the limit value, the limit value relay de-energises. The device is programmed for underspeed when terminals 13 and 14 are left open. If the speed exceeds the limit value, the limit value relay de-energises. A yellow LED indicates the status of the output relay.

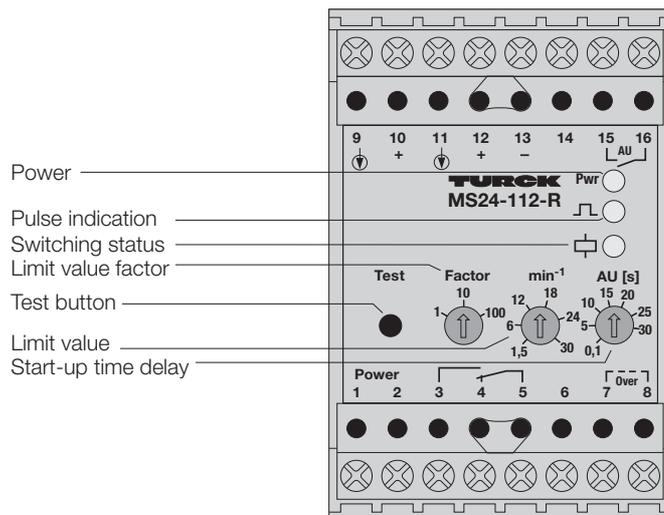
For *underspeed* monitoring, a built-in start-up time delay (AU) is available. During the start-up time delay, the output relay will be energised to prevent that the system is brought to a stop when the input rate is less than the preset limit value. The start-up time delay is triggered under two conditions: upon connection of a potential-free contact between terminals 15 and 16 while the device is powered; or by linking terminals 15 and 16 first and then applying power to the device.

For *overspeed* monitoring, a dynamic input alarm is available that reacts immediately when pulse indication are missing. A variable time delay is set that activates with every incoming pulse. If no pulses are received during the preset time, the limit value and alarm relays de-energise. There are two ways of activating the dynamic input monitoring feature: upon connection of a potential-free contact between terminals 15 and 16 while the device is powered; or by linking terminals 15 and 16 first and then applying power to the device.

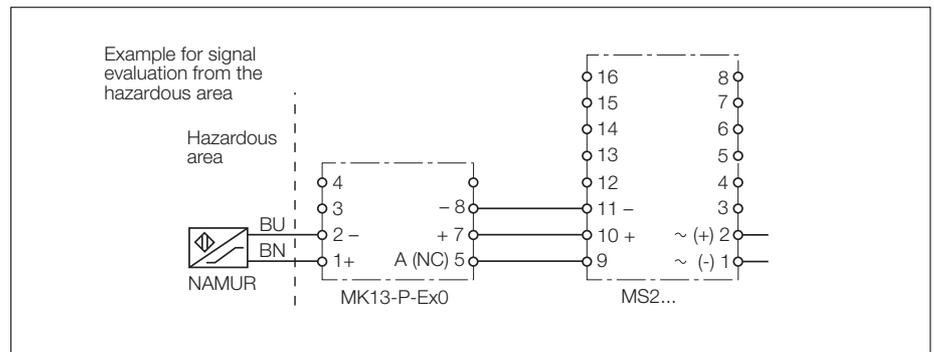


Type	MS24-R
Ident-no.	0519009
Supply voltage U_B	20...250 VUC
Line frequency (AC)	40...70 Hz
Current consumption	≤ 3 W
Galvanic isolation	between input circuit, output circuit and supply voltage for 250 V _{rms} , test voltage 2.5 kV _{rms}
Rotational speed monitoring	overspeed/underspeed
Speed range	0.01...1660 Hz or 0.6...100 000 min ⁻¹
Input frequency	≤ 150 000 min ⁻¹
Pause duration	≥ 0.2 ms
Pulse duration	≥ 0.2 ms
Hysteresis	approx. 10 %
Start-up time delay/dyn. input alarm	0.5...30 s (in 10 increments)
Temperature drift	≤ 0.005 %/K
Repeat accuracy	≤ 0.1 %
Clearances and creepage distances	
- Input circuit to output circuit	≥ 4 mm
- Input circuit to power supply	≥ 4 mm
Input circuits	
NAMUR input	NAMUR/3-wire, pnp according to EN 60947-5-6, terminals 9/10
- Operating characteristics	$U_0 = 8.2$ V; $I_k = 8.2$ mA
- Switching thresholds	1.4 mA $\leq I_b \leq 1.8$ mA
- Wire-break trip point	≤ 0.15 mA
- Short-circuit trip point	≥ 6 mA
3-wire input	pnp, terminals 9...11
- Operating characteristics	$U \leq 15$ V; $I \leq 30$ mA
- "ON" signal	0...5 VDC
- "OFF" signal	10...30 VDC
Output circuits	
Relay outputs	2 relay outputs and pulse output each with 1 SPDT contact
- Switching voltage	≤ 250 V
- Switching current	≤ 2 A
- Switching capacity	≤ 500 VA/60 W
- Contact material	silver-alloy + 3 μ m Au
Pulse output (terminal 12)	14 V/10 mA, short-circuit protected
LED indications	
- Power/Fault indication	green/red (2-colour LED)
- Status indication	yellow
- Pulse indication	yellow
Housing	
Mounting	50 mm wide, Polycarbonate/ABS panel mounting or snap-on clamps for top-hat rail (DIN 50022)
Connection	2 x 8 self-lifting pressure plates
Connection profile	≤ 2 x 2.5 mm ² or 2 x 1.5 mm ² with wire sleeves
Degree of protection (IEC 60529/EN 60529)	IP20
Operating temperature	-25...+60 °C

Rotational Speed Monitor MS24-112-R 1-channel



- 1-channel rotational speed monitor
- Overspeed or undspeed detection
- For use with sensors conforming to EN 60947-5-6 (NAMUR), 3-wire pnp sensors and signal sources with pulse levels from 10...30 VDC
- Relay output with one SPDT contact
- Monitoring ranges from 1.5...3000 min⁻¹ (3 ranges)
- Optional start-up time delay
- Sealed relay with hard gold plated contacts
- Universal supply voltage (20...250 VUC)



The device features three overlapping measuring ranges and can be easily adapted to the application. A 3-position switch serves to adjust the required measuring range. Then the switch point is adjusted by means of the front panel potentiometer.

button is pressed, the output relay remains energised.

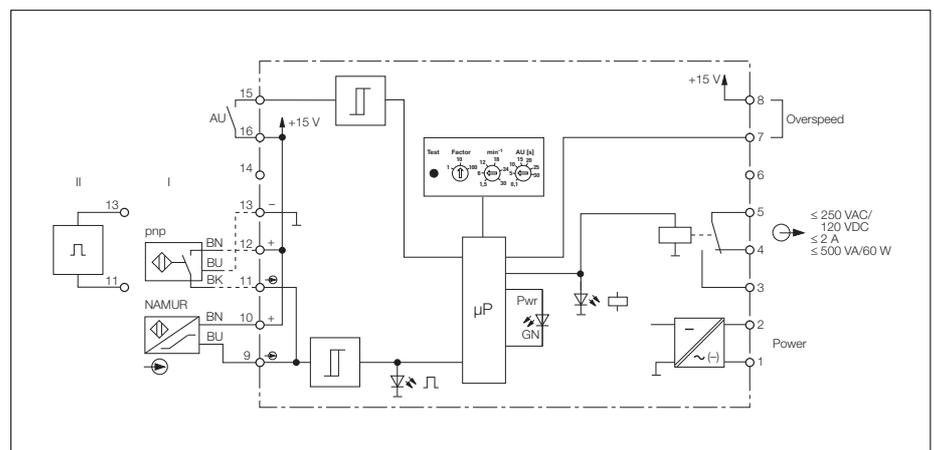
The unit operates on the digital pulse principle. This method provides a fast response and is ideal for applications with relatively low speed.

The test button enables adjustment of the switch point during installation without disabling the output relay. When the test

For *underspeed* monitoring, a built-in start-up time delay (AU) is available. During the start-up time delay, the output relay will be

The rotational speed monitor MS24-112-R may be connected to 3-wire pnp sensors, sensors according to EN 60947-5-6 (NAMUR) or voltage sources with a signal level between 10 and 30 VDC.

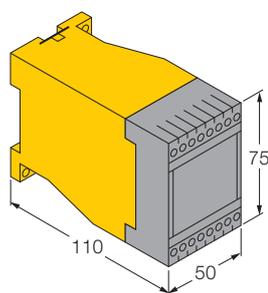
Linking terminals 7/8 selects the *overspeed* monitoring mode. If the preset limit value is exceeded, the relay is de-energised. Leaving terminals 7/8 open activates the *underspeed* monitoring mode. If the speed is below the preset limit value, the relay is de-energised.



Rotational Speed Monitor MS24-112-R

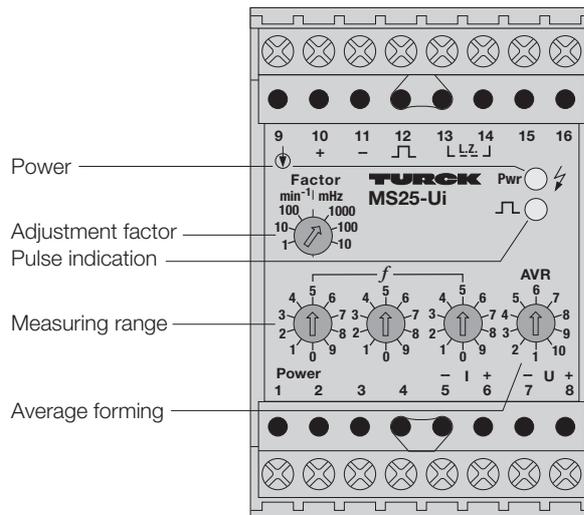
energised to prevent that the system is brought to a stop when the input rate is less than the preset limit value. The start-up time delay is triggered under two conditions: upon connection of a potential-free contact between terminals 15 and 16 while the device is powered; or by linking terminals 15 and 16 first and then applying power to the device.

The switching state of the output relay is indicated by the yellow LED; the device operation is indicated by a green LED. If an input pulse is present, the respective yellow LED lights.



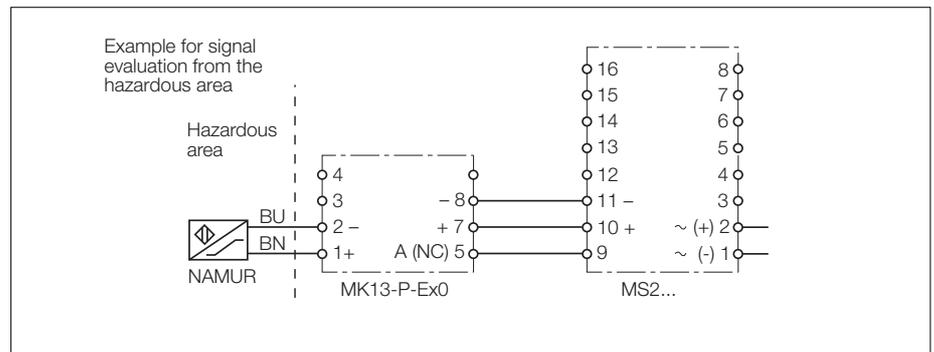
Type	MS24-112-R
Ident-no.	0518003
Supply voltage U_B	20...250 VUC
Line frequency (AC)	40...70 Hz
Power consumption	≤ 3 W
Galvanic isolation	between input circuit, output circuit and supply voltage for 250 V_{rms} , test voltage 2.5 kV_{rms}
Rotational speed monitoring	overspeed/underspeed
Speed range	1.5...3000 min^{-1} (3 ranges)
– Range 1	1.5...30 min^{-1}
– Range 2	15...300 min^{-1}
– Range 3	150...3000 min^{-1}
Input frequency	$\leq 60\,000$ min^{-1}
Pause duration	≥ 0.2 ms
Pulse duration	≥ 0.2 ms
Hysteresis	approx. 10 %
Start-up time delay	0.1...30 s (front panel potentiometer)
Repeat accuracy	≤ 0.1 %
Temperature drift	≤ 0.005 %/K
Clearances and creepage distances	
– Input circuit to output circuit	≥ 4 mm
– Input circuit to power supply	≥ 4 mm
Input circuits	NAMUR or (3-wire, pnp)
NAMUR input	according to EN 60947-5-6, terminals 9/10
– Operating characteristics	$U_0 = 8.2$ V; $I_k = 8.2$ mA
– Switching threshold	1.4 mA $\leq I_e \leq 1.8$ mA
3-wire input	pnp, terminals 11...13
– Operating characteristics	$U \leq 15$ VDC; $I \leq 30$ mA
– "ON" signal	0...5 VDC
– "OFF" signal	10...30 VDC
Output circuits	
Relay output	1 relay output
– Number of contacts	1 SPDT contact, silver-alloy + 3 μ m Au
– Switching voltage	≤ 250 V
– Switching current	≤ 2 A
– Switching capacity	≤ 500 VA/60 W
LED indications	
– Power	green
– Switching status	yellow
– Pulse indication	yellow
Housing	50 mm wide, Polycarbonate/ABS
Mounting	panel mounting or snap-on clamps for top-hat rail (DIN 50022)
Connection	2 x 8 self-lifting pressure plates
Connection profile	$\leq 2 \times 2.5$ mm ² or 2×1.5 mm ² with wire sleeves
Degree of protection (IEC 60529/EN 60529)	IP20
Operating temperature	-25...+60 °C

Rotational Speed Meter MS25-Ui 1-channel



2

- **1-channel rotational speed meter with voltage and current output**
- **For use with sensors conforming to EN 60947-5-6 (NAMUR) with input circuit monitoring, 3-wire pnp sensors and signal sources with pulse levels from 10...30 VDC**
- **Digitally adjustable detection range from 0.01...1 660 Hz or 0.6...100 000 min⁻¹**
- **Stepwise adjustment of the measuring range to the application**
- **Excellent temperature stability and linearity**
- **Adjustable floating average to steady the signal**
- **Pulse output**
- **Universal supply voltage (20...250 VUC)**



To adjust the speed range an end value between 0.6...100 000 min⁻¹ or 0.01...1660 Hz is set using four multi-position switches. An output signal of 10 V or 20 mA accords to the end value.

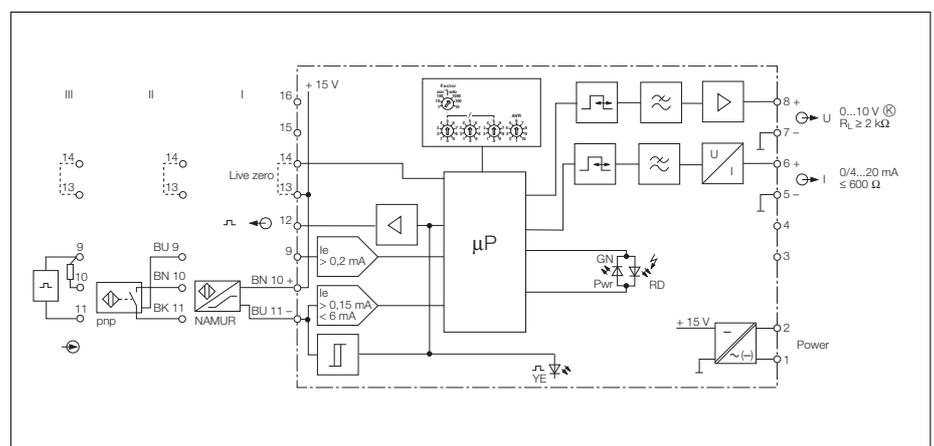
If the speed rate is below 0.6 min⁻¹/0.01Hz an output signal of 0/4 mA or 0 V will be generated.

The voltage output supplies 0...10 V and the current output supplies 0/4...20 mA.

The current output may be programmed for 4...20 mA operation by linking terminals 13 and 14.

If connected to NAMUR sensors, the input circuit is monitored for wire-break and short-circuit conditions. If a fault condition occurs, the dual colour LED turns from green to red and the output current drops to 0 mA (also in live-zero operation) or 0 V, respectively. The two conditions can be distinguished by the yellow LED; wire-break causes it to turn off.

The MS25-Ui is a digital-to-analogue converter that converts an input frequency into an analogue current or voltage relative to the adjusted measuring range. The device can accommodate NAMUR sensors, 3-wire pnp sensors or other voltage sources with pulse levels between 9 and 30 VDC.



Rotational Speed Meter MS25-Ui

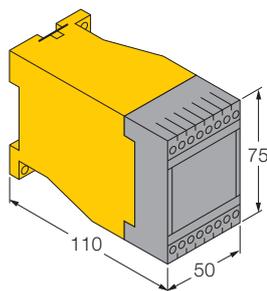
When 3-wire pnp sensors are used, the power supply lines are monitored for wire-break only.

Wire-break and short-circuit conditions on the output side of the sensor are not detected.

When external signal sources are connected, terminals 11 and 9 must be used. In order to suppress error indications, a 1...10 k Ω resistor must be connected between terminals 10 and 11.

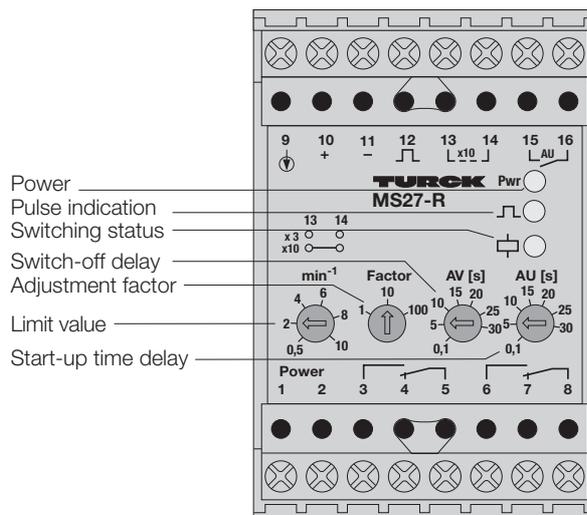
To steady the input signal, an attenuation factor can be set between 1 and 10. When the factor is set to 1 (1 pulse sequence), there is no signal attenuation. The attenuation principle is based upon the floating average formed over the adjusted number of measurements.

Speed monitors used in connection with sensors from the hazardous area require a remote amplifier for operation.



Type	MS25-Ui
Ident-no.	0508220
Supply voltage U_B	20...250 VUC
Line frequency (AC)	40...70 Hz
Power consumption	≤ 3 W
Galvanic isolation	between input circuit, output circuit and supply voltage for 250 V _{rms} test voltage 2.5 kV _{rms}
Function	
Measuring range	0.01...1660 Hz or 0.6...100 000 min ⁻¹ (digitally adjustable)
Input frequency	≤ 150 000 min ⁻¹
Pause duration	≥ 0.2 ms
Pulse duration	≥ 0.2 ms
Temperature drift	≤ 0.005 %/K v.E. (50 ppm)
Linearity error	≤ 0.1 % v.E.
Clearances and creepage distances	
- Input and output circuit to power supply	≥ 4 mm
- Input circuit to power supply	≥ 4 mm
Input circuits	
NAMUR input	NAMUR/3-wire, pnp according to EN 60947-5-6, terminals 9/10
- Operating characteristics	$U_0 = 8.2$ V; $I_k = 8.2$ mA
- Switching thresholds	1.4 mA $\leq I_b \leq 1.8$ mA
- Wire-break trip point	≤ 0.15 mA
- Short-circuit trip point	≥ 6 mA
3-wire input	pnp, terminals 9...11
- Operating characteristics	$U \leq 15$ V; $I \leq 30$ mA
- "ON" signal	0...5 VDC
- "OFF" signal	10...30 VDC
Output circuits	
Current output	current, voltage and pulse output 0/4...20 mA (load ≤ 600 Ω)
Voltage output	0...10 V ($R_L \geq 2$ k Ω), short-circuit protected
- Linearity error	≤ 0.1 % of final value
Pulse output (terminal 12)	14 V/10 mA, short-circuit protected
Temperature drift	typ. ≤ 0.005 %/°C of final value max. 0.01 %/°C of final value
LED indications	
- Power/Fault indication	green/red (2-colour LED)
- Pulse indication	yellow
Housing	
Mounting	50 mm wide, Polycarbonate/ABS panel mounting or snap-on clamps for top-hat rail (DIN 50022)
Connection	2 x 8 self-lifting pressure plates
Connection profile	≤ 2 x 2.5 mm ² or 2 x 1.5 mm ² with wire sleeves
Degree of protection (IEC 60529/EN 60529)	IP20
Operating temperature	-25...+60 °C

Rotational Speed Monitor MS27-R 1-channel



- **1-channel rotational speed monitor**
- **Underspeed detection**
- **For use with sensors conforming to EN 60947-5-6 (NAMUR), 3-wire pnp sensors and signal sources with pulse levels from 10...30 VDC**
- **Detection range from 1.5...10000 min⁻¹ (six subranges)**
- **Adjustable start-up time delay**
- **Adjustable off-delay**
- **2 relay outputs, each with one SPDT contact**
- **2 sealed relays with hard gold plated contacts**
- **Pulse output**
- **Universal supply voltage (20...250 VUC)**

The MS27-R rotational speed monitors accommodate NAMUR sensors according to EN 60947-5-6 (II), 3-wire pnp sensors (I) or signal sources with pulse levels from 10...30 VDC (III). These devices feature two relay outputs, each with one SPDT contact.

This rotational speed monitor is firmly programmed for *underspeed* detection and provides six adjustable, overlapping speed ranges. Adjustment of the speed range is determined by a subrange setting and a range factor. The subrange setting is programmed using terminals 13/14. The range factor is set with the „Factor“ switch located in the front. Fine adjustment of the switch point is done with the potentiometer „min⁻¹“.

The unit operates on the digital pulse principle. This method provides a fast response and is ideal for applications with relatively low speed.

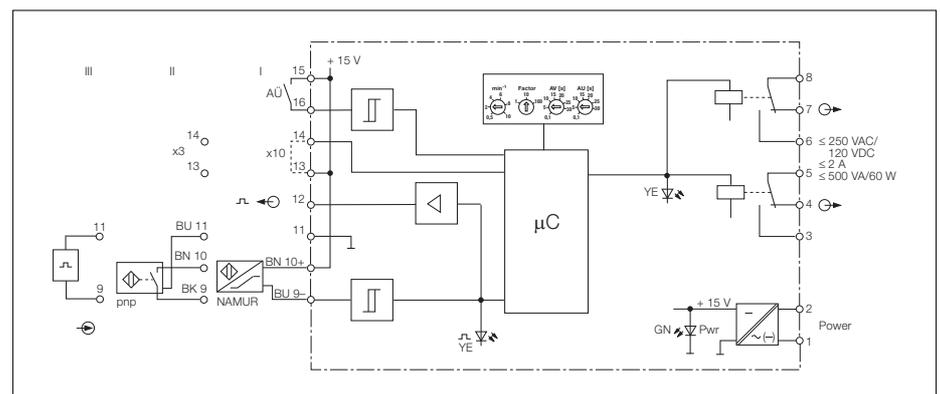
Operational readiness is signalled by a green LED.

An input pulse is indicated by a yellow LED. A yellow LED indicates the status of the output relay.

A start-up time delay can be set from 0.1...30 s using the front potentiometer (AU). During the start-up time delay, the output relay will be energised to prevent that the system is brought to a stop when the input rate is less than the preset limit value. The start-up time delay is triggered under two conditions: by connecting a potential-free contact between terminals 15 and 16 while the device is powered, or by applying power to the device after the terminals have been linked.

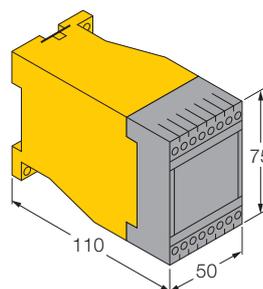
In addition, an off-delay timer is provided for filtering out short duration speed dips. The off-delay is variable from 0.1...30 s and is set with the AV potentiometer.

This device is *not* suitable for safety applications where accurate zero speed detection is required.

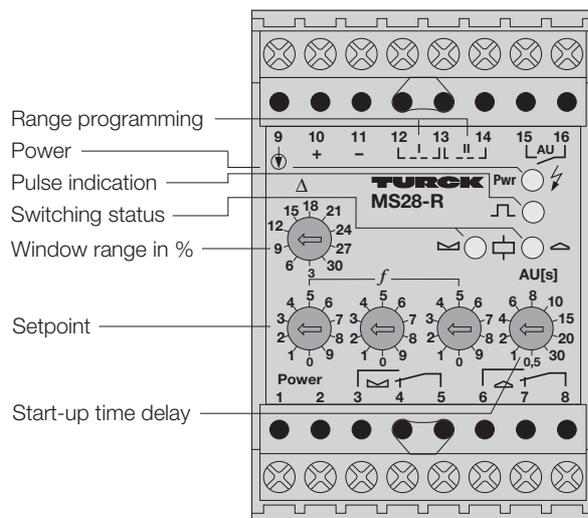


Rotational Speed Monitor MS27-R

Type	MS27-R
Ident-no.	0508412
Supply voltage U_B	20...250 VAC/DC
Line frequency (AC)	40...70 Hz
Power consumption	≤ 3 W
Galvanic isolation	input circuit to output circuit and supply voltage for 250 V _{rms} , test voltage 2,5 kV _{rms}
Clearences and creepage distances	
- Input circuit to output circuit	≥ 4 mm
- Input circuit to power supply	≥ 4 mm
Rotational speed monitoring	
	underspeed
Mounting range	1.5...10 000 min ⁻¹ (six subranges)
Input frequency	≤ 150 000 min ⁻¹
Pause duration	≥ 0.2 ms
Pulse duration	≥ 0.2 ms
Hysteresis	approx. 10 %
Start-up time delay	0.1...30 s (adjustable)
Switch off delay	0.1...30 s (adjustable)
Repeat accuracy	± 0.5 %
Temperature drift	≤ 0.020 %/K
Input circuits	
NAMUR input	NAMUR/3-wire, pnp according to EN 60947-5-6, terminals 9/10
- Operating characteristics	
Voltage	8.2 V
Current	8.2 mA
- Switching threshold	1.4 mA ≤ I _e ≤ 1.8 mA
3-wire input	pnp, terminals 9...11
- Operating characteristics	
Voltage	15 VDC
Current	≤ 30 mA
- "ON" signal	0...5 VDC
- "OFF" signal	10...30 VDC
Output circuits	
Relay outputs	2 relay outputs/pulse output
- Number of contacts	each with 1 SPDT contact, silver alloy + 3 μm Au
- Switching voltage	≤ 250 V
- Switching current	≤ 2 A
- Switching capacity	≤ 500 VA/60 W
Pulse output (terminal 12)	14 VDC/10 mA, short-circuit protected
LED indications	
- Power	green
- Switching status	yellow
- Pulse indication	yellow
Housing	
Mounting	50 mm wide, Polycarbonate/ABS panel mounting or snap-on clamps for top-hat rail (DIN 50022)
Connection	2 x 8 self-lifting pressure plates
Connection profile	≤ 2 x 2.5 mm ² or 2 x 1.5 mm ² with wire sleeves
Degree of protection (IEC 60529/EN 60529)	IP20
Operating temperature	-25...+60 °C

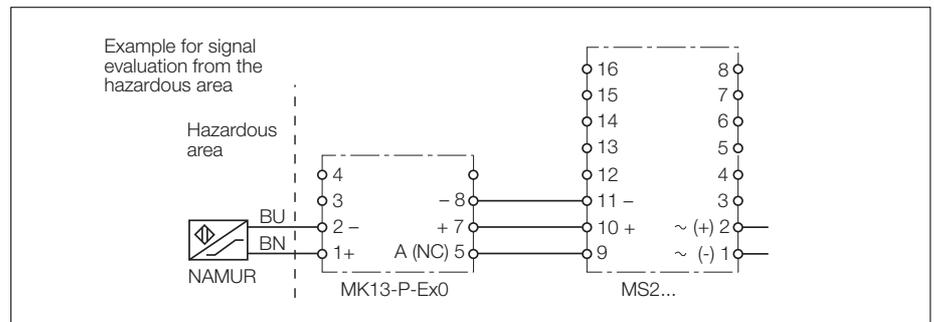


Window Discriminator MS28-R 1-channel



- 1-channel window discriminator
- Overspeed and underspeed monitoring
- For use with sensors conforming to EN 60947-5-6 (NAMUR) with input circuit monitoring, 3-wire pnp sensors and signal sources with pulse levels from 10...30 VDC
- Digital adjustment of setpoints within the range from: 0.01...100 Hz or 1...10 000 min⁻¹
- Adjustable window range: ± 3...30 % of setpoint
- Excellent temperature stability and repeatability
- Adjustable start-up time delay
- 1 relay for overspeed detection and 1 relay for underspeed detection
- Sealed relays with hard gold plated contacts
- Universal supply voltage (20...250 VUC)

The MS28-R rotational speed monitors are used for underspeed or overspeed detection of a speed range. The device has two relay outputs, one for *overspeed* and one for *underspeed* detection. The device accommodates sensors according



to EN 60947-5-6, 3-wire pnp sensors or other voltage sources with pulse levels from 10...30 VDC.

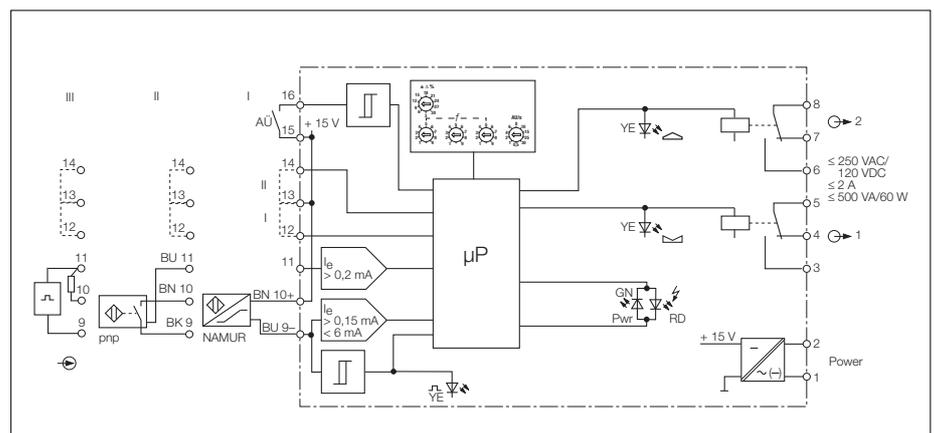
If a NAMUR sensor is used, the input circuit is monitored for wire-break and short-circuit conditions. During a fault condition, the output relays de-energise and the green LED turns to red. The two conditions can be distinguished by the yellow input pulse LED; wire-break causes it to turn off.

If a 3-wire sensor is used as input device, the power supply lines are monitored for

wire-break only. Wire-break and short-circuit conditions on the output of the sensor are not detected.

Terminals 9 and 11 are the inputs for external signal sources. A 1...10 kΩ resistor must be connected between terminals 10 and 11 to suppress fault indications.

The parameters (Hz or min⁻¹) for the speed range as well as the range factor are jumper programmable using terminals 12, 13 and 14.



Window Discriminator MS28-R

There are four possibilities:

12	13	14	Factor	Range
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	1x	1...1000 min ⁻¹
<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	10x	10...10000 min ⁻¹
<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	0.01x	0.01...10 Hz
<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	0.1x	0.1...100 Hz

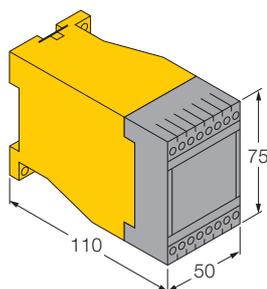
The unit uses the digital pulse principle to detect underspeed and overspeed conditions. This method works well in applications with infrequent pulse indication and provides relatively short response times. The smallest measurable frequency is 10 mHz.

The nominal speed rate is set digitally using three switches on the front of the device. In addition, the device has an adjustable window range from 3...30 % in each direction which is programmed using a 10-position selector switch. During underspeed setpoint relay 1 is de-energised; during overspeed setpoint relay 2 is de-energised. A yellow LED indicates the status of each output relay.

The switching hysteresis of the output relays (as a percentage) relative to the nominal speed rate depends on the width of the adjusted sensing window:

Sensing window	Hysteresis
- 3, 6 and 9 %	1 %
- 12, 15, 18 and 21 %	2 %
- 24, 27 and 30 %	3 %

During drive system start-up, a built-in start-up time is available. The time delay is set with the front cover AU potentiometer. The output relay (setpoint 1) is energised during the start-up time delay to prevent that the system is brought to a stop when the input rate is less than the preset limit value. The start-up time delay is triggered under two conditions: by connecting a potential-free contact between terminals 15 and 16 while the device is powered, or by applying power to the device after the terminals have been linked.



Type	MS28-R
Ident-no.	0508512
Supply voltage U_B	20...250 VUC
Line frequency (AC)	40...70 Hz
Power consumption	≤ 3 W
Galvanic isolation	between input circuit, output circuit and supply voltage for 250 V _{rms} test voltage 2.5 kV _{rms}
Rotational speed monitoring	overspeed and underspeed monitoring
Measuring range	1...10 000 min ⁻¹ or 0.01...100 Hz
Setpoint window range	± 3...30 % (with reference to the nominal speed range)
Input frequency	≤ 150 000 min ⁻¹
Pause duration	≥ 0.2 ms
Pulse duration	≥ 0.2 ms
Hysteresis	1.2 or 3 % (depending on the preset window)
Start-up time delay	0.5...30 s (adjustable)
Repeat accuracy	≤ 0.1 %
Temperature drift	≤ 0.005 %/K
Clearences and creepage distances	
- Input circuit to output circuit	≥ 4 mm
- Input circuit to power supply	≥ 4 mm
Input circuits	NAMUR/3-wire, pnp
NAMUR input	according to EN 60947-5-6, terminals 9/10
- Operating characteristics	$U_0 = 8.2 \text{ V}; I_k = 8.2 \text{ mA}$
- Switching threshold	$1.4 \text{ mA} \leq I_e \leq 1.8 \text{ mA}$
- Wire-break threshold	≤ 0.15 mA
- Short-circuit threshold	≥ 6 mA
3-wire input	pnp, terminals 9...11
- Operating characteristics	$U \leq 15 \text{ V}; I \leq 30 \text{ mA}$
- "ON" signal	0...5 VDC
- "OFF" signal	10...30 VDC
Output circuits	two relay outputs
Relay output	1 SPDT contact
- Switching voltage	≤ 250 V
- Switching current	≤ 2 A
- Switching capacity	≤ 500 VA/60 W
- Contact material	silver-alloy + 3 μm Au
LED indications	
- Power/Fault indication	green/red (2-colour LED)
- Switching status	yellow
- Pulse indication	yellow
Housing	50 mm wide, Polycarbonate/ABS
Mounting	panel mounting or snap-on clamps for top-hat rail (DIN 50022)
Connection	2 x 8 self-lifting pressure plates
Connection profile	≤ 2 x 2.5 mm ² or 2 x 1.5 mm ² with wire sleeves
Degree of protection (IEC 60529/EN 60529)	IP20
Operating temperature	-25...+60 °C