ONLINEHELP

Speed Monitor MOC3SA

Motion Control

GB

SICK
Sensor Intelligence.

Content

1 About the Speed Monitor MOC3SA

The Speed Monitor MOC3SA is a device for safe monitoring of drive speed. It allows safe access to machine and plant parts and safe maintenance mode of machines and plants by comparing the current speed at the drive with an adjustable speed limit.

1.1 Product Features

1.1.1 Features

- Standstill and speed monitoring
- 4 safe semiconductor outputs
- PL e (En ISO 13849), SIL3 (IEC 61508), SILCL3 (EN 62061)
- Maximal input frequency 2 kHz
- Adjustable monitoring limit/ monitoring frequency fom 0.5 to 99 Hz or 0.1 to 9.9 Hz
- 2 application diagnostic outputs for failure and status display
- Diagnostic LEDs

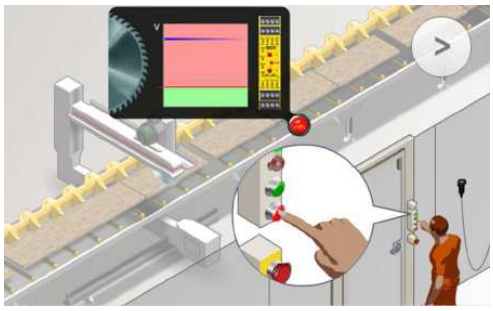
1.1.2 Your benefits

- Easy commissioning using only a screwdriver
- Tool support using the Flexi Soft Designer and Flexi Classic Configurator
- Use of standard sensors (inductive, capacitive and optical sensors, HTL encoders)
- Multiple axes can be cascaded
- Fast realization of connections and change of wiring due to removable terminals
- Can be used with safety controllers (e.g. Flexi Soft) and safety relays (e.g. UE43-2MF) from SICK

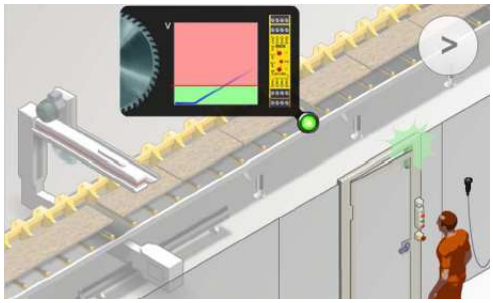
1.2 Application Examples

1.2.1 Guard unlocking with standstill detection:

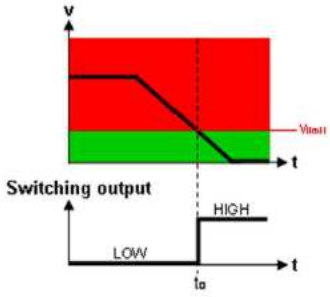
SSM – Safe Speed Monitor



The operator switches the saw off.

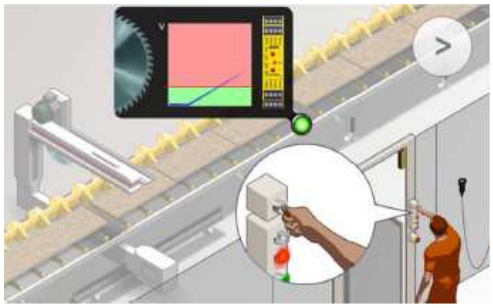


The Speed Monitor MOC3SA allows the operator to open the safety gate when standstill is detected.



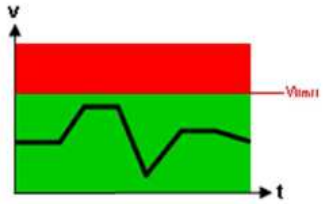
SSM releases a safe signal when the speed limit is exceeded or undercut (standstill detected).

1.2.2 Maintenance mode with reduced speed: SLS – Safely-Limited-Speed



Maintenance mode is switched on.

The saw can continue working with reduced speed while the operator is allowed in the hazardous area. The Speed Monitor MOC3SA monitors the speed (SLS – Safely Limited Speed)

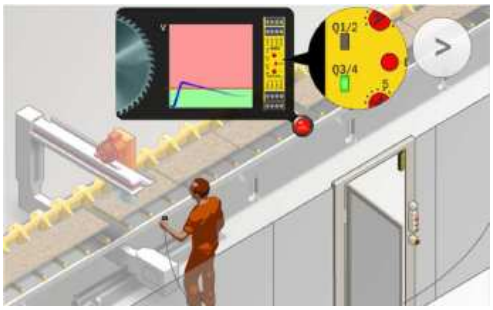


The **SLS** function monitors the speed of the drive. If the speed exceeds the configured speed limit, the drive will be stopped by the drive monitoring device, e.g. via STO.

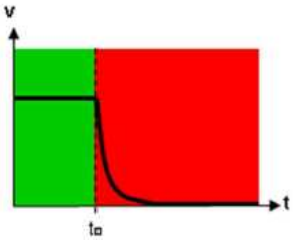
1.2.3 Shut down in case of a malfunction:

STO – Safe Torque Off

An error occurs in maintenance mode and the drive accelerates above the speed limit (SLS).

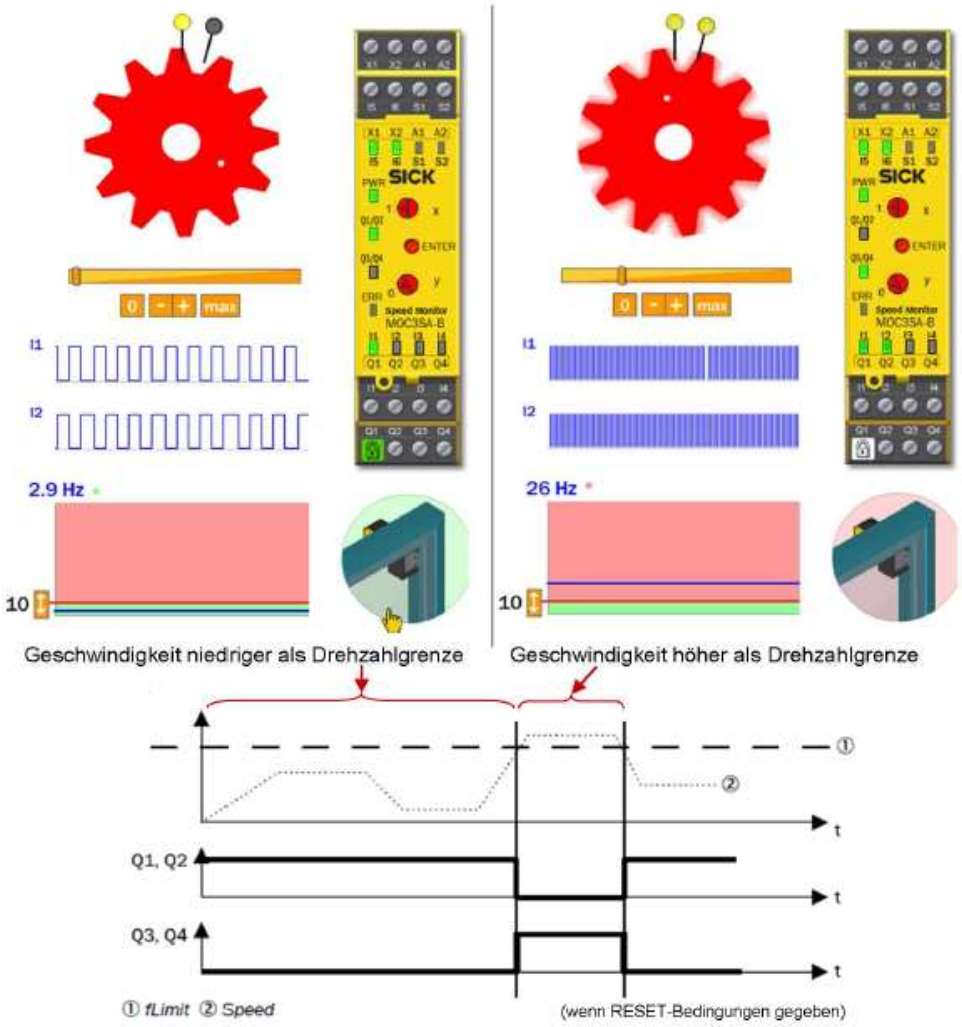


When the speed limit (SLS) is exceeded, the Speed Monitor MOC3SA turns the energy supply off by activating Safe Torque Off (STO). The operator is safe.



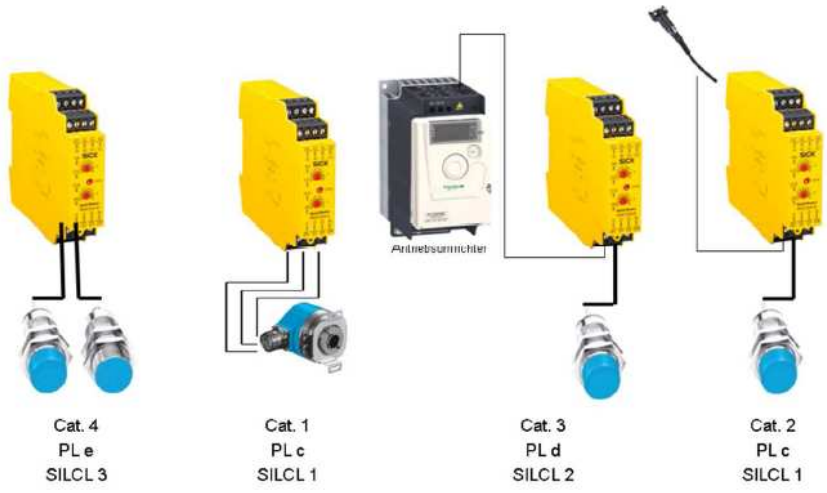
The **STO** function disconnects the energy supply to the drive. Therefore the drive will not be able to start in case of a malfunction. STO can be activated by the Speed Monitor, but it has to be implemented in the drive itself.

1.3 Operation Principle



Q1 and Q2 are HIGH, when the speed is below the configured limit. Q3 and Q4 are the inverse of Q1 and Q2.

1.4 Maximum Safety Figures

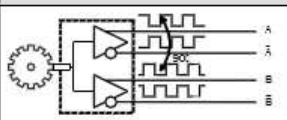
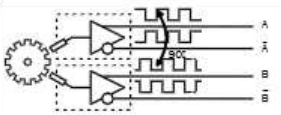
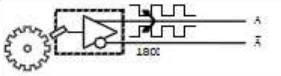
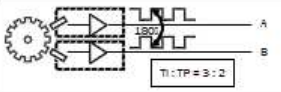
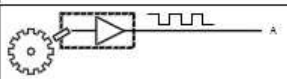
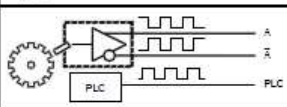
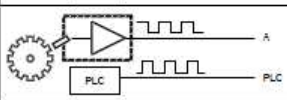
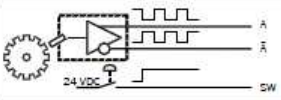
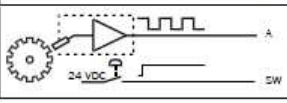


2 Configuration

2.1 Selection of Suitable Operating Mode

The Speed Monitor MOC3SA has nine different operating modes. The operating mode should be selected depending on the desired safety level and the desired selection of sensors.

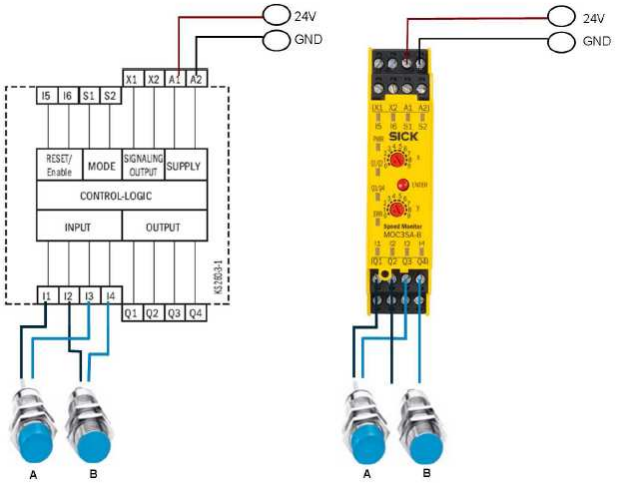
2.1.1 List of operating modes

Operating mode	Sensor signals	I1	I2	I3	I4	S1	S2	Cable break detection	Stuck-at-high detection	Cross-circuit detection	Maximum safety level the application can achieve
A-1		A	B	Ā	B̄	0	0	yes	yes	yes	SIL3 PL e Cat 4
A-2		A	B	Ā	B̄	0	0	yes	yes	yes	SIL3 PL e Cat 4
B-1		A	Ā	0	0	0	1	yes	yes	yes	SIL1 PL c Cat 1
B-2		A	B	0	1	0	1	yes	yes	no	SIL2 PL d Cat 3
B-3		A	0	1	0	0	1	no	no	no	SIL1 PL c Cat 1
C-1		A	PLC	Ā	0	1	0	yes	yes + process error	yes	SIL2 PL d Cat 3
C-2		A	PLC	0	0	1	1	Process error	Process error	no	SIL2 PL d Cat 3
D-1		A	SW	Ā	1	1	0	yes	yes + process error	yes	SIL2 PL c Cat 2
D-2		A	SW	0	1	1	1	Process error	Process error	no	SIL1 PL c Cat 2

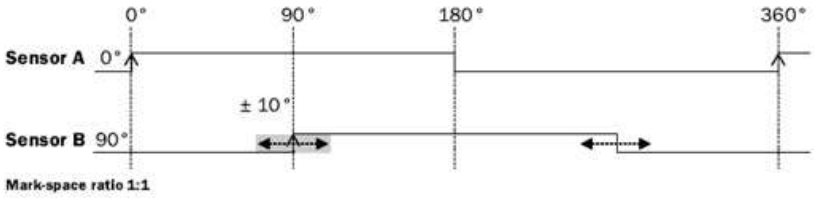
In the following, operating modes A-2, B-1, B-2 and C-2 will be explained in more detail.

2.1.2 Operating mode A-2

For operating mode A-2 two sensors are required, as you can see in the table. The sensors have to be connected at I1 to I4.



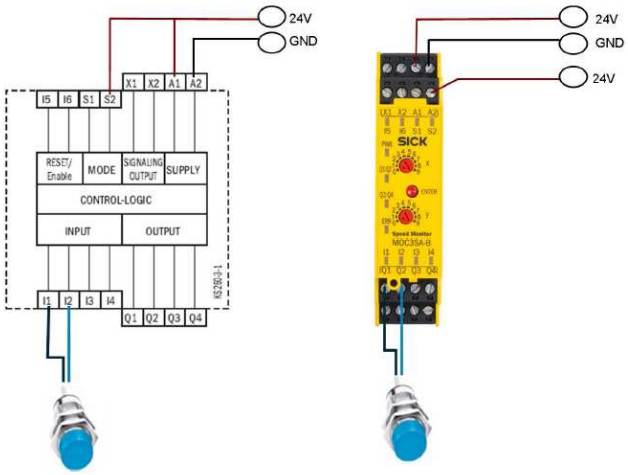
Signal sequences:



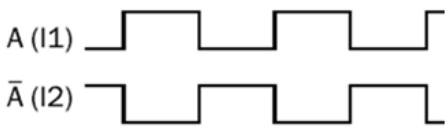
Mark-space ratio 1:1

2.1.3 Operating mode B-1

For operating mode B-1 one sensor is required, as you can see in the table. The sensor has to be connected at I1 and I2.

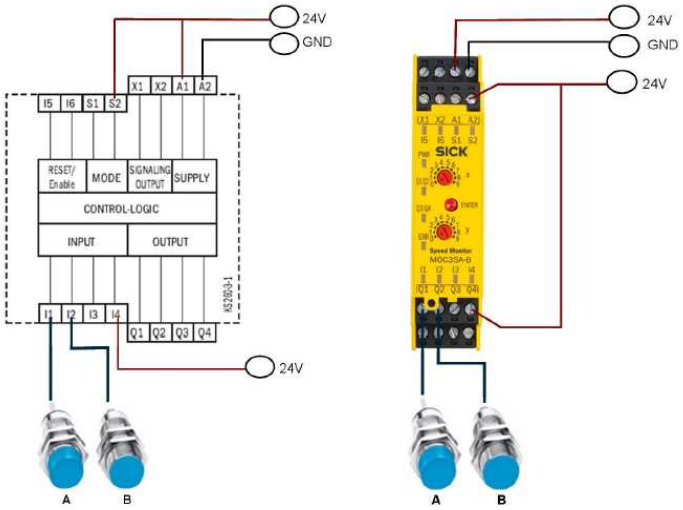


Signal sequences:

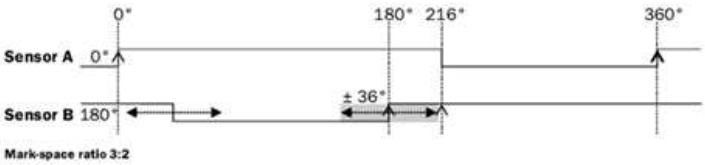


2.1.4 Operating mode B-2

For operating mode B-2 two sensors are required, as you can see in the table. The sensors have to be connected at I1 and I2.

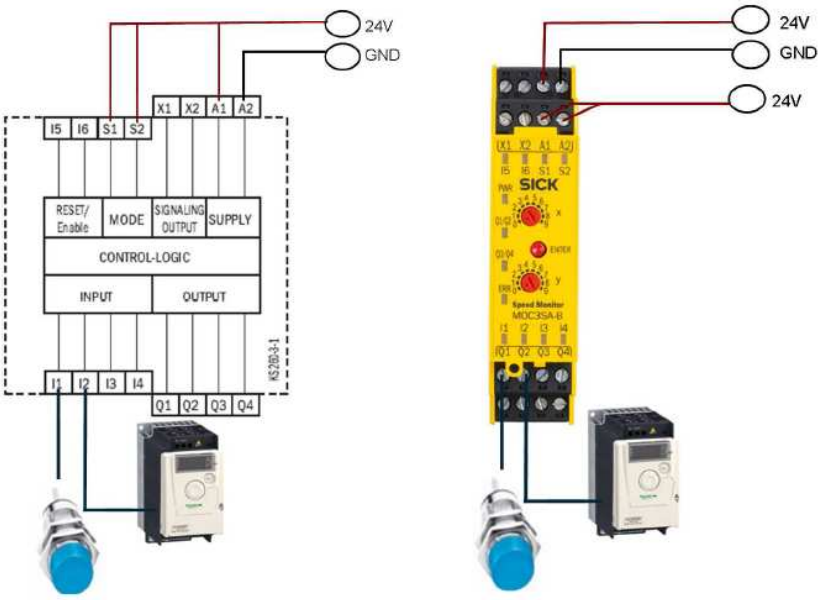


Signal sequences:



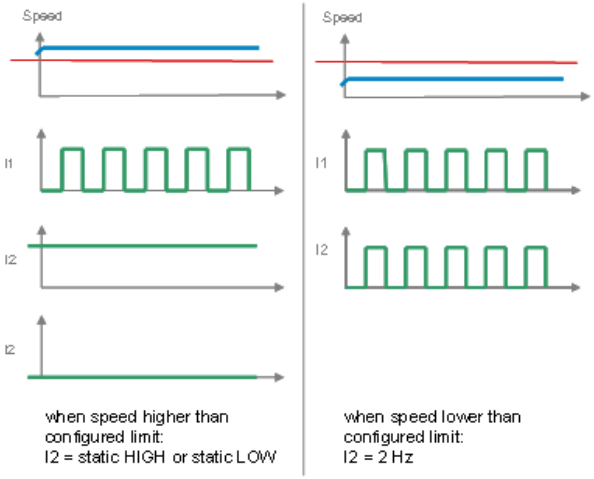
2.1.5 Operating mode C-2

For operating mode C-2 one sensor and one enable signal are required, as you can see in the table. The sensor gets connected at I1 and the enable signal at I2.



The operating mode group C uses two different input conditions for the safe acquisition of the input frequency. The first condition is the sensor signals on I1/I3, the second condition is a dynamic signal on I2 (2 Hz ± 10 %) e. g. from a PLC or a drive.

Signal sequences:



2.2 Selection of Suitable RESET Mode

The Speed Monitor MOC3SA can be configured in two different RESET modes. In the following, both RESET modes will be explained in more detail.

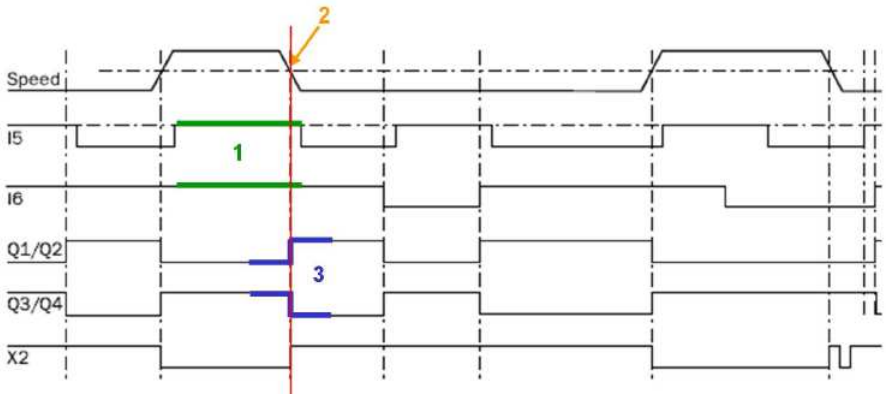
2.2.1 Automatic RESET

An application example for the RESET mode “automatic RESET” is the Safely-Limited Speed in maintenance mode. When the speed limit gets exceeded or undercut, outputs Q1 to Q4 change their state automatically. The logic function is realized in the Flexi Soft, the Speed Monitor only provides information about the speed range.

E.g. Flexi Soft and Speed Monitor MOC3SA from SICK

For the RESET mode “automatic RESET” the input signals I5 (RESET) and I6 (enable) are linked. When there is a HIGH signal on I5 and I6 (1) and the speed is undercutting the limit (2) there will be an automatic change of state on Q1 to Q4 (3). After the state change, only I6 must remain HIGH, I5 can switch to LOW. I5 is connected to the EDM circuit.

➢ Application example: maintenance operation with reduced speed



2.2.2 Manual RESET

In the RESET mode “manual RESET”, the logic function of the Speed Monitor is used. In combination with safety relays the unlocking of the guard can be realized easily when standstill is detected.

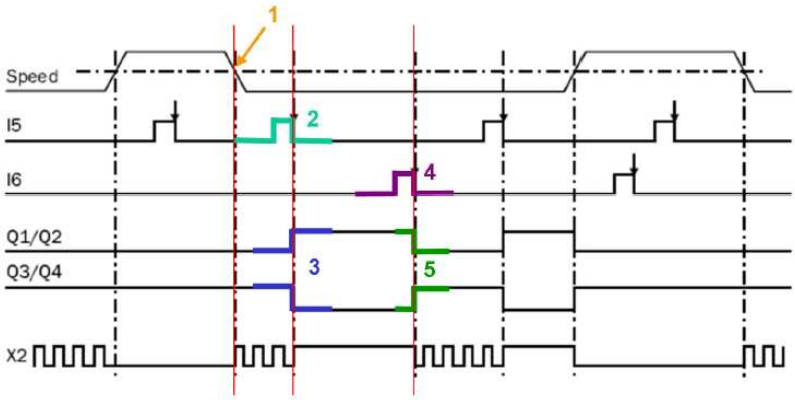
E. g. safety relay UE43-2MF and Speed Monitor MOC3SA from SICK

When configured as manual RESET, the operator enables the stop function by pushing a button. When the speed undercuts the limit (1), a LOW-HIGH-LOW signal on I5 (2) will change the state of Q1 to Q4 (3).

➢Application example: guard unlocking with standstill detection – operator enables guard unlocking manually

The operator enables start by pushing a button. A LOW-HIGH-LOW signal on I6 (4) will change the state of Q1 to Q4 (5).

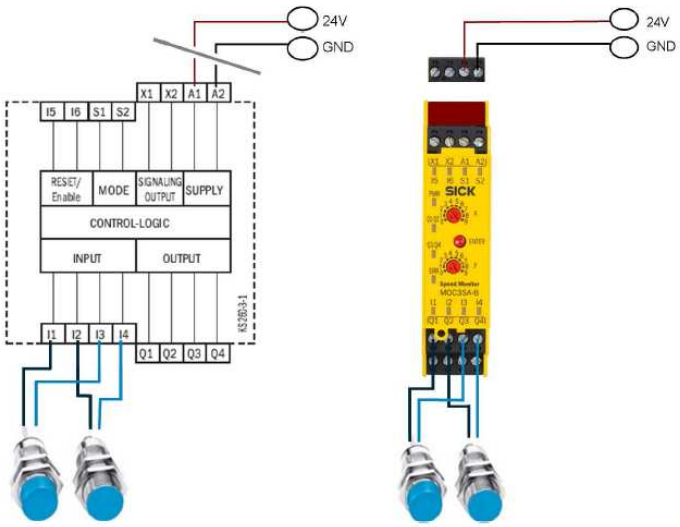
➢Application example: guard unlocking with standstill detection – operator enables guard locking manually



2.3 Configuration Process

2.3.1 Step 1: Disconnection of power supply

Please disconnect the power supply.

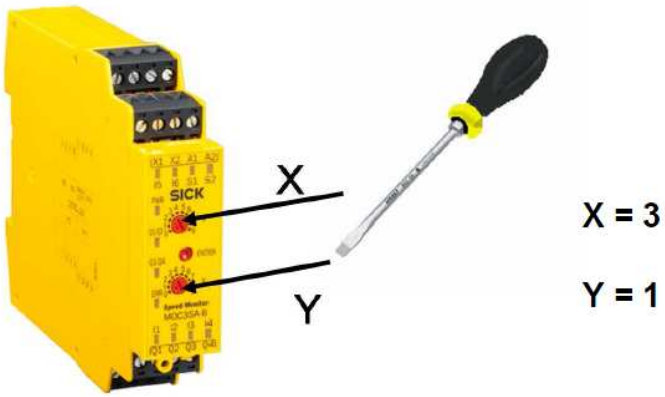


2.3.2 Step 2: Configuration of speed limit

Configure the desired speed limit with a screwdriver on the front of the Speed Monitor.

Model MOC3SA-A can be set to monitoring frequencies between 0.1 and 9.9 Hz and model MOC3SA-B between 0.5 and 99 Hz.

For example, if the desired speed limit is **31 Hz**, model MOC3SA-B should be used and X should be set to 3 and Y to 1.



2.3.3 Step 3: Connect A1 to 24 V and A2 to 0 V

You always have to connect A1 to 24 V and A2 to 0 V, no matter which operating mode you choose. At this point, the power supply still has to be switched off.

2.3.4 Step 4: Connect signals at S1, S2 and I1 to I4

In the list of operating modes (3.1.1) you can find out which inputs you have to connect to sensor(s), 24 V or an enable signal for the desired operating mode.

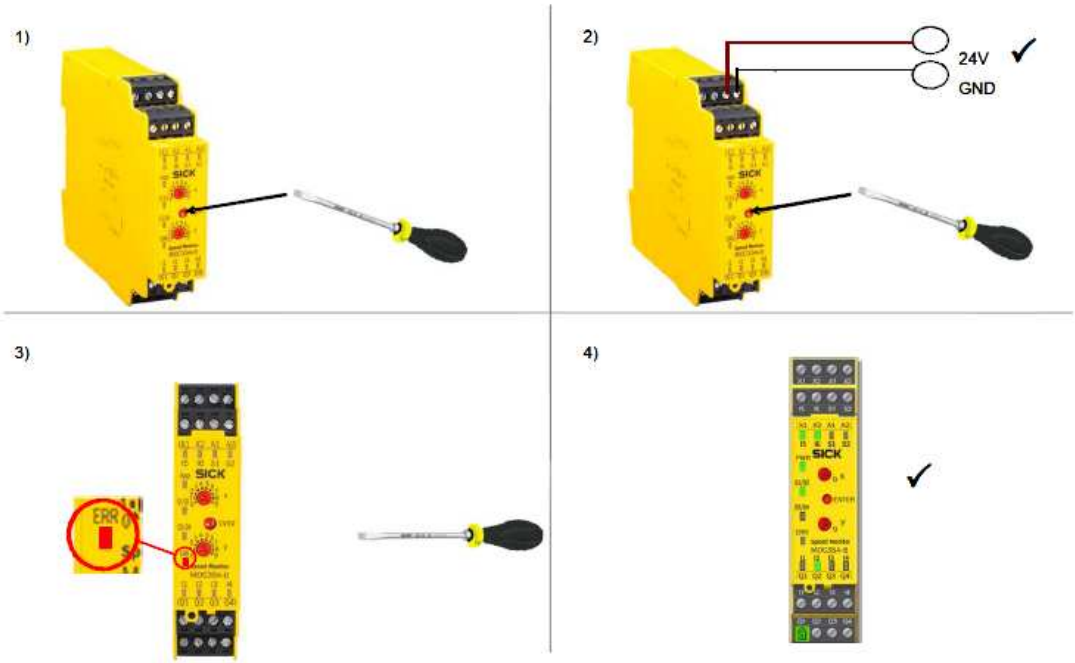
2.3.5 Step 5: Connect I5/leave I5 open

If the device should be configured as automatic RESET, then connect I5 to 24 V. For configuring the device as manual RESET, leave I5 open.

2.3.6 Step 6: Teach the system configuration

To teach the system configuration, follow these steps:

- 1. Press and hold ENTER button
- 2. Connect the power supply
- 3. As soon as LED ERR is flashing: Release ENTER button within the next three seconds
- 4. LED ERR turns off, the Speed Monitor is configured



3 Error Indication and Diagnostics

When an error is indicated by one or more LEDs flashing, you can find out the error type in the following table.

Error behavior and diagnostics				
Error type	**Pulse codes and indications**			**Device status**
	X1	**ERR**	**LED***	
Not recoverable error	Switch off/on device. → Error remains. → Device faulty.			
Internal system errors	HIGH	On	–	Outputs Q1, Q2, Q3, Q4 → LOW
Serious errors	Rectify error. → Switch off/on device. → OK			
Limit frequency	14x	flashing	–	Outputs Q1, Q2, Q3, Q4 → LOW
Supply voltage	13x	flashing	–	Outputs Q1, Q2, Q3, Q4 → LOW
Start-up configuration	12x	flashing	PWR/S2	Outputs Q1, Q2, Q3, Q4 → LOW
Rotary switch configuration error	12x	flashing	PWR	Outputs Q1, Q2, Q3, Q4 → LOW
Operating mode configuration error	12x	flashing	S2	Outputs Q1, Q2, Q3, Q4 → LOW
Discrepancy error	11x	flashing	S1	Outputs Q1, Q2, Q3, Q4 → LOW
Sensor error I1/I2/I3/I4	10x	flashing	I1/I2/I3/I4	Outputs Q1, Q2, Q3, Q4 → LOW
Minor errors	Rectify error → OK			
Operating mode C or D process error	1x	off	–	No effect
RESET process error or EDM error	2x	off	–	No effect
Starting bypass process error	3x	off	–	No effect
Vibration	4x	off	–	No effect
It was not possible to test 90° phase position in operating mode A	5x	Off	–	No effect
No error	OK			
	LOW	off	–	

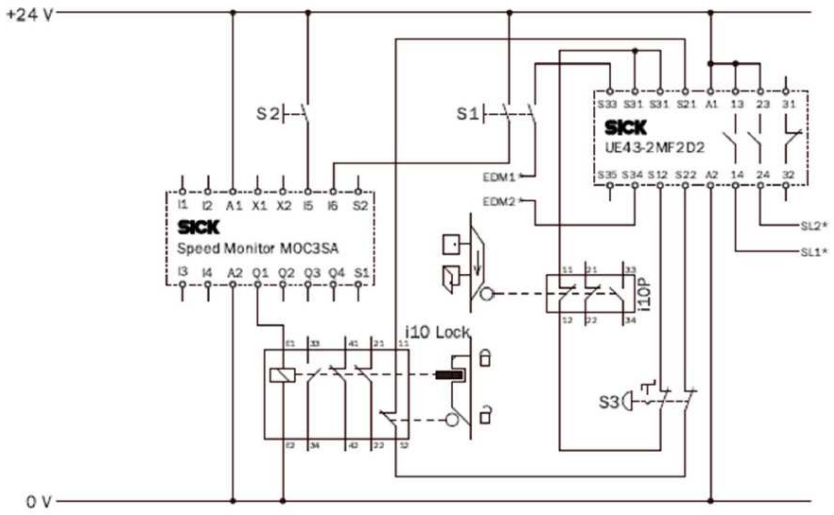
*Additional flashing of the LEDs given.

In the following table you can find out what you can do to resolve the error.

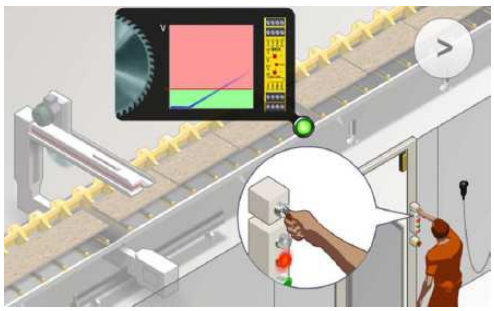
Error type	Description of the possible cause	Error rectification
Internal system error	Internal device error	– Switch off and on again supply, replace device if necessary.
Limit frequency	The upper limit frequency for the device has been exceeded.	– Adjust speed of the drive. – Select signal source (HTL incremental encoders, spur gear, etc.) with a different resolution.
Supply voltage	The supply voltage limits are not met.	– Check connections A1 and A2. – Measure the voltage applied.
Start-up configuration	A configuration element has been changed in the switched off state.	– Re-establish the original configuration. – Check signals at I2 to I5 as well as S1 and S2. – Check the setting of rotary switches X and Y.
Rotary switch configuration error	The standstill speed configured on the two rotary switches has been changed.	– Check the setting of rotary switches X and Y.
Operating mode configuration error	The operating mode configured on S1, S2 or I2, I3, I4, I5 has been changed.	– Check signals at I2 to I5 as well as S1 and S2.
Discrepancy error	The input frequency on I1/I3 was different to that on I2/I4 for more than 30 s.	– Check signals at I1 to I4. – Check mounting of the signal source (HTL incremental encoder, spur gear, etc.).
Sensor error I1/I2/I3/I4	The sensor signal on the inputs I1 to I4 is missing or incorrect.	– Check signals at I1 to I4.
Operating mode C or D process error	A signal has failed in the operating mode group C or D (e.g. PLC).	– Check signal at I2. – Check the process.
RESET process error	The signal for the manual RESET on I5 was too long or too short.	– Comply with signal sequence specified (100 ms ... 5 s).
Starting bypass process error	The signal for the starting bypass on I6 was too long or too short.	– Comply with signal sequence specified (100 ms ... 5 s).
Vibration	There are changing signals on the sensor inputs I1 to I4, triggered by e.g. vibration on the machine.	– Optimize application, reduce vibration present.

4 Circuits for Application Examples

4.1 Guard Unlocking with Standstill Detection

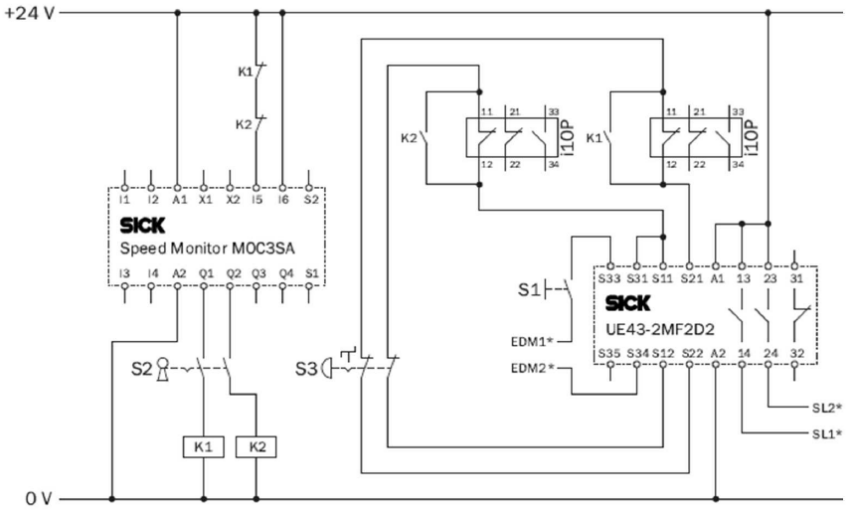


Circuit description



- For this application, the Speed Monitor MOC3SA must be configured in teh RESET mode „manual RESET“.
- i10P und i10 Lock are mounted on the same door for monitoring, i10 Lock is connected to the Speed Monitor via Q1.
- The guard can be unlocked using pushbutton S2 as soon as the drive is stationary/ zero speed (LOW-HIGH-LOW signal on I5).
- When the guard is closed, the drive can be enabled by using pushbutton S1 (LOW-HIGH-LOW signal on I6).

4.2 Maintenance Operation with Reduced Speed



Circuit description

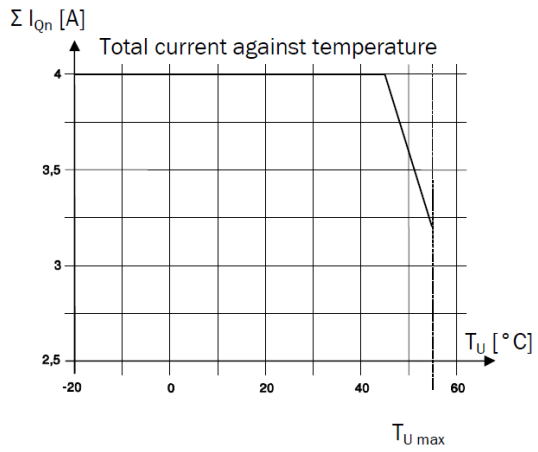
- For this application, the Speed Monitor MOC3SA must be configured in the operating mode „automatic RESET“.
- Maintenance and set-up operation is switched on via the key-operated switch.
- The safety door switches i10P are bypassed via the relays K1 and K2.

5 Technical specifications

5.1 Data Sheet

	Minimum	Typical	Maximum
Supply circuit (A1, A2)			
Supply voltage 24 V DC	19.2 V DC	24 V DC	30 V DC
Type of supply voltage	PELV or SELV The current from the power supply that supplies the main unit must be limited externally to max. 4 A — either by the power supply itself or by a fuse.		
Residual ripple U_{ss}	–	–	3 V
Power consumption	–	–	3 W
Power-up delay after application of U_B	–	–	6 s + 1.8/fLimit
Short-circuit protection	4 A gG, tripping characteristic B or C		
Input circuit (I5, I6, S1, S2)			
Number of inputs			4
Input voltage U_e (HIGH)	13 V DC		30 V DC
Input voltage U_e (LOW)	–5 V DC		+5 V DC
Input current I_e (HIGH)	2.4 mA		3.8 mA
Input current I_e (LOW)	–2.5 mA		+2.1 mA
Input capacitance C_{IN}	9 nF	10 nF	11 nF
Input resistance R_{IN}		7.2 kΩ	
Minimum power-up delay (I5, I6)	100 ms		
Duration of actuation of the RESET button (I5, only for “manual RESET”)	100 ms		5 s
Power-up delay/switch off time (I5, I6)			70 ms
Maximum break time of the input signal without switching of the outputs (Q1–Q4)			4 ms
Repetition rate for the maximum break time	192 ms		
Teach-in time of ENTER button (during power-up)	3 s		

	Minimum	Typical	Maximum
Input circuit (I1, I2, I3, I4)			
Number of inputs			4
Input voltage U_e (HIGH)	13 V DC		30 V DC
Input voltage U_e (LOW)	–5 V DC		+5 V DC
Input current I_e (HIGH)	2.4 mA	3 mA	3.8 mA
Input current I_e (LOW)	–2.5 mA		+2.1 mA
Input capacitance C_{IN}	9 nF	10 nF	11 nF
Input resistance R_{IN}		7.2 kΩ	
Limit frequency (mark-space ratio 3:2)			2 kHz
Frequency change			21 kHz/s
Measuring accuracy for the frequency measurement	1 % (< 1 Hz)	6 % (< 50 Hz)	12 % (≤ 99 Hz)
Error detection time (I1, I2, I3, I4)			
Sensors with inverted outputs short-circuit to GND	52 ms		116 ms
Sensors in operating mode B2, short-circuit to GND	52 ms	3/f	30 s
Short-circuit to U_B			576 ms
Error in supply voltage			576 ms
Control outputs (X1, X2)			
Number of outputs			2
Type of output	PNP semiconductors, short-circuit protected		
Output voltage	18.4 V DC		30 V DC
Output current			120 mA
Readiness time after application of U_B	4 s		
Load capacity			1,000 nF
Cable resistance			100 Ω
Cable length			100 m

	Minimum	Typical	Maximum
Output circuit (Q1, Q2, Q3, Q4)			
Number of outputs			4
Type of output	PNP semiconductors, short-circuit protected, cross-circuit monitored		
Switching voltage	18.4 V DC		30 V DC
Switching current			
I_{Qn}, $T_U \leq 45$ °C			2.0 A
I_{Qn}, $T_U \leq 55$ °C			1.6 A
Total current I_{sum}			
ΣI_{Qn}, $T_U \leq 45$ °C			4 A
ΣI_{Qn}, $T_U \leq 55$ °C			3.2 A
	Load diagram for the outputs Q1 to Q4  		
Test pulse width		400 µs	650 µs
Test pulse frequency	22.7 Hz		32 Hz
Inductive breaking energy $E = 0.5 \times L \times I^2$			370 mJ
Load capacity			500 nF
Cable length (single, Ø 1.5 mm²)			100 m
Response time			12 ms + 1.8/fLimit
General system data			
Weight (without packaging)		0.18 kg	
Electrical safety	Class III		
Electromagnetic compatibility	EN 61 000-6-2, EN 55 011 Class A		
Operating data			
Ambient operating temperature	–25 °C		+55 °C
Storage temperature	–25 °C		+70 °C
Air humidity	10 % to 95 %, non-condensing		
Climatic conditions	EN 61131-2		

	Minimum	Typical	Maximum
Mechanical strength			
Vibration	EN 61131-2		
Vibration resistance	5 ... 500 Hz/5 grms (EN 60068-2-64)		
Terminal and connection data			
Single or fine-stranded wire	1 × 0.14 mm² to 2.5 mm² or 2 × 0.14 mm² to 0.75 mm²		
Single wire with terminal crimps to EN 46 228	1 × 0.25 mm² to 2.5 mm² or 2 × 0.25 mm² to 0.5 mm²		
Insulation stripping length			8 mm
Maximum break-away torque			0.6 Nm

Safety specific characteristics

All these data are based on an ambient temperature of +40 °C.

Safety integrity level	SIL3 (IEC 61508)
SIL claim limit	SILCL3 (EN 62061)
Performance Level	PL e (EN ISO 13849-1)
PFDd	2.2×10^{-5}
PFHd	$5 \times 10^{-9}\ h^{-1}$
SFF	98 %
DC	96 %
T_M (mission time)	20 years (EN ISO 13849-1)

5.2 Dimensional Drawings

Fig. 37: Dimensional drawing (mm), variant with screw type terminals

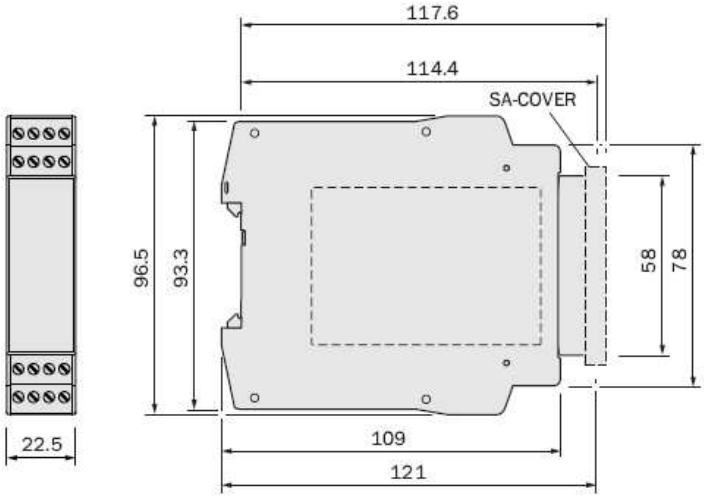
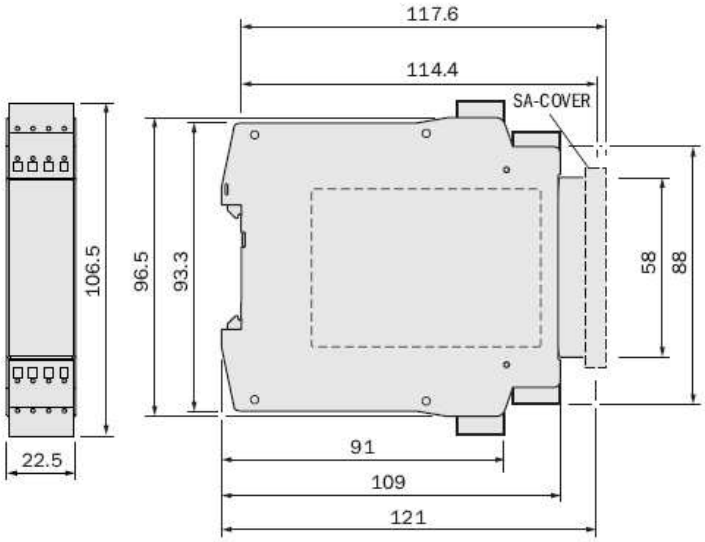


Fig. 38: Dimensional drawing (mm), variant with spring terminals



6 Ordering information

6.1 Ordering Information for the Speed Monitor MOC3SA

Model name	Frequency range	Description	Part no.
MOC3SA-AAB43D31	0.1 ... 9.9 Hz	Removable terminal	6034245
MOC3SA-AAB44D31	0.1 ... 9.9 Hz	Spring terminal	6034246
MOC3SA-BAB43D31	0.5 ... 99 Hz	Removable terminal	6034247
MOC3SA-BAB44D31	0.5 ... 99 Hz	Spring terminal	6034248

6.2 Accessories for the Speed Monitor MOC3SA

Model name	Description	Part no.
IM12-02BPO-ZW1	Inductive proximity sensor, DC-3 conductor (standard series, flush)	6011965
IM12-04NPS-ZW1	Inductive proximity sensor, DC-3 conductor (standard series, non-flush)	6011975
WT9-2P130	Photoelectric proximity sensor with background suppression	1018293
WL9L-330	Laser photoelectric proximity sensor with background suppression	1023977
IQ10-03BPS-KW1	Inductive proximity sensor, DC-3 conductor	7900203
DFS60A-BDEK31400	HTL incremental encoder, rotary incremental (electrical interface: 10 V ... 32 V, HTL/push pull)	1036707
DRS60-E1R00030	HTL incremental encoder, rotary incremental (electrical interface: 10 V ... 32 V, HTL/push pull)	1030874
DFS60	HTL incremental encoders	For ordering information, please refer to the product catalogue
DRS60	HTL incremental encoders	