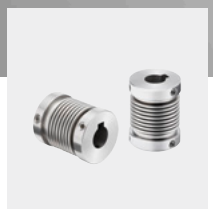

- Encoders for Functional Safety
- Safety Modules
- Safety Services
- Connection Technology
- Accessories

Functional Safety

Our Pulses for Innovations

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Ten international group members and distributors in more than 50 countries offer local product know-how, service and advice throughout the world.

Innovative product and sector solutions, as well as solutions for functional safety and a high level of service, are the reasons behind our global success.

The strict focus on quality ensures the highest levels of reliability and a long service life for our products in the field.

Over 450 dedicated people worldwide make this success possible and ensure that customers can continue to place their trust in our company.

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Sample and Repair Service

We manufacture samples of special designs or according to customer specification within shortest time. We carry out repair work reliably within a maximum of 5 days.

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Safety Services

- Adapted service packages
- Individual customer solutions

10 by 10

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Kübler China +86 10 8471 0818
Kübler India +91 8600 147 280
Kübler USA +1 855 583 2537

Our Product Portfolio

Position and Motion Sensors

- Incremental and Absolute Encoders
- Linear Measuring Technology
- Inclinometers
- Connection Technology

Functional Safety

- Encoders certified up to SIL3/PIe
- Modules for safe Drive Monitoring
- Adapted Service Packages
- Connection Technology

Transmission Technology

- Slip Rings
- Optical Fibre Signal Transmission Modules
- Cables, Connectors and pre-assembled Cordsets

Counters and Process Devices

- Pulse Counters and Preset Counters
- Hour Meters and Timers
- Frequency Meters and Tachometers
- Combination Time and Energy Meters
- Position Displays
- Process Displays and Controllers for Temperature, Analog Signals and Strain-Gauge
- Setpoint Adjuster

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The high performance level and reliability of the Kübler products are based on our long experience in these demanding application sectors. Learn more about our application-specific solutions under:

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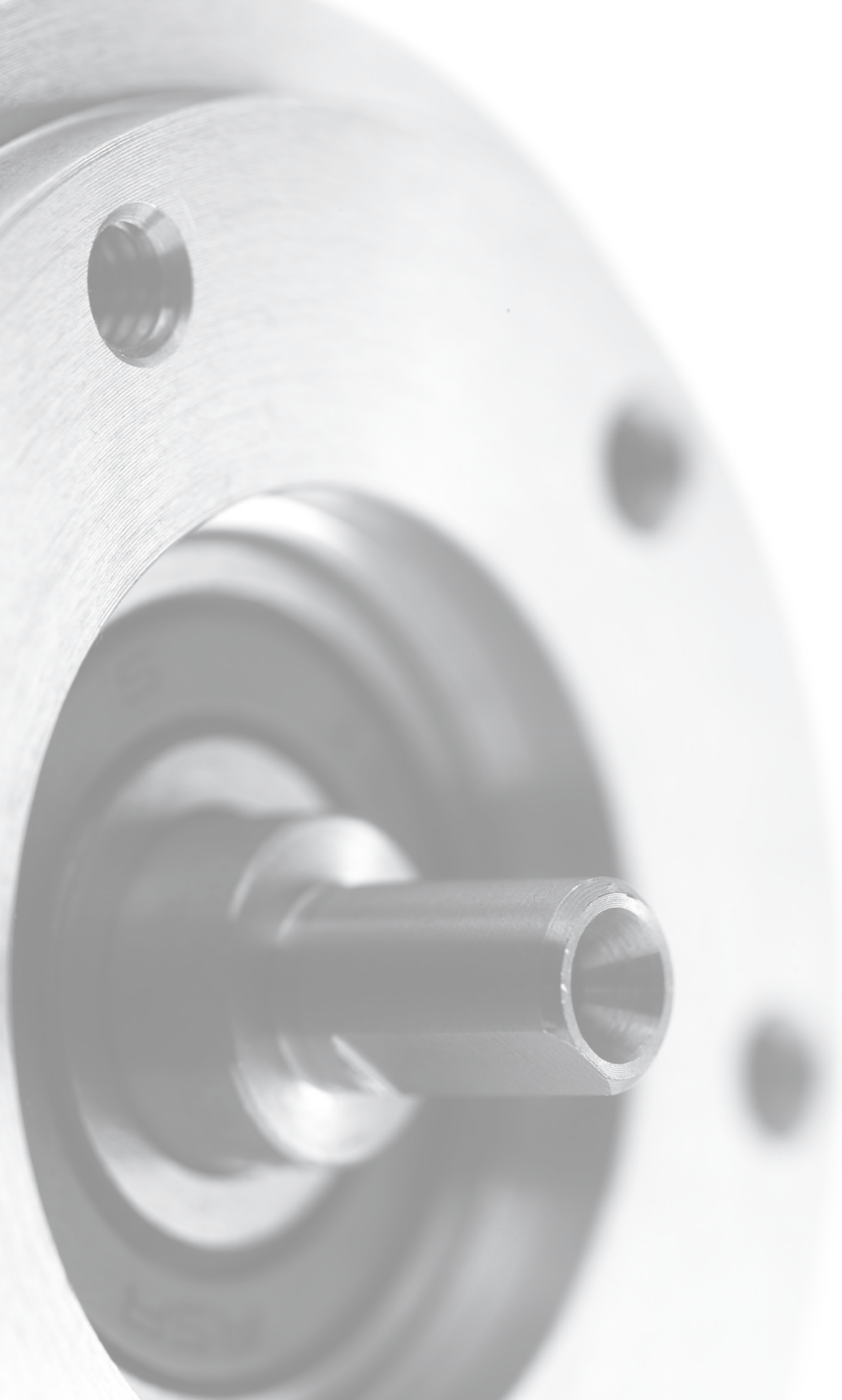

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Product overview

Incremental encoders

		Ø **Dimensions** in mm [inch]	**Optical** (accuracy ≤ ±0.015°)	**Resolution** max. in ppr	**SinCos interface**	**Power supply** in V DC	Ø **Hollow shaft** max. in mm [inch]	**Speed** max. in min^{-1}	**Temperature range** in °C [°F]	**Protection** max.	**Type of connection**	**Pulse frequency** max. in kHz	**RoHS compliant**	**Approvals**	**Page**
	Standard, optical sine wave output, SIL2 / PLd **Sendix SIL 5814FS2** (shaft) **Sendix SIL 5834FS2** (hollow s.)	58 [2.28]	•	1.024 and 2.048	•	5 10 ... 30	14 [0.55]	12.000 / 9.000	-40 ... +90 [-40 ... +194]	IP65	cable M12 M23	400	•		**54**
	Standard, optical sine wave output, SIL3 / PLe **Sendix SIL 5814FS3** (shaft) **Sendix SIL 5834FS3** (hollow s.)	58 [2.28]	•	1.024 and 2.048	•	5 10 ... 30	14 [0.55]	12.000 / 9.000	-40 ... +90 [-40 ... +194]	IP65	cable M12 M23	400	•		**60**
	Standard, optical ATEX / IECEx – zone 1 / 21 SIL2 / PLd **Sendix SIL 7014FS2** (shaft)	70 [2.76]	•	1.024 and 2.048	•	5 10 ... 30	–	6.000	-40 ... +60 [-40 ... +140]	IP67	cable	400	•		**66**
	Standard, optical ATEX / IECEx – zone 1 / 21 SIL3 / PLe **Sendix SIL 7014FS3** (shaft)	70 [2.76]	•	1.024 and 2.048	•	5 10 ... 30	–	6.000	-40 ... +60 [-40 ... +140]	IP67	cable	400	•		**69**

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Product overview

Absolute encoders
Singleturn

		ø Dimensions in mm [inch]	Optical (accuracy ≤ ±0.015°)	Resolution max. in bit	SSI interface	BiSS interface	Additional incremental track	Power supply in V DC	Speed max. in min^{-1}	Temperature range in °C [°F]	Protection max.	Type of connection	RoHS compliant	Approvals	Page
	Standard, optical SIL2 / PLd **Sendix SIL 5853FS2** (shaft) **Sendix SIL 5873FS2** (hollow s.)	58 [2.28]	•	17	•	•	Sin Cos	5 10 ... 30	12.000 / 9.000	-40 ... +90 [-40 ... +194]	IP65	cable M23	•		**74**
	Standard, optical SIL3 / PLe **Sendix SIL 5853FS3** (shaft) **Sendix SIL 5873FS3** (hollow s.)	58 [2.28]	•	17	•	•	Sin Cos	5 10 ... 30	12.000 / 9.000	-40 ... +90 [-40 ... +194]	IP65	cable M23	•		**80**
	Standard, optical ATEX / IECEx – zone 1 / 21 SIL2 / PLd **Sendix SIL 7053FS2** (shaft)	70 [2.76]	•	17	•	•	Sin Cos	10 ... 30	6.000	-40 ... +60 [-40 ... +140]	IP67	cable	•		**86**
	Standard, optical ATEX / IECEx – zone 1 / 21 SIL3 / PLe **Sendix SIL 7053FS3** (shaft)	70 [2.76]	•	17	•	•	Sin Cos	10 ... 30	6.000	-40 ... +60 [-40 ... +140]	IP67	cable	•		**90**

Product overview

Absolute encoders
Multiturn

		ø **Dimensions** in mm [inch]	**Optical** (accuracy ≤ ±0.015°)	**Resolution** max. ST+MT in bit	**SSI interface**	**BiSS interface**	**Additional incremental track**	**Power supply** in V DC	**Speed** max. in min^{-1}	**Temperature range** in °C [°F]	**Protection** max.	**Type of connection**	**RoHS compliant**	**Approvals**	**Page**
	Standard, optical mechanical multiturn SIL2 / PLd **Sendix SIL 5863FS2** (shaft) **Sendix SIL 5883FS2** (hollow s.)	58 [2.28]	•	17 + 12	•	•	SinCos	5 10 ...30	12.000 / 9.000	-40 ... +90 [-40 ... +194]	IP65	cable M23	•		**96**
	Standard, optical mechanical multiturn SIL3 / PLe **Sendix SIL 5863FS3** (shaft) **Sendix SIL 5883FS3** (hollow s.)	58 [2.28]	•	17 + 12	•	•	SinCos	5 10 ...30	12.000 / 9.000	-40 ... +90 [-40 ... +194]	IP65	cable M23	•		**102**
	Standard, optical mechanical multiturn ATEX / IECEx – zone 1 / 21 SIL2 / PLd **Sendix SIL 7063FS2** (shaft)	70 [2.76]	•	17 + 12	•	•	SinCos	10 ...30	6.000	-40 ... +60 [-40 ... +140]	IP67	cable	•		**108**
	Standard, optical mechanical multiturn ATEX / IECEx – zone 1 / 21 SIL3 / PLe **Sendix SIL 7063FS3** (shaft)	70 [2.76]	•	17 + 12	•	•	SinCos	10 ...30	6.000	-40 ... +60 [-40 ... +140]	IP67	cable	•		**112**

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Product overview

Safety modules
Safety-M compact
Basic modules

		Monitoring - number of axes	Encoder system	Safe digital input lines	Analog input lines	Relay output lines	Digitale output lines	Analog output lines	Encoder interface	Max. number of expansion/ bus modules	Power supply in V DC	Module width in mm [inch]	RoHS compliant	Approvals	Page
	Speed monitoring 1 axis / 1 encoder system **SMC1**	1	1	4/2	–	1	4	1 opt.	SinCos	0	24	50 [1.97]	•	SIL3 PLe	**118**
new	Speed monitoring 1 axis / 2 encoder systems **SMC2**	1	2	4/2	–	1	4	1 opt.	HTL/TTL/ SinCos	0	24	50 [1.97]	•	SIL3 PLe	**122**

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Safety modules
Safety-M modular
Basic modules

		Monitoring - number of axes	Digitale safe input lines	Analog input lines	Relay output lines	Digital safe output lines	Safe cross communication	Communication interface	Encoder interface terminal	Max. number of expansion modules	Power supply in V DC	Module width in mm [inch]	RoHS compliant	Approvals	Page
	Digital, with USB diagnostic interface **SMBD.420**	• [1]	8 / 4	• [1]	• [1]	2	–	–	HTL/ Proximity switch	31 safe slaves	24	22.5 [0.89]	•	SIL3 PLe cULus	**126**
	Digital, with Ethernet diagnostic interface **SMBD.32E**	• [1]	6 / 3	• [1]	• [1]	2	•	–	HTL/ Proximity switch	31 safe slaves	24	22.5 [0.89]	•	SIL3 PLe cULus	**129**
	Gateway, universal CANopen **SMBU.021**	• [1]	6 / 3	• [1]	• [1]	6	•	CANopen	–	31 safe slaves	24	100 [3.94]	•	SIL3 PLe cULus	**132**
	Gateway, universal PROFIBUS DP **SMBU.031**	• [1]	6 / 3	• [1]	• [1]	6	•	PROFIBUS DP	–	31 safe slaves	24	100 [3.94]	•	SIL3 PLe cULus	**135**
	Gateway, universal EtherCAT **SMBU.0B1**	• [1]	6 / 3	• [1]	• [1]	6	•	EtherCAT	–	31 safe slaves	24	100 [3.94]	•	SIL3 PLe cULus	**138**
	Gateway, universal PROFINET IO **SMBU.0C1**	• [1]	6 / 3	• [1]	• [1]	6	•	PROFINET IO	–	31 safe slaves	24	100 [3.94]	•	SIL3 PLe cULus	**141**
	Gateway, universal EtherNet/IP **SMBU.0D1**	• [1]	6 / 3	• [1]	• [1]	6	•	EtherNet/IP	–	31 safe slaves	24	100 [3.94]	•	SIL3 PLe cULus	**144**
	Gateway, safe PROFIsafe / PROFIBUS DP **SMBS.S31**	• [1]	6 / 3	• [1]	• [1]	6	–	PROFIsafe PROFIBUS DP	–	31 safe slaves	24	100 [3.94]	•	SIL3 PLe cULus	**147**
	Gateway, safe PROFIsafe / PROFINET IO **SMBS.SC1**	• [1]	6 / 3	• [1]	• [1]	6	–	PROFIsafe PROFINET IO	–	31 safe slaves	24	100 [3.94]	•	SIL3 PLe cULus	**150**

1) Via expansion module.

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Product overview

Safety modules
Safety-M modular
Expansion modules

		Digital input lines	Analog input lines	Digital output lines	Relay contacts	Encoder interface	Power supply in V DC	Module width in mm [inch]	RoHS compliant	Approvals	Page
	Axis expansion, incremental **EMAI.012**	–	–	–	–	HTL	24	22.5 [0.89]	•	SIL3 PLe, cULus	**153**
	Axis expansion, absolute **EMAA.032**	–	–	2	–	SinCos SSI TTL	24	22.5 [0.89]	•	SIL3 PLe, cULus	**156**
	I/O expansion, relay 1 x 4 contacts **EMIO.SR.004**	–	–	–	4	–	24	22.5 [0.89]	•	cULus	**160**
	I/O expansion, relay 2 x 4 contacts **EMIO.SR.008**	–	–	–	8	–	24	22.5 [0.89]	•	cULus	**163**
	I/O expansion, digital 8 + 8 / 4 **EMIO.SIO.048**	8	–	8 / 4	–	–	24	22.5 [0.89]	•	cULus	**166**
	I/O expansion, digital 16 / 8 + 2 / 1 **EMIO.SIO.810**	16 / 8	–	2 / 1	–	–	24	22.5 [0.89]	•	cULus	**169**
	I/O expansion, digital 8 / 4 + 4 / 2 **EMIO.SIO.420**	8 / 4	–	4 / 2	–	–	24	22.5 [0.89]	•	cULus	**172**
	I/O expansion, digital 4 / 2 + 4 **EMIO.SIO.204**	4 / 2	–	4	–	–	24	22.5 [0.89]	•	cULus	**175**
	I/O expansion, digital 2 / 1 + 2 **EMIO.SIO.10xP**	2 / 1	–	2	–	–	–	45 [1.77]	•	cULus	**178**
new	I/O expansion, analog 2 / 1 **EMIO.SAI.200**	–	2 / 1	–	–	–	24	22.5 [0.89]	•	cULus	**181**
	I/O expansion, digital (non safe) 8 + 8 **EMIO.IO.880**	8	–	8	–	–	24	22.5 [0.89]	•	cULus	**184**

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Product overview

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Advice, Safety services

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Services
Support, applikation / service

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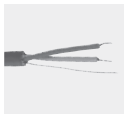
Product overview

Connection technology
Cable,
unprepared, cut to length

	PVC cable	PUR cable	TPE cable	Cross section in mm² [AWG]	Cable diameter in mm	for incremental encoders	for absolute encoders	for safety modules	RoHS compliant	Page
8 core + shield	–	•	–	8 x 0.14 [AWG25] 3 x 2 x 0.14 [AWG25] + 2 x 0.5 [AWG20]	approx. 5.5 approx. 7.4	–	•	•	•	**200**
10 core + shield	–	•	–	4 x 2 x 0.25 [AWG23] + 2 x 1 [AWG17]	approx. 7.9	•	•	•	•	**200**
12 core + shield	•	•	•	10 x 0.14 [AWG25] + 2 x 0.5 [AWG20] 12 x 0.14 [AWG25] 6 x 2 x 0.14 [AWG25] 5 x 2 x 0.14 [AWG25] + 2 x 0.5 [AWG20] 6 x 2 x 0.14 [AWG25]	approx. 6.9 approx. 6.7 approx. 7.5 approx. 8.5 approx. 7.3	•	•	–	•	**201**
 PROFIBUS DP DeviceNet CANopen Industrial Ethernet	•	•	–	2 x 0.34 [AWG25] 2 x 0.52 [AWG20] + 2 x 1.04 [AWG17] 3 x 2 x 0.25 [AWG23] 2 x 2 x 0.34 [AWG25]	approx. 7.6 approx. 8.4 approx. 6.2 approx. 4.8	•	•	•	•	**202**

Connection technology
Connectors, self-assembly

	N°of pins	Housing	Connection technology	Cable diameter Ø in mm	Straight connector	Right angle connector	Wall/panel lead-through	for fieldbus	Page
M12	4, 5, 8	Metal	Screw terminals	4 ... 8	•	•	•	•	**203**
M23	12	Metal	Solder pins	5.5 ... 10.5	•	–	•	–	**208**
RJ45	8	Plastic	Crimp connection	4.5 ... 8	•	–	–	•	**212**
Sub-D	9	ABS metallized	Solder pins	3.5 ... 8.6	–	•	–	–	**215**

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Connection technology
Cordsets, pre-assembled

		PVC cable	PUR cable	Straight connector	Right angle connector	for incremental encoders	for absolute encoders	for safety modules	Page
	with M12 connector	•	•	•	•	•	•	•	**205**
	with M23 connector	•	•	•	–	•	•	–	**209**
	with RJ45 connector	•	•	•	–	–	–	•	**213**
	Ethernet patch cable with Sub-D connector	•	•	–	•	–	•	•	**216**

Accessories

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Product overview

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Encoders

Introduction

Encoders can be used in applications, where length, positions, speed or an angular position are measured. They transform mechanical movements into electrical signals and can be divided into incremental and absolute measuring systems.

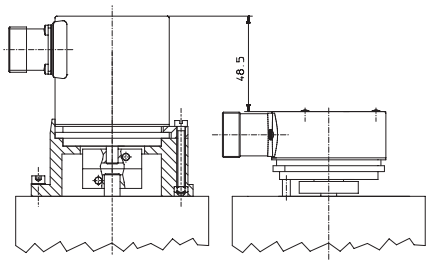
Incremental encoders generate pulses, where the number of pulses can be a measure of speed, length or position.

In absolute encoders, every position corresponds to an unique code pattern. No reference runs after starting-up are necessary as with incremental systems. Safety is increased and the time taken for reference runs is saved.

In principle we can supply all encoders, whether with a solid shaft or in a hollow shaft version.

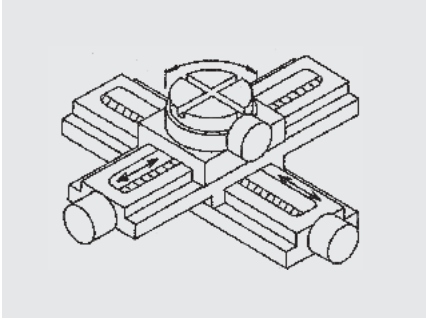
Using a hollow shaft encoder saves up 30 % of costs and up to 50 % of the required space compared to a shaft encoder. This is achieved by avoiding additional couplings, brackets and other assembly aids.

To mount a hollow shaft encoder it just needs to be pushed onto the shaft, clamped, and in the simplest case prevented from rotating by using a cylinder pin. Moreover, in principle, hollow shaft encoders require less installation depth.

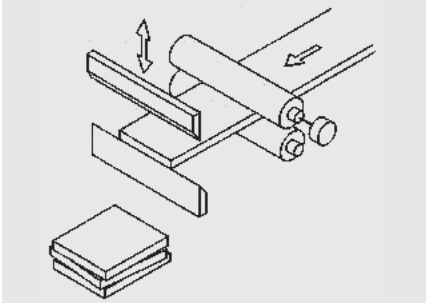


Application examples

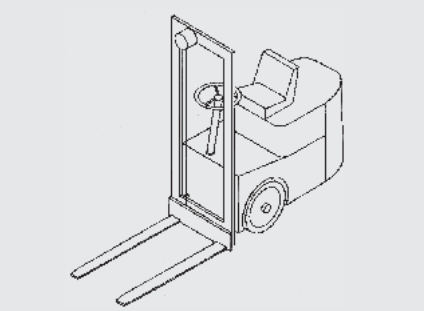
Angular measurement



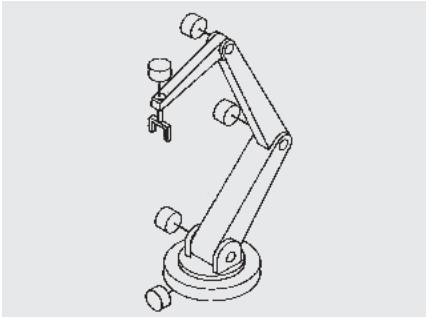
Positioning



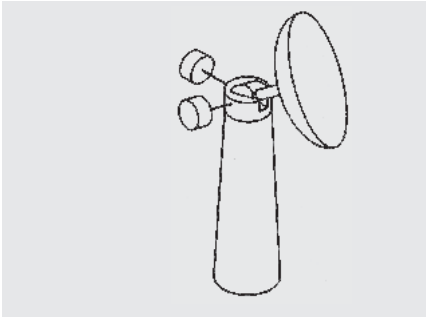
Detecting of fork's position



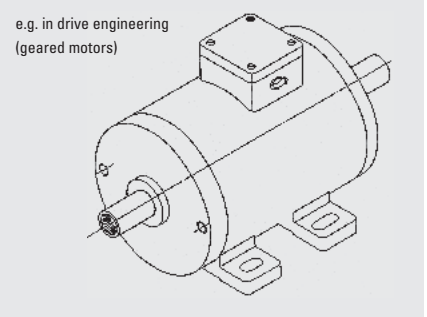
Detecting of position



Angular measurement



Velocity measurement



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Encoders

Functional principle

Assembly and function

Optical scanning (incremental)

A disc fitted with a grating, having a code pattern of slits and bars, is mounted so that it can rotate between an LED and a receiver.

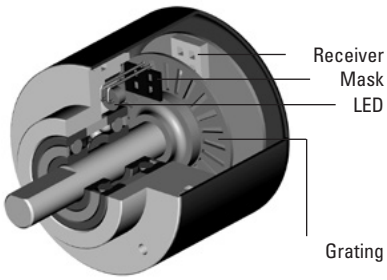
The light emitted by the LED is modulated by the mask and grating and then strikes the receiver, which produces a signal proportional to the luminosity.

When the disc rotates this signal has a shape that approximates to a sine wave.

Optical scanning (absolut)

The light that is emitted by an LED is modulated by a code pattern, which is applied to a rotating disc; this is scanned by a special Kübler Opto ASIC. A unique bit pattern is assigned to each position and this is generally available as Gray Code.

The advantage, compared with incremental encoders, lies in the fact that any movement of the shaft whilst voltage is not applied is immediately detected when power is re-applied, ensuring the correct position is always available.



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Encoders | Incremental encoders

Processing of the signals (optical, incremental encoders)

The sine wave signals are then processed in a specially designed electronic circuitry. Most controllers require square-wave signals on their input.

The signals are therefore pre-processed accordingly in the encoder and made available using various output circuits depending on the application.

Inverted signals

When used in environments, with a lot of electrical noise and/or if very long cable distances are required, we recommend using encoders with inverted (complementary) signals.

These signals are always available with output circuits of the RS422 type and sine wave outputs or optionally with push-pull outputs.

Resolution

The required angular or linear resolution of a application determines the number of pulses per revolution. Linear movements must first be converted into rotary, for example by means of a spindle.

Example:

An encoder is equipped with a measuring wheel. Every revolution corresponds to a distance of 200 mm (circumference). The accuracy should be 0.1 mm. What is the required resolution (ppr)?

given:
- Circumference of the measuring wheel = 200 mm
- Accuracy of the system = 0.1 mm

wanted:
- Resolution of the encoder [ppr] 1)

$$\text{Resolution} = \frac{\text{Circumference}}{\text{Accuracy}}$$

The required resolution would be 2000 ppr 1).

Pulse frequency

The required pulse frequency can be calculated as a result of the number of pulses per revolution (PPR) and the maximum speed (RPM). The maximum pulse frequency is shown in the data sheet specifications for each encoder.

Generally this is 300 KHz, but can be up to 800 KHz with high-resolution encoders.

Example:

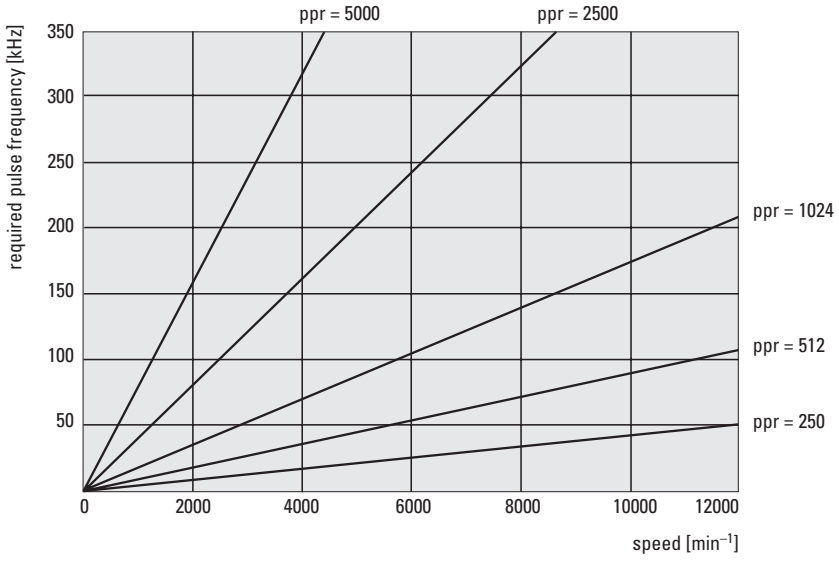
given:
- Speed = 3000 min^{-1}
- Resolution of the encoder= 1000 ppr 1)

wanted:
- Required pulse frequency of the encoder

$$\text{Pulse frequency} = \frac{\text{Speed x Resolution}}{60}$$

The required pulse frequency is thus 50 KHz. This can now be compared with the maximum possible pulse frequency of the desired encoder.

This diagram can be used to estimate the required pulse frequency. 1)



1) ppr = Pulses per revolution

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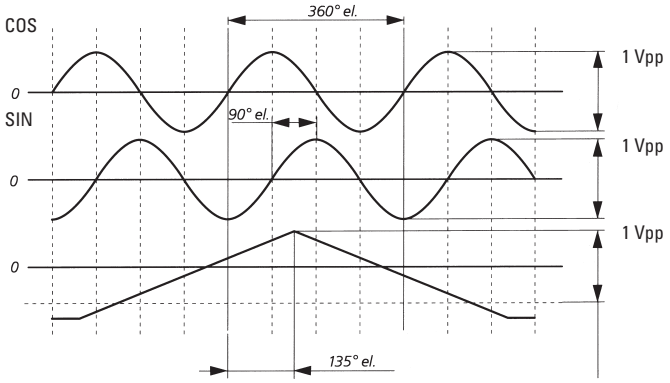
Sine wave outputs

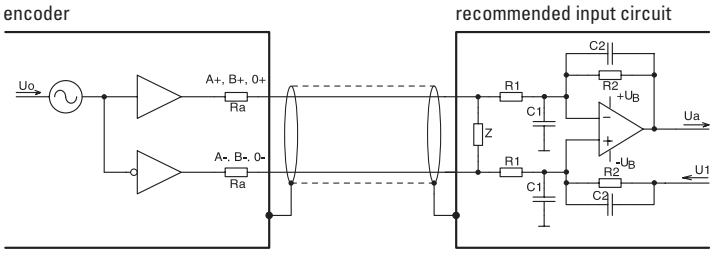
The sine wave signals are available as voltage signals. They can be further processed in the evaluation electronics. Due to the interpolation of the two signals, which are 90° out of phase, a very high resolution can be achieved.

Further they are very suitable for digital drives with a very slow movement, e.g. for grinding machines or lifts and elevators.

- Shaft turning clockwise, top view of shaft
- 0 pulse is generated once per turn (only with 5804 / 5824)



Output circuit and recommended input circuit for sine wave voltage signals



R_a = 10 Ω
C_1 = 150 pF
C_2 = 10 pF
R_1 = 10 kΩ
R_2 = 33 kΩ
U_0 = 2,5 V ±0,5 V

Z = 120 Ω
$U_1 = U_0$

operation amplifier:
e.g. MC33074

Encoders

Absolute encoders

Versions

Singleturn encoders

Depending on the number of divisions they generate unique positions per revolution. After one complete revolution the process re-commences at the start position.

They are suitable for angular measurement over a maximum of one turn of the shaft (=360°), for example in robotics, with cam controllers and in other controlled rotary motion.

Multiturn encoders

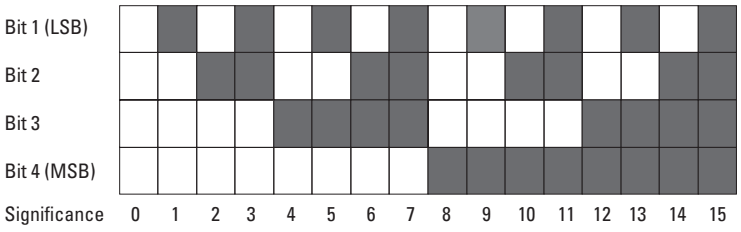
Up to 17 bit unique angular positions per revolution are provided. In addition the number of revolutions is detected. Up to 4096 (12 bit) unique revolutions can be made available on the output.

Multiturn encoders are suitable for angular measurement over more than one turn of a shaft, for example with longer traverse paths, such as high rack storage areas, cranes or machine tools.

Code types

Binary Code

The Binary Code can be processed very easily by computer systems. When using optical read-out, errors may occur, because the change from one bit to another on the different concentric tracks (LSB, LSB+1...) is not exactly synchronized. Due to this, without any correction of the code, the position information could be wrong.



Gray Code

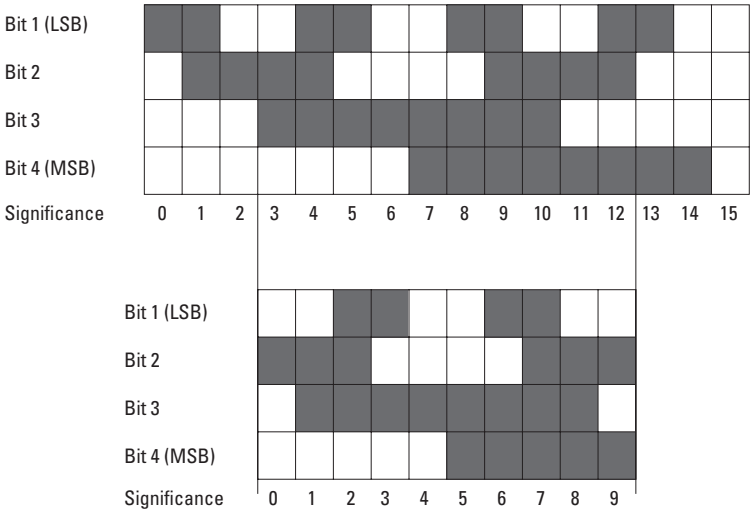
The Gray Code is a single-step code, which guarantees that from one position to the next only 1 bit changes.

This leads to reliable scanning of the code and consequently of the positions.

Symmetrically capped Gray Code (Gray-Excess):

If a particular section of the complete Gray Code is extracted, this results in the so-called Gray Excess Code

This permits even-numbered divisions, such as 360, 720, 1000, and 1440.



Reversion of the Gray Code

The code values increase when the shaft is turning clockwise.

The Gray Code is reversible, i.e. if the most significant bit (MSB) is inverted, the code values decrease when the shaft is turning clockwise.

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The mechanical Sendix Multiturn stage with gear

Kübler plus

- Multiturn gear with purely optical scanning technology. Completely resistant to magnetic fields.
- First stage with double bearing layer.
- Special materials ensure temperature stability and long service life.
- Through hollow shaft diameter up to 14 mm - up to 15 mm as blind hollow shaft.
- Specially developed gear teeth allow for very high rotational speeds and eliminate wear.

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Encoders | Absolute encoders

Outputs

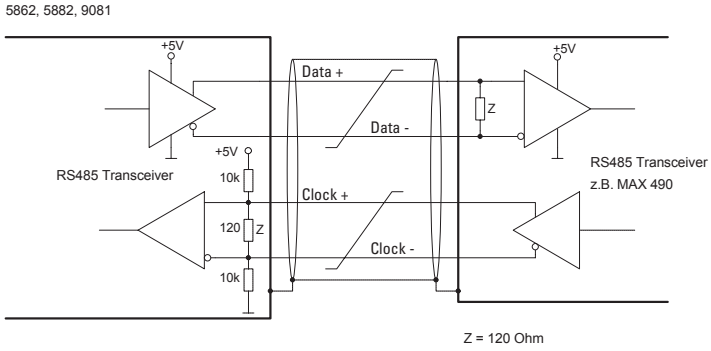
To transfer the position data to a controller, different interfaces are available.

Synchronous Serial Interface (SSI)

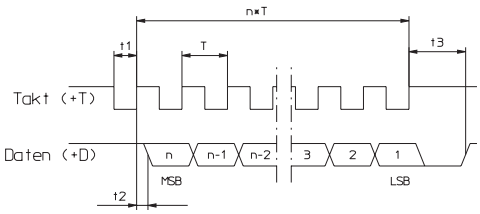
Compared to the parallel interface, the SSI interface needs less components and the EMC characteristics are much better.

In addition less lines are needed for transmission and the possible cable length is much longer.

Output circuit and recommended input circuit



Data transmission SSI



t_1 = T / 2

t_2 < 1 / (4 x fmax)

t_3 = Monoflop time (see below)

n = Resolution in bit

$1/ f_{max} \leq T \leq 1 / f_{min}$

f_{min} = min. clock rate (see data sheet)

f_{max} = max. clock rate (see data sheet)

At rest, the clock and data lines are at a high level. With the first falling clock-pulse edge, the current encoder data are stored in the buffer ready to be sent. With the next rising clock-pulse edge, the data are transmitted bit by bit, starting with the MSB. The transfer of a complete data word requires n+1 rising clock-pulse edges (n=resolution in bit), e.g. 14 clock signals for a complete readout of a 13 bit encoder.

After the last positive-going clock-pulse edge the data line will remain for the duration of the monoflop time t3 at a low level, until the encoder is ready for a new data word. The clock line must stay high for at least as long, and then can begin a new read-out sequence again with the next falling edge.

Please note!

Only for type 5850, 5870, 5862, 5882 and 9081:

The updating of the data occurs synchronously with the read-out cycle. So, the data are as up-to-date as the interval time between two read-outs.

A periodic read-out of the encoder in the application is therefore recommended, using appropriately short cycle times, so that current position values are constantly maintained. It is not possible to read out the same data word several times.

Monoflop time of the encoder: t_3 = max. 40µs

Only for the new Sendix absolute encoders:

The updating of the data occurs immediately with the first falling edge of the clock signal. The data are thus always up-to-date. If a repeated read-out of the same data word is desired, then a new clock sequence must be started within the time interval t_3. If the clock sequence is terminated before the necessary number of clock pulses, needed for a complete readout of the data word, has been transmitted, then after a further time interval t_3 the data line will go high again and signal that the last read-out sequence has been aborted. It will also indicate that it is ready for a new data word to be sent. Monoflop time of the encoder: t_3 = see data sheet.

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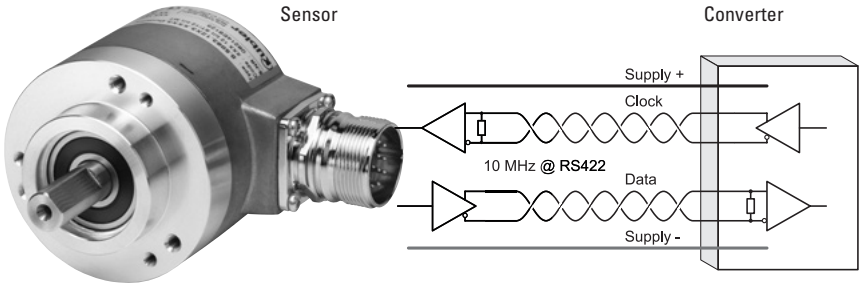
BiSS Interface

Point-to-point communication

- Bidirectional isochronous connection between drive, converter and sensor.
- Purely digital link for maximum performance, reliability and safety in transmission.
- Reduction of hardware, installation and maintenance work.

Advantages at a glance

- Flexible.
- Fast and safe.
- Cost-effective and non proprietary / Open source.
- Fully digital and bidirectional.
- Suitable for motor feedback systems.
- Plug and Play.



Extended possibilities with BiSS

- Motor data and maintenance information can be stored and read out easily in the encoder.
- Condition monitoring through register communication.

Easy supplementing of the BiSS master function

- The existing standard control hardware can mostly be used also for BiSS.
- Extension by firmware update is in most cases possible.
- BiSS as a real alternative to existing, RS422 or RS485-based interfaces.
- Fast and simple BiSS master implementation with free-of-charge BiSS IPs on processors and FPGAs.

Details about our BiSS interface can be found on our website at: www.kuebler.com/biss-interface

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EMC compliant installation

EMC = Electromagnetic compatibility

Safety modules monitor the signals from sensors and in particular from encoders very intensively. This is necessary, as an encoder signal contains positioning or rotational speed regulation information. EMC is considered as one of the main causes of malfunctions in plants and machines during installation and commissioning. Generally, EMC problems translate into sporadically occurring errors or phenomena.

Therefore, one of the main tasks of Safety-M safety modules is to detect and display such signal changes. What is sometimes wrongly described as availability problems is nothing but the effects of insufficient EMC measures.

Several guidelines are to be observed in order to maintain the best signal quality possible:

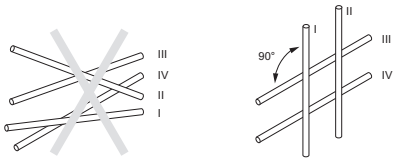
1) Cable routing

Cable routing strongly contributes to the EMC of a plant.
The cables must be classified in four groups I, II, III and IV:

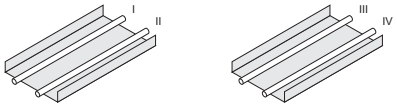
Group I:	Very sensitive to interference (Analog signals, measuring lines).	Group III:	Source of interference (control cables for inductive loads, unswitched power cables, motor brakes, contactors).
Group II:	Sensitive to interference (digital signals, sensor cables, 24 VDC switching signals, communication signals such as e.g. fieldbuses).	Group IV:	Strong source of interference (frequency converter output cables, welding plant power supply cables, switched power cables).

Lines should always be routed so that the signal lines are separated from the power supply lines:

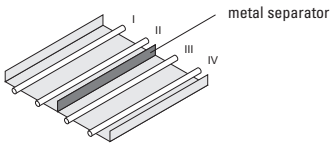
Cross lines of groups I, II and of groups III, IV at right angles.



Ideally:
route the lines in different cable channels.



Alternative:
separate the lines using a metal separator.



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2) Shielding

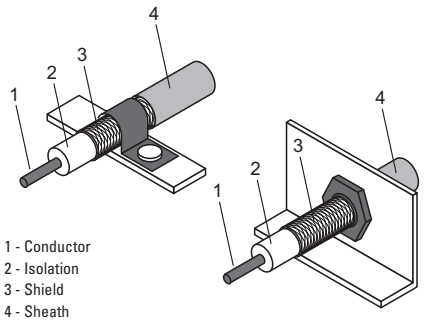
Signal lines should be shielded.

For long signal lines, the cable should be grounded at several locations along the line.

Screwed cable fittings should not interrupt the shield, but take it on (see chapter connection technology).

The shield should be applied on a large surface on the functional earth.

If possible, no compensation currents should flow through the shield. These currents appear when the mass does not have the same reference potential.

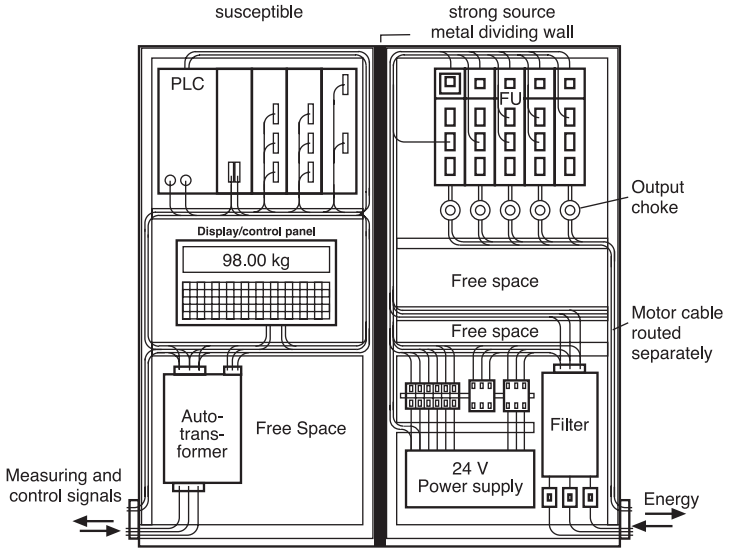


1 - Conductor
2 - Isolation
3 - Shield
4 - Sheath

3) Cabinet layout

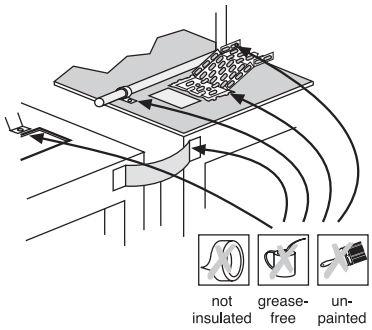
The products should be arranged in functional groups in a cabinet.

The cabinet itself should be equipped with a functional earth applied on large surfaces. The cabinet elements should be connected by means of high-frequency, low-impedance connections.

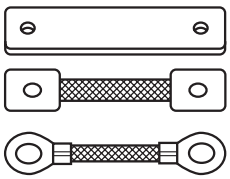


According to VDE 0100, the functional earth is not identical with the protective earth!

Protection against dangerous contact voltage is only a secondary task of the grounding connections.



Typical connections for proper potential equalisation, with the largest contact surface and cross-section possible.



Source: ZVEI

Encoders

Installing encoders

Introduction

Encoders shafts and in turn their bearings are subjected to loads for a variety of reasons:

- Installation tolerances when mounting the encoders (radial and angular displacement).
- Thermal changes, e.g. linear expansion of the drive shaft.
- Effects of wear, e.g. radial runout of the drive shaft or vibrations.

These load factors have a direct effect on the life expectancy of the shaft bearings and on the quality of the signal.

Facilities must therefore be provided during installation to compensate for these forces. For encoders having a solid shaft this is generally done by using shaft couplings between the drive shaft and the encoder shaft. The solution with hollow shaft encoders is to use stator couplings, fixing brackets or torque stops between the encoder flange and the mounting surface.

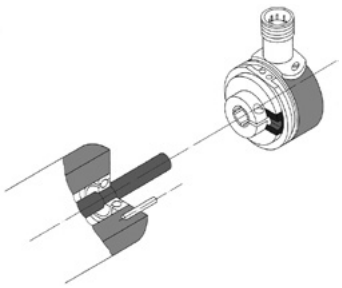
Not making use of a coupling but instead rigidly mounting the shaft and the encoder housing generally leads to unacceptably high loads on the bearings; the ensuing wear will cause the encoder to fail prematurely.

In order to avoid permanent damage of the encoder, certain bearing loads should not be exceeded. If hollow shaft encoders are correctly installed and the torque stops or stator couplings that are available from Kübler are used, then no problems should occur. For solid shaft encoders the maximum permitted axial and radial loads are shown in the appropriate technical data.

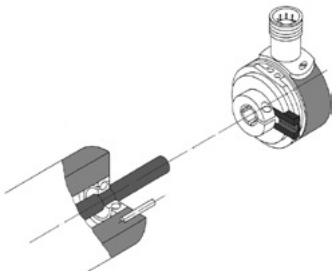
Mounting options for hollow shaft encoders

Hollow shaft encoder with torque stop and pin

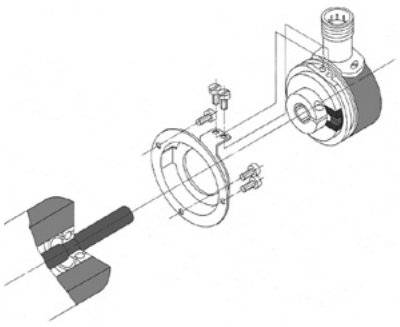
(easiest and fastest mounting)
Standard hollow shaft encoders are equipped with the torque stop (cylindrical pin not supplied).



Extended torque stop and long pin



Stator coupling



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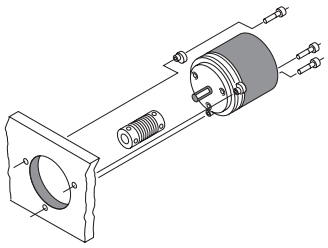
Mounting examples for shaft encoders with synchronous flange

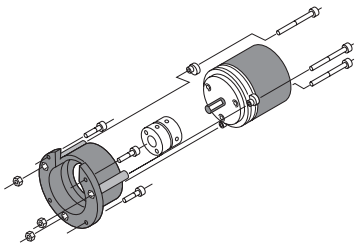
Fastening eccentrics + coupling

(to reduce shaft overload)



Assembly bell, fastening eccentrics + coupling

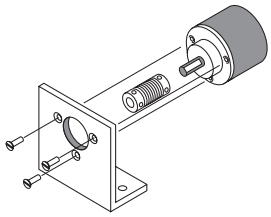
(to prevent shaft overload and to isolate the encoder thermally and electrically)



Mounting examples for shaft encoders with clamping bracket

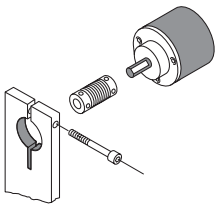
Angular bracket + coupling

(to reduce shaft overload)



Clamping device + coupling

(to reduce shaft overload)



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Loading of encoder shaft bearings using coupling forces

With all spring couplings (shaft coupling, stator coupling, fixing bracket), alignment and axial errors are converted to a force that corresponds to the spring constant of the coupling.

This force has to be absorbed by the encoder shaft bearings. When installing an encoder, this should be done with as little force as possible, i.e. without any unnecessary initial tension on the coupling. If this is adhered to, then with all Kübler couplings adequate tolerance compensation is guaranteed for the whole service life of the encoder bearings.

This force does not occur with torque stops for hollow shaft encoders, where the encoder is prevented from turning also by means of a pin or rod.

Although the encoder is prevented from rotating due to a rigid interlock, the encoder is still free to move in any other direction. This is of course dependent on it being mounted in such a way that it has freedom to move radially and especially axially (thermal linear expansion of the drive shaft!).

Possible errors in accuracy due to couplings

1. Deviations in accuracy caused by torsion of a spring coupling (in particular shaft couplings).

This deviation in accuracy is defined by the torque to be transmitted (bearing friction and mass moment of inertia) and by the torsional spring constant of the torque stop.

The following applies:

$$\text{Max. error (degree)} = \frac{\text{max. torque [Ncm]}}{\text{torsional spring constant [Ncm/Grad]}}$$

The following table serves to estimate the ratio between such an error and the smallest increment of an encoder:

Relationship between the resolution of an encoder in bit and the smallest increment in angular degrees:

Resolution	binary	10 bit	11 bit	12 bit	13 bit	14 bit	17 bit
	ppr	1024	2048	4096	8192	16384	131072
Increment	degrees	0.352	0.176	0.088	0.044	0.022	0.0028
	degrees:min:sec	0:21:06	0:10:33	0:05:16	0:02:38	0:01:19	0:00:10
	sec	1266	633	316	158	79	10

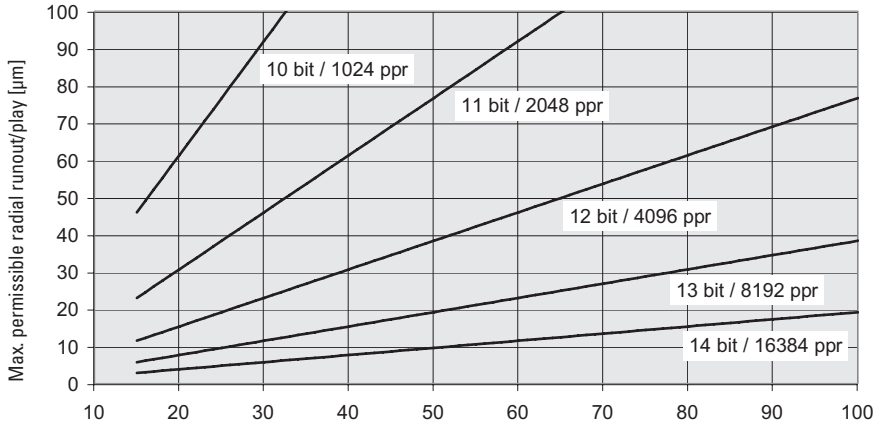
2. Deviations in accuracy caused by radial play in the drive shaft with asymmetrical mounting of the couplings.

Here one has to differentiate between couplings that are mounted in an axially symmetrical manner round the shaft (all shaft couplings, many stator couplings) and asymmetrically mounted couplings (many stator couplings, all mounting brackets and pin-based torque stops).

With asymmetrical couplings deviations in accuracy can arise due to radial movements of the drive shaft (radial runout/play); this is determined by the system. These deviations are dependent on the amount of the radial play and the distance of the torque stop locating point from the drive shaft.

The relationship is shown in the following diagram:

Maximum permissible radial runout to achieve an accuracy <1/2 LSB when using an asymmetrical 1 point torque stop.



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Particular shaft loading due to toothed-wheels, gear-pulleys and similar elements

Measuring wheels, toothed wheels or gear pulleys, which are mounted directly on the encoder shaft, exert radial forces on the latter, dependent on prestressing and angular acceleration.

Kübler encoders are designed so that they can absorb these forces to a great extent. The maximum permissible load capacity of the shaft is shown in the technical data for the encoder.

If these load values may be exceeded in a particular application, then the encoder shaft must be isolated from the radial load by interposing an appropriate shaft with its own bearings that can absorb the forces.

Kübler offers suitable bearing blocks and bearing boxes for this purpose (please refer to the ‚Accessories' section in the catalogue).

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Encoders | Technologies

Safety-Lock™

All Kübler encoders are equipped with the Safety-Lock™ bearing structure.

Safety-Lock™

Interlocked bearings, large bearing span and extra strong outer bearings ensure stability when subjected to vibration and tolerance of installation errors. Machine downtime and repairs are eliminated.

Safety-Lockplus™

The proven Safety-Lock™ construction with additional mechanically protected shaft seal.

Kübler plus

HD-Safety-Lock™ = Safety-Lock™ + additional engineering

Floating bearing on the cover-side eliminates internal stress [1]

- Mechanically decoupled sensor unit ensures constant signal quality with large temperature fluctuations and other adverse environmental influences. [1]
- Dual seals on the shaft-side – friction seal against humidity, labyrinth seal against dust and water jet ingress.
- Very large, highly-robust flange bearings.
- Even greater bearing clearance.
- Extremely robust flange mounting due to screw-on housing.
- Bearing design incorporates integrated isolation (isolating inserts not required), tested up to 2.5 kV for high running accuracy; metal to metal connection for slip free mounting. [2]

Benefits:

The resistance against adverse environmental conditions is greatly increased – especially against high bearing loads and high temperatures.

[1] for Sendix H100 [2] for Sendix H120

	Safety-Lock™	HD-Safety-Lock™
Stability with vibration	+	++
Robustness against installation errors	++	++
Radial load	80 N	400 N
Axial load	40 N	300 N
Elimination of internal stresses	0	++
Constant signal quality with extended temperatures	+	++
Mechanical protection of the seal	0	++

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Encoders

Technologies

Ageing compensation (optical encoders)

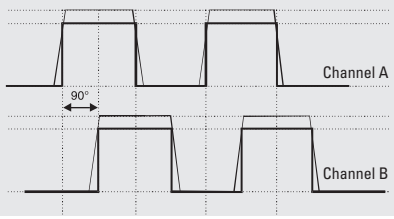
Every LED loses some of its luminosity over time. Without ageing compensation the excellent quality of the output signals would suffer.
The phase shift of 90° necessary to detect the direction of rotation would be lost. This effect however is prevented by means of special electronic circuitry.

Benefit:

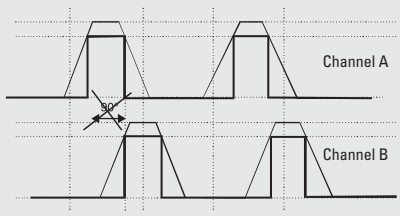
The ageing compensation circuit ensures the same signal, even after many years of operating time.

The downtime of machines will be reduced dramatically and the reliability is increased.

Signals of a new encoder



Signals of an older encoder without ageing compensation



Temperature compensation

This circuit ensures that the signal will remain the same over the whole working temperature range.

Benefit:

The positioning accuracy of a machine will not be affected by temperature changes.

Current consumption

The typical values for current consumption given in the catalogue apply for ambient temperature (23°C).

Because of the temperature compensation, the current consumption of the encoder rises with the temperature.

This increase in current is taken into consideration when giving the figure for maximum current consumption. The output currents are dependent on the user's input circuit and are therefore not included in the figures given; these should therefore be calculated and added in.

Short-circuit protection

The outputs of all the encoders are short-circuit protected, provided that the supply voltage is correctly wired. If an output is connected by mistake to 0 V or $+U_B$ or with another output, the device will not be damaged. As soon as the error is corrected, the encoder is ready for use again.

Benefit:

Wiring circuit errors during installation that often occur in the hectic of day-to-day industrial environments do not lead to the encoder being permanently damaged.

Environmental conditions

Kübler plus

The environmental conditions in which the encoder operates can have a significant influence on its service life, for example

- The ambient temperature.
- The expected shaft load.
- Soiling and humidity.
- Noise interference.

Thanks especially to the high-quality technology employed in our encoders, they are particularly suitable for use in harsh environments.

Numerous references from our customers, including Bosch, Siemens, Bombardier and from suppliers to the automotive industry, are proof of this.

Bearing life

All Kübler encoders are designed to ensure that their bearings give a long service life. This is subject of course to correct installation and to the load limits for the shaft (shaft encoders) being complied with or, in the case of hollow shaft encoders, being mounted with the appropriate stator couplings or torque stops.

The following diagrams show the expected service life of the shaft encoder bearings depending on the bearing load. The calculations are based on a mixed load, where the axial force components are always half of the radial shaft load.

The use of the torque stops and stator couplings that are offered ensure that the shaft load with the hollow shaft encoders as supplied from the factory is kept very small.

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Connection Technology | Introduction

Introduction

All products of chapter connection technology have been tested and released in relation with the corresponding compatible Kübler sensors.

They ensure the full functionality and high signal quality of our sensors - this guarantee is supported by our competent customer service.

Your advantage:

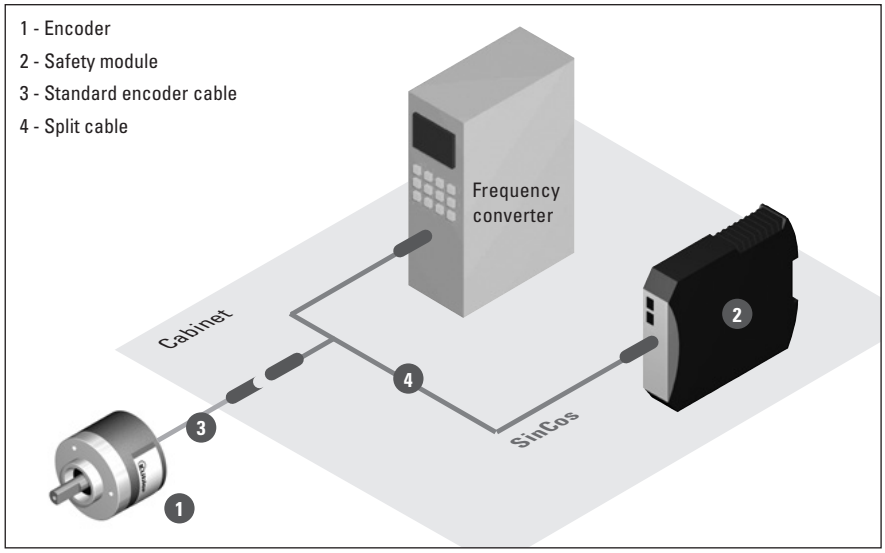
- Prevents from misconnections
  - No time-consuming search for errors.
- Optimal shielding
  - Prevents from EMC problems.
- Shorter mounting times
  - Time- and thus cost-savings.
- No time-consuming search for the suitable connector or cable
  - Time-savings and error prevention.

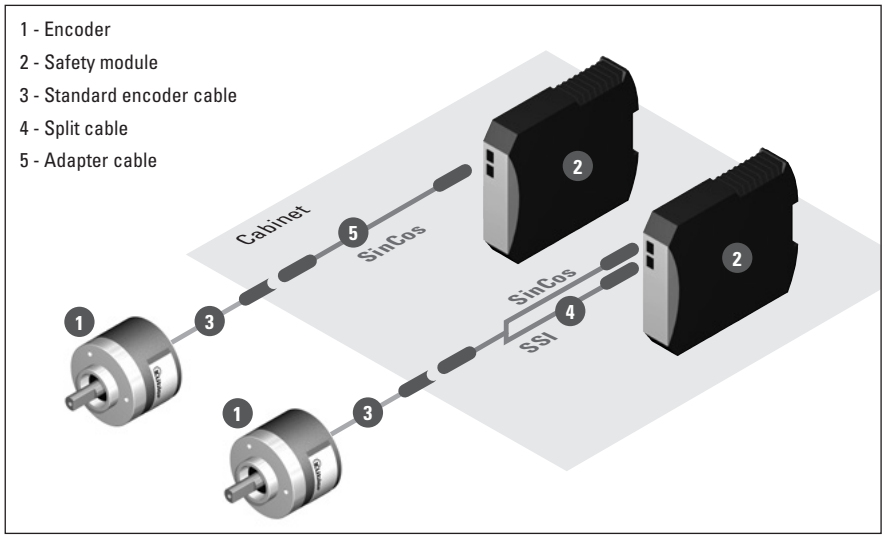
Pre-assembled cordsets for the Functional Safety technology

Kübler offers pre-assembled cordsets to connect an encoder with a Safety-M safety module.

Pre-assembled cordsets are divided into encoder cables and adapter and split cables.

- **Standard encoder cables** are intended to connect the encoder in the application to the cabinet. These cables are available in various materials to cover different environmental conditions and areas of application.
- **Adapter or split cables** are intended to split the signals for different devices / interfaces or to adapt connectors inside of the cabinet.





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Material information - cables

PVC

- Suitable for average mechanical stresses in the area of packaging machines and assembly and production lines.
- Good resistance against acids and alkalis and thus predestined for use in the food and beverage industry.
- Limited friction resistance and partial resistance to oils and chemicals.

PUR

- Flexible, PVC, silicone and halogen-free control cable with PUR cable jacket and polypropylene wire insulation.
- The cable is oil-resistant and non-flammable according to VDE 0472, and it is resistant to chemicals, hydrolysis and microbes.
- Temperature resistance from -30°C to + 90°C.
- Use is possible in trailing cable carriers with a bending radius equal at least to 10 x D.
- Thanks to its resistance to welding sparks, this cable is very well adapted for flexible use in the area of robotics, machine tools and metal cutting production.

Material information - connectors

Two material groups are used for the connectors described in the catalogue:

Metals for contacts and housings

- Contacts:
  Metal, CuZn, gilded.
- Connecting nut /compression screw:
  Metal, CuZn, nickel-plated.

Plastics for insulator and housing

- Contact carrier:
  Plastic, TPU, black.
- Body:
  Plastic, TPU, black.
- Seal:
  Plastic, fluorine rubber (FKM/FPM) FPM/FKM or nitrile-butadiene rubber (NBR).

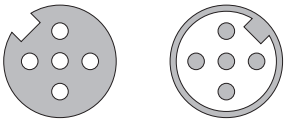
Coding of the M12 x 1 connectors

The connectors are coded to guarantee protection against polarity reversal. This coding is achieved by means of a peg or a notch in the contact carrier.

Kübler connectors make a distinction between A, B or D coding.

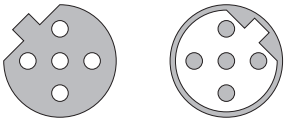
A-coding

Female connector with coupling nut:	Coding notch
Male connector with external thread:	Coding peg
Use:	CANopen and 8-pin connector



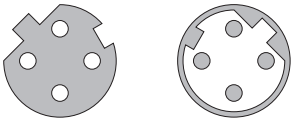
B-coding

Female connector with coupling nut:	Coding peg
Male connector with external thread:	Coding notch
Use:	Profibus



D-coding

Female connector with coupling nut:	Coding peg and Coding notch
Male connector with external thread:	Coding peg and Coding notch
Use:	Profinet and EtherCAT



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Connection Technology | Cables and connectors

Shielding

With round connectors, care must be taken to connect carefully the shielding braid of the cable to the shield connection of the connector.

An all-round contact (360°) is optimal.
Good (in practice often sufficient) shielding values are also reached by connecting the shielding braid firmly to the electrically conductive housing. Connectors purely out of plastic, without metal sleeve, providing no contact for the shielding braid, are not sufficient.

Furthermore, a proper contact with the mating connector is also important, as well as a good contact of the mating connector with the chassis of the equipment.

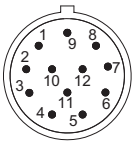
"Allround" shielding with Kübler cordsets

Counting direction cw/ccw

The counting direction of the connectors is indicated by cw for a clockwise arrangement and ccw for a counter-clockwise arrangement. The connector is always viewed from the mating side.

Top view of mating side

Counting direction cw
(e.g. female connector)



Counting direction ccw
(e.g. male connector)

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Connection Technology | Optical fibre signal transmission

Description

The system is made up of an optical fibre transmitter and an optical fibre receiver.

The optical fibre transmitter converts the electrical signals of an encoder into optical fibre signals. A simple glass fibre allows reliable transmission up to distances of 1500 m.

The receiver module converts the optical signals back into electrical signals.

The modules are available in various level and power supply voltage variants.

Main advantages of an optical fibre transmission:

- Insensitivity to electromagnetic interferences and to leakage effects between lines routed parallel.
- Significantly higher transmission speeds.
- The optical fibre cable can be routed through explosive atmospheres.
- Cost and weight savings thanks to reduced cabling work, especially for important cable lengths.

Mounting of optical fibre modules

The optical fibre modules can be mounted directly on a TS35 DIN rail (top-hat rail) according to EN 50022.

The installation width for every module is only 22.5 mm.

Laying and connection of glass fibre cables

Laying the cable is generally easy.

Care must nevertheless be taken to make sure that the bending radius does not become smaller than 30 mm for static laying and 60 mm for dynamic laying.

When connecting the cable, make sure that the bayonet catch is locked and remove the dust protection caps only just before connecting the cable.

Glass fibre cables

The modules can be connected together using 50/125 µm or 62.5/125 µm multimode glass fibre cables with ST/PC type connectors with bayonet catch. Single-mode Simplex patch cables are not suitable.

Kübler offers finished confectioned patch cables adapted to the optical fibre modules as accessories.

They ensure the full functionality and high signal quality of our sensors.

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Functional Safety

System solutions

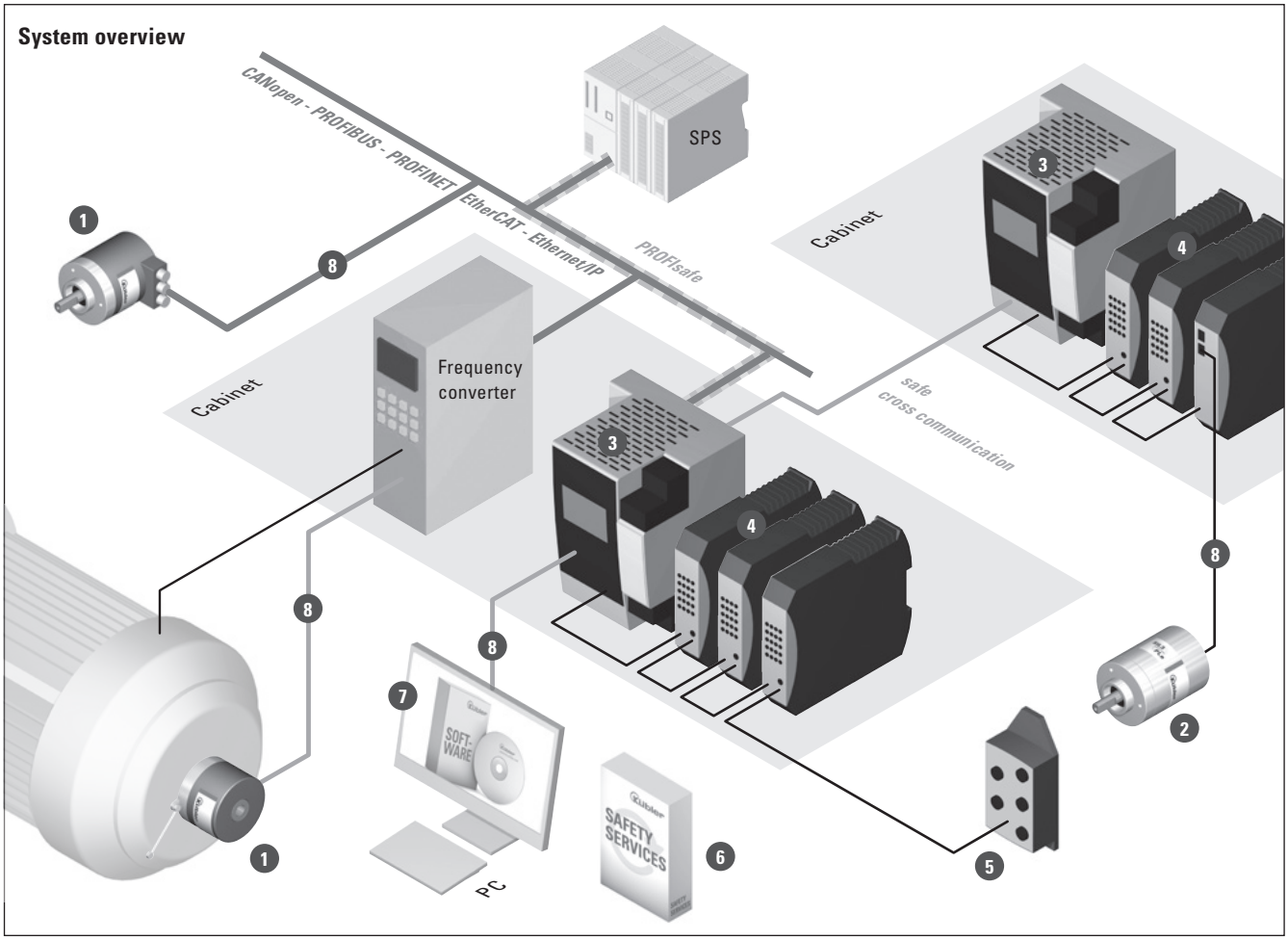
Kübler's extensive product portfolio of rotary and linear position and motion sensors, with the matching safe encoder evaluation devices, provides the basis for safe application-specific drive solutions. However, safe single components alone do not ensure a safe global application.

Legally compliant safety already begins when planning the machine, and this is why the Kübler service technicians and engineers offer a wide range of supports both for the plant manufacturer and for the operator.

The matter Functional Safety technology is simplified by the certified encoders of the Sendix SIL family, which includes both incremental, absolute and ATEX / IECEx encoders. The safe encoder evaluation devices of the Safety-M family include single compact standalone devices for simple applications as well as modular extendable compact controllers that can be connected via a gateway to any higher-level control system.

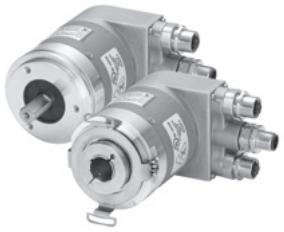
This allows realizing flexible safety release circuits integrating a safe speed and position monitoring to achieve simple machine safety. Kübler's technical safety solutions meet all high safety and reliability requirements.

System overview



1 Standard encoders

- Incremental and absolute encoders
- Fieldbus and Industrial Ethernet encoders
- Encoders with ATEX / IECEx approval



2 Safe encoders

- Incremental and absolute encoders
- Encoders with ATEX / IECEx approval

3 Safety modules

- **Safety-M modular** with fieldbus and Industrial Ethernet protocols, with safe protocols such as Profisafe, with safe cross communication
- **Safety-M compact** with integrated signal splitting, with internal signal conversion into RS422 or Analog signals

4 Extension modules

- Emergency stop with several release circuits
- Inputs (OSSD, Analog)
- Outputs (semiconductor, relays)
- Stop categories
- Rotary speed, position monitoring

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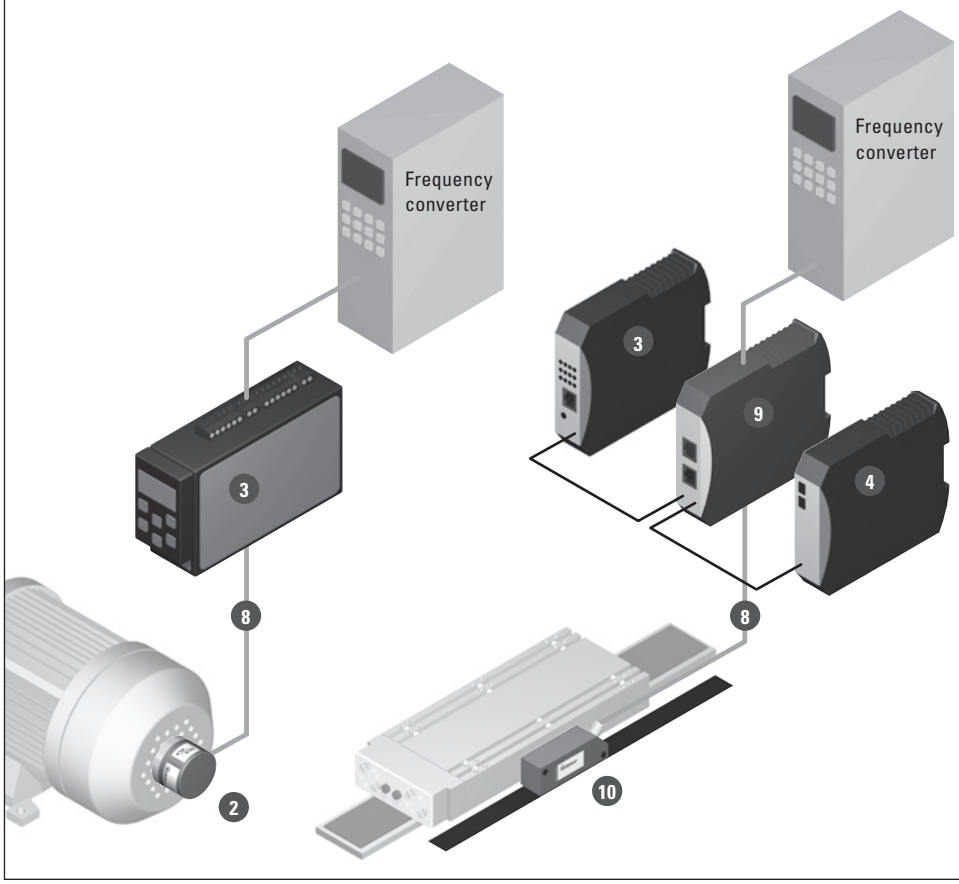
Functional Safety | System solutions

Functional Safety has become an integral part of mechanical engineering.

With a view to machinery Directive 2006/42/EC, Kübler also provides MTTF values for its standard encoders. This allows the user to perform his own calculations in compliance with standard EN ISO 13849-1.

Intelligent, interference-insensitive and cost-effective wiring solutions with SMBS encoder adapter module



8 Connection technology

- M12, M23, RJ45 connectors
- Pre-assembled cordsets
- Adapter cable

9 Encoder signal splitting

- Different solutions: in the cable, as a module, fully integrated
- Easy installation
- EMC compliant

5 Decentralised input/output extensions

- With high IP67 protection level, for remote field installation
- Safe inputs and outputs

6 Safety services

- Preparation of risk analyses
- Elaboration of safety concepts
- On-site commissioning and acceptance
- Retrofit of existing machines

7 PC software

- SafeConfig
- SafeMonitor
- SafePLC
- SafePMT

10 Linear encoder systems

- Incremental and absolute linear systems

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Functional Safety | System solutions

Competence for SIL-compliant encoder projects

Integrated: safety is achieved by the intelligent combination of encoder, controller and actuator.

Efficient: adapted to the requirements of the Functional Safety technology.

Machinery Directive 2006/42/EC of the European Parliament applies to all manufacturers of machines, plants or separately sold safety components.

In order to keep both the extent of the work and the costs relating to new tests and approvals manageable, Kübler offers – as your partner for the implementation of your safety concept – its application know-how for safe position and motion sensors.

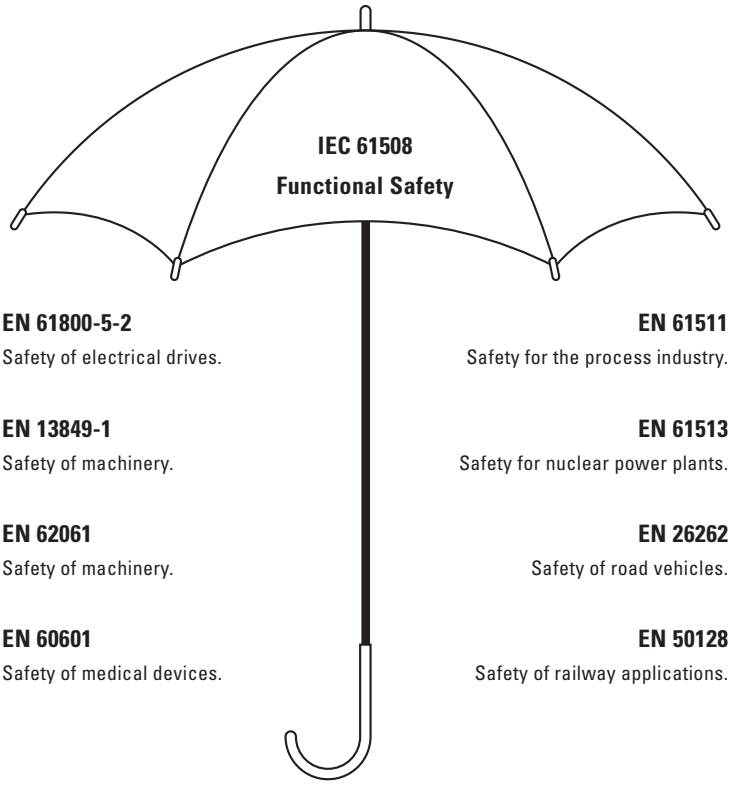
Procedure to determine the right components for your safety project:

1. Definition of the safety concept, including the drive.
2. Realisation of the safety structure: division into safety-related subsystems.
3. Implementation of a FMEA (failure effect analysis) for every subsystem.
4. Differentiation between "dangerous failures" and "safe failures".
5. The error rate of the whole system including the encoder must lie below a specific threshold.

Relevant standards

Standard IEC 61508 with its parts 1 up to 7 is known as an "umbrella standard".

Many various industry-specific standards have been derived from it.



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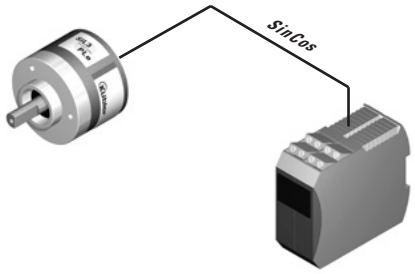
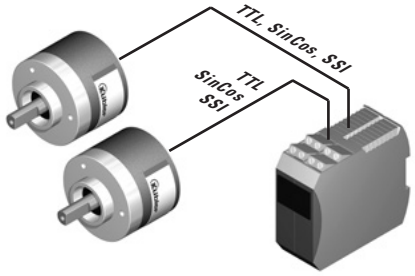
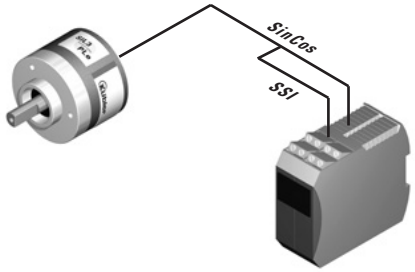
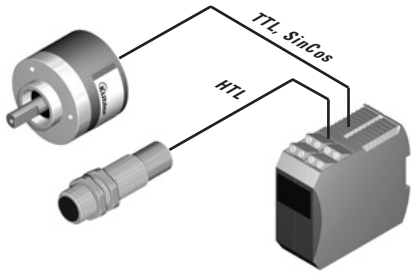
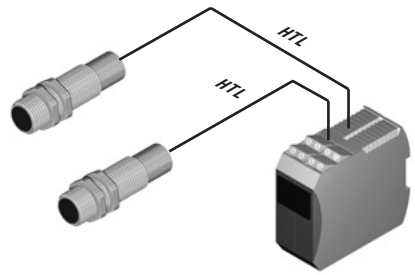
Connection possibilities for safe motion monitoring

Graphic	Components
	1 x certified Sendix SIL encoder 1 x certified Safety-M safety module
	2 x encoders 1 x certified Safety-M safety module
	1 x certified absolute Sendix SIL encoder 1 x certified Safety-M safety module
	1 x encoder 1 x proximity switch 1 x certified Safety-M safety module
	2 x proximity switches 1 x certified Safety-M safety module

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Functional Safety | Encoders

Incremental encoders for the Functional Safety technology

In order to achieve safe information with the incremental encoder, the controller must monitor the validity of the Analog, 90° phase-shifted sine/cosine signals with the help of the function $\sin^2 + \cos^2 = 1$.
If this check takes place continuously, a very high diagnostic coverage can be achieved.

In addition, the encoder manufacturer must certify that the information has been assessed from a safety-related point of view, from its generation, through its conditioning, up to its transmission. Only this allows assuming that sine and cosine are independent from each other and are therefore considered as two channels.

Absolute encoders for the Functional Safety technology

Achieving safe absolute position information requires either transmitting a safe position via a safe channel (e.g. safe fieldbus), or transmitting two independent pieces of information via standard interfaces.

Safe positioning using an absolute encoder with additional incremental tracks (such as e.g. Sendix SIL) is a particularly smart and cost-effective variant.

In this case, the controller reads the absolute value when initializing and can then set immediately the incremental value internally. From now on, the controller counts the incremental pulses and compares the result with the absolute positions that are also provided by the encoder. This way, relative counting is applied to the first channel and absolute counting to the second.

Safe mechanical connection between encoders and the applications

A 100% reliable mechanical connection is required for a safe function in the applications. Otherwise, no application with a certified encoder will be possible.

For hollow shaft encoders, exclusion of faults is achieved with suitably dimensioned mounting attachments. This is the case for all Sendix SIL encoders.

With shaft encoders, a shaft with a feather key or with a flat offers the possibility of safe connection for the application. Also special safety-oriented couplings offer here simple solutions.

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Functional Safety

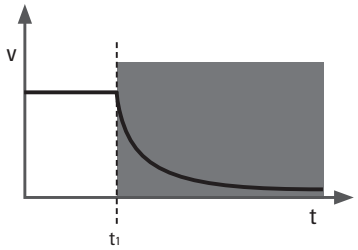
Safety functions for the drives technology

According to DIN EN 13849-1 and DIN EN 61800-5-2 up to SIL3/PLe/Cat.4 the following safety functions can be implemented with the encoder:

Safe Switch-Off

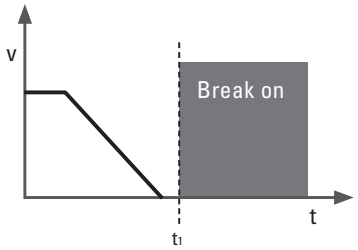
STO – Safe Torque OFF

Safe disabling of the torque on the drive by means of an immediate switching off of the energy supply.



SBC – Safe Break Control

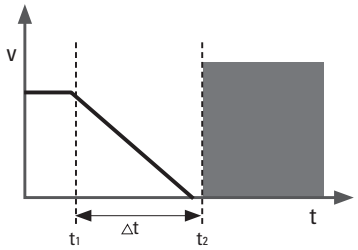
Safe de-energizing of the brake. This allows generating a braking torque.



Safe Standstill

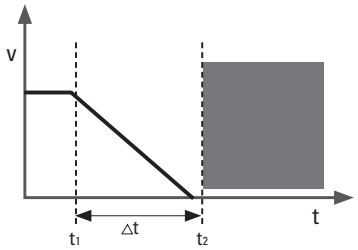
SS1 – Safe Stop 1

Safe monitored standstill followed by the disabling of the torque on the drive.



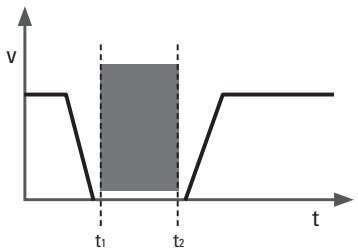
SS2 – Safe Stop 2

Safe monitored standstill followed by standstill monitoring, while the torque remains enabled.



SOS – Safe Operating Stop

The drive is maintained in its position electrically.



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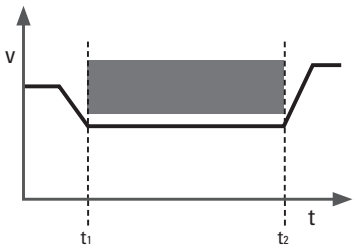
Functional Safety

Safety functions for the drives technology

Safe Motion

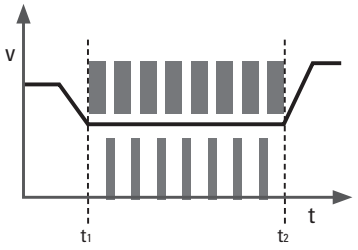
SLS – Safely-Limited Speed

Safe monitoring of a reduced drive speed.



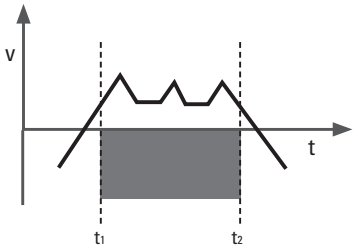
SSR – Safe Speed Range

The safely monitored speed must be within a corridor.



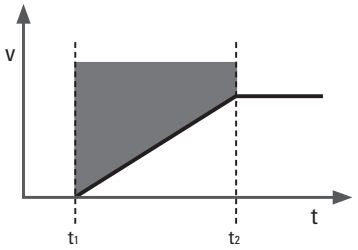
SDI – Safe Direction

Safe monitoring of the direction of movement of the drive.



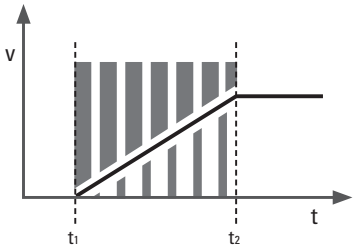
SLA – Safely-Limited Acceleration

Monitoring of the maximum acceleration of the drive.



SAR – Safe Acceleration Range

The safely monitored acceleration must be within a corridor.



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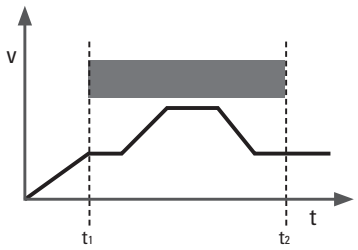
Functional Safety

Safety functions for the drives technology

Safe Monitoring

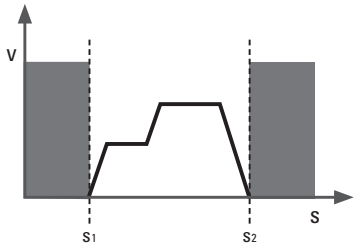
SSM – Safe Speed Monitor

Safe monitoring of a speed range.



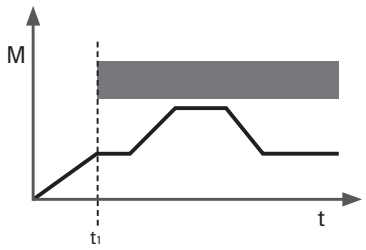
SCA – Safe Cam

Safe monitoring of a defined position range.



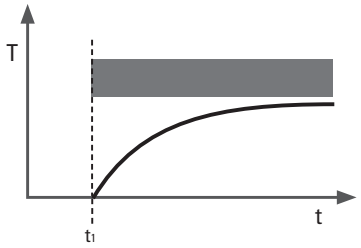
SLT – Safely-Limited Torque

Safe monitoring of a maximum torque.



SMT – Safe Motor Temperature

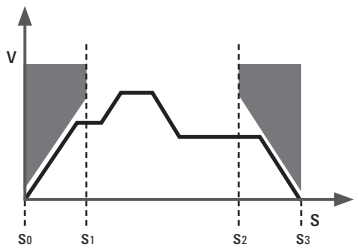
Safe monitoring of a maximum motor temperature.



Safe Positioning

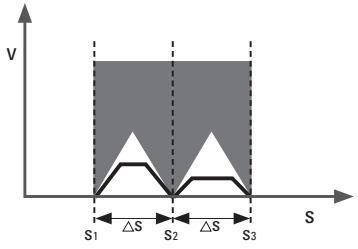
SLP – Safely-Limited Position

Safe monitoring of limit positions = safe software limit switches.



SLI – Safely-Limited Increment

Safe monitoring of an increment for the jog mode.



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Glossary

Actuator

The word actuator relates to controlling or driving elements, e.g. motors, relays, frequency converters, valves, signal lights, etc., which convert electrical signals into mechanical movement (or other physical quantities, e.g. pressure, temperature).

American National Standards Institute (ANSI)

Comparable with the German DIN. ANSI is the US American standardization agency and is a member of the International Organization for Standardization (ISO).

Antivalence

Describes two different signals, e.g., for switching contacts, a normally closed and a normally open contact.

AS-Interface (AS-i)

Standard according to IEC 62026-2 for an actuator-sensor interface since 1999.

AS-i Safe

Safety-oriented communication through the standard AS interface (AS Interface Safety at Work).

Austrian Standards Institute (ASI)

Austrian member of the International Organization for Standardization (ISO).

Average Diagnostic Coverage (DCavg)

Describes the total diagnostic coverage to be achieved for a system, contrary to the diagnostic coverage, which is defined for every channel.

B10

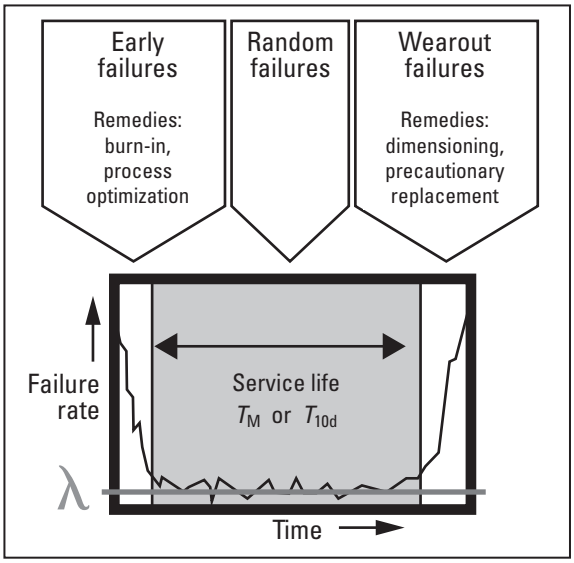
The B10 value for components affected by wear is expressed in the number of switching cycles: this is the number of switching cycles for which 10% of the samples failed during an endurance test (or: number of operating cycles after which 10% of the devices failed). The B10 value and the operating cycle allow calculating the failure rate for electromechanical components.

B10d

In contrast to the B10 value, this value describes exclusively the dangerous failures.

Bathtub Curve / Failure Distribution

The failure distribution describes the distribution in time of the failures of materials, electronic or mechanical components. In the safety technology, the used components must lie in the flat area of the failure rate curve.
Early failures and failures due to wear are prevented by stating a service life.



Source: BGIA Report 2/2008

Bit (Binary Digit)

Smallest discrete piece of information. A bit can be allocated the value 0 or 1.

Cable Color Coding
Code according to DIN IEC 757

abbreviation	color
BK	black
BN	brown
RD	red
OG	orange
YE	yellow
GN	green
BU	blue
VT	violet
GY	grey
WH	white
PK	pink
GD	gold
TQ	turquoise
SR	silver

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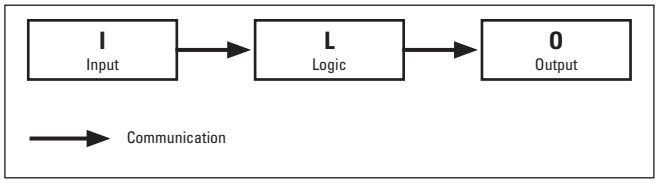
Glossary

Categories (Cat.)

The categories of EN ISO 13849-1 (B, 1, 2, 3 and 4) allow evaluating the performance of safety-relevant parts of a control when failures occur. They describe and classify the system architecture e.g. with redundancies or testing equipment.

Category B:

The control must be designed so that it can withstand the expected influences.
System behavior:
A failure can lead to the loss of the safety function.

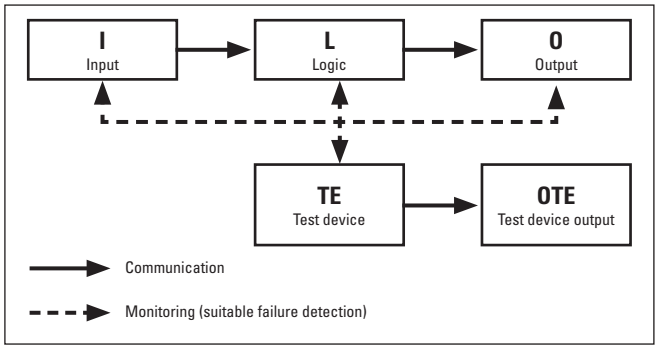


Category 1:

The requirement of B must be met; use of tried and tested safety-relevant components and principles. System behavior: as system behavior B, but with higher safety-related reliability.

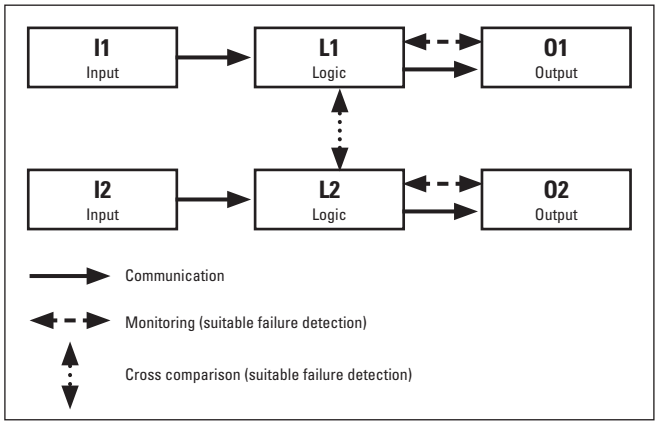
Category 2:

The requirement of B must be met; additional safety function check at appropriate intervals. System behavior: the occurrence of a failure can lead to the loss of the safety function between the checks.



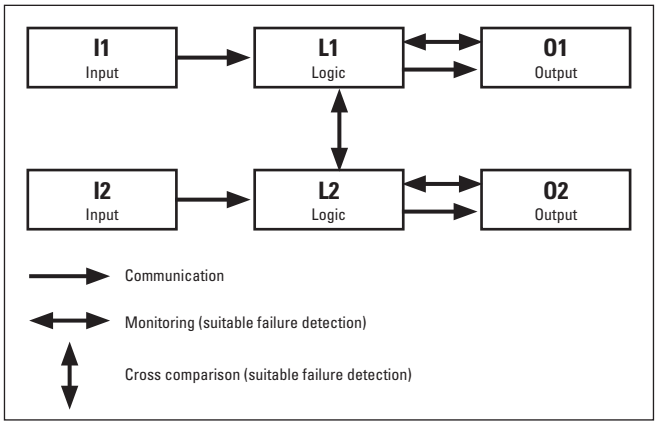
Category 3:

The requirement of B must be met, a single failure shall not lead to the loss of the safety function; single failures must be detected. The failure safety is increased by redundancy. System behavior: the safety function always is maintained in case of occurrence of single failures.



Category 4:

The requirement of B must be met; the single failure must be detected prior to or during the following request for the safety function.
The failure safety is increased by redundancy. System behavior: when failures occur, the safety function always remains maintained; the failures are detected in time.



ccw (counter clockwise)

Turning the encoder shaft in counterclockwise direction (in view of the shaft side of the encoder).

cw (clockwise)

Turning the encoder shaft in clockwise direction (in view of the shaft side of the encoder).

CIPsafety

Safe Common Industrial Protocol

Safety-oriented communication via standard EtherNet/IP or Sercos III.

Clock Output / Pulse Output

When wired accordingly, these special outputs apply defined clock signals/clock patterns to the inputs. This allows detecting cross-short-cuts.

Common Cause Failure (CCF)

Failure of several subassemblies due to a common cause (e.g. short-circui).
The CCF allows evaluating whether a system having e.g. a redundant structure withstands sufficiently such failures.

In standard EN ISO 13849-1, measures must be taken against these failures. Points can be scored for various measures, the sum of which must be >60 to demonstrate that the system is resistant enough.

Conformité Européenne (CE) (European Conformity)

The machine manufacturer is to mark his products with the CE mark if he wants to market his machine (Machinery Directive, “Protection against arbitrariness”).

Remark: the CE marking for the Low-Voltage Directive is not comparable with the CE marking for the Machinery Directive.

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Cross Comparison

Cross comparison is the direct comparison of two events, values. In safety technology, this is used e.g. for redundant systems that monitor each other. Every system detects the faulty operation of the other system thanks to the different result of the same operation.

Cross-Short-Cut

Can only occur in case of multichannel device control and is a short-circuit between channels (e.g. in a two-channel sensor circuit).

Cyclic Redundancy Check (CRC)

The cyclic redundancy check, generally called CRC, is a method for determining a test value for data in order to detect errors during transmission or storage. A CRC is calculated prior to the transmission, and the receiver checks the data and calculates a second CRC after the transmission. If both CRCs are identical, the data has not been altered during transmission.

Danger Zone

Area in or around a machine in which a person is exposed to the risk of an injury or damage to health.

Demand Rate

Operating modes are subdivided in so-called demand rates. This allows displaying how frequently the safety function is requested.

A distinction is made between:

- Low Demand:
  Operating mode with low demand rate, in which the safety function is only carried out upon request to place the system in a defined safe state, with a request frequency that does not exceed once a year.
- High Demand:
  Operating mode with high demand rate, in which the safety function is only carried out upon request to place the system in a defined safe state, with a request frequency exceeding once a year.
- Continuous Demand:
  Operating mode with continuous demand, in which the safety function maintains the system in a safe state as a part of the normal operation.

Declaration of Conformity

Certificate issued by the manufacturer of the machine, certifying that the machine meets all relevant Machinery Directive provisions and can therefore be marketed. This is shown to the user by the CE mark.

Deutsches Institut Für Normung (DIN)

German member of the International Organization for Standardization (ISO).

Deutsche Kommission Elektrotechnik Elektronik Informationstechnik (DKE)

Deutsche Kommission Elektrotechnik Elektronik Informationstechnik, a body of the Deutsche Institut für Normung (DIN) and of the Verband der Elektrotechnik, Elektronik und Informationstechnik (VDE).

Diagnostic Coverage (DC)

Diagnostic coverage $\lambda_{dd}/\lambda_{total}$, with

- λ_{dd}, Rate of the detected dangerous failures.
- λ_{total}, Rate of all dangerous failures in total ($\lambda_{dd} + \lambda_{du}$).

$$DC = \frac{\sum \lambda_{dd}}{\sum \lambda_{dd} + \sum \lambda_{du}} = \frac{\sum \lambda_{dd}}{\sum \lambda_{d}}$$

The diagnostic coverage is subdivided in various classes in standard EN ISO 13849-1:

DC (diagnostic coverage)	
Designation	Range
small	DC < 60 %
low	60 % < DC < 90 %
medium	90 % < DC < 99 %
high	99 % < DC

Diversity

Describes the variety of something. Used in relation with redundancy to describe a redundancy created using different paths, i.e. using different means to realize a required function. It is understood as a strategy for increasing failure safety.

Emergency Stop

Emergency action intended to stop a process or movement that is becoming dangerous.

Endangering

Endangering (due to an event) represents a danger for the user and can lead to injury (potential source of harm).

Failure

Describes the condition of a device that is not able to carry out a requested function, with the exception of the inability during maintenance work, other scheduled actions or the lack of external means.

Failure Behavior

Describes the possibilities for a system to fail.

Failure Exclusion

Ability to resist failures. For certain components, defined failures can be excluded for the time of SRP/CS operation. A short-circuit can e.g. be excluded by safe cable routing. The justification of a failure exclusion must be documented!

Failure In Time (FIT)

Error measure describing the number of failures in 109 hours

$1Fit = 10^{-9}$ 1/h

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Glossary

Failure Mode Effect Analysis (FMEA)

Failure mode and effects analysis (failure effects analysis).

Analytic method for the systematic and complete registration of potential failures and failure conditions of components of a system and of their effect.

Failure Modes, Effects and Diagnostic Coverage Analysis (FMEDA)

In addition fo the FMEA, the FMEDA determines the Safe Failure Fraction (SFF) as an evaluation parameter for the Functional Safety Management according to IEC 61508.

Failure Probability

A statistical value for the failure of the component/of the system. The failure safety describes the safety achieved.

Failure Safety

Falure safety is the defined safety against a failure. The Performance Level (PL) or the Safety Integrity Level (SIL) describe a measure for failure safety in functional safety technology.

Failure Tolerance

Describes the resistance of a system against failures.

Feedback Loop

Electrical circuit for monitoring the controlled contactors/relays.

The function of the contactors/relays can be monitored by having an evaluation device read back the positively guided auxiliary contacts. If contactor/relay contacts are welded, the evaluation device prevents from re-starting.

Functional Safety (FS)

The part of the safety of an installation (e.g. machine, plant) that depends of the correct operation.

Institut Für Arbeitsschutz (IFA)

The Institute for Occupational Safety and Health of the German statutory accident insurance, former Berufsgenossenschaftliches Institut für Arbeitsschutz (BGIA) is a research and testing institute based in Sankt Augustin near Bonn.

[http://www.dguv.de/ifa]

International Electrotechnical Commission (IEC)

The International Electrotechnical Commission is an international standardization organization based in Geneva for standards in the electrotechnical and electronic field. Some standards have been developed jointly with the ISO.

International Standard Organisation (ISO)

International Organization for Standardization.

Harmonized Standard

The type A (basic standards), type B (group standards) and type C (product standards) allow applying the presumption of conformity ("compliance" with the Machinery Directive).

Low Voltage Directive (LVD)

Official designation: Directive 2006/95/EC of the European Parliament and of the Council of 12 December 2006 on the harmonization of the laws of Member States relating to electrical equipment designed for use within certain voltage limits. It is used for the safety of electrically powered devices.

Mean Time Between Failures (MTBF)

Mean time between device failures.

Sum of MTTF (mean time to failure) and MTTR (mean time to repair). The mean time between failures is the time that elapses in normal device or plant operation before a new failure occurs.

Mean Time To Failure (MTTF)

Period of time between the first start-up and a failure.

The MTTF can be determined for components by means of the analysis of field data or predictions. With a constant failure rate, the average value of the failure-free operating time MTTF = $1/\lambda$, λ being the failure rate of the device (from a statistical point of view, it can be assumed that, after the expiration of the MTTF, 63.2 % of the concerned components have failed).

Mean Time To Dangerous Failure (MTTFd)

Period of time between the first start-up and a dangerous failure.

MTTFd = $1/\lambda_d$

MTTFd = 2x MTTF

MTTFd = B10d/0.1xnop

Mean Time To Repair (MTTR)

Mean time necessary for repairing a device.

MTTR is always significantly smaller that MTTF.

Mission Time™

Identical to the service life.

Muting

Is a bypass function. Neutralization of the safety function with additional sensors, limited in time and in accordance with the intended purpose (EN ISO 13849-1:2006: temporary automatic bypass of a safety function).

National Fire Protection Association (NFPA)

The US-american National Fire Protection Association edits a comprehensive rule book about fire protection (National Fire Codes) that applies mainly in the USA. The NFPA corresponds approximately to the German Vereinigung zur Förderung des Deutschen Brandschutzes.

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Nationally Recognized Testing Laboratory (NRTL)

This laboratory can test products for use in the USE in compliance with NFPA79. An NRTL listing is equivalent to a certification.

Occupational Safety And Health Administration (OSHA)

US American federal authority in charge of safety issues in the industry. It can be compared with the German Institut für Arbeitsschutz of the German statutory accident insurances. The goal of this organizations is to reduce the number and consequences of accidents at work.

Operating Mode

The operating modes are various predictable conditions of a machine. The machine must be safe in any operating mode. A distinction is e.g. made between automatic operation, manual mode, set-up mode, maintenance mode.

Performance Level (PL)

Ability of safety-related parts to perform a safety function under foreseeable conditions (that should be taken into consideration), in order to achieve the expected risk reduction: from PLa …. PLe.

Performance Level Required (PLr)

Required Performance Level (see PL).

Probability Of Dangerous Failure Per Hour (PFH)

A failure probability measure of IEC 61508.

Probability Of Dangerous Failure On Demand (PFD)

A failure probability measure of IEC 61508.

Proof Test / Proof Test Interval

Proof test: periodic repeat inspection performed to detect failures in a SRECS so that, if necessary, the system can be reset to or as close as practically possible to an “as-new-condition” (derived from IEC 61508-4).

Presumption of Conformity

When the requirements of the harmonized standards of the Machinery Directive are met, it can be presumed that the requirements of the Machinery Directive are also met.

PUR - Polyurethanes

Polyurethanes are generally soft and elastic plastics or synthetic resins used in cable manufacturing. Used generally here as external sheathing.

PVC – Polyvinyl Chloride

Polyvinyl chloride is a plastic made soft and elastic by the addition of plasticizers and stabilizers, used in cable manufacturing. Used generally here as sheathing or cable insulation.

Qualification

Means the assessment of capabilities (qualifications) that are necessary for a determined task or requirement.

The verification that the capabilities are sufficient to meet the requirements in a reproducible way in practice is the content of the so-called validation.

Quantification

A quantification describes a result statement in the form of a numerical value, in which one or several characteristics of an object or the nature of a situation are reformulated as measurable quantities and numerical values.

Reaction Time

Time between the detection of the hazardoue event and the restoration of the safe condition.

Redundancy / Two-Channel Design

Presence of more means than those basically necessary for performing the intended tasks.

Reset

Reset is a switch-on function (ON) that brings a system back to a defined initialization status, it represents a restart interlock.

This may become necessary if the system does not operate correctly after a failure and does not react properly to inputs any more.

Response Time

Time that elapses between the powering of the device and its readiness for operation.

Risk

Combination of the probability of occurrence of damage and of the the extent of damage.

Risk Analysis

The risk analysis is a part of the risk assessment. It identifies the dangers in a machine.

Risk Assessment

Standard ISO 14121 includes procedures that are required for carrying out a risk assessment. The risk assessment includes a risk analysis followed by a risk evaluation.

Risk Evaluation

The risk analysis is a part of the risk assessment. It classifies the dangers in a machine.

Safe State

The safe state is the state in which a machine does not represent any danger for men, machines or the environment.

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Glossary

Safety Arrangement

Is required wherever danger for men, machines end environment may occur. It can be achieved e.g. in the form of safety circuits with electronic components.

Safety Component

Component used for ensuring a safety function whose failure and/or malfunction endangers the safety of persons and that is not necessary for machine operation or that may be replaced with components usual for machine operation. Safety components are listed in Annex IV of Machinery Directive 2006/42/EC and receive a CE mark. Exemples of safety components:

Sensor-controlled protective equipment (light barriers, safety mats, electromagnetic detectors), automatic mobile protective equipment on machines in compliance with Letter A Number 9, 10 and 11, two-hand circuits, roll-over protection structures and falling-object protective structures.

Safety Integrity Level (SIL)

Safety Integrity Level, a requirement classification according to EN 61508 / EN 61511 / EN 62061. It is used for evaluating electrical/electronic/programmable electronic (E/E/PE) systems in terms of reliability of the safety functions.

Safety Function

Function (e.g. of a machine or control) whose failure (or breakdown) can increase the risk/the risks.

Safety-M

Family name of the safety modules of the Kübler company.

This family today includes several series:

- Safety-M compact
- Safety-M modular

Safety-M compact is a compact safety controller suitable especially for the drive safety functions. It has limited extension possibilities and is characterized by a very compact design.

Safety-M modular is a compact safety controller suitable especially for the drive safety functions. It is characterized by its freely selectable and modularly extensible functionality.

Safety Related Control Function (SRCF)

Safety-related control function performed by the SRECS with a defined Integrity Level, intended for maintaining the safe state of a machine or preventing an immediate increase of the risks.

Safety Related Electrical Control System (SRECS)

Safety-related electrical control system of a machine whose failure leads to an immediate increase of risks.

Safety Related Parts Of Control Systems (SRP/CS)

Safety-related part of a control system that reacts to safety-related input signals and generates safety-related output signals.

Schweizerische Normen-Vereinigung (SNV)

Swiss member of the International Organization for Standardization (ISO).

Service Life

Describes the maximum time a component may be operated from a safety technology point of view.

Short-Circuit

A practically unopposed conductive connection between two live electrical lines.

Shut-Off Path

Designs the section of the safety system used for shutting down the machine. This often also allows achieving the safe state, and this is why the function of the shut-off paths must be tested during validation.

Single-Failure-Proof

Describes a system that does not loose its safety in spite of a failure. This is classically achieved for systems as from category 3.

SIL Claim Limit (SIL CL)

Safety Integrity Level, a requirement classification according to EN 62061 [refer also to Safety Integrity Level (SIL)].

Sistema

Free software for the evaluation of the safety of controls within the framework of DIN EN ISO 13849-1. Issued by the IFA. The Windows tool simulates the structure of the safety-related control elements on the basis of the so-called planned architectures and calculates reliability values on various levels of detail including the attained performance level.

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Glossary

Soiling and Humidity

The IP classification according to EN 60529 describes how the encoder is protected against particles and water. It is described as an abbreviation "IP" followed by two numbers.

These two tables summarise the most used IP ratings.

Protection against particles (first digit)

The higher the number the smaller the particles.

0	Not protected
1	Protected against particles 50 mm and larger
2	Protected against particles 12.5 mm and larger
3	Protected against particles 2.5 mm and larger
4	Protected against particles 1.0 mm and larger
5	Protected against dust
6	Dust proof

Our encoders have a protection up to IP69k.

Protection against water (second digit)

The higher the number, the higher the water pressure can be.

0	Not protected
1	Protected against vertically falling drops of water
2	Protected against vertically falling drops of water when enclosure is tilted up to 15°
3	Protected against spraying water
4	Protected against splashing water
5	Protected against water jets
6	Protected against powerful water jets
7	Protected against the effects of temporary immersion in water
8	Protected against the effects of continuous immersion in water

9k	Acc. to DIN 40050 / Part 9: protected against high-pressure water / steam jet cleaning

Speed Monitoring

Monitoring of the rotary speed of a mechanical movement (e.g. drive) in a defined speed window. This can be achieved without sensor (current, frequency) or by means of a (generally incremental) encoder.

Start Interlock / Restart

After having triggered a safety function or restored the power supply, the machine / plant must restart. Automatic restarting is only allowed for well-defined exceptions. Automatic restarting is prevented by a safety control device.

Stop Category

Term used in EN 60204-1 to define three different shutdown functions.

Refer to Safety Functions.

Temperature

Working temperature:

Is defined as the environmental temperature, in which the encoder will produce the signals defined in the data sheets.

Operating temperature:

Is defined as the environmental temperature, in which the encoder can be operated without incurring damage.

TPE – Thermoplastic Elastomers

Thermoplastic elastomers are plastics that are soft, as all classical elastomers. The material looses these rubber-elastic properties at high temperatures; it can then be formed.

Two-Hand Operation / Two-Hand Control

Two-hand operation is a safety concept/control unit for working on machines in which a crushing or shearing hazard is possible for the hands and therefore requires two-hand operation.

Working in the hazardous area is required to place or remove parts in presses, punching machines, casting machines and similar machines. The working stroke may only be triggered (started) when both hands have left the hazardous area. This is achieved thanks to a simultaneous and seperate actuation of switches or levers. The distance between the operating elements is chosen so as to make one-hand operation impossible.

The rule is standard DIN EN 574.

User Information

The user information includes all indications, instructions, descriptions required for the safe and intended operation of the machine, e.g.: pictograms on the machine, operating instructions, maintenance instructions etc.

Validation

Proof of the reproducibility of a result from a described procedure under defined conditions.

Verification

Proof that suspected or alleged circumstances are true.

Verband der Elektrotechnik, Elektronik und Informationstechnik (VDE)

The Verband der Elektrotechnik, Elektronik und Informationstechnik is a technical-scientific association in Germany. The VDE is committed to a better innovation climate, safety standards, modern engineering education and better public acceptance for technology.

Zero Signal

The zero signal is emitted once per revolution, it can be used e.g. as a reference signal during the first revolution after power on.

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Basics

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SIL3
PLe

Incremental encoders

Series		Type	Output circuit	Page
Standard, optical	Sine wave output, SIL2/PLd	Sendix SIL 5814FS2 / 5834FS2 (shaft / hollow shaft)	SinCos	**54**
	Sine wave output, SIL3/PLe	Sendix SIL 5814FS3 / 5834FS3 (shaft / hollow shaft)	SinCos	**60**
	ATEX/IECEx – zone 1/21, SIL2/PLd	Sendix SIL 7014FS2 (shaft)	SinCos	**66**
	ATEX/IECEx – zone 1/21, SIL3/PLe	Sendix SIL 7014FS3 (shaft)	SinCos	**69**

Further incremental encoders you will find in our catalogue "Position and Motion Sensors" or under:
www.kuebler.com/incremental

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Standard
sine wave output, SIL2/PLd, optical

Sendix SIL 5814FS2 / 5834FS2 (shaft / hollow shaft)

SinCos

The incremental encoders 5814FS2 and 5834FS2 of the Sendix SIL family are suited for use in safety-related applications up to SIL2 according to EN 61800-5-2 or PLd to EN ISO 13849-1.

These encoders are particularly suited for applications in the field of safe drive technology.

Safety-Lock™ | High rotational speed | Temperature range | High protection level | High shaft load capacity | Shock / vibration resistant | Magnetic field proof | Reverse polarity protection | SinCos | Optical sensor

Functional Safety

- Encoder with individual certificate from IFA / TÜV.
- Suitable for applications up to SIL2 acc. to EN 61800-5-2.
- Suitable for applications up to PLd acc. to EN ISO 13849-1.
- With incremental SinCos tracks.
- Certified mechanical mounting + electronic.

Flexible

- Shaft and hollow shaft versions.
- Cable and connector variants.
- Various mounting options available.

Order code Shaft version

8.5814FS2	.	1	X	X	X	.	XXXX
Type		a	b	c	d		e

If for each parameter of an encoder the **underlined preferred option** is selected, then the delivery time will be 10 working days for a maximum of 10 pieces. Qts. up to 50 pcs. of these types generally have a delivery time of 15 working days.

a *Flange*
1 = clamping flange, IP65, ø 58 mm [2.28"]

b *Shaft (ø x L)*
2 = 10 x 20 mm [0.39 x 0.79"], with flat
A = 10 x 20 mm [0.39 x 0.79"], with feather key

c *Output circuit / power supply*
1 = SinCos / 5 V DC
2 = SinCos / 10 ... 30 V DC

d *Type of connection*
1 = axial cable, 1 m [3.28'] PVC
A = axial cable, special length PVC *)
2 = radial cable, 1 m [3.28'] PVC
B = radial cable, special length PVC *)
3 = axial M23 connector, 12 pin
4 = radial M23 connector, 12 pin
5 = axial M12 connector, 8 pin
6 = radial M12 connector, 8 pin

*) Available special lengths (connection types A, B):
2, 3, 5, 8, 10, 15 m [6.56, 9.84, 16.40, 26.25, 32.80, 49.21']
order code expansion .XXXX = length in dm
ex.: 8.5814FS2.122A.2048.0030 (for cable length 3 m)

e *Pulse rate*
1024, **2048**

Optional on request
- Ex 2/22

Order code Hollow shaft

8.5834FS2	.	X	X	X	X	.	XXXX
Type		a	b	c	d		e

If for each parameter of an encoder the **underlined preferred option** is selected, then the delivery time will be 10 working days for a maximum of 10 pieces. Qts. up to 50 pcs. of these types generally have a delivery time of 15 working days.

a *Flange*
9 = with torque stop, flexible, IP65
A = with torque stop set, rigid, IP65
B = with stator coupling, IP65, ø 63 mm [2.48"]

b *Hollow shaft*
3 = ø 10 mm [0.39"]
4 = ø 12 mm [0.47"]
5 = ø 14 mm [0.55"]
K = ø 10 mm [0.39"], tapered shaft

c *Output circuit / power supply*
1 = SinCos / 5 V DC
2 = SinCos / 10 ... 30 V DC

d *Type of connection*
2 = radial cable, 1 m [3.28'] PVC
B = radial cable, special length PVC *)
E = tangential cable, 1 m [3.28'] PVC
F = tangential cable, special length PVC *)
4 = radial M23 connector, 12 pin
6 = radial M12 connector, 8 pin

*) Available special lengths (connection types B, F):
2, 3, 5, 8, 10, 15 m [6.56, 9.84, 16.40, 26.25, 32.80, 49.21']
order code expansion .XXXX = length in dm
ex.: 8.5834FS2.B42B.2048.0030 (for cable length 3 m)

e *Pulse rate*
1024, **2048**

Optional on request
- Ex 2/22
(not for connection type E + F)

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Standard
sine wave output, SIL2/PLd, optical | **Sendix SIL 5814FS2 / 5834FS2 (shaft / hollow shaft)** | **SinCos**

Accessories		Order no.
EMC shield terminal	for top-hat rail mounting	**8.0000.4G06.0000**
Screw retention	Loctite 243, 5 ml	**8.0000.4G05.0000**
Bellows coupling, safety-oriented	You will find an overview of our couplings for Sendix SIL shaft encoders in the accessories section or under www.kuebler.com/accessories.	
Safety modules Safety-M compact / modular	You will find an overview of our systems and components for Functional Safety and the corresponding software in the safety technology section or under www.kuebler.com/safety.	

Further accessories can be found in the accessories section or in the accessories area of our website at: www.kuebler.com/accessories.

Connection technology		Order no.
Cordset, pre-assembled	M12 female connector with coupling nut – single-ended, 2 m [6.56'] PVC cable [1]	**05.00.6041.8211.002M**
	M23 female connector with coupling nut – single-ended, 2 m [6.56'] PVC cable [1]	**8.0000.6901.0002**
Connector, self-assembly (straight)	M12 female connector with coupling nut	**05.CMB 8181-0**
	M23 female connector with coupling nut	**8.0000.5012.0000**

Additional connectors can be found in the connection technology section or in the connection technology area of our website at: www.kuebler.com/connection_technology.

Technical data

Notes regarding "Functional Safety"

These encoders are suitable for use in safety-related systems up to SIL2 acc. to EN 61800-5-2 and PLd to EN ISO 13849-1 in conjunction with controllers or evaluation units, which possess the necessary functionality.

Additional functions can be found in the operating manual.

Safety characteristics

Classification	PLd / SIL2
System structure	2 channel (Cat. 3 / HFT = 1)
PFH_d value [2]	2.16×10^{-8} h^{-1}
Mission time / Proof test interval	20 years
Relevant standards	EN ISO 13849-1:2008; EN ISO 13849-2:2013; EN 61800-5-2:2007

Electrical characteristics

Power supply		5 V DC (±5 %) or 10 ... 30 V DC
Power consumption (no load)	5 V DC	max. 70 mA
	10 ... 30 V DC	max. 45 mA
Reverse polarity protection of the power supply		yes
Short circuit proof outputs		yes [4]
UL approval		file 224618
CE compliant acc. to		
	(up to April 19, 2016)	EMC guideline 2004/108/EC Machinery directive 2006/42/EC RoHS guideline 2011/65/EU
	(as from April 20, 2016)	EMC guideline 2014/30/EU Machinery directive 2006/42/EC RoHS guideline 2011/65/EU

Mechanical characteristics

Maximum speed, shaft version		
	up to 70°C [158°F]	12000 min^{-1}, 10000 min^{-1} (continuous)
	up to T_{max}	8000 min^{-1}, 5000 min^{-1} (continuous)
Maximum speed, hollow shaft version		
	up to 70°C [158°F]	9000 min^{-1}, 6000 min^{-1} (continuous)
	up to T_{max}	6000 min^{-1}, 3000 min^{-1} (continuous)
Starting torque – at 20°C [68°F]		
	shaft version	< 0.01 Nm
	hollow shaft version	< 0.03 Nm
Mass moment of inertia		
	shaft version	4.0×10^{-6} kgm^2
	hollow shaft version	7.0×10^{-6} kgm^2
Insertion depth for shaft		
	hollow shaft version	min. 34 mm [1.34"]
Load capacity of shaft	radial	80 N
	axial	40 N
Weight		approx. 0.45 kg [15.87 oz]
Protection acc. to EN 60529		IP65
Working temperature range		-40°C ... +90°C [-40°F ... +194°F] [3]
Materials	shaft / hollow shaft	stainless steel
	flange	aluminium
	housing	zinc die-cast
	cable	PVC
Shock resistance acc. to EN 60068-2-27		500 m/s^2, 11 ms
Vibration resistance acc. to EN 60068-2-6		200 m/s^2, 10 ... 150 Hz

1) Other lengths available.
2) The specified value is based on a diagnostic coverage of 90 %, that must be achieved with an encoder evaluation unit.
The encoder evaluation unit must meet at least the requirements for SIL2.
3) Cable version: -30°C ... + 90°C [-22°F ... +194°F] fixed installation.
4) Short circuit to 0 V or to output, one channel at a time, power supply correctly applied.

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Standard
sine wave output, SIL2/PLd, optical | **Sendix SIL 5814FS2 / 5834FS2 (shaft / hollow shaft)** | **SinCos**

EMC	
Relevant standards	EN 55011 class B :2009 / A1:2010 EN 61000-6-3:2007 / A1:2011 EN 61000-6-2:2005

SinCos interface	
Max. frequency -3dB	400 kHz
Signal level	1 Vpp (±10 %)
Short circuit proof	yes [1]
Pulse rate	1024 / 2048 ppr

Terminal assignment

Output circuit	Type of connection	Cable (isolate unused wires individually before initial start-up)							
1, 2	1, 2, A, B, E, F	Signal:	0 V	+V	A	$\overline{A}$	B	$\overline{B}$	⏚
		Cable colour:	WH	BN	GN	YE	GY	PK	shield

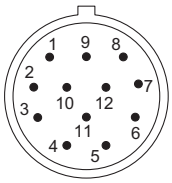
Output circuit	Type of connection	M23 connector, 12-pin							
1, 2	3, 4	Signal:	0 V	+V	A	$\overline{A}$	B	$\overline{B}$	⏚
		Pin:	10	12	5	6	8	1	PH [2]

Output circuit	Type of connection	M12 connector, 8-pin							
1, 2	5, 6	Signal:	0 V	+V	A	$\overline{A}$	B	$\overline{B}$	⏚
		Pin:	1	2	3	4	5	6	PH [2]

+V: Encoder power supply +V DC
0 V: Encoder power supply ground GND (0 V)
A, $\overline{A}$: Cosine signal
B, $\overline{B}$: Sine signal
PH ⏚: Plug connector housing (shield)

Top view of mating side, male contact base

M12 connector, 8-pin



M23 connector, 12-pin

1) Short circuit to 0 V or to output, one channel at a time, power supply correctly applied.
2) PH = shield is attached to connector housing.

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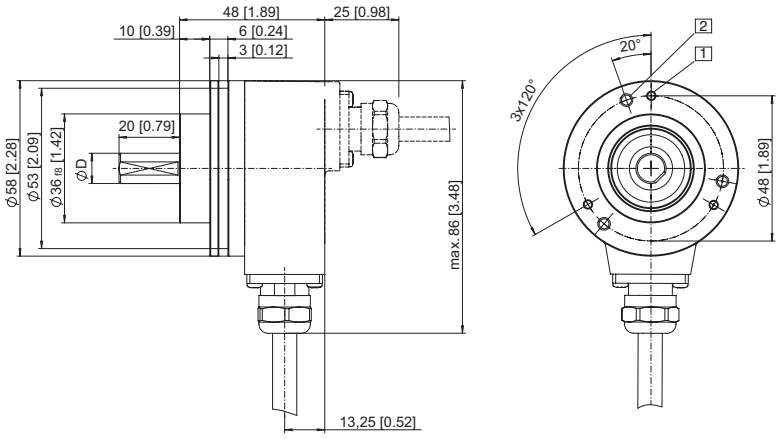
Standard
sine wave output, SIL2/PLd, optical | **Sendix SIL 5814FS2 / 5834FS2 (shaft / hollow shaft)** | **SinCos**

Dimensions shaft version

Dimensions in mm [inch]

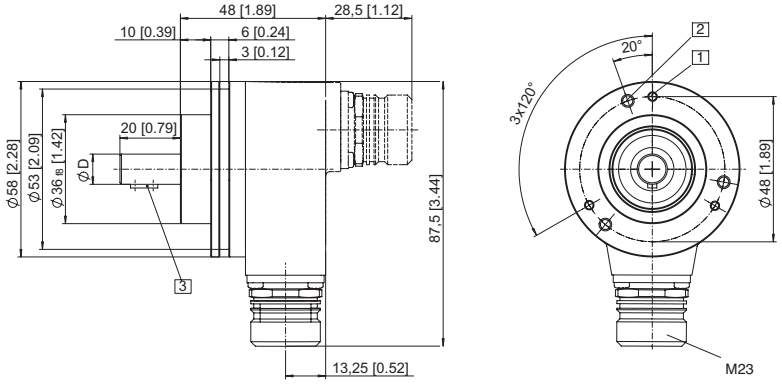
Clamping flange, ø 58 [2.28]
Flange type 1 with shaft type 2
(drawing with cable)

1 3 x M3, 6 [0.24] deep
2 3 x M4, 8 [0.32] deep
D =10 f7 [0.39]



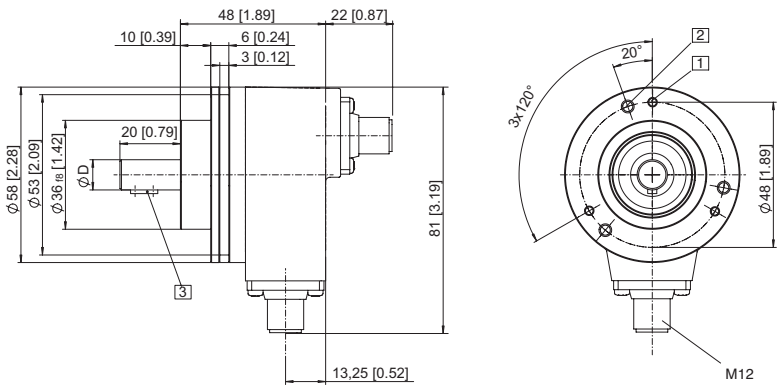
Clamping flange, ø 58 [2.28]
Flange type 1 with shaft type A
(drawing with M23 connector)

1 3 x M3, 6 [0.24] deep
2 3 x M4, 8 [0.32] deep
3 Feather key DIN 6885 - A - 3x3x6
D =10 f7 [0.39]



(drawing with M12 connector)

1 3 x M3, 6 [0.24] deep
2 3 x M4, 8 [0.32] deep
3 Feather key DIN 6885 - A - 3x3x6
D =10 f7 [0.39]



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Standard
sine wave output, SIL2/PLd, optical | **Sendix SIL 5814FS2 / 5834FS2 (shaft / hollow shaft)** | **SinCos**

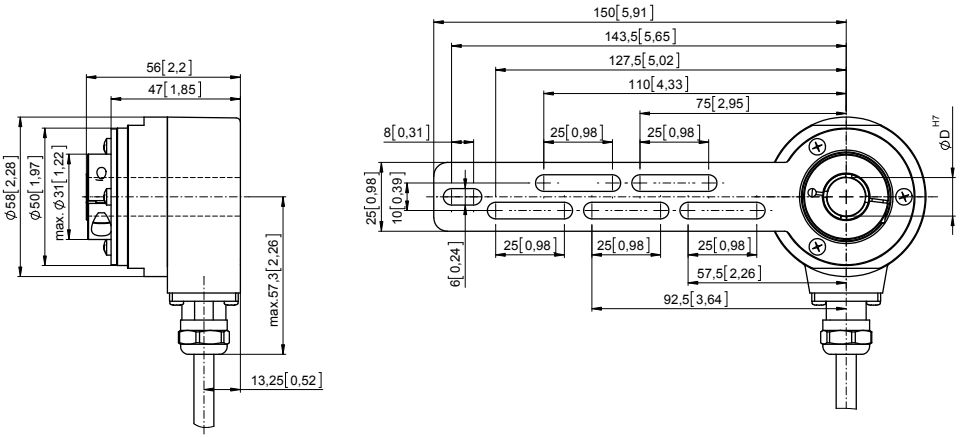
Dimensions hollow shaft version

Dimensions in mm [inch]

Flange with torque stop set, rigid
Flange type A
Through hollow shaft
(drawing with cable)

1 SW 3,
recommended torque for the clamping ring 2.5 Nm

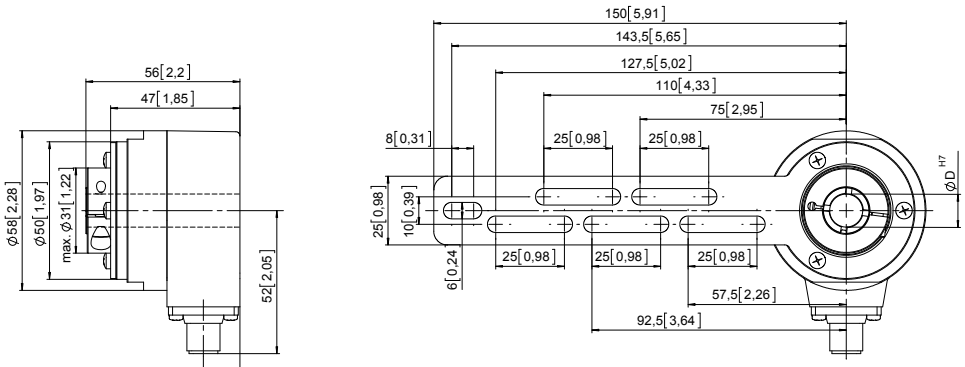
D = ø 10 H7 [0.39]
ø 12 H7 [0.47]
ø 14 H7 [0.55]



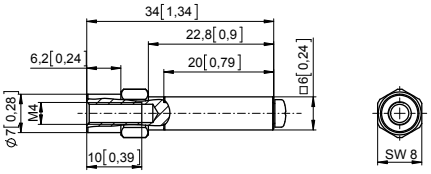
(drawing with M12 connector)

1 SW 3,
recommended torque for the clamping ring 2.5 Nm

D = ø 10 H7 [0.39]
ø 12 H7 [0.47]
ø 14 H7 [0.55]



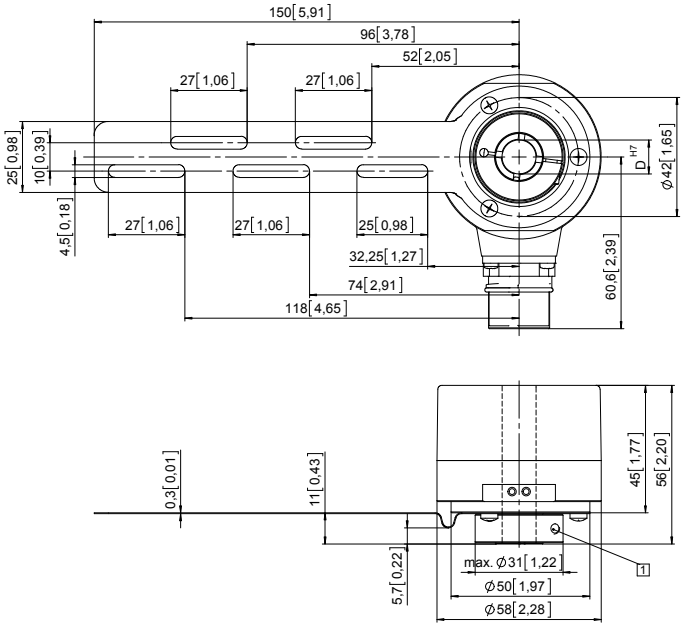
Torque pin with rectangular sleeve with M4 thread



Flange with torque stop, flexible
Flange type 9
Through hollow shaft
(drawing with M23 connector)

1 Recommended torque for the clamping ring 2.5 Nm

D = ø 10 H7 [0.39]
ø 12 H7 [0.47]
ø 14 H7 [0.55]



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Standard
sine wave output, SIL2/PLd, optical | **Sendix SIL 5814FS2 / 5834FS2 (shaft / hollow shaft)** | **SinCos**

Dimensions hollow shaft version

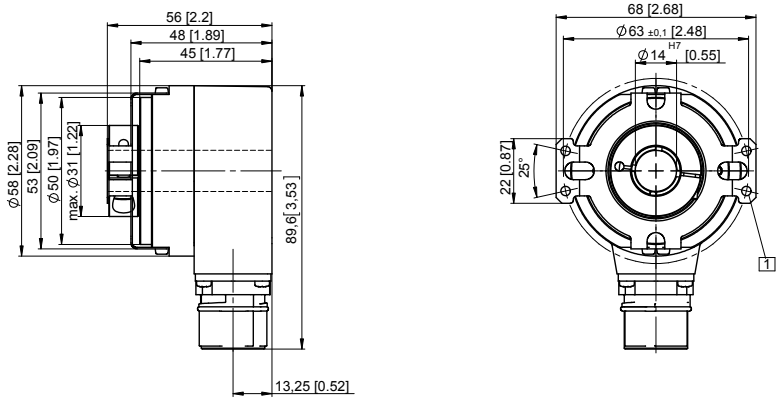
Dimensions in mm [inch]

Flange with stator coupling, ø 63 [2.48]
Flange type B
Through hollow shaft
(drawing with M23 connector)

1 SW 3,
recommended torque for the clamping ring 2.5 Nm

2 For (4x) M3 screw

D = ø 10 H7 [0.39]
ø 12 H7 [0.47]
ø 14 H7 [0.55]



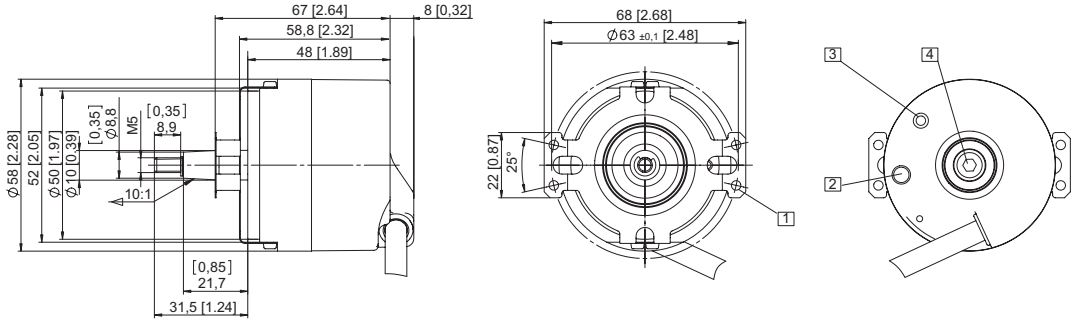
Flange with stator coupling, ø 63 [2.48]
Flange type B
Tapered shaft
(drawing with tangential cable outlet)

1 For (4x) M3 screw

2 Status LED

3 SET button

4 SW 4



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Standard
sine wave output, SIL3/PLe, optical

Sendix SIL 5814FS3 / 5834FS3 (shaft / hollow shaft)

SinCos

The incremental encoders 5814FS3 and 5834FS3 of the Sendix SIL family are suited for use in safety-related applications up to SIL3 according to EN 61800-5-2 or PLe to EN ISO 13849-1.

These encoders are particularly suited for applications in the field of safe drive technology.

Safety-Lock™ | High rotational speed | Temperature range | High protection level | High shaft load capacity | Shock / vibration resistant | Magnetic field proof | Reverse polarity protection | SinCos | Optical sensor

Functional Safety

- Encoder with individual certificate from IFA / TÜV.
- Suitable for applications up to SIL3 acc. to EN 61800-5-2.
- Suitable for applications up to PLe acc. to EN ISO 13849-1.
- With incremental SinCos tracks.
- Certified mechanical mounting + electronic.

Flexible

- Shaft and hollow shaft versions.
- Cable and connector variants.
- Various mounting options available.

Order code Shaft version

8.5814FS3	.	1	X	X	X	.	XXXX
Type		a	b	c	d		e

If for each parameter of an encoder the **underlined preferred option** is selected, then the delivery time will be 10 working days for a maximum of 10 pieces. Qts. up to 50 pcs. of these types generally have a delivery time of 15 working days.

10 by 10

a *Flange*
1 = clamping flange, IP65, ø 58 mm [2.28"]

b *Shaft (ø x L)*
2 = 10 x 20 mm [0.39 x 0.79"], with flat
A = 10 x 20 mm [0.39 x 0.79"], with feather key

c *Output circuit / power supply*
1 = SinCos / 5 V DC
2 = SinCos / 10 ... 30 V DC

d *Type of connection*
1 = axial cable, 1 m [3.28'] PVC
A = axial cable, special length PVC *)
2 = radial cable, 1 m [3.28'] PVC
B = radial cable, special length PVC *)
3 = axial M23 connector, 12 pin
4 = radial M23 connector, 12 pin
5 = axial M12 connector, 8 pin
6 = radial M12 connector, 8 pin

*) Available special lengths (connection types A, B):
2, 3, 5, 8, 10, 15 m [6.56, 9.84, 16.40, 26.25, 32.80, 49.21']
order code expansion .XXXX = length in dm
ex.: 8.5814FS3.122A.2048.0030 (for cable length 3 m)

e *Pulse rate*
1024, **2048**

Optional on request
- Ex 2/22

Order code Hollow shaft

8.5834FS3	.	X	X	X	X	.	XXXX
Type		a	b	c	d		e

If for each parameter of an encoder the **underlined preferred option** is selected, then the delivery time will be 10 working days for a maximum of 10 pieces. Qts. up to 50 pcs. of these types generally have a delivery time of 15 working days.

10 by 10

a *Flange*
9 = with torque stop, flexible, IP65
A = with torque stop set, rigid, IP65
B = with stator coupling, IP65, ø 63 mm [2.48"]

b *Hollow shaft*
3 = ø 10 mm [0.39"]
4 = ø 12 mm [0.47"]
5 = ø 14 mm [0.55"]
K = ø 10 mm [0.39"], tapered shaft

c *Output circuit / power supply*
1 = SinCos / 5 V DC
2 = SinCos / 10 ... 30 V DC

d *Type of connection*
2 = radial cable, 1 m [3.28'] PVC
B = radial cable, special length PVC *)
E = tangential cable, 1 m [3.28'] PVC
F = tangential cable, special length PVC *)
4 = radial M23 connector, 12 pin
6 = radial M12 connector, 8 pin

*) Available special lengths (connection types B, F):
2, 3, 5, 8, 10, 15 m [6.56, 9.84, 16.40, 26.25, 32.80, 49.21']
order code expansion .XXXX = length in dm
ex.: 8.5834FS3.B42B.2048.0030 (for cable length 3 m)

e *Pulse rate*
1024, **2048**

Optional on request
- Ex 2/22
(not for connection type E + F)

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Standard
sine wave output, SIL3/PLe, optical | **Sendix SIL 5814FS3 / 5834FS3 (shaft / hollow shaft)** | **SinCos**

Accessories		Order no.
EMC shield terminal	for top-hat rail mounting	**8.0000.4G06.0000**
Screw retention	Loctite 243, 5 ml	**8.0000.4G05.0000**
Bellows coupling, safety-oriented	You will find an overview of our couplings for Sendix SIL shaft encoders in the accessories section or under www.kuebler.com/accessories.	
Safety modules Safety-M compact / modular	You will find an overview of our systems and components for Functional Safety and the corresponding software in the safety technology section or under www.kuebler.com/safety.	

Further accessories can be found in the accessories section or in the accessories area of our website at: www.kuebler.com/accessories.

Connection technology		Order no.
Cordset, pre-assembled	M12 female connector with coupling nut – single-ended, 2 m [6.56'] PVC cable [1]	**05.00.6041.8211.002M**
	M23 female connector with coupling nut – single-ended, 2 m [6.56'] PVC cable [1]	**8.0000.6901.0002**
Connector, self-assembly (straight)	M12 female connector with coupling nut	**05.CMB 8181-0**
	M23 female connector with coupling nut	**8.0000.5012.0000**

Additional connectors can be found in the connection technology section or in the connection technology area of our website at: www.kuebler.com/connection_technology.

Technical data

Notes regarding "Functional Safety"

These encoders are suitable for use in safety-related systems up to SIL3 acc. to EN 61800-5-2 and PLe to EN ISO 13849-1 in conjunction with controllers or evaluation units, which possess the necessary functionality.

Additional functions can be found in the operating manual.

Safety characteristics

Classification	PLe / SIL3
System structure	2 channel (Cat. 4 / HFT = 1)
PFH_d value [2]	$1.09 \times 10^{-8}\ h^{-1}$
Mission time / Proof test interval	20 years
Relevant standards	EN ISO 13849-1:2008; EN ISO 13849-2:2013; EN 61800-5-2:2007

Electrical characteristics

Power supply		5 V DC (±5 %) or 10 ... 30 V DC
Power consumption (no load)	5 V DC	max. 70 mA
	10 ... 30 V DC	max. 45 mA
Reverse polarity protection of the power supply		yes
Short circuit proof outputs		yes [4]
UL approval		file 224618
CE compliant acc. to		
	(up to April 19, 2016)	EMC guideline 2004/108/EC Machinery directive 2006/42/EC RoHS guideline 2011/65/EU
	(as from April 20, 2016)	EMC guideline 2014/30/EU Machinery directive 2006/42/EC RoHS guideline 2011/65/EU

Mechanical characteristics

Maximum speed, shaft version		
	up to 70°C [158°F]	12000 min^{-1}, 10000 min^{-1} (continuous)
	up to T_{max}	8000 min^{-1}, 5000 min^{-1} (continuous)
Maximum speed, hollow shaft version		
	up to 70°C [158°F]	9000 min^{-1}, 6000 min^{-1} (continuous)
	up to T_{max}	6000 min^{-1}, 3000 min^{-1} (continuous)
Starting torque – at 20°C [68°F]		
	shaft version	< 0.01 Nm
	hollow shaft version	< 0.03 Nm
Mass moment of inertia		
	shaft version	$4.0 \times 10^{-6}\ kgm^2$
	hollow shaft version	$7.0 \times 10^{-6}\ kgm^2$
Insertion depth for shaft		
	hollow shaft version	min. 34 mm [1.34"]
Load capacity of shaft	radial	80 N
	axial	40 N
Weight		approx. 0.45 kg [15.87 oz]
Protection acc. to EN 60529		IP65
Working temperature range		-40°C ... +90°C [-40°F ... +194°F] [3]
Materials	shaft / hollow shaft	stainless steel
	flange	aluminium
	housing	zinc die-cast
	cable	PVC
Shock resistance acc. to EN 60068-2-27		500 m/s^2, 11 ms
Vibration resistance acc. to EN 60068-2-6		200 m/s^2, 10 ... 150 Hz

1) Other lengths available.
2) The specified value is based on a diagnostic coverage of 99 %, that must be achieved with an encoder evaluation unit.
The encoder evaluation unit must meet at least the requirements for SIL3.
3) Cable version: -30°C ... + 90°C [-22°F ... +194°F] fixed installation.
4) Short circuit to 0 V or to output, one channel at a time, power supply correctly applied.

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Standard
sine wave output, SIL3/PLe, optical | **Sendix SIL 5814FS3 / 5834FS3 (shaft / hollow shaft)** | **SinCos**

EMC	
Relevant standards	EN 55011 class B :2009 / A1:2010 EN 61000-6-3:2007 / A1:2011 EN 61000-6-2:2005

SinCos interface	
Max. frequency -3dB	400 kHz
Signal level	1 Vpp (±10 %)
Short circuit proof	yes [1]
Pulse rate	1024 / 2048 ppr

Terminal assignment

Output circuit	Type of connection	Cable (isolate unused wires individually before initial start-up)							
1, 2	1, 2, A, B, E, F	Signal:	0 V	+V	A	$\overline{A}$	B	$\overline{B}$	⏚
		Cable colour:	WH	BN	GN	YE	GY	PK	shield

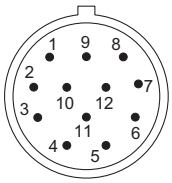
Output circuit	Type of connection	M23 connector, 12-pin							
1, 2	3, 4	Signal:	0 V	+V	A	$\overline{A}$	B	$\overline{B}$	⏚
		Pin:	10	12	5	6	8	1	PH [2]

Output circuit	Type of connection	M12 connector, 8-pin							
1, 2	5, 6	Signal:	0 V	+V	A	$\overline{A}$	B	$\overline{B}$	⏚
		Pin:	1	2	3	4	5	6	PH [2]

+V: Encoder power supply +V DC
0 V: Encoder power supply ground GND (0 V)
A, $\overline{A}$: Cosine signal
B, $\overline{B}$: Sine signal
PH ⏚: Plug connector housing (shield)

Top view of mating side, male contact base

M12 connector, 8-pin



M23 connector, 12-pin

1) Short circuit to 0 V or to output, one channel at a time, power supply correctly applied.
2) PH = shield is attached to connector housing.

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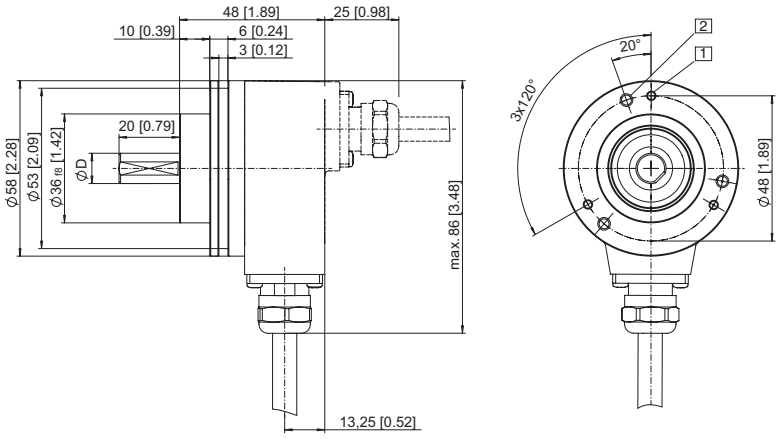
Standard
sine wave output, SIL3/PLe, optical | **Sendix SIL 5814FS3 / 5834FS3 (shaft / hollow shaft)** | **SinCos**

Dimensions shaft version

Dimensions in mm [inch]

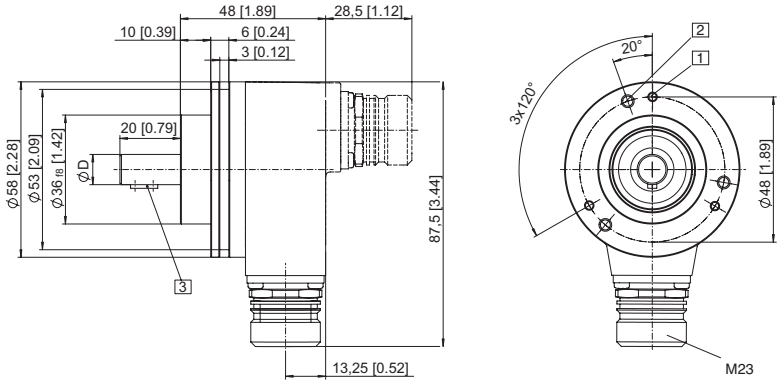
Clamping flange, ø 58 [2.28]
Flange type 1 with shaft type 2
(drawing with cable)

1 3 x M3, 6 [0.24] deep
2 3 x M4, 8 [0.32] deep
D =10 ^{f7} [0.39]



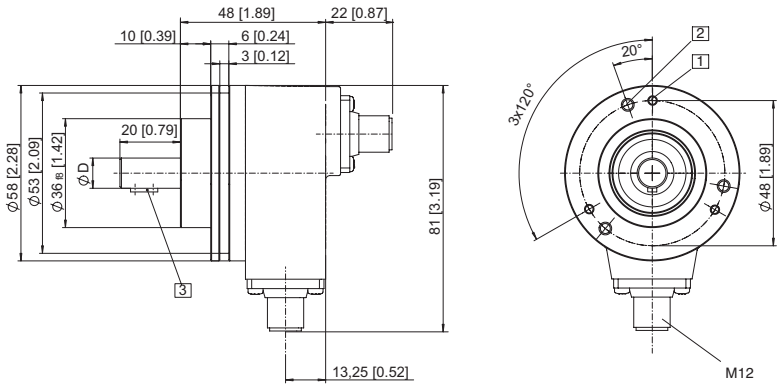
Clamping flange, ø 58 [2.28]
Flange type 1 with shaft type A
(drawing with M23 connector)

1 3 x M3, 6 [0.24] deep
2 3 x M4, 8 [0.32] deep
3 Feather key DIN 6885 - A - 3x3x6
D =10 ^{f7} [0.39]



(drawing with M12 connector)

1 3 x M3, 6 [0.24] deep
2 3 x M4, 8 [0.32] deep
3 Feather key DIN 6885 - A - 3x3x6
D =10 ^{f7} [0.39]



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Standard
sine wave output, SIL3/PLe, optical | **Sendix SIL 5814FS3 / 5834FS3 (shaft / hollow shaft)** | **SinCos**

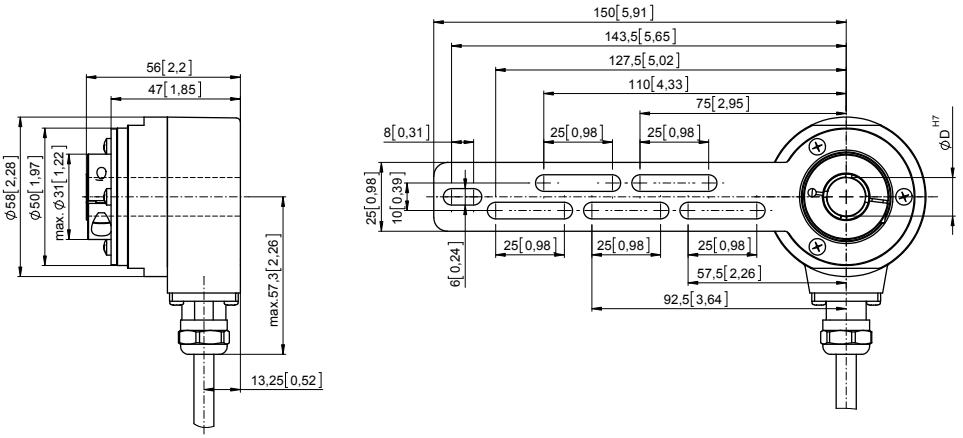
Dimensions hollow shaft version

Dimensions in mm [inch]

Flange with torque stop set, rigid
Flange type A
Through hollow shaft
(drawing with cable)

1 SW 3,
recommended torque for the clamping ring 2.5 Nm

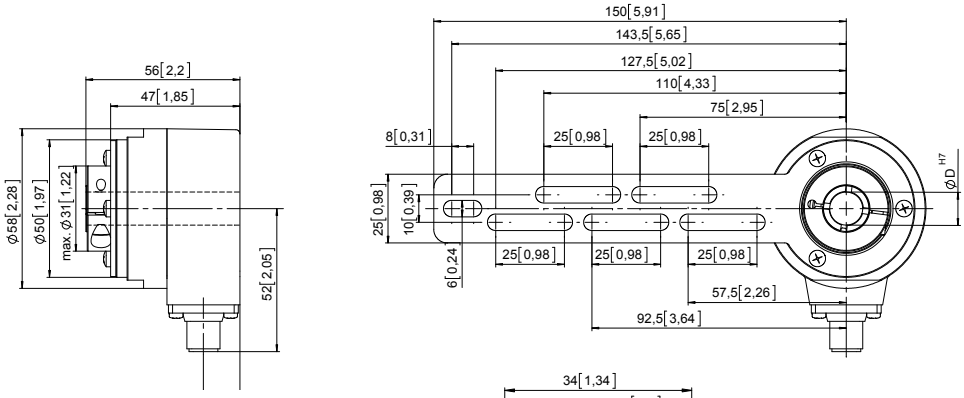
D = ø 10 H7 [0.39]
ø 12 H7 [0.47]
ø 14 H7 [0.55]



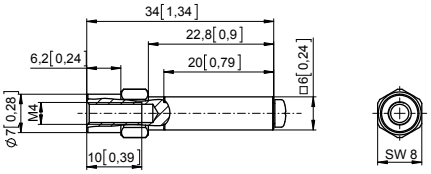
(drawing with M12 connector)

1 SW 3,
recommended torque for the clamping ring 2.5 Nm

D = ø 10 H7 [0.39]
ø 12 H7 [0.47]
ø 14 H7 [0.55]



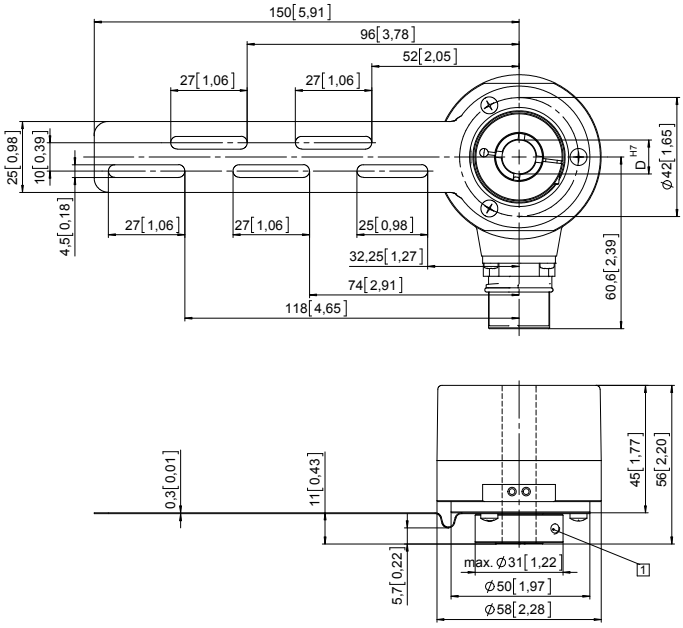
Torque pin with rectangular sleeve with M4 thread



Flange with torque stop, flexible
Flange type 9
Through hollow shaft
(drawing with M23 connector)

1 Recommended torque for the clamping ring 2.5 Nm

D = ø 10 H7 [0.39]
ø 12 H7 [0.47]
ø 14 H7 [0.55]



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Standard
sine wave output, SIL3/PLe, optical | **Sendix SIL 5814FS3 / 5834FS3 (shaft / hollow shaft)** | **SinCos**

Dimensions hollow shaft version

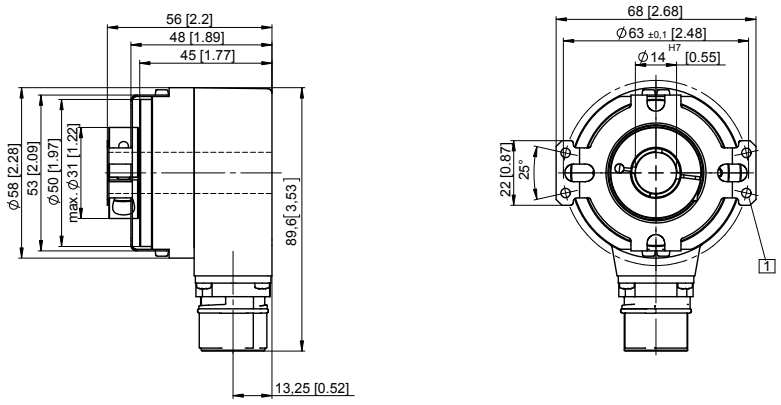
Dimensions in mm [inch]

Flange with stator coupling, ø 63 [2.48]
Flange type B
Through hollow shaft
(drawing with M23 connector)

1 SW 3,
recommended torque for the clamping ring 2.5 Nm

2 For (4x) M3 screw

D = ø 10 H7 [0.39]
ø 12 H7 [0.47]
ø 14 H7 [0.55]



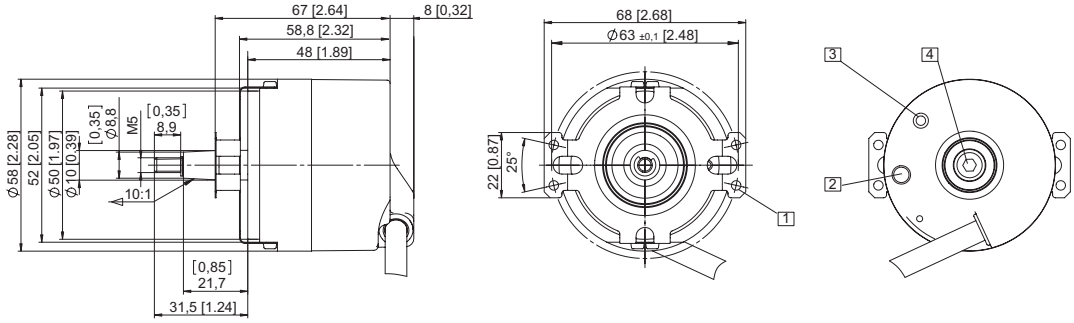
Flange with stator coupling, ø 63 [2.48]
Flange type B
Tapered shaft
(drawing with tangential cable outlet)

1 For (4x) M3 screw

2 Status LED

3 SET button

4 SW 4



Standard
ATEX/IECEx – zone 1/21, SIL2/PLd, optical | **Sendix SIL 7014FS2 (shaft)** | **SinCos**

Ex protection and Functional Safety in one device.

The incremental encoders 7014FS2 of the Sendix SIL family are suited for use in safety-related applications up to SIL2 acc. to EN 61800-5-2 or PLd to EN ISO 13849-1.

In addition, these devices ensure Ex protection in a compact 70 mm housing out of seawater durable aluminium.

Ex approval | Safety-Lock™ | High rotational speed | High protection level | High shaft load capacity | Shock / vibration resistant | Magnetic field proof | Short-circuit proof | Reverse polarity protection | Optical sensor | Seawater durable

Functional Safety

- Encoder with individual certificate from IFA / TÜV.
- Suitable for applications up to SIL2 acc. to EN 61800-5-2.
- Suitable for applications up to PLd acc. to EN ISO 13849-1.
- With incremental SinCos tracks.
- Certified mechanical mounting + electronic.

Explosion protection

- "Flameproof-enclosure" version.
- ATEX with EC type examination certificate.
- IECEx with certificate of conformity (CoC).

Order code Shaft version

8.7014 FS2	.	1	X	X	X	.	XXXX	.	XXXX
Type		a	b	c	d		e		f

a *Flange*
1 = clamping / synchronous flange, IP67 ø 70 mm [2.76"]

b *Shaft (ø x L)*
2 = 10 x 20 mm [0.39 x 0.79"], with flat
1 = 12 x 25 mm [0.47 x 0.98"], with keyway for 4 x 4 mm [0.16 x 0.16"] key

c *Output circuit / power supply*
1 = SinCos / 5 V DC
2 = SinCos / 10 ... 30 V DC

d *Type of connection*
1 = axial cable, 2 m [6.56'] PUR
2 = radial cable, 2 m [6.56'] PUR
A = axial cable, length > 2 m [6.56']
B = radial cable, length > 2 m [6.56']

e *Pulse rate*
1024, 2048

f *Cable length in dm* [1)]
0050 = 5 m [16.40']
0100 = 10 m [32.81']
0150 = 15 m [49.21']

Optional on request
- special cable length
- stainless steel version

Accessories		Order no.
EMC shield terminal	for top-hat rail mounting	**8.0000.4G06.0000**
Screw retention	Loctite 243, 5 ml	**8.0000.4G05.0000**
Bellows coupling, safety-oriented	You will find an overview of our couplings for Sendix SIL shaft encoders in the accessories section or under www.kuebler.com/accessories.	
Safety modules Safety-M compact / modular	You will find an overview of our systems and components for Functional Safety and the corresponding software in the safety technology section or under www.kuebler.com/safety.	

Further accessories can be found in the accessories section or in the accessories area of our website at: www.kuebler.com/accessories.
Additional connectors can be found in the connection technology section or in the connection technology area of our website at: www.kuebler.com/connection_technology.

1) Not applicable with connection types 1 and 2.

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Standard
ATEX/IECEx – zone 1/21, SIL2/PLd, optical | **Sendix SIL 7014FS2 (shaft)** | **SinCos**

Technical data

Explosion protection ATEX

EC type-examination certificate	PTB09 ATEX 1106 X
Category (gas)	Ex II 2 G Ex d IIC T4 - T6 Gb
Category (dust)	Ex II 2D Ex tb IIIC T135°C - T85°C Db IP6x
Relevant standards	EN 60079-0:2009; EN 60079-1:2007; EN 60079-31:2009

Explosion protection IECEx

Certificate of conformity (CoC)	IECEx PTB 13.0026 X
Category (gas)	Ex d IIC T4 - T6 Gb
Category (dust)	Ex tb IIIC T135°C - T85°C Db IP6x
Relevant standards	IEC 60079-0:2007; IEC 60079-1:2007; IEC 60079-31:2008

Notes regarding "Functional Safety"

These encoders are suitable for use in safety-related systems up to SIL2 acc. to EN 61800-5-2 and PLd to EN ISO 13849-1 in conjunction with controllers or evaluation units, which possess the necessary functionality.

Additional functions can be found in the operating manual.

Electrical characteristics

Power supply	10 ... 30 V DC
Current consumption (no load)	max. 45 mA
Reverse polarity protection for power supply	yes
Short circuit proof outputs	yes [2]
CE compliant acc. to	
(up to April 19, 2016)	EMC guideline 2004/108/EC ATEX guideline 94/9/EC Machinery directive 2006/42/EC RoHS guideline 2011/65/EU
(as from April 20, 2016)	EMC guideline 2014/30/EU ATEX guideline 2014/34/EU Machinery directive 2006/42/EC RoHS guideline 2011/65/EU

EMC

Relevant standards	EN 55011 class B :2009 / A1:2010 EN 61000-6-3:2007 / A1:2011 EN 61000-6-2:2005

Safety characteristics

Classification	PLd / SIL2
System structure	2 channel (Cat. 3 / HFT = 1)
PFH_d value [1]	2.16 x 10^{-8} h^{-1}
Mission time / Proof test interval	20 years
Relevant standards	EN ISO 13849-1:2008; EN ISO 13849-2:2013; EN 61800-5-2:2007

Mechanical characteristics

Maximum speed		6000 min^{-1} (continuous)
Starting torque – at 20°C [68°F]		< 0.05 Nm
Mass moment of inertia		4.0 x 10^{-6} kgm^2
Load capacity of shaft	radial	80 N
	axial	40 N
Weight		approx. 1.3 kg [45.86 oz]
Protection acc. to EN 60529		IP67
Ambient temperature		-40°C ... +60°C [-40 ... +140°F] Please note the specifications for temperature class in EC type-examination certificate!
Materials	shaft	stainless steel
	flange / housing	seawater durable Al, type AlSiMgMn (EN AW-6082)
	cable	PUR
Shock resistance acc. to EN 60068-2-27		500 m/s^2, 11 ms
Vibration resistance acc. to EN 60068-2-6		200 m/s^2, 10 ... 150 Hz

SinCos interface

Max. frequency -3dB	400 kHz
Signal level	1 Vpp (±10 %)
Short circuit proof	yes [2]
Pulse rate	1024 / 2048 ppr

Terminal assignment

Output circuit	Type of connection	Cable (isolate unused wires individually before initial start-up)							
1, 2	1, 2, A, B	Signal:	0 V	+V	A	$\overline{A}$	B	$\overline{B}$	⏚
		Cable marking:	6	1	7	8	9	10	shield

+V: Encoder power supply +V DC
0 V: Encoder power supply ground GND (0 V)
A, $\overline{A}$: Cosine signal
B, $\overline{B}$: Sine signal
⏚: Plug connector housing (shield)

1) The specified value is based on a diagnostic coverage of 90 %, that must be achieved with an encoder evaluation unit.
The encoder evaluation unit must meet at least the requirements for SIL2.
2) Short-circuit with 0 V or output, only one channel at a time, power supply correctly applied.

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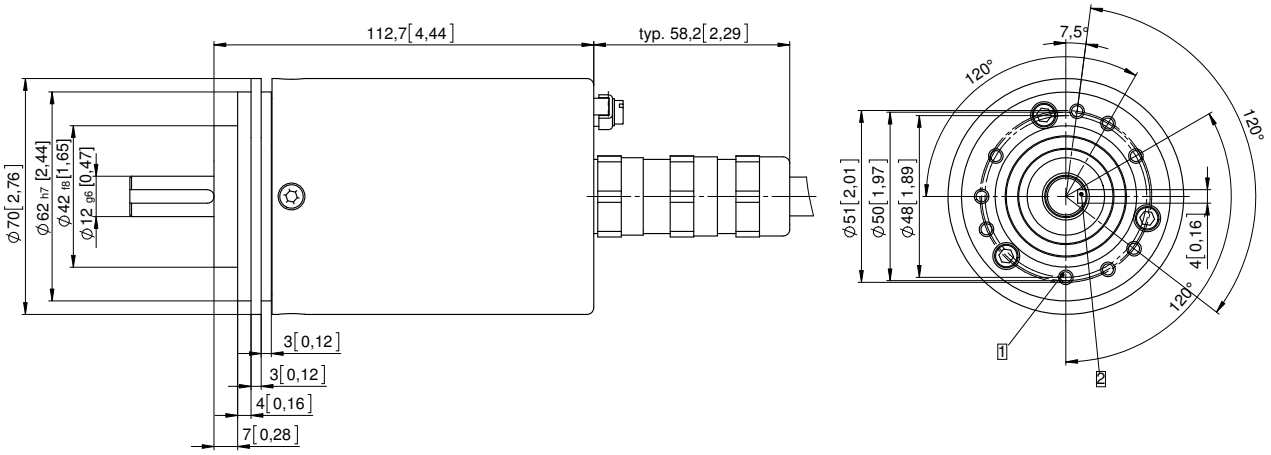
Standard
ATEX/IECEx – zone 1/21, SIL2/PLd, optical | **Sendix SIL 7014FS2 (shaft)** | **SinCos**

Dimensions

Dimensions in mm [inch]

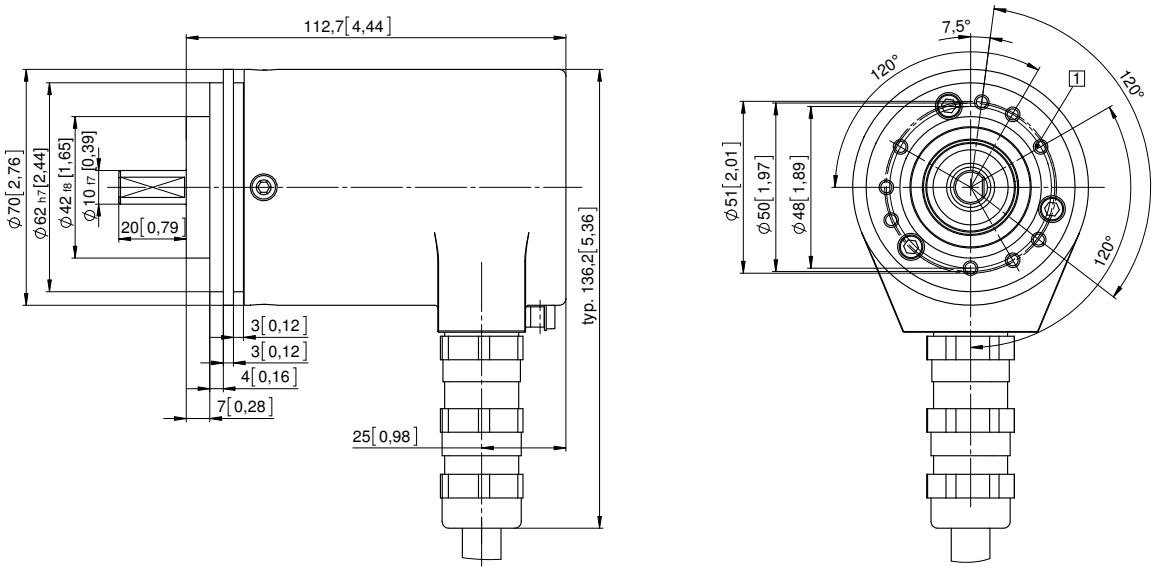
Clamping / synchronous flange, ø 70 [2.76]
Shaft type 1 with axial cable outlet

1 9 x M4, 10 [0.39] deep
2 Keyway for DIN 6885-A-4x4x25 key



Clamping / synchronous flange, ø 70 [2.76]
Shaft type 2 with radial cable outlet

1 9 x M4, 10 [0.39] deep



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Standard
ATEX/IECEx – zone 1/21, SIL3/PLe, optical | **Sendix SIL 7014FS3 (shaft)** | **SinCos**

Ex protection and Functional Safety in one device.

The incremental encoders 7014FS3 of the Sendix SIL family are suited for use in safety-related applications up to SIL3 acc. to EN 61800-5-2 or PLe to EN ISO 13849-1.

In addition, these devices ensure Ex protection in a compact 70 mm housing out of seawater durable aluminium.

Ex approval | Safety-Lock™ | High rotational speed | High protection level | High shaft load capacity | Shock / vibration resistant | Magnetic field proof | Short-circuit proof | Reverse polarity protection | Optical sensor | Seawater durable

Functional Safety

- Encoder with individual certificate from IFA / TÜV.
- Suitable for applications up to SIL3 acc. to EN 61800-5-2.
- Suitable for applications up to PLe acc. to EN ISO 13849-1.
- With incremental SinCos tracks.
- Certified mechanical mounting + electronic.

Explosion protection

- "Flameproof-enclosure" version.
- ATEX with EC type examination certificate.
- IECEx with certificate of conformity (CoC).

Order code Shaft version

8.7014 FS3	.	1	X	X	X	.	XXXX	.	XXXX
Type		a	b	c	d		e		f

a *Flange*
1 = clamping / synchronous flange, IP67 ø 70 mm [2.76"]

b *Shaft (ø x L)*
2 = 10 x 20 mm [0.39 x 0.79"], with flat
1 = 12 x 25 mm [0.47 x 0.98"], with keyway for 4 x 4 mm [0.16 x 0.16"] key

c *Output circuit / power supply*
1 = SinCos / 5 V DC
2 = SinCos / 10 ... 30 V DC

d *Type of connection*
1 = axial cable, 2 m [6.56'] PUR
2 = radial cable, 2 m [6.56'] PUR
A = axial cable, length > 2 m [6.56']
B = radial cable, length > 2 m [6.56']

e *Pulse rate*
1024, 2048

f *Cable length in dm* [1)]
0050 = 5 m [16.40']
0100 = 10 m [32.81']
0150 = 15 m [49.21']

Optional on request
- special cable length
- stainless steel version

Accessories		Order no.
EMC shield terminal	for top-hat rail mounting	**8.0000.4G06.0000**
Screw retention	Loctite 243, 5 ml	**8.0000.4G05.0000**
Bellows coupling, safety-oriented	You will find an overview of our couplings for Sendix SIL shaft encoders in the accessories section or under www.kuebler.com/accessories.	
Safety modules Safety-M compact / modular	You will find an overview of our systems and components for Functional Safety and the corresponding software in the safety technology section or under www.kuebler.com/safety.	

Further accessories can be found in the accessories section or in the accessories area of our website at: www.kuebler.com/accessories.
Additional connectors can be found in the connection technology section or in the connection technology area of our website at: www.kuebler.com/connection_technology.

1) Not applicable with connection types 1 and 2.

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Standard
ATEX/IECEx – zone 1/21, SIL3/PLe, optical | **Sendix SIL 7014FS3 (shaft)** | **SinCos**

Technical data

Explosion protection ATEX

EC type-examination certificate	PTB09 ATEX 1106 X
Category (gas)	Ex II 2 G Ex d IIC T4 - T6 Gb
Category (dust)	Ex II 2D Ex tb IIIC T135°C - T85°C Db IP6x
Relevant standards	EN 60079-0:2009; EN 60079-1:2007; EN 60079-31:2009

Explosion protection IECEx

Certificate of conformity (CoC)	IECEx PTB 13.0026 X
Category (gas)	Ex d IIC T4 - T6 Gb
Category (dust)	Ex tb IIIC T135°C - T85°C Db IP6x
Relevant standards	IEC 60079-0:2007; IEC 60079-1:2007; IEC 60079-31:2008

Notes regarding "Functional Safety"

These encoders are suitable for use in safety-related systems up to SIL3 acc. to EN 61800-5-2 and PLe to EN ISO 13849-1 in conjunction with controllers or evaluation units, which possess the necessary functionality.

Additional functions can be found in the operating manual.

Electrical characteristics

Power supply	10 ... 30 V DC
Current consumption (no load)	max. 45 mA
Reverse polarity protection for power supply	yes
Short circuit proof outputs	yes [2]
CE compliant acc. to	
(up to April 19, 2016)	EMC guideline 2004/108/EC ATEX guideline 94/9/EC Machinery directive 2006/42/EC RoHS guideline 2011/65/EU
(as from April 20, 2016)	EMC guideline 2014/30/EU ATEX guideline 2014/34/EU Machinery directive 2006/42/EC RoHS guideline 2011/65/EU

EMC

Relevant standards	EN 55011 class B :2009 / A1:2010 EN 61000-6-3:2007 / A1:2011 EN 61000-6-2:2005

Safety characteristics

Classification	PLe / SIL3
System structure	2 channel (Cat. 4 / HFT = 1)
PFH_d value [1]	$1.09 \times 10^{-8}\ h^{-1}$
Mission time / Proof test interval	20 years
Relevant standards	EN ISO 13849-1:2008; EN ISO 13849-2:2013; EN 61800-5-2:2007

Mechanical characteristics

Maximum speed		6000 min^{-1} (continuous)
Starting torque – at 20°C [68°F]		< 0.05 Nm
Mass moment of inertia		$4.0 \times 10^{-6}\ kgm^2$
Load capacity of shaft	radial	80 N
	axial	40 N
Weight		approx. 1.3 kg [45.86 oz]
Protection acc. to EN 60529		IP67
Ambient temperature		-40°C ... +60°C [-40 ... +140°F] Please note the specifications for temperature class in EC type-examination certificate!
Materials	shaft	stainless steel
	flange / housing	seawater durable Al, type AlSiMgMn (EN AW-6082)
	cable	PUR
Shock resistance acc. to EN 60068-2-27		500 m/s^2, 11 ms
Vibration resistance acc. to EN 60068-2-6		200 m/s^2, 10 ... 150 Hz

SinCos interface

Max. frequency -3dB	400 kHz
Signal level	1 Vpp (±10 %)
Short circuit proof	yes [2]
Pulse rate	1024 / 2048 ppr

Terminal assignment

Output circuit	Type of connection	Cable (isolate unused wires individually before initial start-up)							
1, 2	1, 2, A, B	Signal:	0 V	+V	A	$\overline{A}$	B	$\overline{B}$	⏚
		Cable marking:	6	1	7	8	9	10	shield

+V: Encoder power supply +V DC
0 V: Encoder power supply ground GND (0 V)
A, $\overline{A}$: Cosine signal
B, $\overline{B}$: Sine signal
⏚: Plug connector housing (shield)

1) The specified value is based on a diagnostic coverage of 99 %, that must be achieved with an encoder evaluation unit.
The encoder evaluation unit must meet at least the requirements for SIL3.
2) Short-circuit with 0 V or output, only one channel at a time, power supply correctly applied.

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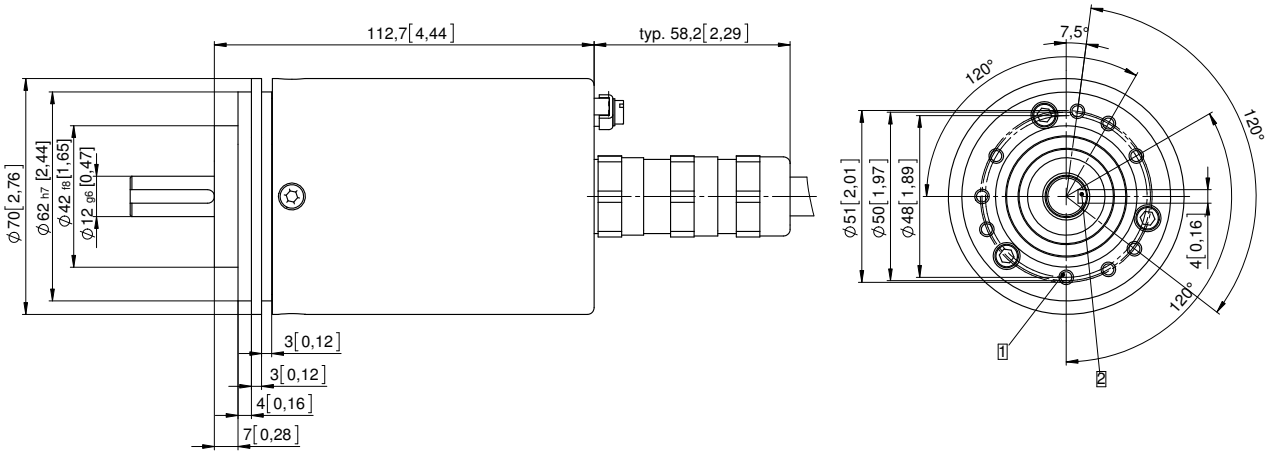
Standard
ATEX/IECEx – zone 1/21, SIL3/PLe, optical | **Sendix SIL 7014FS3 (shaft)** | **SinCos**

Dimensions

Dimensions in mm [inch]

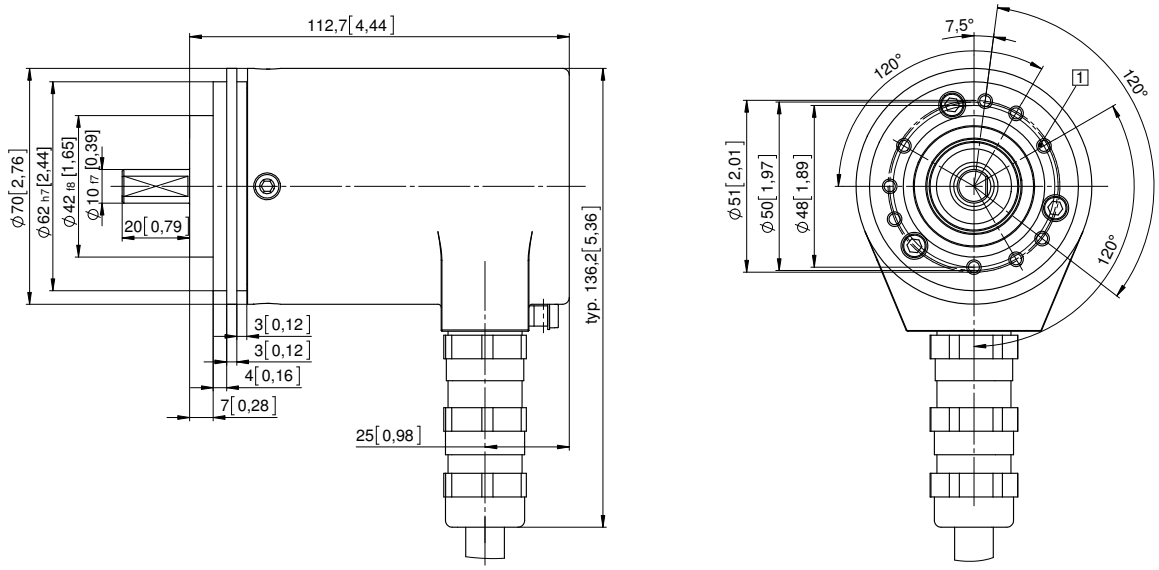
Clamping / synchronous flange, ø 70 [2.76]
Shaft type 1 with axial cable outlet

1 9 x M4, 10 [0.39] deep
2 Keyway for DIN 6885-A-4x4x25 key



Clamping / synchronous flange, ø 70 [2.76]
Shaft type 2 with radial cable outlet

1 9 x M4, 10 [0.39] deep



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Absolute encoders - singleturn

Series		Type	Interface	Page
Standard, optical	SIL2/PLd	Sendix SIL 5853FS2 / 5873FS2 (shaft / hollow shaft)	SSI / BiSS + SinCos	**74**
	SIL3/PLe	Sendix SIL 5853FS3 / 5873FS3 (shaft / hollow shaft)	SSI / BiSS + SinCos	**80**
	ATEX/IECEx – zone 1/21, SIL2/PLd	Sendix SIL 7053FS2 (shaft)	SSI / BiSS + SinCos	**86**
	ATEX/IECEx – zone 1/21, SIL3/PLe	Sendix SIL 7053FS3 (shaft)	SSI / BiSS + SinCos	**90**

Further absolute encoders you will find in our catalogue "Position and Motion Sensors" or under:
www.kuebler.com/absolute

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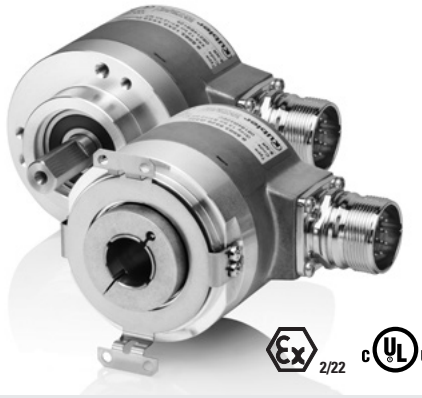
Standard
SIL2/PLd, optical

Sendix SIL 5853FS2 / 5873FS2 (shaft / hollow shaft)

SSI / BiSS + SinCos



The absolute singleturn encoders 5853FS2 and 5873FS2 of the Sendix SIL family are suited for use in safety-related applications up to SIL2 according to EN 61800-5-2 or PLd to EN ISO 13849-1.

The extra strong Safety-Lock™ design interlocked bearings, the high integration density of the components based on OptoASIC technology and the rugged die-cast housing make these devices ideal also for demanding applications outdoors up to IP65.

Safety-Lock™ | High rotational speed | Temperature range | High protection level | High shaft load capacity | Shock / vibration resistant | Magnetic field proof | Reverse polarity protection | SinCos | Optical sensor

Functional Safety

- Encoder with individual certificate from IFA / TÜV.
- Suitable for applications up to SIL2 acc. to EN 61800-5-2.
- Suitable for applications up to PLd acc. to EN ISO 13849-1.
- SSI or BiSS interface with incremental SinCos tracks with 2048 ppr.
- Certified mechanical mounting + electronic.

Flexible

- Shaft and hollow shaft versions.
- Cable and connector variants.
- Various mounting options available.

Order code Shaft version

8.5853FS2	.	1	X	X	X	.	X	X	2	X
Type		a	b	c	d		e	f	g	h

If for each parameter of an encoder the **underlined preferred option** is selected, then the delivery time will be 10 working days for a maximum of 10 pieces. Qts. up to 50 pcs. of these types generally have a delivery time of 15 working days.

10 by 10

a *Flange*
1 = clamping flange, IP65, ø 58 mm [2.28"]

b *Shaft (ø x L)*
2 = 10 x 20 mm [0.39 x 0.79"], with flat
A = 10 x 20 mm [0.39 x 0.79"], with feather key

c *Interface / power supply*
3 = SSI, BiSS + 2048 ppr. SinCos / 5 V DC
4 = SSI, BiSS + 2048 ppr. SinCos / 10 ... 30 V DC

d *Type of connection*
1 = axial cable, 1 m [3.28'] PVC
A = axial cable, special length PVC *)
2 = radial cable, 1 m [3.28'] PVC
B = radial cable, special length PVC *)
3 = axial M23 connector, 12-pin
4 = radial M23 connector, 12-pin

*) Available special lengths (connection types A, B):
2, 3, 5, 8, 10, 15 m [5.56, 9.84, 16.40, 26.25, 32.80, 49.21']
order code expansion .XXXX = length in dm
ex.: 8.5853FS2.124A.G322.0030 (for cable length 3 m)

e *Code*
B = SSI, binary
C = BiSS, binary
G = SSI, gray

f *Resolution* [1)]
A = 10 bit
1 = 11 bit
2 = 12 bit
3 = 13 bit
4 = 14 bit
7 = 17 bit

g *Input / output* [1)]
2 = SET, DIR input

h *Options (service)*
1 = no option
2 = status LED
3 = SET button and status LED

Optional on request
- Ex 2/22
- other resolutions

1) Resolution, preset value and count direction are factory-programmable.

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Absolute encoders - singleturn

Standard
SIL2/PLd, optical

Sendix SIL 5853FS2 / 5873FS2 (shaft / hollow shaft)

SSI / BiSS + SinCos

Order code Hollow shaft

8.5873FS2	.	X	X	X	X	.	X	X	2	X
Type		a	b	c	d		e	f	g	h

If for each parameter of an encoder the **underlined preferred option** is selected, then the delivery time will be 10 working days for a maximum of 10 pieces. Qts. up to 50 pcs. of these types generally have a delivery time of 15 working days.

10 by 10

a *Flange*
9 = with torque stop, flexible, IP65
A = with torque stop set, rigid, IP65
B = with stator coupling, IP65, ø 63 mm [2.48"]

b *Hollow shaft*
3 = ø 10 mm [0.39"]
4 = ø 12 mm [0.47"]
5 = ø 14 mm [0.55"]
K = ø 10 mm [0.39"], tapered shaft

c *Interface / power supply*
3 = SSI, BiSS + 2048 ppr. SinCos / 5 V DC
4 = SSI, BiSS + 2048 ppr. SinCos / 10 ... 30 V DC

d *Type of connection*
2 = radial cable, 1 m [3.28'] PVC
B = radial cable, special length PVC *)
E = tangential cable, 1 m [3.28'] PVC
F = tangential cable, special length PVC *)
4 = radial M23 connector, 12 pin

*) Available special lengths (connection types B, F): 2, 3, 5, 8, 10, 15 m [5.56, 9.84, 16.40, 26.25, 32.80, 49.21'] order code expansion .XXXX = length in dm ex.: 8.5873FS2.B44B.G322.0030 (for cable length 3 m)

e *Code*
B = SSI, binary
C = BiSS, binary
G = SSI, gray

f *Resolution* [1)]
A = 10 bit
1 = 11 bit
2 = 12 bit
3 = 13 bit
4 = 14 bit
7 = 17 bit

g *Input / output* [1)]
2 = SET, DIR input

h *Options (service)*
1 = no option
2 = status LED
3 = SET button and status LED

Optional on request
- Ex 2/22 (not for type of connection E, F)
- other resolutions

Accessories

		Order no.
EMC shield terminal	for top-hat rail mounting	**8.0000.4G06.0000**
Screw retention	Loctite 243, 5 ml	**8.0000.4G05.0000**
Bellows coupling, safety-oriented	You will find an overview of our couplings for Sendix SIL shaft encoders in the accessories section or under www.kuebler.com/accessories.	
Safety modules Safety-M compact / modular	You will find an overview of our systems and components for Functional Safety and the corresponding software in the safety technology section or under www.kuebler.com/safety.	
LED SSI display 570 / 575	Electronic position display up to 32 bit. You will find an overview in the accessories section or under www.kuebler.com/position_display.	

Further accessories can be found in the accessories section or in the accessories area of our website at: www.kuebler.com/accessories.

Connection technology

		Order no.
Cordset, pre-assembled	M23 female connector with coupling nut – single-ended, 2 m [6.56'] PVC cable [2)]	**8.0000.6901.0002.0031**
	M23 female connector with coupling nut – male connector with external thread, 2 m [6.56'] PVC cable [2)]	**8.0000.6905.0002.0032**
Connector, self-assembly (straight)	M23 female connector with coupling nut	**8.0000.5012.0000**

Additional connectors can be found in the connection technology section or in the connection technology area of our website at: www.kuebler.com/connection_technology.

Technical data

Notes regarding "Functional Safety"

These encoders are suitable for use in safety-related systems up to SIL2 acc. to EN 61800-5-2 and PLd to EN ISO 13849-1 in conjunction with controllers or evaluation units, which possess the necessary functionality.

Additional functions can be found in the operating manual.

Safety characteristics

Classification	PLd / SIL2
System structure	2 channel (Cat. 3 / HFT = 1)
PFH_d value [3)]	2.16×10^{-8} h^{-1}
Mission time / Proof test interval	20 years
Relevant standards	EN ISO 13849-1:2008 EN ISO 13849-2:2013 EN 61800-5-2:2007

1) Resolution, preset value and count direction are factory-programmable.
2) Other lengths available.
3) The specified value is based on a diagnostic coverage of 90 %, that must be achieved with an encoder evaluation unit.
The encoder evaluation unit must meet at least the requirements for SIL2.

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Standard
SIL2/PLd, optical

Sendix SIL 5853FS2 / 5873FS2 (shaft / hollow shaft)

SSI / BiSS + SinCos

Mechanical characteristics

Maximum speed shaft version		
	up to 70°C [158°F]	12000 min^{-1}, 10000 min^{-1} (continuous)
	up to T_{max}	8000 min^{-1}, 5000 min^{-1} (continuous)
Maximum speed hollow shaft version		
	up to 70°C [158°F]	9000 min^{-1}, 6000 min^{-1} (continuous)
	up to T_{max}	6000 min^{-1}, 3000 min^{-1} (continuous)
Starting torque - at 20°C [68°F]		
	shaft version	< 0.01 Nm
	hollow shaft version	< 0.03 Nm
Mass moment of inertia		
	shaft version	4.0 x 10^{-6} kgm^2
	hollow shaft version	7.0 x 10^{-6} kgm^2
Insertion depth for shaft		
	hollow shaft version	min. 34 mm [1.34"]
Load capacity of shaft	radial	80 N
	axial	40 N
Weight		approx. 0.45 kg [15.87 oz]
Protection acc. to EN 60529		IP65
Working temperature range		-40°C ... +90°C [-40°F ... +194°F] 1)
Material	shaft / hollow shaft	stainless steel
	flange	aluminium
	housing	zinc die-cast
	cable	PVC
Shock resistance acc. to EN 60068-2-27		500 m/s^2, 11 ms
Vibration resistance acc. to EN 60068-2-6		200 m/s^2, 10 ... 150 Hz

Electrical characteristics

Power supply		5 V DC (±5 %) or 10 ... 30 V DC
Current consumption (no load)	5 V DC	max. 70 mA
	10 ... 30 V DC	max. 45 mA
Reverse polarity protection of the power supply		yes
Short circuit proof outputs		yes 2)
UL approval		file 224618
CE compliant acc. to		
	(up to April 19, 2016)	EMC guideline 2004/108/EC Machinery directive 2006/42/EC RoHS guideline 2011/65/EU
	(as from April 20, 2016)	EMC guideline 2014/30/EU Machinery directive 2006/42/EC RoHS guideline 2011/65/EU

EMC

Relevant standards	EN 55011 class B :2009 / A1:2010 EN 61000-6-3:2007 / A1:2011 EN 61000-6-2:2005

Power-ON

After Power-ON the encoder requires a time of approx. 150 ms before valid data can be read. Avoid encoder hot-plugging.

LED

The optional LED (red) serves to display various alarm or error messages.
In normal operation the LED is OFF.

If the LED is ON (status output LOW) this indicates:
- sensor error, singleturn or multiturn (soiling, glass breakage etc.)
- LED error, failure or ageing
- Over- or under-temperature

In the SSI mode, the fault indication can only be reset by switching off the power supply to the device.

SSI interface

Output driver		RS485 transceiver type
Permissible load / channel		max. +/- 20 mA
Signal level	HIGH	typ. 3.8 V
	LOW at I_{Load} = 20 mA	typ. 1.3 V
Resolution		10 ... 14 bit and 17 bit
Code		binary or gray
SSI clock rate		50 kHz ... 2 MHz
Monoflop time		≤ 15 µs

Note: If the clock starts cycling within the monoflop time, a second data transfer starts with the same data. If the clock starts cycling after the monoflop time, the data transfer starts with the new values. The update rate is dependent on the clock speed, data length and monoflop-time.

Data refresh rate	resolution ≤ 14 bit	≤ 1 µs
	resolution ≥ 15 bit	4 µs

BiSS interface

Resolution	10 ... 14 bit and 17 bit
Code	binary
Clock rate	up to 10 MHz
Max. update rate	< 10 µs, depends on the clock rate and the data length
Data refresh rate	≤ 1 µs

Note:
- bidirectional, factory programmable parameters are: resolution, code, direction, alarms and warnings
- CRC data verification

SinCos interface

Max. frequency -3dB	400 kHz
Signal level	1 Vpp (±10 %)
Short circuit proof	yes 2)
Pulse rate	2048 ppr

SET input or SET button

Input		active HIGH
Input type		comparator
Signal level	HIGH	min: 60 % of +V, max: +V
	LOW	max: 25 % of +V (power supply)
Input current		< 0.5 mA
Min. pulse duration (SET)		10 ms
Timeout after SET signal		14 ms
Reaction time (DIR input)		1 ms

The encoder can be set to zero at any position by means of a HIGH signal on the SET input or by pressing the optional SET button (with a pencil, ball-point pen or similar). Other preset values can be factory-programmed.
The SET input has a signal delay time of approx. 1 ms. Once the SET function has been triggered, the encoder requires an internal processing time of approx. 15 ms before the new position data can be read. During this time the LED is ON.

DIR input

A HIGH signal switches the direction of rotation from the default CW to CCW. This function can also be factory-programmed to be inverted. If DIR is changed when the device is already switched on, then this will be interpreted as an error. The LED will come ON and the status output will switch to LOW.

1) Cable version: -30°C ... +90°C [-22°F ... +194°F].
2) Short circuit to 0 V or to output, one channel at a time, power supply correctly applied.

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Standard
SIL2/PLd, optical

Sendix SIL 5853FS2 / 5873FS2 (shaft / hollow shaft)

SSI / BiSS + SinCos

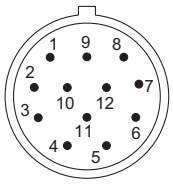
Terminal assignment

Interface	Type of connection	Cable (isolate unused wires individually before initial start-up)													
3, 4	1, 2, A, B, E, F	Signal:	0 V	+V	C+	C-	D+	D-	SET	DIR	A	$\overline{A}$	B	$\overline{B}$	⏚
		Cable colour:	WH	BN	GN	YE	GY	PK	BU	RD	BK	VT	GY-PK	RD-BU	shield

Interface	Type of connection	M23 connector, 12-pin													
3, 4	3, 4	Signal:	0 V	+V	C+	C-	D+	D-	SET	DIR	A	$\overline{A}$	B	$\overline{B}$	⏚
		Pin:	1	2	3	4	5	6	7	8	9	10	11	12	PH

+V: Encoder power supply +V DC
0 V: Encoder power supply ground GND (0 V)
C+, C-: Clock signal
D+, D-: Data signal
SET: Set input. The current position becomes defined as position zero.
DIR: Direction input: If this input is active, output values are counted backwards (decrease) when the shaft is turning clockwise.
A, $\overline{A}$: Cosine signal
B, $\overline{B}$: Sine signal
PH ⏚: Plug connector housing (shield)

Top view of mating side, male contact base



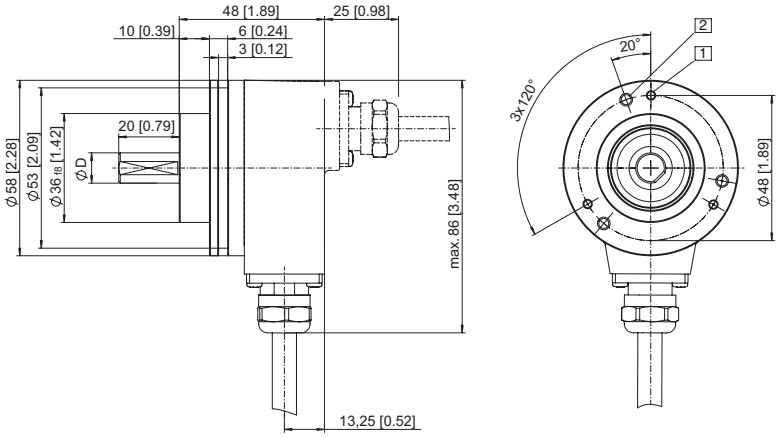
M23 connector, 12-pin

Dimensions shaft version

Dimensions in mm [inch]

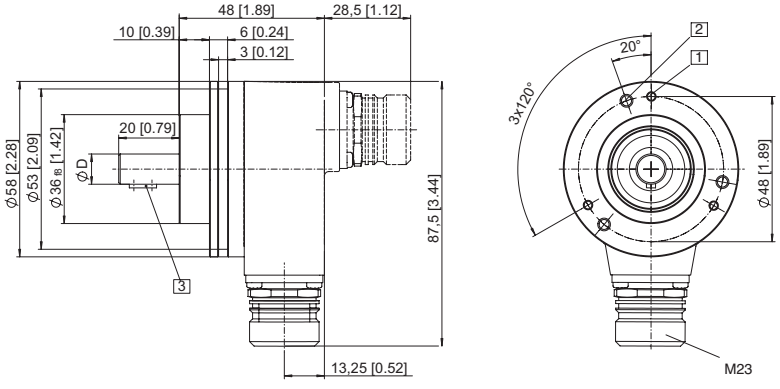
Clamping flange, ø 58 [2.28]
Flange type 1 with shaft type 2
(drawing with cable)

1 3 x M3, 6 [0.24] deep
2 3 x M4, 8 [0.32] deep
D = 10 f7 [0.39]



Clamping flange, ø 58 [2.28]
Flange type 1 with shaft type A
(drawing with M23 connector)

1 3 x M3, 6 [0.24] deep
2 3 x M4, 8 [0.32] deep
3 Feather key DIN 6885 - A - 3x3x6
D = 10 f7 [0.39]



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Standard
SIL2/PLd, optical | **Sendix SIL 5853FS2 / 5873FS2 (shaft / hollow shaft)** | **SSI / BiSS + SinCos**

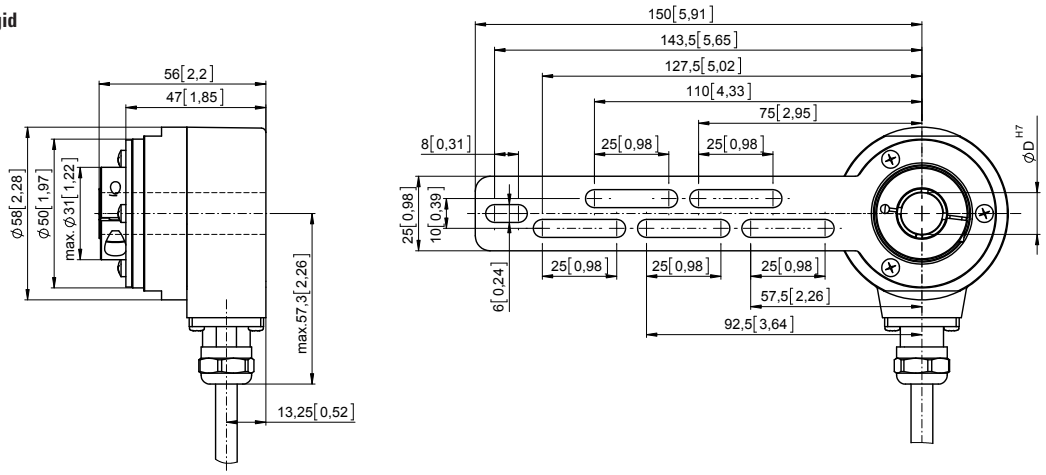
Dimensions hollow shaft version

Dimensions in mm [inch]

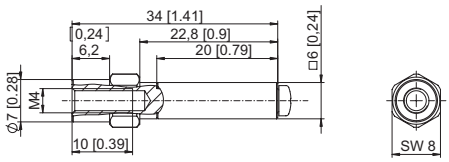
Flange with torque stop set, rigid
Flange type A
Through hollow shaft
(drawing with cable)

1 SW 3, recommended torque for the clamping ring 2.5 Nm

D = ø 10 H7 [0.39]
ø 12 H7 [0.47]
ø 14 H7 [0.55]



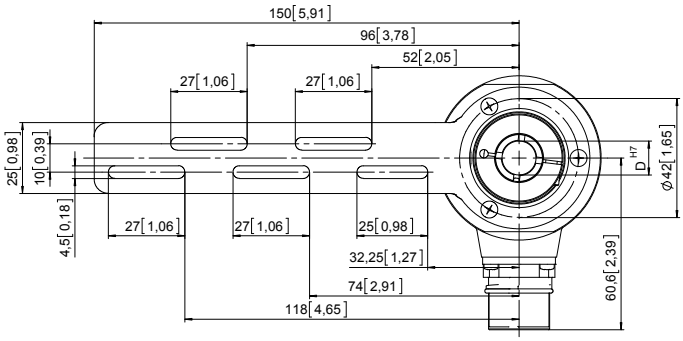
Torque pin with rectangular sleeve with M4 thread

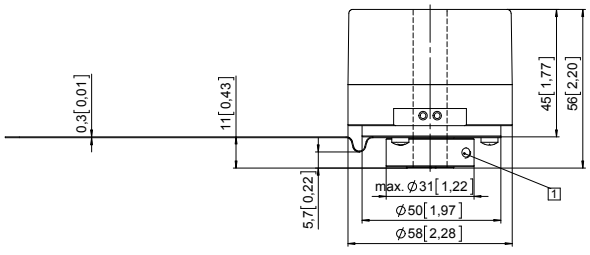


Flange with torque stop, flexible
Flange type 9
Through hollow shaft
(drawing with M23 connector)

1 Recommended torque for the clamping ring 2.5 Nm

D = ø 10 H7 [0.39]
ø 12 H7 [0.47]
ø 14 H7 [0.55]





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Standard
SIL2/PLd, optical

Sendix SIL 5853FS2 / 5873FS2 (shaft / hollow shaft)

SSI / BiSS + SinCos

Dimensions hollow shaft version

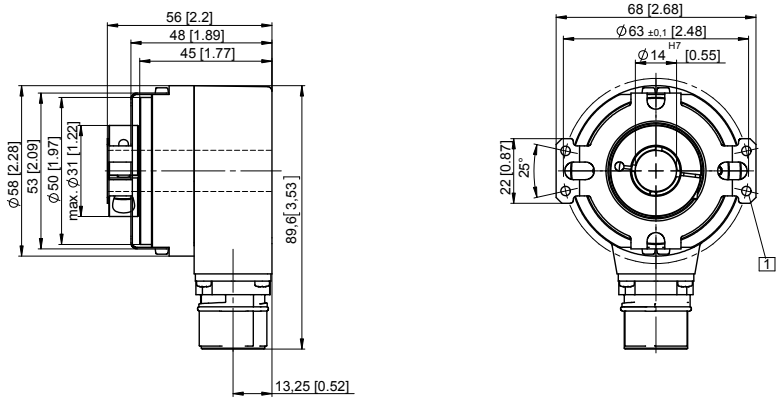
Dimensions in mm [inch]

Flange with stator coupling, ø 63 [2.48]
Flange type B
Through hollow shaft
(drawing with M23 connector)

1 SW 3, recommended torque for the clamping ring 2.5 Nm

2 For (4x) M3 screw

D = ø 10 H7 [0.39]
ø 12 H7 [0.47]
ø 14 H7 [0.55]



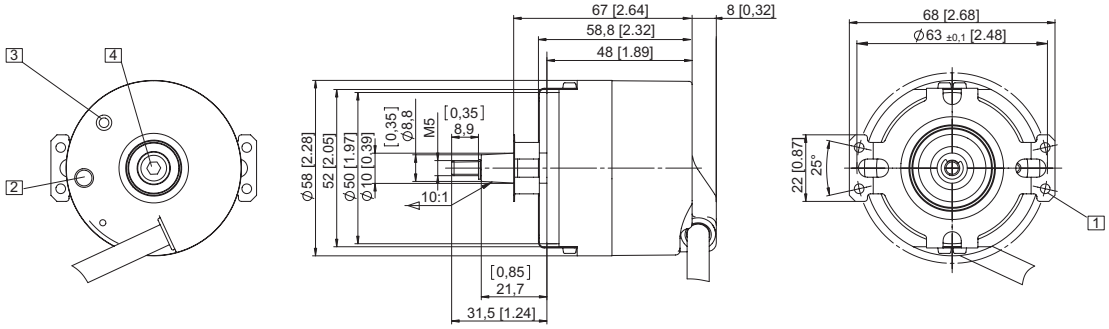
Flange with stator coupling, ø 63 [2.48]
Flange type B
Tapered shaft
(drawing with tangential cable outlet)

1 For (4x) M3 screw

2 Status LED

3 SET button

4 SW 4



Standard
SIL3/PLe, optical

Sendix SIL 5853FS3 / 5873FS3 (shaft / hollow shaft)

SSI / BiSS + SinCos

The absolute singleturn encoders 5853FS3 and 5873FS3 of the Sendix SIL family are suited for use in safety-related applications up to SIL3 according to EN 61800-5-2 or PLe to EN ISO 13849-1.

The extra strong Safety-Lock™ Design interlocked bearings, the high integration density of the components based on OptoASIC technology and the rugged die-cast housing make these devices ideal also for demanding applications outdoors up to IP65.

Safety-Lock™ | High rotational speed | Temperature range | High protection level | High shaft load capacity | Shock / vibration resistant | Magnetic field proof | Reverse polarity protection | SinCos | Optical sensor

Functional Safety

- Encoder with individual certificate from IFA / TÜV.
- Suitable for applications up to SIL3 acc. to EN 61800-5-2.
- Suitable for applications up to PLe acc. to EN ISO 13849-1.
- SSI or BiSS interface with incremental SinCos tracks with 2048 ppr.
- Certified mechanical mounting + electronic.

Flexible

- Shaft and hollow shaft versions.
- Cable and connector variants.
- Various mounting options available.

Order code Shaft version

8.5853FS3	.	1	X	X	X	.	X	X	2	X
Type		a	b	c	d		e	f	g	h

If for each parameter of an encoder the **underlined preferred option** is selected, then the delivery time will be 10 working days for a maximum of 10 pieces. Qts. up to 50 pcs. of these types generally have a delivery time of 15 working days.

10 by 10

a *Flange*
1 = clamping flange, IP65, ø 58 mm [2.28"]

b *Shaft (ø x L)*
2 = 10 x 20 mm [0.39 x 0.79"], with flat
A = 10 x 20 mm [0.39 x 0.79"], with feather key

c *Interface / power supply*
3 = SSI, BiSS + 2048 ppr. SinCos / 5 V DC
4 = SSI, BiSS + 2048 ppr. SinCos / 10 ... 30 V DC

d *Type of connection*
1 = axial cable, 1 m [3.28'] PVC
A = axial cable, special length PVC *)
2 = radial cable, 1 m [3.28'] PVC
B = radial cable, special length PVC *)
3 = axial M23 connector, 12-pin
4 = radial M23 connector, 12-pin
*) Available special lengths (connection types A, B): 2, 3, 5, 8, 10, 15 m [5.56, 9.84, 16.40, 26.25, 32.80, 49.21'] order code expansion .XXXX = length in dm ex.: 8.5853FS3.124A.G322.0030 (for cable length 3 m)

e *Code*
B = SSI, binary
C = BiSS, binary
G = SSI, gray

f *Resolution* [1]
A = 10 bit
1 = 11 bit
2 = 12 bit
3 = 13 bit
4 = 14 bit
7 = 17 bit

g *Input / output* [1]
2 = SET, DIR input

h *Options (service)*
1 = no option
2 = status LED
3 = SET button and status LED

Optional on request
- Ex 2/22
- other resolutions

1) Resolution, preset value and count direction are factory-programmable.

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Absolute encoders - singleturn

Standard
SIL3/PLe, optical

Sendix SIL 5853FS3 / 5873FS3 (shaft / hollow shaft)

SSI / BiSS + SinCos

Order code Hollow shaft

8.5873FS3	.	X	X	X	X	.	X	X	2	X
Type		a	b	c	d		e	f	g	h

If for each parameter of an encoder the **underlined preferred option** is selected, then the delivery time will be 10 working days for a maximum of 10 pieces. Qts. up to 50 pcs. of these types generally have a delivery time of 15 working days.

10 by 10

a *Flange*
9 = with torque stop, flexible, IP65
A = with torque stop set, rigid, IP65
B = with stator coupling, IP65, ø 63 mm [2.48"]

b *Hollow shaft*
3 = ø 10 mm [0.39"]
4 = ø 12 mm [0.47"]
5 = ø 14 mm [0.55"]
K = ø 10 mm [0.39"], tapered shaft

c *Interface / power supply*
3 = SSI, BiSS + 2048 ppr. SinCos / 5 V DC
4 = SSI, BiSS + 2048 ppr. SinCos / 10 ... 30 V DC

d *Type of connection*
2 = radial cable, 1 m [3.28'] PVC
B = radial cable, special length PVC *)
E = tangential cable, 1 m [3.28'] PVC
F = tangential cable, special length PVC *)
4 = radial M23 connector, 12 pin

*) Available special lengths (connection types B, F):
2, 3, 5, 8, 10, 15 m [5.56, 9.84, 16.40, 26.25, 32.80, 49.21']
order code expansion .XXXX = length in dm
ex.: 8.5873FS3.B44B.G322.0030 (for cable length 3 m)

e *Code*
B = SSI, binary
C = BiSS, binary
G = SSI, gray

f *Resolution* [1)]
A = 10 bit
1 = 11 bit
2 = 12 bit
3 = 13 bit
4 = 14 bit
7 = 17 bit

g *Input / output* [1)]
2 = SET, DIR input

h *Options (service)*
1 = no option
2 = status LED
3 = SET button and status LED

Optional on request
- Ex 2/22 (not for type of connection E, F)
- other resolutions

Accessories

		Order no.
EMC shield terminal	for top-hat rail mounting	**8.0000.4G06.0000**
Screw retention	Loctite 243, 5 ml	**8.0000.4G05.0000**
Bellows coupling, safety-oriented	You will find an overview of our couplings for Sendix SIL shaft encoders in the accessories section or under www.kuebler.com/accessories.	
Safety modules Safety-M compact / modular	You will find an overview of our systems and components for Functional Safety and the corresponding software in the safety technology section or under www.kuebler.com/safety.	
LED SSI display 570 / 575	Electronic position display up to 32 bit. You will find an overview in the accessories section or under www.kuebler.com/position_display.	

Further accessories can be found in the accessories section or in the accessories area of our website at: www.kuebler.com/accessories.

Connection technology

		Order no.
Cordset, pre-assembled	M23 female connector with coupling nut – single-ended, 2 m [6.56'] PVC cable [2)]	**8.0000.6901.0002.0031**
	M23 female connector with coupling nut – male connector with external thread, 2 m [6.56'] PVC cable [2)]	**8.0000.6905.0002.0032**
Connector, self-assembly (straight)	M23 female connector with coupling nut	**8.0000.5012.0000**

Additional connectors can be found in the connection technology section or in the connection technology area of our website at: www.kuebler.com/connection_technology.

Technical data

Notes regarding "Functional Safety"

These encoders are suitable for use in safety-related systems up to SIL3 acc. to EN 61800-5-2 and PLe to EN ISO 13849-1 in conjunction with controllers or evaluation units, which possess the necessary functionality.

Additional functions can be found in the operating manual.

Safety characteristics

Classification	PLe / SIL3
System structure	2 channel (Cat. 4 / HFT = 1)
PFH_d value [3)]	1.09×10^{-8} h^{-1}
Mission time / Proof test interval	20 years
Relevant standards	EN ISO 13849-1:2008 EN ISO 13849-2:2013 EN 61800-5-2:2007

1) Resolution, preset value and count direction are factory-programmable.
2) Other lengths available.
3) The specified value is based on a diagnostic coverage of 99 %, that must be achieved with an encoder evaluation unit.
The encoder evaluation unit must meet at least the requirements for SIL3.

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Standard
SIL3/PLe, optical

Sendix SIL 5853FS3 / 5873FS3 (shaft / hollow shaft)

SSI / BiSS + SinCos

Mechanical characteristics

Maximum speed shaft version		
	up to 70°C [158°F]	12000 min^{-1}, 10000 min^{-1} (continuous)
	up to T_{max}	8000 min^{-1}, 5000 min^{-1} (continuous)
Maximum speed hollow shaft version		
	up to 70°C [158°F]	9000 min^{-1}, 6000 min^{-1} (continuous)
	up to T_{max}	6000 min^{-1}, 3000 min^{-1} (continuous)
Starting torque - at 20°C [68°F]		
	shaft version	< 0.01 Nm
	hollow shaft version	< 0.03 Nm
Mass moment of inertia		
	shaft version	4.0 x 10^{-6} kgm^2
	hollow shaft version	7.0 x 10^{-6} kgm^2
Insertion depth for shaft		
	hollow shaft version	min. 34 mm [1.34"]
Load capacity of shaft	radial	80 N
	axial	40 N
Weight		approx. 0.45 kg [15.87 oz]
Protection acc. to EN 60529		IP65
Working temperature range		-40°C ... +90°C [-40°F ... +194°F] 1)
Material	shaft / hollow shaft	stainless steel
	flange	aluminium
	housing	zinc die-cast
	cable	PVC
Shock resistance acc. to EN 60068-2-27		500 m/s^2, 11 ms
Vibration resistance acc. to EN 60068-2-6		200 m/s^2, 10 ... 150 Hz

Electrical characteristics

Power supply		5 V DC (±5 %) or 10 ... 30 V DC
Current consumption (no load)	5 V DC	max. 70 mA
	10 ... 30 V DC	max. 45 mA
Reverse polarity protection of the power supply		yes
Short circuit proof outputs		yes 2)
UL approval		file 224618
CE compliant acc. to		
	(up to April 19, 2016)	EMC guideline 2004/108/EC Machinery directive 2006/42/EC RoHS guideline 2011/65/EU
	(as from April 20, 2016)	EMC guideline 2014/30/EU Machinery directive 2006/42/EC RoHS guideline 2011/65/EU

EMC

Relevant standards	EN 55011 class B :2009 / A1:2010 EN 61000-6-3:2007 / A1:2011 EN 61000-6-2:2005

Power-ON

After Power-ON the encoder requires a time of approx. 150 ms before valid data can be read. Avoid encoder hot-plugging.

LED

The optional LED (red) serves to display various alarm or error messages.
In normal operation the LED is OFF.

If the LED is ON (status output LOW) this indicates:
- sensor error, singleturn or multiturn (soiling, glass breakage etc.)
- LED error, failure or ageing
- Over- or under-temperature

In the SSI mode, the fault indication can only be reset by switching off the power supply to the device.

SSI interface

Output driver		RS485 transceiver type
Permissible load / channel		max. +/- 20 mA
Signal level	HIGH	typ. 3.8 V
	LOW at I_{Load} = 20 mA	typ. 1.3 V
Resolution		10 ... 14 bit and 17 bit
Code		binary or gray
SSI clock rate		50 kHz ... 2 MHz
Monoflop time		≤ 15 µs

Note: If the clock starts cycling within the monoflop time, a second data transfer starts with the same data. If the clock starts cycling after the monoflop time, the data transfer starts with the new values. The update rate is dependent on the clock speed, data length and monoflop-time.

Data refresh rate	resolution ≤ 14 bit	≤ 1 µs
	resolution ≥ 15 bit	4 µs

BiSS interface

Resolution	10 ... 14 bit and 17 bit
Code	binary
Clock rate	up to 10 MHz
Max. update rate	< 10 µs, depends on the clock rate and the data length
Data refresh rate	≤ 1 µs

Note:
- bidirectional, factory programmable parameters are: resolution, code, direction, alarms and warnings
- CRC data verification

SinCos interface

Max. frequency -3dB	400 kHz
Signal level	1 Vpp (±10 %)
Short circuit proof	yes 2)
Pulse rate	2048 ppr

SET input or SET button

Input		active HIGH
Input type		comparator
Signal level	HIGH	min: 60 % of +V, max: +V
	LOW	max: 25 % of +V (power supply)
Input current		< 0.5 mA
Min. pulse duration (SET)		10 ms
Timeout after SET signal		14 ms
Reaction time (DIR input)		1 ms

The encoder can be set to zero at any position by means of a HIGH signal on the SET input or by pressing the optional SET button (with a pencil, ball-point pen or similar). Other preset values can be factory-programmed.
The SET input has a signal delay time of approx. 1 ms. Once the SET function has been triggered, the encoder requires an internal processing time of approx. 15 ms before the new position data can be read. During this time the LED is ON.

DIR input

A HIGH signal switches the direction of rotation from the default CW to CCW. This function can also be factory-programmed to be inverted. If DIR is changed when the device is already switched on, then this will be interpreted as an error. The LED will come ON and the status output will switch to LOW.

1) Cable version: -30°C ... +90°C [-22°F ... +194°F].
2) Short circuit to 0 V or to output, one channel at a time, power supply correctly applied.

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Standard
SIL3/PLe, optical

Sendix SIL 5853FS3 / 5873FS3 (shaft / hollow shaft)

SSI / BiSS + SinCos

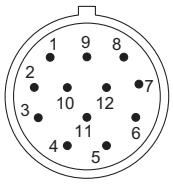
Terminal assignment

Interface	Type of connection	Cable (isolate unused wires individually before initial start-up)													
3, 4	1, 2, A, B, E, F	Signal:	0 V	+V	C+	C-	D+	D-	SET	DIR	A	$\overline{A}$	B	$\overline{B}$	⏚
		Cable colour:	WH	BN	GN	YE	GY	PK	BU	RD	BK	VT	GY-PK	RD-BU	shield

Interface	Type of connection	M23 connector, 12-pin													
3, 4	3, 4	Signal:	0 V	+V	C+	C-	D+	D-	SET	DIR	A	$\overline{A}$	B	$\overline{B}$	⏚
		Pin:	1	2	3	4	5	6	7	8	9	10	11	12	PH

+V: Encoder power supply +V DC
0 V: Encoder power supply ground GND (0 V)
C+, C-: Clock signal
D+, D-: Data signal
SET: Set input. The current position becomes defined as position zero.
DIR: Direction input: If this input is active, output values are counted backwards (decrease) when the shaft is turning clockwise.
A, $\overline{A}$: Cosine signal
B, $\overline{B}$: Sine signal
PH ⏚: Plug connector housing (shield)

Top view of mating side, male contact base



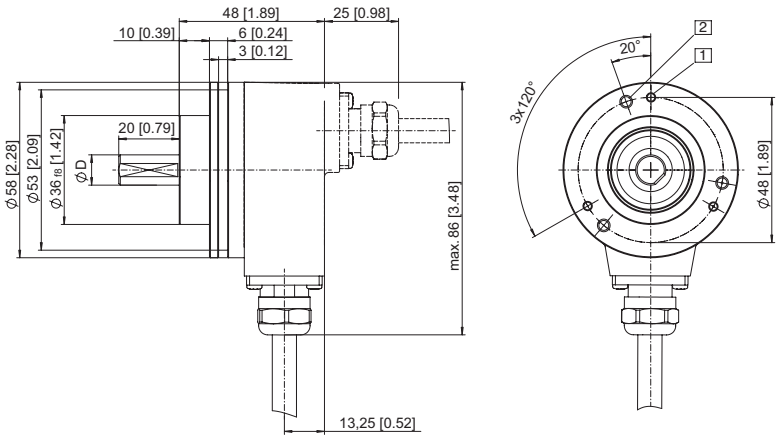
M23 connector, 12-pin

Dimensions shaft version

Dimensions in mm [inch]

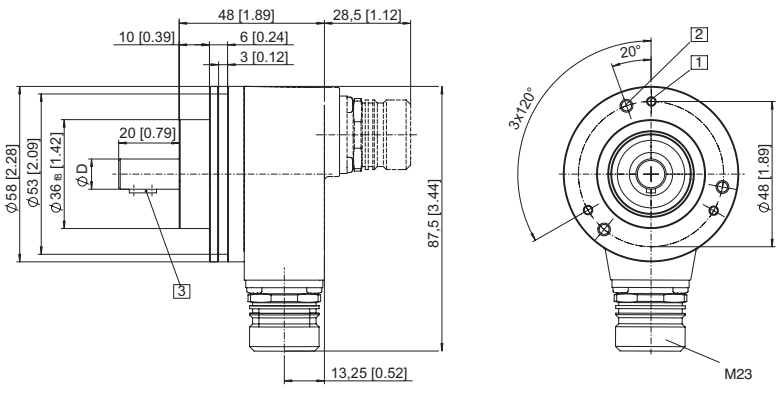
Clamping flange, ø 58 [2.28]
Flange type 1 with shaft type 2
(drawing with cable)

1 3 x M3, 6 [0.24] deep
2 3 x M4, 8 [0.32] deep
D = 10 f7 [0.39]



Clamping flange, ø 58 [2.28]
Flange type 1 with shaft type A
(drawing with M23 connector)

1 3 x M3, 6 [0.24] deep
2 3 x M4, 8 [0.32] deep
3 Feather key DIN 6885 - A - 3x3x6
D = 10 f7 [0.39]



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Standard
SIL3/PLe, optical

Sendix SIL 5853FS3 / 5873FS3 (shaft / hollow shaft)

SSI / BiSS + SinCos

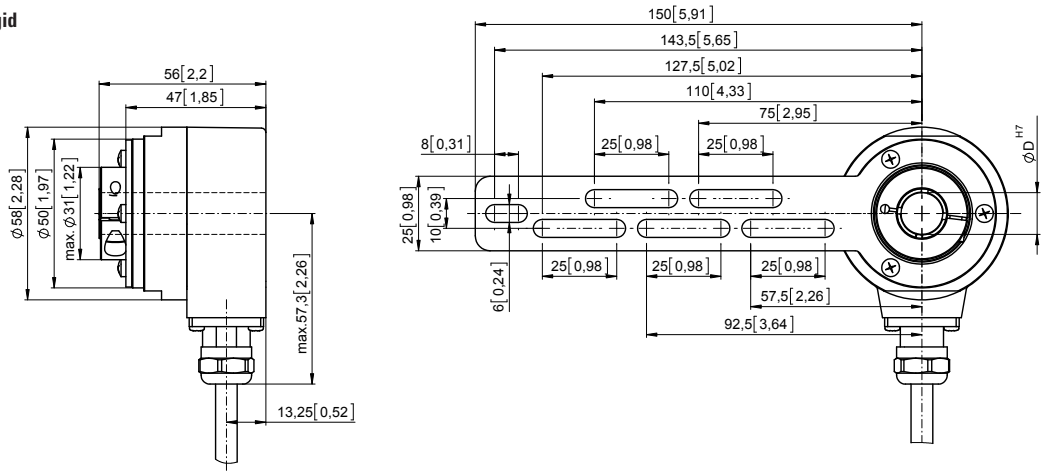
Dimensions hollow shaft version

Dimensions in mm [inch]

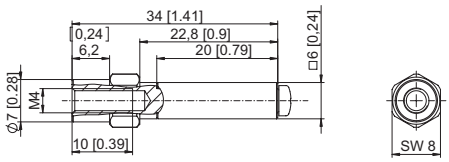
Flange with torque stop set, rigid
Flange type A
Through hollow shaft
(drawing with cable)

1 SW 3, recommended torque for the clamping ring 2.5 Nm

D = ø 10 H7 [0.39]
ø 12 H7 [0.47]
ø 14 H7 [0.55]



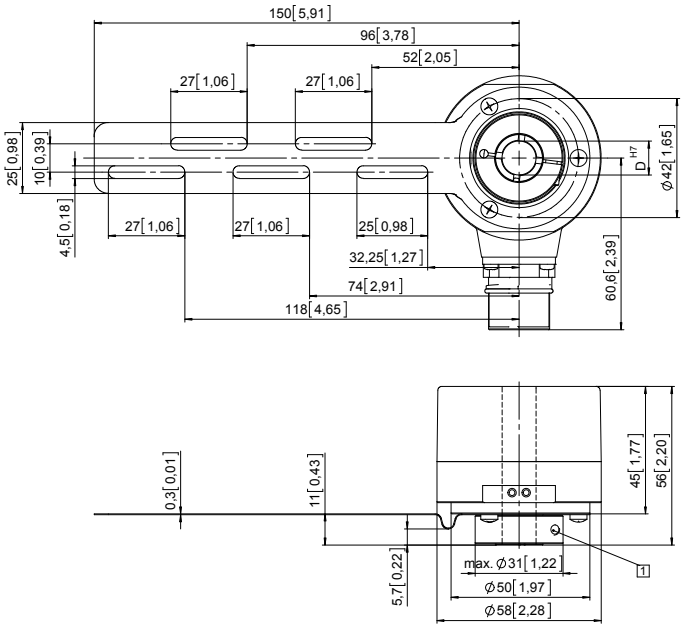
Torque pin with rectangular sleeve with M4 thread



Flange with torque stop, flexible
Flange type 9
Through hollow shaft
(drawing with M23 connector)

1 Recommended torque for the clamping ring 2.5 Nm

D = ø 10 H7 [0.39]
ø 12 H7 [0.47]
ø 14 H7 [0.55]



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Standard
SIL3/PLe, optical

Sendix SIL 5853FS3 / 5873FS3 (shaft / hollow shaft)

SSI / BiSS + SinCos

Dimensions hollow shaft version

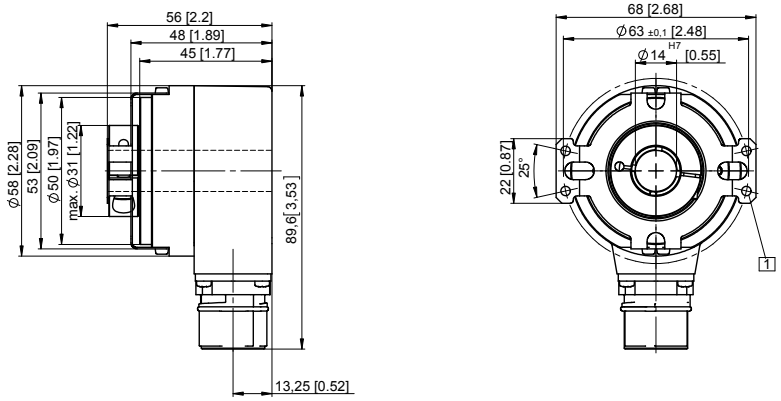
Dimensions in mm [inch]

Flange with stator coupling, ø 63 [2.48]
Flange type B
Through hollow shaft
(drawing with M23 connector)

1 SW 3, recommended torque for the clamping ring 2.5 Nm

2 For (4x) M3 screw

D = ø 10 H7 [0.39]
ø 12 H7 [0.47]
ø 14 H7 [0.55]



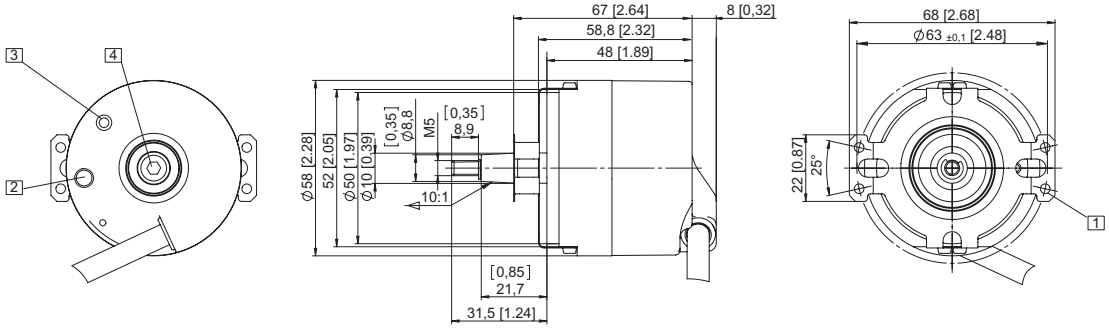
Flange with stator coupling, ø 63 [2.48]
Flange type B
Tapered shaft
(drawing with tangential cable outlet)

1 For (4x) M3 screw

2 Status LED

3 SET button

4 SW 4



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Standard
ATEX / IECEx – zone 1 / 21, SIL2/PLd, optical | **Sendix SIL 7053FS2 (shaft)** | **SSI / BiSS + SinCos**

Ex protection and Functional Safety in one device.

The absolute singleturn encoders 7053FS2 of the Sendix SIL family are suited for use in safety-related applications up to SIL2 acc. to EN 61800-5-2 or PLd to EN ISO 13849-1.

In addition, these devices ensure Ex protection in a compact 70 mm housing out of seawater durable aluminium.

Ex approval | Safety-Lock™ | High rotational speed | High protection level | High shaft load capacity | Shock / vibration resistant | Magnetic field proof | Short-circuit proof | Reverse polarity protection | Optical sensor | Seawater durable

Functional Safety

- Encoder with individual certificate from IFA / TÜV.
- Suitable for applications up to SIL2 acc. to EN 61800-5-2.
- Suitable for applications up to PLd acc. to EN ISO 13849-1.
- SSI or BiSS interface with incremental SinCos tracks with 2048 ppr.
- Certified mechanical mounting + electronic.

Explosion protection

- "Flameproof-enclosure" version.
- ATEX with EC type examination certificate.
- IECEx with certificate of conformity (CoC).

Order code Shaft version

8.7053FS2	.	1	X	4	X	.	X	X	2	1	.	XXXX
Type		a	b	c	d		e	f	g	h		i 1)

a *Flange*
1 = clamping / synchronous flange, IP67, ø 70 mm [2.76"]

b *Shaft (ø x L)*
2 = 10 x 20 mm [0.39 x 0.79"], with flat
1 = 12 x 25 mm [0.47 x 0.98"], with keyway for 4 x 4 mm [0.16 x 0.16"] key

c *Interface / power supply*
4 = SSI, BiSS + 2048 ppr. SinCos / 10 ... 30 V DC

d *Type of connection*
1 = axial cable, 2 m [6.56'] PUR
2 = radial cable, 2 m [6.56'] PUR
A = axial cable, length > 2 m [6.56']
B = radial cable, length > 2 m [6.56']
preferred length see **i**, e. g.: 0100 = 10 m [32.81']

e *Code*
B = SSI, binary
C = BiSS, binary
G = SSI, gray

f *Resolution* [2]
A = 10 bit
1 = 11 bit
2 = 12 bit
3 = 13 bit
4 = 14 bit
7 = 17 bit

g *Inputs / outputs* [2]
2 = SET input

h *Options*
1 = no option

i *Cable length in dm* [1]
0050 = 5 m [16.40']
0100 = 10 m [32.81']
0150 = 15 m [49.21']

Optional on request
- special cable length
- stainless steel version
- other resolutions

1) Not applicable with connection types 1 and 2.
2) Resolution, preset value and counting direction factory-programmable.

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Absolute encoders - singleturn

Standard ATEX / IECEx – zone 1 / 21, SIL2/PLd, optical	Sendix SIL 7053FS2 (shaft)	SSI / BiSS + SinCos

Accessories		Order no.
EMC shield terminal	for top-hat rail mounting	**8.0000.4G06.0000**
Screw retention	Loctite 243, 5 ml	**8.0000.4G05.0000**
Bellows coupling, safety-oriented	You will find an overview of our couplings for Sendix SIL shaft encoders in the accessories section or under www.kuebler.com/accessories.	
Safety modules Safety-M compact / modular	You will find an overview of our systems and components for Functional Safety and the corresponding software in the safety technology section or under www.kuebler.com/safety.	
LED SSI display 570 / 575	Electronic position display up to 32 bit. You will find an overview in the accessories section or under www.kuebler.com/position_display.	

Further accessories can be found in the accessories section or in the accessories area of our website at: www.kuebler.com/accessories.
Additional connectors can be found in the connection technology section or in the connection technology area of our website at: www.kuebler.com/connection_technology.

Technical data

Explosion protection ATEX

EC type-examination certificate	PTB09 ATEX 1106 X
Category (gas)	Ex II 2 G Ex d IIC T4 - T6 Gb
Category (dust)	Ex II 2D Ex tb IIIC T135°C - T85°C Db IP6x
Relevant standards	EN 60079-0:2009 EN 60079-1:2007 EN 60079-31:2009

Explosion protection IECEx

Certificate of conformity (CoC)	IECEx PTB 13.0026 X
Category (gas)	Ex d IIC T4 - T6 Gb
Category (dust)	Ex tb IIIC T135°C - T85°C Db IP6x
Relevant standards	IEC 60079-0:2007 IEC 60079-1:2007 IEC 60079-31:2008

Notes regarding "Functional Safety"

These encoders are suitable for use in safety-related systems up to SIL2 acc. to EN 61800-5-2 and PLd to EN ISO 13849-1 in conjunction with controllers or evaluation units, which possess the necessary functionality.
Additional functions can be found in the operating manual.

Safety characteristics

Classification	PLd / SIL2
System structure	2 channel (Cat. 3 / HFT = 1)
PFH_d value [1]	2.16×10^{-8} h^{-1}
Mission time / Proof test interval	20 years
Relevant standards	EN ISO 13849-1:2008 EN ISO 13849-2:2013 EN 61800-5-2:2007

Electrical characteristics

Power supply	10 ... 30 V DC
Current consumption (no load)	max. 45 mA
Reverse polarity protection for power supply	yes
Short circuit proof outputs	yes [2]
CE compliant acc. to (up to April 19, 2016)	EMC guideline 2004/108/EC ATEX guideline 94/9/EC Machinery directive 2006/42/EC RoHS guideline 2011/65/EU
(as from April 20, 2016)	EMC guideline 2014/30/EU ATEX guideline 2014/34/EU Machinery directive 2006/42/EC RoHS guideline 2011/65/EU

EMC

Relevant standards	EN 55011 class B :2009 / A1:2010 EN 61000-6-3:2007 / A1:2011 EN 61000-6-2:2005

Mechanical characteristics

Maximum speed		6000 min^{-1} (continuous)
Starting torque – at 20°C [68°F]		< 0.05 Nm
Mass moment of inertia		4.0×10^{-6} kgm^2
Load capacity of shaft	radial axial	80 N 40 N
Weight		approx. 1.3 kg [45.86 oz]
Protection acc. to EN 60529		IP67
Ambient temperature		-40°C ... +60°C [-40 ... +140°F] Please note the specifications for temperature class in EC type-examination certificate!
Material	shaft flange / housing cable	stainless steel seawater durable Al, type AlSiMgMn (EN AW-6082) PUR
Shock resistance acc. to. EN 60068-2-27		500 m/s^2, 11 ms
Vibration resistance acc. to EN 60068-2-6		200 m/s^2, 10 ... 150 Hz

1) The specified value is based on a diagnostic coverage of 90 %, that must be achieved with an encoder evaluation unit.
The encoder evaluation unit must meet at least the requirements for SIL2.
2) Short circuit to 0 V or to output, one channel at a time, power supply correctly applied.

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Standard
ATEX/IECEx – zone 1/21, SIL2/PLd, optical | **Sendix SIL 7053FS2 (shaft)** | **SSI/BiSS+SinCos**

SSI interface

Output driver		RS485 transceiver type
Permissible load / channel		max. +/- 20 mA
Signal level	HIGH	typ 3.8 V
	LOW at I_{Load} = 20 mA	typ 1.3 V
Resolution		10 ... 14 bit and 17 bit
Code		binary or gray
SSI clock rate		50 kHz ... 2 MHz
Monoflop time		≤ 15 µs

Note: if clock starts cycling within monoflop time a second data transfer starts with the same data. If clock starts cycling after monoflop time, the data transfer starts with updated values. The update rate depends on clock speed, data length and monoflop time.

Data refresh rate	resolution ≤ 14 bit	≤ 1 µs
	resolution ≥ 15 bit	4 µs

BiSS interface

Resolution	10 ... 14 bit and 17 bit
Code	binary
Clock rate	up to 10 MHz
Max. update rate	< 10 µs, depends on the clock rate and the data length
Data refresh rate	≤ 1 µs

Note:
- bidirectional, factory programmable parameters are: resolution, code, direction, alarms and warnings
- CRC data verification

SinCos interface

Max. frequency -3dB	400 kHz
Signal level	1 Vpp (±10 %)
Short circuit proof	yes [1]
Pulse rate	2048 ppr

SET input

Input		HIGH active
Input type		comparator
Signal level (+V = Power supply)	HIGH	min. 60 % of +V max. +V
	LOW	max. 25 % of +V
Input current		< 0.5 mA
Min. pulse duration (SET)		10 ms
Timeout after SET signal		14 ms

The encoder can be set to zero at any position by means of a HIGH signal on the SET input. Other preset values can be factory-programmed.
The SET input has a signal delay time of approximately 1 ms. Once the SET function has been triggered, the encoder requires an internal processing time of approximately 15 ms before the new position data can be read.

Power-ON

After Power-ON, the device requires a time of approximately 150 ms before valid data can be read.

Avoid encoder hot-plugging.

Terminal assignment

Interface	Type of connection	Features	Cable (isolate unused wires individually before initial start-up)												
4	1, 2, A, B	SET	Signal:	0 V	+V	C+	C-	D+	D-	SET	A	$\overline{A}$	B	$\overline{B}$	⏚
			Cable marking:	6	1	2	3	4	5	11	7	8	9	10	shield

+V: Encoder power supply +V DC
0 V: Encoder power supply ground GND (0 V)
C+, C-: Clock signal
D+, D-: Data signal
SET: SET input. The current position becomes defined as position zero.
A, $\overline{A}$: Cosine signal
B, $\overline{B}$: Sine signal
⏚: Protective earth

1) Short circuit to 0 V or to output, one channel at a time, power supply correctly applied.

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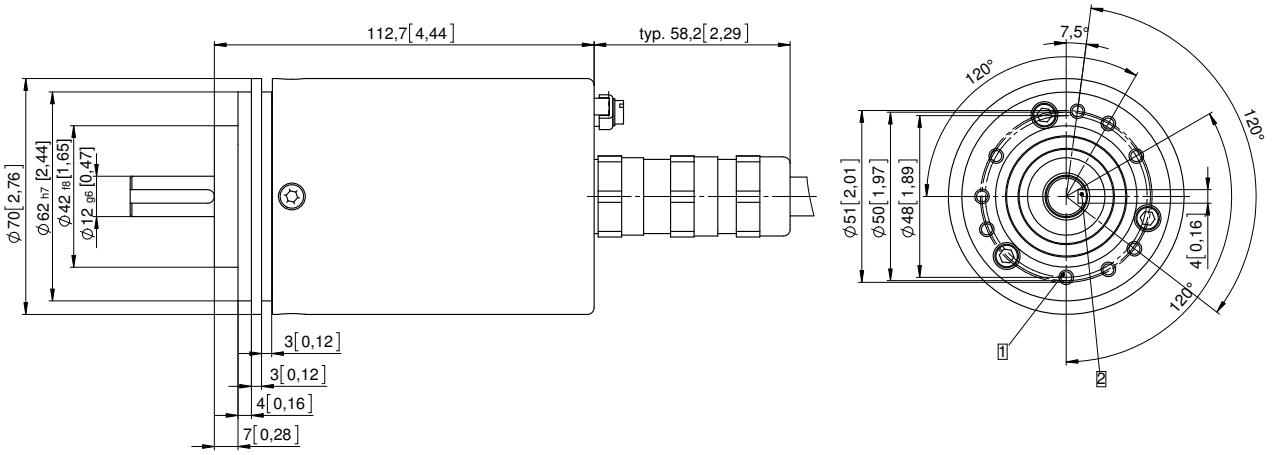
Standard
ATEX/IECEx – zone 1/21, SIL2/PLd, optical | **Sendix SIL 7053FS2 (shaft)** | **SSI/BiSS + SinCos**

Dimensions

Dimensions in mm [inch]

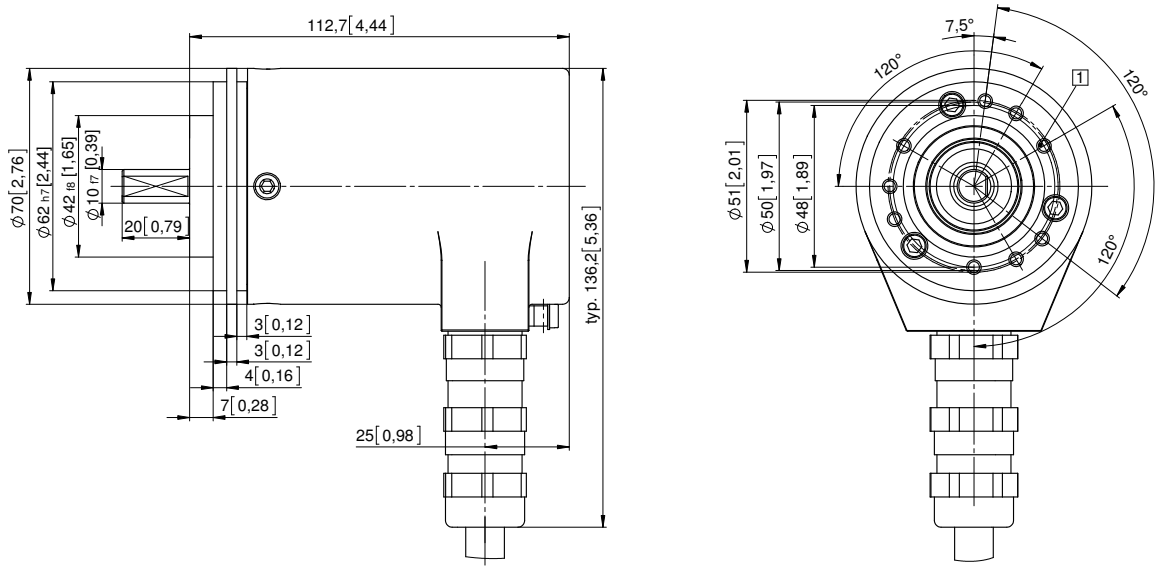
Clamping / synchronous flange, ø 70 [2.76]
Shaft type 1 with axial cable outlet

1 9 x M4, 10 [0.39] deep
2 Keyway for DIN 6885-A-4x4x25 key



Clamping / synchronous flange, ø 70 [2.76]
Shaft type 2 with radial cable outlet

1 9 x M4, 10 [0.39] deep



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Standard
ATEX / IECEx – zone 1 / 21, SIL3/PLe, optical | **Sendix SIL 7053FS3 (shaft)** | **SSI / BiSS + SinCos**

Ex protection and Functional Safety in one device.

The absolute singleturn encoders 7053FS3 of the Sendix SIL family are suited for use in safety-related applications up to SIL3 acc. to EN 61800-5-2 or PLe to EN ISO 13849-1.

In addition, these devices ensure Ex protection in a compact 70 mm housing out of seawater durable aluminium.

Ex approval | Safety-Lock™ | High rotational speed | High protection level | High shaft load capacity | Shock / vibration resistant | Magnetic field proof | Short-circuit proof | Reverse polarity protection | Optical sensor | Seawater durable

Functional Safety

- Encoder with individual certificate from IFA / TÜV.
- Suitable for applications up to SIL3 acc. to EN 61800-5-2.
- Suitable for applications up to PLe acc. to EN ISO 13849-1.
- SSI or BiSS interface with incremental SinCos tracks with 2048 ppr.
- Certified mechanical mounting + electronic.

Explosion protection

- "Flameproof-enclosure" version.
- ATEX with EC type examination certificate.
- IECEx with certificate of conformity (CoC).

Order code Shaft version

8.7053FS3	.	1	X	4	X	.	X	X	2	1	.	XXXX
Type		a	b	c	d		e	f	g	h		i 1)

a *Flange*
1 = clamping / synchronous flange, IP67, ø 70 mm [2.76"]

b *Shaft (ø x L)*
2 = 10 x 20 mm [0.39 x 0.79"], with flat
1 = 12 x 25 mm [0.47 x 0.98"], with keyway for 4 x 4 mm [0.16 x 0.16"] key

c *Interface / power supply*
4 = SSI, BiSS + 2048 ppr. SinCos / 10 ... 30 V DC

d *Type of connection*
1 = axial cable, 2 m [6.56'] PUR
2 = radial cable, 2 m [6.56'] PUR
A = axial cable, length > 2 m [6.56']
B = radial cable, length > 2 m [6.56']
preferred length see **i**, e. g.: 0100 = 10 m [32.81']

e *Code*
B = SSI, binary
C = BiSS, binary
G = SSI, gray

f *Resolution* [2]
A = 10 bit
1 = 11 bit
2 = 12 bit
3 = 13 bit
4 = 14 bit
7 = 17 bit

g *Inputs / outputs* [2]
2 = SET input

h *Options*
1 = no option

i *Cable length in dm* [1]
0050 = 5 m [16.40']
0100 = 10 m [32.81']
0150 = 15 m [49.21']

Optional on request
- special cable length
- stainless steel version
- other resolutions

1) Not applicable with connection types 1 and 2.
2) Resolution, preset value and counting direction factory-programmable.

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Absolute encoders - singleturn

Standard
ATEX / IECEx – zone 1 / 21, SIL3/PLe, optical | **Sendix SIL 7053FS3 (shaft)** | **SSI / BiSS + SinCos**

Accessories		Order no.
EMC shield terminal	for top-hat rail mounting	**8.0000.4G06.0000**
Screw retention	Loctite 243, 5 ml	**8.0000.4G05.0000**
Bellows coupling, safety-oriented	You will find an overview of our couplings for Sendix SIL shaft encoders in the accessories section or under www.kuebler.com/accessories.	
Safety modules Safety-M compact / modular	You will find an overview of our systems and components for Functional Safety and the corresponding software in the safety technology section or under www.kuebler.com/safety.	
LED SSI display 570 / 575	Electronic position display up to 32 bit. You will find an overview in the accessories section or under www.kuebler.com/position_display.	

Further accessories can be found in the accessories section or in the accessories area of our website at: www.kuebler.com/accessories.
Additional connectors can be found in the connection technology section or in the connection technology area of our website at: www.kuebler.com/connection_technology.

Technical data

Explosion protection ATEX

EC type-examination certificate	PTB09 ATEX 1106 X
Category (gas)	Ex II 2 G Ex d IIC T4 - T6 Gb
Category (dust)	Ex II 2D Ex tb IIIC T135°C - T85°C Db IP6x
Relevant standards	EN 60079-0:2009 EN 60079-1:2007 EN 60079-31:2009

Explosion protection IECEx

Certificate of conformity (CoC)	IECEx PTB 13.0026 X
Category (gas)	Ex d IIC T4 - T6 Gb
Category (dust)	Ex tb IIIC T135°C - T85°C Db IP6x
Relevant standards	IEC 60079-0:2007 IEC 60079-1:2007 IEC 60079-31:2008

Notes regarding "Functional Safety"

These encoders are suitable for use in safety-related systems up to SIL3 acc. to EN 61800-5-2 and PLe to EN ISO 13849-1 in conjunction with controllers or evaluation units, which possess the necessary functionality.
Additional functions can be found in the operating manual.

Safety characteristics

Classification	PLe / SIL3
System structure	2 channel (Cat. 4 / HFT = 1)
PFH_d value [1]	1.09×10^{-8} h^{-1}
Mission time / Proof test interval	20 years
Relevant standards	EN ISO 13849-1:2008 EN ISO 13849-2:2013 EN 61800-5-2:2007

Electrical characteristics

Power supply	10 ... 30 V DC
Current consumption (no load)	max. 45 mA
Reverse polarity protection for power supply	yes
Short circuit proof outputs	yes [2]
CE compliant acc. to	
(up to April 19, 2016)	EMC guideline 2004/108/EC ATEX guideline 94/9/EC Machinery directive 2006/42/EC RoHS guideline 2011/65/EU
(as from April 20, 2016)	EMC guideline 2014/30/EU ATEX guideline 2014/34/EU Machinery directive 2006/42/EC RoHS guideline 2011/65/EU

EMC

Relevant standards	EN 55011 class B :2009 / A1:2010 EN 61000-6-3:2007 / A1:2011 EN 61000-6-2:2005

Mechanical characteristics

Maximum speed		6000 min^{-1} (continuous)
Starting torque – at 20°C [68°F]		< 0.05 Nm
Mass moment of inertia		4.0×10^{-6} kgm^2
Load capacity of shaft	radial	80 N
	axial	40 N
Weight		approx. 1.3 kg [45.86 oz]
Protection acc. to EN 60529		IP67
Ambient temperature		-40°C ... +60°C [-40 ... +140°F] Please note the specifications for temperature class in EC type-examination certificate!
Material	shaft	stainless steel
	flange / housing	seawater durable Al, type AlSiMgMn (EN AW-6082)
	cable	PUR
Shock resistance acc. to. EN 60068-2-27		500 m/s^2, 11 ms
Vibration resistance acc. to EN 60068-2-6		200 m/s^2, 10 ... 150 Hz

1) The specified value is based on a diagnostic coverage of 99 %, that must be achieved with an encoder evaluation unit.
The encoder evaluation unit must meet at least the requirements for SIL3.
2) Short circuit to 0 V or to output, one channel at a time, power supply correctly applied.

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Standard
ATEX/IECEx – zone 1/21, SIL3/PLe, optical | **Sendix SIL 7053FS3 (shaft)** | **SSI/BiSS+SinCos**

SSI interface

Output driver		RS485 transceiver type
Permissible load / channel		max. +/- 20 mA
Signal level	HIGH	typ 3.8 V
	LOW at I_{Load} = 20 mA	typ 1.3 V
Resolution		10 ... 14 bit and 17 bit
Code		binary or gray
SSI clock rate		50 kHz ... 2 MHz
Monoflop time		≤ 15 µs

Note: if clock starts cycling within monoflop time a second data transfer starts with the same data. If clock starts cycling after monoflop time, the data transfer starts with updated values. The update rate depends on clock speed, data length and monoflop time.

Data refresh rate	resolution ≤ 14 bit	≤ 1 µs
	resolution ≥ 15 bit	4 µs

BiSS interface

Resolution	10 ... 14 bit and 17 bit
Code	binary
Clock rate	up to 10 MHz
Max. update rate	< 10 µs, depends on the clock rate and the data length
Data refresh rate	≤ 1 µs

Note:
- bidirectional, factory programmable parameters are: resolution, code, direction, alarms and warnings
- CRC data verification

SinCos interface

Max. frequency -3dB	400 kHz
Signal level	1 Vpp (±10 %)
Short circuit proof	yes [1]
Pulse rate	2048 ppr

SET input

Input		HIGH active
Input type		comparator
Signal level (+V = Power supply)	HIGH	min. 60 % of +V max. +V
	LOW	max. 25 % of +V
Input current		< 0.5 mA
Min. pulse duration (SET)		10 ms
Timeout after SET signal		14 ms

The encoder can be set to zero at any position by means of a HIGH signal on the SET input. Other preset values can be factory-programmed.
The SET input has a signal delay time of approximately 1 ms. Once the SET function has been triggered, the encoder requires an internal processing time of approximately 15 ms before the new position data can be read.

Power-ON

After Power-ON, the device requires a time of approximately 150 ms before valid data can be read.

Avoid encoder hot-plugging.

Terminal assignment

Interface	Type of connection	Features	Cable (isolate unused wires individually before initial start-up)												
4	1, 2, A, B	SET	Signal:	0 V	+V	C+	C-	D+	D-	SET	A	$\overline{A}$	B	$\overline{B}$	⏚
			Cable marking:	6	1	2	3	4	5	11	7	8	9	10	shield

+V: Encoder power supply +V DC
0 V: Encoder power supply ground GND (0 V)
C+, C-: Clock signal
D+, D-: Data signal
SET: SET input. The current position becomes defined as position zero.
A, $\overline{A}$: Cosine signal
B, $\overline{B}$: Sine signal
⏚: Protective earth

1) Short circuit to 0 V or to output, one channel at a time, power supply correctly applied.

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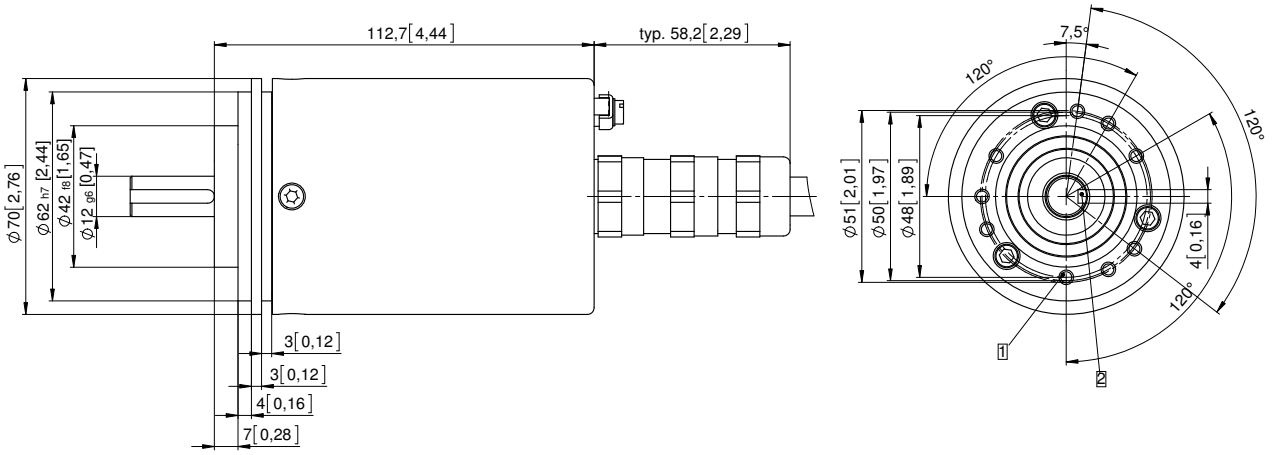
Standard
ATEX/IECEx – zone 1/21, SIL3/PLe, optical | **Sendix SIL 7053FS3 (shaft)** | **SSI/BiSS + SinCos**

Dimensions

Dimensions in mm [inch]

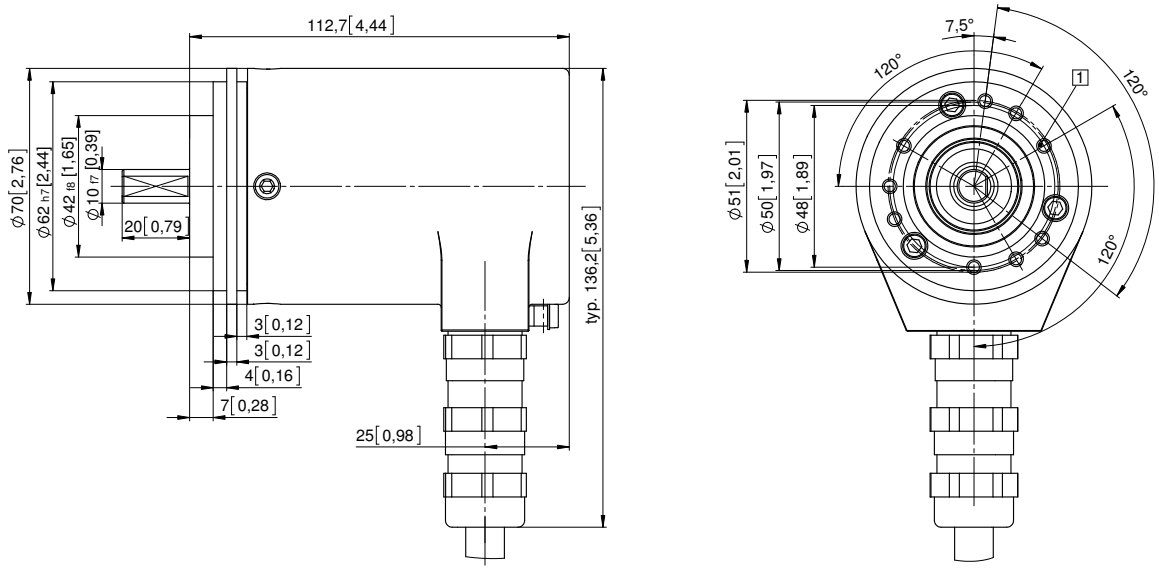
Clamping / synchronous flange, ø 70 [2.76]
Shaft type 1 with axial cable outlet

1 9 x M4, 10 [0.39] deep
2 Keyway for DIN 6885-A-4x4x25 key



Clamping / synchronous flange, ø 70 [2.76]
Shaft type 2 with radial cable outlet

1 9 x M4, 10 [0.39] deep



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Absolute encoders – multiturn

Series		Type	Interface	Page
Standard, optical	SIL2/PLd, mechanical multiturn	Sendix SIL 5863FS2 / 5883FS2 (shaft/hollow s.)	SSI / BiSS + SinCos	**96**
	SIL3/PLe, mechanical multiturn	Sendix SIL 5863FS3 / 5883FS3 (shaft/hollow s.)	SSI / BiSS + SinCos	**102**
	ATEX/IECEx – zone 1/21, SIL2/PLd, mech. MT	Sendix SIL 7063FS2 (shaft)	SSI / BiSS + SinCos	**108**
	ATEX/IECEx – zone 1/21, SIL3/PLe, mech. MT	Sendix SIL 7063FS3 (shaft)	SSI / BiSS + SinCos	**112**

Further absolute encoders you will find in our catalogue "Position and Motion Sensors" or under:
www.kuebler.com/absolute

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Standard
SIL2/PLd, mech. multiturn, optical

Sendix SIL 5863FS2 / 5883FS2 (shaft / hollow shaft)

SSI / BiSS + SinCos

The absolute multiturn encoders 5863FS2 and 5883FS2 of the Sendix SIL family are suited for use in safety-related applications up to SIL2 according to EN 61800-5-2 or PLd to EN ISO 13849-1.

The extra strong Safety-Lock™ design interlocked bearings, the high integration density of the components based on OptoASIC technology and the rugged die-cast housing make these devices ideal also for demanding applications outdoors up to IP65.

Mechanical drive | Safety-Lock™ | High rotational speed | Temperature range | High protection level | High shaft load capacity | Shock / vibration resistant | Magnetic field proof | Reverse polarity protection | SinCos | Optical sensor

Functional Safety

- Encoder with individual certificate from IFA / TÜV.
- Suitable for applications up to SIL2 acc. to EN 61800-5-2.
- Suitable for applications up to PLd acc. to EN ISO 13849-1.
- SSI or BiSS interface with incremental SinCos tracks with 2048 ppr.
- Certified mechanical mounting + electronic.

Flexible

- Shaft and hollow shaft versions.
- Cable and connector variants.
- Various mounting options available.

Order code Shaft version

8.5863FS2	.	1	X	X	X	.	X	X	2	X
Type		a	b	c	d		e	f	g	h

If for each parameter of an encoder the **underlined preferred option** is selected, then the delivery time will be 10 working days for a maximum of 10 pieces. Qts. up to 50 pcs. of these types generally have a delivery time of 15 working days.

10 by 10

a *Flange*
1 = clamping flange, IP65, ø 58 mm [2.28"]

b *Shaft (ø x L)*
2 = 10 x 20 mm [0.39 x 0.79"], with flat
A = 10 x 20 mm [0.39 x 0.79"], with feather key

c *Interface / power supply*
3 = SSI, BiSS + 2048 ppr. SinCos / 5 V DC
4 = SSI, BiSS + 2048 ppr. SinCos / 10 ... 30 V DC

d *Type of connection*
1 = axial cable, 1 m [3.28'] PVC
A = axial cable, special length PVC *)
2 = radial cable, 1 m [3.28'] PVC
B = radial cable, special length PVC *)
3 = axial M23 connector, 12-pin
4 = radial M23 connector, 12-pin
*) Available special lengths (connection types A, B): 2, 3, 5, 8, 10, 15 m [5.56, 9.84, 16.40, 26.25, 32.80, 49.21'] order code expansion .XXXX = length in dm ex.: 8.5863FS2.124A.G322.0030 (for cable length 3 m)

e *Code*
B = SSI, binary
C = BiSS, binary
G = SSI, gray

f *Resolution* [1]
A = 10 bit ST + 12 bit MT
1 = 11 bit ST + 12 bit MT
2 = 12 bit ST + 12 bit MT
3 = 13 bit ST + 12 bit MT
4 = 14 bit ST + 12 bit MT
7 = 17 bit ST + 12 bit MT

g *Input / output* [1]
2 = SET, DIR input

h *Options (service)*
1 = no option
2 = status LED
3 = SET button and status LED

Optional on request
- Ex 2/22
- other singleturn resolutions

1) Resolution, preset value and count direction are factory-programmable.

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Absolute encoders – multiturn

Standard
SIL2/PLd, mech. multiturn, optical | **Sendix SIL 5863FS2 / 5883FS2 (shaft / hollow shaft)** | **SSI / BiSS + SinCos**

Order code Hollow shaft

8.5883FS2	.	X	X	X	X	.	X	X	2	X
Type		a	b	c	d		e	f	g	h

If for each parameter of an encoder the **underlined preferred option** is selected, then the delivery time will be 10 working days for a maximum of 10 pieces. Qts. up to 50 pcs. of these types generally have a delivery time of 15 working days.

10 by 10

a *Flange*
9 = with torque stop, flexible, IP65
A = with torque stop set, rigid, IP65
B = with stator coupling, IP65, ø 63 mm [2.48"]

b *Hollow shaft*
3 = ø 10 mm [0.39"]
4 = ø 12 mm [0.47"]
5 = ø 14 mm [0.55"]
K = ø 10 mm [0.39"], tapered shaft

c *Interface / power supply*
3 = SSI, BiSS + 2048 ppr. SinCos / 5 V DC
4 = SSI, BiSS + 2048 ppr. SinCos / 10 ... 30 V DC

d *Type of connection*
2 = radial cable, 1 m [3.28'] PVC
B = radial cable, special length PVC *)
E = tangential cable, 1 m [3.28'] PVC
F = tangential cable, special length PVC *)
4 = radial M23 connector, 12 pin

*) Available special lengths (connection types B, F):
2, 3, 5, 8, 10, 15 m [5.56, 9.84, 16.40, 26.25, 32.80, 49.21']
order code expansion .XXXX = length in dm
ex.: 8.5883FS2.B44B.G322.0030 (for cable length 3 m)

e *Code*
B = SSI, binary
C = BiSS, binary
G = SSI, gray

f *Resolution* [1]
A = 10 bit ST + 12 bit MT
1 = 11 bit ST + 12 bit MT
2 = 12 bit ST + 12 bit MT
3 = 13 bit ST + 12 bit MT
4 = 14 bit ST + 12 bit MT
7 = 17 bit ST + 12 bit MT

g *Input / output* [1]
2 = SET, DIR input

h *Options (service)*
1 = no option
2 = status LED
3 = SET button and status LED

Optional on request
- Ex 2/22 (not for type of connection E, F)
- other singleturn resolutions

Accessories		Order no.
EMC shield terminal	for top-hat rail mounting	**8.0000.4G06.0000**
Screw retention	Loctite 243, 5 ml	**8.0000.4G05.0000**
Bellows coupling, safety-oriented	You will find an overview of our couplings for Sendix SIL shaft encoders in the accessories section or under www.kuebler.com/accessories.	
Safety modules Safety-M compact / modular	You will find an overview of our systems and components for Functional Safety and the corresponding software in the safety technology section or under www.kuebler.com/safety.	
LED SSI display 570 / 575	Electronic position display up to 32 bit. You will find an overview in the accessories section or under www.kuebler.com/position_display.	

Further accessories can be found in the accessories section or in the accessories area of our website at: www.kuebler.com/accessories.

Connection technology		Order no.
Cordset, pre-assembled	M23 female connector with coupling nut – single-ended, 2 m [6.56'] PVC cable [2]	**8.0000.6901.0002.0031**
	M23 female connector with coupling nut – male connector with external thread, 2 m [6.56'] PVC cable [2]	**8.0000.6905.0002.0032**
Connector, self-assembly (straight)	M23 female connector with coupling nut	**8.0000.5012.0000**

Additional connectors can be found in the connection technology section or in the connection technology area of our website at: www.kuebler.com/connection_technology.

Technical data

Notes regarding "Functional Safety"

These encoders are suitable for use in safety-related systems up to SIL2 acc. to EN 61800-5-2 and PLd to EN ISO 13849-1 in conjunction with controllers or evaluation units, which possess the necessary functionality.

Additional functions can be found in the operating manual.

Safety characteristics

Classification	PLd / SIL2
System structure	2 channel (Cat. 3 / HFT = 1)
PFH_d value [3]	2.16×10^{-8} h^{-1}
Mission time / Proof test interval	20 years
Relevant standards	EN ISO 13849-1:2008; EN ISO 13849-2:2013; EN 61800-5-2:2007

1) Resolution, preset value and count direction are factory-programmable.
2) Other lengths available.
3) The specified value is based on a diagnostic coverage of 90 %, that must be achieved with an encoder evaluation unit.
The encoder evaluation unit must meet at least the requirements for SIL2.

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Standard
SIL2/PLd, mech. multiturn, optical | **Sendix SIL 5863FS2 / 5883FS2 (shaft / hollow shaft)** | **SSI / BiSS + SinCos**

Mechanical characteristics

Maximum speed shaft version		
	up to 70°C [158°F]	12000 min^{-1}, 10000 min^{-1} (continuous)
	up to T_{max}	8000 min^{-1}, 5000 min^{-1} (continuous)
Maximum speed hollow shaft version		
	up to 70°C [158°F]	9000 min^{-1}, 6000 min^{-1} (continuous)
	up to T_{max}	6000 min^{-1}, 3000 min^{-1} (continuous)
Starting torque - at 20°C [68°F]		
	shaft version	< 0.01 Nm
	hollow shaft version	< 0.03 Nm
Mass moment of inertia		
	shaft version	4.0 x 10^{-6} kgm^2
	hollow shaft version	7.0 x 10^{-6} kgm^2
Insertion depth for shaft		
	hollow shaft version	min. 34 mm [1.34"]
Load capacity of shaft	radial	80 N
	axial	40 N
Weight		approx. 0.45 kg [15.87 oz]
Protection acc. to EN 60529		IP65
Working temperature range		-40°C ... +90°C [-40°F ... +194°F] 1)
Material	shaft / hollow shaft	stainless steel
	flange	aluminium
	housing	zinc die-cast
	cable	PVC
Shock resistance acc. to EN 60068-2-27		500 m/s^2, 11 ms
Vibration resistance acc. to EN 60068-2-6		200 m/s^2, 10 ... 150 Hz

Electrical characteristics

Power supply		5 V DC (±5 %) or 10 ... 30 V DC
Current consumption (no load)	5 V DC	max. 80 mA
	10 ... 30 V DC	max. 50 mA
Reverse polarity protection of the power supply		yes
Short circuit proof outputs		yes 2)
UL approval		file 224618
CE compliant acc. to		
	(up to April 19, 2016)	EMC guideline 2004/108/EC Machinery directive 2006/42/EC RoHS guideline 2011/65/EU
	(as from April 20, 2016)	EMC guideline 2014/30/EU Machinery directive 2006/42/EC RoHS guideline 2011/65/EU

EMC

Relevant standards	EN 55011 class B :2009 / A1:2010 EN 61000-6-3:2007 / A1:2011 EN 61000-6-2:2005

Power-ON

After Power-ON the encoder requires a time of approx. 150 ms before valid data can be read. Avoid encoder hot-plugging.

LED

The optional LED (red) serves to display various alarm or error messages.
In normal operation the LED is OFF.

If the LED is ON (status output LOW) this indicates:
- sensor error, singleturn or multiturn (soiling, glass breakage etc.)
- LED error, failure or ageing
- Over- or under-temperature

In the SSI mode, the fault indication can only be reset by switching off the power supply to the device.

SSI interface

Output driver		RS485 transceiver type
Permissible load / channel		max. +/- 20 mA
Signal level	HIGH	typ 3.8 V
	LOW at I_{Load} = 20 mA	typ 1.3 V
Resolution singleturn		10 ... 14 bit and 17 bit
Number of revolutions (multiturn)		4096 (12 bit)
Code		binary or gray
SSI clock rate		50 kHz ... 2 MHz
Monoflop time		≤ 15 µs

Note: If the clock starts cycling within the monoflop time, a second data transfer starts with the same data. If the clock starts cycling after the monoflop time, the data transfer starts with the new values. The update rate is dependent on the clock speed, data length and monoflop-time.

Data refresh rate	ST resolution ≤ 14 bit	≤ 1 µs
	ST resolution ≥ 15 bit	4 µs

BiSS interface

Resolution singleturn	10 ... 14 bit and 17 bit
Number of revolutions (multiturn)	4096 (12 bit)
Code	binary
Clock rate	up to 10 MHz
Max. update rate	< 10 µs, depends on the clock rate and the data length
Data refresh rate	≤ 1 µs

Note:
- bidirectional, factory programmable parameters are: resolution, code, direction, alarms and warnings
- CRC data verification

SinCos interface

Max. frequency -3dB	400 kHz
Signal level	1 Vpp (±10 %)
Short circuit proof	yes 2)
Pulse rate	2048 ppr

SET input or SET button

Input		HIGH active
Input type		comparator
Signal level	HIGH	min: 60 % of +V, max: +V
	LOW	max: 25 % of +V (power supply)
Input current		< 0.5 mA
Min. pulse duration (SET)		10 ms
Timeout after SET signal		14 ms
Reaction time (DIR input)		1 ms

The encoder can be set to zero at any position by means of a HIGH signal on the SET input or by pressing the optional SET button (with a pencil, ball-point pen or similar). Other preset values can be factory-programmed.
The SET input has a signal delay time of approx. 1 ms. Once the SET function has been triggered, the encoder requires an internal processing time of approx. 15 ms before the new position data can be read. During this time the LED is ON.

DIR input

A HIGH signal switches the direction of rotation from the default cw to ccw. This function can also be factory-programmed to be inverted. If DIR is changed when the device is already switched on, then this will be interpreted as an error. The LED will come ON and the status output will switch to LOW.

1) Cable version: -30°C ... +90°C [-22°F ... +194°F].
2) Short circuit to 0 V or to output, one channel at a time, power supply correctly applied.

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Standard
SIL2/PLd, mech. multiturn, optical | **Sendix SIL 5863FS2 / 5883FS2 (shaft / hollow shaft)** | **SSI / BiSS + SinCos**

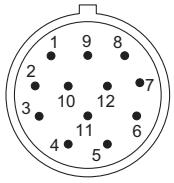
Terminal assignment

Interface	Type of connection	Cable (isolate unused wires individually before initial start-up)												
3, 4	1, 2, A, B, E, F	Signal:	0 V	+V	C+	C-	D+	D-	SET	DIR	A	$\overline{A}$	B	$\overline{B}$	⏚
		Cable colour:	WH	BN	GN	YE	GY	PK	BU	RD	BK	VT	GY-PK	RD-BU	shield

Interface	Type of connection	M23 connector, 12-pin													
3, 4	3, 4	Signal:	0 V	+V	C+	C-	D+	D-	SET	DIR	A	$\overline{A}$	B	$\overline{B}$	⏚
		Pin:	1	2	3	4	5	6	7	8	9	10	11	12	PH

+V: Encoder power supply +V DC
0 V: Encoder power supply ground GND (0 V)
C+, C-: Clock signal
D+, D-: Data signal
SET: Set input. The current position becomes defined as position zero.
DIR: Direction input: If this input is active, output values are counted backwards (decrease) when the shaft is turning clockwise.
A, $\overline{A}$: cosine signal
B, $\overline{B}$: sine signal
PH ⏚: Plug connector housing (shield)

Top view of mating side, male contact base



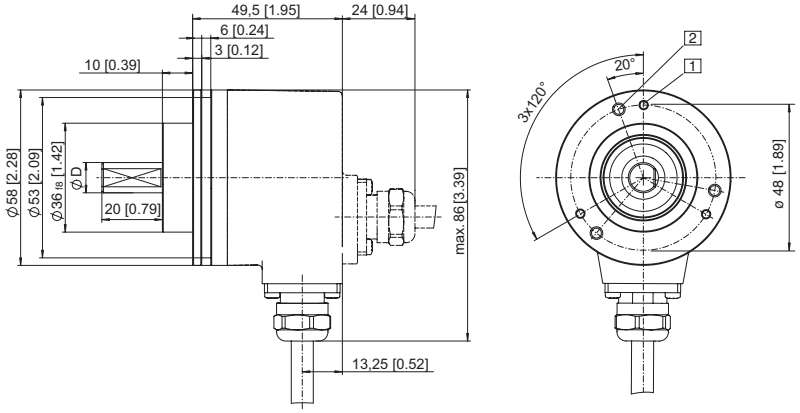
M23 connector, 12-pin

Dimensions shaft version

Dimensions in mm [inch]

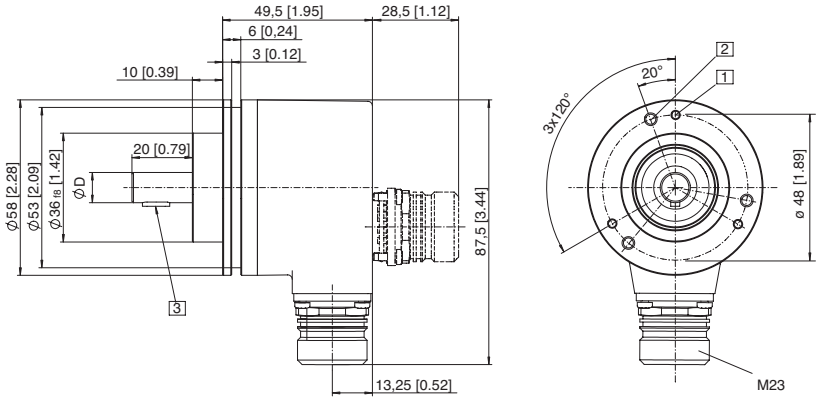
Clamping flange, ø 58 [2.28]
Flange type 1 with shaft type 2
(drawing with cable)

1 3 x M3, 6 [0.24] deep
2 3 x M4, 8 [0.32] deep
D = 10 f7 [0.39]



Clamping flange, ø 58 [2.28]
Flange type 1 with shaft type A
(drawing with M23 connector)

1 3 x M3, 6 [0.24] deep
2 3 x M4, 8 [0.32] deep
3 Feather key DIN 6885 - A - 3x3x6
D = 10 f7 [0.39]



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Standard
SIL2/PLd, mech. multiturn, optical | **Sendix SIL 5863FS2 / 5883FS2 (shaft / hollow shaft)** | **SSI / BiSS + SinCos**

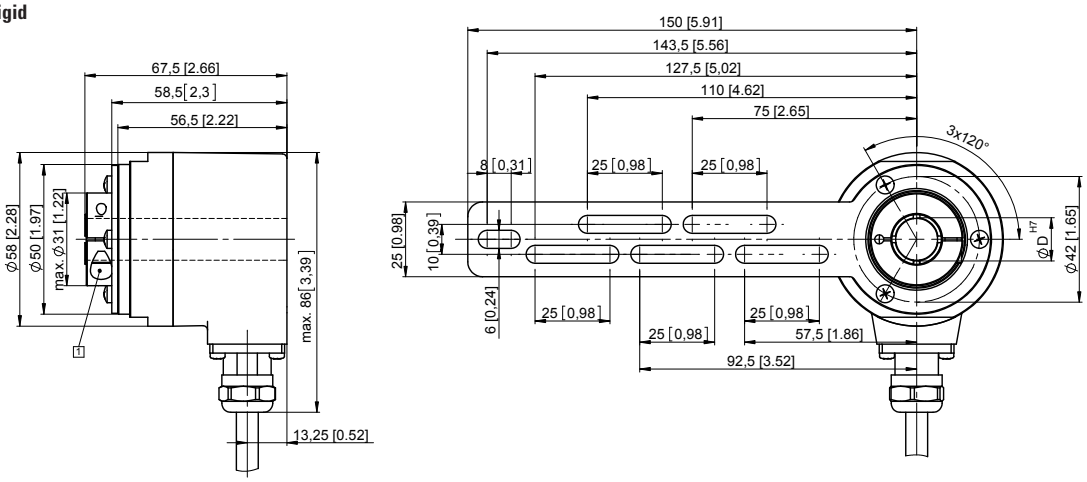
Dimensions hollow shaft version

Dimensions in mm [inch]

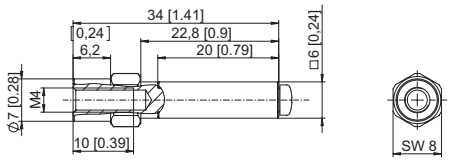
Flange with torque stop set, rigid
Flange type A
Through hollow shaft
(drawing with cable)

1 SW 3, recommended torque for the clamping ring 2.5 Nm

D = ø 10 H7 [0.39]
ø 12 H7 [0.47]
ø 14 H7 [0.55]



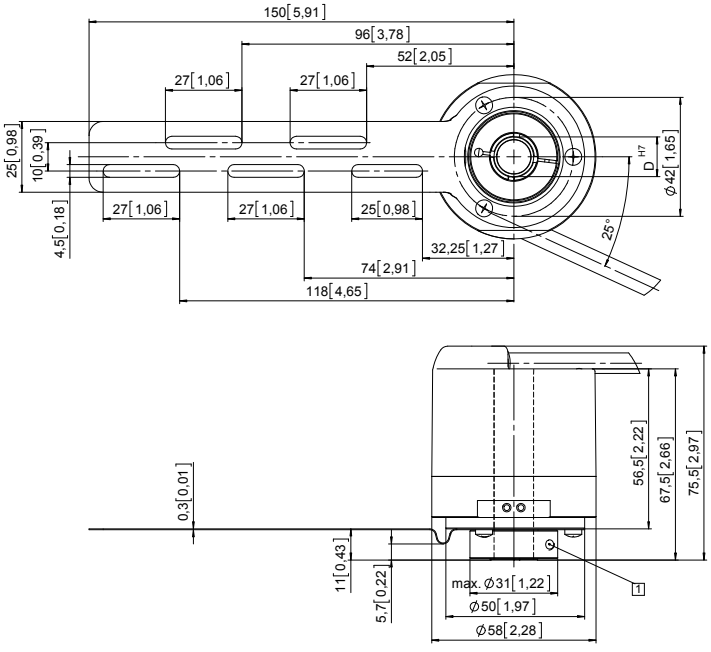
Torque pin with rectangular sleeve with M4 thread



Flange with torque stop, flexible
Flange type 9
Through hollow shaft
(drawing with M23 connector)

1 Recommended torque for the clamping ring 2.5 Nm

D = ø 10 H7 [0.39]
ø 12 H7 [0.47]
ø 14 H7 [0.55]



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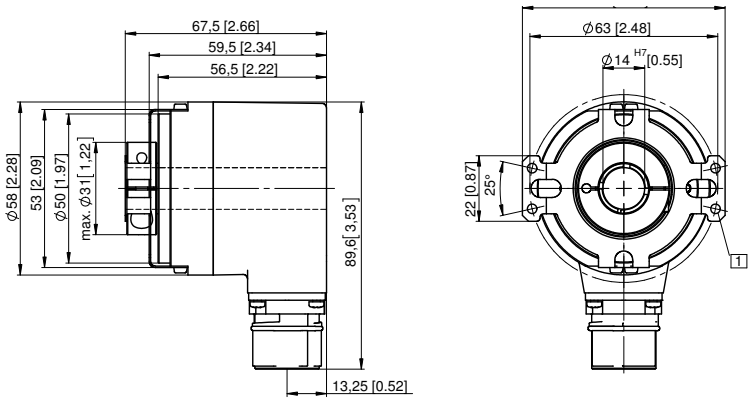
Standard
SIL2/PLd, mech. multiturn, optical | **Sendix SIL 5863FS2 / 5883FS2 (shaft / hollow shaft)** | **SSI / BiSS + SinCos**

Dimensions hollow shaft version

Dimensions in mm [inch]

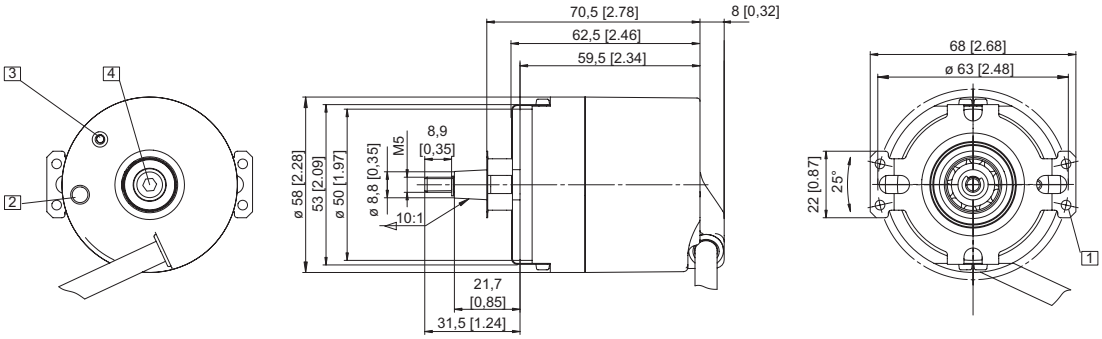
Flange with stator coupling, ø 63 [2.48]
Flange type B
Through hollow shaft
(drawing with M23 connector)

1 SW 3, recommended torque for the clamping ring 2.5 Nm
2 For (4x) M3 screw
D = ø 10 H7 [0.39]
ø 12 H7 [0.47]
ø 14 H7 [0.55]



Flange with stator coupling, ø 63 [2.48]
Flange type B
Tapered shaft
(drawing with tangential cable outlet)

1 For (4x) M3 screw
2 Status LED
3 SET button
4 SW 4



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Standard
SIL3/PLe, mech. multiturn, optical

Sendix SIL 5863FS3 / 5883FS3 (shaft / hollow shaft)

SSI / BiSS + SinCos

The absolute multiturn encoders 5863FS3 and 5883FS3 of the Sendix SIL family are suited for use in safety-related applications up to SIL3 according to EN 61800-5-2 or PLe to EN ISO 13849-1.

The extra strong Safety-Lock™ design interlocked bearings, the high integration density of the components based on OptoASIC technology and the rugged die-cast housing make these devices ideal also for demanding applications outdoors up to IP65.

Mechanical drive | Safety-Lock™ | High rotational speed | Temperature range | High protection level | High shaft load capacity | Shock / vibration resistant | Magnetic field proof | Reverse polarity protection | SinCos | Optical sensor

Functional Safety

- Encoder with individual certificate from IFA / TÜV.
- Suitable for applications up to SIL3 acc. to EN 61800-5-2.
- Suitable for applications up to PLe acc. to EN ISO 13849-1.
- SSI or BiSS interface with incremental SinCos tracks with 2048 ppr.
- Certified mechanical mounting + electronic.

Flexible

- Shaft and hollow shaft versions.
- Cable and connector variants.
- Various mounting options available.

Order code Shaft version

8.5863FS3	.	1	X	X	X	.	X	X	2	X
Type		a	b	c	d		e	f	g	h

If for each parameter of an encoder the **underlined preferred option** is selected, then the delivery time will be 10 working days for a maximum of 10 pieces. Qts. up to 50 pcs. of these types generally have a delivery time of 15 working days.

10 by 10

a *Flange*
1 = clamping flange, IP65, ø 58 mm [2.28"]

b *Shaft (ø x L)*
2 = 10 x 20 mm [0.39 x 0.79"], with flat
A = 10 x 20 mm [0.39 x 0.79"], with feather key

c *Interface / power supply*
3 = SSI, BiSS + 2048 ppr. SinCos / 5 V DC
4 = SSI, BiSS + 2048 ppr. SinCos / 10 ... 30 V DC

d *Type of connection*
1 = axial cable, 1 m [3.28'] PVC
A = axial cable, special length PVC *)
2 = radial cable, 1 m [3.28'] PVC
B = radial cable, special length PVC *)
3 = axial M23 connector, 12-pin
4 = radial M23 connector, 12-pin
*) Available special lengths (connection types A, B): 2, 3, 5, 8, 10, 15 m [5.56, 9.84, 16.40, 26.25, 32.80, 49.21'] order code expansion .XXXX = length in dm ex.: 8.5863FS3.124A.G322.0030 (for cable length 3 m)

e *Code*
B = SSI, binary
C = BiSS, binary
G = SSI, gray

f *Resolution* [1)]
A = 10 bit ST + 12 bit MT
1 = 11 bit ST + 12 bit MT
2 = 12 bit ST + 12 bit MT
3 = 13 bit ST + 12 bit MT
4 = 14 bit ST + 12 bit MT
7 = 17 bit ST + 12 bit MT

g *Input / output* [1)]
2 = SET, DIR input

h *Options (service)*
1 = no option
2 = status LED
3 = SET button and status LED

Optional on request
- Ex 2/22
- other singleturn resolutions

1) Resolution, preset value and count direction are factory-programmable.

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Absolute encoders – multiturn

Standard
SIL3/PLe, mech. multiturn, optical | **Sendix SIL 5863FS3 / 5883FS3 (shaft / hollow shaft)** | **SSI / BiSS + SinCos**

Order code Hollow shaft

8.5883FS3	.	X	X	X	X	.	X	X	2	X
Type		a	b	c	d		e	f	g	h

If for each parameter of an encoder the **underlined preferred option** is selected, then the delivery time will be 10 working days for a maximum of 10 pieces. Qts. up to 50 pcs. of these types generally have a delivery time of 15 working days.

10 by 10

a *Flange*
9 = with torque stop, flexible, IP65
A = with torque stop set, rigid, IP65
B = with stator coupling, IP65, ø 63 mm [2.48"]

b *Hollow shaft*
3 = ø 10 mm [0.39"]
4 = ø 12 mm [0.47"]
5 = ø 14 mm [0.55"]
K = ø 10 mm [0.39"], tapered shaft

c *Interface / power supply*
3 = SSI, BiSS + 2048 ppr. SinCos / 5 V DC
4 = SSI, BiSS + 2048 ppr. SinCos / 10 ... 30 V DC

d *Type of connection*
2 = radial cable, 1 m [3.28'] PVC
B = radial cable, special length PVC *)
E = tangential cable, 1 m [3.28'] PVC
F = tangential cable, special length PVC *)
4 = radial M23 connector, 12 pin

*) Available special lengths (connection types B, F):
2, 3, 5, 8, 10, 15 m [5.56, 9.84, 16.40, 26.25, 32.80, 49.21']
order code expansion .XXXX = length in dm
ex.: 8.5883FS3.B44B.G322.0030 (for cable length 3 m)

e *Code*
B = SSI, binary
C = BiSS, binary
G = SSI, gray

f *Resolution* [1]
A = 10 bit ST + 12 bit MT
1 = 11 bit ST + 12 bit MT
2 = 12 bit ST + 12 bit MT
3 = 13 bit ST + 12 bit MT
4 = 14 bit ST + 12 bit MT
7 = 17 bit ST + 12 bit MT

g *Input / output* [1]
2 = SET, DIR input

h *Options (service)*
1 = no option
2 = status LED
3 = SET button and status LED

Optional on request
- Ex 2/22 (not for type of connection E, F)
- other singleturn resolutions

Accessories

		Order no.
EMC shield terminal	for top-hat rail mounting	**8.0000.4G06.0000**
Screw retention	Loctite 243, 5 ml	**8.0000.4G05.0000**
Bellows coupling, safety-oriented	You will find an overview of our couplings for Sendix SIL shaft encoders in the accessories section or under www.kuebler.com/accessories.	
Safety modules Safety-M compact / modular	You will find an overview of our systems and components for Functional Safety and the corresponding software in the safety technology section or under www.kuebler.com/safety.	
LED SSI display 570 / 575	Electronic position display up to 32 bit. You will find an overview in the accessories section or under www.kuebler.com/position_display.	

Further accessories can be found in the accessories section or in the accessories area of our website at: www.kuebler.com/accessories.

Connection technology

		Order no.
Cordset, pre-assembled	M23 female connector with coupling nut – single-ended, 2 m [6.56'] PVC cable [2]	**8.0000.6901.0002.0031**
	M23 female connector with coupling nut – male connector with external thread, 2 m [6.56'] PVC cable [2]	**8.0000.6905.0002.0032**
Connector, self-assembly (straight)	M23 female connector with coupling nut	**8.0000.5012.0000**

Additional connectors can be found in the connection technology section or in the connection technology area of our website at: www.kuebler.com/connection_technology.

Technical data

Notes regarding "Functional Safety"

These encoders are suitable for use in safety-related systems up to SIL3 acc. to EN 61800-5-2 and PLe to EN ISO 13849-1 in conjunction with controllers or evaluation units, which possess the necessary functionality.

Additional functions can be found in the operating manual.

Safety characteristics

Classification	PLe / SIL3
System structure	2 channel (Cat. 4 / HFT = 1)
PFH_d value [3]	1.09×10^{-8} h^{-1}
Mission time / Proof test interval	20 years
Relevant standards	EN ISO 13849-1:2008; EN ISO 13849-2:2013; EN 61800-5-2:2007

1) Resolution, preset value and count direction are factory-programmable.
2) Other lengths available.
3) The specified value is based on a diagnostic coverage of 99 %, that must be achieved with an encoder evaluation unit.
The encoder evaluation unit must meet at least the requirements for SIL3.

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Standard
SIL3/PLe, mech. multiturn, optical | **Sendix SIL 5863FS3 / 5883FS3 (shaft / hollow shaft)** | **SSI / BiSS + SinCos**

Mechanical characteristics

Maximum speed shaft version		
	up to 70°C [158°F]	12000 min^{-1}, 10000 min^{-1} (continuous)
	up to T_{max}	8000 min^{-1}, 5000 min^{-1} (continuous)
Maximum speed hollow shaft version		
	up to 70°C [158°F]	9000 min^{-1}, 6000 min^{-1} (continuous)
	up to T_{max}	6000 min^{-1}, 3000 min^{-1} (continuous)
Starting torque - at 20°C [68°F]		
	shaft version	< 0.01 Nm
	hollow shaft version	< 0.03 Nm
Mass moment of inertia		
	shaft version	4.0 x 10^{-6} kgm^2
	hollow shaft version	7.0 x 10^{-6} kgm^2
Insertion depth for shaft		
	hollow shaft version	min. 34 mm [1.34"]
Load capacity of shaft	radial	80 N
	axial	40 N
Weight		approx. 0.45 kg [15.87 oz]
Protection acc. to EN 60529		IP65
Working temperature range		-40°C ... +90°C [-40°F ... +194°F] 1)
Material	shaft / hollow shaft	stainless steel
	flange	aluminium
	housing	zinc die-cast
	cable	PVC
Shock resistance acc. to EN 60068-2-27		500 m/s^2, 11 ms
Vibration resistance acc. to EN 60068-2-6		200 m/s^2, 10 ... 150 Hz

Electrical characteristics

Power supply		5 V DC (±5 %) or 10 ... 30 V DC
Current consumption (no load)	5 V DC	max. 80 mA
	10 ... 30 V DC	max. 50 mA
Reverse polarity protection of the power supply		yes
Short circuit proof outputs		yes 2)
UL approval		file 224618
CE compliant acc. to		
	(up to April 19, 2016)	EMC guideline 2004/108/EC Machinery directive 2006/42/EC RoHS guideline 2011/65/EU
	(as from April 20, 2016)	EMC guideline 2014/30/EU Machinery directive 2006/42/EC RoHS guideline 2011/65/EU

EMC

Relevant standards	EN 55011 class B :2009 / A1:2010 EN 61000-6-3:2007 / A1:2011 EN 61000-6-2:2005

Power-ON

After Power-ON the encoder requires a time of approx. 150 ms before valid data can be read. Avoid encoder hot-plugging.

LED

The optional LED (red) serves to display various alarm or error messages.
In normal operation the LED is OFF.

If the LED is ON (status output LOW) this indicates:
- sensor error, singleturn or multiturn (soiling, glass breakage etc.)
- LED error, failure or ageing
- Over- or under-temperature

In the SSI mode, the fault indication can only be reset by switching off the power supply to the device.

SSI interface

Output driver		RS485 transceiver type
Permissible load / channel		max. +/- 20 mA
Signal level	HIGH	typ 3.8 V
	LOW at I_{Load} = 20 mA	typ 1.3 V
Resolution singleturn		10 ... 14 bit and 17 bit
Number of revolutions (multiturn)		4096 (12 bit)
Code		binary or gray
SSI clock rate		50 kHz ... 2 MHz
Monoflop time		≤ 15 µs

Note: If the clock starts cycling within the monoflop time, a second data transfer starts with the same data. If the clock starts cycling after the monoflop time, the data transfer starts with the new values. The update rate is dependent on the clock speed, data length and monoflop-time.

Data refresh rate	ST resolution ≤ 14 bit	≤ 1 µs
	ST resolution ≥ 15 bit	4 µs

BiSS interface

Resolution singleturn	10 ... 14 bit and 17 bit
Number of revolutions (multiturn)	4096 (12 bit)
Code	binary
Clock rate	up to 10 MHz
Max. update rate	< 10 µs, depends on the clock rate and the data length
Data refresh rate	≤ 1 µs

Note:
- bidirectional, factory programmable parameters are: resolution, code, direction, alarms and warnings
- CRC data verification

SinCos interface

Max. frequency -3dB	400 kHz
Signal level	1 Vpp (±10 %)
Short circuit proof	yes 2)
Pulse rate	2048 ppr

SET input or SET button

Input		HIGH active
Input type		comparator
Signal level	HIGH	min: 60 % of +V, max: +V
	LOW	max: 25 % of +V (power supply)
Input current		< 0.5 mA
Min. pulse duration (SET)		10 ms
Timeout after SET signal		14 ms
Reaction time (DIR input)		1 ms

The encoder can be set to zero at any position by means of a HIGH signal on the SET input or by pressing the optional SET button (with a pencil, ball-point pen or similar). Other preset values can be factory-programmed.
The SET input has a signal delay time of approx. 1 ms. Once the SET function has been triggered, the encoder requires an internal processing time of approx. 15 ms before the new position data can be read. During this time the LED is ON.

DIR input

A HIGH signal switches the direction of rotation from the default cw to ccw. This function can also be factory-programmed to be inverted. If DIR is changed when the device is already switched on, then this will be interpreted as an error. The LED will come ON and the status output will switch to LOW.

1) Cable version: -30°C ... +90°C [-22°F ... +194°F].
2) Short circuit to 0 V or to output, one channel at a time, power supply correctly applied.

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Standard
SIL3/PLe, mech. multiturn, optical | **Sendix SIL 5863FS3 / 5883FS3 (shaft / hollow shaft)** | **SSI / BiSS + SinCos**

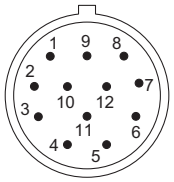
Terminal assignment

Interface	Type of connection	Cable (isolate unused wires individually before initial start-up)												
3, 4	1, 2, A, B, E, F	Signal:	0 V	+V	C+	C-	D+	D-	SET	DIR	A	$\overline{A}$	B	$\overline{B}$	⏚
		Cable colour:	WH	BN	GN	YE	GY	PK	BU	RD	BK	VT	GY-PK	RD-BU	shield

Interface	Type of connection	M23 connector, 12-pin													
3, 4	3, 4	Signal:	0 V	+V	C+	C-	D+	D-	SET	DIR	A	$\overline{A}$	B	$\overline{B}$	⏚
		Pin:	1	2	3	4	5	6	7	8	9	10	11	12	PH

+V: Encoder power supply +V DC
0 V: Encoder power supply ground GND (0 V)
C+, C-: Clock signal
D+, D-: Data signal
SET: Set input. The current position becomes defined as position zero.
DIR: Direction input: If this input is active, output values are counted backwards (decrease) when the shaft is turning clockwise.
A, $\overline{A}$: cosine signal
B, $\overline{B}$: sine signal
PH ⏚: Plug connector housing (shield)

Top view of mating side, male contact base



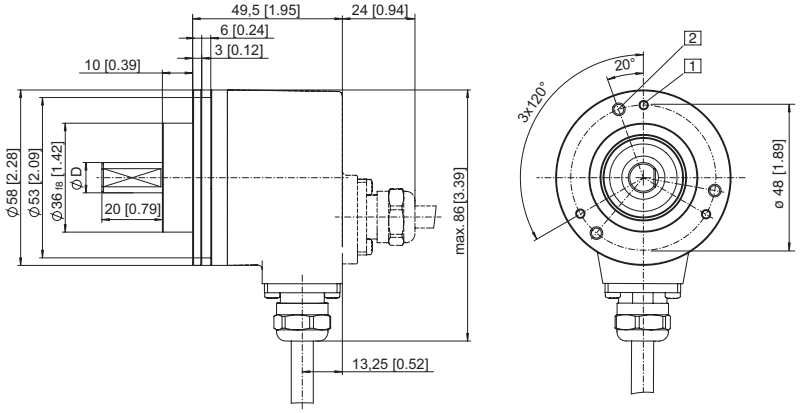
M23 connector, 12-pin

Dimensions shaft version

Dimensions in mm [inch]

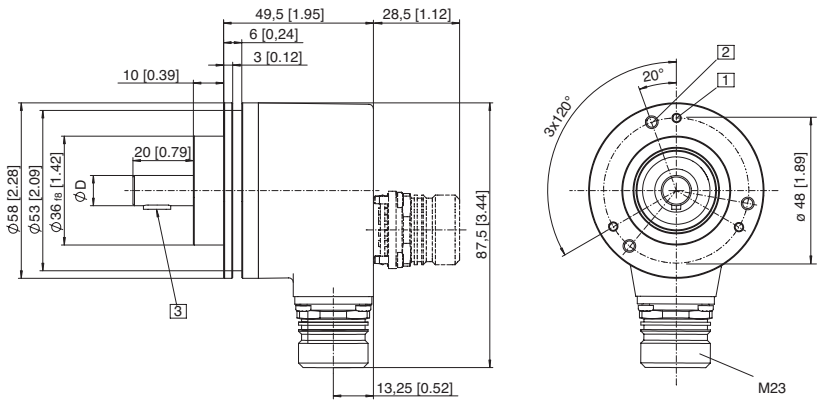
Clamping flange, ø 58 [2.28]
Flange type 1 with shaft type 2
(drawing with cable)

1 M3, 6 [0.24] deep
2 M4, 8 [0.32] deep
D = 10 f7 [0.39]



Clamping flange, ø 58 [2.28]
Flange type 1 with shaft type A
(drawing with M23 connector)

1 M3, 6 [0.24] deep
2 M4, 8 [0.32] deep
3 Feather key DIN 6885 - A - 3x3x6
D = 10 f7 [0.39]



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Standard
SIL3/PLe, mech. multiturn, optical | **Sendix SIL 5863FS3 / 5883FS3 (shaft / hollow shaft)** | **SSI / BiSS + SinCos**

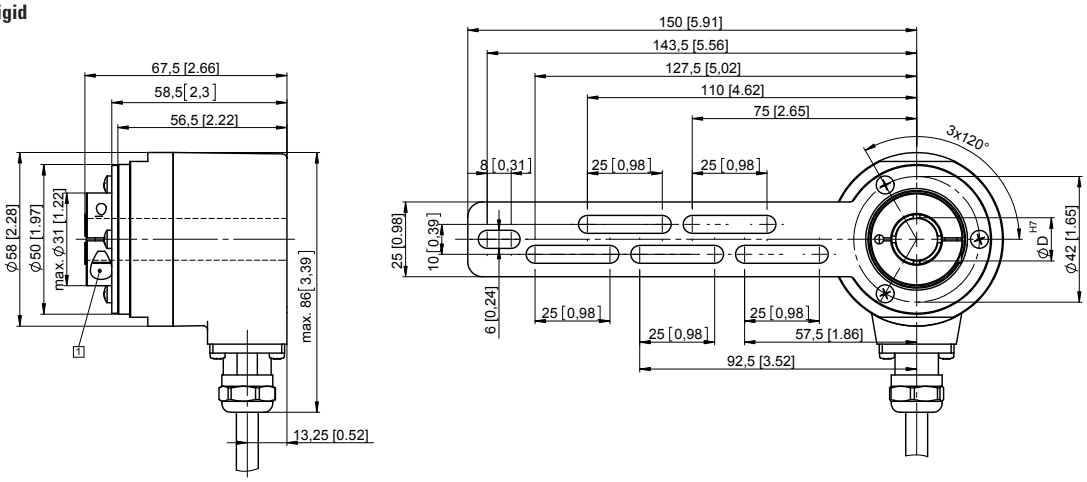
Dimensions hollow shaft version

Dimensions in mm [inch]

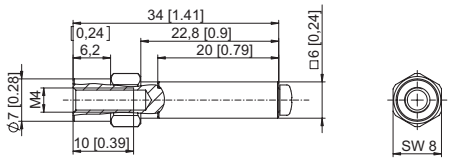
Flange with torque stop set, rigid
Flange type A
Through hollow shaft
(drawing with cable)

1 SW 3, recommended torque for the clamping ring 2.5 Nm

D = ø 10 H7 [0.39]
ø 12 H7 [0.47]
ø 14 H7 [0.55]



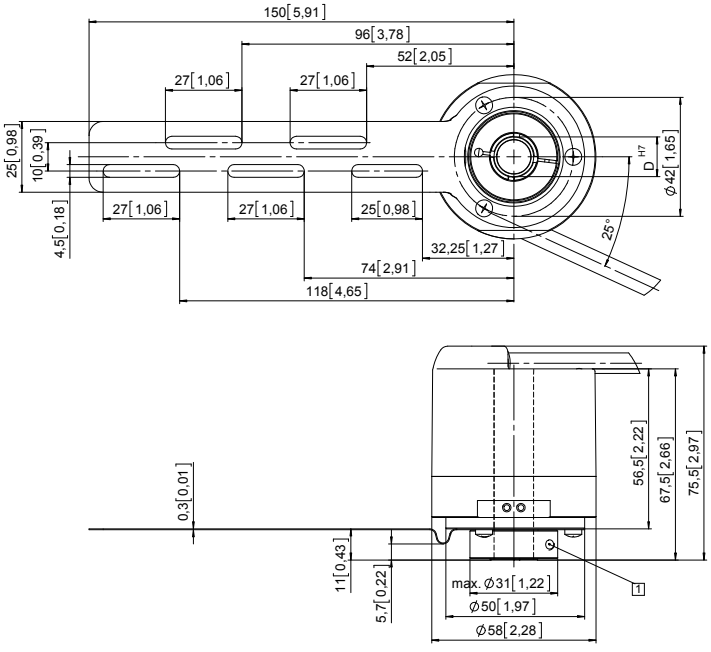
Torque pin with rectangular sleeve with M4 thread



Flange with torque stop, flexible
Flange type 9
Through hollow shaft
(drawing with M23 connector)

1 Recommended torque for the clamping ring 2.5 Nm

D = ø 10 H7 [0.39]
ø 12 H7 [0.47]
ø 14 H7 [0.55]



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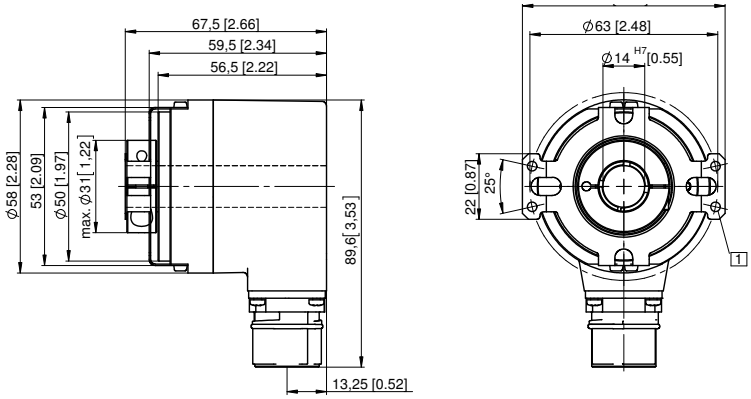
Standard
SIL3/PLe, mech. multiturn, optical | **Sendix SIL 5863FS3 / 5883FS3 (shaft / hollow shaft)** | **SSI / BiSS + SinCos**

Dimensions hollow shaft version

Dimensions in mm [inch]

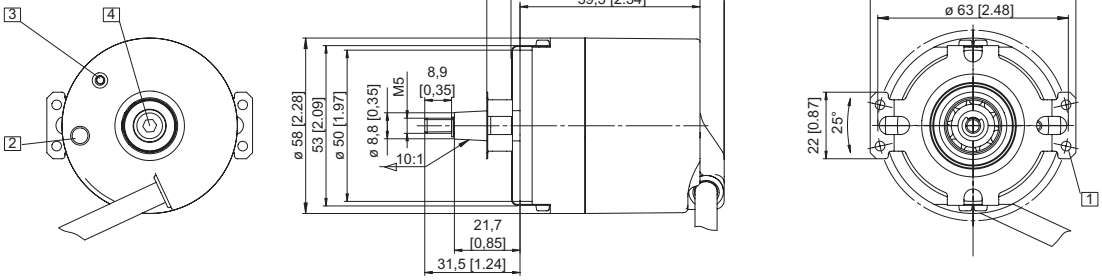
Flange with stator coupling, ø 63 [2.48]
Flange type B
Through hollow shaft
(drawing with M23 connector)

1 SW 3, recommended torque for the clamping ring 2.5 Nm
2 For (4x) M3 screw
D = ø 10 H7 [0.39]
ø 12 H7 [0.47]
ø 14 H7 [0.55]



Flange with stator coupling, ø 63 [2.48]
Flange type B
Tapered shaft
(drawing with tangential cable outlet)

1 For (4x) M3 screw
2 Status LED
3 SET button
4 SW 4



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Standard
ATEX / IECEx – zone 1 / 21, SIL2/PLd, mech. multiturn, optical | **Sendix SIL 7063FS2 (shaft)** | **SSI / BiSS + SinCos**

Ex protection and Functional Safety in one device.

The absolute multiturn encoders 7063FS2 of the Sendix SIL family are suited for use in safety-related applications up to SIL2 acc. to EN 61800-5-2 or PLd to EN ISO 13849-1.

In addition, these devices ensure Ex protection in a compact 70 mm housing out of seawater durable aluminium.

Ex approval | Safety-Lock™ | High rotational speed | High protection level | High shaft load capacity | Shock / vibration resistant | Magnetic field proof | Short-circuit proof | Reverse polarity protection | Optical sensor | Seawater durable

Functional Safety

- Encoder with individual certificate from IFA / TÜV.
- Suitable for applications up to SIL2 acc. to EN 61800-5-2.
- Suitable for applications up to PLd acc. to EN ISO 13849-1.
- SSI or BiSS interface with incremental SinCos tracks with 2048 ppr.
- Certified mechanical mounting + electronic.

Explosion protection

- "Flameproof-enclosure" version.
- ATEX with EC type examination certificate.
- IECEx with certificate of conformity (CoC).

Order code Shaft version

8.7063FS2	.	1	X	4	X	.	X	X	2	1	.	XXXX
Type		a	b	c	d		e	f	g	h		i 1)

a *Flange*
1 = clamping / synchronous flange, IP67, ø 70 mm [2.76"]

b *Shaft (ø x L)*
2 = 10 x 20 mm [0.39 x 0.79"], with flat
1 = 12 x 25 mm [0.47 x 0.98"], with keyway for 4 x 4 mm [0.16 x 0.16"] key

c *Interface / power supply*
4 = SSI, BiSS + 2048 ppr. SinCos / 10 ... 30 V DC

d *Type of connection*
1 = axial cable, 2 m [6.56'] PUR
2 = radial cable, 2 m [6.56'] PUR
A = axial cable, length > 2 m [6.56']
B = radial cable, length > 2 m [6.56']
preferred length see **i**, e. g.: 0100 = 10 m [32.81']

e *Code*
B = SSI, binary
C = BiSS, binary
G = SSI, gray

f *Resolution* [2]
A = 10 bit ST + 12 bit MT
1 = 11 bit ST + 12 bit MT
2 = 12 bit ST + 12 bit MT
3 = 13 bit ST + 12 bit MT
4 = 14 bit ST + 12 bit MT
7 = 17 bit ST + 12 bit MT

g *Inputs / outputs* [2]
2 = SET input

h *Options*
1 = no option

i *Cable length in dm* [1]
0050 = 5 m [16.40']
0100 = 10 m [32.81']
0150 = 15 m [49.21']

Optional on request
- special cable length
- stainless steel version
- other singleturn resolutions

1) Not applicable with connection types 1 and 2.
2) Resolution, preset value and counting direction factory-programmable.

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Absolute encoders – multiturn

Standard ATEX / IECEx – zone 1 / 21, SIL2/PLd, mech. multiturn, optical	Sendix SIL 7063FS2 (shaft)	SSI / BiSS + SinCos

Accessories		Order no.
EMC shield terminal	for top-hat rail mounting	**8.0000.4G06.0000**
Screw retention	Loctite 243, 5 ml	**8.0000.4G05.0000**
Bellows coupling, safety-oriented	You will find an overview of our couplings for Sendix SIL shaft encoders in the accessories section or under www.kuebler.com/accessories.	
Safety modules Safety-M compact / modular	You will find an overview of our systems and components for Functional Safety and the corresponding software in the safety technology section or under www.kuebler.com/safety.	
LED SSI display 570 / 575	Electronic position display up to 32 bit. You will find an overview in the accessories section or under www.kuebler.com/position_display.	

Further accessories can be found in the accessories section or in the accessories area of our website at: www.kuebler.com/accessories.
Additional connectors can be found in the connection technology section or in the connection technology area of our website at: www.kuebler.com/connection_technology.

Technical data

Explosion protection ATEX

EC type-examination certificate	PTB09 ATEX 1106 X
Category (gas)	Ex II 2 G Ex d IIC T4 - T6 Gb
Category (dust)	Ex II 2D Ex tb IIIC T135°C - T85°C Db IP6x
Relevant standards	EN 60079-0:2009 EN 60079-1:2007 EN 60079-31:2009

Explosion protection IECEx

Certificate of conformity (CoC)	IECEx PTB 13.0026 X
Category (gas)	Ex d IIC T4 - T6 Gb
Category (dust)	Ex tb IIIC T135°C - T85°C Db IP6x
Relevant standards	IEC 60079-0:2007 IEC 60079-1:2007 IEC 60079-31:2008

Notes regarding "Functional Safety"

These encoders are suitable for use in safety-related systems up to SIL2 acc. to EN 61800-5-2 and PLd to EN ISO 13849-1 in conjunction with controllers or evaluation units, which possess the necessary functionality.
Additional functions can be found in the operating manual.

Safety characteristics

Classification	PLd / SIL2
System structure	2 channel (Cat. 3 / HFT = 1)
PFH_d value [1]	2.16×10^{-8} h^{-1}
Mission time / Proof test interval	20 years
Relevant standards	EN ISO 13849-1:2008 EN ISO 13849-2:2013 EN 61800-5-2:2007

Electrical characteristics

Power supply	10 ... 30 V DC
Current consumption (no load)	max. 50 mA
Reverse polarity protection for power supply	yes
Short circuit proof outputs	yes [2]
CE compliant acc. to (up to April 19, 2016)	EMC guideline 2004/108/EC ATEX guideline 94/9/EC Machinery directive 2006/42/EC RoHS guideline 2011/65/EU
(as from April 20, 2016)	EMC guideline 2014/30/EU ATEX guideline 2014/34/EU Machinery directive 2006/42/EC RoHS guideline 2011/65/EU

EMC

Relevant standards	EN 55011 class B :2009 / A1:2010 EN 61000-6-3:2007 / A1:2011 EN 61000-6-2:2005

Mechanical characteristics

Maximum speed		6000 min^{-1} (continuous)
Starting torque – at 20°C [68°F]		< 0.05 Nm
Mass moment of inertia		4.0×10^{-6} kgm^2
Load capacity of shaft	radial axial	80 N 40 N
Weight		approx. 1.3 kg [45.86 oz]
Protection acc. to EN 60529		IP67
Ambient temperature		-40°C ... +60°C [-40 ... +140°F] Please note the specifications for temperature class in EC type-examination certificate!
Material	shaft flange / housing cable	stainless steel seawater durable Al, type AlSiMgMn (EN AW-6082) PUR
Shock resistance acc. to. EN 60068-2-27		500 m/s^2, 11 ms
Vibration resistance acc. to EN 60068-2-6		200 m/s^2, 10 ... 150 Hz

1) The specified value is based on a diagnostic coverage of 90 %, that must be achieved with an encoder evaluation unit.
The encoder evaluation unit must meet at least the requirements for SIL2.
2) Short circuit to 0 V or to output, one channel at a time, power supply correctly applied.

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Standard
ATEX / IECEx – zone 1 / 21, SIL2/PLd, mech. multiturn, optical | Sendix SIL 7063FS2 (shaft) | SSI / BiSS + SinCos

SSI interface

Output driver		RS485 transceiver type
Permissible load / channel		max. +/- 20 mA
Signal level	HIGH	typ 3.8 V
	LOW at I_{Load} = 20 mA	typ 1.3 V
Resolution singleturn		10 ... 14 bit and 17 bit
Number of revolutions (multiturn)		4096 (12 bit)
Code		binary or gray
SSI clock rate		50 kHz ... 2 MHz
Monoflop time		≤ 15 µs

Note: if clock starts cycling within monoflop time a second data transfer starts with the same data. If clock starts cycling after monoflop time, the data transfer starts with updated values. The update rate depends on clock speed, data length and monoflop time.

Data refresh rate	ST resolution ≤ 14 bit	≤ 1 µs
	ST resolution ≥ 15 bit	4 µs

BiSS interface

Resolution singleturn	10 ... 14 bit and 17 bit
Number of revolutions (multiturn)	4096 (12 bit)
Code	binary
Clock rate	up to 10 MHz
Max. update rate	< 10 µs, depends on the clock rate and the data length
Data refresh rate	≤ 1 µs

Note:
- bidirectional, factory programmable parameters are: resolution, code, direction, alarms and warnings
- CRC data verification

SinCos interface

Max. frequency -3dB	400 kHz
Signal level	1 Vpp (±10 %)
Short circuit proof	yes [1]
Pulse rate	2048 ppr

SET input

Input		HIGH active
Input type		comparator
Signal level (+V = Power supply)	HIGH	min. 60 % of +V max. +V
	LOW	max. 25 % of +V
Input current		< 0.5 mA
Min. pulse duration (SET)		10 ms
Timeout after SET signal		14 ms

The encoder can be set to zero at any position by means of a HIGH signal on the SET input. Other preset values can be factory-programmed.
The SET input has a signal delay time of approximately 1 ms. Once the SET function has been triggered, the encoder requires an internal processing time of approximately 15 ms before the new position data can be read.

Power-ON

After Power-ON, the device requires a time of approximately 150 ms before valid data can be read.

Avoid encoder hot-plugging.

Terminal assignment

Interface	Type of connection	Features	Cable (isolate unused wires individually before initial start-up)												
4	1, 2, A, B	SET	Signal:	0 V	+V	C+	C-	D+	D-	SET	A	$\overline{A}$	B	$\overline{B}$	⏚
			Cable marking:	6	1	2	3	4	5	11	7	8	9	10	shield

+V: Encoder power supply +V DC
0 V: Encoder power supply ground GND (0 V)
C+, C-: Clock signal
D+, D-: Data signal
SET: SET input. The current position becomes defined as position zero.
A, $\overline{A}$: Cosine signal
B, $\overline{B}$: Sine signal
⏚: Protective earth

1) Short circuit to 0 V or to output, one channel at a time, power supply correctly applied.

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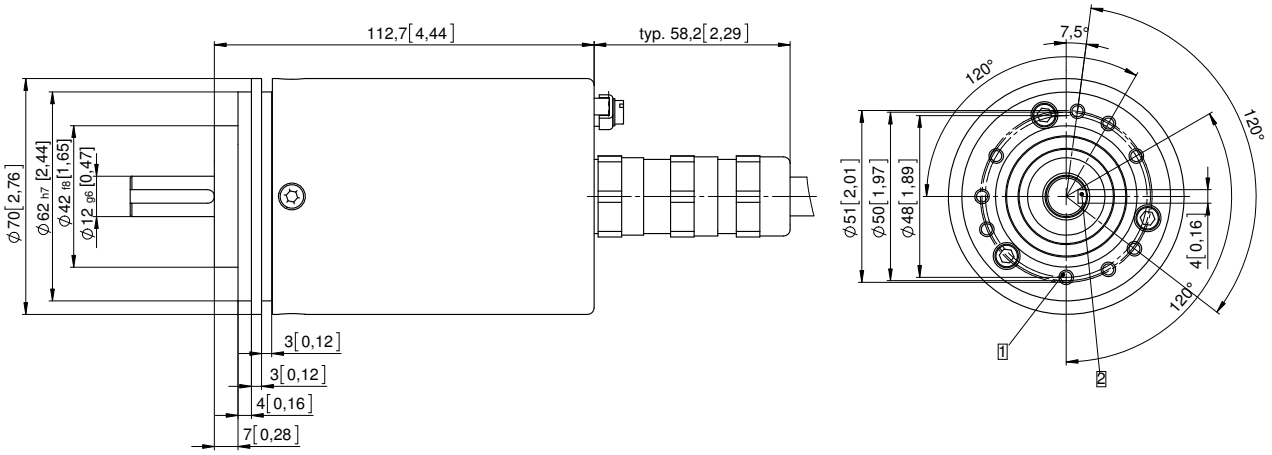
Standard
ATEX / IECEx – zone 1 / 21, SIL2/PLd, mech. multiturn, optical | **Sendix SIL 7063FS2 (shaft)** | **SSI / BiSS + SinCos**

Dimensions

Dimensions in mm [inch]

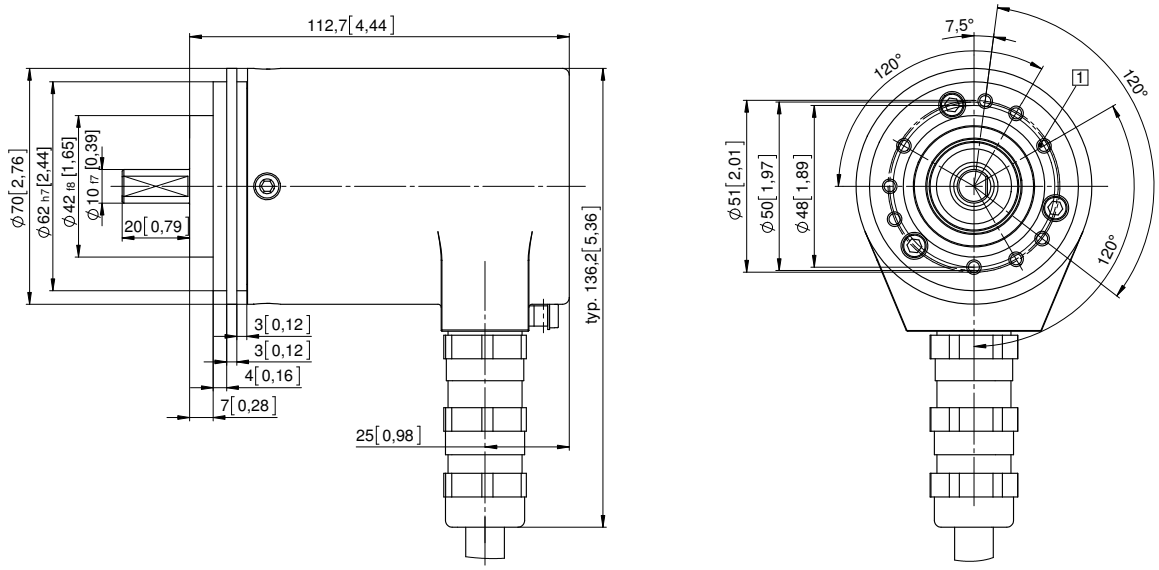
Clamping / synchronous flange, ø 70 [2.76]
Shaft type 1 with axial cable outlet

1 9 x M4, 10 [0.39] deep
2 Keyway for DIN 6885-A-4x4x25 key



Clamping / synchronous flange, ø 70 [2.76]
Shaft type 2 with radial cable outlet

1 9 x M4, 10 [0.39] deep



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Standard
ATEX / IECEx – zone 1 / 21, SIL3/PLe, mech. multiturn, optical | **Sendix SIL 7063FS3 (shaft)** | **SSI / BiSS + SinCos**

Ex protection and Functional Safety in one device.

The absolute multiturn encoders 7063FS3 of the Sendix SIL family are suited for use in safety-related applications up to SIL3 acc. to EN 61800-5-2 or PLe to EN ISO 13849-1.

In addition, these devices ensure Ex protection in a compact 70 mm housing out of seawater durable aluminium.

Ex approval | Safety-Lock™ | High rotational speed | High protection level | High shaft load capacity | Shock / vibration resistant | Magnetic field proof | Short-circuit proof | Reverse polarity protection | Optical sensor | Seawater durable

Functional Safety

- Encoder with individual certificate from IFA / TÜV.
- Suitable for applications up to SIL3 acc. to EN 61800-5-2.
- Suitable for applications up to PLe acc. to EN ISO 13849-1.
- SSI or BiSS interface with incremental SinCos tracks with 2048 ppr.
- Certified mechanical mounting + electronic.

Explosion protection

- "Flameproof-enclosure" version.
- ATEX with EC type examination certificate.
- IECEx with certificate of conformity (CoC).

Order code Shaft version

8.7063FS3	.	1	X	4	X	.	X	X	2	1	.	XXXX
Type		a	b	c	d		e	f	g	h		i 1)

a *Flange*
1 = clamping / synchronous flange, IP67, ø 70 mm [2.76"]

b *Shaft (ø x L)*
2 = 10 x 20 mm [0.39 x 0.79"], with flat
1 = 12 x 25 mm [0.47 x 0.98"], with keyway for 4 x 4 mm [0.16 x 0.16"] key

c *Interface / power supply*
4 = SSI, BiSS + 2048 ppr. SinCos / 10 ... 30 V DC

d *Type of connection*
1 = axial cable, 2 m [6.56'] PUR
2 = radial cable, 2 m [6.56'] PUR
A = axial cable, length > 2 m [6.56']
B = radial cable, length > 2 m [6.56']
preferred length see **i**, e. g.: 0100 = 10 m [32.81']

e *Code*
B = SSI, binary
C = BiSS, binary
G = SSI, gray

f *Resolution* 2)
A = 10 bit ST + 12 bit MT
1 = 11 bit ST + 12 bit MT
2 = 12 bit ST + 12 bit MT
3 = 13 bit ST + 12 bit MT
4 = 14 bit ST + 12 bit MT
7 = 17 bit ST + 12 bit MT

g *Inputs / outputs* 2)
2 = SET input

h *Options*
1 = no option

i *Cable length in dm* 1)
0050 = 5 m [16.40']
0100 = 10 m [32.81']
0150 = 15 m [49.21']

Optional on request
- special cable length
- stainless steel version
- other singleturn resolutions

1) Not applicable with connection types 1 and 2.
2) Resolution, preset value and counting direction factory-programmable.

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Absolute encoders – multiturn

Standard ATEX / IECEx – zone 1 / 21, SIL3/PLe, mech. multiturn, optical	Sendix SIL 7063FS3 (shaft)	SSI / BiSS + SinCos

Accessories		Order no.
EMC shield terminal	for top-hat rail mounting	**8.0000.4G06.0000**
Screw retention	Loctite 243, 5 ml	**8.0000.4G05.0000**
Bellows coupling, safety-oriented	You will find an overview of our couplings for Sendix SIL shaft encoders in the accessories section or under www.kuebler.com/accessories.	
Safety modules Safety-M compact / modular	You will find an overview of our systems and components for Functional Safety and the corresponding software in the safety technology section or under www.kuebler.com/safety.	
LED SSI display 570 / 575	Electronic position display up to 32 bit. You will find an overview in the accessories section or under www.kuebler.com/position_display.	

Further accessories can be found in the accessories section or in the accessories area of our website at: www.kuebler.com/accessories.
Additional connectors can be found in the connection technology section or in the connection technology area of our website at: www.kuebler.com/connection_technology.

Technical data

Explosion protection ATEX

EC type-examination certificate	PTB09 ATEX 1106 X
Category (gas)	Ex II 2 G Ex d IIC T4 - T6 Gb
Category (dust)	Ex II 2D Ex tb IIIC T135°C - T85°C Db IP6x
Relevant standards	EN 60079-0:2009 EN 60079-1:2007 EN 60079-31:2009

Explosion protection IECEx

Certificate of conformity (CoC)	IECEx PTB 13.0026 X
Category (gas)	Ex d IIC T4 - T6 Gb
Category (dust)	Ex tb IIIC T135°C - T85°C Db IP6x
Relevant standards	IEC 60079-0:2007 IEC 60079-1:2007 IEC 60079-31:2008

Notes regarding "Functional Safety"

These encoders are suitable for use in safety-related systems up to SIL3 acc. to EN 61800-5-2 and PLe to EN ISO 13849-1 in conjunction with controllers or evaluation units, which possess the necessary functionality.
Additional functions can be found in the operating manual.

Safety characteristics

Classification	PLe / SIL3
System structure	2 channel (Cat. 4 / HFT = 1)
PFH_d value [1]	1.09×10^{-8} h^{-1}
Mission time / Proof test interval	20 years
Relevant standards	EN ISO 13849-1:2008 EN ISO 13849-2:2013 EN 61800-5-2:2007

Electrical characteristics

Power supply	10 ... 30 V DC
Current consumption (no load)	max. 50 mA
Reverse polarity protection for power supply	yes
Short circuit proof outputs	yes [2]
CE compliant acc. to	
(up to April 19, 2016)	EMC guideline 2004/108/EC ATEX guideline 94/9/EC Machinery directive 2006/42/EC RoHS guideline 2011/65/EU
(as from April 20, 2016)	EMC guideline 2014/30/EU ATEX guideline 2014/34/EU Machinery directive 2006/42/EC RoHS guideline 2011/65/EU

EMC

Relevant standards	EN 55011 class B :2009 / A1:2010 EN 61000-6-3:2007 / A1:2011 EN 61000-6-2:2005

Mechanical characteristics

Maximum speed		6000 min^{-1} (continuous)
Starting torque – at 20°C [68°F]		< 0.05 Nm
Mass moment of inertia		4.0×10^{-6} kgm^2
Load capacity of shaft	radial	80 N
	axial	40 N
Weight		approx. 1.3 kg [45.86 oz]
Protection acc. to EN 60529		IP67
Ambient temperature		-40°C ... +60°C [-40 ... +140°F] Please note the specifications for temperature class in EC type-examination certificate!
Material	shaft	stainless steel
	flange / housing	seawater durable Al, type AlSiMgMn (EN AW-6082)
	cable	PUR
Shock resistance acc. to EN 60068-2-27		500 m/s^2, 11 ms
Vibration resistance acc. to EN 60068-2-6		200 m/s^2, 10 ... 150 Hz

1) The specified value is based on a diagnostic coverage of 99 %, that must be achieved with an encoder evaluation unit.
The encoder evaluation unit must meet at least the requirements for SIL3.
2) Short circuit to 0 V or to output, one channel at a time, power supply correctly applied.

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Standard
ATEX / IECEx – zone 1 / 21, SIL3/PLe, mech. multiturn, optical | **Sendix SIL 7063FS3 (shaft)** | **SSI / BiSS + SinCos**

SSI interface

Output driver		RS485 transceiver type
Permissible load / channel		max. +/- 20 mA
Signal level	HIGH	typ 3.8 V
	LOW at I_{Load} = 20 mA	typ 1.3 V
Resolution singleturn		10 ... 14 bit and 17 bit
Number of revolutions (multiturn)		4096 (12 bit)
Code		binary or gray
SSI clock rate		50 kHz ... 2 MHz
Monoflop time		≤ 15 µs

Note: if clock starts cycling within monoflop time a second data transfer starts with the same data. If clock starts cycling after monoflop time, the data transfer starts with updated values. The update rate depends on clock speed, data length and monoflop time.

Data refresh rate	resolution ≤ 14 bit	≤ 1 µs
	resolution ≥ 15 bit	4 µs

BiSS interface

Resolution singleturn	10 ... 14 bit and 17 bit
Number of revolutions (multiturn)	4096 (12 bit)
Code	binary
Clock rate	up to 10 MHz
Max. update rate	< 10 µs, depends on the clock rate and the data length
Data refresh rate	≤ 1 µs

Note:
- bidirectional, factory programmable parameters are: resolution, code, direction, alarms and warnings
- CRC data verification

SinCos interface

Max. frequency -3dB	400 kHz
Signal level	1 Vpp (±10 %)
Short circuit proof	yes [1]
Pulse rate	2048 ppr

SET input

Input		HIGH active
Input type		comparator
Signal level (+V = Power supply)	HIGH	min. 60 % of +V max. +V
	LOW	max. 25 % of +V
Input current		< 0.5 mA
Min. pulse duration (SET)		10 ms
Timeout after SET signal		14 ms

The encoder can be set to zero at any position by means of a HIGH signal on the SET input. Other preset values can be factory-programmed.
The SET input has a signal delay time of approximately 1 ms. Once the SET function has been triggered, the encoder requires an internal processing time of approximately 15 ms before the new position data can be read.

Power-ON

After Power-ON, the device requires a time of approximately 150 ms before valid data can be read.

Avoid encoder hot-plugging.

Terminal assignment

Interface	Type of connection	Features	Cable (isolate unused wires individually before initial start-up)												
4	1, 2, A, B	SET	Signal:	0 V	+V	C+	C-	D+	D-	SET	A	$\overline{A}$	B	$\overline{B}$	⏚
			Cable marking:	6	1	2	3	4	5	11	7	8	9	10	shield

+V: Encoder power supply +V DC
0 V: Encoder power supply ground GND (0 V)
C+, C-: Clock signal
D+, D-: Data signal
SET: SET input. The current position becomes defined as position zero.
A, $\overline{A}$: Cosine signal
B, $\overline{B}$: Sine signal
⏚: Protective earth

1) Short circuit to 0 V or to output, one channel at a time, power supply correctly applied.

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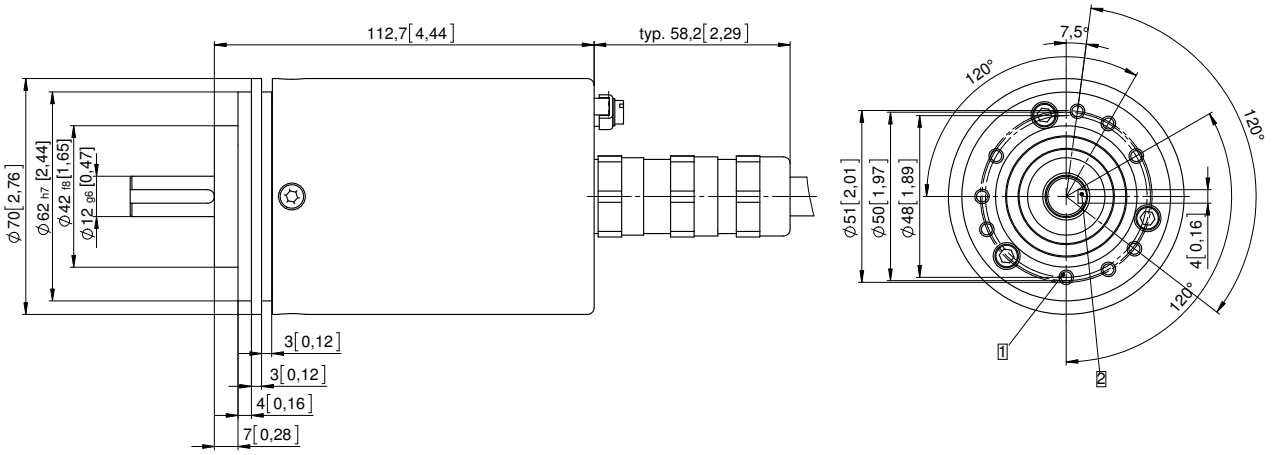
Standard
ATEX / IECEx – zone 1 / 21, SIL3/PLe, mech. multiturn, optical | **Sendix SIL 7063FS3 (shaft)** | **SSI / BiSS + SinCos**

Dimensions

Dimensions in mm [inch]

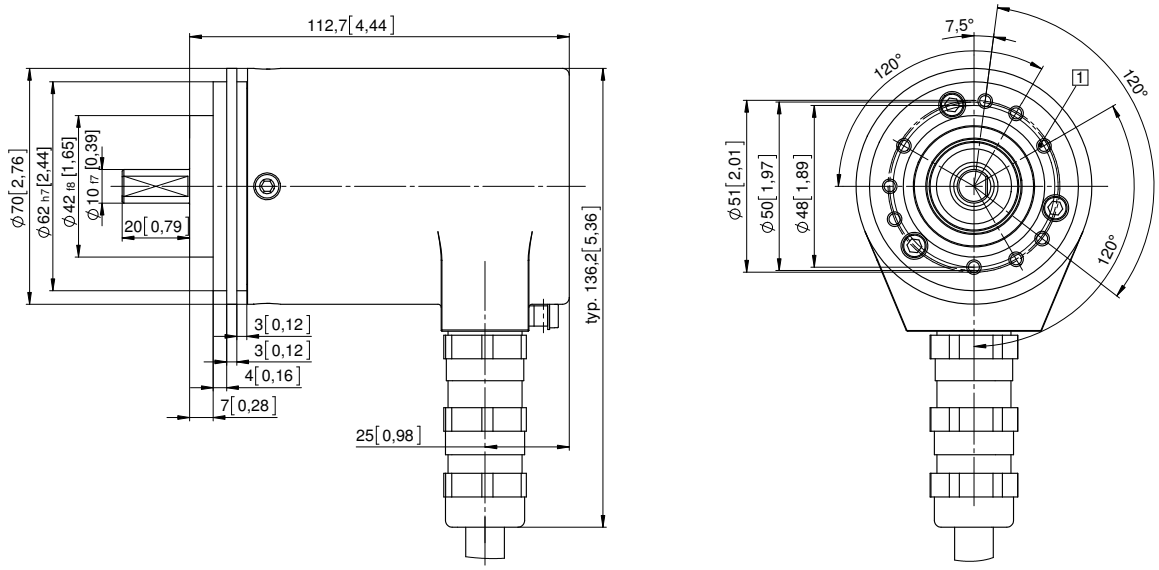
Clamping / synchronous flange, ø 70 [2.76]
Shaft type 1 with axial cable outlet

1 9 x M4, 10 [0.39] deep
2 Keyway for DIN 6885-A-4x4x25 key



Clamping / synchronous flange, ø 70 [2.76]
Shaft type 2 with radial cable outlet

1 9 x M4, 10 [0.39] deep



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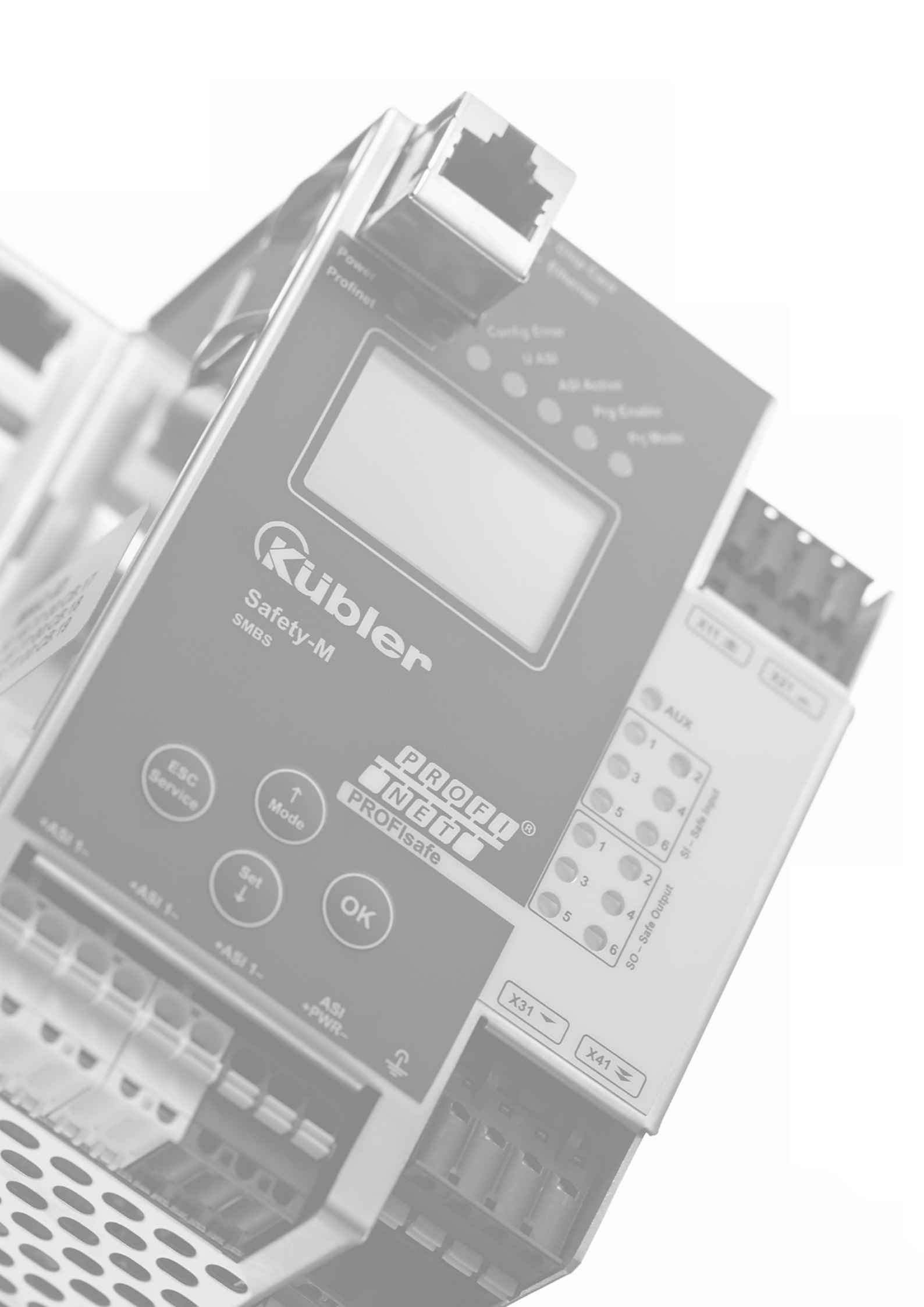
Power
Profinet
Config Error
U ASI
ASI Active
Prg Enable
Prg Mode
Kübler
Safety-M
SMBS
ESC
Service
Mode
Set
OK
PROFINET
PROFIsafe
AUX
SI - Safe Input
SO - Safe Output
+ASI 1-
+ASI 1-
+ASI 1-
ASI
+PWR-
X31
X41

Safety modules

Safety-M compact				Type	Page
Basic modules	Speed monitoring	1 axis / 1 encoder system		SMC1	**118**
	Speed monitoring	1 axis / 2 encoder systems	new	SMC2	**122**
Safety-M modular				**Type**	**Page**
Basic modules	Digital	With USB diagnostic interface		SMBD.420	**126**
	Digital	With Ethernet diagnostic interface		SMBD.32E	**129**
	Gateway, universal	CANopen		SMBU.021	**132**
	Gateway, universal	PROFIBUS DP		SMBU.031	**135**
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Accessories	Encoder adapter module	For axis expansion		SMAS	**242**

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Safety-M compact
Basic module

Speed monitoring – SMC1

1 axis / 1 encoder system

SMC1 is a compact safety module of the Safety-M family with integrated drive monitoring for one axis with a safe encoder system.

For optimal integration in existing safety circuits or for upgrading old machines.

Parameterizable by means of a removable control unit or a simple PC software.

1-encoder solution (SinCos) is supported for the safe speed detection.

- Extensive library of pre-configured safe sensors and command devices.
- Complete range of speed-related safe drive monitoring functions equivalent to EN 61800-5-2 already integrated in firmware (e.g. SOS, SLS, SSM, STO).
- Integrated signal splitter for SinCos signal forwarding (optional).
- Snap-on installation on 35 mm C profile rail.
- LED on the front side indicates operating state.
- Removable control and diagnosis display (optional).
- 2 safe input lines, 8/4 safe shut-off channels.
- Cross-short-cut monitoring functionality (EDM).
- Potential-free relay open contacts.
- Contact multiplication or increase of power capability by external contactors in connection with the device-internal monitoring function for external contacts.
- Extensive diagnostic functionality integrated in FW.
- 1 analog output 4 ... 20 mA.
- Free “SafeConfig” parameterization software.

Order code

8	.	SMC1	.	1 (a)	X (b)	A (c)	.	241

(a) *Encoder interface*
1 = 1 x Sub-D SinCos

(b) *Internal signal splitting*
0 = without
S = with

(c) *Analog output*
A = 4 ... 20 mA

Accessories		Order no.
Control and diagnostic display, OLED touch screen		**8.SMCB.000**
Programming cable, Multi-USB Adapter		**05.C162RK1**
Shield terminal for encoder cable, C profile rail		**8.0000.4G06.0000**
Connection technology		Order no.
Cordset, pre-assembled 2 m [1]	cable with 1 x M23 / 1 x Sub-D, 9-pin, male connector	**8.0000.6V00.0002.0085**
for Sendix SIL encoders	cable with 1 x M12 / 1 x Sub-D, 9-pin, male connector	**8.0000.6V00.0002.0084**
	cable, single-ended / 1 x Sub-D, 9-pin, male connector	**8.0000.6V00.0002.0087**
	cable, single-ended / 1 x Sub-D, 9-pin, female connector	**8.0000.6V00.0002.0086**

Further accessories can be found in accessories area of our website at: www.kuebler.com/accessories.
Additional connectors can be found in the connection technology section or in the connection technology area of our website at: www.kuebler.com/connection_technology.
You will find an overview of our systems and components for Functional Safety under www.kuebler.com/safety.

1) Other lengths available

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Safety-M compact Basic module | Speed monitoring – SMC1 | 1 axis / 1 encoder system

Technical data

General data

Digital input lines	4 / 2
Digital output lines	8 / 4
Safe relay outputs	1
Type of connection	pluggable screw terminals
Max. terminal cross section	1.5 mm^2 [AWG 15]
Drive monitoring - number of axis	1 axis

Electrical characteristics

Power supply	24 V DC / 2.5 A
Tolerance	±20 %
Current consumption (no load)	max. 150 mA
Power consumption	max. 45 W
Fuse on power supply	max. 2.5 A, medium time-lag
Rated data digital inputs	24 V DC / 15 mA
Rated data digital outputs	24 V DC / 30 mA
Rated data relay	24 V DC / 5 A
Rated encoder power supply data	approx. 2V below the supply voltage / max. 200 mA

Environmental data

Operating temperature	-20°C ... +55°C [-4°F ...+131°F]
Storage temperature	-25°C ... +70°C [-13°F ...+158°F]
Protection acc. to EN 60529	IP20
Climate class	3 acc. to DIN 50178 (non condensing)
CE compliant acc. to (up to April 19, 2016)	EMC guideline 2004/108/EG Machinery directive 2006/42/EC Low voltage guideline 2006/95/EC RoHS guideline 2011/65/EU
(as from April 20, 2016)	EMC guideline 2014/30/EU Machinery directive 2006/42/EC Low voltage guideline 2014/35/EU RoHS guideline 2011/65/EU

EMC

Relevant standards	EN 61000-6-2:2005 / AC:2005 EN 61000-6-4:2007 / A1:2011 EN 61326-3-2:2008

Safety characteristics

Classification	PLe / SIL3
System structure	2 channel (Cat. 3 / HFT = 1)
PFH_d value	3.76 x 10^{-8} h^{-1}
Mission time / Proof test interval	20 years
Reaction times	see operating instructions
Relevant standards	EN ISO 13849-1:2008 EN 62061:2005

SinCos interface (IN) X6

Type of connection	Sub-D, male connector, 9-pin
Signal	SinCos
Frequency	max. 500 kHz
Signal level	1 Vpp (±20 %)
Signal offset	2.5 V ±0.1 V
Signal termination	120 Ω

Incremental interface (IN) X10

Type of connection	pluggable screw terminals, 5-pin
Signal	digital inputs
Signal level	PNP (24 V DC)
Execution	complementary

Incremental interface (OUT) X2

Type of connection	pluggable screw terminals, 8-pin
Signal	HTL / Push-Pull

Incremental interface (OUT) X4

Type of connection	pluggable screw terminals, 7-pin
Signal	RS422 / TTL
Frequency	max. 500 kHz
Signal delay	approx. 600 ns

Analog interface (OUT) X4

Type of connection	pluggable screw terminals, 7-pin
Signal	analog
Resolution	14 bit
Accuracy	0.1 %
Output	1 ms
Frequency	4 ... 20 mA
Load	max. 270 Ω

SinCos interface (OUT) X5

Type of connection	Sub-D, female connector, 9-pin
Signal	SinCos
Frequency	max. 500 kHz
Signal delay	approx. 200 ns

USB interface X12

Type	USB-B female connector
Standard	USB 1.0

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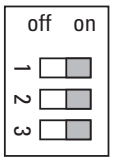
Safety-M compact Basic module | Speed monitoring – SMC1 | 1 axis / 1 encoder system

Mechanical characteristics		
Size w x h x d		50 x 100 x 165 mm [1.97 x 3.94 x 6.50"]
Weight		390 g [13.76 oz]
Mounting		snap-on mounting on standard head rail
Material	housing	plastic
Shock resistance acc. to EN 60068-2-27		300 m/s², 11 ms 170 m/s², 6 ms
Vibration resistance acc. to EN 60068-2-6		70 m/s², 10 ... 200 Hz

LED display		
ERROR (yellow)	steadily on	error
	flashing quickly	peripheral alarm
	flashing slowly	DIP 1 = OFF, factory setting DIP 3 = OFF, programming mode
ON (green)	steadily on	power on

Internal signal splitter			
Conversion time max.	*IN*	*OUT*	
	SinCos <-->	SinCos	200 ns
	SinCos <-->	RS422	600 ns
	RS422 <-->	RS422	600 ns
	HTL <-->	RS422	600 ns

DIP switch S1

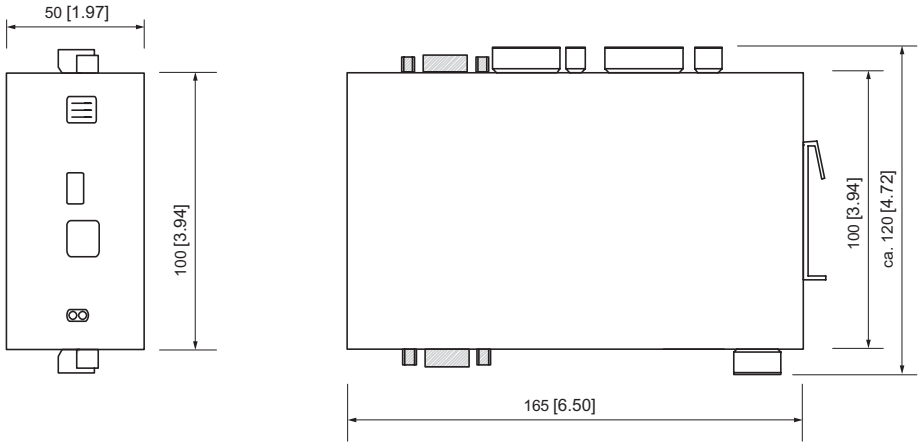


ON		Normal operation
OFF	1	Factory setting
	2	Self-test report
	3	Programming mode

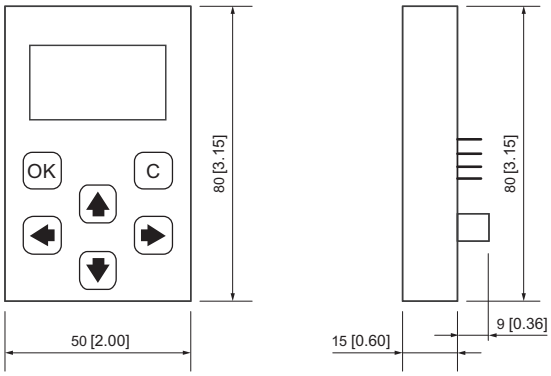
Dimensions

Dimensions in mm [inch]

Basic module



Control and diagnostic display – 8.SMCB.000
(further information can be found in the section accessories)



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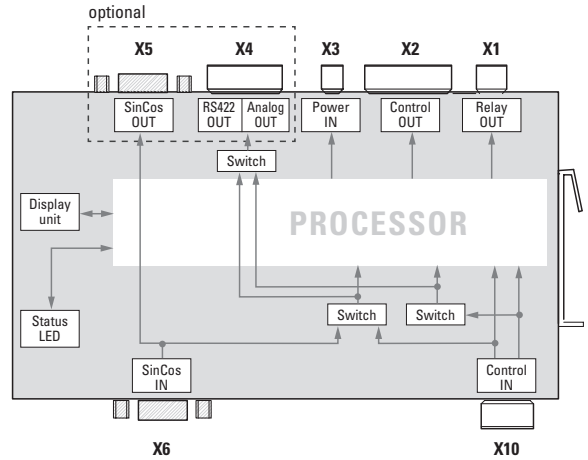
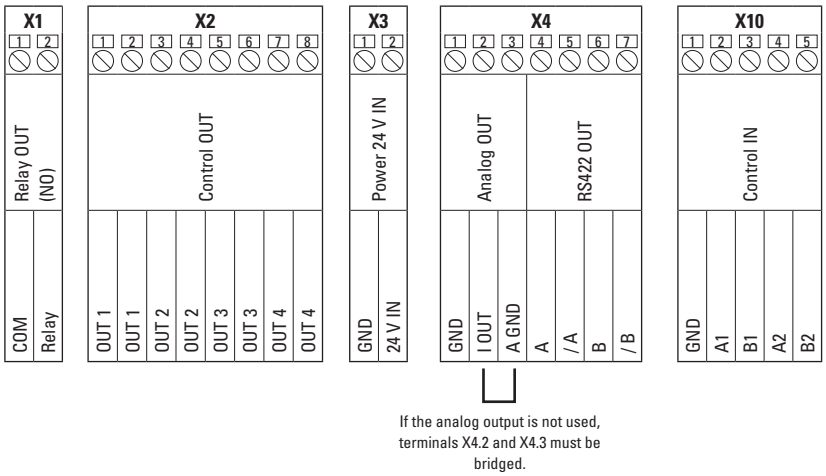
Safety-M compact Basic module | Speed monitoring – SMC1 | 1 axis / 1 encoder system

Terminal assignment



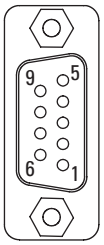


If the analog output is not used, terminals X4.2 and X4.3 must be bridged.

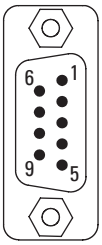
Interface	Sub-D female connector										
Terminal X5	Signal: SinCos	A	$\overline{B}$	B	–	0 V	–	–	–	$\overline{A}$	⏚
	Pin:	1	2	3	4	5	6	7	8	9	PH

Interface	Sub-D male connector										
Terminal X6	Signal: SinCos	A	$\overline{B}$	B	+V	0 V	–	–	–	$\overline{A}$	⏚
	Pin:	1	2	3	4	5	6	7	8	9	PH

+V: Power supply encoder +V DC
0 V: Encoder power supply ground GND (0V)
A, $\overline{A}$: Cosine signal / Incremental channel A
B, $\overline{B}$: Sine signal / Incremental channel B
PH ⏚: Plug connector housing (Shield)



Sub-D female connector, 9-pin
terminal X5



Sub-D male connector, 9-pin
terminal X6

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Safety-M compact
Basic module

Speed monitoring – SMC2

1 axis / 2 encoder systems

SMC2 is a compact safety module of the Safety-M family with integrated drive monitoring for one axis with 2 encoder sytems.

For optimal integration in existing safety circuits or for upgrading old machines.

Parameterizable by means of a removable control unit or a simple PC software.

SinCos RS422 TTL Push-Pull HTL

2-encoder solutions (HTL/proximity switch, TTL/RS422, SinCos) are supported for the safe speed detection.

- Extensive library of pre-configured safe sensors and command devices.
- Complete range of speed-related safe drive monitoring functions equivalent to EN 61800-5-2 already integrated in firmware (e.g. SOS, SLS, SSM, STO).
- Different encoder interfaces for TTL / RS422, SinCos and HTL /Push-Pull / proximity switch.
- Integrated signal splitter for encoder signal forwarding (optional).
- Snap-on installation on 35 mm C profile rail.
- LED on the front side indicates operating state.
- Removable control and diagnosis display (optional).
- 2 safe input lines, 8/4 safe shut-off channels.
- Cross-short-cut monitoring functionality (EDM).
- Potential-free relay open contacts.
- Contact multiplication or increase of power capability by external contactors in connection with the device-internal monitoring function for external contacts.
- Extensive diagnostic functionality integrated in FW.
- 1 analog output 4 ... 20 mA.
- Free “SafeConfig” parameterization software.

Order code

8	.	SMC2	.	2 (a)	X (b)	A (c)	241

(a) *Encoder interface*
2 = 2 x Sub-D SinCos

(b) *Internal signal splitting*
0 = without
S = with

(c) *Analog output*
A = 4 ... 20 mA

Accessories		Order no.
Control and diagnostic display, OLED touch screen		**8.SMCB.000**
Programming cable, Multi-USB Adapter		**05.C162RK1**
Shield terminal for encoder cable, C profile rail		**8.0000.4G06.0000**
Connection technology		Order no.
Cordset, pre-assembled 2 m [1]	cable with 1 x M23 / 1 x Sub-D, 9-pin, male connector	**8.0000.6V00.0002.0085**
for Sendix SIL encoders	cable with 1 x M12 / 1 x Sub-D, 9-pin, male connector	**8.0000.6V00.0002.0084**
	cable, single-ended / 1 x Sub-D, 9-pin, male connector	**8.0000.6V00.0002.0087**
	cable, single-ended / 1 x Sub-D, 9-pin, female connector	**8.0000.6V00.0002.0086**

Further accessories can be found in accessories area of our website at: www.kuebler.com/accessories.
Additional connectors can be found in the connection technology section or in the connection technology area of our website at: www.kuebler.com/connection_technology.
You will find an overview of our systems and components for Functional Safety under www.kuebler.com/safety.

1) Other lengths available

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Safety-M compact Basic module | Speed monitoring – SMC2 | 1 axis / 2 encoder systems

Technical data

General data

Digital input lines	4 / 2
Digital output lines	8 / 4
Safe relay outputs	1
Type of connection	pluggable terminals
Max. terminal cross section	1.5 mm^2 [AWG 15]
Drive monitoring - number of axis	1 axis

Electrical characteristics

Power supply	24 V DC / 2.5 A
Tolerance	±20 %
Current consumption (no load)	max. 150 mA
Power consumption	max. 45 W
Fuse on power supply	max. 2.5 A, medium time-lag
Rated data digital inputs	24 V DC / 15 mA
Rated data digital outputs	24 V DC / 30 mA
Rated data relay	24 V DC / 5 A
Rated encoder power supply data	approx. 2V below the supply voltage / max. 200 mA

Environmental data

Operating temperature	-20°C ... +55°C [-4°F ...+131°F]
Storage temperature	-25°C ... +70°C [-13°F ...+158°F]
Protection acc. to EN 60529	IP20
Climate class	3 acc. to DIN 50178 (non condensing)
CE compliant acc. to	
(up to April 19, 2016)	EMC guideline 2004/108/EG Machinery directive 2006/42/EC Low voltage guideline 2006/95/EC RoHS guideline 2011/65/EU
(as from April 20, 2016)	EMC guideline 2014/30/EU Machinery directive 2006/42/EC Low voltage guideline 2014/35/EU RoHS guideline 2011/65/EU

EMC

Relevant standards	EN 61000-6-2:2005 / AC:2005 EN 61000-6-4:2007 / A1:2011 EN 61326-3-2:2008

Safety characteristics

Classification	PLe / SIL3
System structure	2 channel (Cat. 3 / HFT = 1)
PFH_d value	3.76 x 10^{-8} h^{-1}
Mission time / Proof test interval	20 years
Reaction times	see operating instructions
Relevant standards	EN ISO 13849-1:2008 EN 62061:2005

SinCos interface (IN) X6, X7

Type of connection	Sub-D, male connector, 9-pin
Signal	SinCos
Frequency	max. 500 kHz
Signal level	1 Vpp (±20 %)
Signal offset	2.5 V ±0.1 V
Signal termination	120 Ω

Incremental interface (IN) X8, X9

Type of connection	pluggable screw terminals, 7-pin
Signal	RS422 / TTL
Frequency	max. 500 kHz
Signal termination	120 Ω, 220 pF

Incremental interface (IN) X10

Type of connection		pluggable screw terminals, 5-pin
Signal	incremental interface	proximity switch / HTL or digital inputs
Frequency		max. 250 kHz
Signal level		PNP (24 V DC)
Execution		complementary

Incremental interface (OUT) X2

Type of connection	pluggable screw terminals, 8-pin
Signal	HTL / Push-Pull

Incremental interface (OUT) X4

Type of connection	pluggable screw terminals, 7-pin
Signal	RS422 / TTL
Frequency	max. 500 kHz
Signal delay	approx. 600 ns

Analog interface (OUT) X4

Type of connection	pluggable screw terminals, 7-pin
Signal	analog
Resolution	14 bit
Accuracy	0.1 %
Output	1 ms
Frequency	4 ... 20 mA
Load	max. 270 Ω

SinCos interface (OUT) X5

Type of connection	Sub-D, female connector, 9-pin
Signal	SinCos
Frequency	max. 500 kHz
Signal delay	approx. 200 ns

USB interface X12

Type	USB-B female connector
Standard	USB 1.0

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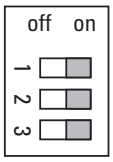
Safety-M compact Basic module | Speed monitoring – SMC2 | 1 axis / 2 encoder systems

Mechanical characteristics		
Size w x h x d		50 x 100 x 165 mm [1.97 x 3.94 x 6.50"]
Weight		390 g [13.76 oz]
Mounting		snap-on mounting on standard head rail
Material	housing	plastic
Shock resistance acc. to EN 60068-2-27		300 m/s², 11 ms 170 m/s², 6 ms
Vibration resistance acc. to EN 60068-2-6		70 m/s², 10 ... 200 Hz

LED display		
ERROR (yellow)	steadily on	error
	flashing quickly	peripheral alarm
	flashing slowly	DIP 1 = OFF, factory setting DIP 3 = OFF, programming mode
ON (green)	steadily on	power on

Internal signal splitter			
Conversion time max.	*IN*	*OUT*	
	SinCos <-->	SinCos	200 ns
	SinCos <-->	RS422	600 ns
	RS422 <-->	RS422	600 ns
	HTL <-->	RS422	600 ns

DIP switch S1

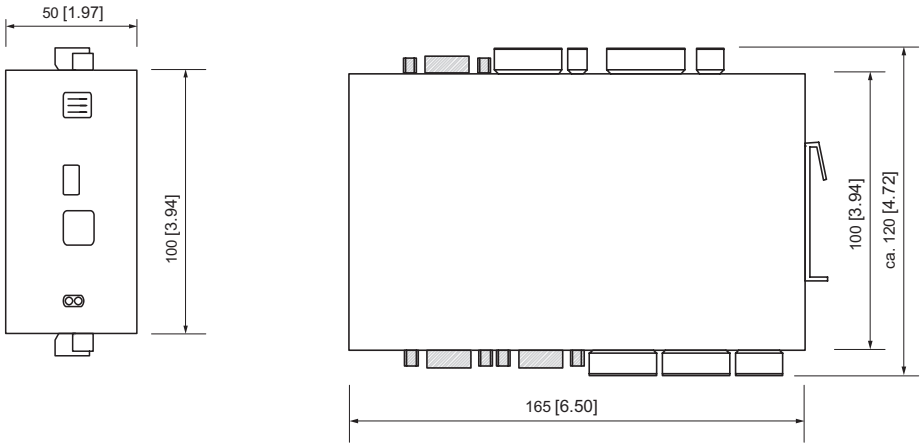


ON		Normal operation
OFF	1	Factory setting
	2	Self-test report
	3	Programming mode

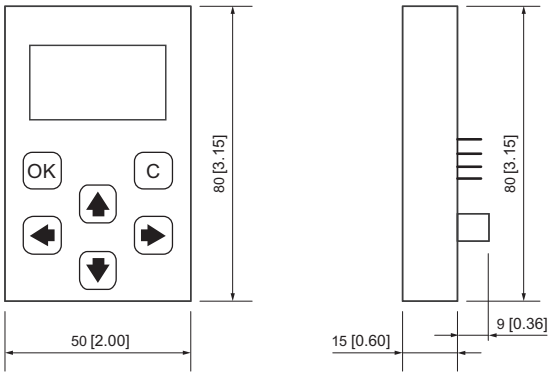
Dimensions

Dimensions in mm [inch]

Basic module



Control and diagnostic display – 8.SMCB.000
(further information can be found in the section accessories)



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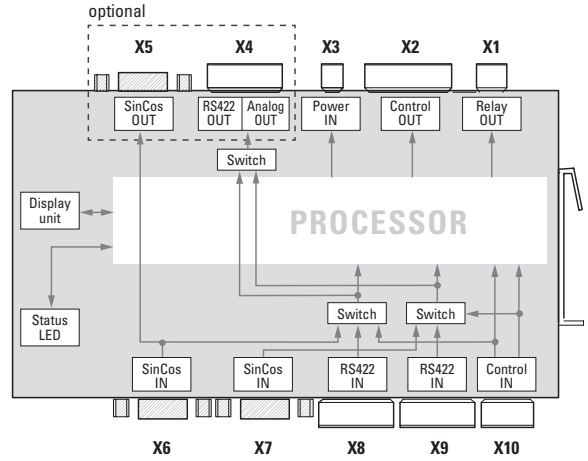
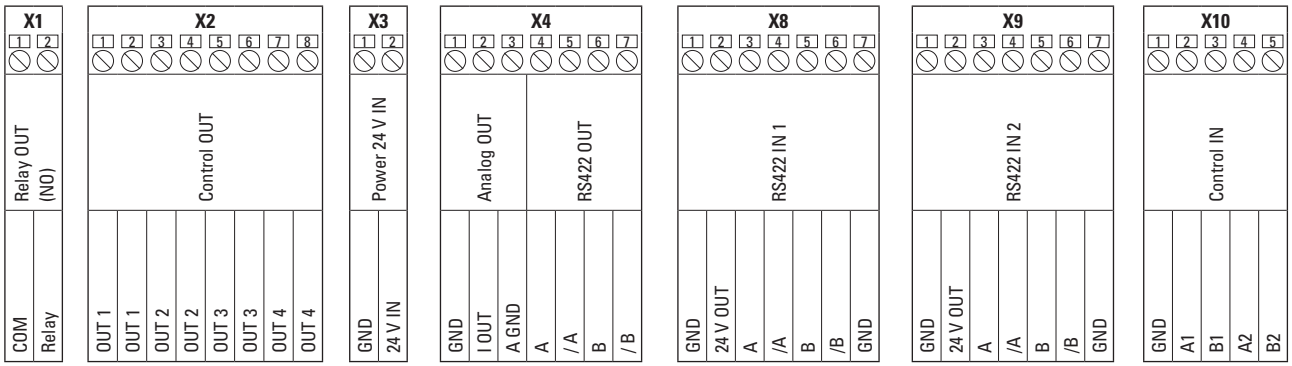
Safety-M compact Basic module | Speed monitoring – SMC2 | 1 axis / 2 encoder systems

Terminal assignment



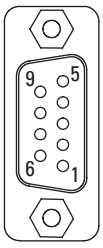


If the analog output is not used, terminals X4.2 and X4.3 must be bridged.

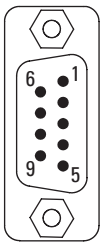
Interface	Sub-D female connector										
Terminal X5	Signal: SinCos	A	$\overline{B}$	B	–	0 V	–	–	–	$\overline{A}$	⏚
	Pin:	1	2	3	4	5	6	7	8	9	PH

Interface	Sub-D male connector										
Terminal X6, X7	Signal: SinCos	A	$\overline{B}$	B	+V	0 V	–	–	–	$\overline{A}$	⏚
	Pin:	1	2	3	4	5	6	7	8	9	PH

+V: Power supply encoder +V DC
0 V: Encoder power supply ground GND (0V)
A, $\overline{A}$: Cosine signal / Incremental channel A
B, $\overline{B}$: Sine signal / Incremental channel B
PH ⏚: Plug connector housing (Shield)



Sub-D female connector, 9-pin
terminal X5



Sub-D male connector, 9-pin
terminal X6, X7

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Safety-M modular
Basic module

With USB diagnostic interface – SMBD.420

Digital

SMBD is a compact and modular safety control of the Safety-M modular product family with integrated drive monitoring. This device is freely programmable for safe processing of drive-related safety functions and of EMERGENCY STOP switches, two-hand controls, light barriers, operating mode selectors, etc.

The basic device offers 8 / 4 safe inputs and 2 safe shut-off channels.

- Basic module for setting up a monitoring system for safe speed and/or position measurement with configurable inputs and outputs.
- Extensive library of pre-configured safe sensors and command devices.
- Speed-related safe drive monitoring functions via counting inputs (e.g. SS1, SOS, SLS, SSM).
- Extended drive monitoring via axis expansion module EMAx (e.g. SS1, SS2, SOS, SLS, SDI, SLA, SSM, SCA, ...).
- Safe brake control "SBC" via output expansion modules EMIO e.g. for suspended loads.
- Programming with SafeMonitor software.
- Status LED on the front side.
- Basic unit comes with 4 safe input lines and 2 safe shut-off channels. The 4 safe inputs can also be used as 8 standard inputs.
- Cross-short-cut monitoring functionality (EDM).
- Contact multiplication or increase of power capability by external contactors in connection with the device-internal monitoring function for external contacts.
- Extensive diagnostic functionality integrated in FW.
- Integrated chip card for saving configuration data, ensuring easy device replacement.
- Parameterizable inputs for HTL/Push-Pull sensors for direct speed monitoring up to 4 kHz, also as e.g. proximity switch.
- AS-i master functionality with up to 31 safe slaves.
- Reduced module width and therefore costs saving at cabinet level.
- Easy, fast and comfortable wiring, without topological restrictions.

Order no.

SMBD	Basic module	**8.SMBD.420**

Accessories		Order no.
Memory chip card	replacement (10 pieces), 32 kB / 256 kbits	**8.SMCC.032**
USB-Programming cable	2 m length	**05.68784.002M**
SafeMonitor license	single user software license	**8.SMSW.000**

Further accessories can be found in accessories area of our website at: www.kuebler.com/accessories.
Additional connectors can be found in the connection technology section or in the connection technology area of our website at: www.kuebler.com/connection_technology.
You will find an overview of our systems and components for Functional Safety under www.kuebler.com/safety.

Modular construction

Basic module
Modular safety control system.

Expansion modules
For additional inputs and outputs and axis monitoring.

SMBx | **EMxx**

Expansion modules

EMAI	Axis expansion for incremental encoders.
EMAA	Axis expansion for absolute encoders.
EMIO	Input / output expansion.

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Safety-M modular
Basic module
With USB diagnostic interface – SMBD.420
Digital

Technical data

General data

Safe digital input lines	8 / 4, OSSD compatible
Safe digital output lines	2
Type of connection	pluggable screw terminals
Max. terminal cross section	1.5 mm² [AWG 15]
Interface for expansion modules	AS-i

Electrical characteristics

Power supply	24 V DC / 4 A
Tolerance	-15 %, +25 %
Power consumption	4.8 W
Fuse on power supply	max. 4 A
Rated data digital inputs	24 V DC / 15 mA, type 1 to EN 61131-2
Rated data digital outputs	24 V DC / 700 mA
Pulse output lines	max. 250 mA

Environmental data

Operating temperature	0°C ... +55°C [+32°F ...+131°F]
Storage temperature	-25°C ... +85°C [-13°F ...+185°F]
Protection acc. to EN 60529	IP20
Climate class	3 acc. to DIN 50178
CE compliant acc. to	
(up to April 19, 2016)	EMC guideline 2004/108/EG Machinery directive 2006/42/EC RoHS guideline 2011/65/EU
(as from April 20, 2016)	EMC guideline 2014/30/EU Machinery directive 2006/42/EC RoHS guideline 2011/65/EU

Safety characteristics

Classification	PLe / SIL3
System structure	2 channel (Cat. 4 / HFT = 1)
PFH_d value	5.08 x 10^{-9} h^{-1}
Mission time / Proof test interval	20 years
Max. response time	< 40 ms
Max. mission time	12 months
Relevant standards	EN ISO 13849-1 :2008 / AC:2009 EN ISO 13849-2 :2012 EN 62061 :2005 / A1:2013

EMC

Relevant standards	EN 61326-3-1 :2008 EN 61000-6-2 :2005 / AC:2005 EN 61000-6-4 :2007 / A1:2011 EN 62026-2 :2013 EN 61131-2 :2007 / A1:2011

Mechanical characteristics

Size w x h x d	22.5 x 99 x 114.5 mm [0.89 x 3.90 x 4.51"]
Weight	160 g [5.64 oz]
Mounting	snap-on mounting on standard head rail

Display LEDs – for other statuses please contact the Kübler Service

S1 … S8	LED yellow	off	contact (S1 … S8) open
		blinking 1 Hz	cross short-cut
		on	contact (S1 … S8) closed
SM [1]		off	AS-i voltage faulty
	LED green	blinking 1 Hz	protection mode and SafeMonitor active
		on	protection mode active
	LED red	blinking 1 Hz	configuration mode and SafeMonitor active
		on	configuration mode active
	LED yellow	blinking 1 Hz	service button, status 'Teach error'
		on	service button, status 'Ready'
	LED red/yellow	blinking 1 Hz	at least 1 device in state "red blinking" or "yellow blinking"
AS-i M [2]		off	offline, monitor mode
	LED green	blinking 1 Hz	master: programming mode, no error
		on	master: protected mode, no error
	LED red	blinking 1 Hz	peripheral error without config. error
		on	config. error, auto addressing impossible
	LED red/green	blinking 1 Hz	config. error, auto addressing possible
O1 ... O2 [3]		off	output (O1 ... O2) off
	LED yellow	blinking 1 Hz	restart interlock
		blinking 8 Hz	rectifiable fault condition
		on	output (O1 ... O2) on
	LED red	on	AUX voltage missing
SM + AS-i M + O1 + O2			
	LED red	blinking 1 Hz	compending master active

LED flashing sample

Chip card is written (yellow)		
	S1 ... S8	blinking 1Hz, common mode
Circuit or internal error (red)		
	S1 ... S8	off
	SM, AS-i M, O1, O2	blinking 8 Hz
Data on chip card and device different (yellow)		
	S1, S3, S5, S7	blinking 1 Hz, push-pull mode
	S2, S4, S6, S8	off
Chip card defective (yellow)		
	S1, S3, S5, S7	blinking 1 Hz, common mode
	S2, S4, S6, S8	off

1) "yellow" has higher priority than "red" and "green" and will displayed preferentially.
2) If "config. error" and "peripheral fault" occur simultaneously, only "config. error" is displayed.
3) "red" has highe priority than "yellow".

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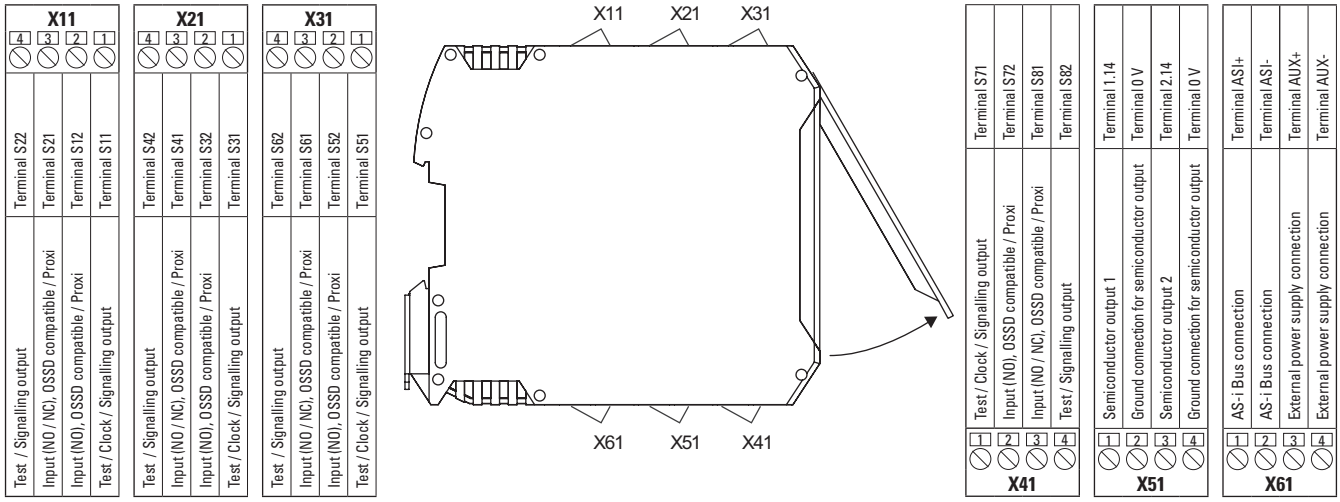
Safety-M modular Basic module | With USB diagnostic interface – SMBD.420 | Digital

Encoder interface terminal X31 / X41		
Signal		HTL/proximity switch
Frequency		max. 4 kHz, resolution 0.1 Hz
Axes	2 x 2 channel 2 x 1 channel	PLd, SIL2 – speed + standstill PLc, SIL1 – speed
Inputs status		yellow
Speed monitoring	1 channel	X31: S52 input 1 S61 input 2 X41: S72 input 3 S81 input 4
	2 channel	X31: S52 input 1.1 S61 input 1.2 X41: S72 input 2.1 S81 input 2.2

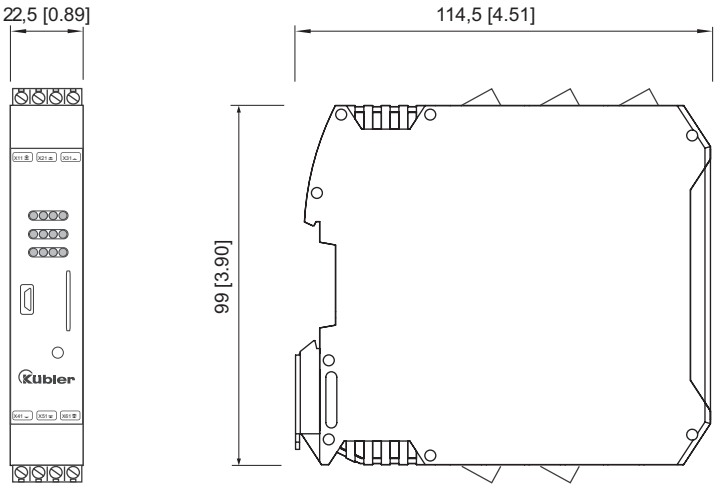
AS-i interface	
Type	AS-i 3.0 Master
Voltage	18 ... 31.6 V
Power consumption	max. 200 mA

Terminal assignment



Dimensions

Dimensions in mm [inch]



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Safety-M modular Basic module | With Ethernet diagnostic interface – SMBD.32E | Digital

SMBD is a compact and modular safety control of the Safety-M modular product family with integrated drive monitoring. This device is freely programmable for safe processing of drive-related safety functions and of EMERGENCY STOP switches, two-hand controls, light barriers, operating mode selectors, etc.

The basic device offers 6 / 3 safe inputs and 2 safe shut-off channels.

- Basic module for setting up a monitoring system for safe speed and/or position measurement with configurable inputs and outputs.
- Extensive library of pre-configured safe sensors and command devices.
- Speed-related safe drive monitoring functions via counting inputs (e.g. SS1, SOS, SLS, SSM).
- Extended drive monitoring via axis expansion module EMAx (e.g. SS1, SS2, SOS, SLS, SDI, SLA, SSM, SCA, ...).
- Safe brake control "SBC" via output expansion modules EMIO e.g. for suspended loads.
- Programming with SafeMonitor software.
- Status LED on the front side.
- Basic unit comes with 3 safe input lines and 2 safe shut-off channels. The 3 safe inputs can also be used as 6 standard inputs.
- Cross-short-cut monitoring functionality (EDM).
- Contact multiplication or increase of power capability by external contactors in connection with the device-internal monitoring function for external contacts.
- Extensive diagnostic functionality integrated in FW.
- Integrated chip card for saving configuration data, ensuring easy device replacement.
- Parameterizable inputs for HTL/Push-Pull sensors for direct speed monitoring up to 4 kHz, also as e.g. proximity switch.
- Safe cross communication with other SMBx modules.
- AS-i master functionality with up to 31 safe slaves.
- Reduced module width and therefore costs saving at cabinet level.
- Easy, fast and comfortable wiring, without topological restrictions.

Order no.

SMBD	Basic module	**8.SMBD.32E**

Accessories		Order no.
Memory chip card	replacement (10 pieces), 32 kB / 256 kbits	**8.SMCC.032**
SafeMonitor license	single user software license	**8.SMSW.000**

Connection technology		Order no.
Cordset, pre-assembled, 2 m [6.56']	Ethernet programming cable	**05.00.60A1.7272.002M**
Crossover adapter	Ethernet adapter	**05.CA.RJ45**
USB Fast Ethernet Port	USB <–> Ethernet adapter	**05.UA0144**

Further accessories can be found in accessories area of our website at: www.kuebler.com/accessories.
Additional connectors can be found in the connection technology section or in the connection technology area of our website at: www.kuebler.com/connection_technology.
You will find an overview of our systems and components for Functional Safety under www.kuebler.com/safety.

Modular construction

Basic module
Modular safety control system.

Expansion modules
For additional inputs and outputs and axis monitoring.

SMBx | **EMxx**

Expansion modules

EMAI Axis expansion for incremental encoders.
EMAA Axis expansion for absolute encoders.
EMIO Input / output expansion.

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Safety-M modular Basic module | With Ethernet diagnostic interface – SMBD.32E | Digital

Technical data

General data

Safe digital input lines	6 / 3, OSSD compatible
Safe digital output lines	2
Type of connection	pluggable screw terminals
Max. terminal cross section	1.5 mm² [AWG 15]
Interface for expansion modules	AS-i

Electrical characteristics

Power supply	24 V DC / 4 A
Tolerance	-15 %, +25 %
Power consumption	4.8 W
Fuse on power supply	max. 4 A
Rated data digital inputs	24 V DC / 15 mA, type 1 to EN 61131-2
Rated data digital outputs	24 V DC / 700 mA
Pulse output lines	max. 250 mA

Environmental data

Operating temperature	0°C ... +55°C [+32°F ...+131°F]
Storage temperature	-25°C ... +85°C [-13°F ...+185°F]
Protection acc. to EN 60529	IP20
Climate class	3 acc. to DIN 50178
CE compliant acc. to	
(up to April 19, 2016)	EMC guideline 2004/108/EG Machinery directive 2006/42/EC RoHS guideline 2011/65/EU
(as from April 20, 2016)	EMC guideline 2014/30/EU Machinery directive 2006/42/EC RoHS guideline 2011/65/EU

Safety characteristics

Classification	PLe / SIL3
System structure	2 channel (Cat. 4 / HFT = 1)
PFH_d value	5.08 x 10^{-9} h^{-1}
Mission time / Proof test interval	20 years
Max. response time	< 40 ms
Max. mission time	12 months
Relevant standards	EN ISO 13849-1 :2008 / AC:2009 EN ISO 13849-2 :2012 EN 62061 :2005 / A1:2013

EMC

Relevant standards	EN 61326-3-1 :2008 EN 61000-6-2 :2005 / AC:2005 EN 61000-6-4 :2007 / A1:2011 EN 62026-2 :2013 EN 61131-2 :2007 / A1:2011

Mechanical characteristics

Size w x h x d	22.5 x 99 x 114.5 mm [0.89 x 3.90 x 4.51"]
Weight	160 g [5.64 oz]
Mounting	snap-on mounting on standard head rail

Display LEDs – for other statuses please contact the Kübler Service

NET	LED green	off	Modbus inactive
		on	Modbus active
S1 … S8	LED yellow	off	contact (S1 … S8) open
		blinking 1 Hz	cross short-cut
		on	contact (S1 … S8) closed
SM [1]		off	AS-i voltage faulty
	LED green	blinking 1 Hz	protection mode and SafeMonitor active
		on	protection mode active
	LED red	blinking 1 Hz	configuration mode and SafeMonitor active
		on	configuration mode active
	LED yellow	blinking 1 Hz	service button, status 'Teach error'
		on	service button, status 'Ready'
	LED red/yellow	blinking 1 Hz	at least 1 device in state "red blinking" or "yellow blinking"
AS-i M [2]		off	offline, monitor mode
	LED green	blinking 1 Hz	master: programming mode, no error
		on	master: protected mode, no error
	LED red	blinking 1 Hz	peripheral error without config. error
		on	config. error, auto addressing impossible
	LED red/green	blinking 1 Hz	config. error, auto addressing possible
O1 ... O2 [3]		off	output (O1 ... O2) off
	LED yellow	blinking 1 Hz	restart interlock
		blinking 8 Hz	rectifiable fault condition
		on	output (O1 ... O2) on
	LED red	on	AUX voltage missing
SM + AS-i M + O1 + O2			
	LED red	blinking 1 Hz	compending master active

LED flashing sample

Chip card is written (yellow)		
	S1 ... S8	blinking 1Hz, common mode
Circuit or internal error (red)		
	S1 ... S8	off
	SM, AS-i M, O1, O2	blinking 8 Hz
Compending master active (rot)		
	SM, ASI M, O1, O2	blinking 1 Hz
Data on chip card and device different (yellow)		
	S1, S3, S5, S7	blinking 1 Hz, push-pull mode
	S2, S4, S6, S8	off
Chip card defective (yellow)		
	S1, S3, S5, S7	blinking 1 Hz, common mode
	S2, S4, S6, S8	off

1) "yellow" has higher priority than "red" and "green" and will displayed preferentially.
2) If "config. error" and "peripheral fault" occur simultaneously, only "config. error" is displayed.
3) "red" has highe priority than "yellow".

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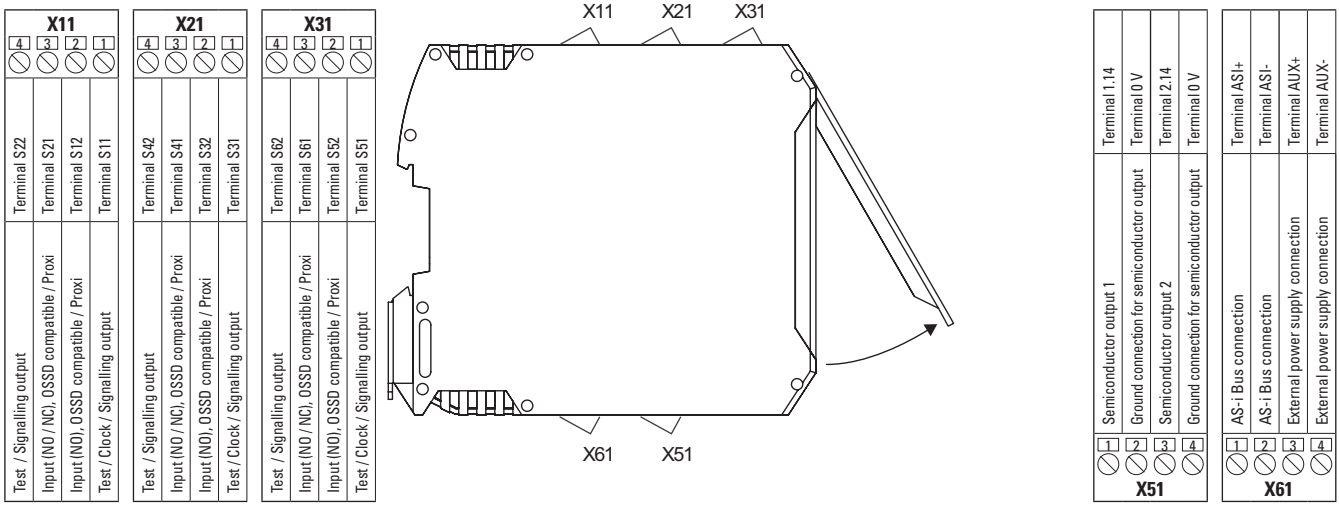
Safety-M modular Basic module | With Ethernet diagnostic interface – SMBD.32E | Digital

Encoder interface terminal X31		
Signal		HTL/proximity switch
Frequency		max. 4 kHz, resolution 0.1 Hz
Axes	2 x 2 channel 2 x 1 channel	PLd, SIL2 – speed + standstill PLc, SIL1 – speed
Inputs status		yellow
Speed monitoring	1 channel 2 channel	X31: S52 input 1 S61 input 2 X31: S52 input 1.1 S61 input 1.2

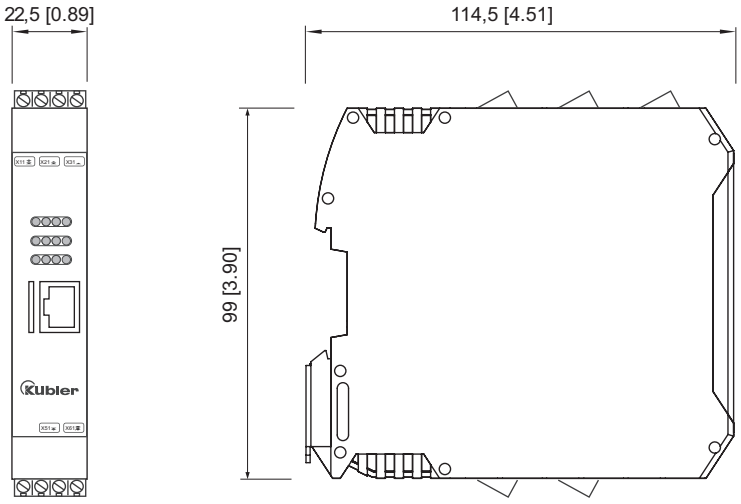
AS-i interface	
Type	AS-i 3.0 Master
Voltage	18 ... 31.6 V
Power consumption	max. 200 mA

Terminal assignment



Dimensions

Dimensions in mm [inch]



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Safety-M modular
Basic module

Gateway, universal – SMBU.021

CANopen

SMBU is a compact and modular safety control of the Safety-M modular product family with integrated drive monitoring. This device is freely programmable for safe processing of drive-related safety functions and of EMERGENCY STOP switches, two-hand controls, light barriers, operating mode selectors, etc.

The basic device offers 6 / 3 safe inputs and 6 safe shut-off channels.

CANopen Gateway.

- Basic module for setting up a monitoring system for safe speed and/or position measurement with configurable inputs and outputs.
- Extensive library of pre-configured safe sensors and command devices.
- Extended drive monitoring via axis expansion module EMAx (e.g. SS1, SS2, SOS, SLS, SDI, SLA, SSM, SCA, ...).
- Safe brake control "SBC" via output expansion modules EMIO e.g. for suspended loads.
- Programming with SafeMonitor software.
- Status LED on the front side.
- Plain text display with 5 different languages.
- Gateway functionality with access to all data of the basic and extension modules.
- Gateway parameter file (GSD, GSDML, ESI, etc.) integrated in the device-internal web server.
- Basic unit comes with 3 safe input lines and 6 safe shut-off channels. The 3 safe inputs can also be used as 6 standard inputs or as messaging outputs.
- Cross-short-cut monitoring functionality (EDM).
- Contact multiplication or increase of power capability by external contactors in connection with the device-internal monitoring function for external contacts.
- Extensive diagnostic functionality integrated in FW.
- Integrated chip card for saving configuration data, ensuring easy device replacement.
- Safe cross communication with other SMBx modules.
- AS-i master functionality with up to 31 safe slaves.
- Easy, fast and comfortable wiring, without topological restrictions.

Order no.

SMBU	Basic module	**8.SMBU.021.330**

Accessories		Order no.
Memory chip card	replacement (10 pieces), 128 kB / 1024 kbit	**8.SMCC.128**
SafeMonitor license	single user software license	**8.SMSW.000**

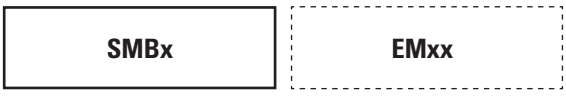
Connection technology		Order no.
Cordset, pre-assembled, 2 m [6.56']	Ethernet programming cable	**05.00.60A1.7272.002M**
Crossover adapter	Ethernet adapter	**05.CA.RJ45**
USB Fast Ethernet Port	USB <–> Ethernet adapter	**05.UA0144**

Further accessories can be found in accessories area of our website at: www.kuebler.com/accessories.
Additional connectors can be found in the connection technology section or in the connection technology area of our website at: www.kuebler.com/connection_technology.
You will find an overview of our systems and components for Functional Safety under www.kuebler.com/safety.

Modular construction

Basic module
Modular safety control system.

Expansion modules
For additional inputs and outputs and axis monitoring.



Expansion modules

EMAI	Axis expansion for incremental encoders.
EMAA	Axis expansion for absolute encoders.
EMIO	Input / output expansion.

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Safety-M modular Basic module | Gateway, universal – SMBU.021 | CANopen

Technical data

General data

Safe digital input lines	6 / 3, OSSD compatible
Safe digital output lines	6
Type of connection	pluggable terminals
Max. terminal cross section	1.5 mm^2 [AWG 15]
Interface for expansion modules	AS-i

Electrical characteristics

Power supply	24 V DC
Tolerance	-15 %, +25 %
Power consumption	4.8 W
Fuse on power supply	max. 4 A
Rated data digital inputs	24 V DC / 15 mA, type 1 to EN 61131-2
Rated data digital outputs	24 V DC / 100 mA

Environmental data

Operating temperature	0°C ... +55°C [+32°F ...+131°F]
Storage temperature	-25°C ... +85°C [-13°F ...+185°F]
Protection acc. to EN 60529	IP20
Climate class	3 acc. to DIN 50178
CE compliant acc. to	
(up to April 19, 2016)	EMC guideline 2004/108/EG Machinery directive 2006/42/EC RoHS guideline 2011/65/EU
(as from April 20, 2016)	EMC guideline 2014/30/EU Machinery directive 2006/42/EC RoHS guideline 2011/65/EU

Safety characteristics

Classification	PLe / SIL3
System structure	2 channel (Cat. 4 / HFT = 1)
PFH_d value	5.36 x 10^{-9} h^{-1}
Mission time / Proof test interval	20 years
Max. response time	< 40 ms
Max. mission time	12 months
Relevant standards	EN ISO 13849-1 :2008 EN ISO 13849-2 :2012 EN 62061 :2005 / A1:2013

EMC

Relevant standards	EN 61326-3-1 :2008 EN 61000-6-2 :2005 / AC:2005 EN 61000-6-4 :2007 / A1:2011 EN 62026-2 :2013 EN 61131-2 :2007 / A1:2011

Mechanical characteristics

Size w x h x d	100 x 120 x 106 mm [3.94 x 4.72x 4.17"]
Weight	800 g [28.22 oz]
Mounting	snap-on mounting on standard head rail

Display LEDs – for other statuses please contact the Kübler Service

LCD	menu, AS-i slave address display, plain text error messages
LED power	voltage ON
LED CAN	CAN Master detected
LED config error	configuration error
LED U AS-i	AS-i voltage o.k.
LED AS-i active	AS-i operation normal
LED prg enable	automatic slave programming possible
LED prj mode	programming mode active
LED AUX	auxilary energy available
LEDs SI1 ... SI6 (Input status)	
off	open
on	closed
LEDs SO1 ... SO6 (Output status)	
off	open
on	closed

AS-i interface

Type	AS-i 3.0 Master
Voltage	18 ... 31.6 V
Power consumption	max. 200 mA

CANopen interface

Interface	CAN acc. to ISO 11898
Protocol	CANopen profile DS301
Baud rate	10 ... 1000 kbit/s
Type of connection	Combicon connnector
Functions	extended boot-up, minimum boot-up, life guarding
PDOs	up to 35 Rx, 35 Tx
PDO Modi	async, cyclic, acyclic

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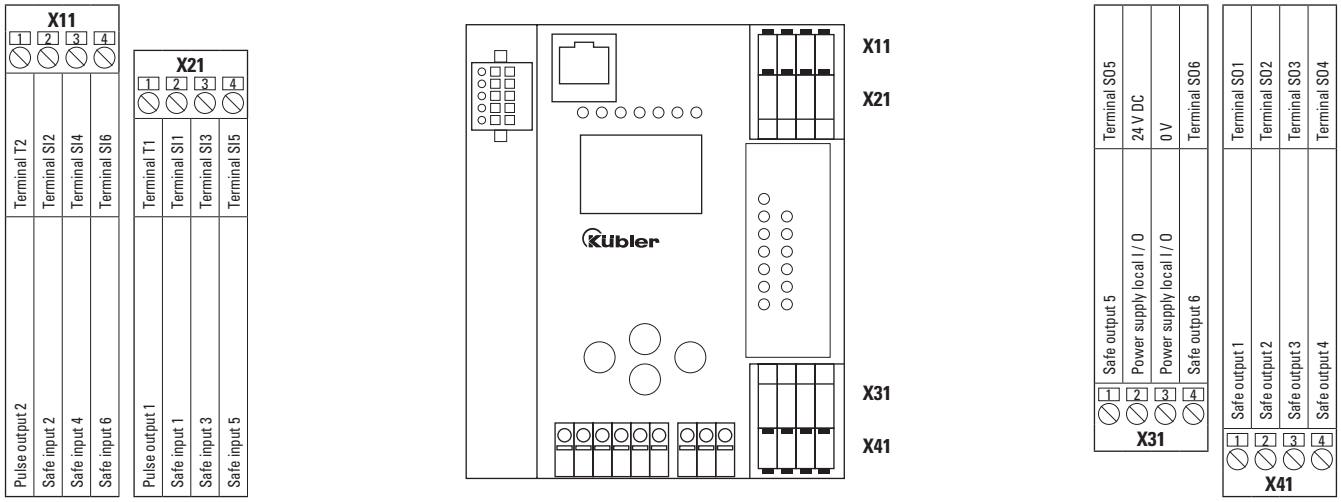
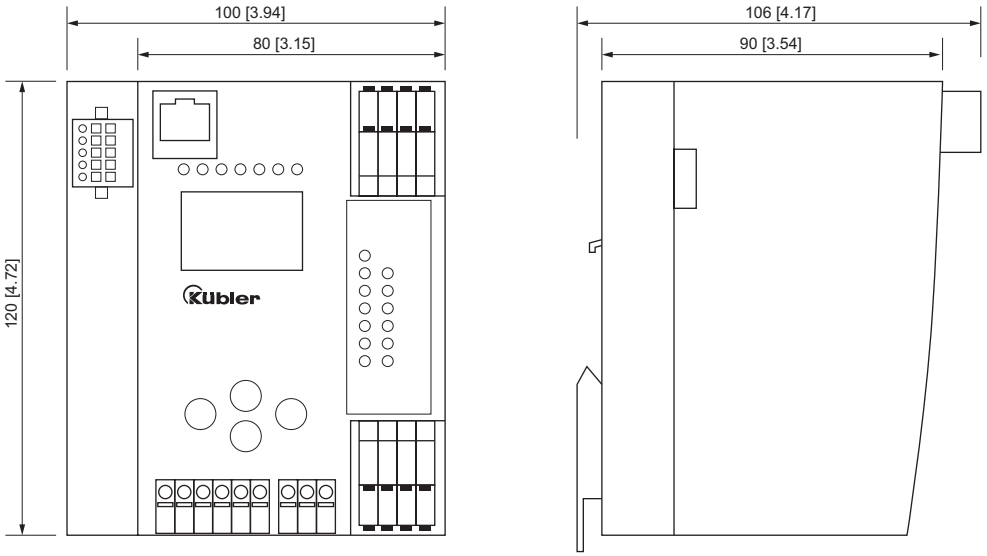
Safety-M modular Basic module | Gateway, universal – SMBU.021 | CANopen

Terminal assignment



Dimensions

Dimensions in mm [inch]



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Safety-M modular Basic module | Gateway, universal – SMBU.031 | PROFIBUS DP

SMBU is a compact and modular safety control of the Safety-M modular product family with integrated drive monitoring. This device is freely programmable for safe processing of drive-related safety functions and of EMERGENCY STOP switches, two-hand controls, light barriers, operating mode selectors, etc.

The basic device offers 6 / 3 safe inputs and 6 safe shut-off channels.

Profibus Gateway.

- Basic module for setting up a monitoring system for safe speed and/or position measurement with configurable inputs and outputs.
- Extensive library of pre-configured safe sensors and command devices.
- Extended drive monitoring via axis expansion module EMAx (e.g. SS1, SS2, SOS, SLS, SDI, SLA, SSM, SCA, ...).
- Safe brake control "SBC" via output expansion modules EMIO e.g. for suspended loads.
- Programming with SafeMonitor software.
- Status LED on the front side.
- Plain text display with 5 different languages.
- Gateway functionality with access to all data of the basic and extension modules.
- Gateway parameter file (GSD, GSDML, ESI, etc.) integrated in the device-internal web server.
- Basic unit comes with 3 safe input lines and 6 safe shut-off channels. The 3 safe inputs can also be used as 6 standard inputs or as messaging outputs.
- Cross-short-cut monitoring functionality (EDM).
- Contact multiplication or increase of power capability by external contactors in connection with the device-internal monitoring function for external contacts.
- Extensive diagnostic functionality integrated in FW.
- Integrated chip card for saving configuration data, ensuring easy device replacement.
- Safe cross communication with other SMBx modules.
- AS-i master functionality with up to 31 safe slaves.
- Easy, fast and comfortable wiring, without topological restrictions.

Order no.

SMBU	Basic module	**8.SMBU.031.330**

Accessories		Order no.
Memory chip card	replacement (10 pieces), 128 kB / 1024 kbit	**8.SMCC.128**
SafeMonitor license	single user software license	**8.SMSW.000**

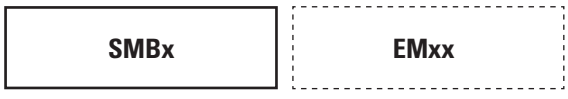
Connection technology		Order no.
Cordset, pre-assembled, 2 m [6.56']	Ethernet programming cable	**05.00.60A1.7272.002M**
Crossover adapter	Ethernet adapter	**05.CA.RJ45**
USB Fast Ethernet Port	USB <–> Ethernet adapter	**05.UA0144**

Further accessories can be found in accessories area of our website at: www.kuebler.com/accessories.
Additional connectors can be found in the connection technology section or in the connection technology area of our website at: www.kuebler.com/connection_technology.
You will find an overview of our systems and components for Functional Safety under www.kuebler.com/safety.

Modular construction

Basic module
Modular safety control system.

Expansion modules
For additional inputs and outputs and axis monitoring.



Expansion modules

EMAI	Axis expansion for incremental encoders.
EMAA	Axis expansion for absolute encoders.
EMIO	Input / output expansion.

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Safety-M modular Basic module | **Gateway, universal – SMBU.031** | **PROFIBUS DP**

Technical data

General data

Safe digital input lines	6 / 3, OSSD compatible
Safe digital output lines	6
Type of connection	pluggable terminals
Max. terminal cross section	1.5 mm^2 [AWG 15]
Interface for expansion modules	AS-i

Electrical characteristics

Power supply	24 V DC
Tolerance	-15 %, +25 %
Power consumption	4.8 W
Fuse on power supply	max. 4 A
Rated data digital inputs	24 V DC / 15 mA, type 1 to EN 61131-2
Rated data digital outputs	24 V DC / 100 mA

Environmental data

Operating temperature	0°C ... +55°C [+32°F ...+131°F]
Storage temperature	-25°C ... +85°C [-13°F ...+185°F]
Protection acc. to EN 60529	IP20
Climate class	3 acc. to DIN 50178
CE compliant acc. to	
(up to April 19, 2016)	EMC guideline 2004/108/EG Machinery directive 2006/42/EC RoHS guideline 2011/65/EU
(as from April 20, 2016)	EMC guideline 2014/30/EU Machinery directive 2006/42/EC RoHS guideline 2011/65/EU

Safety characteristics

Classification	PLe / SIL3
System structure	2 channel (Cat. 4 / HFT = 1)
PFH_d value	5.36 x 10^{-9} h^{-1}
Mission time / Proof test interval	20 years
Max. response time	< 40 ms
Max. mission time	12 months
Relevant standards	EN ISO 13849-1 :2008 EN ISO 13849-2 :2012 EN 62061 :2005 / A1:2013

EMC

Relevant standards	EN 61326-3-1 :2008 EN 61000-6-2 :2005 / AC:2005 EN 61000-6-4 :2007 / A1:2011 EN 62026-2 :2013 EN 61131-2 :2007 / A1:2011

Mechanical characteristics

Size w x h x d	100 x 120 x 106 mm [3.94 x 4.72x 4.17"]
Weight	800 g [28.22 oz]
Mounting	snap-on mounting on standard head rail

Display LEDs – for other statuses please contact the Kübler Service

LCD	menu, AS-i slave address display, plain text error messages
LED power	voltage ON
LED Profibus	PROFIBUS Master detected
LED config error	configuration error
LED U AS-i	AS-i voltage o.k.
LED AS-i active	AS-i operation normal
LED prg enable	automatic slave programming possible
LED prj mode	programming mode active
LED AUX	auxilary energy available
LEDs SI1 ... SI6 (input status)	
off	open
on	closed
LEDs SO1 ... SO6 (output status)	
off	open
on	closed

AS-i interface

Type	AS-i 3.0 Master
Voltage	18 ... 31.6 V
Power consumption	max. 200 mA

PROFIBUS DP interface

Interface	Specification acc. to PROFIBUS DP 2.0 IEC 61158 / IEC 61784
Baud rate	9.6 kBaud ... 12 MBaud automatic detection
Type of connection	Sub-D, 9-pin
DP functions	Representation of the expansion modules as I/O process data in the PROFIBUS. Comprehensive diagnostics and configuration via Profibus Master.

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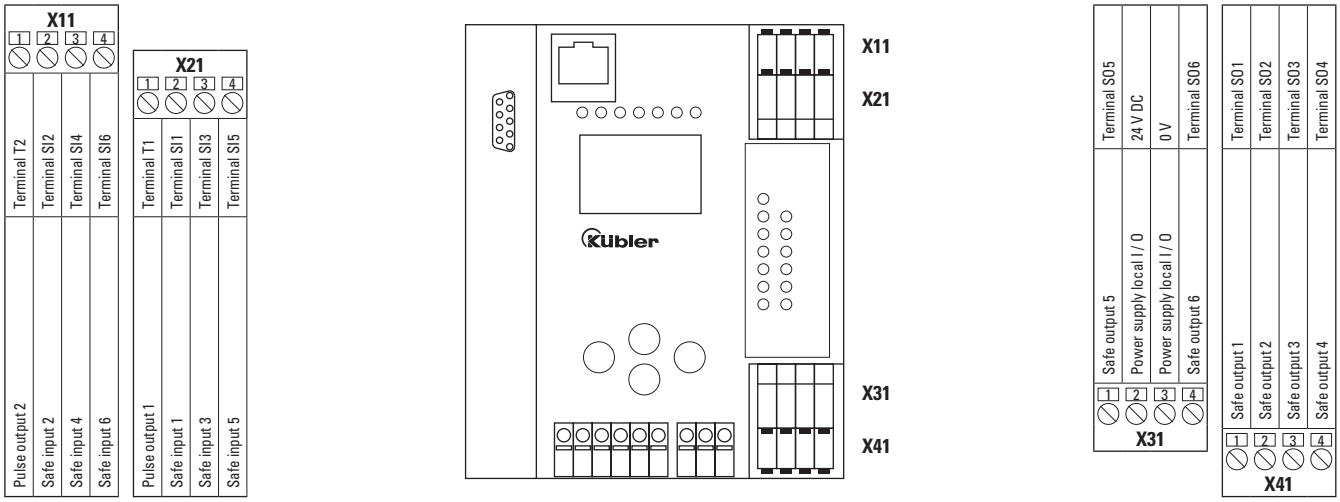
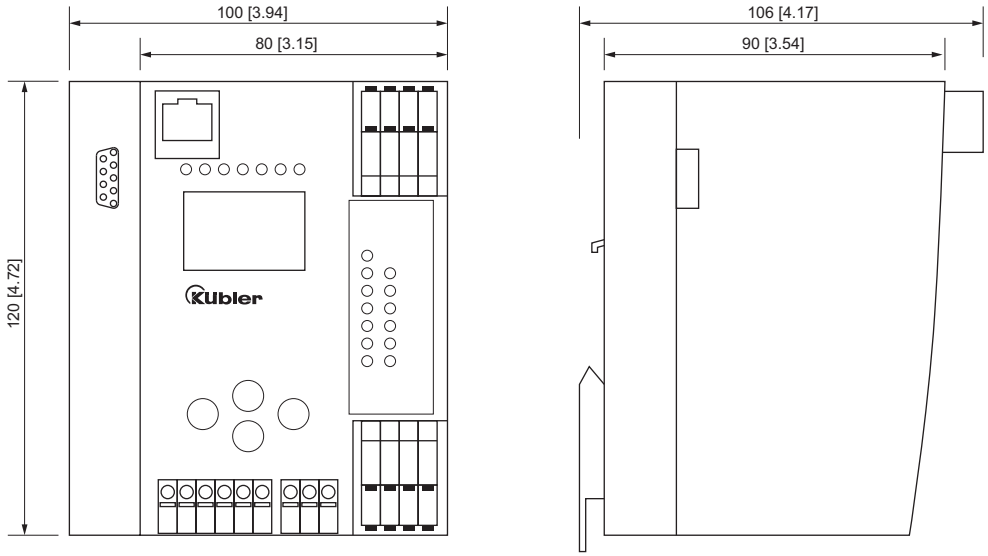
Safety-M modular
Basic module
Gateway, universal – SMBU.031
PROFIBUS DP

Terminal assignment



Dimensions

Dimensions in mm [inch]



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Safety-M modular
Basic module
Gateway, universal – SMBU.0B1
EtherCAT

SMBU is a compact and modular safety control of the Safety-M modular product family with integrated drive monitoring. This device is freely programmable for safe processing of drive-related safety functions and of EMERGENCY STOP switches, two-hand controls, light barriers, operating mode selectors, etc.

The basic device offers 6 / 3 safe inputs and 6 safe shut-off channels.

EtherCAT Gateway.

- Basic module for setting up a monitoring system for safe speed and/or position measurement with configurable inputs and outputs.
- Extensive library of pre-configured safe sensors and command devices.
- Extended drive monitoring via axis expansion module EMAx (e.g. SS1, SS2, SOS, SLS, SDI, SLA, SSM, SCA, ...).
- Safe brake control "SBC" via output expansion modules EMIO e.g. for suspended loads.
- Programming with SafeMonitor software.
- Status LED on the front side.
- Plain text display with 5 different languages.
- Gateway functionality with access to all data of the basic and extension modules.
- Gateway parameter file (GSD, GSDML, ESI, etc.) integrated in the device-internal web server.
- Basic unit comes with 3 safe input lines and 6 safe shut-off channels. The 3 safe inputs can also be used as 6 standard inputs or as messaging outputs.
- Cross-short-cut monitoring functionality (EDM).
- Contact multiplication or increase of power capability by external contactors in connection with the device-internal monitoring function for external contacts.
- Extensive diagnostic functionality integrated in FW.
- Integrated chip card for saving configuration data, ensuring easy device replacement.
- Safe cross communication with other SMBx modules.
- AS-i master functionality with up to 31 safe slaves.
- Easy, fast and comfortable wiring, without topological restrictions.

Order no.

SMBU	Basic module	**8.SMBU.0B1.330**

Accessories		Order no.
Memory chip card	replacement (10 pieces), 128 kB / 1024 kbit	**8.SMCC.128**
SafeMonitor license	single user software license	**8.SMSW.000**

Connection technology		Order no.
Cordset, pre-assembled, 2 m [6.56']	Ethernet programming cable	**05.00.60A1.7272.002M**
Crossover adapter	Ethernet adapter	**05.CA.RJ45**
USB Fast Ethernet Port	USB <–> Ethernet adapter	**05.UA0144**

Further accessories can be found in accessories area of our website at: www.kuebler.com/accessories.
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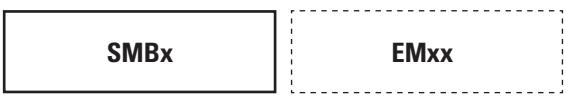
Modular construction

Basic module
Modular safety control system.

Expansion modules
For additional inputs and outputs and axis monitoring.



Expansion modules

EMAI	Axis expansion for incremental encoders.
EMAA	Axis expansion for absolute encoders.
EMIO	Input / output expansion.

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Safety-M modular Basic module | **Gateway, universal – SMBU.0B1** | **EtherCAT**

Technical data

General data

Safe digital input lines	6 / 3, OSSD compatible
Safe digital output lines	6
Type of connection	pluggable terminals
Max. terminal cross section	1.5 mm^2 [AWG 15]
Interface for expansion modules	AS-i

Electrical characteristics

Power supply	24 V DC
Tolerance	-15 %, +25 %
Power consumption	4.8 W
Fuse on power supply	max. 4 A
Rated data digital inputs	24 V DC / 15 mA, type 1 to EN 61131-2
Rated data digital outputs	24 V DC / 100 mA

Environmental data

Operating temperature	0°C ... +55°C [+32°F ...+131°F]
Storage temperature	-25°C ... +85°C [-13°F ...+185°F]
Protection acc. to EN 60529	IP20
Climate class	3 acc. to DIN 50178
CE compliant acc. to	
(up to April 19, 2016)	EMC guideline 2004/108/EG Machinery directive 2006/42/EC RoHS guideline 2011/65/EU
(as from April 20, 2016)	EMC guideline 2014/30/EU Machinery directive 2006/42/EC RoHS guideline 2011/65/EU

Safety characteristics

Classification	PLe / SIL3
System structure	2 channel (Cat. 4 / HFT = 1)
PFH_d value	5.36 x 10^{-9} h^{-1}
Mission time / Proof test interval	20 years
Max. response time	< 40 ms
Max. mission time	12 months
Relevant standards	EN ISO 13849-1 :2008 EN ISO 13849-2 :2012 EN 62061 :2005 / A1:2013

EMC

Relevant standards	EN 61326-3-1 :2008 EN 61000-6-2 :2005 / AC:2005 EN 61000-6-4 :2007 / A1:2011 EN 62026-2 :2013 EN 61131-2 :2007 / A1:2011

Mechanical characteristics

Size w x h x d	100 x 120 x 106 mm [3.94 x 4.72x 4.17"]
Weight	800 g [28.22 oz]
Mounting	snap-on mounting on standard head rail

Display LEDs – for other statuses please contact the Kübler Service

LCD	menu, AS-i slave address display, plain text error messages
LED power	voltage ON
LED EtherCAT	EtherCAT Master detected
LED config error	configuration error
LED U AS-i	AS-i voltage o.k.
LED AS-i active	AS-i operation normal
LED prg enable	automatic slave programming possible
LED prj mode	programming mode active
LED AUX	auxilary energy available
LEDs SI1 ... SI6 (input status)	
off	open
on	closed
LEDs SO1 ... SO6 (output status)	
off	open
on	closed

AS-i interface

Type	AS-i 3.0 Master
Voltage	18 ... 31.6 V
Power consumption	max. 200 mA

EtherCAT interface

Interface	EtherCAT
Baud rate	10 / 100 MBaud
Type of connection	2 x RJ45, IN / OUT

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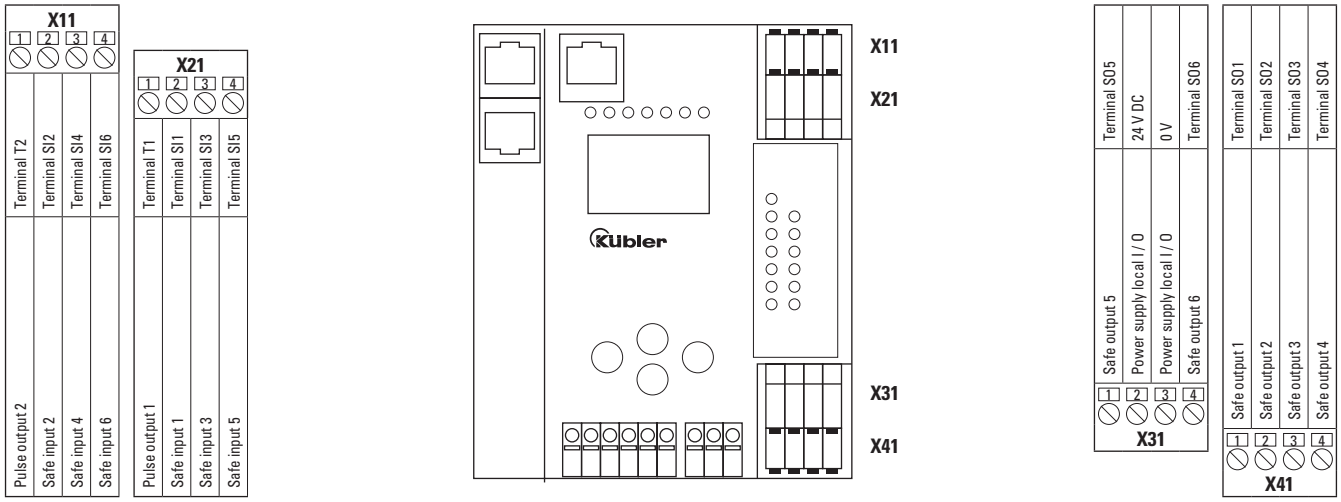
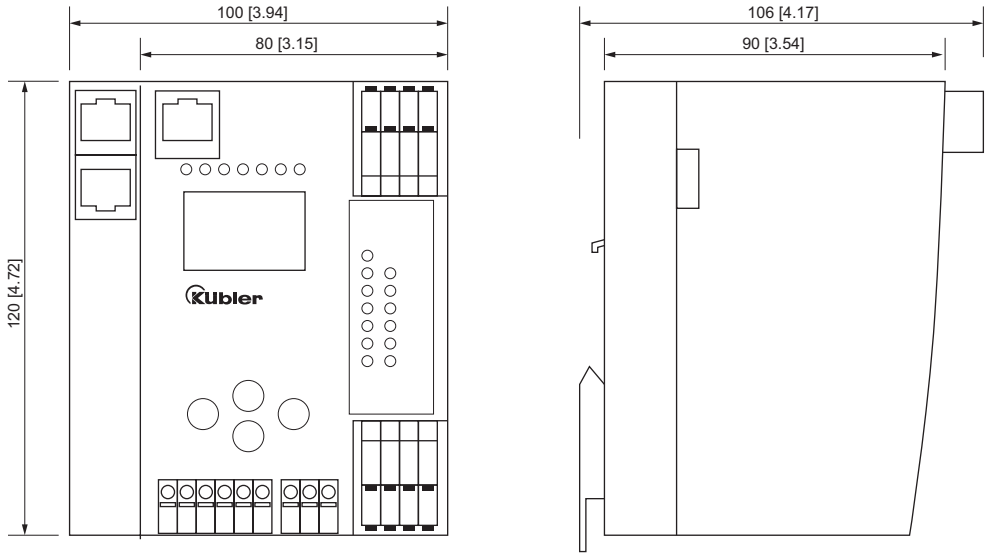
Safety-M modular
Basic module
Gateway, universal – SMBU.0B1
EtherCAT

Terminal assignment



Dimensions

Dimensions in mm [inch]



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Safety-M modular Basic module | Gateway, universal – SMBU.0C1 | PROFINET IO

SMBU is a compact and modular safety control of the Safety-M modular product family with integrated drive monitoring. This device is freely programmable for safe processing of drive-related safety functions and of EMERGENCY STOP switches, two-hand controls, light barriers, operating mode selectors, etc.

The basic device offers 6 / 3 safe inputs and 6 safe shut-off channels.

PROFINET Gateway.

- Basic module for setting up a monitoring system for safe speed and/or position measurement with configurable inputs and outputs.
- Extensive library of pre-configured safe sensors and command devices.
- Extended drive monitoring via axis expansion module EMAx (e.g. SS1, SS2, SOS, SLS, SDI, SLA, SSM, SCA, ...).
- Safe brake control "SBC" via output expansion modules EMIO e.g. for suspended loads.
- Programming with SafeMonitor software.
- Status LED on the front side.
- Plain text display with 5 different languages.
- Gateway functionality with access to all data of the basic and extension modules.
- Gateway parameter file (GSD, GSDML, ESI, etc.) integrated in the device-internal web server.
- Basic unit comes with 3 safe input lines and 6 safe shut-off channels. The 3 safe inputs can also be used as 6 standard inputs or as messaging outputs.
- Cross-short-cut monitoring functionality (EDM).
- Contact multiplication or increase of power capability by external contactors in connection with the device-internal monitoring function for external contacts.
- Extensive diagnostic functionality integrated in FW.
- Integrated chip card for saving configuration data, ensuring easy device replacement.
- Safe cross communication with other SMBx modules.
- AS-i master functionality with up to 31 safe slaves.
- Easy, fast and comfortable wiring, without topological restrictions.

Order no.

SMBU	Basic module	**8.SMBU.0C1.330**

Accessories		Order no.
Memory chip card	replacement (10 pieces), 128 kB / 1024 kbit	**8.SMCC.128**
SafeMonitor license	single user software license	**8.SMSW.000**

Connection technology		Order no.
Cordset, pre-assembled, 2 m [6.56']	Ethernet programming cable	**05.00.60A1.7272.002M**
Crossover adapter	Ethernet adapter	**05.CA.RJ45**
USB Fast Ethernet Port	USB <–> Ethernet adapter	**05.UA0144**

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Additional connectors can be found in the connection technology section or in the connection technology area of our website at: www.kuebler.com/connection_technology.
You will find an overview of our systems and components for Functional Safety under www.kuebler.com/safety.

Modular construction

Basic module
Modular safety control system.

Expansion modules
For additional inputs and outputs and axis monitoring.

SMBx | **EMxx**

Expansion modules

EMAI Axis expansion for incremental encoders.
EMAA Axis expansion for absolute encoders.
EMIO Input / output expansion.

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Safety-M modular Basic module — Gateway, universal – SMBU.0C1 — PROFINET IO

Technical data

General data	
Safe digital input lines	6 / 3, OSSD compatible
Safe digital output lines	6
Type of connection	pluggable terminals
Max. terminal cross section	1.5 mm² [AWG 15]
Interface for expansion modules	AS-i

Electrical characteristics	
Power supply	24 V DC
Tolerance	-15 %, +25 %
Power consumption	4.8 W
Fuse on power supply	max. 4 A
Rated data digital inputs	24 V DC / 15 mA, type 1 to EN 61131-2
Rated data digital outputs	24 V DC / 100 mA

Environmental data	
Operating temperature	0°C ... +55°C [+32°F ...+131°F]
Storage temperature	-25°C ... +85°C [-13°F ...+185°F]
Protection acc. to EN 60529	IP20
Climate class	3 acc. to DIN 50178
CE compliant acc. to	
(up to April 19, 2016)	EMC guideline 2004/108/EG Machinery directive 2006/42/EC RoHS guideline 2011/65/EU
(as from April 20, 2016)	EMC guideline 2014/30/EU Machinery directive 2006/42/EC RoHS guideline 2011/65/EU

Safety characteristics	
Classification	PLe / SIL3
System structure	2 channel (Cat. 4 / HFT = 1)
PFH_d value	5.36 x 10^{-9} h^{-1}
Mission time / Proof test interval	20 years
Max. response time	< 40 ms
Max. mission time	12 months
Relevant standards	EN ISO 13849-1 :2008 EN ISO 13849-2 :2012 EN 62061 :2005 / A1:2013

EMC	
Relevant standards	EN 61326-3-1 :2008 EN 61000-6-2 :2005 / AC:2005 EN 61000-6-4 :2007 / A1:2011 EN 62026-2 :2013 EN 61131-2 :2007 / A1:2011

Mechanical characteristics	
Size w x h x d	100 x 120 x 106 mm [3.94 x 4.72x 4.17"]
Weight	800 g [28.22 oz]
Mounting	snap-on mounting on standard head rail

Display LEDs – for other statuses please contact the Kübler Service		
LCD		menu, AS-i slave address display, plain text error messages
LED power		voltage ON
LED PROFINET	green red	PROFINET Master detected PROFINET Master not detected
LED config error		configuration error
LED U AS-i		AS-i voltage o.k.
LED AS-i active		AS-i operation normal
LED prg enable		automatic slave programming possible
LED prj mode		programming mode active
LED AUX		auxilary energy available
LEDs SI1 ... SI6 (input status)		
	off on	open closed
LEDs SO1 ... SO6 (output status)		
	off on	open closed

AS-i interface	
Type	AS-i 3.0 Master
Voltage	18 ... 31.6 V
Power consumption	max. 200 mA

PROFINET IO interface	
Interface	PROFINET IO
Baud rate	100 MBaud
Type of connection	2 x RJ45, 2-port switch
Conformance class	B

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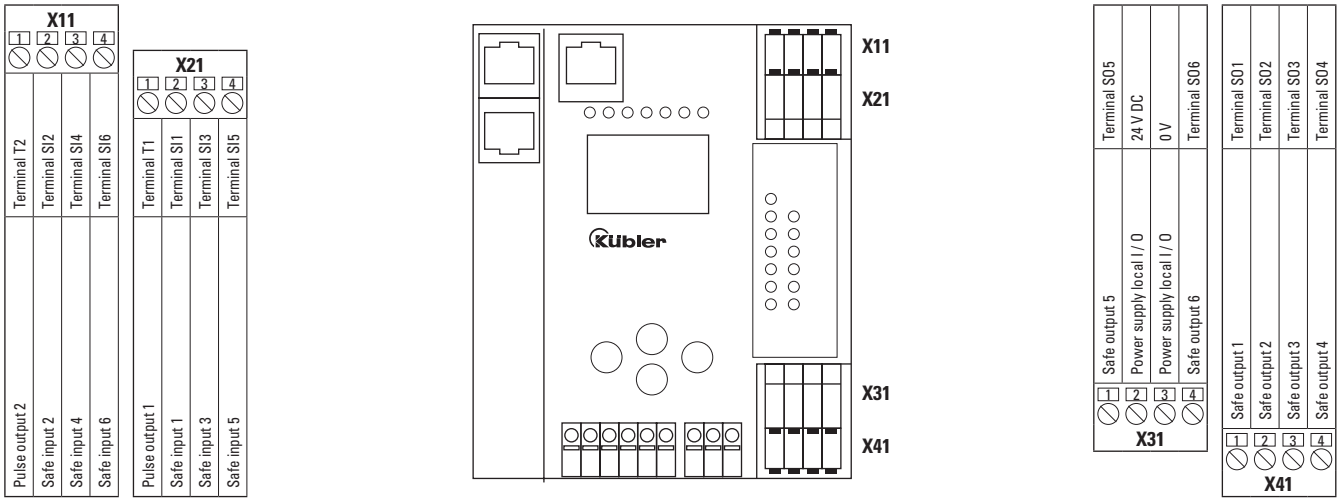
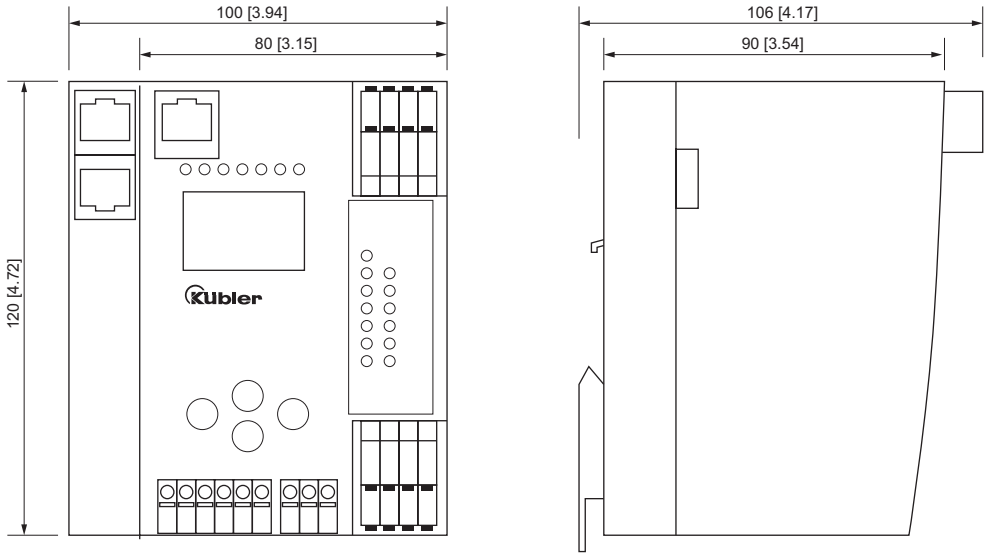
Safety-M modular Basic module	Gateway, universal – SMBU.0C1	PROFINET IO

Terminal assignment



Dimensions

Dimensions in mm [inch]



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Safety-M modular
Basic module

Gateway, universal – SMBU.0D1

EtherNet/IP

SMBU is a compact and modular safety control of the Safety-M modular product family with integrated drive monitoring. This device is freely programmable for safe processing of drive-related safety functions and of EMERGENCY STOP switches, two-hand controls, light barriers, operating mode selectors, etc.

The basic device offers 6 / 3 safe inputs and 6 safe shut-off channels.

EtherNet/IP Gateway.

- Basic module for setting up a monitoring system for safe speed and/or position measurement with configurable inputs and outputs.
- Extensive library of pre-configured safe sensors and command devices.
- Extended drive monitoring via axis expansion module EMAx (e.g. SS1, SS2, SOS, SLS, SDI, SLA, SSM, SCA, ...).
- Safe brake control "SBC" via output expansion modules EMIO e.g. for suspended loads.
- Programming with SafeMonitor software.
- Status LED on the front side.
- Plain text display with 5 different languages.
- Gateway functionality with access to all data of the basic and extension modules.
- Gateway parameter file (GSD, GSDML, ESI, etc.) integrated in the device-internal web server.
- Basic unit comes with 3 safe input lines and 6 safe shut-off channels. The 3 safe inputs can also be used as 6 standard inputs or as messaging outputs.
- Cross-short-cut monitoring functionality (EDM).
- Contact multiplication or increase of power capability by external contactors in connection with the device-internal monitoring function for external contacts.
- Extensive diagnostic functionality integrated in FW.
- Integrated chip card for saving configuration data, ensuring easy device replacement.
- Safe cross communication with other SMBx modules.
- AS-i master functionality with up to 31 safe slaves.
- Easy, fast and comfortable wiring, without topological restrictions.

Order no.

SMBU	Basic module	**8.SMBU.0D1.330**

Accessories		Order no.
Memory chip card	replacement (10 pieces), 128 kB / 1024 kbit	**8.SMCC.128**
SafeMonitor license	single user software license	**8.SMSW.000**

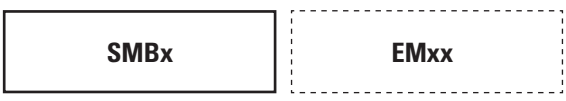
Connection technology		Order no.
Cordset, pre-assembled, 2 m [6.56']	Ethernet programming cable	**05.00.60A1.7272.002M**
Crossover adapter	Ethernet adapter	**05.CA.RJ45**
USB Fast Ethernet Port	USB <–> Ethernet adapter	**05.UA0144**

Further accessories can be found in accessories area of our website at: www.kuebler.com/accessories.
Additional connectors can be found in the connection technology section or in the connection technology area of our website at: www.kuebler.com/connection_technology.
You will find an overview of our systems and components for Functional Safety under www.kuebler.com/safety.

Modular construction

Basic module
Modular safety control system.

Expansion modules
For additional inputs and outputs and axis monitoring.



Expansion modules

EMAI	Axis expansion for incremental encoders.
EMAA	Axis expansion for absolute encoders.
EMIO	Input / output expansion.

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Safety-M modular Basic module | **Gateway, universal – SMBU.0D1** | **EtherNet/IP**

Technical data

General data

Safe digital input lines	6 / 3, OSSD compatible
Safe digital output lines	6
Type of connection	pluggable terminals
Max. terminal cross section	1.5 mm^2 [AWG 15]
Interface for expansion modules	AS-i

Electrical characteristics

Power supply	24 V DC
Tolerance	-15 %, +25 %
Power consumption	4.8 W
Fuse on power supply	max. 4 A
Rated data digital inputs	24 V DC / 15 mA, type 1 to EN 61131-2
Rated data digital outputs	24 V DC / 100 mA

Environmental data

Operating temperature	0°C ... +55°C [+32°F ...+131°F]
Storage temperature	-25°C ... +85°C [-13°F ...+185°F]
Protection acc. to EN 60529	IP20
Climate class	3 acc. to DIN 50178
CE compliant acc. to	
(up to April 19, 2016)	EMC guideline 2004/108/EG Machinery directive 2006/42/EC RoHS guideline 2011/65/EU
(as from April 20, 2016)	EMC guideline 2014/30/EU Machinery directive 2006/42/EC RoHS guideline 2011/65/EU

Safety characteristics

Classification	PLe / SIL3
System structure	2 channel (Cat. 4 / HFT = 1)
PFH_d value	5.36 x 10^{-9} h^{-1}
Mission time / Proof test interval	20 years
Max. response time	< 40 ms
Max. mission time	12 months
Relevant standards	EN ISO 13849-1 :2008 EN ISO 13849-2 :2012 EN 62061 :2005 / A1:2013

EMC

Relevant standards	EN 61326-3-1 :2008 EN 61000-6-2 :2005 / AC:2005 EN 61000-6-4 :2007 / A1:2011 EN 62026-2 :2013 EN 61131-2 :2007 / A1:2011

Mechanical characteristics

Size w x h x d	100 x 120 x 106 mm [3.94 x 4.72x 4.17"]
Weight	800 g [28.22 oz]
Mounting	snap-on mounting on standard head rail

Display LEDs – for other statuses please contact the Kübler Service

LCD	menu, AS-i slave address display, plain text error messages
LED power	voltage ON
LED EtherNet/IP	EtherNet/IP Master detected
LED config error	configuration error
LED U AS-i	AS-i voltage o.k.
LED AS-i active	AS-i operation normal
LED prg enable	automatic slave programming possible
LED prj mode	programming mode active
LED AUX	auxilary energy available
LEDs SI1 ... SI6 (input status)	
off	open
on	closed
LEDs SO1 ... SO6 (output status)	
off	open
on	closed

AS-i interface

Type	AS-i 3.0 Master
Voltage	18 ... 31.6 V
Power consumption	max. 200 mA

EtherNet/IP interface

Interface	EtherNet/IP acc. to IEEE 802.3
Baud rate	10 / 100 MBaud
Type of connection	2 x RJ45, 2-port switch

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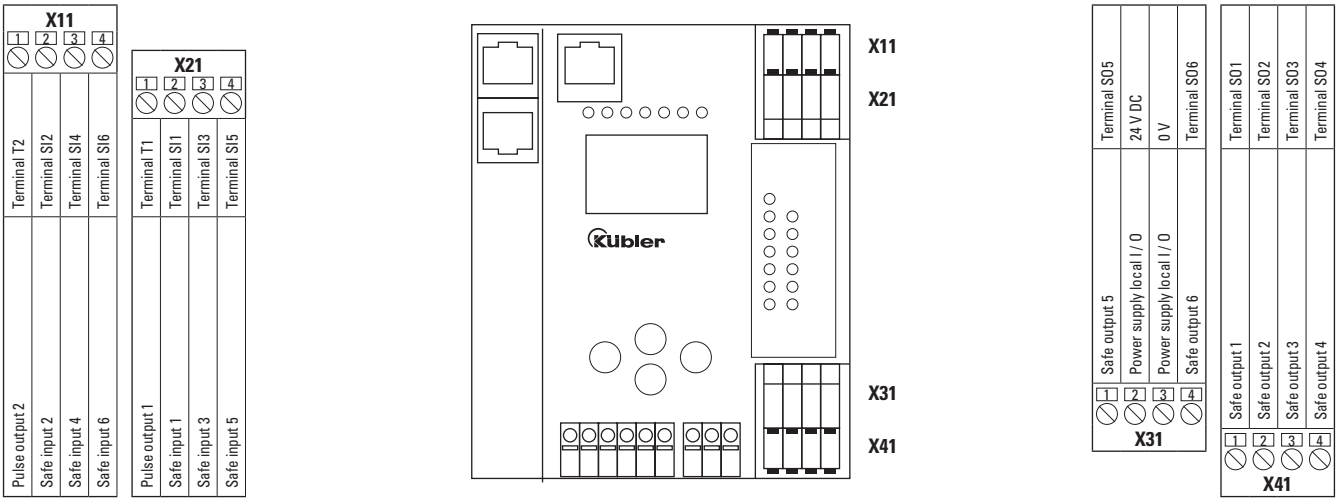
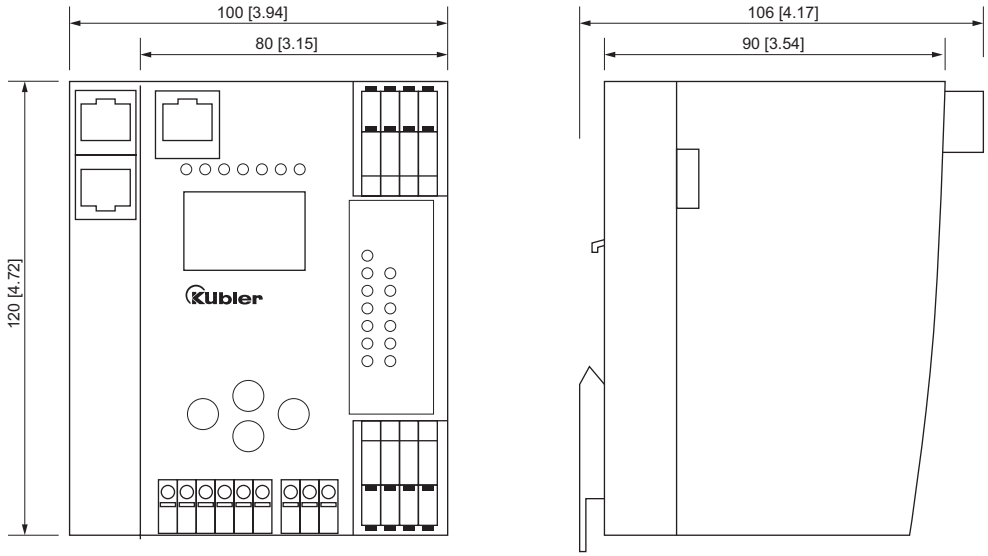
Safety-M modular Basic module | Gateway, universal – SMBU.0D1 | EtherNet/IP

Terminal assignment



Dimensions

Dimensions in mm [inch]



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Safety-M modular
Basic module

Gateway, safe – SMBS.S31

PROFIsafe over PROFIBUS DP

SMBS is a compact and modular safety control of the Safety-M modular product family with integrated drive monitoring. This device is freely programmable for safe processing of drive-related safety functions and of EMERGENCY STOP switches, two-hand controls, light barriers, operating mode selectors, etc.

The basic device offers 6 / 3 safe inputs and 6 safe shut-off channels.

Profisafe Gateway over PROFIBUS DP.

- Basic module for setting up a monitoring system for safe speed and/or position measurement with configurable inputs and outputs.
- Extensive library of pre-configured safe sensors and command devices.
- Extended drive monitoring via axis expansion module EMAx (e.g. SS1, SS2, SOS, SLS, SDI, SLA, SSM, SCA, ...).
- Safe brake control "SBC" via output expansion modules EMIO e.g. for suspended loads.
- Programming with SafeMonitor software.
- Status LED on the front side.
- Plain text display with 5 different languages.
- Gateway functionality with access to all data of the basic and extension modules.
- Gateway parameter file (GSD, GSDML, ESI, etc.) integrated in the device-internal web server.
- Basic unit comes with 3 safe input lines and 6 safe shut-off channels. The 3 safe inputs can also be used as 6 standard inputs or as messaging outputs.
- Cross-short-cut monitoring functionality (EDM).
- Contact multiplication or increase of power capability by external contactors in connection with the device-internal monitoring function for external contacts.
- Extensive diagnostic functionality integrated in FW.
- Integrated chip card for saving configuration data, ensuring easy device replacement.
- Safe cross communication with other SMBx modules.
- AS-i master functionality with up to 31 safe slaves.
- Easy, fast and comfortable wiring, without topological restrictions.

Order no.

SMBS	Basic module	**8.SMBS.S31.330**

Accessories		Order no.
Memory chip card	replacement (10 pieces), 128 kB / 1024 kbit	**8.SMCC.128**
SafeMonitor license	single user software license	**8.SMSW.000**

Connection technology		Order no.
Cordset, pre-assembled, 2 m [6.56']	Ethernet programming cable	**05.00.60A1.7272.002M**
Crossover adapter	Ethernet adapter	**05.CA.RJ45**
USB Fast Ethernet Port	USB <–> Ethernet adapter	**05.UA0144**

Further accessories can be found in accessories area of our website at: www.kuebler.com/accessories.
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Modular construction

Basic module
Modular safety control system.

Expansion modules
For additional inputs and outputs and axis monitoring.

Expansion modules

EMAI	Axis expansion for incremental encoders.
EMAA	Axis expansion for absolute encoders.
EMIO	Input / output expansion.

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Safety-M modular Basic module | **Gateway, safe – SMBS.S31** | **PROFIsafe over PROFIBUS DP**

Technical data

General data

Safe digital input lines	6 / 3, OSSD compatible
Safe digital output lines	6
Type of connection	pluggable terminals
Max. terminal cross section	1.5 mm^2 [AWG 15]
Interface for expansion modules	AS-i

Electrical characteristics

Power supply	24 V DC
Tolerance	-15 %, +25 %
Power consumption	4.8 W
Fuse on power supply	max. 4 A
Rated data digital inputs	24 V DC / 15 mA, type 1 to EN 61131-2
Rated data digital outputs	24 V DC / 100 mA

Environmental data

Operating temperature	0°C ... +55°C [+32°F ...+131°F]
Storage temperature	-25°C ... +85°C [-13°F ...+185°F]
Protection acc. to EN 60529	IP20
Climate class	3 acc. to DIN 50178
CE compliant acc. to	
(up to April 19, 2016)	EMC guideline 2004/108/EG Machinery directive 2006/42/EC RoHS guideline 2011/65/EU
(as from April 20, 2016)	EMC guideline 2014/30/EU Machinery directive 2006/42/EC RoHS guideline 2011/65/EU

Safety characteristics

Classification	PLe / SIL3
System structure	2 channel (Cat. 4 / HFT = 1)
PFH_d value	5.36 x 10^{-9} h^{-1}
Mission time / Proof test interval	20 years
Max. response time	< 40 ms
Max. mission time	12 months
Relevant standards	EN ISO 13849-1 :2008 EN ISO 13849-2 :2012 EN 62061 :2005 / A1:2013

EMC

Relevant standards	EN 61326-3-1 :2008 EN 61000-6-2 :2005 / AC:2005 EN 61000-6-4 :2007 / A1:2011 EN 62026-2 :2013 EN 61131-2 :2007 / A1:2011

Mechanical characteristics

Size w x h x d	100 x 120 x 106 mm [3.94 x 4.72x 4.17"]
Weight	800 g [28.22 oz]
Mounting	snap-on mounting on standard head rail

Display LEDs – for other statuses please contact the Kübler Service

LCD	menu, AS-i slave address display, plain text error messages
LED power	voltage ON
LED Profibus	PROFIBUS Master detected
LED config error	configuration error
LED U AS-i	AS-i voltage o.k.
LED AS-i active	AS-i operation normal
LED prg enable	automatic slave programming possible
LED prj mode	programming mode active
LED AUX	auxilary energy available
LEDs SI1 ... SI6 (input status)	
off	open
on	closed
LEDs SO1 ... SO6 (output status)	
off	open
on	closed

AS-i interface

Type	AS-i 3.0 Master
Voltage	18 ... 31.6 V
Power consumption	max. 200 mA

PROFIBUS DP interface

Interface	specification acc. to PROFIBUS DP 2.0 IEC 61158 / IEC 61784
Baud rate	9.6 kBaud ... 12 MBaud automatic detection
Type of connection	Sub-D, 9-pin
DP functions	Representation of the expansion modules as I/O process data in the PROFIBUS. Comprehensive diagnostics and configuration via Profibus Master.
PROFIsafe functions	signal safe inputs via PROFIsafe write safe outputs via PROFIsafe

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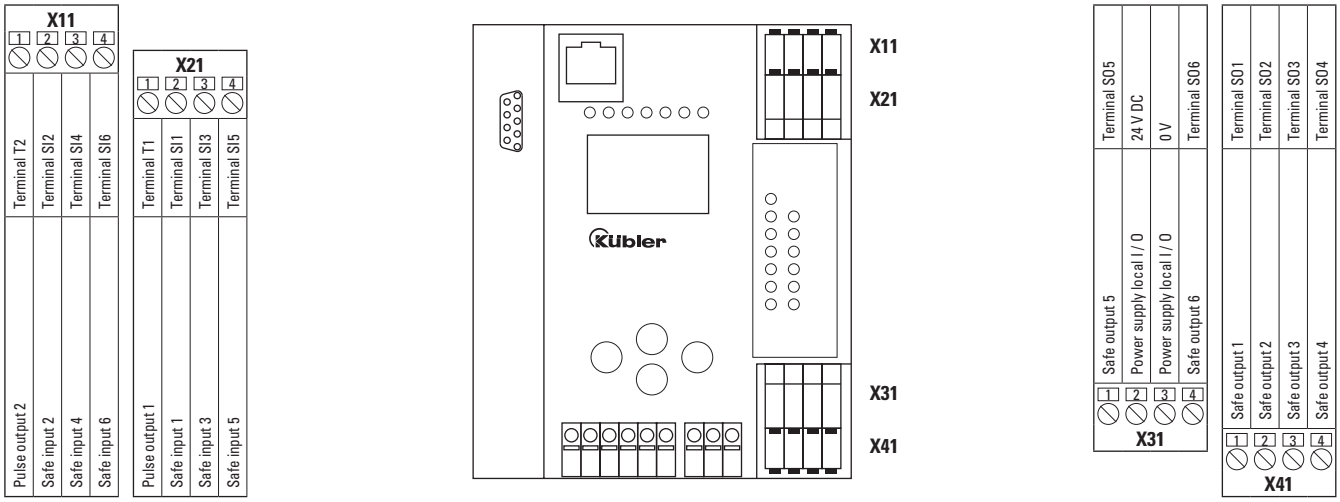
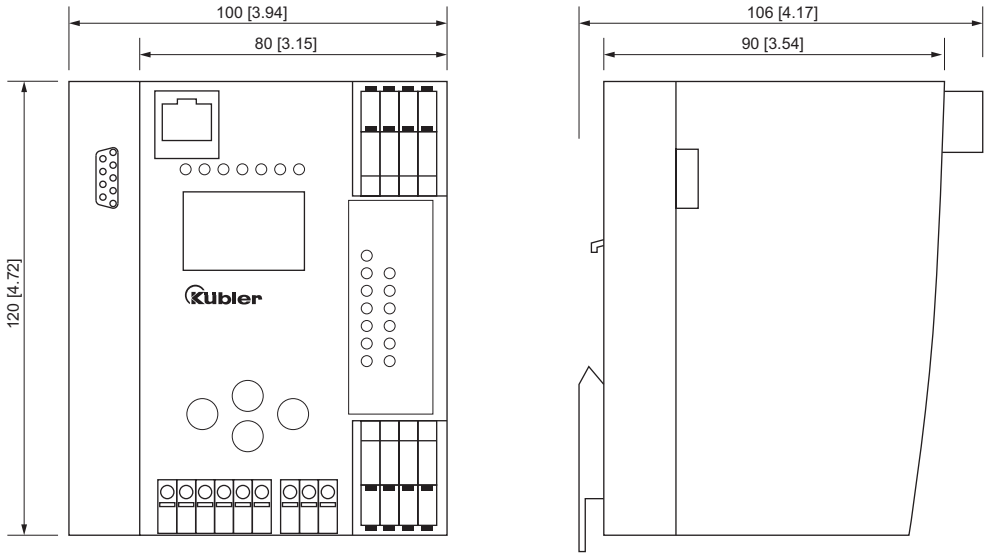
Safety-M modular Basic module | Gateway, safe – SMBS.S31 | PROFIsafe over PROFIBUS DP

Terminal assignment



Dimensions

Dimensions in mm [inch]



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Safety-M modular
Basic module

Gateway, safe – SMBS.SC1

PROFIsafe over PROFINET IO

SMBS is a compact and modular safety control of the Safety-M modular product family with integrated drive monitoring. This device is freely programmable for safe processing of drive-related safety functions and of EMERGENCY STOP switches, two-hand controls, light barriers, operating mode selectors, etc.

The basic device offers 6 / 3 safe inputs and 6 safe shut-off channels.

Profisafe Gateway over PROFINET IO.

- Basic module for setting up a monitoring system for safe speed and/or position measurement with configurable inputs and outputs.
- Extensive library of pre-configured safe sensors and command devices.
- Extended drive monitoring via axis expansion module EMAx (e.g. SS1, SS2, SOS, SLS, SDI, SLA, SSM, SCA, ...).
- Safe brake control "SBC" via output expansion modules EMIO e.g. for suspended loads.
- Programming with SafeMonitor software.
- Status LED on the front side.
- Plain text display with 5 different languages.
- Gateway functionality with access to all data of the basic and extension modules.
- Gateway parameter file (GSD, GSDML, ESI, etc.) integrated in the device-internal web server.
- Basic unit comes with 3 safe input lines and 6 safe shut-off channels. The 3 safe inputs can also be used as 6 standard inputs or as messaging outputs.
- Cross-short-cut monitoring functionality (EDM).
- Contact multiplication or increase of power capability by external contactors in connection with the device-internal monitoring function for external contacts.
- Extensive diagnostic functionality integrated in FW.
- Integrated chip card for saving configuration data, ensuring easy device replacement.
- Safe cross communication with other SMBx modules.
- AS-i master functionality with up to 31 safe slaves.
- Easy, fast and comfortable wiring, without topological restrictions.

Order no.

SMBS	Basic module	**8.SMBS.SC1.330**

Accessories		Order no.
Memory chip card	replacement (10 pieces), 128 kB / 1024 kbit	**8.SMCC.128**
SafeMonitor license	single user software license	**8.SMSW.000**

Connection technology		Order no.
Cordset, pre-assembled, 2 m [6.56']	Ethernet programming cable	**05.00.60A1.7272.002M**
Crossover adapter	Ethernet adapter	**05.CA.RJ45**
USB Fast Ethernet Port	USB <–> Ethernet adapter	**05.UA0144**

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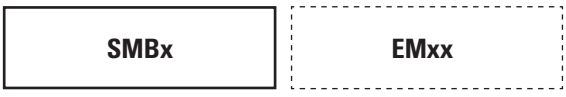
Modular construction

Basic module
Modular safety control system.

Expansion modules
For additional inputs and outputs and axis monitoring.



Expansion modules

EMAI	Axis expansion for incremental encoders.
EMAA	Axis expansion for absolute encoders.
EMIO	Input / output expansion.

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Safety-M modular Basic module | **Gateway, safe – SMBS.SC1** | **PROFIsafe over PROFINET IO**

Technical data

General data

Safe digital input lines	6 / 3, OSSD compatible
Safe digital output lines	6
Type of connection	pluggable terminals
Max. terminal cross section	1.5 mm^2 [AWG 15]
Interface for expansion modules	AS-i

Electrical characteristics

Power supply	24 V DC
Tolerance	-15 %, +25 %
Power consumption	4.8 W
Fuse on power supply	max. 4 A
Rated data digital inputs	24 V DC / 15 mA, type 1 to EN 61131-2
Rated data digital outputs	24 V DC / 100 mA

Environmental data

Operating temperature	0°C ... +55°C [+32°F ...+131°F]
Storage temperature	-25°C ... +85°C [-13°F ...+185°F]
Protection acc. to EN 60529	IP20
Climate class	3 acc. to DIN 50178
CE compliant acc. to	
(up to April 19, 2016)	EMC guideline 2004/108/EG Machinery directive 2006/42/EC RoHS guideline 2011/65/EU
(as from April 20, 2016)	EMC guideline 2014/30/EU Machinery directive 2006/42/EC RoHS guideline 2011/65/EU

Safety characteristics

Classification	PLe / SIL3
System structure	2 channel (Cat. 4 / HFT = 1)
PFH_d value	5.36 x 10^{-9} h^{-1}
Mission time / Proof test interval	20 years
Max. response time	< 40 ms
Max. mission time	12 months
Relevant standards	EN ISO 13849-1 :2008 EN ISO 13849-2 :2012 EN 62061 :2005 / A1:2013

EMC

Relevant standards	EN 61326-3-1 :2008 EN 61000-6-2 :2005 / AC:2005 EN 61000-6-4 :2007 / A1:2011 EN 62026-2 :2013 EN 61131-2 :2007 / A1:2011

Mechanical characteristics

Size w x h x d	100 x 120 x 106 mm [3.94 x 4.72x 4.17"]
Weight	800 g [28.22 oz]
Mounting	snap-on mounting on standard head rail

Display LEDs – for other statuses please contact the Kübler Service

LCD		menu, AS-i slave address display, plain text error messages
LED power		voltage ON
LED PROFINET	green red	PROFINET Master detected PROFINET Master nor detected
LED config error		configuration error
LED U AS-i		AS-i voltage o.k.
LED AS-i active		AS-i operation normal
LED prg enable		automatic slave programming possible
LED prj mode		programming mode active
LED AUX		auxilary energy available
LEDs SI1 ... SI6 (input status)		
	off on	open closed
LEDs SO1 ... SO6 (output status)		
	off on	open closed

AS-i interface

Type	AS-i 3.0 Master
Voltage	18 ... 31.6 V
Power consumption	max. 200 mA

PROFINET IO interface

Interface	PROFINET IO
Baud rate	100 MBaud
Type of connection	2 x RJ45, 2-port switch
Conformance class	B
PROFIsafe functions	signal safe inputs via PROFIsafe write safe outputs via PROFIsafe

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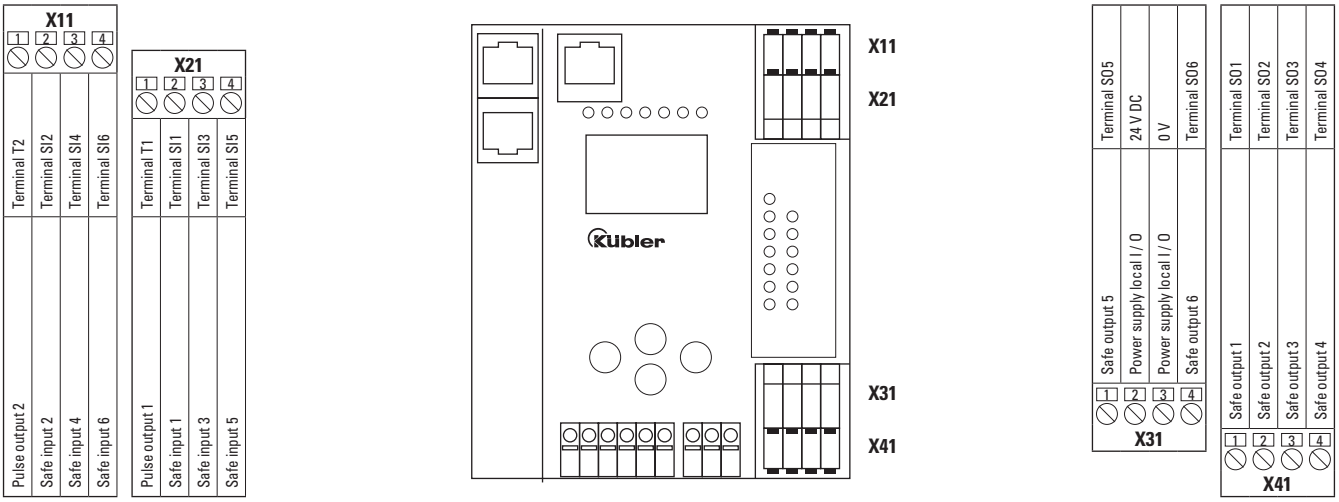
Safety-M modular
Basic module

Gateway, safe – SMBS.SC1

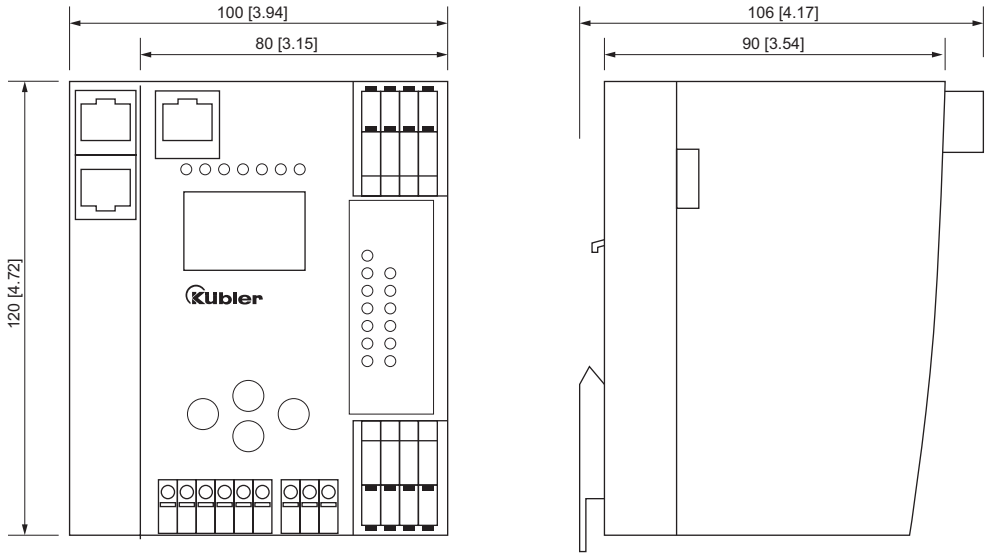
PROFIsafe over PROFINET IO

Terminal assignment



Dimensions

Dimensions in mm [inch]



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Safety-M modular Expansion module	Axis expansion – EMAI.012	Incremental HTL / Push-pull

Expansion module for the basic modules of the Safety-M modular product family.

Incremental axis expansion for safe motion monitoring with HTL encoders.

- For the safe speed detection.
- Extensive library of pre-configured safe sensors and command devices.
- Extended drive monitoring acc. to EN 61800-5-2 (e.g. SS1, SS2, SOS, SLS, SDI, SLA, SSM, SCA, ...).
- Programming with SafeMonitor software.
- Status LED on the front side.
- In-depth encoder monitoring.
- Integrated chip card for saving configuration data, ensuring easy device replacement.
- AS-i slave.
- Rotary speed teach-in possible via front-side key.

Order no.

EMAI	Expansion module	**8.EMAI.012.000**

Accessories		Order no.
EMC terminal	for encoder cable shield, top hat rail installation	**8.0000.4G06.0000**
Memory chip card	replacement (10 pieces), 32 kB / 256 kBit	**8.SMCC.032**

Connection technology		Order no.
Connection cable 5 m [16.40']	for encoder connection box, Mini-IO – wire	**8.SMAS.C01.005M**

Further accessories can be found in accessories area of our website at: www.kuebler.com/accessories.
Additional connectors can be found in the connection technology section or in the connection technology area of our website at: www.kuebler.com/connection_technology.
You will find an overview of our systems and components for Functional Safety under www.kuebler.com/safety.

Modular construction

Basic module
Modular safety control system.

Expansion modules
For additional inputs and outputs and axis monitoring.

SMBx | EMxx

Basic modules

SMBD	Basic module digital.
SMBU	Basic module with universal gateway functionality.
SMBS	Basic module with safe gateway functionality.

Expansion modules

EMAI	Axis expansion for incremental encoders.
EMAA	Axis expansion for absolute encoders.
EMIO	Input / output expansion.

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Safety-M modular Expansion module | **Axis expansion – EMAI.012** | **Incremental HTL / Push-pull**

Technical data

General data

Safe digital input lines	0
Safe digital output lines	0
Type of connection	plugable screw terminal
Max. terminal cross section	1.5 mm² [AWG 15]

Electrical characteristics

Power supply	24 V DC
Tolerance	±25 %
Power consumption	3.6 W
Fuse on power supply	max. 2 A
Memory	chip card 32 k

Mechanical characteristics

Size w x h x d	22.5 x 99 x 114.5 mm [0.89 x 3.90 x 4.51"]
Weight	160 g [5.64 oz]
Mounting	snap-on mounting on standard head rail

Environmental data

Operating temperature	0°C ... +55°C [+32°F ...+131°F]
Storage temperature	-25°C ... +85°C [-13°F ...+185°F]
Protection acc. to EN 60529	IP20
Climate class	3 acc. to DIN 50178
CE compliant acc. to	
(up to April 19, 2016)	EMC guideline 2004/108/EG Machinery directive 2006/42/EC RoHS guideline 2011/65/EU
(as from April 20, 2016)	EMC guideline 2014/30/EU Machinery directive 2006/42/EC RoHS guideline 2011/65/EU

Safety characteristics

Classification	PLe / SIL3
System structure	2 channel (Cat. 4 / HFT = 1)
PFH_d value	5.36 x 10^{-9} h^{-1}
Mission time / Proof test interval	20 years
Max. response time	< 40 ms
Max. mission time	12 months
Relevant standards	EN ISO 13849-1 :2008 EN ISO 13849-2 :2012 EN 62061 :2005 / A1:2013

EMC

Relevant standards	EN 61326-3-1 :2008 EN 61000-6-2 :2005 / AC:2005 EN 61000-6-4 :2007 / A1:2011 EN 62026-2 :2013 EN 61131-2 :2007 / A1:2011

Display LEDs – for other statuses please contact the Kübler Service

ASI	LED green	off	AS-i supply voltage not OK
		blinking 1 Hz	peripheral fault or address "0", configuration not validated
		on	AS-i supply voltage OK
Fault	LED red	off	on-line
		blinking 1 Hz	peripheral fault, configuration not validated
		on	off-line, address "0"
AUX	LED green	off	24 VDC AUX missing
		on	24 VDC AUX present
CONF	LED yellow	off	normal operation
		blinking 2 x 1 Hz	chip card is written
		blinking 1 Hz	frequency stored via configuration button
ST1, ST2	LED yellow	off	corresponding encoder not connected
		blinking 1 Hz	error message
		on	corresponding encoder connected
F1, F2	LED yellow	off	no safe, low frequency or stop axis 1/2
		blinking 1 Hz	error message
		on	safe, low frequency or stop axis 1/2

LED flashing sample

Error encoder 1	ST1	on
	F1	blinking 1 Hz
	ST2, F2	–
Error encoder 2	ST2	on
	F2	blinking 1 Hz
	ST1, F1	–
Data on chip card and device different (not empty)		
	ST1, F1	blinking 1 Hz
	ST2, F2	off
Chip card defective	ST1, F1	off
	ST2, F2	blinking 1 Hz
Serious error		
	ST1, ST2 , F1, F2	blinking 1 Hz

Encoder interface front ENC1 / ENC2

Type of connection	Mini-IO
Number of interfaces	2 (software configurable)
Interface	HTL/Push-Pull
Processing	1 encoder – 2 axes 2 encoder – 1 axis

HTL interface

Singal level	HTL
Max. pulse frequency	200 kHz
Reverse polarity protection	yes
Pulse rate	adjustable

AS-i interface

Type	AS-i slave
Voltage	18 ... 31.6 V
Power consumption	max. 150 mA

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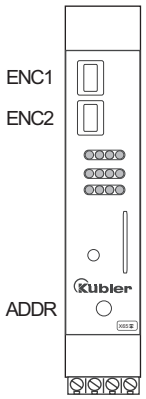
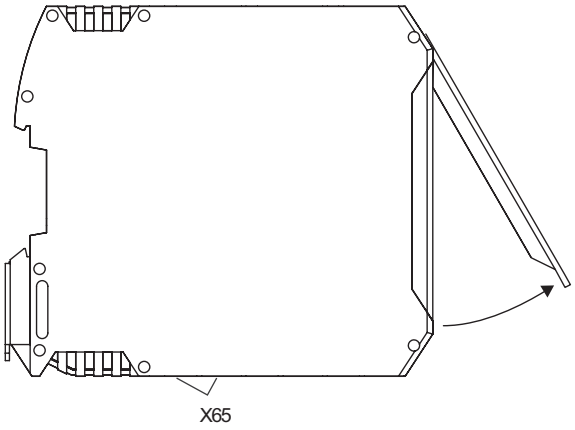
Safety-M modular Expansion module	Axis expansion – EMAI.012	Incremental HTL / Push-pull

Terminal assignment

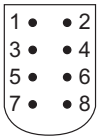




Terminal encoder 1 and 2

ENC1 / ENC2 – Mini IO female connector									
Signal: HTL	$\overline{B}$	B	nc	nc	A	$\overline{A}$	+V	0 V	⏚
Pin:	1	2	3	4	5	6	7	8	PH

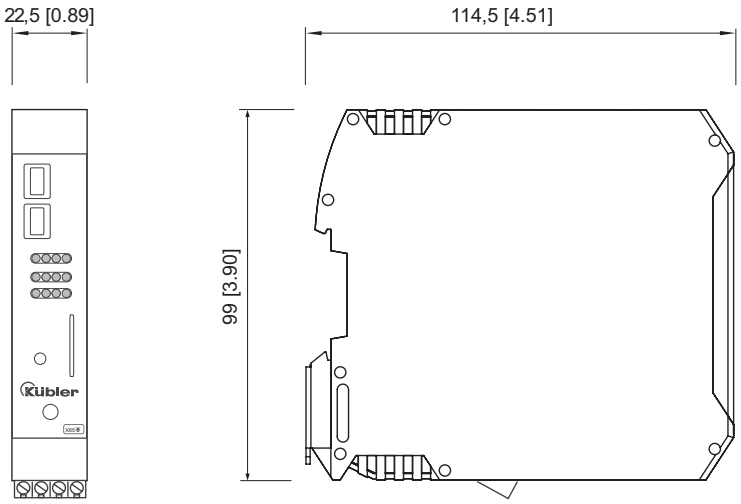
Female connector, Mini-IO



+V: Power supply +V DC
0 V: Encoder power supply ground GND (0 V)
A, $\overline{A}$: Incremental channel A
B, $\overline{B}$: Incremental channel B
PH ⏚: Plug connector housing (Shield)

Dimensions

Dimensions in mm [inch]



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Safety-M modular Expansion module	Axis expansion – EMAA.032	Absolute SSI, SinCos, TTL

Expansion module for the basic modules of the Safety-M modular product family.

Absolute and incremental axis expansion for safe position and motion monitoring with SinCos and/or SSI encoders.

- For the safe speed and/or position detection.
- Extensive library of pre-configured safe sensors and command devices.
- Extended drive monitoring acc. to EN 61800-5-2 (e.g. SS1, SS2, SOS, SLS, SDI, SLA, SSM, SCA, SLI, SLP, ...).
- Programming with SafeMonitor software.
- Status LED on the front side.
- In-depth encoder monitoring.
- Fast local shut-off via safe semiconductor outputs.
- Integrated chip card for saving configuration data, ensuring easy device replacement.
- Two safe outputs for fast direct shut-off.
- AS-i slave.
- Rotary speed teach-in possible via front-side key.

Order no.

EMAI	Expansion module	**8.EMAA.032.010**

Accessories		Order no.
Encoder connection box	adapter module for splitting encoder signals	**8.SMAS.000**
EMC terminal	for encoder cable shield, top hat rail installation	**8.0000.4G06.0000**
Memory chip card	replacement (10 pieces), 32 kB / 256 kBit	**8.SMCC.032**
Connection technology		Order no.
Connection cable 0.25 m [0.82']	for encoder connection box, RJ45 – RJ45	**8.SMAS.C22.0M25**

Further accessories can be found in accessories area of our website at: www.kuebler.com/accessories.
Additional connectors can be found in the connection technology section or in the connection technology area of our website at: www.kuebler.com/connection_technology.
You will find an overview of our systems and components for Functional Safety under www.kuebler.com/safety.

Modular construction

Basic module
Modular safety control system.

Expansion modules
For additional inputs and outputs and axis monitoring.

SMBx | **EMxx**

Basic modules

SMBD Basic module digital.
SMBU Basic module with universal gateway functionality.
SMBS Basic module with safe gateway functionality.

Expansion modules

EMAI Axis expansion for incremental encoders.
EMAA Axis expansion for absolute encoders.
EMIO Input / output expansion.

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Safety-M modular Expansion module | **Axis expansion – EMAA.032** | **Absolute SSI, SinCos, TTL**

Technical data

General data

Safe digital input lines	0
Safe digital output lines	2 / 1
Type of connection	pluggable screw terminals
Max. terminal cross section	1.5 mm^2 [AWG 15]

Electrical characteristics

Power supply	24 V DC
Tolerance	± 25 %
Power consumption	3.6 W
Fuse on power supply	max. 2 A
Memory	chip card 32 k

Mechanical characteristics

Size w x h x d	22.5 x 99 x 114.5 mm [0.89 x 3.90 x 4.51"]
Weight	160 g [5.64 oz]
Mounting	snap-on mounting on standard head rail

Environmental data

Operating temperature	0°C ... +55°C [+32°F ...+131°F]
Storage temperature	-25°C ... +85°C [-13°F ...+185°F]
Protection acc. to EN 60529	IP20
Climate class	3 acc. to DIN 50178
CE compliant acc. to	
(up to April 19, 2016)	EMC guideline 2004/108/EG Machinery directive 2006/42/EC RoHS guideline 2011/65/EU
(as from April 20, 2016)	EMC guideline 2014/30/EU Machinery directive 2006/42/EC RoHS guideline 2011/65/EU

Safety characteristics

Classification	PLe / SIL3
System structure	2 channel (Cat. 4 / HFT = 1)
PFH_d value	5.36 x 10^{-9} h^{-1}
Mission time / Proof test interval	20 years
Max. response time	< 40 ms
Max. mission time	12 months
Relevant standards	EN ISO 13849-1 :2008 EN ISO 13849-2 :2012 EN 62061 :2005 / A1:2013

EMC

Relevant standards	EN 61326-3-1 :2008 EN 61000-6-2 :2005 / AC:2005 EN 61000-6-4 :2007 / A1:2011 EN 62026-2 :2013 EN 61131-2 :2007 / A1:2011

Display LEDs – for other statuses please contact the Kübler Service

ASI	LED green	off	AS-i supply voltage not OK
		blinking 1 Hz	peripheral fault or address "0" configuration not validated
		on	AS-i supply voltage OK
FAULT	LED red	off	on-line
		blinking 1 Hz	peripheral fault, configuration not validated
		on	off-line or address "0"
AUX	LED green	off	24 VDC AUX missing
		on	24 VDC AUX present
CONF	LED yellow	off	normal operation
	blinking red/yellow 2 x 1 Hz		chip card is written
		on	frequency stored via configuration button
ST1, ST2	LED yellow	off	encoder 1/2 not connected
		blinking 1 Hz	error message
		on	encoder 1/2 connected
F1, F2	LED yellow	off	no safe, low frequency or stop axis 1/2
		blinking 1 Hz	error message
		on	safe, low frequency or stop axis 1/2
O1, O2	LED yellow	blinking 1 Hz	overload cut-off
		on	state of output switching element
Peripheral fault			
	LED red	blinking 1 Hz	AUX voltage is missing, ground short circuit

LED flashing sample

Error encoder 1	ST1	on
	F1	blinking 1 Hz
	ST2, F2	off
Error encoder 2	ST2	on
	F2	blinking 1 Hz
	ST1, F1	off
Data on chip card and device different		
	ST1, F1	blinking 1 Hz
	ST2, F2	off
Chip card defective	ST2, F2	blinking 1 Hz
	ST1, F1	off
Circuit or internal error		
	ST1, ST2 , F1, F2	blinking 1 Hz
Factory reset		
	ST1, ST2 , F1, F2	chaser lights
Configuration not validated		
	FAULT (green) / AUX (red)	blinking 1 Hz, push-pull mode
	ASI, CONF	off

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Safety-M modular Expansion module	Axis expansion – EMAA.032	Absolute SSI, SinCos, TTL

Encoder interface front ENC1 / ENC2	
Type of connection	RJ45
Number of interfaces	2 (software configurable)
Interface	SSI, SinCos, TTL
Processing	1 encoder – 2 axes 2 encoder – 1 axis

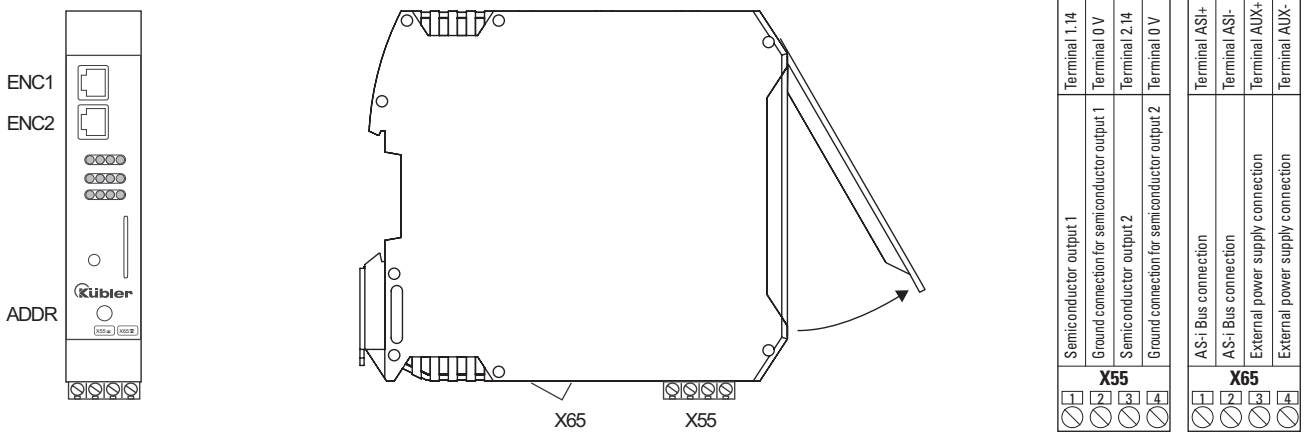
SSI interface		
Singal level		RS485
Pulse frequency	mastermode slavemode	150 kHz max. 250 kHz
Code		Binary or Gray
Monoflop time		< 1 µs
Data length		10 ... 32 bit

AS-i interface	
Type	AS-i slave
Voltage	18 ... 31.6 V
Power consumption	max. 150 mA

SinCos interface	
Singal level	1 Vpp (± 15 %)
Max. Frequency ~ 3dB	200 kHz
Reverse polarity protection	yes
Pulse rate	adjustable

TTL interface	
Singal level	RS422
Max. Frequency ~ 3dB	200 kHz
Reverse polarity protection	yes
Pulse rate	adjustable

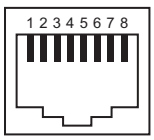
Terminal assignment



Terminal encoder 1 and 2

RJ45 female connector										
Signal:	SinCos	+V	0 V	-	B	$\overline{B}$	-	A	$\overline{A}$	⏚
	SSI	+V	0 V	C+	D+	D-	C-	-	-	⏚
Pin:		1	2	3	4	5	6	7	8	PH

RJ45 female connector



+V: Power supply +V DC
0 V: Encoder power supply ground GND (0 V)
A, $\overline{A}$: Cosine signal / Incremental channel A
B, $\overline{B}$: Sine signal / Incremental channel B
C+, C- : Clock signal
D+, D- : Data signal
PH ⏚: Plug connector housing (Shield)

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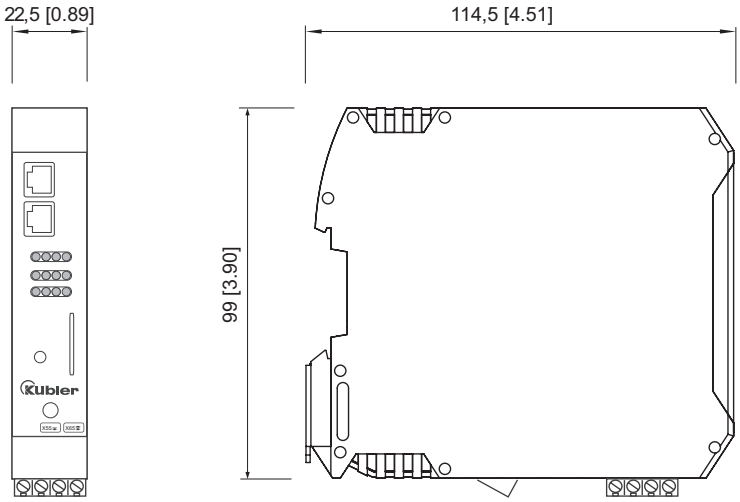
Safety-M modular Expansion module	Axis expansion – EMAA.032	Absolute SSI, SinCos, TTL

Dimensions

Dimensions in mm [inch]



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Safety-M modular Expansion module | I/O expansion – EMIO.SR.004 | Relay 1 x 4 contacts

I/O expansion for the basic modules of the Safety-M modular product family.

The expansion module is equipped a safe relay with four contact sets.

The expansion module allows signal duplication on potential-free contacts (contact expansion).

- Safe contact expansion, undelayed.
- 1 x 4 potential-free normally open contacts (NO).
- 1 EDM feedback channel.

Order no.

EMIO	I/O expansion, relay contacts	**8.EMIO.SR.004**

Modular construction

Basic module
Modular safety control system.

SMBx

Expansion modules
For additional inputs and outputs.

EMxx

Basic modules

SMBD	Basic module digital.
SMBU	Basic module with universal gateway functionality.
SMBS	Basic module with safe gateway functionality.

Expansion modules

EMAI	Axis expansion for incremental encoders.
EMAA	Axis expansion for absolute encoders.
EMIO	Input / output expansion.

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Safety-M modular Expansion module | I/O expansion – EMIO.SR.004 | Relay 1 x 4 contacts

Technical data

General data

Safe relays	1
Contacts per relay	4
Type of connection	pluggable screw terminals
Max. terminal cross section	1.5 mm^2 [AWG 15]

Electrical characteristics

Input

Signal level	0 signal	< 2.4 V DC
	1 signal	18 ... 26.5 V DC
Permissible test pulse duration		max. 1.5 ms
Rated current		60 mA per channel

Output

Contact type		positively driven
Output circuits short-circuit protection (external)		3 A fast-acting; 2 A delayed
Closing / opening delay		< 20 ms / < 20 ms
Switching frequency		max. 15Hz
Max. switch-on current		6 A for 20 ms
Rating surge voltage		4 kV
Switching current		5 mA ... 3 A
Total current (per channel)		12 A
Utilization category (DIN EN 60347-4-1 / EN 60947-5-1)	AC1	230 V/3 A (appr. 150 x 10^3 cycles)
	AC15	230 V/3 A (appr. 80 x 10^3 cycles)
	DC1	24 V/3 A (appr. 500 x 10^3 cycles)
	DC13	24 V/3 A/0.1 Hz (appr. 50 x 10^3 cycles)
Switching voltage AC		10 ... 230 V
Switching voltage DC		10 ... 230 V
Input circuit isolation		
	X23	reinforced insulation (6 kV)
	X53	basic insulation (4 kV)

Contact load EDM

Switching current	max. 20 mA

Environmental data

Operating temperature	-20°C ... +50°C [-4°F ...+122°F]
Storage temperature	-40°C ... +70°C [-40°F ...+158°F]
Humidity	non-condensing
Protection acc. to EN 60529	IP20
Climate class	3 acc. to DIN 50178
CE compliant acc. to	
(up to April 19, 2016)	EMC guideline 2004/108/EG Machinery directive 2006/42/EC RoHS guideline 2011/65/EU
(as from April 20, 2016)	EMC guideline 2014/30/EU Machinery directive 2006/42/EC RoHS guideline 2011/65/EU

Safety characteristics

B10d (AC15)	1.96 x 10^6 cycles
B10d (DC13)	780 x 10^3 cycles

Mechanical characteristics

Size w x h x d	22.5 x 99 x 114.5 mm [0.89 x 3.90 x 4.51“]
Weight	190 g [6.70 oz]
Mounting	snap-on mounting on standard head rail

EMC

Relevant standards	EN 61000-6-2 :2005 / AC:2005 EN 61000-6-4 :2007 / A1:2011 EN 60947-1 :2007 / A1:2011 EN 60947-5-1 :2004 / AC:2005

LED display

LED 1 (CH 1)	safe input 1
LED 3 (EDM 1)	EDM channel 1

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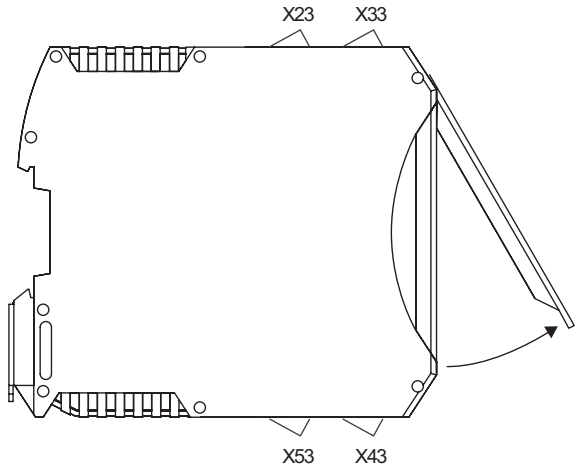
Safety-M modular Expansion module | I/O expansion – EMIO.SR.004 | Relay 1 x 4 contacts

Terminal assignment

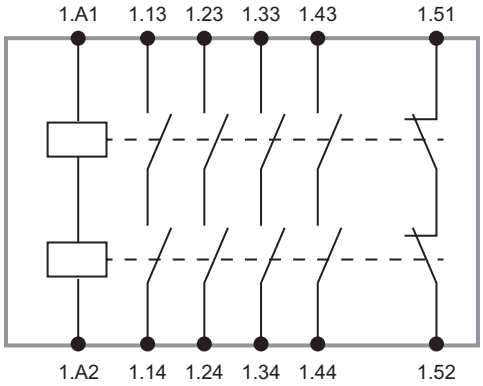
X23				X33			
4	3	2	1	4	3	2	1
Terminal 1.13	Terminal 1.14	Terminal 1.23	Terminal 1.24	NC	NC	Terminal 1.52	Terminal 1.51
Output channel 1.1	Output channel 1.1	Output channel 1.2	Output channel 1.2	NC	NC	EDM (feedback loop) channel 1	EDM (feedback loop) channel 1



X43			
1	2	3	4
Terminal 1.A1	Terminal 1.A2	NC	NC
Normally open contacts channel 1	Normally open contacts channel 1	NC	NC

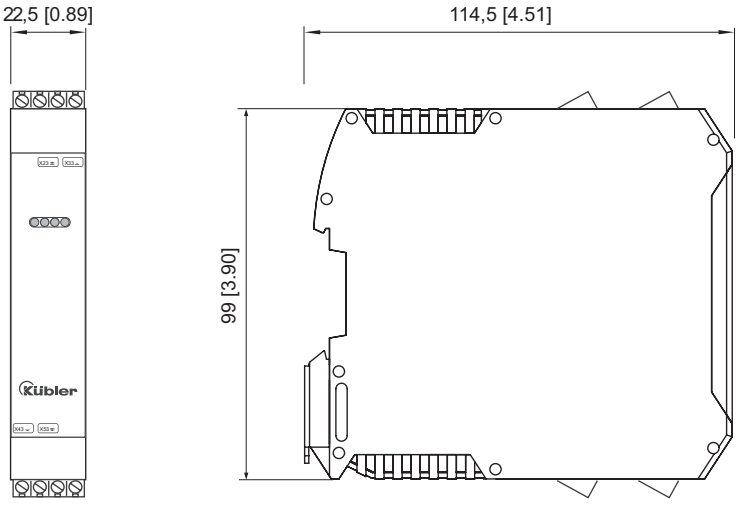
X53			
1	2	3	4
Terminal 1.43	Terminal 1.44	Terminal 1.33	Terminal 1.34
Output channel 1.4	Output channel 1.4	Output channel 1.3	Output channel 1.3

Output relay



Dimensions

Dimensions in mm [inch]



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Safety-M modular Expansion module | I/O expansion – EMIO.SR.008 | Relay 2 x 4 contacts

I/O expansion for the basic modules of the Safety-M modular product family.

The expansion module is equipped with two safe relays, each with four contact sets.

The expansion module allows signal duplication on potential-free contacts (contact expansion).

- Safe contact expansion, undelayed.
- 2 x 4 potential-free normally open contacts (NO).
- 2 EDM feedback channels.

Order no.

EMIO	I/O expansion, relay contacts	**8.EMIO.SR.008**

Modular construction

Basic module
Modular safety control system.

SMBx

Expansion modules
For additional inputs and outputs.

EMxx

Basic modules

SMBD	Basic module digital.
SMBU	Basic module with universal gateway functionality.
SMBS	Basic module with safe gateway functionality.

Expansion modules

EMAI	Axis expansion for incremental encoders.
EMAA	Axis expansion for absolute encoders.
EMIO	Input / output expansion.

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Safety-M modular Expansion module | **I/O expansion – EMIO.SR.008** | **Relay 2 x 4 contacts**

Technical data

General data

Safe relays	2
Contacts per relay	4
Type of connection	pluggable screw terminals
Max. terminal cross section	1.5 mm^2 [AWG 15]

Electrical characteristics

Input

Signal level	0 signal	< 2.4 V DC
	1 signal	18 ... 26.5 V DC
Permissible test pulse duration		max. 1.5 ms
Rated current		60 mA per channel

Output

Contact type		positively driven
Output circuits short-circuit protection (external)		3 A fast-acting; 2 A delayed
Closing / opening delay		< 20 ms / < 20 ms
Switching frequency		max. 15 Hz
Max. switch-on current		6 A for 20 ms
Rating surge voltage		4 kV
Switching current		5 mA ... 3 A
Total current (per channel)	< 40°C [104°F]	12 A
	> 40°C [104°F]	9 A
Utilization category (DIN EN 60347-4-1 / EN 60947-5-1)	AC1	230 V/3 A (appr. 150 x 10^3 cycles)
	AC15	230 V/3 A (appr. 80 x 10^3 cycles)
	DC1	24 V/3 A (appr. 500 x 10^3 cycles)
	DC13	24 V/3 A/0.1 Hz (appr. 50 x 10^3 cycles)
Switching voltage AC		10 ... 230 V
Switching voltage DC		10 ... 230 V
Input circuit isolation		
	X13, X23	reinforced insulation (6 kV)
	X53, X63	basic insulation (4 kV)

Contact load EDM

Switching current	max. 20 mA

Environmental data

Operating temperature	-20°C ... +50°C [-4°F ...+122°F]
Storage temperature	-40°C ... +70°C [-40°F ...+158°F]
Humidity	non-condensing
Protection acc. to EN 60529	IP20
Climate class	3 acc. to DIN 50178
CE compliant acc. to	
(up to April 19, 2016)	EMC guideline 2004/108/EG Machinery directive 2006/42/EC RoHS guideline 2011/65/EU
(as from April 20, 2016)	EMC guideline 2014/30/EU Machinery directive 2006/42/EC RoHS guideline 2011/65/EU

Safety characteristics

B10d (AC15)	1.96 x 10^6 cycles
B10d (DC13)	780 x 10^3 cycles

Mechanical characteristics

Size w x h x d	22.5 x 99 x 114.5 mm [0.89 x 3.90 x 4.51“]
Weight	280 g [9.88 oz]
Mounting	snap-on mounting on standard head rail

EMC

Relevant standards	EN 61000-6-2 :2005 / AC:2005 EN 61000-6-4 :2007 / A1:2011 EN 60947-1 :2007 / A1:2011 EN 60947-5-1 :2004 / AC:2005

LED display

LED 1 (CH 1)	safe input 1
LED 2 (CH 2)	safe input 2
LED 3 (EDM 1)	EDM channel 1
LED 4 (EDM 2)	EDM channel 2

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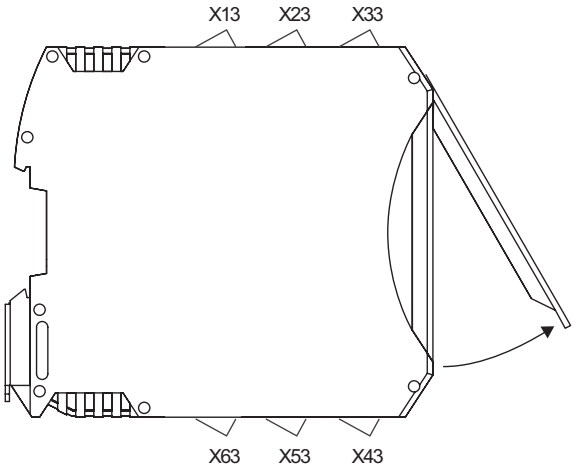
Safety-M modular Expansion module | I/O expansion – EMIO.SR.008 | Relay 2 x 4 contacts

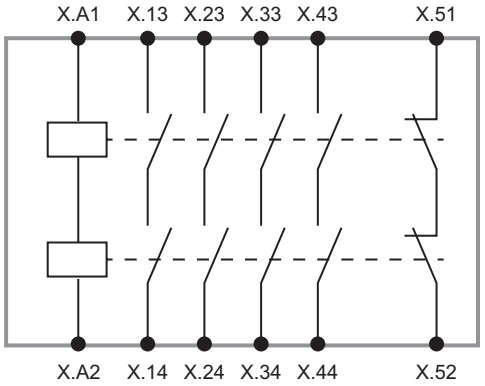
Terminal assignment

X13				X23				X33			
4	3	2	1	4	3	2	1	4	3	2	1
Terminal 2.13	Terminal 2.14	Terminal 2.23	Terminal 2.24	Terminal 1.13	Terminal 1.14	Terminal 1.23	Terminal 1.24	Terminal 2.52	Terminal 2.51	Terminal 1.52	Terminal 1.51
Output channel 2.1	Output channel 2.1	Output channel 2.2	Output channel 2.2	Output channel 1.1	Output channel 1.1	Output channel 1.2	Output channel 1.2	EDM (feedback loop) channel 2	EDM (feedback loop) channel 2	EDM (feedback loop) channel 1	EDM (feedback loop) channel 1



X43				X53				X63			
1	2	3	4	1	2	3	4	1	2	3	4
Normally open contacts channel 1	Normally open contacts channel 1	Normally open contacts channel 2	Normally open contacts channel 2	Output channel 1.4	Output channel 1.4	Output channel 1.3	Output channel 1.3	Output channel 2.4	Output channel 2.4	Output channel 2.3	Output channel 2.3
Terminal 1.A1	Terminal 1.A2	Terminal 2.A1	Terminal 2.A2	Terminal 1.43	Terminal 1.44	Terminal 1.33	Terminal 1.34	Termina l 2.43	Termina l 2.44	Termina l 2.33	Termina l 2.34

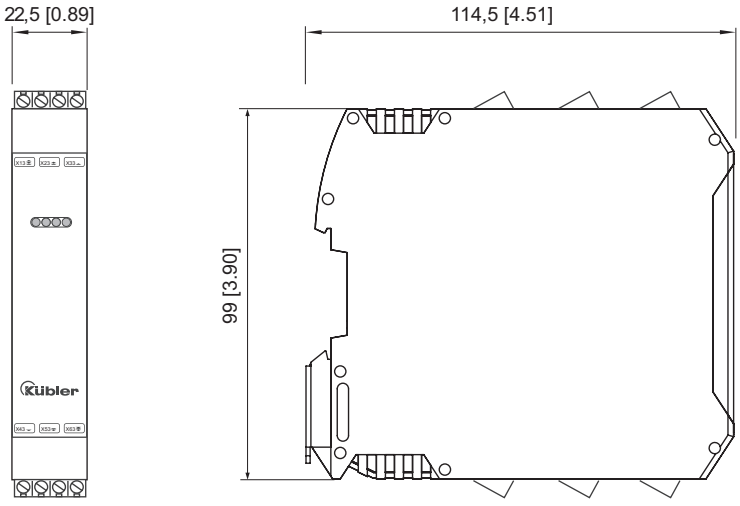
Output relay



X: 1 = relay 1
2 = relay 2

Dimensions

Dimensions in mm [inch]



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Safety-M modular Expansion module — I/O expansion – EMIO.SIO.048 — Digital 8 + 8 / 4

Digital I/O expansion for the basic modules of the Safety-M modular product family.

The expansion module is equipped with 8 digital inputs, 8 / 4 safe outputs and 1 messaging output.

- 8 digital input lines.
- 8 / 4 safe output lines.
- 1 messaging output.
- Cross-short-cut monitoring functionality.
- Contact multiplication or increase of power capability by external contactors in connection with the device-internal monitoring function for external contacts.
- Extensive diagnostic functionality integrated in FW.

Order no.

EMIO	I/O expansion, digital	**8.EMIO.SIO.048**

Modular construction

Basic module
Modular safety control system.

SMBx

Expansion modules
For additional inputs and outputs.

EMxx

Basic modules

SMBD	Basic module digital.
SMBU	Basic module with universal gateway functionality.
SMBS	Basic module with safe gateway functionality.

Expansion modules

EMAI	Axis expansion for incremental encoders.
EMAA	Axis expansion for absolute encoders.
EMIO	Input / output expansion.

Technical data

General data	
Digital input lines	8
Safe digital output lines	8 / 4
Messaging outputs	1
Type of connection	pluggable screw terminals
Max. terminal cross section	1.5 mm² [AWG 15]

Mechanical characteristics	
Size w x h x d	22.5 x 99 x 114.5 mm [0.89 x 3.90 x 4.51“]
Weight	190 g [6.70 oz]
Mounting	snap-on mounting on standard head rail

Environmental data	
Operating temperature	0°C ... +55°C [+32°F ...+131°F]
Storage temperature	-25°C ... +85°C [-13°F ...+185°F]
Protection acc. to EN 60529	IP20
Humidity	non-condensing
CE compliant acc. to (up to April 19, 2016)	EMC guideline 2004/108/EG Machinery directive 2006/42/EC RoHS guideline 2011/65/EU
(as from April 20, 2016)	EMC guideline 2014/30/EU Machinery directive 2006/42/EC RoHS guideline 2011/65/EU

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Safety-M modular Expansion module | I/O expansion – EMIO.SIO.048 | Digital 8 + 8 / 4

Electrical characteristics

AUX

Power supply		18 ... 30 V DC (PELV)
Power consumption		max. 1 A
Isolation voltage AS-i / AUX		500 V

Input

Power supply		from AUX
Input level		10 mA, R < 150 Ω
Singal level	0 signal	< 5 V DC
	1 signal	> 15 V DC
Rated data digital inputs		24 V DC / 20 mA

Output

Power supply		from AUX
Contact load		0.7 A, DC-13 at 30 V
Rated data digital outputs		24 V DC / 250 mA

Safety characteristics

Classification	PLe / SIL3
System structure	2 channel (Cat. 4 / HFT = 1)
PFH_d value	5.21 x 10^{-9} h^{-1}
Mission time / Proof test interval	20 years
Relevant standards	EN ISO 13849-1 :2008 EN ISO 13849-2 :2008 EN 62061 :2005 / A1:2010

EMC

Relevant standards	EN 61326-3-1 :2008 EN 61000-6-2 :2005 / AC:2005 EN 61000-6-4 :2007 / A1:2011 EN 62026-2 :2013 EN 61131-2 :2007 / A1:2011

AS-i interface

Type		AS-i slave
Profile	configuration slave	S-7.A.5
	4I / 4O slave	S-7.A.7
	safe output slaves	S-7.F
	diagnostic slaves	S-7.A.E
Voltage		18 ... 31.6 V
Power consumption		max. 200 mA

Display LEDs – for other statuses please contact the Kübler Service

SO1 ... SO8	LED yellow	off	output off
		blinking 1 Hz	restart block
		blinking 8 Hz	unlockable error status
		on	output on
PWR	LED green	off	AS-i supply voltage not OK
		blinking 1 Hz	address "0" oder peripheral fault
		on	AS-i supply voltage OK
FAULT	LED red	off	at least one slave is on-line
		blinking 1 Hz	at least one slave has peripheral fault
		on	no addressed slave is on-line
AUX	LED green	on	24 VDC AUX on
I1 ... I8	LED yellow	on	state of inputs
O1	LED yellow	on	PLC indicates alarm
Peripheral fault	LED red	blinking 1 Hz	AUX voltage is missing, overload output

LED flashing sample

Addressing mode		
	I1 ... I8, SO1 ... SO8	chaser lights
Chip card is written		
	I1 ... I8, SO1 ... SO8	blinking 2 x 1 Hz
Restart block	SO1 ... SO8	blinking 1 Hz
Unlockable error status		
	SO1 ... SO8	blinking 8 Hz
Circuit or internal error		
	I1 ... I8, SO1 ... SO8	off
	PWR, FAULT, AUX, O1	blinking 8 Hz
Data on chip card and device different		
	I2, I4, I6, I8, SO2, SO4, SO6, SO8	off
	I1, I3, I5, I7, SO1, SO3, SO5, SO7	blinking 1 Hz, push-pull mode
Chip card defective		
	I2, I4, I6, I8, SO2, SO4, SO6, SO8	off
	I1, I3, I5, I7, SO1, SO3, SO5, SO7	blinking 1 Hz, common mode
Desired address is blocked (incorrect double configuration)		
	I1 ... I8, SO1 ... SO4	off
	SO5 ... SO8	blinking 1 Hz, push-pull mode
Identification of the device via the configuration slave SafeMonitor		
	I6, I7, SO2, SO3	off
	I1 ... I5, I8, SO1, SO4, SO5 ... SO8	blinking 1 Hz (5 sec)

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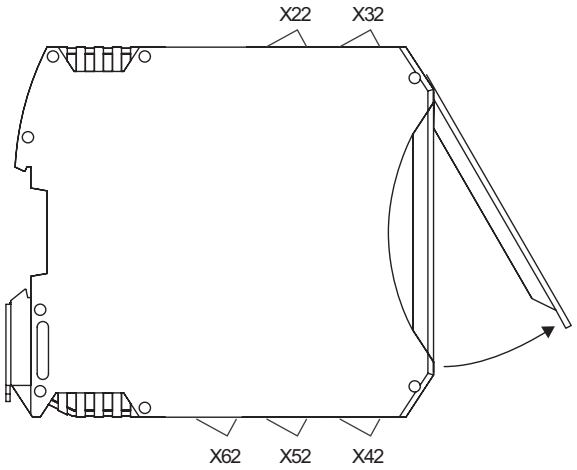
Safety-M modular Expansion module | I/O expansion – EMIO.SIO.048 | Digital 8 + 8 / 4

Terminal assignment

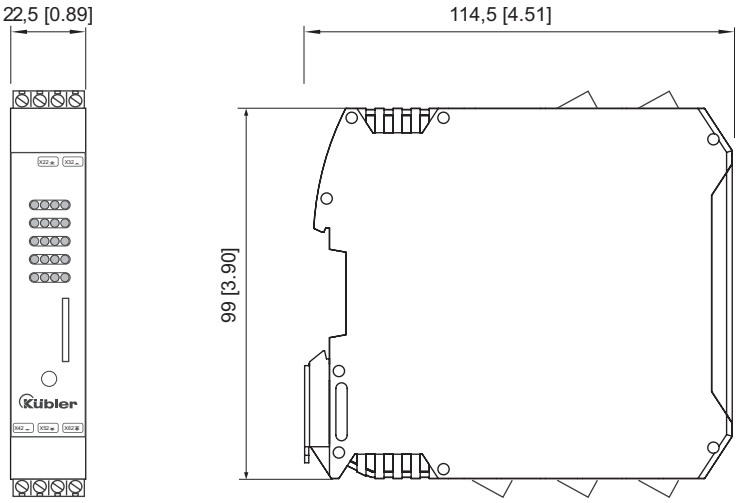
X22				X32			
4	3	2	1	4	3	2	1
Terminal 4	Terminal 3	Terminal 2	Terminal 1	Terminal 8	Terminal 7	Terminal 6	Terminal 5
Input terminal, feedback 4	Input terminal, feedback 3	Input terminal, feedback 2	Input terminal, feedback 1	Input terminal, feedback 8	Input terminal, feedback 7	Input terminal, feedback 6	Input terminal, feedback 5



X42				X52				X62			
1	2	3	4	1	2	3	4	1	2	3	4
Terminal SO1	Terminal SO2	Terminal SO3	Terminal SO4	Terminal SO5	Terminal SO6	Terminal SO7	Terminal SO8	ASI+	ASI-	AUX+	AUX-
Safe output terminal, output 1	Safe output terminal, output 2	Safe output terminal, output 3	Safe output terminal, output 4	Safe output terminal, output 5	Safe output terminal, output 6	Safe output terminal, output 7	Safe output terminal, output 8	AS-i Bus connection	AS-i Bus connection	Power supply input line	Power supply input line

Dimensions

Dimensions in mm [inch]



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Safety-M modular Expansion module | I/O expansion – EMIO.SIO.810 | Digital 16 / 8 + 2 / 1

Digital I/O expansion for the basic modules of the Safety-M modular product family.

The expansion module is equipped with 16 / 8 safe inputs and 2 / 1 safe outputs.

- 16 / 8 safe digital input lines.
- 2 / 1 safe digital output lines.
- Cross-short-cut monitoring functionality.
- Contact multiplication or increase of power capability by external contactors in connection with the device-internal monitoring function for external contacts.
- Extensive diagnostic functionality integrated in FW.

Order no.

EMIO	I/O expansion, digital	**8.EMIO.SIO.810**

Modular construction

Basic module
Modular safety control system.

SMBx

Expansion modules
For additional inputs and outputs.

EMxx

Basic modules

SMBD	Basic module digital.
SMBU	Basic module with universal gateway functionality.
SMBS	Basic module with safe gateway functionality.

Expansion modules

EMAI	Axis expansion for incremental encoders.
EMAA	Axis expansion for absolute encoders.
EMIO	Input / output expansion.

Technical data

General data

Safe digital input lines	16 / 8
Safe digital output lines	2 / 1
Type of connection	pluggable screw terminals
Max. terminal cross section	1.5 mm² [AWG 15]

Mechanical characteristics

Size w x h x d	22.5 x 99 x 114.5 mm [0.89 x 3.90 x 4.51“]
Weight	180 g [6.35 oz]
Mounting	snap-on mounting on standard head rail

Environmental data

Operating temperature	0°C ... +55°C [+32°F ...+131°F]
Storage temperature	-25°C ... +85°C [-13°F ...+185°F]
Protection acc. to EN 60529	IP20
Humidity	non-condensing
CE compliant acc. to (up to April 19, 2016)	EMC guideline 2004/108/EG Machinery directive 2006/42/EC RoHS guideline 2011/65/EU
(as from April 20, 2016)	EMC guideline 2014/30/EU Machinery directive 2006/42/EC RoHS guideline 2011/65/EU

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Safety-M modular Expansion module | I/O expansion – EMIO.SIO.810 | Digital 16 / 8 + 2 / 1

Electrical characteristics

AUX

Power supply		18 ... 30 V DC (PELV)
Power consumption		max. 1 A
Isolating voltage AS-i/AUX		500 V

Input

Power supply		from AUX
Input level		10 mA, R < 150 Ω
Singal level	0 signal	< 5 V DC
	1 signal	> 15 V DC
Rated data digital inputs		24 V DC / 20 mA

Output

Power supply		from AUX
Contact load		0.7 A, DC-13 at 30 V
Rated data digital outputs		24 V DC / 250 mA

Safety characteristics

Classification	PLe / SIL3
System structure	2 channel (Cat. 4 / HFT = 1)
PFH_d value	$5.08 \times 10^{-9}\ h^{-1}$
Mission time / Proof test interval	20 years
Relevant standards	EN ISO 13849-1 :2008 EN ISO 13849-2 :2008 EN 62061 :2005 / A1:2010

EMC

Relevant standards	EN 61326-3-1 :2008 EN 61000-6-2 :2005 / AC:2005 EN 61000-6-4 :2007 / A1:2011 EN 62026-2 :2013 EN 61131-2 :2007 / A1:2011

AS-i interface

Type		AS-i slave
Profile	safe input slaves	S-0.B.F.0
	diagnostic slaves	S-7.A.5.E
Voltage		18 ... 31.6 V
Power consumption		max. 200 mA

Display LEDs – for other statuses please contact the Kübler Service

S1 ... S16	LED yellow	off	corresponding input not switched on
		blinking 1 Hz, common mode	cross-circuit
		blinking 1 Hz, push-pull mode	restart block after unilateral opening a channel with linked inputs
		on	corresponding input switched on
PWR	LED green	off	AS-i supply voltage not OK
		blinking 1 Hz	address "0" or peripheral fault
		on	AS-i supply voltage OK
FLT	LED red	off	at least one slave is on-line
		blinking 1 Hz	at least one slave has peripheral fault
		on	no addressed slave is on-line
AUX	LED green	on	24 VDC AUX on
O1	LED yellow	off	output off
		blinking 1 Hz	restart block
		blinking 8 Hz	unlockable error status
		on	output on

LED flashing sample

Addressing mode	S1 ... S16	chaser lights
Chip card is written		
	S1 ... S16	blinking 2 x 1 Hz
Restart block	AUX, O1	blinking 1 Hz
Unlockable error status		
	AUX, O1	blinking 8 Hz
Circuit or internal error		
	S1 ... S16	off
	PWR, FLT, AUX, O1	blinking 8 Hz
Data on chip card and device different		
	S1 ... S16	blinking 1 Hz, push-pull mode
Chip card defective	S1 ... S16	blinking 1 Hz, common mode
Desired address is blocked (incorrect double configuration)		
	S1 ... S12	off
	S13 ... S16	blinking 1 Hz, push-pull mode
Identification of the device via the cofiguration slave via SafeMonitor		
	S7, S8, S10, S11	off
	S1 ... S5, S8, S9, S10 ... S16	blinking 1 Hz, 5 sec

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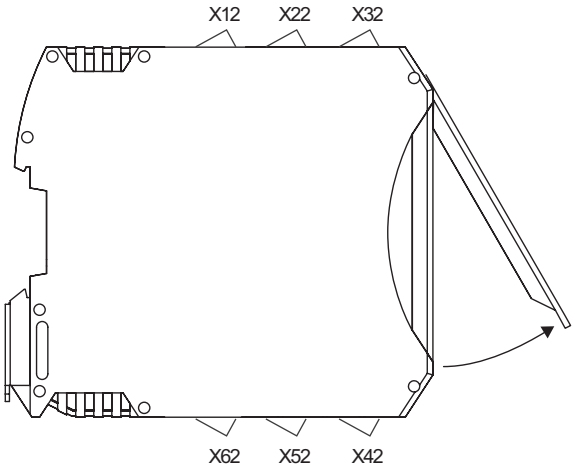
Safety-M modular Expansion module | I/O expansion – EMIO.SIO.810 | Digital 16 / 8 + 2 / 1

Terminal assignment

X12			
4	3	2	1
Terminal S4	Terminal S3	Terminal S2	Terminal S1
Safe input terminal, input 4	Safe input terminal, input 3	Safe input terminal, input 2	Safe input terminal, input 1

X22			
4	3	2	1
Terminal S8	Terminal S7	Terminal S6	Terminal S5
Safe input terminal, input 8	Safe input terminal, input 7	Safe input terminal, input 6	Safe input terminal, input 5

X32			
4	3	2	1
Terminal S12	Terminal S11	Terminal S10	Terminal S9
Safe input terminal, input 12	Safe input terminal, input 11	Safe input terminal, input 10	Safe input terminal, input 9



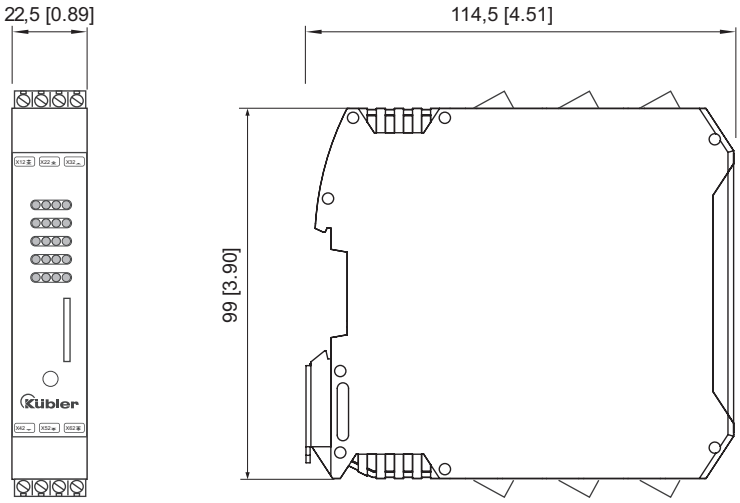
X42			
1	2	3	4
Safe input terminal, input 13	Safe input terminal, input 14	Safe input terminal, input 15	Safe input terminal, input 16
Terminal S13	Terminal S14	Terminal S15	Terminal S16

X52			
1	2	3	4
Semiconductor output 1	Ground connection for semiconductor output	Pulse 1 (S1, S3, S5, S7, S9, S11, S13, S15)	Pulse 2 (S2, S4, S6, S8, S10, S12, S14, S16)
Terminal 1.14	Terminal 0 V	Terminal T1	Terminal T2

X62			
1	2	3	4
AS-i Bus connection	AS-i Bus connection	Power supply input line	Power supply input line
ASI+	ASI-	AUX+	AUX-

Dimensions

Dimensions in mm [inch]



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Safety-M modular Expansion module | I/O expansion – EMIO.SIO.420 | Digital 8 / 4 + 4 / 2

Digital I/O expansion for the basic modules of the Safety-M modular product family.

The expansion module is equipped with 8 / 4 safe inputs and 4 / 2 safe outputs.

- 8 / 4 safe input lines.
- 4 / 2 safe output lines.
- Cross-short-cut monitoring functionality.
- Contact multiplication or increase of power capability by external contactors in connection with the device-internal monitoring function for external contacts.
- Extensive diagnostic functionality integrated in FW.

Order no.

EMIO	I/O expansion, digital	**8.EMIO.SIO.420**

Modular construction

Basic module
Modular safety control system.

SMBx

Expansion modules
For additional inputs and outputs.

EMxx

Basic modules

SMBD	Basic module digital.
SMBU	Basic module with universal gateway functionality.
SMBS	Basic module with safe gateway functionality.

Expansion modules

EMAI	Axis expansion for incremental encoders.
EMAA	Axis expansion for absolute encoders.
EMIO	Input / output expansion.

Technical data

General data

Safe digital input lines	8 / 4
Safe digital output lines	4 / 2
Type of connection	pluggable screw terminals
Max. terminal cross section	1.5 mm^2 [AWG 15]

Mechanical characteristics

Size w x h x d	22.5 x 99 x 114.5 mm [0.89 x 3.90 x 4.51“]
Weight	180 g [6.35 oz]
Mounting	snap-on mounting on standard head rail

Environmental data

Operating temperature	0°C ... +55°C [+32°F ...+131°F]
Storage temperature	-25°C ... +85°C [-13°F ...+185°F]
Protection acc. to EN 60529	IP20
Humidity	non-condensing
CE compliant acc. to (up to April 19, 2016)	EMC guideline 2004/108/EG Machinery directive 2006/42/EC RoHS guideline 2011/65/EU
(as from April 20, 2016)	EMC guideline 2014/30/EU Machinery directive 2006/42/EC RoHS guideline 2011/65/EU

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Safety-M modular Expansion module | I/O expansion – EMIO.SIO.420 | Digital 8 / 4 + 4 / 2

Electrical characteristics

AUX

Voltage		20 ... 30 V DC (PELV)
Power consumption		max. 4 A
Isolation voltage AS-i / AUX		500 V

Input

Power supply		from AUX
Input level		10 mA, R < 150 Ω
Switching current	static	4 mA for 24 V DC
	dynamic	15 mA for 24 V DC (T = 100 µs)

Output

Power supply		from AUX
Contact load		max. 0.7 A, DC-13 for 30 V
Max. output current		1.4 A

Safety characteristics

Classification	PLe / SIL3
System structure	2 channel (Cat. 4 / HFT = 1)
PFH_d value	$5.08 \times 10^{-9}\ h^{-1}$
Mission time / Proof test interval	20 years
Relevant standards	EN ISO 13849-1 :2008 EN ISO 13849-2 :2008 EN 62061 :2005 / A1:2010

EMC

Relevant standards	EN 61326-3-1 :2008 EN 61000-6-2 :2005 / AC:2005 EN 61000-6-4 :2007 / A1:2011 EN 62026-2 :2013 EN 61131-2 :2007 / A1:2011

AS-i interface

Type		AS-i slave
Profile	safe input slaves	S-0.B.F.0
	diagnostic slaves	S-7.A.5.E
Voltage		18 ... 31.6 V
Power consumption		max. 200 mA

Display LEDs – for other statuses please contact the Kübler Service

SI1 ... SI8	LED yellow	off	corresponding input not switched on
		blinking 1 Hz	cross-connection at the safe inputs
		chaser lights	addressing mode
		on	corresponding input switched on
PWR	LED green	off	AS-i supply voltage not OK
		blinking 1 Hz	no AS-i communication or peripheral fault
		on	AS-i supply voltage OK
FLT	LED red	off	at least one slave is on-line
		blinking 1 Hz	at least one slave has peripheral fault
		on	no addressied slave ist on-line
AUX	LED green	on	24 VDC AUX on
SO1, SO2	LED yellow	off	output off
		blinking 1 Hz	restart block
		blinking 8 Hz	unlockable error status
		on	output on

LED flashing sample

Addressing mode	SI1 ... SI8	chaser lights
Chip card is written		
	SI1 ... SI8	blinking 2 x 1 Hz
Restart block	SO1, SO2	blinking 1 Hz
Unlockable error status		
	SO1, SO2	blinking 8 Hz
Circuit or internal error		
	SI1 ... SI8	off
	PWR, FLT, AUX, O1	blinking 8 Hz
Data on chip card and device different		
	SI1 ... SI8	blinking 1 Hz, push-pull mode
Chip card defective	SI1 ... SI8	blinking 1 Hz, common mode
Desired address is blocked (incorrect double configuration)		
	SI1 ... SI4	off
	SI5 ... SI8	blinking 1 Hz, push-pull mode

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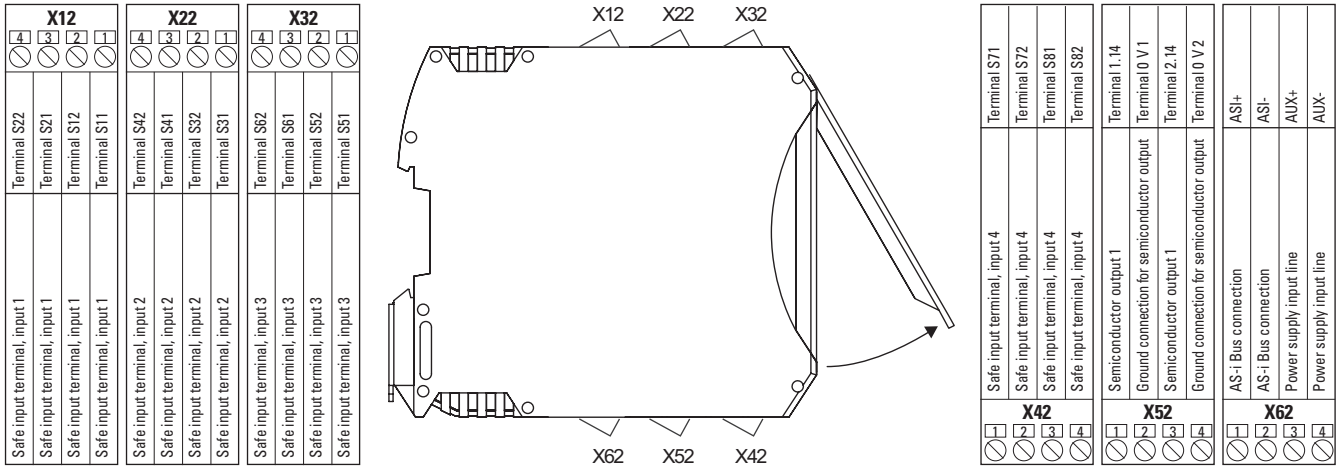
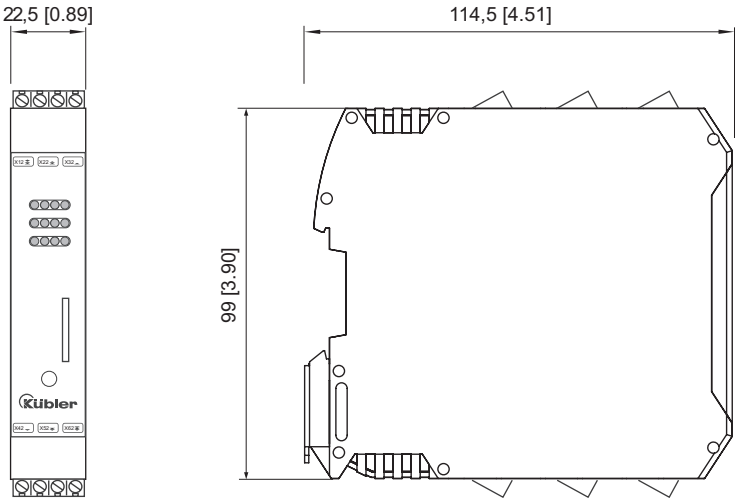
Safety-M modular Expansion module | I/O expansion – EMIO.SIO.420 | Digital 8 / 4 + 4 / 2

Terminal assignment



Dimensions

Dimensions in mm [inch]



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Safety-M modular Expansion module | I/O expansion – EMIO.SIO.204 | Digital 4 / 2 + 4

Digital I/O expansion for the basic modules of the Safety-M modular product family.

The expansion module is equipped with 4 / 2 safe inputs and 4 messaging outputs.

- 4 / 2 safe input lines.
- 4 messaging outputs.

Order no.

EMIO	I/O expansion, digital	**8.EMIO.SIO.204**

Modular construction

Basic module
Modular safety control system.

SMBx

Expansion modules
For additional inputs and outputs.

EMxx

Basic modules

SMBD	Basic module digital.
SMBU	Basic module with universal gateway functionality.
SMBS	Basic module with safe gateway functionality.

Expansion modules

EMAI	Axis expansion for incremental encoders.
EMAA	Axis expansion for absolute encoders.
EMIO	Input / output expansion.

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Safety-M modular Expansion module | I/O expansion – EMIO.SIO.204 | Digital 4 / 2 + 4

Technical data

General data

Safe digital input lines	4 / 2
Messaging outputs	4
Type of connection	pluggable screw terminals
Max. terminal cross section	1.5 mm^2 [AWG 15]

Electrical characteristics

AUX

Power supply		24 V DC (20 ... 30 V DC)
Power consumption		max. 4 A

Input

Power supply		from AUX
Switching current	static dynamic	4 mA at 24 V DC 15 mA at 24 V DC (T = 100 µs)
Input level		10 mA, R < 150 Ω

Output

Power supply	from AUX
Max. output current	1 A per output
Total current	3 A

Environmental data

Operating temperature	0°C ... +70°C [+32°F ...+158°F]
Storage temperature	-40°C ... +85°C [-40°F ...+185°F]
Protection acc. to EN 60529	IP20
Humidity	non-condensing
CE compliant acc. to (up to April 19, 2016) (as from April 20, 2016)	 EMC guideline 2004/108/EG Machinery directive 2006/42/EC RoHS guideline 2011/65/EU EMC guideline 2014/30/EU Machinery directive 2006/42/EC RoHS guideline 2011/65/EU

Safety characteristics

Classification	PLe / SIL3
System structure	2 channel (Cat. 4 / HFT = 1)
PFH_d value	5.18 x 10^{-9} h^{-1}
Mission time / Proof test interval	20 years
Relevant standards	EN ISO 13849-1 :2008 EN ISO 13849-2 :2008 EN 62061 :2005 / A1:2010

EMC

Relevant standards	EN 61326-3-1 :2008 EN 61000-6-2 :2005 / AC:2005 EN 61000-6-4 :2007 / A1:2011 EN 62026-2 :2013 EN 61131-2 :2007 / A1:2011

Mechanical characteristics

Size w x h x d	22.5 x 99 x 114.5 mm [0.89 x 3.90 x 4.51“]
Weight	120 g [4.23 oz]
Mounting	snap-on mounting on standard head rail

LED display

LEDs SI1 ... SI4 (yellow)		status of inputs SI1 ... SI4
LEDs O1 ... O4 (yellow)		status of outputs O1 ... O4
LED ASI/FLT1 (red/green)	green red yellow/red blinking red/green blinking	slave online no data exchange address 0 peripheral error
LED ASI/FLT2 (red/green)	green red yellow/red blinking red/green blinking red blinking	slave online no data exchange address 0 peripheral error slave switched off, while slave 1 has address 0
LED AUX (green)		24 V DC AUX on
LED CC (green)		input circuit cross short cut, peripheral error

AS-i interface

Type		AS-i slave
Profile	slave 1 slave 2	S-7.B.0, ID1 = F S-7.B.0, ID1 = E
Address		2 single slaves
Voltage		22 ... 31.6 V
Power consumption		max. 60 mA

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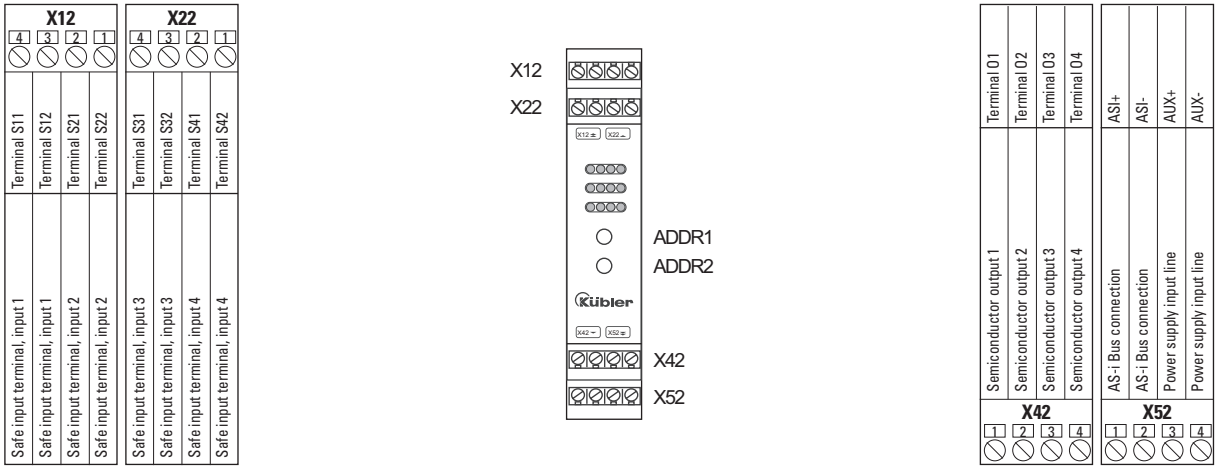
Safety-M modular Expansion module | I/O expansion – EMIO.SIO.204 | Digital 4 / 2 + 4

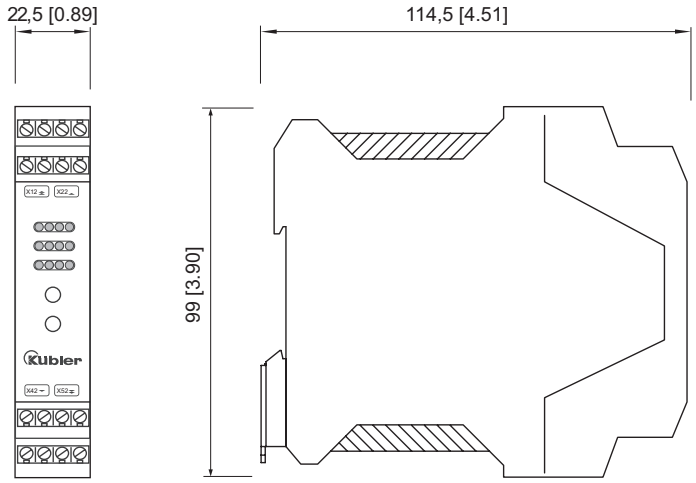
Terminal assignment



ADDR1 = Addressing socket 1
ADDR2 = Addressing socket 2

Dimensions

Dimensions in mm [inch]



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Safety-M modular Expansion module | I/O expansion – EMIO.SIO.10xP | Digital 2 / 1 + 2

Digital I/O expansion for the basic modules of the Safety-M modular product family.

The decentralized expansion module with high protection level is equipped with 2 / 1 safe inputs and 2 messaging outputs.

- 2 / 1 safe inputs.
- 2 messaging outputs.
- Hohe IP value.
- M12 connector.
- Cross-short-cut monitoring functionality.
- Contact multiplication or increase of power capability by external contactors in connection with the device-internal monitoring function for external contacts.
- Extensive diagnostic functionality integrated in FW.

Order no.

EMIO	2 / 1 digital inputs (OSSD compatible)	**8.EMIO.SIO.101P**
	2 / 1 digital inputs	**8.EMIO.SIO.102P**

Modular construction

Basic module
Modular safety control system.

Expansion modules
For additional inputs and outputs.

SMBx | **EMxx**

Basic modules

SMBD	Basic module digital.
SMBU	Basic module with universal gateway functionality.
SMBS	Basic module with safe gateway functionality.

Expansion modules

EMAI	Axis expansion for incremental encoders.
EMAA	Axis expansion for absolute encoders.
EMIO	Input / output expansion.

Connection technology		Order no.
Connector, self-assembly	M12 male connector with external thread, 5 pin	**05.BS-8151-0/9**
	M12 female connector with coupling nut, 4 pin	**05.B8141-0**
Cordset, pre-assembled	With M12 male connector with external thread, 5 pin, single-ended, 2 m [6.56'] PVC cable	**05.00.6091.A411.002M**
	With M12 female connector with coupling nut, 4 pin, single-ended, 2 m [6.56'] PUR cable	**05.00.6061.6211.002M**

Further accessories can be found in accessories area of our website at: www.kuebler.com/accessories.
Additional connectors can be found in the connection technology section or in the connection technology area of our website at: www.kuebler.com/connection_technology.
You will find an overview of our systems and components for Functional Safety under www.kuebler.com/safety.

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Safety-M modular Expansion module | I/O expansion – EMIO.SIO.10xP | Digital 2 / 1 + 2

Technical data

General data

Safe digital input lines	2 / 1
Messaging outputs	2
Type of connection	M12 connector

Electrical characteristics

AUX

Power supply	24 V DC (20 ... 30 V DC), PELV
Power consumption	max. 3 A

Input

Safety signal	potential-free contact
static switching current	4 mA
dynamic switching current	15 mA for 24 V DC (T = 100 µs)
Power supply	from AS-i
Switching threshold	10 mA, R < 150 Ω

Output

Power supply	from AUX
Max. output current	1 A
Total current	max. 3 A, O1 ... O2

Environmental data

Operating temperature	0°C ... +55°C [+32°F ...+131°F]
Storage temperature	-40°C ... +85°C [-40°F ...+185°F]
Protection acc. to EN 60529	IP67
Shock and vibration resistance	≤ 15 g, T ≤ 11 ms 10 ... 55 Hz, 0.5 mm amplitude
Humidity	non-condensing
CE compliant acc. to	
(up to April 19, 2016)	EMC guideline 2004/108/EG Machinery directive 2006/42/EC RoHS guideline 2011/65/EU
(as from April 20, 2016)	EMC guideline 2014/30/EU Machinery directive 2006/42/EC RoHS guideline 2011/65/EU

Safety characteristics

Classification	PLe / SIL3
System structure	2 channel (Cat. 4 / HFT = 1)
PFH_d value	$5.18 \times 10^{-9}\ h^{-1}$
Mission time / Proof test interval	20 years
Relevant standards	EN ISO 13849-1 :2008 EN ISO 13849-2 :2008 EN 62061 :2005

EMC

Relevant standards	EN 61000-6-2 :2005 / AC:2005 EN 61000-6-4 :2007 / A1:2011 EN 60947-1 :2007 / A1:2011 EN 60947-5-1 :2004 / AC:2005

Mechanical characteristics

Size w x h x d	116.5 x 45 x 47.5 mm [4.59 x 1.77 x 1.87“]
Weight	120 g [4.23 oz]

LED display

2 x LED (yellow)		status of input SI1 ... SI2
2 x LED (yellow)		status of output O1 ... O2
LED AUX (green)		24 V DC AUX active
LED ASI (green)		AS-i power supply active
LED FLT (red)	LED on	AS-i communication error, slave is not in normal data transfer
	LED blinks	peripheral error

AS-i interface

Type	AS-i slave
Profile	S-7.B.=, ID1 = F
Voltage	22 ... 31.6 V
Power consumption	max. 80 mA

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Safety-M modular Expansion module | **I/O expansion – EMIO.SIO.10xP** | **Digital 2 / 1 + 2**

Terminal assignment

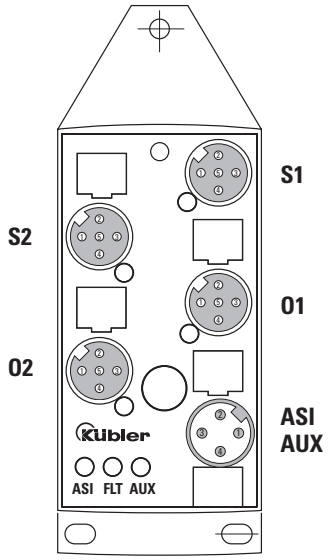
M12 connector, A coded, terminal S1					
Signal EMIO.SIO.101P	24 V ext. out	OSSD2	0 V ext. out	OSSD1	Shield
Signal EMIO.SIO.102P	SI1+	SI1-	S2+	S2-	-
Pin	1	2	3	4	5

M12 connector, A coded, terminal S2					
Signal EMIO.SIO.101P	24 V ext. out	-	0 V ext. out	24 V ext. out	Shield
Signal EMIO.SIO.102P	SI2+	SI2-	-	-	-
Pin	1	2	3	4	5

M12 connector, A coded, terminal O1					
Signal EMIO.SIO.101P	-	Out2	0 V ext. out	Out1	-
Signal EMIO.SIO.102P	-	Out2	0 V ext. out	Out1	-
Pin	1	2	3	4	5

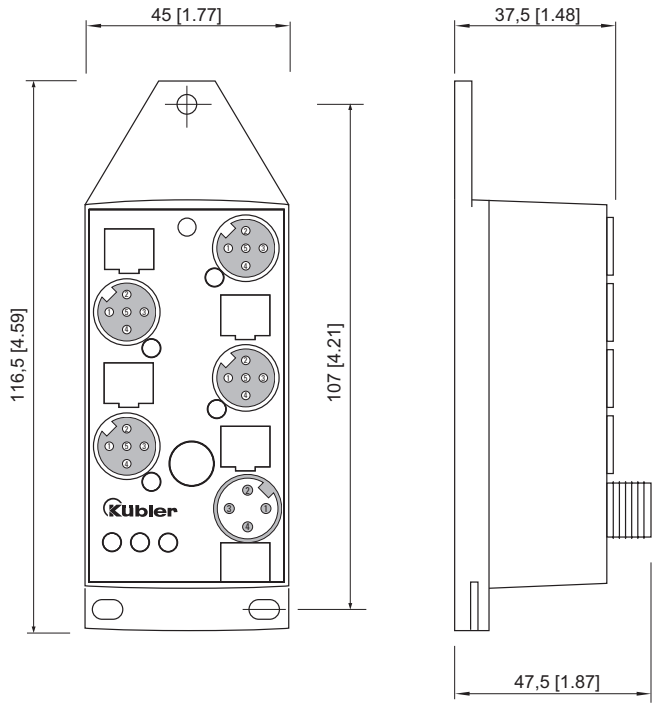
M12 connector, A coded, terminal O2					
Signal EMIO.SIO.101P	-	-	0 V ext. out	Out1	-
Signal EMIO.SIO.102P	-	-	0 V ext. out	Out2	-
Pin	1	2	3	4	5

M12 connector, A coded, terminal ASI / AUX					
Signal EMIO.SIO.101P	AS-i+	0 V ext. in	AS-i-	24 V ext. in	-
Signal EMIO.SIO.102P	AS-i+	0 V ext. in	AS-i-	24 V ext. in	-
Pin	1	2	3	4	5



Dimensions

Dimensions in mm [inch]



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Safety-M modular Expansion module | I/O expansion – EMIO.SAI.200 | Analog 2 / 1

Analog I/O expansion for the basic modules of the Safety-M modular product family.

The expansion module is equipped with 2 / 1 analog inputs.

Analog output

- 2 / 1 safe analog input lines.
- Connection of:
  - Voltage signals (0 ... 10 V)
  - Current signals (4 ... 20 mA)
  - Pt100 temperature signals (-200°C ... +850°C)
- Monitoring of min. value, max. value, range.
- Monitoring of 2 analog signals.
- Extensive diagnostic functionality integrated in FW.

Order no.

EMIO	I/O expansion, analog	**8.EMIO.SAI.200**

Modular construction

Basic module
Modular safety control system.

SMBx

Expansion modules
For additional inputs and outputs.

EMxx

Basic modules

SMBD	Basic module digital.
SMBU	Basic module with universal gateway functionality.
SMBS	Basic module with safe gateway functionality.

Expansion modules

EMAI	Axis expansion for incremental encoders.
EMAA	Axis expansion for absolute encoders.
EMIO	Input / output expansion.

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Safety-M modular Expansion module | I/O expansion – EMIO.SAI.200 | Analog 2 / 1

Technical data

General data

Safe analog input lines	2 / 1
Type of connection	pluggable scrw screw terminals
Max. terminal cross section	1.5 mm² [AWG 15]

Electrical characteristics

AUX

Voltage	20 ... 30 V DC (PELV)
Power consumption	max. 1 A
Isolation voltage AS-i / AUX	500 V

Input

Power supply		from AUX
Input voltage		max. 25 V
Input current		max. 40 mA
Internal resistance		50Ω / 100kΩ
Resolution		16 bit
Value range	4 ... 20 mA	4000 ... 20000 dez.
	0 ... 10 V	0 ... 10000 dez.
	-200°C ... +850°C	-2000 ... 8500 dez.

Environmental data

Operating temperature	0°C ... +55°C [+32°F ...+131°F]
Storage temperature	-25°C ... +85°C [-13°F ...+185°F]
Protection acc. to EN 60529	IP20
Humidity	non-condensing
CE compliant acc. to	
(up to April 19, 2016)	EMC guideline 2004/108/EG Machinery directive 2006/42/EC RoHS guideline 2011/65/EU
(as from April 20, 2016)	EMC guideline 2014/30/EU Machinery directive 2006/42/EC RoHS guideline 2011/65/EU

Safety characteristics

Classification	PLe / SIL3
System structure	2 channel (Cat. 4 / HFT = 1)
PFH_d value	5.08×10^{-9} h^{-1}
Mission time / Proof test interval	20 years
Relevant standards	EN ISO 13849-1 :2008 EN ISO 13849-2 :2008 EN 62061 :2005 / A1:2010

EMC

Relevant standards	EN 61326-3-1 :2008 EN 61000-6-2 :2005 / AC:2005 EN 61000-6-4 :2007 / A1:2011 EN 62026-2 :2013 EN 61131-2 :2007 / A1:2011

Mechanical characteristics

Size w x h x d	22.5 x 99 x 114.5 mm [0.89 x 3.90 x 4.51"]
Weight	180 g [6.35 oz]
Mounting	snap-on mounting on standard head rail

Display LEDs – for other statuses please contact the Kübler Service

ASI	LED green	off	AS-i supply voltage not OK
		blinking 1 Hz	addresse "0" or peripheral fault
		on	AS-i supply voltage OK
FLT	LED red	off	on-line
		blinking 1 Hz	peripheral fault
		on	off-line
Conf	LED yellow	off	normal operation
		blinking 2 x 1 Hz	chip card is written
AUX	LED green	off	24 VDC AUX missing
		on	24 VDC AUX present
U1, U2	LED yellow	off	no voltage input
		blinking 1 Hz	error message
		on	voltage input is set
I1, I2	LED yellow	off	no current input
		blinking 1 Hz	error message
		on	voltage current is set
R1, R2	LED yellow	off	no PT100 input
		blinking 1 Hz	error message
		on	PT100 input is set
F1, F2	LED yellow	off	no safety range, 0 sequence (shut-off) is running
		blinking 1 Hz	error message
		on	safety range, at least one sequence is running
Peripheral fault			
	LED red	blinking 1 Hz	"analoge signal outside range of values" or " difference between channels is outside of present margin" or "AUX voltage missing"

LED flashing sample

Error input I1 / U1	I1	blinking 1 Hz
	F1	off
	I2, F2	any
Error input I2 / U2	I2	blinking 1 Hz
	F2	off
	I1, F2	any
Data on chip card and device different		
	I1, I2	off
	F1, F2	blinking 1 Hz
Chip card defective	I1, I2	blinking 1 Hz
	F1, F2	off
Serious error		
	I1+2, U1+2, R1+2, F1+2	blinking 8 Hz

AS-i interface

Type		AS-i slave
Profile	safe input slaves	S-0.B.E
	diagnostic slaves	S-7.A.5
Voltage		18 ... 31.6 V
Power consumption		max. 80 mA

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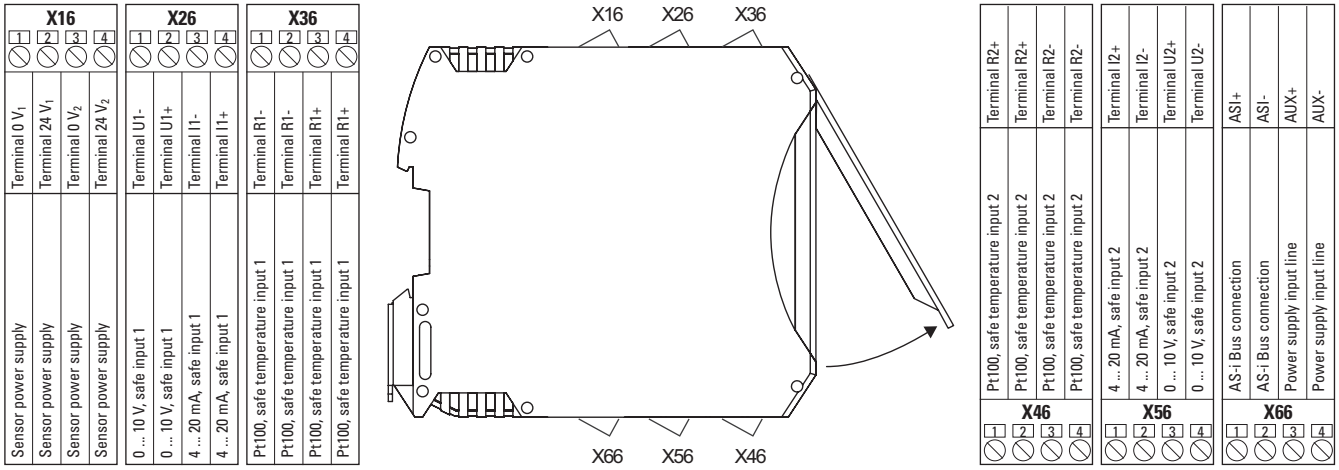
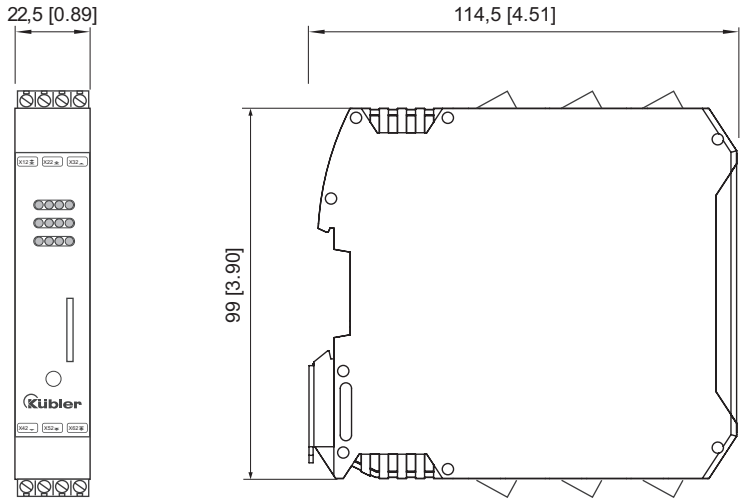
Safety-M modular Expansion module | I/O expansion – EMIO.SAI.200 | Analog 2 / 1

Terminal assignment



Dimensions

Dimensions in mm [inch]



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Safety-M modular Expansion module | I/O expansion – EMIO.IO.880 | Digital (non safe) 8 + 8

Digital I/O expansion for the basic modules of the Safety-M modular product family.

The expansion module is equipped with 8 standard inputs and 8 standard outputs.

- 8 digital input lines.
- 8 digital output lines.

Order no.

EMIO	I/O expansion, digital	**8.EMIO.IO.880**

Modular construction

Basic module
Modular safety control system.

SMBx

Expansion modules
For additional inputs and outputs.

EMxx

Basic modules

SMBD	Basic module digital.
SMBU	Basic module with universal gateway functionality.
SMBS	Basic module with safe gateway functionality.

Expansion modules

EMAI	Axis expansion for incremental encoders.
EMAA	Axis expansion for absolute encoders.
EMIO	Input / output expansion.

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Safety-M modular Expansion module | I/O expansion – EMIO.IO.880 | Digital (non safe) 8 + 8

Technical data

General data

Digital inputs	8
Digital outputs	8
Type of connection	pluggable screw terminals
Max. terminal cross section	1.5 mm² [AWG 15]

Electrical characteristics

AUX

Power supply		18 ... 30 V DC
Power consumption		8 A

Input

Number of inputs		8
Singal level	0 signal 1 signal	< 5 V DC > 15 V DC
Rated data digital inputs		24 V DC / 20 mA

Output

Number of outputs	8 x electronic
Power supply	from AUX
Rated data digital outputs	1000 mA
Max. output current	1 A
Total current (per terminal)	max. 3 A, X44 (01 ... 04) max. 3 A, X54 (05 ... 08)

Environmental data

Operating temperature	-25°C ... +70°C [-13°F ...+158°F]
Storage temperature	-25°C ... +85°C [-13°F ...+185°F]
Protection acc. to EN 60529	IP20
Humidity	non-condensing
CE compliant acc. to	
(up to April 19, 2016)	EMC guideline 2004/108/EG Machinery directive 2006/42/EC RoHS guideline 2011/65/EU
(as from April 20, 2016)	EMC guideline 2014/30/EU Machinery directive 2006/42/EC RoHS guideline 2011/65/EU

EMC

Relevant standards	EN 61000-6-2 :2005 / AC:2005 EN 61000-6-4 :2007 / A1:2011 EN 62026-2 :2013 EN 61131-2 :2007 / A1:2011

Mechanical characteristics

Size w x h x d	22.5 x 99 x 114.5 mm
Weight	140 g [4.94 oz]
Mounting	snap-on mounting on standard head rail

LED display

LED AS-i/FLT1 (red / green)	green	slave online
	red	slave offline
	yellow/red blinking	address 0
	red/green blinking	peripheral error
LED AS-i/FLT2 (red / green)	green	slave online
	red	slave offline
	yellow/red blinking	address 0
	red/green blinking	peripheral error
	red blinking	slave 2 is switched off, while slave 1 is offline
LEDs I1 ... I8 (yellow)		status of inputs I1 ... I8
LEDs O1 ... O8 (yellow)		status of outputs O1 ... O8
LED AUX (green)	on	24 V DC AUX
	off	no 24 V DC AUX

AS-i interface

Type		AS-i slave
Profile	slave 1	S-7.0.E, ID1 = F (default)
	slave 2	S-7.0.E, ID1 = E (default)
AS-i Address		2 single slaves
Voltage		18 ... 31.6 V
Power consumption		max. 60 mA

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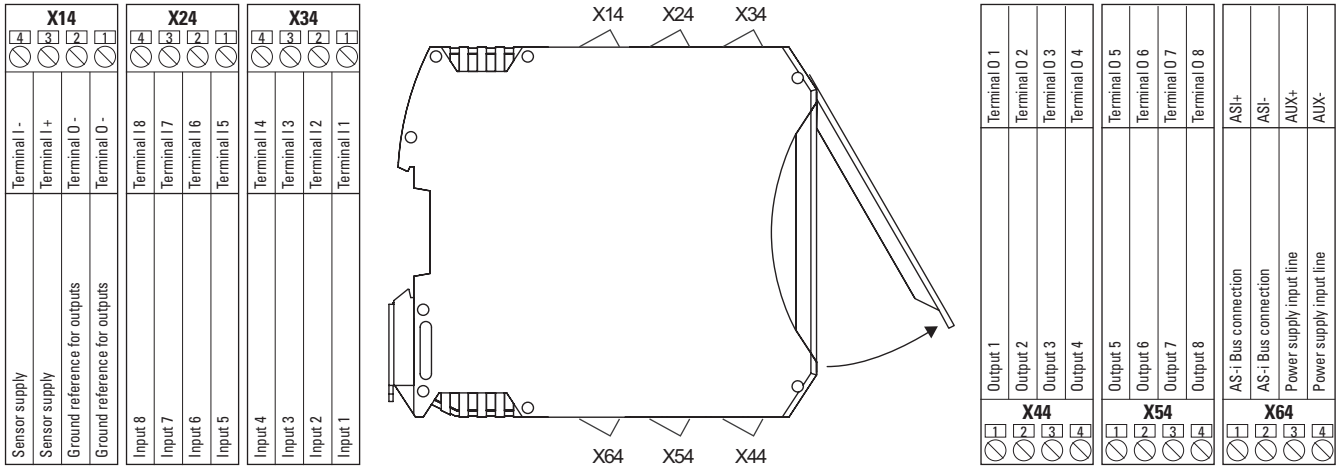
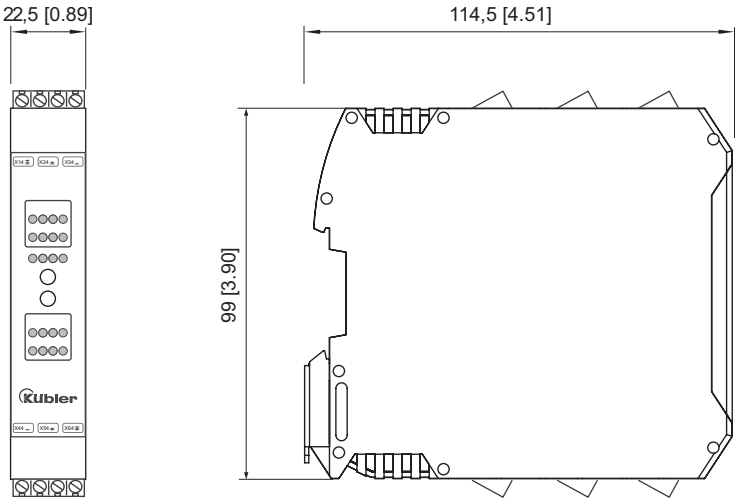
Safety-M modular Expansion module | I/O expansion – EMIO.IO.880 | Digital (non safe) 8 + 8

Terminal assignment



Dimensions

Dimensions in mm [inch]



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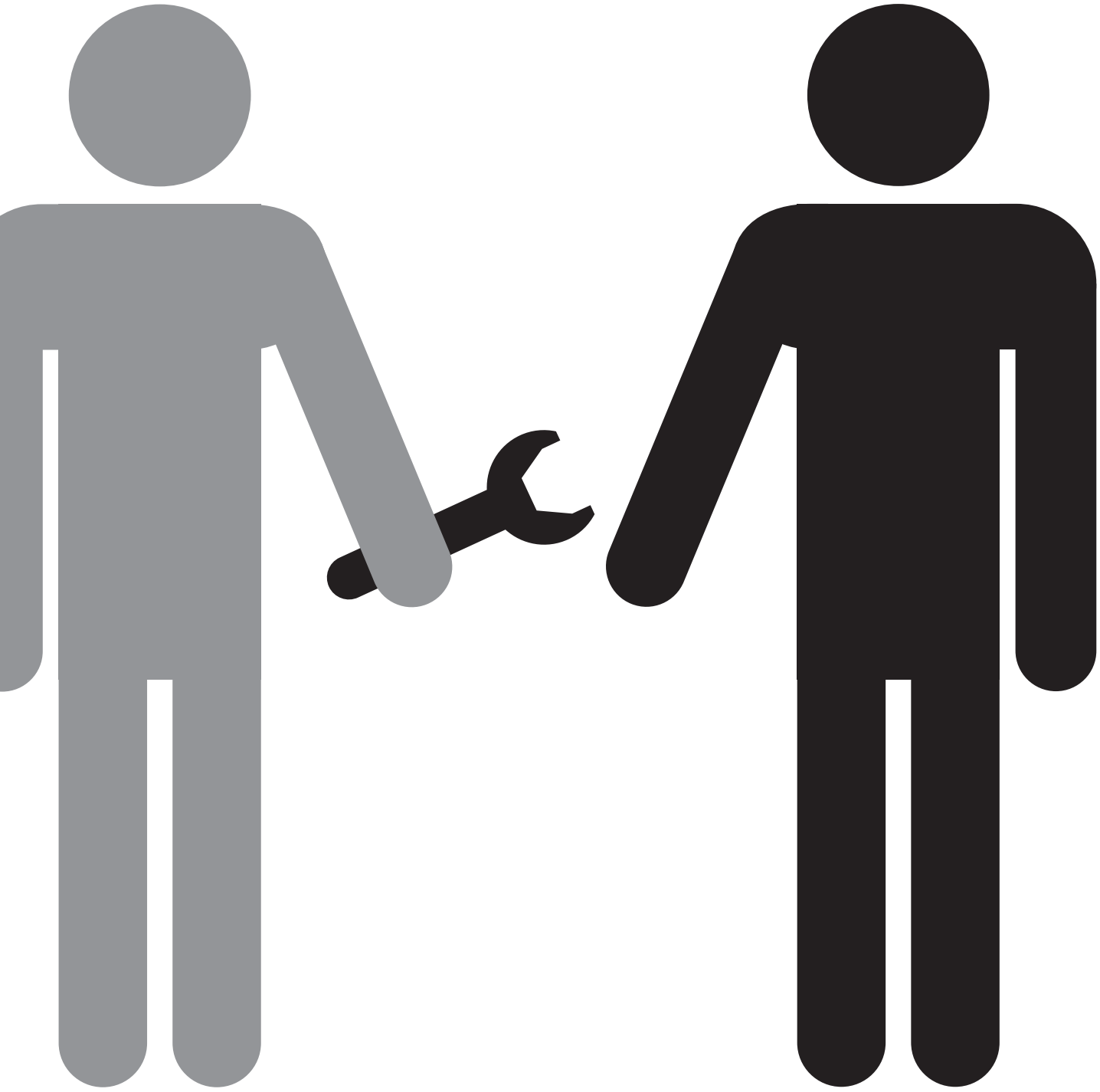

Services

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Advice | **Safety Services** | **Risk Assessment**

The Risk Assessment service package includes the following points:

- **Directives and standards research**
- **Analysis of the operating modes**
- **Risk assessment**
- **Documentation**

Operators of machines or plants can be exposed to increased hazard potentials. These potentials can be mitigated with suitable protective equipment and safety measures.

Safety Services by Kübler will support you with custom-tailored service packages during the whole service life cycle of your machine / plant.

Risk Assessment

The compliance with the applicable safety and health requirements is the cornerstone of a safe machine. Something that goes wrong already at the start, during risk assessment, can lead to expensive consequences at a later time. No one wants to have to add constructive measures or to modify totally the control concept because of missing safety technology. And, at the end, all steps need to be documented in a legally secure way.

This service package is based on a description of the machine, its processes and operating sequences.

Risk assessment pursuant to Annex I of the Machinery Directive, using standard EN ISO 12100.

Contents

- **Directives and standards research**
  Inspection of the machine / plant according to the applicable international or national provisions.
- **Analysis of the operating modes**
  Definition and evaluation of the different operating modes of the machine / plant.
- **Risk assessment**
  Determination of the risks in all operating modes of the machine / plant.
- **Documentation**
  Preparation of a customer documentation for an EC-compliant proof.

Order no.	
Risk Assessment (Service Package)	**8.DLSS.100**

Other Safety Services	Order no.
Safety Concept	**8.DLSS.200**
Start-up / Validation	**8.DLSS.400**
Safety Retrofit	**8.DLSS.500**
Further service packages on request	

Further information can be found on our website under www.kuebler.com/safety.

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Advice | Safety Services | Safety Concept

The Safety Concept service package includes the following points:

- **Analysis of the risks**
- **Selection of the components**
- **Documentation**

Operators of machines or plants can be exposed to increased hazard potentials. These potentials can be mitigated with suitable protective equipment and safety measures.

Safety Services by Kübler will support you with custom-tailored service packages during the whole service life cycle of your machine / plant.

Safety Concept

The best safety concepts are useless if they cannot be implemented; this is why the many years of know-how of this branch are requested when working out the concept. The safety concept turns the requirement of the risk assessments into actions. Constructive actions, technical actions or organisational actions can be defined here, always according to the state-of-the-art technology, for a long service life of the machine / plant.

This service package is based on a risk assessment of the machine.

Safety Concept pursuant to Annex I of the Machinery Directive, using standard EN ISO 12100.

Contents

- **Analysis of the risks**
  This analysis is based on a risk assessment for identifying all risks.
- **Selection of the components**
  Selection of the suitable components with description of the respective tasks, and supply of the respective documentation.
- **Documentation**
  Preparation of a customer documentation for an EC-compliant proof.

Order no.	
Safety Concept (Service Package)	**8.DLSS.200**

Other Safety Services	Order no.
Risk Assessment	**8.DLSS.100**
Start-up / Validation	**8.DLSS.400**
Safety Retrofit	**8.DLSS.500**
Further service packages on request	

Further information can be found on our website under www.kuebler.com/safety.

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Advice | **Safety Services** | **Start-up / Validation**

The Start-up / Validation service package includes the following points:

- **Installation of the components**
- **Functional test in the plant**
- **Acceptance of the components**
- **Documentation**

Operators of machines or plants can be exposed to increased hazard potentials. These potentials can be mitigated with suitable protective equipment and safety measures.

Safety Services by Kübler will support you with custom-tailored service packages during the whole service life cycle of your machine / plant.

Start-up / Validation

The selected components are commissioned by Kübler according to the requirements of the safety concept. The customer saves a thorough training in the software and in the handling. After the functional tests, the components are accepted and handed out to the customer. A comprehensive protocol is elaborated to serve as a documentation.

Acceptance with functional and system tests using standard EN ISO 13849-2.

Contents

- **Installation of the components**
  Commissioning of the safety components according to the instructions.
- **Functional test in the plant**
  Functional test of all safety functions and switching-off paths of the safety components.
- **Acceptance of the components**
  Validation of the safety functions and integration in the documentation, on request also in cooperation with a certifying body.
- **Documentation**
  Preparation of a customer documentation for an EC-compliant proof.

Order no.	
Start-up / Validation (Service Package)	**8.DLSS.400**

Other Safety Services	Order no.
Risk Assessment	**8.DLSS.100**
Safety Concept	**8.DLSS.200**
Safety Retrofit	**8.DLSS.500**
Further service packages on request	

Further information can be found on our website under www.kuebler.com/safety.

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Advice | **Safety Services** | **Safety Retrofit**

The Safety Retrofit service package includes the following points:

- **Project management**
- **Working out a safety concept**
- **Components procurement**
- **Modification / Integration**
- **Commissioning / Acceptance**
- **Documentation**

Operators of machines or plants can be exposed to increased hazard potentials. These potentials can be mitigated with suitable protective equipment and safety measures.

Safety Services by Kübler will support you with custom-tailored service packages during the whole service life cycle of your machine / plant.

Safety Retrofit

The largest service package encompasses other service packages (Safety Concept and Start-up / Validation) and includes in addition the mechanical and electrical installation of the components. Optionally, the risk assessment can be carried out previously with the customer.

Since modifications or integrations of new machine elements are mostly issues that are time-critical and involve complex safety technology, this service package ensures the customer an all-round „no-worry“ package allowing him to concentrate in a time-optimised manner on his core competencies. After the acceptance, the customer has a revised safe machine and a legally secure documentation describing the modification for his files.

Contents

- **Project management**
  A well-functioning project management is important for the coordination of the timeframes and a reliable planning.
- **Working out a safety concept**
  Preparation of a safety concept that will result in the actions for risk minimisation.
- **Components procurement**
  Definition and procurement of all necessary components.
- **Modification / Integration**
  Mechanical and electrical modifications of the machine and plant.
- **Commissioning / Acceptance**
  Commissioning and test of all safety components.
- **Documentation**
  Preparation of a customer documentation for an EC-compliant proof.

Order no.	
Safety Retrofit (Service Package)	**8.DLSS.500**

Other Safety Services	Order no.
Risk Assessment	**8.DLSS.100**
Further service packages on request	

Further information can be found on our website under www.kuebler.com/safety.

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Support | **Application** | **PreSales**

Kübler Hotline

An expert is always available for your questions, per phone or e-mail, on our Kübler Service hotline.

Whatever the topic, general information or complex technical questions or problems: we react immediately and find the suitable solution to your request.

- Contact persons with technical training.
- Specialists with practical experience.
- Highly efficient processes and solutions.
- Quick response with immediate delivery of parts.
- Solution for applications involving third-party suppliers.
- Advice and choice of tailor-made products.
- Analysis and selection of a suitable device for the customer's task/application.

Web Service

Service at any time and anywhere. Kübler offers on line an elaborate all-round service program. We answer your questions – from planning, passing through design and programming up to maintenance – in a systematic, user-friendly and understandable way. Our service for continuous availability and lasting solutions.

- Technical data and drawings.
- Data sheets, operating instructions, catalogues, manuals.
- CAD data for mechanical design.
- ePlan macros for electrical design.
- Kübler webinars about many technical topics.
- Targeted product finder.

Application Engineering

Qualified application engineers are at your disposal to guide you from products overview with suitable product selection through project planning, mounting and integration, up to successfully and safely operating systems. With Kübler, you can rely on guaranteed safety – up to the Functional Safety technology.

- Support as from the first planning step.
- Experienced project engineers.
- Costs reduction thanks to fast commissioning.
- Reliable and safe functions.
- Adaptation and implementation.
- Support in case of malfunctions and troubleshooting.
- Comprehensive advice.

Tailor-made Solutions – Kübler Design System (KDS) OEM Products and Systems (OPS)

Together with our customers, we develop product and engineering solutions for customer-specific products, integrated drive solutions, up to complete systems (sensors, electronics and mechanics).

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Support | Application | PreSales

Prototyping

Together with our customers, we turn ideas into parts that can be touched:

regardless of whether they are sensors, electronic or mechanical parts. We develop engineering products ranging from integrated drive solutions to complete customer-specific systems.

- Technical and economic feasibility study.
- Upon release, delivery of a test sample of the customer-specific device including possibly necessary accessories and mounting parts.

Training

Long-term success with successful systems begins with the foundation: a comprehensive offer of product and topical trainings and seminaries prepares you and your product for the future. The graded contents range - of course prepared accordingly - from the basics up to the refinements of sophisticated solutions.

- Product trainings in the customer's or in our premises.
- Topical training relating to field bus, safety, encoder basics and many others.
- Project and innovation workshops for new solutions.
- On-line training via remote connections.

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Support	Service	AfterSales

Kübler Hotline

An expert is always available for your questions, per phone or e-mail, on our Kübler Service Hotline.

Whatever the topic, general information or complex technical questions or problems: we react immediately and find the suitable solution to your request.

- Technical explanations.
- Assistance for programming.
- Support for connection and commissioning.
- Problem and troubleshooting.

On-Site Service

Kübler experts are working for you all over the world.

- On-site as-is analysis in collaboration with the customer for error analysis and problem solving.
- Direct communication during physical system analysis.
- Customer maintenance personnel relief.

Commissioning Support

Commissioning monitored by Kübler Service specialists saves time and costs. This ensures our customers a twofold benefit:

Thanks to fast processes followed by long trouble-free operation. Everything works as planned.

- Cost saving thanks to shorter commissioning.
- Prevents consequential damage.
- Proper parameterising of the Kübler components.
- Safety thanks to test runs.
- Plant integration.
- Possibly necessary adaptations.

Repair Service

Good to know: your product is in good hands with us.

If it must be sent back for repair, we put it back in perfect condition according to a clear and systematic procedure. Our service is reliable and fast, our service technicians are conscientious and well-trained. Because we want everything to run smoothly for you.

- Structured registration upon RMA (Return Material Authorisation).
- Fast device analysis: max. 5 working days.
- Repair report, test report, detailed failure description, cause analysis.
- Estimated charges / Timetable.

48 h Express Service

We manufacture your order within 48 hours; products on stock are shipped the same day.

- Simplified orders.
- Calculable delivery.
- Flexible use of small batch sizes.

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Service Sites

Kübler has service sites all over the world for diagnostics, error analysis and repair, with qualified technicians who will be glad to support you.

- Germany – Villingen Schwenningen
- Frankreich – Wittelsheim
- Italien – Milano
- China – Beijing
- India – Pune
- USA – Charlotte

Service Centers / Technical Hotline

Kübler's technicians are available on site all over the world for advice, analysis or installation support.

Phone

Kübler Germany	+49 7720 3903 952
Kübler France	+33 3 89 53 45 45
Kübler Italy	+39 026 423 345
Kübler Poland	+48 61 84 99 902
Kübler Turkey	+90 216 999 9791
Kübler China	+86 10 8471 0818
Kübler India	+91 8600 147 280
Kübler USA	+1 855 583 2537

E-Mail

support_EN@kuebler.com

safetysupport@kuebler.com

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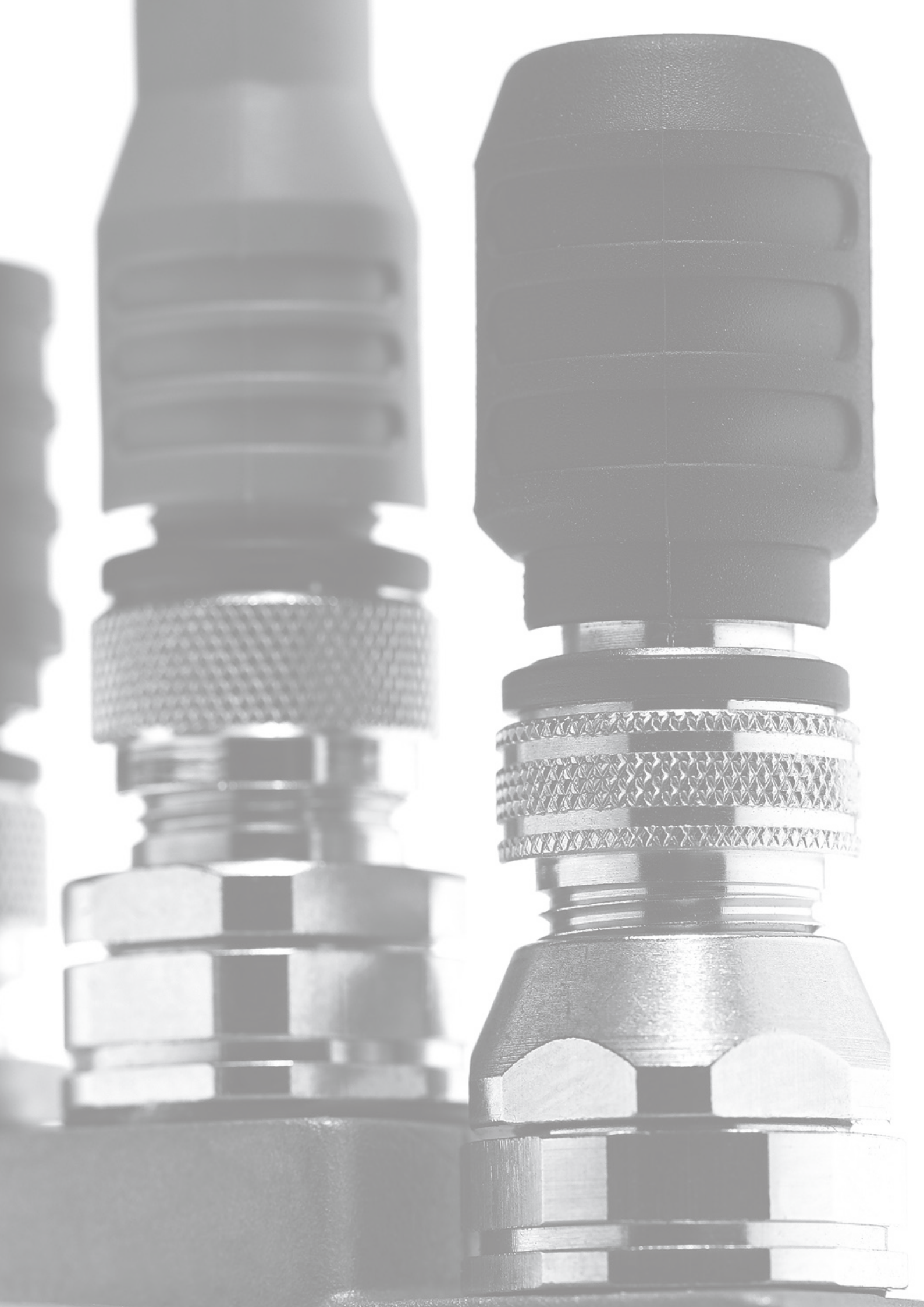

Connection technology

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Further connection technology you will find in our catalogue "Transmission Technology" or under:
www.kuebler.com/connection_technology

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Cable — Unprepared, cut to length

8 core + shield

				Order no.
PUR trailing cable halogen-free	**Cross section**	8 x 0.14 mm² [AWG25]	suitable for:	**8.0000.6P00.XXXX** [1]
	Permanent working temperature range flexible installation	-20°C ... +90°C [-4°F ... +194°F]	Limes, 365X, 368X SSI and analog Safety-M	
	Permanent working temperature range secure installation	-40°C ... +90°C [-40°F ... +194°F]		
	Bending radius flexible installation	min. 65 mm [2.56"]		
	Bending radius secure installation	min. 45 mm [1.77"]		
	Cable diameter	approx. 5.5 mm ±0.2 mm		
PUR trailing cable halogen-free	**Cross section**	3 x 2 x 0.14 mm² [AWG25] + 2 x 0.5 mm² [AWG20]	suitable for:	**8.0000.6F00.XXXX** [1]
	Permanent working temperature range flexible installation	-40°C ... +90°C [-40°F ... +194°F]	Limes, 365X, 368X SSI and analog Safety-M	
	Permanent working temperature range secure installation	-50°C ... +90°C [-58°F ... +194°F]		
	Bending radius flexible installation	min. 111 mm [4.37"]		
	Bending radius secure installation	min. 55 mm [2.17"]		
	Cable diameter	approx. 7.4 mm ±0.3 mm		

10 core + shield

				Order no.
PUR electronic trailing cable halogen-free	**Cross section**	4 x 2 x 0.25 mm² [AWG23] + 2 x 1 mm² [AWG17]	suitable for:	**8.0000.6400.XXXX** [1]
	Permanent working temperature range flexible installation	-40°C ... +90°C [-40°F ... +194°F]	H100, H120 LA10, LA50 Safety-M	
	Permanent working temperature range secure installation	-50°C ... +90°C [-58°F ... +194°F]		
	Bending radius flexible installation	min. 95 mm [3.74"]		
	Bending radius secure installation	min. 40 mm [1.57"]		
	Cable diameter	approx. 7.9 mm ±0.8 mm		

1) XXXX = cable length in meters (e.g. 10 m = 0010)

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Cable — Unprepared, cut to length

12 core + shield					Order no.
PUR electronic trailing cable halogen-free	**Cross section**		10 x 0.14 mm² [AWG25] + 2 x 0.5 mm² [AWG20]	suitable for: robust incremental encoders	**8.0000.6100.XXXX** [1]
	Permanent working temperature range	flexible installation	-30°C ... +80°C [-22°F ... +176°F]		
		secure installation	-50°C ... +90°C [-58°F ... +194°F]		
	Bending radius	flexible installation	min. 50 mm [1.97"]		
		secure installation	min. 35 mm [1.38"]		
	Cable diameter		approx. 6.9 mm ±0.3 mm		
PVC electronic cable LiYCY	**Cross section**		12 x 0.14 mm² [AWG25]	suitable for: incremental encoders standard cable	**8.0000.6200.XXXX** [1]
	Permanent working temperature range	flexible installation	-10°C ... +90°C [+14°F ... +194°F]		
		secure installation	-30°C ... +90°C [-22°F ... +194°F]		
	Bending radius	flexible installation	min. 100 mm [3.94"]		
		secure installation	min. 65 mm [2.56"]		
	Cable diameter		approx. 6.7 mm ±0.2 mm		
PUR electronic trailing cable halogen-free	**Cross section**		6 x 2 x 0.14 mm² [AWG25]	suitable for: robust incremental encoders LA10	**8.0000.6Y00.XXXX** [1]
	Permanent working temperature range	flexible installation	-30°C ... +90°C [-22°F ... +194°F]		
		secure installation	-40°C ... +90°C [-40°F ... +194°F]		
	Bending radius	flexible installation	min. 90 mm [3.54"]		
		secure installation	min. 40 mm [1.57"]		
	Cable diameter		approx. 7.5 mm ±0.2 mm		
TPE electronic cable halogen-free	**Cross section**		5 x 2 x 0.14 mm² + 2 x 0.5 mm²	suitable for: high temperatures or encoders with sine wave output	**8.0000.6E00.XXXX** [1]
	Permanent working temperature range	flexible installation	-25°C ... +110°C [-13°F ... +230°F]		
		secure installation	-40°C ... +135°C [-40°F ... +275°F]		
	Bending radius	flexible installation	min. 90 mm [3.54"]		
		secure installation	min. 70 mm [2.76"]		
	Cable diameter		approx. 8.5 mm ±0.9 mm		
PVC electronic cable LiYCY	**Cross section**		6 x 2 x 0.14 mm² [AWG25]	suitable for: absolute encoders with SSI or 4 ... 20 mA analog output, twisted pair conductors	**8.0000.6900.XXXX** [1]
	Permanent working temperature range	flexible installation	-5°C ... +70°C [+23°F ... +158°F]		
		secure installation	-30°C ... +80°C [-22°F ... +176°F]		
	Bending radius	flexible installation	min. 110 mm [4.33"]		
		secure installation	min. 75 mm [2.95"]		
	Cable diameter		approx. 7.3 mm ±0.2 mm		

1) XXXX = cable length in meters (e.g. 10 m = 0010)

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Cable — Unprepared, cut to length

PROFIBUS DP - cable

PUR outer jacket, PE wire insulation halogen-free

Cross section		2 x 0.34 mm² [AWG22]	suitable for:
Permanent working temperature range	flexible installation	-25°C ... +60°C [-13°F ... +140°F]	all Profibus fieldbus encoders, Safety-M BM31, Safety-M modular SMBU and SMBS
	secure installation	-50°C ... +90°C [-58°F ... +194°F]	
Bending radius	flexible installation	min. 80 mm [3.15"]	
	secure installation	min. 40 mm [1.57"]	
Cable diameter		approx. 7.6 mm ±0.2 mm	

Order no.: **05.KABEL451.XXX** [1)]

DeviceNet - cable

PUR outer jacket, PE wire insulation

Cross section		2 x 0.52 mm² [AWG24] + 2 x 1.04 mm² [AWG17]	suitable for:
Permanent working temperature range	flexible installation	-30°C ... +70°C [-22°F ... +158°F]	all DeviceNet fieldbus encoders, Safety-M BM11
	secure installation	-40°C ... +80°C [-40°F ... +176°F]	
Bending radius	flexible installation	min. 70 mm [2.76"]	
	secure installation	min. 50 mm [1.97"]	
Cable diameter		approx. 8.4 mm ±0.2 mm	

Order no.: **05.KABEL5723.XXX** [1)]

CANopen - cable

PVC electronic cable

Cross section		3 x 2 x 0.25 mm² [AWG23]	suitable for:
Permanent working temperature range	flexible installation	-10°C ... +90°C [+14°F ... +194°F]	all CANopen fieldbus encoders, Safety-M BM21, Safety-M modular SMBU
	secure installation	-30°C ... +90°C [-22°F ... +194°F]	
Bending radius	flexible installation	min. 130 mm [5.12"]	
	secure installation	min. 60 mm [2.36"]	
Cable diameter		approx. 6.2 mm ±0.2 mm	

Order no.: **8.0000.6V00.XXXX** [1)]

Industrial Ethernet - cable

PUR electronic cable

Cross section		2 x 2 x 0.34 mm² [AWG22]	suitable for:
Permanent working temperature range	flexible installation	-30°C ... +70°C [-22°F ... +158°F]	all EtherCAT / PROFINET IO / EtherNet/IP encoders, Safety-M BMB1 and BMC1, Safety-M modular SMBU and SMBS
	secure installation	-40°C ... +80°C [-40°F ... +176°F]	
Bending radius	flexible installation	min. 50 mm [1.97"]	
	secure installation	min. 25 mm [0.98"]	
Cable diameter		approx. 4.8 mm ±0.2 mm	

Order no.: **05.00.6031.1111.XXXM** [1)]

1) XXXX = cable length in meters (e.g. 10 m = 0010)

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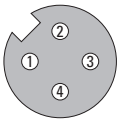
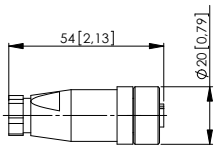
M12 connection technology | Connectors, self-assembly

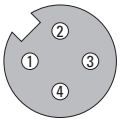
4 pin

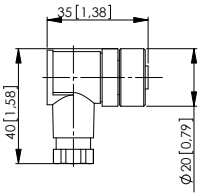
			Order no.
Female connector with coupling nut A coded, straight power supply Housing: plastic, IP67	screw connections, for cable ø 4 ... 6 mm [0.16 ... 0.24“]	suitable for our series: EMIO.SIO.10xP 5858 / 5878 5868 / 5888 9080	**05.B8141-0**





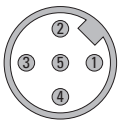
			Order no.
Female connector with coupling nut A coded, right-angle power supply Housing: plastic, IP67	screw connections, for cable ø 4 ... 6 mm [0.16 ... 0.24“]	suitable for our series: EMIO.SIO.10xP 5858 / 5878 5868 / 5888 9080	**05.B8241-0**

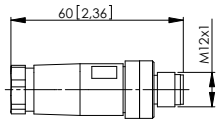




5 pin

			Order no.
Male connector with external thread A coded, straight Housing: metal / plastic, IP67	screw connections, for cable ø 6 ... 8 mm [0.24 ... 0.32“]	suitable for our series: 9080 IS60 EMIO.SIO.10xP	**05.BS-8151-0/9**





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M12 connection technology — Connectors, self-assembly

8 pin

Order no.

Female connector with coupling nut
A coded, straight

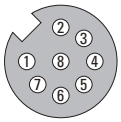
screw connections,
for cable ø 6 ... 8 mm [0.24 ... 0.32“]

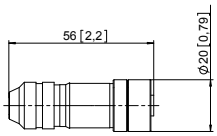
suitable for our series:

3610 / 3620	5821
F3653 / F3673	5814 / 5834
F3663 / F3683	5853 / 5873
5000 / 5020	5863 / 5883
5006 / 5026	58x4FSx
A020 / A02H	5876

05.CMB 8181-0

Housing: metal, IP67





Male connector with external thread
A coded, straight

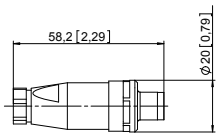
screw connections,
for cable ø 6 ... 8 mm [0.24 ... 0.32“]

suitable for:

versions with cable outlet

05.CMBS 8181-0

Housing: metal, IP67



Accessories

Order no.

Securing clip for M12 connectors

against accidental disconnection under load

working temperature range
-25°C ... +90°C [-13°F ... +194°F]

8.0000.5000.0006

Material: plastic

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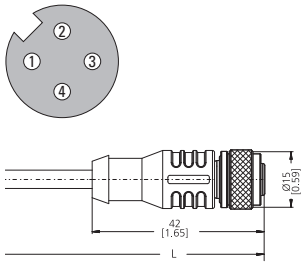
M12 connection technology | Cordsets, pre-assembled

With connector, 4 pin

Working temp. -30°C ... +80°C [-22°F ... +176°F]

Female connector with coupling nut + single-ended
A coded, straight
power supply

Cable: PUR, 4 x 0.34 mm² [AWG22]
Housing: metal / plastic, IP67



suitable for our series:

EMIO.SIO.10xP

5858 / 5878
5868 / 5888
9080

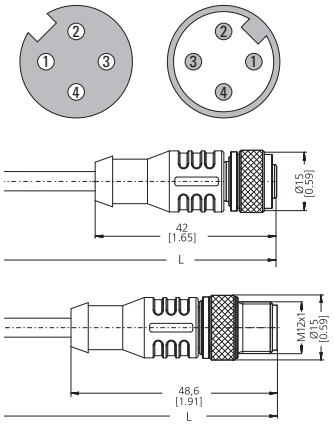
Terminal assignment

Pin female contacts:	1	2	3	4
Wire colour:	BN	WH	BU	BK

Cable length [1]	Order no.
2 m [6.56']	**05.00.6061.6211.002M**
5 m [16.40']	**05.00.6061.6211.005M**
10 m [32.81']	**05.00.6061.6211.010M**
15 m [49.21']	**05.00.6061.6211.015M**

Female connector with coupling nut + male connector with external thread
A coded, straight
power supply

Cable: PUR, 4 x 0.34 mm² [AWG22]
Housing: metal / plastic, IP67



suitable for our series:

EMIO.SIO.10xP

5858 / 5878
5868 / 5888
9080

Cable length [1]	Order no.
2 m [6.56']	**05.00.6061.6462.002M**
5 m [16.40']	**05.00.6061.6462.005M**
10 m [32.81']	**05.00.6061.6462.010M**
15 m [49.21']	**05.00.6061.6462.015M**

1) Other cable lengths on request.

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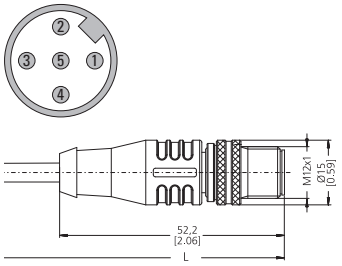
M12 connection technology — Cordsets, pre-assembled

With connector, 5 pin

Working temp. -30°C ... +80°C [-22°F ... +176°F]

Male connector with external thread + single-ended
A coded, straight

Cable: PVC, 3 x 2 x 0.25 mm² [AWG23]
Housing: metal / plastic, IP67



Terminal assignment

Pin male contacts:	1	2	3	4	5	PH [2]
Wire colour:	GY	BN	WH	GN	YE	PH [2]

Bus out

suitable for our series:

EMIO.SIO.10xP

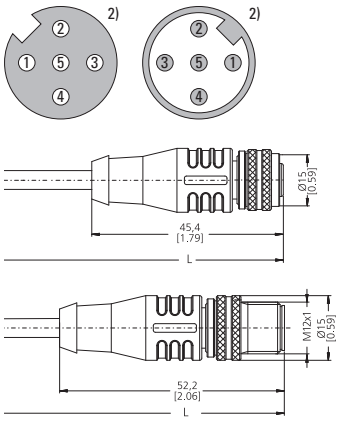
M3658 / M3678
F5868 / F5888
5858 / 5878
5868 / 5888

CANopen

Cable length [1]	Order no.
2 m [6.56']	**05.00.6091.A411.002M**
5 m [16.40']	**05.00.6091.A411.005M**
10 m [32.81']	**05.00.6091.A411.010M**
15 m [49.21']	**05.00.6091.A411.015M**

Female connector with coupling nut + male connector with external thread
A coded, straight

Cable: PUR, 4 x 0.34 mm² [AWG22]
Housing: metal / plastic, IP67



Bus in / out

suitable for our series:

EMIO.SIO.10xP

9080

DeviceNet

Cable length [1]	Order no.
2 m [6.56']	**05.00.6021.2422.002M**
5 m [16.40']	**05.00.6021.2422.005M**
10 m [32.81']	**05.00.6021.2422.010M**
15 m [49.21']	**05.00.6021.2422.015M**

1) Other cable lengths on request.
2) Shield on housing.
3) Shield with pin 1.

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M12 connection technology | Cordsets, pre-assembled

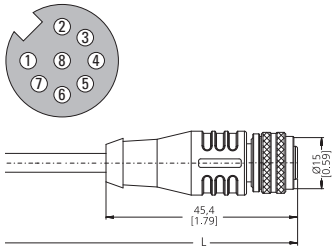
With connector, 8 pin

Working temp. -30°C ... +80°C [-22°F ... +176°F]

Order no.

Female connector with coupling nut + single-ended
A coded, straight

Cable: PVC, 8 x 0.25 mm² [AWG23]
Housing: metal / plastic, IP67



suitable for our series:

3610 / 3620 5000 / 5020
5814 / 5834 5814FSx / 5834FSx
5006 / 5026 5821
A020 / A02H
F3653 / F3673
5853 / 5873
M3663 / M3683 M3663R / M3683R
F3663 / F3683 F5863 / F5883
5863 / 5883
5876

Terminal assignment

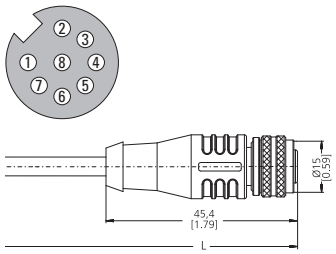
Pin female contacts:	1	2	3	4	5	6	7	8	PH [2]
Wire colour:	WH	BN	GN	YE	GY	PK	BU	RD	PH [2]

Cable length [1]

2 m [6.56']	**05.00.6041.8211.002M**
5 m [16.40']	**05.00.6041.8211.005M**
10 m [32.81']	**05.00.6041.8211.010M**
15 m [49.21']	**05.00.6041.8211.015M**

Female connector with coupling nut + single-ended
A coded, straight

Cable: PUR, 8 x 0.25 mm² [AWG23]
Housing: metal / plastic, IP67



suitable for our series:

3610 / 3620 5000 / 5020
5814 / 5834 5814FSx / 5834FSx
5006 / 5026 5821
A020 / A02H
F3653 / F3673
5853 / 5873
M3663 / M3683 M3663R / M3683R
F3663 / F3683 F5863 / F5883
5863 / 5883
5876

Terminal assignment

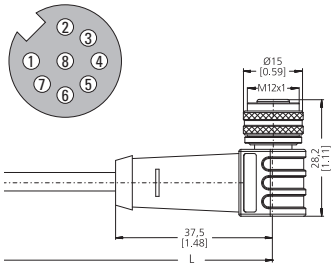
Pin female contacts:	1	2	3	4	5	6	7	8	PH [2]
Wire colour:	WH	BN	GN	YE	GY	PK	BU	RD	PH [2]

Cable length [1]

2 m [6.56']	**05.00.6051.8211.002M**
5 m [16.40']	**05.00.6051.8211.005M**
10 m [32.81']	**05.00.6051.8211.010M**
15 m [49.21']	**05.00.6051.8211.015M**

Female connector with coupling nut + single-ended
A coded, right-angle

Cable: PVC, 8 x 0.25 mm² [AWG23]
Housing: metal / plastic, IP67



suitable for our series:

3610 / 3620 5000 / 5020
5814 / 5834 5814FSx / 5834FSx
5006 / 5026 5821
A020 / A02H
F3653 / F3673
5853 / 5873
M3663 / M3683 M3663R / M3683R
F3663 / F3683 F5863 / F5883
5863 / 5883
5876

Terminal assignment

Pin female contacts:	1	2	3	4	5	6	7	8	PH [2]
Wire colour:	WH	BN	GN	YE	GY	PK	BU	RD	PH [2]

Cable length [1]

2 m [6.56']	**05.00.6041.8311.002M**
5 m [16.40']	**05.00.6041.8311.005M**
10 m [32.81']	**05.00.6041.8311.010M**
15 m [49.21']	**05.00.6041.8311.015M**

1) Other cable lengths on request.
2) Shield on housing.

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M23 connection technology | Connectors, self-assembly

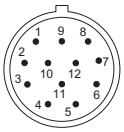
12 pin

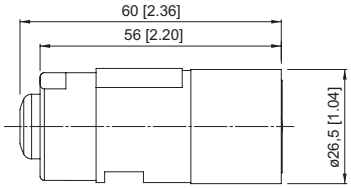
Order no.

Male connector with external thread
pin assignment ccw

Housing: metal, IP67

solder connections,
for cable ø 5.5 ... 10.5 mm [0.22 ... 0.41“]





suitable for:

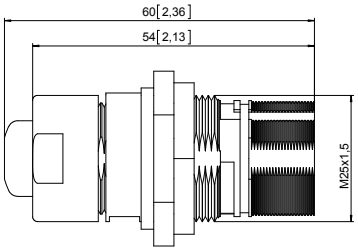
versions with cable outlet

8.0000.5015.0001

Male connector with external thread
pin assignment ccw
central fastening

Housing: metal, IP67

solder connections,
for cable ø 5.5 ... 10.5 mm [0.22 ... 0.41“]



suitable for:

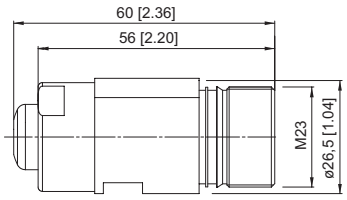
versions with cable outlet

8.0000.5015.0000

Female connector with coupling nut
pin socket assignment cw

Housing: metal, IP67

solder connections,
for cable ø 5.5 ... 10.5 mm [0.22 ... 0.41“]



suitable for:

5000 / 5020	580X / 582X
5814 / 5834	5814FSx / 5834FSx
F5863 / F5883	
585x / 587x	5853FSx /5873FSx
586x / 588x	5863FSx /5883FSx
9000	908x
A02x	

8.0000.5012.0000

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M23 connection technology | Cordsets, pre-assembled

With connector, 12 pin

Working temp. -30°C ... +80°C [-22°F ... +176°F] | Order no.

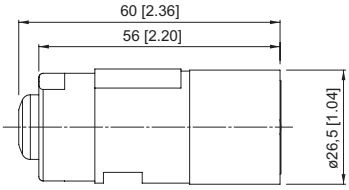
Female connector with coupling nut + single-ended

Cable: PVC, 6 x 2 x 0.14 mm² [AWG25]
Housing: metal, IP67

pin socket
assignment cw

suitable for our series with RS422 or SinCos output:

5000 / 5020 5803 / 5823
5804 / 5824 5805 / 5825
5814 / 5834 5814FSx / 5834FSx
A020 / A02H H120



Terminal assignment

Pin female contacts:	1	2	3	4	5	6	7	8	9	10	11	12	PH [2]
Wire colour:	PK	RD-BU	BU	RD	GN	YE	–	GY	–	WH	GY-PK	BN	PH [2]

Cable length [1]

2 m [6.56']	**8.0000.6901.0002**
5 m [16.40']	**8.0000.6901.0005**
10 m [32.81']	**8.0000.6901.0010**
15 m [49.21']	**8.0000.6901.0015**

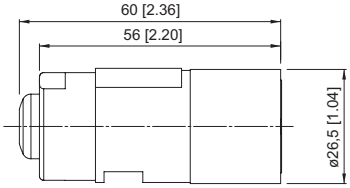
Female connector with coupling nut + single-ended

Cable: PUR, 10 x 0.14 mm² [AWG25] + 2 x 0.5 mm² [AWG20]
Housing: metal, IP67

pin socket
assignment cw

suitable for our series with RS422 or SinCos output:

5000 / 5020 5803 / 5823
5804 / 5824 5805 / 5825
5814 / 5834 5814FSx / 5834FSx
A020 / A02H H120



Terminal assignment

Pin female contacts:	1	2	3	4	5	6	7	8	9	10	11	12	PH [2]
Wire colour:	PK	BN	BU	RD	GN	YE	–	GY	–	WH 0.5 mm²	WH	BN 0.5 mm²	PH [2]

Cable length [1]

2 m [6.56']	**8.0000.6101.0002**
5 m [16.40']	**8.0000.6101.0005**
10 m [32.81']	**8.0000.6101.0010**
15 m [49.21']	**8.0000.6101.0015**

1) Other cable lengths on request.
2) Shield on housing.

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M23 connection technology | Cordsets, pre-assembled

With connector, 12 pin

Working temp. -30°C ... +80°C [-22°F ... +176°F]

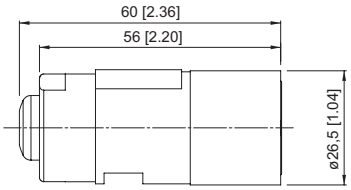
Female connector with coupling nut + single-ended

Cable: PVC, 6 x 2 x 0.14 mm² [AWG25]
Housing: metal, IP67

pin socket
assignment cw

suitable for our series with SSI or analog output:

5850 / 5870 F5863 / F5883
5853 / 5873 5853FSx / 5873FSx
5863 / 5883 5863FSx / 5883FSx
9081



Terminal assignment

Pin female contacts:	1	2	3	4	5	6	7	8	9	10	11	12	PH [2]
Wire colour:	WH	BN	GN	YE	GY	PK	BU	RD	BK	VT	GY-PK	RD-BU	PH [2]

Cable length [1]	Order no.
2 m [6.56′]	**8.0000.6901.0002.0031**
5 m [16.40′]	**8.0000.6901.0005.0031**
10 m [32.81′]	**8.0000.6901.0010.0031**
15 m [49.21′]	**8.0000.6901.0015.0031**

1) Other cable lengths on request.
2) Shield on housing.

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M23 connection technology | Cordsets, pre-assembled

With connector, 12 pin

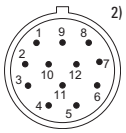
Working temp. -30°C ... +80°C [-22°F ... +176°F] | Order no.

Female connector with coupling nut + male connector with external thread

Cable: PVC, 6 x 2 x 0.14 mm² [AWG25]
Housing: metal, IP67

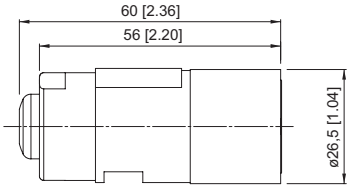
pin socket assignment cw

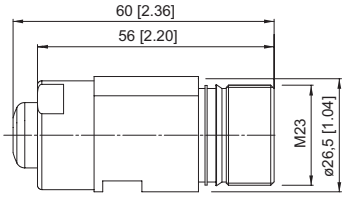
pin socket assignment ccw



suitable for our series:

5000 / 5020 5803 / 5823
5804 / 5824 5805 / 5825
5814 / 5834 5814FSx / 5834FSx
A020 / A02H H120





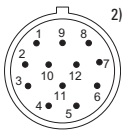
Cable length [1]	
2 m [6.56']	**8.0000.6905.0002**
5 m [16.40']	**8.0000.6905.0005**
10 m [32.81']	**8.0000.6905.0010**
15 m [49.21']	**8.0000.6905.0015**

Female connector with coupling nut + male connector with external thread

Cable: PVC, 6 x 2 x 0.14 mm² [AWG25]
Housing: metal, IP67

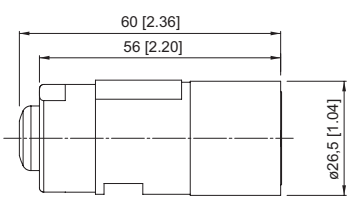
pin socket assignment cw

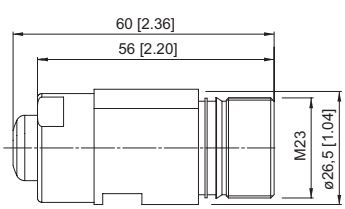
pin socket assignment ccw



suitable for our series with SSI output:

5850 / 5870 F5863 / F5883
5853 / 5873 5853FSx / 5873FSx
5863 / 5883 5863FSx / 5883FSx
9081





Cable length [1]	
2 m [6.56']	**8.0000.6905.0002.0032**
5 m [16.40']	**8.0000.6905.0005.0032**
10 m [32.81']	**8.0000.6905.0010.0032**
15 m [49.21']	**8.0000.6905.0015.0032**

1) Other cable lengths on request.
2) Shield on housing.

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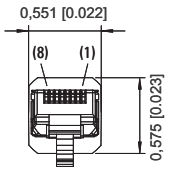
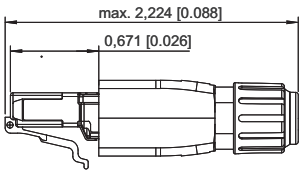
RJ45 connection technology | Connectors, self-assembly

8 pin			Order no.
RJ45 connector straight Housing: plastic, IP20	screw connections, for cable ø 4.5 ... 8 mm [0.18 ... 0.32“]	suitable for our series: BMB1, BMC1, SMBU, SMBS, SMBD	**05.VS-08-RJ45-5-Q/IP20**





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RJ45 connection technology — Cordsets, pre-assembled

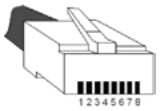
With RJ45 and Mini-IO connector, 8 pin

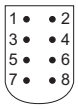
Working temp. -20°C ... +60°C [-4°F ... +140°F]

Order no.

RJ45 connector +
Mini-IO connector

Cable: PVC, 6 x 2 x 0.14 mm² [AWG 25]
Housing: ABS, metallised





suitable for our series:

EMAI
SMAS

Terminal assignment

Signal:	0 V	+V	B	$\overline{B}$	A	$\overline{A}$	⏚
Pin Mini-I/O:	8	n.c.	5	6	2	1	PH [2]
Pin RJ45:	2	1	4	5	7	8	PH [2]

Cable length [1]

Terminal ENC1, ENC2
HTL, SinCos

1 m [3.28']

8.SMAS.C21.001M

+V: encoder power supply +V DC
0 V: encoder power supply ground GND (0 V)
A, $\overline{A}$: cosine signal, incremental signal A
B, $\overline{B}$: sine signal, incremental signal B
PH ⏚: plug connector housing (shield)

1) Other cable lengths on request.
2) Shield on housing.

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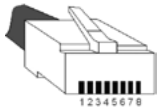
RJ45 connection technology | Cordsets, pre-assembled

Ethernet patch cable with 2 x RJ45 connector

Working temp. -20°C ... +60°C [-4°F ... +140°F]

Ethernet adapter cable

Cable: PVC, orange
category 6A acc. to EN 50173-1
6 x 2 x 0.14 mm² [AWG 25],
shielded twisted pairs
Housing: ABS, metallised



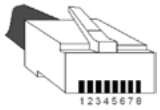
suitable for our series:

EMAA
SMAS

	Cable length [1]	Order no.
Terminal ENC1, ENC2	0.25 m [0.82′]	**8.SMAS.C22.0M25**
SinCos, SSI	0.5 m [1.64′]	**8.SMAS.C22.0M50**
	1 m [3.28′]	**8.SMAS.C22.001M**

Ethernet patch cable

Cable: PUR, grey/white
4 x 2 x 0.15 mm² [AWG 25],
shielded
Housing: ABS, metallised



suitable for our series:

SMBD.32E
SMBU
SMBS
BMB1
BMC1

	Cable length [1]	Order no.
Terminal Ethernet	2 m [6.56′]	**05.00.60A1.7272.002M**
Parameterizing interface	5 m [16.40′]	**05.00.60A1.7272.005M**
	10 m [32.81′]	**05.00.60A1.7272.010M**
	15 m [49.21′]	**05.00.60A1.7272.015M**

1) Other cable lengths on request.
2) Shield on housing.

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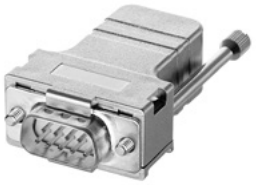
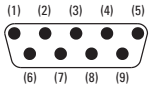
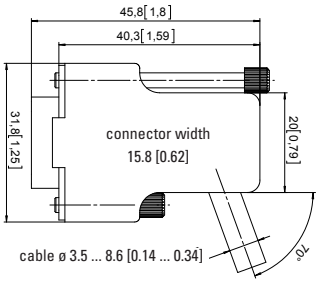
Sub-D connection technology | Connectors, self-assembly

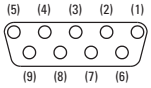
9 pin			Order no.
Male connector with cable outlet 70° Housing: ABS, metallised, IP20	solder contacts, for cable ø 3.5 ... 8.6 mm [0.14 ... 0.34“]	suitable for our series: SMC1, SMC2	**8.0000.514A.0000**
Female connector with cable outlet 70° Housing: ABS, metallised, IP20	solder contacts, for cable ø 3.5 ... 8.6 mm [0.14 ... 0.34“]	suitable for our series: SMC1, SMC2	**8.0000.514B.0000**



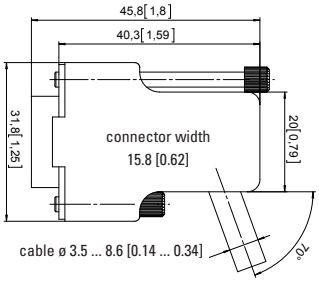


Shield on housing





Shield on housing



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Sub-D connection technology Cordsets, pre-assembled

With Sub-D connector

Working temp. -30°C ... +80°C [-22°F ... +176°F]

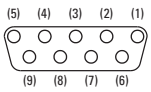
Order no.

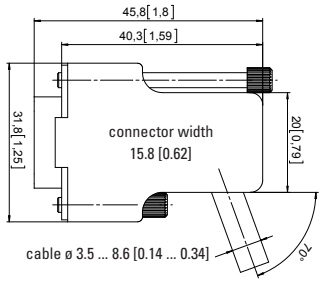
Sub-D female connector, 9-pin with cable outlet 70° + single-ended

Cable: PVC, 3 x 2 x 0.25 mm² [AWG 23]
Housing: ABS, metallised, IP20

suitable for our series:

SMC1, SMC2





Terminal assignment

Signal:	0 V	+V	A	$\overline{A}$	B	$\overline{B}$	⏚
Pin Sub-D:	5	4	1	9	3	2	PH [1]
Wire colour:	WH	BR	GN	YE	GY	PK	

Cable length [1]

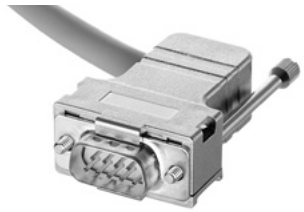
Terminal X6, X7	2 m [6.56']	**8.0000.6V00.0002.0086**
for SinCos signals	5 m [16.40']	**8.0000.6V00.0005.0086**
	10 m [32.81']	**8.0000.6V00.0010.0086**
	15 m [49.21']	**8.0000.6V00.0015.0086**

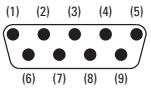
Sub-D male connector, 9-pin with cable outlet 70° + single-ended

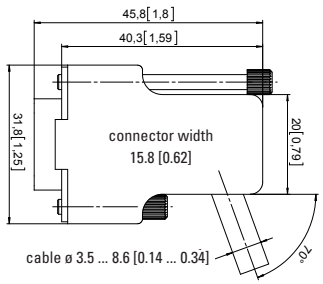
Cable: PVC, 3 x 2 x 0.25 mm² [AWG 23]
Housing: ABS, metallised, IP20

suitable for our series:

SMC1, SMC2







Terminal assignment

Signal:	0 V	+V	A	$\overline{A}$	B	$\overline{B}$	⏚
Pin Sub-D:	5	4	1	9	3	2	PH [1]
Wire colour:	WH	BR	GN	YE	GY	PK	

Cable length [1]

Terminal X5	2 m [6.56']	**8.0000.6V00.0002.0087**
for SinCos signals	5 m [16.40']	**8.0000.6V00.0005.0087**
	10 m [32.81']	**8.0000.6V00.0010.0087**
	15 m [49.21']	**8.0000.6V00.0015.0087**

+V: encoder power supply +V DC
0 V: encoder power supply ground GND (0 V)
C+, C- : clock signal
D+, D- : data signal
A, $\overline{A}$: cosine signal
B, $\overline{B}$: sine signal
PH ⏚: plug connector housing (shield)

1) Other cable lengths on request.
2) Shield on housing.

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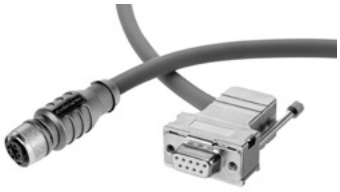
Sub-D connection technology | Cordsets, pre-assembled

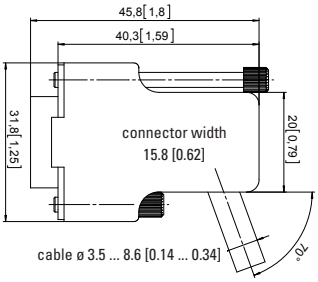
With Sub-D connector + M12 connector

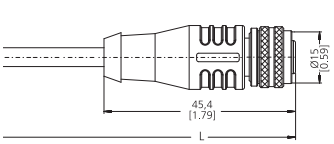
Working temp. -30°C ... +80°C [-22°F ... +176°F]

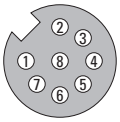
Sub-D male connector, 9 pin, cable outlet 70° + M12 female connector with coupling nut, 8 pin, A coded

Cable: PVC, 3 x 2 x 0.25 mm² [AWG 23]
Housing Sub-D: ABS, metallised, IP20
Housing M12: metal / plastic, IP67









suitable for our series:

5000 / 5020 5006 / 5026
5814 / 5834 5814FSx / 5834FSx
5821
SMC1, SMC2

Terminal assignment

Pin Sub-D:	5	4	1	9	3	2	PH [2]
Pin M12:	1	2	3	4	5	6	PH [2]
	pins arranged below each other are connected internally						

for terminal X6, X7 at SMC1, SMC2

Cable length [1]	Order no.
2 m [6.56']	**8.0000.6V00.0002.0084**
5 m [16.40']	**8.0000.6V00.0005.0084**
10 m [32.81']	**8.0000.6V00.0010.0084**
15 m [49.21']	**8.0000.6V00.0015.0084**

1) Other cable lengths on request.
2) Shield on housing.

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Sub-D connection technology | Cordsets, pre-assembled

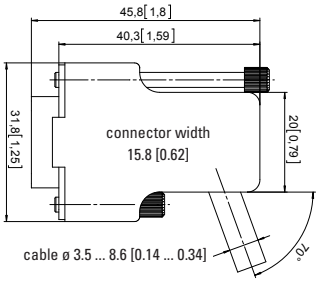
With Sub-D connector + M23 connector

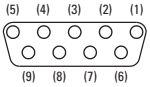
Working temp. -30°C ... +80°C [-22°F ... +176°F]

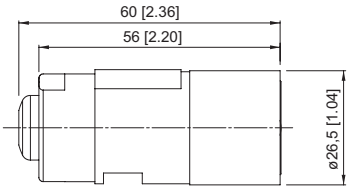
Order no.

Sub-D female connector, 9-pin, cable outlet 70° + M23 female connector with coupling nut, 12 pin

Cable: PVC, 3 x 2 x 0.25 mm² [AWG 23]
Housing Sub-D: ABS, metallised, IP20
Housing M23: metal, IP67







pin socket assignment cw

suitable for our series:

5000 / 5020 5006 / 5026
5814 / 5834 5814FSx / 5834FSx
5821
SMC1, SMC2

Terminal assignment

Pin Sub-D:	5	4	1	9	3	2	PH [2]
Pin M23:	10	12	5	6	8	1	PH [2]
	pins arranged below each other are connected internally						

for terminal X6, X7 at SMC1, SMC2

Cable length [1]	Order no.
2 m [6.56′]	**8.0000.6V00.0002.0085**
5 m [16.40′]	**8.0000.6V00.0005.0085**
10 m [32.81′]	**8.0000.6V00.0010.0085**
15 m [49.21′]	**8.0000.6V00.0015.0085**

1) Other cable lengths on request.
2) Shield on housing.

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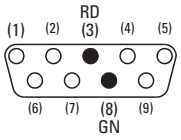
Sub-D connection technology | Cordsets, pre-assembled

With Sub-D connector

Working temp. -30°C ... +80°C [-22°F ... +176°F]

Sub-D female connector, cable outlet 90° + single-ended
Profibus master with terminating resistor

Cable: PUR, 2 x 0.34 mm² [AWG22]
Housing: metal / plastic



suitable for our series:

5858 / 5878
5868 / 5888
9080

SMBU.031
SMBS.S31

Terminal assignment

Pin Sub-D:	1	2	3	4	5	6	7	8	9	PH [2]
Wire colour:	–	–	RD	–	–	–	–	GN	–	

Cable length [1]	Order no.
2 m [6.56']	**05.00.6011.5511.002M**
5 m [16.40']	**05.00.6011.5511.005M**
10 m [32.81']	**05.00.6011.5511.010M**
15 m [49.21']	**05.00.6011.5511.015M**

1) Other cable lengths on request.
2) Shield on housing.

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Accessories

Encoders		Page
Encoder mounting attachments	Fixing components for hollow shaft encoders	**222**
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LED displays	SSI absolute encoder display – type 570	**230**
	SSI or incremental display – type 575	**233**
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Safety-M modular		**240**

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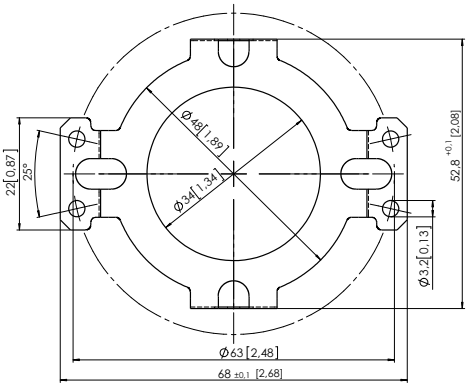
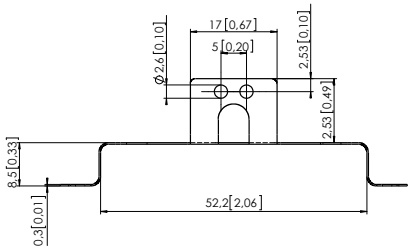
Encoders

Fixing components for hollow shaft encoders

Dimensions / Details	Dimensions in mm [inch]	Order no.

Stator coupling





Scope of delivery:
- Stator coupling (stainless steel)
- 4 screws M3x6 mm [M3 x 0.24"] for fixing to the encoder

Connection to application:
- 4 screws (not supplied)

Max. permissible shaft connection tolerances:
- Axial offset < ± 0.25 mm
- Radialversatz < ± 0.20 mm
- Winkelversatz < 1°

Suitable for our encoders:
Sendix SIL 5834FSx
Sendix SIL 5873FSx
Sendix SIL 5883FSx

8.0010.4048.00FS

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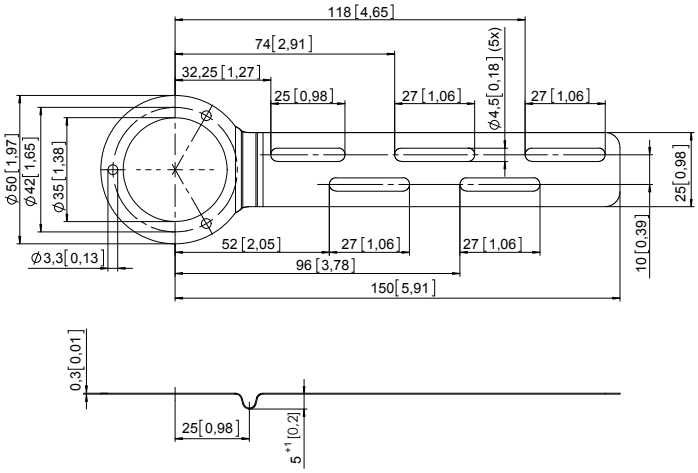
Encoders

Fixing components for hollow shaft encoders

Dimensions / Details	Dimensions in mm [inch]	Order no.

Fastening arm, flexible



Scope of delivery:
- Fastening arm (stainless steel)
- 3 screws M3x6 mm [M3 x 0.24“] for fixing to the encoder

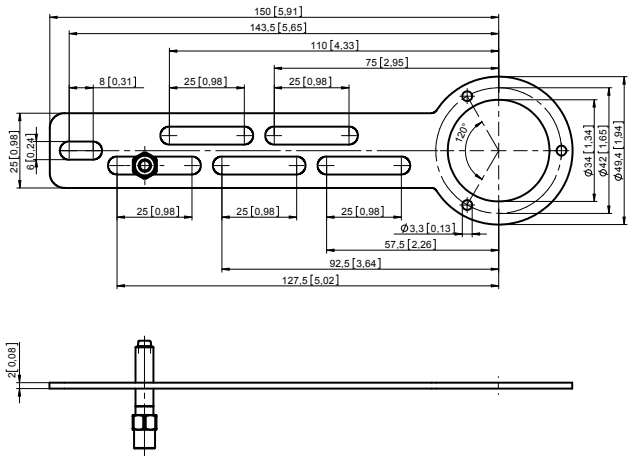
Connection to application:
- 1 screw (not supplied)

Max. permissible shaft connection tolerances:
- Axial offset < ± 0.25 mm
- Radial offset < ± 0.20 mm
- Angular offset < 1°

Suitable for our encoders:
Sendix SIL 5834FSx
Sendix SIL 5873FSx
Sendix SIL 5883FSx

8.0010.4047.00FS

Fastening arm set, rigid



Scope of delivery:
- Fastening arm (stainless steel)
- 3 screws M3x6 mm [M3 x 0.24“] for fixing to the encoder

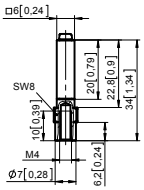
Connection to application:
- 1 screw (not supplied)

Max. permissible shaft connection tolerances:
- Axial offset < ± 0.25 mm
- Radial offset < ± 0.20 mm
- Angular offset < 1°

Suitable for our encoders:
Sendix SIL 5834FSx
Sendix SIL 5873FSx
Sendix SIL 5883FSx

8.0010.4051.00FS

Cylindrical pin (replacement)



Suitable for:
Fastening arm
8.0010.4051.00FS

8.0010.4049.0075

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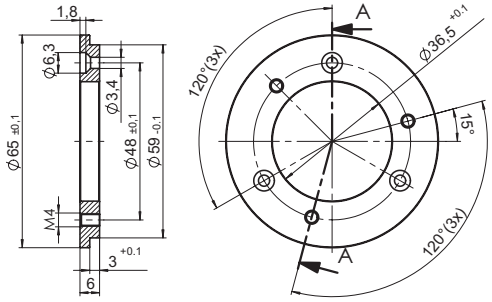
Encoders

Fixing components for shaft encoders

Dimensions / Details	Dimensions in mm [inch]	Order no.

Flange, ø 65 [2.56]

With this adapter flange, Kübler encoders with size 58 [2.28] can replace encoders with diameter 65 [2.56] and pitch circle diameter 48 [1.89].



Scope of delivery:
- flange (aluminium)
- 3 screws for fixing to the encoder

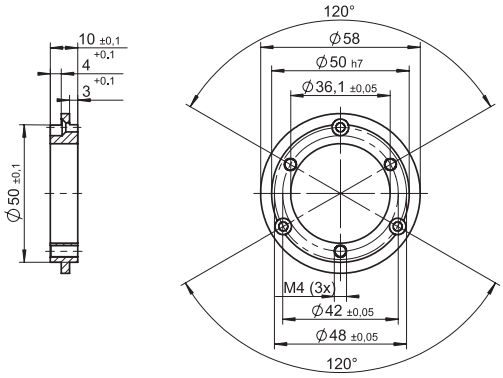
Connection to application:
- 3 screws (not supplied)

Suitable for our encoders:
Sendix SIL 5834FSx
Sendix SIL 5873FSx
Sendix SIL 5883FSx

8.0010.2230.0000

Flange, ø 58 [2.28]

Converts encoders with a clamping flange into synchro flange.



Scope of delivery:
- flange (aluminium)
- 3 screws for encoder mounting

Connection to application:
- 3 screws (not supplied)

Suitable for our encoders:
Sendix SIL 5834FSx
Sendix SIL 5873FSx
Sendix SIL 5883FSx

8.0010.2180.0000

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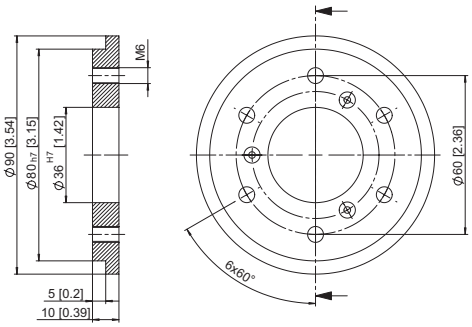
Encoders | Fixing components for shaft encoders

Dimensions / Details	Dimensions in mm [inch]	Order no.

Flange, ø 90 [3.54]

Mechanically compatible with former encoder type 9000



Scope of delivery:
- flange
- 3 screws for encoder mounting

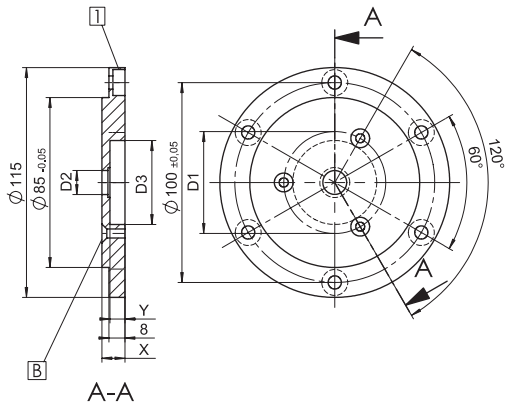
Connection to application:
- 6 screws (not supplied)

Suitable for our encoders:
Sendix SIL 5834FSx
Sendix SIL 5873FSx
Sendix SIL 5883FSx

8.0010.2270.0000

Flange, ø 115 [4.53], Euroflange (Euro REO 444)

encoder type	*D1*	*D2*	*D3*	*X*	*Y*	B	
580X/5000	48 [1.89]	36 [1.42]	58 [2.28]	11 [0.43]	1 [0.039]	DIN 74-BM3	**8.0010.2160.0000**
70XX	51 [2.01]	12 [0.47]	42 [1.65]	11.5 [0.45]	7.5 [0.30]	DIN 74-BM4	**8.0010.2170.0000**



Scope of delivery:
- flange (aluminium)
- 3 screws for encoder mounting

Connection to application:
- 6 screws (not supplied)

Suitable for our encoders:
Sendix SIL 58xxFS
Sendix SIL 70xxFS

1 Countersunk DIN 74-Hm6

B See table

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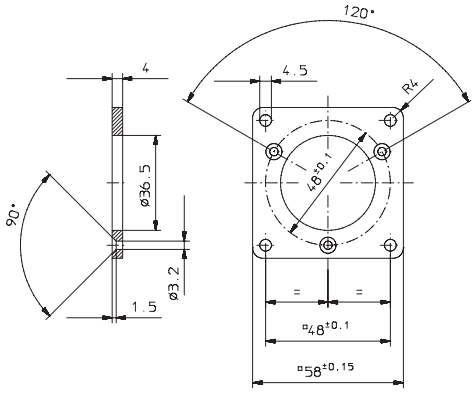
Encoders

Fixing components for shaft encoders

Dimensions / Details	Dimensions in mm [inch]	Order no.

Flange, square

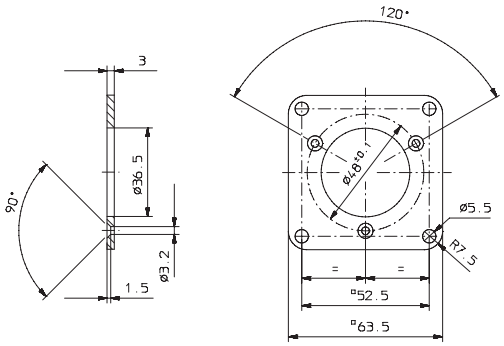


Scope of delivery:
- flange (aluminium)
- 3 screws for fixing to the encoder

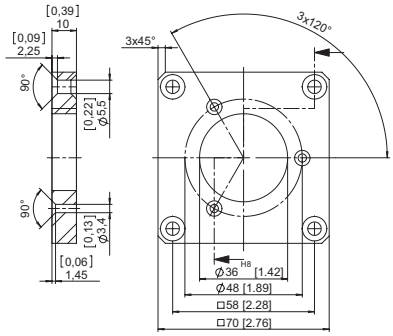
Connection to application:
- 4 screws (not supplied)

Suitable for our encoders:
Sendix SIL 58xxFSx

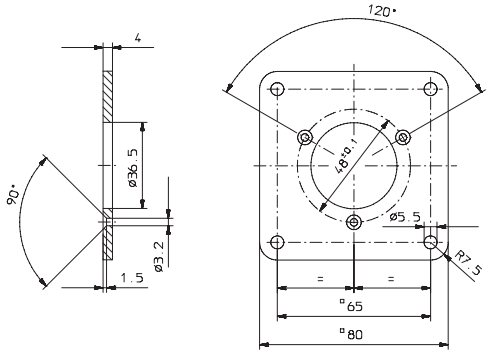
8.0010.2100.0000



8.0010.2120.0000



8.0010.2600.0000



8.0010.2800.0000

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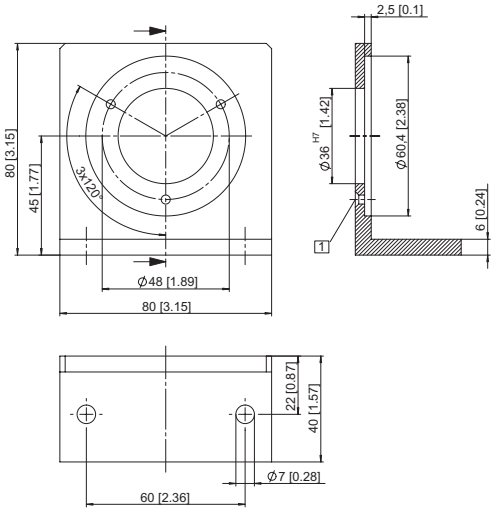
Encoders

Fixing components for shaft encoders

Dimensions / Details	Dimensions in mm [inch]	Order no.

Angular flange



Scope of delivery:
- angular flange (aluminium)
- 3 screws for encoder mounting

Connection to application:
- 2 screws (not supplied)

Suitable for our encoders:
Sendix SIL 58xxFSx

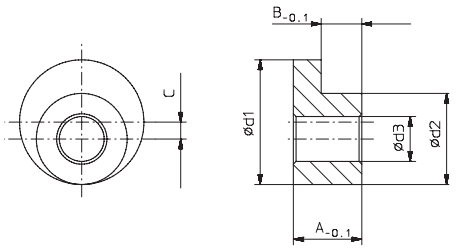
1 Countersunk DIN 74-Hm6

8.0010.2300.0000

Fastening eccentrics for encoders with synchro flange

- Suitable for Kübler encoders with synchro flange
- Material ACu Zn 39 Pb 3
- Surface finish: galvanised Ni

encoder type	*D1*	*D2*	*D3*	*A*	*B*	*C*
58xxFSx 70xxFSx	9.6	6.5	3.2	5.6	2.9	1.2



Scope of delivery:
- 3 eccentrics
- 3 screws

(Use at least three fastening eccentrics to mount the encoder)

Suitable for our encoders:
Sendix SIL 58xxFSx
Sendix SIL 70xxFSx

8.0010.4100.0000

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Bellows couplings provide cost-effective connection of the motor and encoder. They are also able to correct any angular errors between the drive and encoder.

These bellows couplings (FS) are used for safe connection of applications and Sendix SIL encoders.

The safety-oriented bellows coupling has, in addition to the metallic bellows, internal claws that ensure the driving of the encoder in case of breakage of the bellows connection.

Order code Couplings

8.0000	.	1	X	FS	.	XX	XX
Type			ⓐ			ⓑ	ⓒ

ⓐ *Type of coupling*
5 = bellows coupling ø 25 mm [0.98"]

ⓑ *Bore diameter d1*
(see technical data)

ⓒ *Bore diameter d2*
(see technical data)

Example: d1 = 10 mm and d2 = 12 mm
Order No. = 8.0000.15FS.**1012**

Accessories		Order no.
Screw retention	Loctite 243, 5 ml	**8.0000.4G05.0000**

Technical data

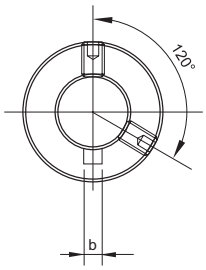
Mechanical characteristics

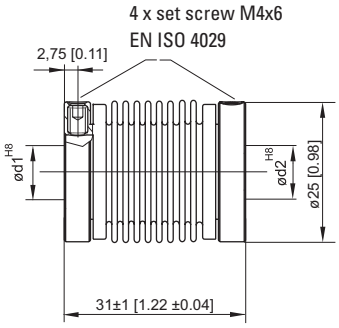
Max. speed		10000 min^{-1}
Max. torque		200 Ncm
Max. shaft offset	radial	± 0.3 mm
	axial	± 0.45 mm
	angular	± 3°
Torsion spring stiffness		183 Nm/rad
Radial spring stiffness		17.8 N/mm
Moment of inertia		9.1 gcm^2
Headless set screw tightening torque	min.	80 Ncm
	max.	100 Ncm

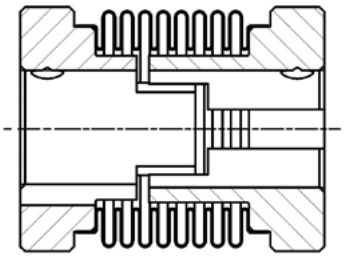
Working temperature range		-30°C ... +120°C [-22 ... +248°F]
Weight approx.		54 g
Material	flange	stainless steel 1.4104
	bellows	stainless steel 1.4571
Standard bore diameter	(d1 / d2)	10 / 10 mm [0.39 / 0.39"]
		10 / 12 mm [0.39 / 0.47"]
		12 / 12 mm [0.47 / 0.47"]
Insertion depth	min.	6 mm [0.24"]
	max.	11 mm [0.43"]

Dimensions

Dimensions in mm [inch]







Nut DIN 6885

nut width b	d1 / d2
3 [0.12]	10 [0.39]
4 [0.16]	12 [0.47]

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Encoders — General

Dimensions / Details	Dimensions in mm [inch]	Order no.

Screw retention Loctite 243 (5 ml)

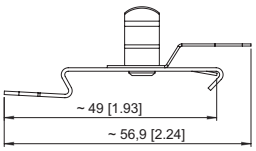
Chemical basis:	dimethacrylate ester
Components:	single-component (no mixing required)
Viscosity:	medium, thixotrope
Cure:	anaerobic
Secondary cure:	activator
Use:	screw retention
Strength:	medium

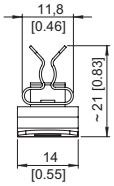
Suitable for our series:
Sendix SIL
Safety-M compact
Safety-M modular
Safety-M

8.0000.4G05.0000

EMC shield terminal

For an EMC-compliant installation of the encoder cable,
top-hat rail mounting,
Shield diameter 3.0 ... 6.0 mm,
Clamp (spring steel, galvanised)
Foot (spring steel)



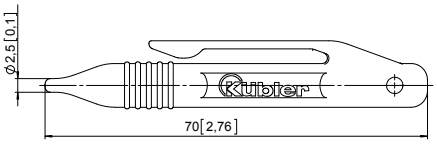


Suitable for our series:
Sendix SIL
Safety-M compact
Safety-M modular
Safety-M

8.0000.4G06.0000

Stylus for the set key

For easy operation of the set key on the encoder
Material POM (HKS8 orange)



Suitable for our series:
Sendix SIL
5853FSx
5863FSx
5873FSx
5883FSx

8.0010.4052.0000

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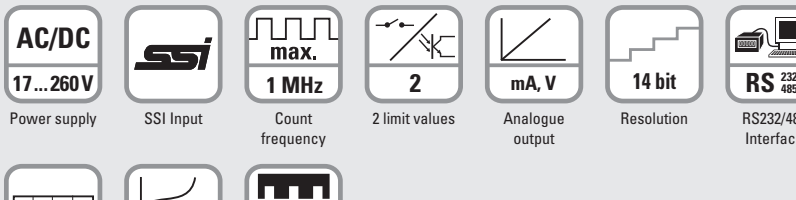
LED position preset counters | SSI absolute encoder display (AC+DC) | 570

The fast SSI display type 570 is designed for absolute SSI encoders with a resolution up to 32 bits. It can be used as either a master or a slave display.

Thanks to simple bit assignment and bit blanking the display, which can be scaled and linearized, can also be cascaded, in order to extend the display range as desired. Output options include 2 limit values, analogue output or interface.



Characteristics

- Suitable for SSI-protocols from 8 up to 32 bits
- Version with 2 optocoupler outputs to work as limit or preset values; also with programmable tracking preset
- Version with scaleable analogue output, resolution 14 bits, 0 ... 10 V, -10 ... +10 V, 0 ... 20 mA or 4 ... 20 mA
- Version with serial interface for reading data in and out (RS232 / RS485)
- **NEW**: Version with 2 relay outputs as limit values or presets; can also be programmed as tracking preset and with RS232 / RS485 interface
- Gray or binary code
- 96 x 48 mm DIN-housing, IP65

Benefits

- AC and DC power supply in one unit
- Master- or slave mode
- Plug-in screw terminals
- SSI-clock frequency from 100 Hz up to 1 MHz
- Display may be adjusted using scaling- and offset-features
- Large 15 mm high LED display, 6-digit, with adjustable brightness
- Round-loop function
- Linearization with teach option
- Bit blanking

Order specifications

Display with:	*Order no.*	*Delivery specification*
2 optocoupler outputs	**0.570.011.E00** 1)	- Display 570 - Gasket - Mounting kit - Operating instruction German/English
Analogue output	**0.570.012.E90** 1)	
Serial interface RS232/485	**0.570.012.E05**	
2 relay outputs and RS232/485	**0.570.010.305**	

Accessories			Order no.
Mounting frame with cut-out 92 x 45 [3.62 x 1.77]	For snap-on mounting on 35 [1.38] top-hat DIN rail, for counters 96 x 48 [3.74 x 1.89]	grey	**G300005**
OS32 software for parameter setting	can be downloaded at www.kuebler.com		

Suitable gaskets as well as further accessories can be found in the accessories section or in the accessories area of our website at: www.kuebler.com/accessories.

1) Stock types

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LED position preset counters | SSI absolute encoder display (AC+DC) | 570

Technical data

General technical data

Display	LED display, 15 mm high 6 decades
Operating temperature	0°C ... +45°C [+32°F ... +113°F] (non-condensing)
Storage temperature	-25°C ... +70°C [-13°F ... +158°F]
Altitude	up to 2000 m [6562']

Electrical characteristics

Power supply	(0.570.01X.EXX)	17 ... 30 V DC and 115/230 V AC, ± 12.5 %
	(0.570.010.305)	17 ... 30 V DC
Current consumption DC	17 V	190 mA
	24 V	150 mA
	30 V	120 mA
Power consumption AC		7.5 VA
Sensor power supply (for encoder)		24 V DC ± 15%, 120 mA
EMC	Immunity to interference	EN 55011 class B
	Emitted interference	EN 61000-6-2
Device safety	Designed to	EN 61010 part 1
	Protection class	2
	Application area	Pollution level 2

Mechanical characteristics

Protection	IP65 (front side)
Weight	approx. 200 g [7.06 oz]

Inputs

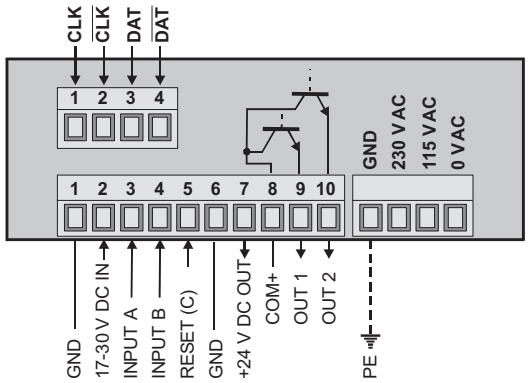
SSI data inputs		Differential RS422 input
Input frequency range		100 Hz ... 1 MHz
SSI clock output		Differential RS422 output
Output frequency range		100 Hz ... 1 MHz
Input reset		PNP or NPN, programmable 5.1 mA, 24 V DC R_i = 4.7 kOhm
Input level	LOW	0 ... 2 V
	HIGH	9 ... 35 V
Min. reset pulse time		min. 5 ms

Outputs

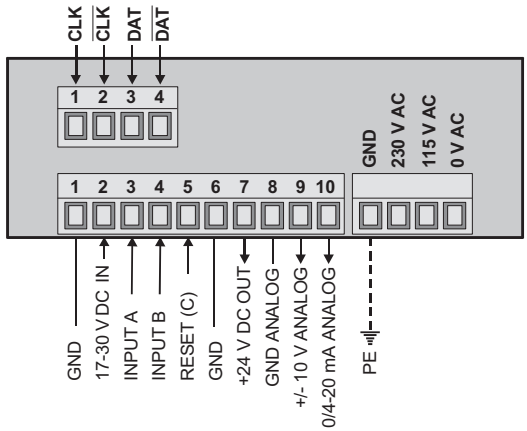
Scaleable analogue output	(0.570.012.E90)	0 ... 10 V, –10 ... + 10 V or 0 ... 20 mA, 4 ... 20 mA
Resolution		14 bit + sign
Accuracy		0.1 %
Optocoupler output	(0.570.011.E00)	5 ... 35 V DC/150 mA reaction time approx. 5 ms
Interface	(0.570.012.E05 + 0.570.010.305)	RS232 and RS485 acc. to ISO 1745 drivecom protocol or printer protocol
Relay output	(0.570.010.305)	2 changeover contacts max. 250 V AC / 1 A / 250 VA max. 100 V DC / 1 A / 100 W reaction time approx. 10 ms

Terminal assignment

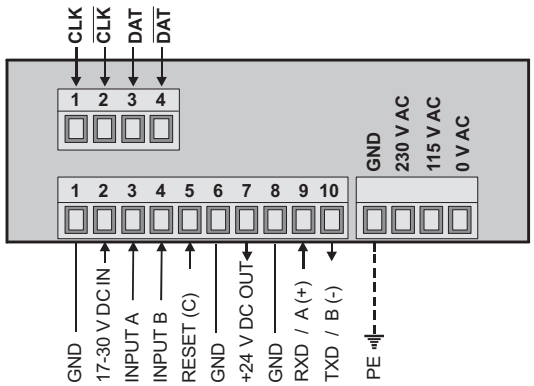
Display with 2 optocoupler outputs (0.570.011.E00)



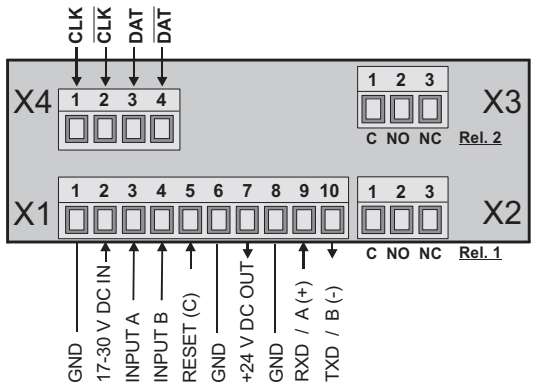
Display with analogue output (0.570.012.E90)



Display with serial interface RS 232/485 (0.570.012.E05)



Display with 2 relay outputs, RS 232/485 (0.570.010.305)



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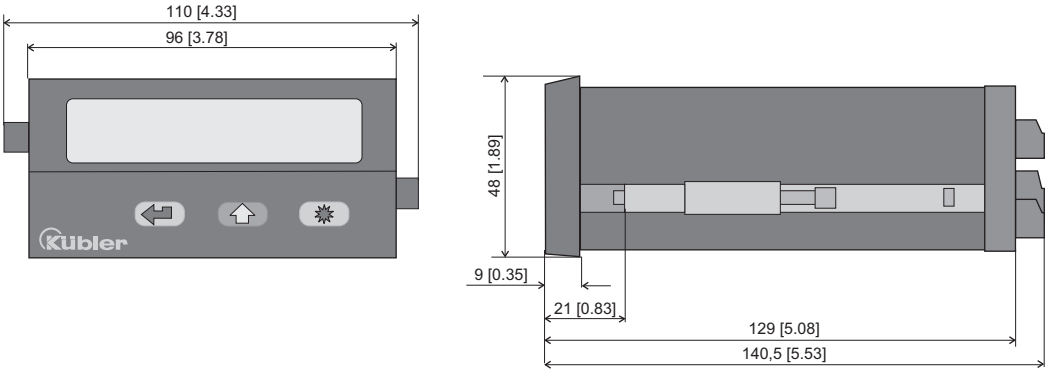
LED position preset counters | SSI absolute encoder display (AC+DC) | 570

Dimensions

Dimensions in mm [inch]

Panel cut-out
92 x 45 [3.62 x 1.77]



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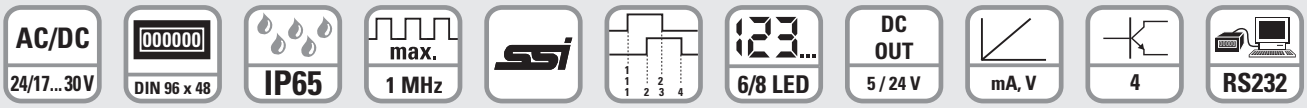
Encoders | LED SSI or incremental display | 575

Counter series for demanding applications with two individually scalable encoder inputs, each SSI master / SSI slave or A, /A, B, /B, for count frequencies up to 1 MHz per channel.

Programmable operating modes include position or event counter, totaliser, difference counter.

RoHS



Innovative

- 3 display values: counter 1, 2 as well as calculation-based display.
- 2 separate freely scalable count inputs: SSI master, SSI slave or TTL incremental (also with inverted inputs) max. input frequency 1 MHz/channel.
- Very bright LED display, 15 mm (6-digit) and 10 mm (8-digit) high.
- 4 freely programmable fast solid-state outputs, each with 350 mA output current.
- Step or tracking presets.
- Simple programming – with function codes, dependent on the operating mode selected.
- With 8 different fixed count functions, such as simple count, difference count and total count of both inputs, separate display of the inputs.

Compact and multifunctional

- One device caters for AC and DC power supplies.
- Simple programming with 4 keys and programmable dual functions.
- Can be used as counter or position display with limit values, where 2 values are monitored or calculated with respect to each other.
- 4 fast, programmable inputs with various functions, such as re-set, gate, display memory (store), reference input or switching between the display values.
- Scalable analogue output 0/4 ... 20 mA, ±10 V or 0 ... 10 V.
- RS232 interface as standard, for parameter setting, readout of values or for modifications during operation.
- 2 auxiliary power supplies for sensors: 5.2 V DC and 24 V DC.

Order specifications

4 fast switch outputs and serial interface (RS232)	*Order no.*	*Delivery specification*
6 digits	**6.575.0116.D05**	- Controller 575 - Gasket - Fastening set - Instruction manual German/English
6 digits, scalable analogue outputs	**6.575.0116.D95**	
8 digits	**6.575.0118.D05**	
8 digits, scalable analogue outputs	**6.575.0118.D95**	

Accessories	Dimensions in mm [inch]		Order no.
Mounting frame with cut-out 92 x 45 [3.62 x 1.77]	For snap-on mounting on 35 [1.38] top-hat DIN rail, for counters 96 x 48 [3.78 x 1.89]	grey	**G300005**
OS2 software for parameter setting	can be downloaded at www.kuebler.com		

Suitable gaskets as well as further accessories can be found in the accessories section or in the accessories area of our website at: www.kuebler.com/accessories.

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Encoders | LED SSI or incremental display | 575

Technical data

General technical data

Display	6 digits	LED display, 15 mm [0.59“]high
	8 digits	LED display, 10 mm [0.39“]high
Operating temperature		0°C ... +45°C [+32°F ... +113°F] (non-condensing)
Storage temperature		-25°C ... +70°C [-13°F ... +158°F]

Electrical characteristics

Power supply		24 V AC, + 10% 24 (17 ... 30) V DC
Current consumption DC		100 mA + current consumption encoder
Connected load AC		15 VA
Auxiliary power supply output for sensors		2 x 5.2 V DC, each 150 mA 2 x 24 V DC, each 120 mA
EMC	Emitted interference	EN 61000-6-3
	Immunity to interference	EN 61000-6-2
Device safety	Designed to	EN 61010 part 1
	Protection class	2
	Application area	Pollution level 2

Mechanical characteristics

Housing		Noryl UL94-V-0
Screw terminal	Cable cross-section	max. 1.5 mm² [AWG 25]
Protection acc. to EN 60529		IP65 (front side)
Weight		approx. 250 g [8.82 oz]

Inputs

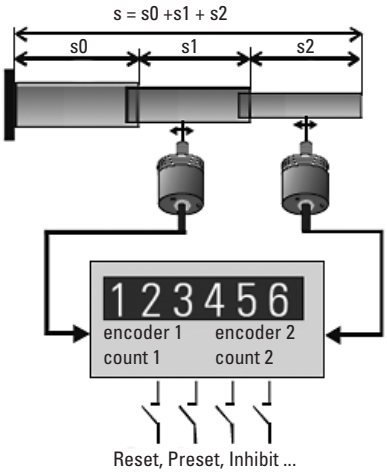
Universal SSI incremental encoder inputs		2
Count frequency (per encoder)	RS422 and TTL with Inv.	1 MHz
	SSI master	1 MHz (max. 32 bit)
	SSI slave	1 MHz (max. 32 bit)
Control inputs HTL		4
Ri (input resistor)		3.3 kOhm
Switching level	LOW	< 2.5 V
	HIGH	> 10 V
Min. pulse duration		50 µs

Outputs

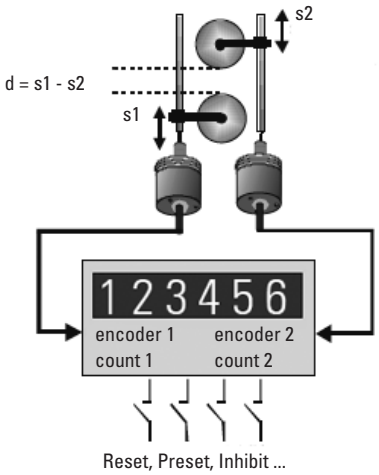
Switch outputs	
4 fast power transistors	5 ... 30 V DC, 350 mA
Reaction time	< 1ms [1]
Inductive loads require a freewheeling diode	
Seriel interface	RS232, 2400 ... 38400 Baud
Analogue outputs	
Current	0 / 4 ... 20 mA
Load	max. 270 Ohm
Voltage	0 ... +10 V (max. 3 mA)
Resolution	14 bit
Precision	0.1 %
Reaction time	< 1 m

Application examples

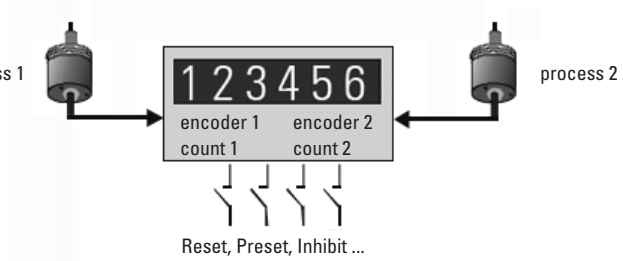
Total position display



Difference position display



Independent individual operation



1) Intensive serial communication can temporarily prolong the reaction time.

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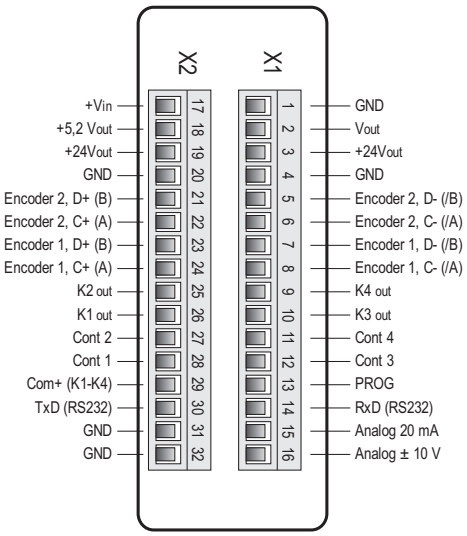
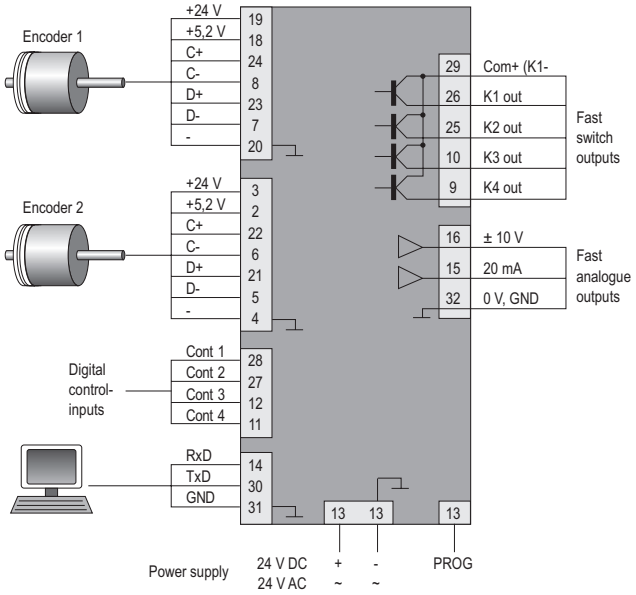
Encoders | LED SSI or incremental display | 575

Terminal assignment



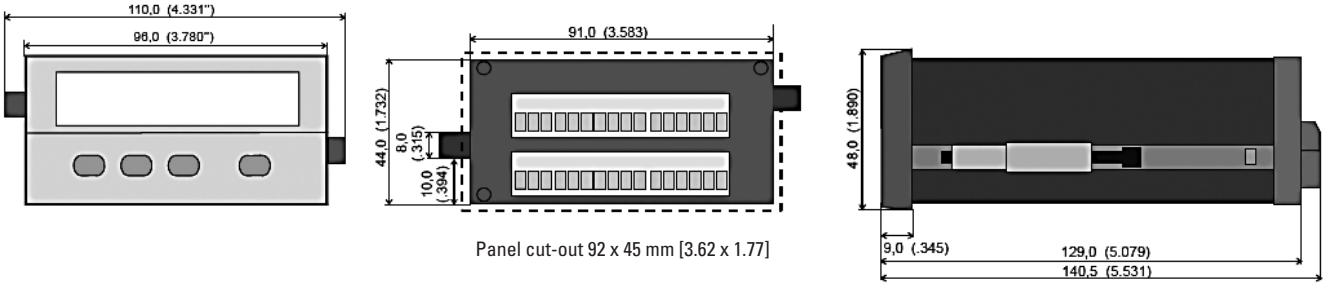
Connection examples

Example shows encoder with 5 V-supply and TTL / RS422-output



Dimensions

Dimensions in mm [inch]



Panel cut-out 92 x 45 mm [3.62 x 1.77]

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Encoders | Optical fibre signal transmission – transmitter and receiver | SSI

eco plus

Cost advantage compared to conventional wiring over 150 m length*

Optical fibre transmission system for SSI absolute encoders

The system is made up of an optical fibre transmitter and an optical fibre receiver. The optical fibre transmitter converts the electrical signals of a normal absolute encoder with Synchronous Serial Interface (SSI) into a light signal for transmission by means of an optical fibre. The receiving module converts the optical signal back into electrical signals.

Absolute signals can be transmitted safely through one glass fibre over distances of up to 2000 m. A rotary switch on the front side of the module allows adjusting the SSI clock between 1 and 99 bits.

Reliable transmission

- Safe signal transmission up to 2000 m.
- Resists extremely strong electro-magnetic fields.

Easy installation

- Signal transmission via a single glass fibre.
- Clock of 1 ... 99 bit can be set via rotary switch.
- LED for monitoring of power supply and clock.
- DIN-rail mounting – requires min. installation space – only 19 mm wide.

Application areas

- Process control technology and automation technology.
- Crane systems.
- High voltage plants.
- Heavy industry.
- Wind power plants.
- Drive technology.
- Rolling mills.

Order code Optical fibre transmitter / receiver

6.LWLA . X X X
(a) (b) (c)

(a)
S = Optical fibre transmitter
E = Optical fibre receiver

(b) *Power supply*
1 = 10 ... 30 V DC
4 = 5 V DC

(c) *Type of connection*
0 = Terminal clamp
1 = Plug-in connector Sub-D9

Scope of delivery:
- Optical fibre transmission module
- Operating manual, dual language, German and English

Accessories		Order no.
Simplex Patch cable ST-ST - Multimode	Connector: 2 x ST/PC, Optical fibre: 1 x 50/125	**05.B09-B09-821-XXXX** XXXX = Length in m Standard lengths: 2 m, 5 m, 8 m, 10 m, 15 m, 20 m, ... (in 5 m steps)
ST Multimode coupling	Barrel: ceramic, slotted	**05.LWLK.001**

* Comparison of costs:
Costs per meter standard copper cable compared to costs per meter optical fibre signal cable + costs of transmitter + costs of receiver

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Encoders | Optical fibre signal transmission – transmitter and receiver | SSI

Technical data

General technical data	
Power supply	10 ... 30 DC V eg. 5 V DC ±5 %
Power consumption per module	< 1 W
Operating voltage reverse connection protection	available
Electrical inputs / outputs (Optical fibre transmitter / receiver)	Clock C+ and C-, RS422 Data D+ and D-, RS422 NPN error input on transmitter Open-Drain outut on receiver
SSI clock rate	max. 1 MHz
Optical wavelength	820 nm (infrared)
Optical fibre connection	ST connector, on the bottom side of the housing
Glass fibre	multimode fibre, 50/125 µm, 62.5/125 µm
Optical fibre transmission distance	max. 2000 m [6561']

Dimensions (W x L x H)		19.0 x 110.8 x 92.3 mm [0.75 x 4.36 x 3.63"]
Protection acc. to EN 60529		IP40, terminals IP20
Connection	terminal clamps	11-pin plug-in screw terminal, RM 3.5
	Sub-D9	9-pin Sub-D female contacts (for signals)
	power supply	2-pin plug-in screw terminal
Temperature range		-10°C ... +70°C [+14°F ... +158°F]
Weight		appr. 70 g [2.47 oz]

EMC		
Standards	Emitted interference	EN 55011 class B1
	Immunity to interference	EN 61000-6-2

Terminal assignment

Optical fibre transmitter

Type of connection	Terminal clamp											
0	Signal:	0 V	+V	C+	C-	D+	D-	input/error	–	–	–	⏚
	Pin female contact:	1	2	3	4	5	6	7	8	9	10	11

Type of connection	Plug-in connector, Sub-D9									
1	Signal:	0 V	+V	input/error	D-	D+	C-	C+	–	⏚
	Pin female contact:	1	2	3	4	5	6	7	8	9

Optical fibre receiver

Type of connection	Terminal clamp											
0	Signal:	0 V	+V	C+	C-	D+	D-	output/error	–	–	–	⏚
	Pin female contact:	1	2	3	4	5	6	7	8	9	10	11

Type of connection	Plug-in connector, Sub-D9									
1	Signal:	0 V	+V	output/error	D-	D+	C-	C+	–	⏚
	Pin female contact:	1	2	3	4	5	6	7	8	9

Power supply

	Screw terminal, 2 pin		
	Signal:	0 V	+V
	Pin female contact:	1	2

Contacts 1/2 of the 2-pin plug-in screw terminal are connected to contacts 1/2 of the 11-pin plug-in screw terminal or with contacts 1/2 of the Sub-D connector.

+V: Power supply +V DC
0 V: Power supply ground GND (0 V)
C+, C- : Clock signal
D+, D- : Data signal
⏚: Shield

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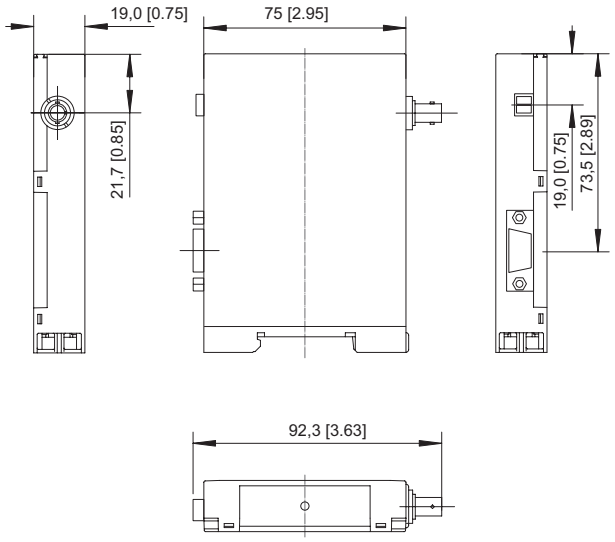
Dimensions

Dimensions in mm [inch]



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Safety modules | Safety-M compact

Dimensions / Details	Dimensions in mm [inch]			Order no.
Control and diagnostic display 	Real value display for rotary speed and direction Parameterizing tool for changing device parameters. - 6 programmable parameters - autonomously parameterizable - memory copy unit *Technical data:* Ambient temperature: -20°C ... +55°C [-4°F ... +131°F] Interface to the PC: USB Mini-B (underside) Interface to the SMCx: 8-pole pin strip (rear side) Dimensions (WxHxD): 50 x 80 x 15 mm [1.97 x 3.15 x 0.59"] Display: OLED 128 x 64 pixels (1.54") Keyboard: Touch screen (6 capacitive keys) Weight: appr. 50 g [1.76 oz] Protection: IP20 Conformity and standards: EN 61000-6-2, EN 61000-6-3, EN 61000-6-4		*Suitable for our safety modules Safety-M compact:* SMC1, SMC2	**8.SMCB.000**
Programming cable Safety-M compact 	Multi-USB-Adapter *Scope of delivery:* • Retractable USB cable • Adapter for USB type A plug • Adapter for USB type A socket • Adapter for USB type B plug • Adapter for USB type B socket • Adapter for USB Mini B plug • Adapter for USB Mini B socket		*Suitable for our safety modules Safety-M compact:* SMC1, SMC2	**05.C162RK1**
SafeConfig software 	The SafeConfig software allows PC-based configuration of the Safety-M compact family.		*Suitable for our safety modules Safety-M compact:* SMC1, SMC2	*Online on our homepage* **www.kuebler.com/safeconfig**

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Safety modules | Safety-M modular

Dimensions / Details	Dimensions in mm [inch]		Order no.
Programming cable Safety-M modular (USB) 	*Scope of delivery:* Mini USB cable Length 2 m [6.56'] *Suitable for our safety modules Safety-M modular:* SMBD.420		**05.68784.002M**
Programming cable Safety-M modular (Ethernet) 	For programming Safety-M modular Cable: 2 x RJ45 PUR, grey 4 x 2 x 0.15 mm² [AWG 35], shielded Length 2 m [6.56'] *Suitable for our safety modules Safety-M modular:* SMBD.32E SMBU SMBS		**05.00.60A1.7272.002M**
Ethernet crossover adapter 	• Plug/Socket (RJ45) • Crossover assignment • For adapting a 1:1 patch cable as a crossover-patch cable • Unshielded • Assignment: 1/2 – 3/6 – 4/5 – 7/8 *Suitable for our safety modules Safety-M modular:* SMBD.32E SMBU SMBS		**05.CA.RJ45**
USB Fast Ethernet adapter 	For easy programming of Safety-M modular using the Ethernet programming interface • USB1.1/2.0 to 10/100 Fast Ethernet • Plug-and-Play • Supports Windows XP/7, Mac OS 5.0 or higher *Suitable for our safety modules Safety-M modular:* 8.SMBD.32E 8.SMBU.031 8.SMBU.0B1 8.SMBU.0C1 8.SMBU.0D1 8.SMBS.S31 8.SMBS.SC1		**05.UA0144**
Software SafeMonitor 	SafeMonitor programming software	*Suitable for our safety modules Safety-M modular*	*Online on our homepage* **www.kuebler.com/safemonitor**
Software license SafeMonitor 	Software license for the SafeMonitor programming software (including release code for download and registration)	*Suitable for the software SafeMonitor*	**8.SMSW.000**

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Safety modules | Safety-M modular

Dimensions / Details	Dimensions in mm [inch]			Order no.
Chip card 32k 	Memory capacity Weight Dimensions	32 kBytes (256 kbits) appr. 1 g [0.035 oz] 25 x 15 x 1 mm [0.98 x 0.59 x 0.039“]	*Suitable for our safety modules Safety-M modular:* SMBD EMAI EMAA EMIO	**8.SMCC.032**
Chip card 128k 	Memory capacity Weight Dimensions	128 kBytes (1024 kbits) appr. 1 g [0.035 oz] 25 x 15 x 1 mm [0.98 x 0.59 x 0.039“]	*Suitable for our safety modules Safety-M modular:* SMBU SMBS	**8.SMCC.128**

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Safety modules | Safety-M modular – SMAS | Encoder adapter module

Encoder adapter module for EMAI / EMAA axis expansion of the Safety-M modular product family.

With encoder input and output and splitted branching for the axis modules. All signal types (SSI, BiSS, Sin Cos, TTL / RS422, HTL / Push-Pull) can be connected thanks to passive splitting.

- Clear, EMC-compliant wiring possible.
- Passive signal splitting.
- Internally entirely shielded.
- Pin assignment switchable for EMAI / EMAA.
- For incremental and absolute encoders.
- Top-hat rail mounting.

Order no.

SMAS	Encoder expansion module	**8.SMAS.000**

Accessories		Order no.
EMC terminal	for encoder cable shield, top hat rail installation	**8.0000.4G06.0000**

Connection technology		Order no.
Cordset, pre-assembled, 0,25 m [0.82']	RJ45 / RJ45	**8.SMAS.C22.0M25**
Cordset, pre-assembled, 1 m [3.28']	RJ45 / Mini-IO	**8.SMAS.C21.001M**
Cordset, pre-assembled, 5 m [16.40']	Mini-IO / wire	**8.SMAS.C01.005M**

Further accessories can be found in the accessories area of our website at: www.kuebler.com/accessories.
Additional connectors can be found in the connection technology section or in the connection technology area of our website at: www.kuebler.com/connection_technology.
You will find an overview of our systems and components for Functional Safety under www.kuebler.com/safety.

Technical data

General data	
Type of connection	plug-in screw terminals
Max. terminal cross section	1.5 mm² [AWG 15]

Environmental data	
Operating temperature	0°C ... +55°C [+32°F ...+131°F]
Storage temperature	-25°C ... +85°C [-13°F ...+185°F]
Protection acc. to EN 60529	IP20
Climate class	3 acc. to DIN 50178

EMC	
Relevant standards	EN 61000-6-2 :2005 / AC:2005 EN 61000-6-4 :2007 / A1:2011

Mechanical characteristics	
Size w x h x d	22.5 x 99 x 114.5 mm [0.89 x 3.90 x 4.51"]
Weight	160 g [5.64 oz]
Mounting	snap-on mounting on standard head rail

Input X47, X57, X67	
Type of connection	plug-in screw terminals
Number of encoders	max. 2
Type of signal	HTL / Push-pull TTL / RS422 SinCos SSI BiSS

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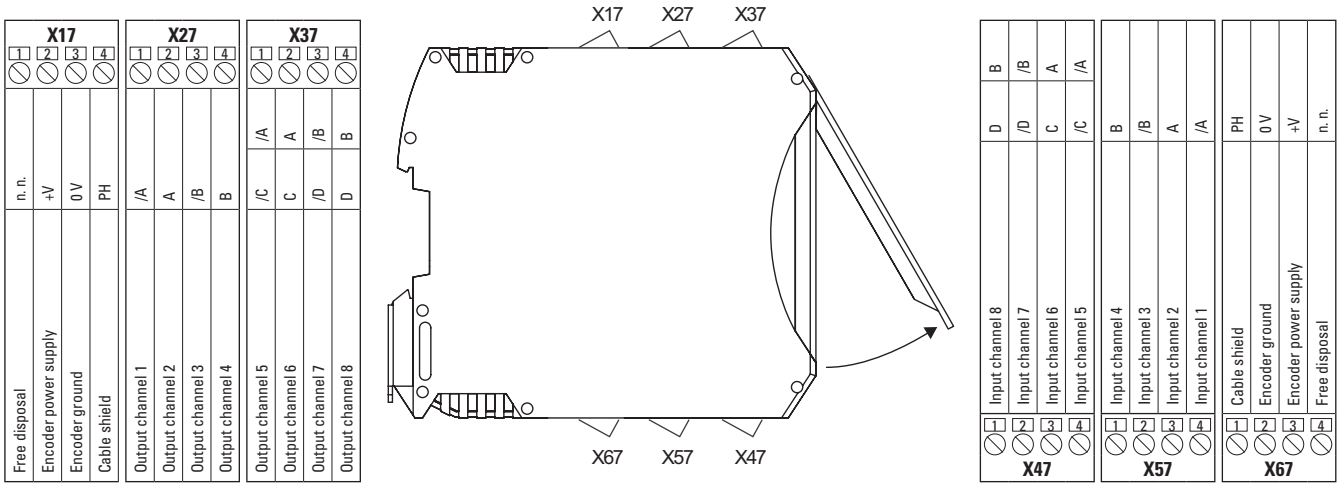
Safety modules | **Safety-M modular – SMAS** | **Encoder adapter module**

Terminal assignment



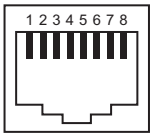
Terminal RJ45-1 (channel 1 ... 4)

Channel					1	2	3	4
Terminal output		X17:4	X17:2	X17:3	X27:1	X27:2	X27:3	X27:4
Terminal input		X67:1	X67:3	X67:2	X57:4	X57:3	X57:2	X57:1
Signal		PH	+V	0 V	$\overline{A}$	A	$\overline{B}$	B
RJ45-1	DIP switch = INK	PH	1	2	8	7	5	4
RJ45-1	DIP switch = ABS	PH	1	2	6	3	5	4

Terminal RJ45-2 (channel 5 ... 8)

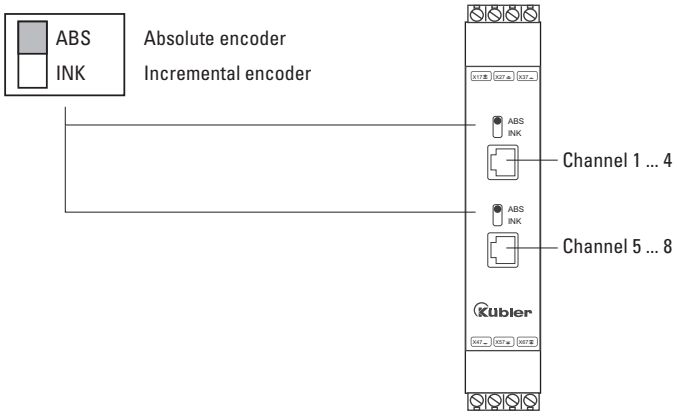
Channel					5	6	7	8
Terminal output		X17:4	X17:2	X17:3	X37:1	X37:2	X37:3	X37:4
Terminal input		X67:1	X67:3	X67:2	X47:4	X47:3	X47:2	X47:1
Signal		PH	+V	0 V	$\overline{A}$ / C-	A / C+	$\overline{B}$ / D-	B / D+
RJ45-2	DIP switch = INK	PH	1	2	8	7	5	4
RJ45-2	DIP switch = ABS	PH	1	2	6	3	5	4

+V: Encoder power supply +V DC
0 V: Encoder power supply ground GND (0 V)
A, $\overline{A}$: Cosine signal / incremental channel A
B, $\overline{B}$: Sine signal / incremental channel B
C+, C- : Clock signal
D+, D- : Data signal
PH ⏚: Plug connector housing (Shield)

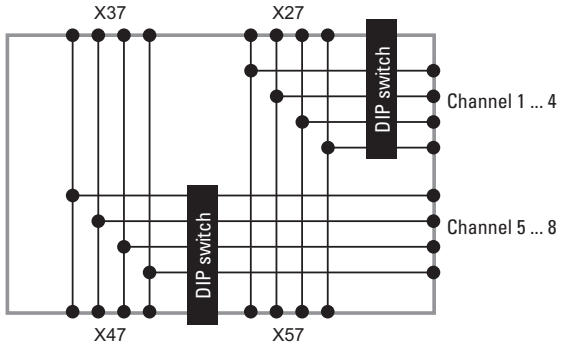


Switching

The DIP switch allows changing the pin assignment of the RJ45 socket.



Passive signal splitting



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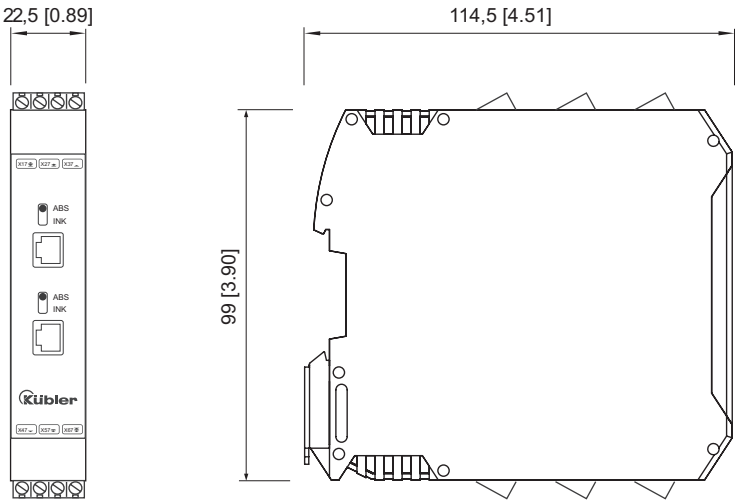
Dimensions

Dimensions in mm [inch]



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Kübler worldwide

Kübler Group

Fritz Kübler GmbH,
Germany
Schubertstraße 47
D-78054
Villingen-Schwenningen
Phone +49 7720 3903-0
Fax +49 7720 21564
info@kuebler.com
www.kuebler.com

Fritz Kübler SARL,
France
2 rue de Grande Bretagne
F-68310 Wittelsheim
Phone +33 3 89 53 45 45
Fax +33 3 89 53 66 77
info@kuebler-sarl.com
www.kuebler.fr

Kübler Italia S.r.l.,
Italy
Viale Sarca, 96
I-20125 Milano MI
Phone +39 026 423 345
Fax +39 026 611 3843
info@kuebler.it
www.kuebler.it

Kubler SP. Z O.O.,
Poland
l. Dabrowskiego 441
PL-60-451 Poznan
Phone +48 61 84 99 902
Fax +48 61 84 99 903
info@kubler.pl
www.kubler.pl

Kübler Turkey Otomasyon Ticaret Ltd. Sti.
Turkey
Yeni mahalle Balikesir Cad.
Uprise Elit Residence C1 AB Blok
No:180 Soganlik
TR - 34880 Kartal/Istanbul
Phone: +90 216 999 9791
Fax:+90 216 999 9784
cengizhan.temurcin@kuebler.com
www.kuebler.com

Kuebler (Beijing) Automation Trading Co. Ltd.,
China
Rm 1603, B Area, Tower 2,
Wangjing Soho,
No.1 Futong East Street,
Chaoyang, Beijing, China,100102
Phone +86 10 8471 0818
Fax: +86 10 8471 0819
beijing@kuebler.com
www.kuebler.com

Kuebler Automation India Pvt. Ltd.
India
Plot No 677, S.No. 269/3,
Paud Road, Bhugaon,
Pune 412 115,
Maharashtra
Phone +91 99 7065 5599
Tel. +91 20 6790 1-200 / 230 / 214 / 202
Fax +91 20 6790 1232
info@kuebler.in
www.kuebler.in

Kuebler Korea (by F&B),
South Korea
578, Kwaebop-dong, Sasang-ku
Pusan Industrial Supplies
Market 9-116
ROK-PUSAN
Phone +82 51 319 12 30
Fax +82 51 319 12 50
fnb@kuebler.co.kr
www.kuebler.kr

Kuebler Inc.
USA
10430-J Harris Oak Boulevard
Charlotte, NC 28269
Phone +1-704-705-4710
Toll Free +1-855-KUEBLER (583-2537)
Fax +1-704-733-9170
usa@kuebler.com
www.kuebler.com/usa

Europe

Austria
Fritz Kübler GmbH
Schubertstraße 47
D-78054
Villingen-Schwenningen
Phone +49 7720 3903-0
Fax +49 7720 21564
info@kuebler.com
www.kuebler.com

Belarus
FEK Company
Pushkin Ave., 29B
BY-220015 Minsk
Phone +375 17 202 68 00
Fax +375 17 202 68 01
turck@fek.by
www.fek.by

Belgium
Multiprox N.V
Lion d'Orweg 12
B-9300 Aalst
Phone +32 53 76 65 66
Fax +32 53 78 39 77
mail@multiprox.be
www.multiprox.be

Bulgaria
Sensomat Ltd.
Ul.Stratsin 4, vh.A, app.1
P.O.B. 116
BG-9300-Dobrich
Phone +359-888 403 570
Fax +359-58-603 033
info@sensomat.info
www.sensomat.info

Croatia
Bering d.o.o.
Naselje Tršinski 7b
HR-49210 Zabok
Phone +385 49 221 182
Fax +385 49 223 658
bering@email.t-com.hr
www.bering.hr

Czech Republic
TURCK s.r.o
Hradecká 1151
CZ-500 03 Hradec Králové
Phone +420 - 4 95 51 87 66
Fax +420 - 4 95 51 87 67
turck-cz@turck.com
www.turck.cz

Denmark
Hans Følsgaard A/S
Theilgaards Torv 1
DK-4600 Køge
Phone + 45 43 20 86 00
Fax + 45 43 96 88 55
hf@hf.net
www.hf.net

Estonia
Standel AS
Kiisa 8
EE-11313 Tallinn
Phone +372 6 558 180
Fax +372 6 558 179
standel@standel.ee
www.standel.ee

Finland
Sähkölehto Oy
Holkkitie 14
FIN-00880 Helsinki
Phone +358 9 774 6420
Fax +358 9 759 1071
office@sahkolehto.fi
www.sahkolehto.fi

France
Fritz Kübler S.à.r.l.
Compteurs et codeurs industriels
2 rue de Grande Bretagne
F-68310 Wittelsheim
Phone +33 3 89 53 45 45
Fax +33 3 89 53 66 77
info@kuebler-sarl.com
www.kuebler.fr

Great Britain
OEM Automatic Ltd
Whiteacres, Cambridge Road
Whetstone
GB-Leicester LE8 6ZG
Phone +44 116 284 99 00
Fax +44 116 284 17 21
information@uk.oem.se
www.oem.co.uk

Greece
Industrial Automation Systems
L.J. Skourgialos
241, El. Venizelou Ave.
GR-176 73 Kallithea - Athens
Phone +30 210 9510260
Fax +30 210 9511048
info@ias.gr
www.ias.gr

Hungary
Kvalix Automatika Kft.
Kiss Ernö u. 1-3
H-1046 Budapest
Phone +36 1 272 2242
Fax +36 1 272 2244
info@kvalix.hu
www.kvalix.hu

Iceland
Reykjafell Ltd.
Skipholti 35
IS-125 Reykjavik
Phone +354 5 88 60 00
Fax +354 5 88 60 88
reykjafell@reykjafell.is
www.reykjafell.is

Ireland
Kübler Group
Fritz Kübler GmbH
Schubertstr. 47
D-78054
Villingen-Schwenningen
Phone +49 7720 3903-0
Fax +49 7720 21564
info@kuebler.com
www.kuebler.com

Italy
• Encoders:
Kübler Italia Srl.
Viale Sarca, 96
I-20125 Milano MI
Phone +39 026 423 345
Fax +39 026 611 3843
info@kuebler.it
www.kuebler.it

• Counters and process devices:
MAS AUTOMAZIONE S.R.L.
Via G. Galilei 20
I-20090 Segrate (MI)
Phone +39 02 26 92 20 90
Fax +39 02 26 92 16 87
info@masautomazione.it
www.masautomazione.it

Lithuania
UAB FEK Elektronika
Naugarduko 91-415
LT-03160, Vilnius, Lietuva
Phone +370 700 01760
Phone +3705 2133603
Fax + 3705 2159198
info@fek.lt
www.fek.lt

Netherlands
Duranmatic B.V.
Robijn 800
NL-3316 KE Dordrecht
Phone +31 78 631 05 99
Fax +31 78 613 11 33
info@duranmatic.nl
www.duranmatic.nl

Norway
ELTECO AS
Floodmyrveien 24
N-3946 Porsgrunn
Phone +47 35 56 20 70
Fax +47 35 56 20 99
firmapost@elteco.no
www.elteco.no

Poland
Kubler Sp. z o.o.
ul. Dabrowskiego 441
PL-60-451 Poznan
Phone +48 61 849 99 02
Fax +48 61 849 99 03
info@kubler.pl
www.kubler.pl

ASTAT sp. z o.o.
ul. Dabrowskiego 441
PL-60-451 Poznan
Phone +48 61 848 8871
Fax +48 61 848 8276
info@astat.com.pl
www.astat.com.pl

• Electronic counters and process displays:
IMPOL-1 Sp.J.
ul. Krakowiaków 103
PL-02-255 Warszawa
Phone +48 22 886 56 02
Fax +48 22 886 56 04
biuro@impol-1.pl
www.impol-1.pl

• Encoders:
OEM AUTOMATIC Sp. z o.o.
ul. Działkowa 121 A
PL-02-234 Warszawa
Phone +48 22 863 27 22
Fax +48 22 863 27 24
info@pl.oem.se
www.oemautomatic.pl

Portugal
LA2P – Tecnologias de Automação, LDA
Rua Teófilo Braga, 156 A
Escrit. F - Edifício S. Domingos Cabeço do Mouro
PT-2785 - 122 S. Domingos de Rana
Phone +351 21 444 70 70
Fax +351 21 444 70 75
la2p@la2p.pt
www.la2p.pt

Romania
Syscom 18 SRL
Calea Plevnei 139B, Sector 6
RO-060011 Bucharest
Phone +40 21 310 26 78
Fax +40 21 316 91 76
syscom@syscom18.com
www.syscom.ro

Russia
Servotechnica ZAO
Klara Tsetkin str., 33/35
RUS-125130 Moscow
Phone +7 495 797 8866
Fax +7 495 450 0043
info@servotechnica.ru
www.servotechnica.ru

Slovakia
S.D.A. s. r. o.
Jána Bottu 4
SK-974 01 Banská Bystrica
Phone +421 48 472 34 11
Fax +421 48 472 343 69
sekretariat@s-d-a.sk
www.s-d-a.sk

Slovenia
Balluff d.o.o.
Livadna ulica 1
SLO-2204
Miklavž na Dravskem polju
Phone +386 2 6 29 03 00
Fax +386 2 6 29 03 02
senzorji.sb@siol.net
www.senzorji-sb.si

Spain
Elion, S.A.
Farell, 5
E-08014 Barcelona
Phone +34 93 298 20 00
Fax +34 93 431 18 00
elion@elion.es
www.elion.es

Sweden
OEM AUTOMATIC AB
Dalagatan 4, Box 1011
S-57328 Tranas
Phone +46 75-242 4100
Fax +46 75-242 4119
info@aut.oem.se
www.oemautomatic.se

Switzerland
(French)
Fritz Kübler S.à.r.l.
2 rue de Grande Bretagne
F-68310 Wittelsheim
Phone +33 3 89 53 45 45
Fax +33 3 89 53 66 77
info@kuebler-sarl.com
www.kuebler.fr

(Italian)
Kübler Italia Srl.
Viale Sarca, 96
I-20125 Milano MI
Phone +39 026 423 345
Fax +39 026 611 3843
info@kuebler.it
www.kuebler.it

(German)
Fritz Kübler GmbH
Schubertstraße 47
D-78054
Villingen-Schwenningen
Phone +49 7720 3903-0
Fax +49 7720 21564
vedrana.solic@kuebler.com
www.kuebler.com

Turkey
Kübler Turkey Otomasyon Ticaret Ltd. Sti.
Yeni mahalle Balikesir Cad.
Uprise Elit Residence C1 AB Blok
No:180 Soganlik
TR - 34880 Kartal/Istanbul
Phone +90 216 999 9791
Fax:+90 216 999 9784
cengizhan.temurcin@kuebler.com
www.kuebler.com

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Tusak Sokak
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Fax +90 212 256 94 04
sanil@sanil.com.tr
www.sanil.com.tr

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Necatibey Caddesi
Sait Demirbag Han No.5 K.1
TR-34425 Istanbul
Phone +90 212 2 93 60 36
Fax +90 212 2 44 51 56
eruzelektrik@eruzelektrik.com.tr
www.eruzelektrik.com.tr

Ukraine
SV Altera Ltd.
4, Ivana Lepse blvd, Kyiv,
UA-03680 Ukraine
Phone +38 044 496-18-88
Fax +38 044 496-18-18
office@sv-altera.com
www.svaltera.ua

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America, Asia, Australia, Africa

Catalogue distributors: (Europe)

Austria
Farnell GmbH
Birkenstrasse 2
A-5300 Salzburg/Hallwang
Phone +43 662 - 218 06 80
Fax +43 662 - 218 06 70
verkauf.at@farnell.com
www.farnell.at

RS Components
Albrechtser Straße 11
A-3950 Gmünd
Phone +43 28 52 505
Fax +43 28 52 53 223
www.rs-components.at

France
RS Components SAS
Rue Norman King BP 40453
F-60031 Beauvais CEDEX
Phone +33 3 44 10 16 48
Fax +33 3 44 10 16 44
www.radiospares.fr

Farnell France SAS
81-83 rue Henri Depagneux
BP 60426 Limas
F-69654 Villefranche sur Saône
Cedex
Phone +33 4 74 68 99 99
Fax +33 4 74 68 99 90
ventes@farnell.com
www.farnell.fr

Great Britain
RS Components Ltd.
PO Box 99, Corby
GB-Northants NN17 9RS
Phone +44 84 58 50 99 00
Fax +44 15 36 40 56 78
www.rs-components.com

Farnell
Canal Road
GB-Leeds, LS12 2TU
Phone +44 8447 11 11 11
Fax +44 8447 11 11 13
sales@farnell.co.uk
www.farnell.co.uk

Italy
RS Components S.p.A.
Via De Vizzi 93/95
I-20092, Cinisello Balsamo, Milano
Phone +39 02 660 581
Fax +39 02 660 580 51
www.rs-components.it

Distrelec Italia s.r.l.
Via Canova 40/42
I-20020 Lainate (Mi)
Phone +39 02 - 93 75 51
Fax +39 02 - 93 75 57 55
info-it@distrelec.com
www.distrelec.com

Switzerland
Distrelec AG
Grabenstraße 6
CH-8606 Nänikon
Phone +41- 44 9 44 99 11
Fax +41- 44 9 44 99 88
www.distrelec.com

Farnell AG
Brandschenkestr. 178
Postfach 1703
CH-8027 Zürich
Phone +41 1 - 204 64 64
Fax +41 1 - 204 64 54
verkauf.ch@farnell.com
www.farnell.ch

Argentina
AUMECON S.A.
Acassuso 4768
1605 Munro
Prov. de Buenos Aires
Phone +54 11 47 56 1251
Fax +54 11 47 62 63 31
ventas@aumecon.com.ar
www.aumecon.com.ar

Australia
Balluff PTY LTD
Unit 18 Malvern Street
Bayswater, VIC 3153
Phone +61 1300 225833
Fax +61 1300 653894
sales@balluff.com.au
www.balluff.com.au

Brazil
Kübler Group
Fritz Kübler GmbH
Schubertstr. 47
78054 Villingen-Schwenningen
Phone +49 7720 3903-0
Fax +49 7720 21564
info@kuebler.com
www.kuebler.com

Canada
Turck Chartwell Canada Inc.
140 Duffield Drive
Markham, Ontario L6G 1B5
Phone +1 905 513 7100
Fax +1 905 513 7101
sales@www.chartwell.ca
www.chartwell.ca

China
Kuebler (Beijing) Automation Trading Co. Ltd.
Rm 1603, B Area, Tower 2,
Wangjing Soho,
No.1 Futong East Street,
Chaoyang, Beijing,
China,100102
Phone +86 10 8471 0818
Fax: +86 10 8471 0819
beijing@kuebler.com
www.kuebler.com

Egypt
AEE Advanced Electronic Engineering Co.
3 Hassan El-Sheraie St.Off
El-Horiya St-Heliopolis
Cairo
Phone +20 2 2418 50 20
Fax +20 2 2415 92 65
hfarid@aeecontrols.com
www.aeecontrols.com

Hong Kong
Po Kwong Electric (HK) Ltd.
Rm. 177-180, 1/F., Blk C,
Hang Wai Ind. Ctr.,
6 Kin Tai St., Tuen Mun, N.T
Phone +852 24 23 66 22
Fax +852 24 61 10 02
sales@pokwong.com
www.pokwong.com

India
Kuebler Automation India Pvt Ltd
Plot No 677, S. No. 269/3,
Paud Road, Bhugaon,
Pune 412 115,
Maharashtra
Phone +91 99 7065 5599
Tel. +91 20 6790 1-200 / 230 / 214 / 202
Fax +91 20 6790 1232
info@kuebler.in
www.kuebler.in

Rajdeep Automation Pvt. Ltd.
G3A, Anand Estate, Ground floor
Sane Guruji Marg, Mahalaxmi
Mumbai 400 011
Phone +91 22 23 00 28 37 / 8
Fax +91 22 23 00 2839
info@rajdeep.in
www.rajdeep.in

Indonesia
PT. Supra Engineering
Jl. Pecenongan 17 D
RI-10120 Jakarta
Phone +62 21 345 73 55
Fax +62 21 345 73 18
atsupra@supra.co.id
www.supra-engineering.com

Israel
Omega Engineering
P.o.Box 190
Ein Carmel 30860
Phone +972-4-9544993
Fax +972-4-9544992
info@omegae.net
www.omegae.net

Lebanon
Industrial Technologies S.A.L (ITEC)
Blvd. Fouad Chehab
Point Center, Sin El Fil, Beirut
Phone +961 (1) 491161
Fax +961 (1) 491162
info@iteclb.com
www.iteclb.com

Malaysia
dpstar Smart Solutions Sdn Bhd
No. 37-1, Jalan OP 1/2
Pusat Perdagangan One Puchong,
Off Jalan Puchong,
47160 Puchong,
Selangor Darul Ehsan,
Malaysia
Phone +603 8074 8866
Fax +603 8074 8666
chrisliau@dpstar.com.my
www.dpstar.com.my

Mexico
TURCK Comercial, S. de RL de CV
Blvd. Campestre No. 100
Parque Industrial SERVER
C.P. 25350 Arteaga, Coahuila
Phone +52 844 411 6650
Toll Free: 01-800-01-TURCK (Mexico only)
Fax +52 844 482 6926
mexico@turck.com
www.turck.com.mx

Morocco
r2i Consult SARL
109 rue Montaigne Val Fleuri Maarif Casablanca
Maroc
Phone +212522986960
Fax +212522989537
info@r2imaroc.ma
www.r2imaroc.com

New Zealand
Carrel-Electrade Ltd.
P.O. Box 11-078
Ellerslie
NZ-Auckland 1542
Phone +64 95251753
Fax +64 95251756
sales@carrel-electrade.co.nz
www.carrel-electrade.co.nz

Peru
Techpro SAC
Calle Alberto del Campo 414
Magdalena del Mar
Lima 17 - Peru
Phone +51 98943 58-54
Fax +51 17272 685
techpro.peru@techprocorp.net
www.techprocorp.net

Philippines
Technorand Sales Coporation
122 McArthur Highway
0 Malabon, Metro Manila
Phone +632 985 07 05
Fax +632 716 59 86
technorand@gmail.com

Singapore
Raymond International Pte. Ltd.
Blk 219 Henderson Road #07-04
Henderson Industrial Park
Singapore 159556
Phone +65 62 76 37 38
Fax +65 62 76 37 39
sales@raymondcom.com
www.raymondcom.com

South Africa
Kübler Group
Fritz Kübler GmbH
Schubertstr. 47
78054 Villingen-Schwenningen
Phone +49 7720 3903-0
Fax +49 7720 21564
info@kuebler.com
www.kuebler.com

South Korea
Kuebler Korea (by F&B)
578, Kwaebop-dong, Sasang-ku
Pusan Industrial Supplies Market 9-116
PUSAN
Phone +82 51 319 12 30
Fax +82 51 319 12 50
fnb@kuebler.co.kr
www.kuebler.kr

Taiwan, R.O.C.
• Encoders, transmission technology:
E-E-Sensors & Automation Int'l Corp.
No.17-2, Beichang 2nd St.
Fengshan Dist.,
Kaohsiung City 83053
Taiwan, R.O.C.
Phone +886-7-7323606
Fax +886-7-7333023
ez-corp@umail.hinet.net
www.e-sensors.com.tw

• Electronic counters and process devices:
Canaan Electric Corp.
6F-5, No. 63, Sec. 2
Chang An East Road
Taipei
Phone +886 225 08 23 31
Fax +886 225 08 47 44
sales@canaan-elec.com.tw
www.canaan-elec.com.tw

Thailand
Technology Instruments Co., Ltd.
549/9 Onnut Road Kwaeng Pravet, Khet Pravet
Bangkok 10250
Phone +662 74 388 88
Fax +662 74 388 43
marketing@tic.co.th
www.tic.co.th

Tunisia
H2M Technologies
13, Rue El Moutanabi
TN-2037 El Menzah 7 -Tunis
Phone +216 71 42 76 77
Fax +216 71 42 76 88
h2m.tech@planet.tn

U.S.A.
Kuebler Inc.
10430-J Harris Oak Boulevard
Charlotte, NC 28269
Phone +1-704-705-4710
Toll Free +1-855-KUEBLER (583-2537)
Fax +1-704-733-9170
usa@kuebler.com
www.kuebler.com/usa

• Counting and process technology:
Global Industrial Products Inc.
8129 North Austin AVE
Morton Grove, IL 60053
Toll-free number:
1-800-951-8774
Phone 847 965 9808
Fax 847 901 9846
sales@globalepower.com
www.kueblerusa.com

United Arabe Emirates
Baer Measurements LLC
P.O. Box 111393
Al Gaith Tower 505,
Hamdan Street
Abu Dhabi - UAE
Phone +971 2 627 2097
Fax +971 2 627 2091
info@bml.ae
www.bml-international.com

Vietnam
GNN Co., Ltd
153, Nguyen Van Thu
Da Koa Ward, District 1
Ho Chi Minh City
Phone +84 8 3517 4923
Fax +84 8 3517 4924
contact@gnnvietnam.com
www.gnnvietnam.com

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Contact partners in Germany

PLZ 01000 … 09999
PLZ 15000 … 15999
Kübler Vertriebsbüro Süd-Ost
Lars Meyer
Durchfahrt 9
09569 Oederan
Phone +49 37292 283500
Fax +49 37292 283501
lars.meyer@kuebler.com

PLZ 10000 … 14999
PLZ 16000 … 19999
PLZ 20000 … 32999
PLZ 38000 … 39999
Kübler Vertriebsbüro Nord
Hermi Herrmann
Mohnblumenweg 6
28876 Oyten
Phone +49 4207 6880-32
Fax +49 4207 6880-34
hermi.herrmann@kuebler.com

PLZ 33000 … 33999
Kübler Vertriebsbüro West
Torsten Czubkowski
Auf der Ümcke 11 a
59757 Arnsberg
Phone +49 2932 891898
Fax +49 2932 53311
torsten.czubkowski@
kuebler.com

PLZ 34000 … 37999
Kübler Vertriebsbüro Mitte
Stefan Heinigk
Gartenstraße 10
35759 Driedorf
Phone +49 2775 578427
Fax +49 2775 578428
stefan.heinigk@kuebler.com

PLZ 40000 … 47999
Kübler Vertriebsbüro West
Torsten Czubkowski
Auf der Ümcke 11a
59757 Arnsberg
Phone +49 2932 891898
Fax +49 2932 53311
torsten.czubkowski@
kuebler.com

PLZ 48000 … 49999
Kübler Vertriebsbüro Nord
Hermi Herrmann
Mohnblumenweg 6
28876 Oyten
Phone +49 4207 6880-32
Fax +49 4207 6880-34
hermi.herrmann@kuebler.com

PLZ 50000 … 54999
PLZ 55300 … 55999
PLZ 56500 … 56999
PLZ 58000 … 59999
Kübler Vertriebsbüro West
Torsten Czubkowski
Auf der Ümcke 11a
59757 Arnsberg
Phone +49 2932 891898
Fax +49 2932 53311
torsten.czubkowski@
kuebler.com

PLZ 55000 … 55299
PLZ 56000 … 56499
PLZ 57000 … 57999
Kübler Vertriebsbüro Mitte
Stefan Heinigk
Gartenstraße 10
35759 Driedorf
Phone +49 2775 578427
Fax +49 2775 578428
stefan.heinigk@kuebler.com

PLZ 60000 … 65999
PLZ 67000 … 67599
PLZ 68000 … 69999
Kübler Vertriebsbüro Mitte
Stefan Heinigk
Gartenstraße 10
35759 Driedorf
Phone +49 2775 578427
Fax +49 2775 578428
stefan.heinigk@kuebler.com

PLZ 66000 … 66999
PLZ 67600 … 67999
Kübler Vertriebsbüro West
Torsten Czubkowski
Auf der Ümcke 11a
59757 Arnsberg
Phone +49 2932 891898
Fax +49 2932 53311
torsten.czubkowski@
kuebler.com

PLZ 70000 … 79999
Kübler Vertriebsbüro
Süd-West
Philipp Lang
Lembergstraße 6
72119 Ammerbuch-Altingen
Phone +49 7032 2293665
Fax +49 7032 2993454
philipp.lang@kuebler.com

PLZ 80000 … 87999
PLZ 89200 … 89499
Kübler Vertriebsbüro Süd
Bernhard Preißler
Am Seeacker 8
93326 Abensberg
Phone +49 9443 9186926
Fax +49 9443 9186974
bernhard.preissler@kuebler.com

PLZ 88000 … 89199
PLZ 89500 … 89999
Kübler Vertriebsbüro
Süd-West
Philipp Lang
Lembergstraße 6
72119 Ammerbuch-Altingen
Phone +49 7032 2293665
Fax +49 7032 2993454
philipp.lang@kuebler.com

PLZ 90000 … 93999
PLZ 95000 … 95999
Kübler Vertriebsbüro Süd-Ost
Lars Meyer
Durchfahrt 9
09569 Oederan
Phone +49 37292 283500
Fax +49 37292 283501
lars.meyer@kuebler.com

PLZ 94000 … 94999
Kübler Vertriebsbüro Süd
Bernhard Preißler
Am Seeacker 8
93326 Abensberg
Phone +49 9443 9186926
Fax +49 9443 9186974
bernhard.preissler@kuebler.com

PLZ 96000 … 99999
Kübler Vertriebsbüro Mitte
Stefan Heinigk
Gartenstraße 10
35759 Driedorf
Phone +49 2775 578427
Fax +49 2775 578428
stefan.heinigk@kuebler.com

Approved system partners/ distributors

22149 Hamburg
Hermann Seidel GmbH
Techn. Vertretungen
Rahlstedter Str. 16
Phone +49 40 675085-0
Fax +49 40 675085-85
info@seidel-gmbh.de
www.seidel-gmbh.de

42499 Hückeswagen
Fuhrmeister + Co. GmbH
Industrie-Elektronik
Stahlschmidtsbrücke 61
Phone +49 2192 851122
Fax +49 2192 851127
info@fuhrmeister-gmbh.de
www.fuhrmeister-gmbh.de

66287 Göttelborn
Herbert Neundörfer
GmbH & Co. KG
Werksvertretungen
Am Campus 5
Phone +49 6825 9545-0
Fax +49 6825 9545-99
info@herbert-neundoerfer.de
www.herbert-neundoerfer.de

82069 Hohenschäftlarn
Bachmann
Electronic GmbH
Am Wagnerfeld 4
Phone +49 8178-8676-0
Fax +49 8178-8676-50
info@bachmann-electronic.de
www.bachmann-electronic.de

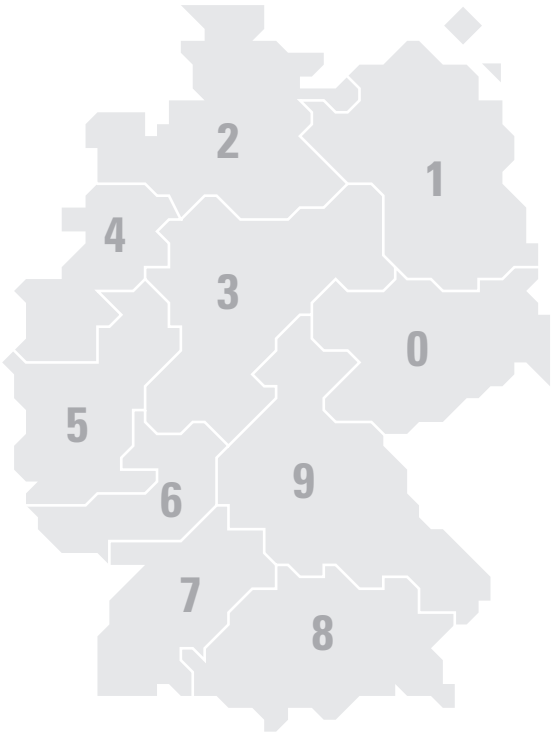
Catalogue distributors (Germany):

28359 Bremen
Distrelec Schuricht GmbH
Lise Meitner-Str. 4
Phone +49 1805 2234-35
Fax +49 1805 2234-36
scc@distrelec.de
www.distrelec.de

64546 Mörfelden-Walldorf
RS Components GmbH
Hessenring 13 b
Phone +49 6105 401234
Fax +49 6105 401100
www.rs-components.de

82041 Oberhaching
Farnell GmbH
Keltenring 14
Phone +49 89 61393939
www.farnell.de

92240 Hirschau
Conrad Electronic SE
Klaus-Conrad-Straße 1
Phone +49 9622-30-4145
www.conrad.com



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Headquarters in Villingen-Schwenningen

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Position and Motion Sensors

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Kübler Group
Fritz Kübler GmbH
Schubertstrasse 47
D-78054 Villingen-Schwenningen
Germany
Phone +49 7720 3903-0
Fax +49 7720 21564
info@kuebler.com
www.kuebler.com

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