Kübler

SIL3 Functional Safety PLe

Systems and components for Functional Safety

- Approved SIL3/PLe encoders absolute and incremental
- Safety modules for safe drive monitoring
- Control solutions for safe processing of safety sensors

pulses for automation

Functional Safety

SIL3 / PLe approved encoders

Safety is – not least since the EU Machinery Directive 2006/42/EC – an "integral part of the construction of drives". When choosing the right encoder for functional safety the principle applies that safety is achieved through the intelligent combination of encoder, controller and actuator.
Sendix SSI absolute encoders, with an additional SinCos incremental output, and SinCos versions of incremental encoders are available with certification.
But safety goes further than this: safe components are characterised by a robust reliable interface and by the ability to cope with high mechanical and electronic loads.

Safe Incremental Encoder Function

In order to achieve safe incremental information with the encoder, the controller must monitor the validity of the analogue, 90° phase-shifted sine/cosine signals with the help of the function:
$\sin^2 + \cos^2 = 1$

Safe Absolute Encoder Function

In order to obtain safe information with the encoder regarding the absolute position, the controller counts the incremental pulses and compares the result with the absolute positions also provided by the encoder.

Safe mechanical connection

A 100% reliable mechanical connection is required for a safe function in the applications.
Suitably sturdy fixing elements can help eliminate the risk of faults.

Multitalented device: Absolute encoder with incremental sine/cosine signals, multiturn stage and integrated functional safety

Drive control using incremental sine and cosine signals is a triedand-tested technology with a number of advantages. The high interpolatability of the analogue sine and cosine signals, with more than 1 million steps per revolution, allows for precise control of both slow turning as well as highly dynamic drives.

Combined with the high resolution and very accurate position information provided by the absolute encoder, all the data necessary for a precisely controlled motor start-up with an encoder is available.

Furthermore, the multiturn sensor technology permits position control over a wide range. And finally, the high information content of the signals – all independent of one another – forms the basis for a sensor with high functional safety.

Absolute Singleturn / Multiturn Encoders

Sendix 5853SIL/5873SIL, Sendix 5863SIL/5883SIL (SSI, BiSS-C and SinCos)

The absolute position of the encoder family 58x3SIL is transmitted in the form of a digital SSI or BiSS-C data word.
With the singleturn variants 5853SIL and 5873SIL the resolution is between 10 bits and 17 bits, depending on the variant.
In contrast to the singleturn variants 5853SIL / 5873SIL, the multiturn variants 5863SIL / 5883SIL have in addition a gear for detecting positions greater than 360°. The maximum measurable number of revolutions is 12 bits. This thus gives a total resolution for the multiturn of up to 29 bits.
The incremental position is provided in the form of an analogue sine/cosine signal. The resolution per revolution is 2048 sine/cosine periods.
Additional features:

- Interlocked bearings for a high degree of ruggedness, accuracy and long service life
- Protection rating IP65 or IP67
- Magnetically insensitive due to optical scanning

ATEX Encoders

Sendix 7014SIL – Incremental encoder (SinCos)
Sendix 7053SIL – Absolute singleturn encoder (SSI, BiSS-C and SinCos)
Sendix 7063SIL – Absolute multiturn encoder (SSI, BiSS-C and SinCos)

EX protection and Functional Safety in one device.
The Sendix encoders Sendix 7014 SIL, 7053 SIL and 7063 SIL can be used in safety-relevant applications up to SIL3 according to DIN EN ISO 61800-5-2 or PLe according to DIN EN ISO13849.
The Sendix ATEX encoders with “flameproof enclosure” are approved for zones 1, 2, 21 and 22.
The shock and vibration-resistant encoders operate flexibly with a resolution of up 29 bits. With a protection level of IP67, a wide temperature range from -40°C to +60°C and a housing and flange out of seawater-resistant aluminium, they are best suitable for outdoor offshore or coastal applications.
The compact design, with its installation depth of only 145 mm, diameter of 70 mm and space-saving cable outlet, rounds off the flexible, diverse application possibilities in areas with explosion hazards.

Incremental Encoders

Sendix 5814SIL / 5834SIL with SinCos outputs

The incremental position of the encoder family 58x4SIL is provided in the form of an analogue sine/cosine signal; here the resolution per revolution is 1024 or 2048 sine/cosine periods.
Additional features:

- With protected Safety Lock™ Technology: interlocked bearings for a high degree of ruggedness, accuracy and long service life
- Protection rating IP65 or IP67
- Magnetically insensitive due to optical scanning

MTTFd Values

With regard to the requirements of the Machinery Directive 2006/42/EC the MTTFd values for the most important standard encoders from Kübler are also provided.
This thus enables the user to carry out his own calculations according to DIN EN 61800-5-2 and DIN EN ISO 13849.

Safety modules for safe drive monitoring

Safe motion control for speed or position monitoring in multi-axes operation – the Safety-M modules allow you implementing your safety technique tasks in compliance with the Directive on machines 2006/42/EC.
Independently from the drive technology, the Safety-M modules offer all functions according to EN 61800-5-2 for drive monitoring and, in addition, practice-oriented function extensions.

Safety-M modules – the ideal solution for all safety-relevant tasks

Kübler's Safety-M modules allow for easy implementation of the requirements of the Directive on machines.
For just a few digital signals or for a whole production island – the Safety-M modules offer an optimal solution for every task.
The modules are easily extendable and can be integrated without problems in any standard control environment. The BM field bus extension modules take in charge the connection of the Safety-M modules with existing Profibus, Profinet, CANopen or EtherCat networks.
The integrated digital signal processing functions – such as the safe motion monitoring with highest requirement – ensure a very comfortable resolution of typical safety tasks.

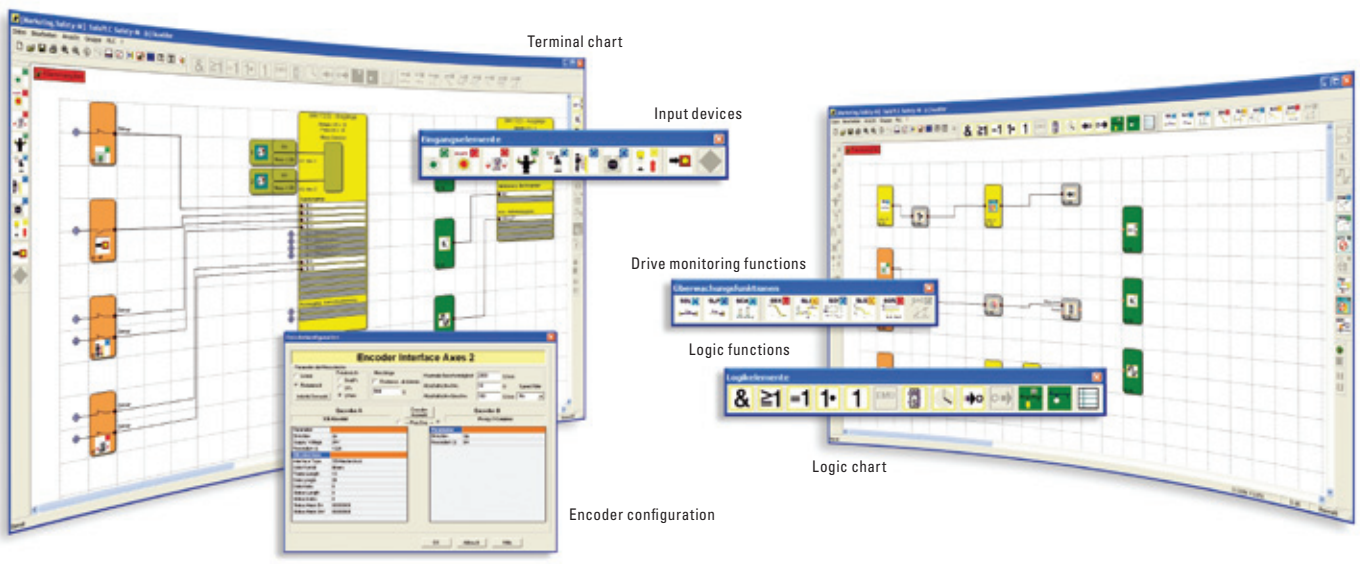
But the Safety-M modules offer much more!
Safe sensors, command devices and shut-off channels – no problem with Safety-M.
Integrated monitoring functions with many additional practice-oriented functions ensure a simple and transparent implementation of your task.

Safe PLC – simple programming of the monitoring functions

The Safe PLC software offers a comfortable graphic programming with function chart and block functions.

A comprehensive functions library is available, for the pre-processing of sensors (inputs) or actuators (outputs) and, above all, for the safe drive monitoring.
A simple combination of the input, monitoring and output functions by means of logic blocks allows a quick and transparent creation of even comprehensive safety functions. All functions have an open design with respect to the used sensors, drives and actuators.
Variable parameters can be set easily during assembly or on the field, without having to alter the program.

Main advantages of the Safe PLC software:
- Easy programming
- Easy parameterising
- Easy validation



Safety-M modules – Compact and extendable safety!

- Suitable up to PLe acc. to EN 13849 or SIL3 acc. to EN 61508
- Basic device with 14 safe inputs and 3 safe outputs
- Extendable up to 65 safe I/Os
- Optional communication interface
- Comprehensive firmware for a safe motion monitoring on board

	Basic modules				Field bus extension modules
SIL3 PLe TÜVRheinland					
	Safety-MS1	**Safety-MSP1**	**Safety-MS2**	**Safety-MSP2**	**BM_**
Max. number of extension modules	**2**	**2**	**2**	**2**	–
Safe digital input lines – I	**14**	**14**	**14**	**14**	–
Safe digital output lines – O	**2**	**2**	**2**	**2**	–
Safe relay outputs	**1**	**1**	**1**	**1**	–
Standard output lines	**2**	**2**	**2**	**2**	–
Pulse output lines	**2**	**2**	**2**	**2**	–
Communication	–	–	–	–	Profibus **- BM31** CANopen **- BM21** EtherCat **- BMB1** PROFINET **- BMC1**
Drive monitoring - number of axis	**1**	**1**	**2**	**2**	–
Encoder interface front (D-SUB 9-pol)	**1** SSI / SinCos / Incr. TTL	**2** SSI / SinCos / Incr. TTL Resolver	**2** SSI / SinCos / Incr. TTL	**4** SSI / SinCos / Incr. TTL Resolver	–
Encoder interface terminals	**1** Proxi-Sw. / Incr.-HTL	**1** Proxi-Sw. / Incr.-HTL	**2** Proxi-Sw. / Incr.-HTL	**2** Proxi-Sw. / Incr.-HTL	–
Supply voltage	24 V DC / 2 A				of the basic module
Rated voltage digital I/O	24 V DC				24 V DC
Max. load digital outputs	0,25 A				–
Max. load relay	24 V DC / 2 A or 230 V AC / 2 A				–

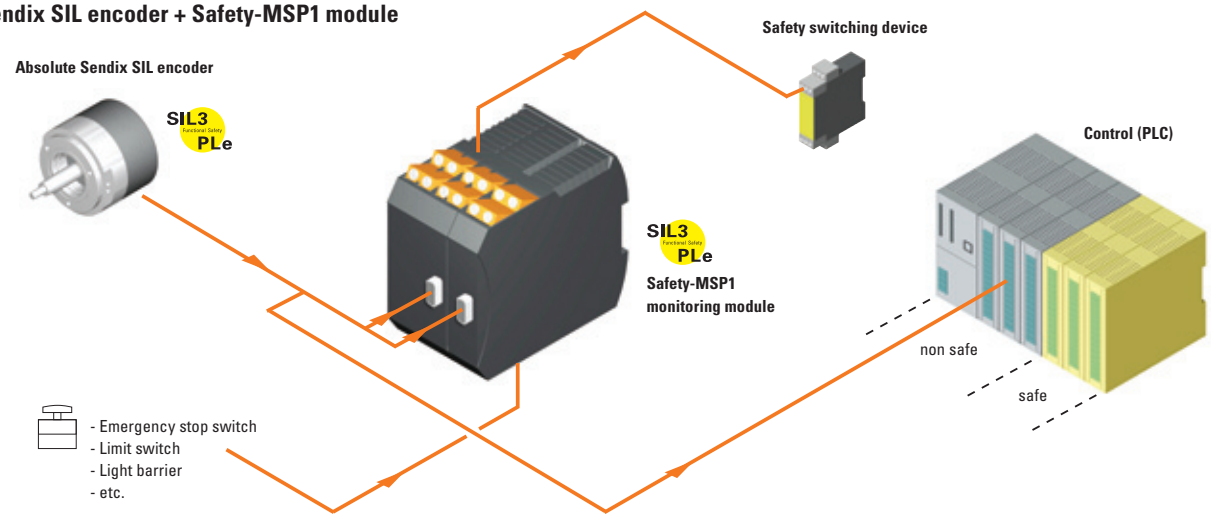
System solutions for Functional Safety

Just safe single components do not ensure a safe global application. Only the optimal combination of safety sensors and safety monitoring modules brings about reliable solutions, which will meet the necessary safety requirements. The optimal combination of Kübler's Safety-M modules and Sendix SIL encoders allows an easy implementation of a safe drive monitoring system.

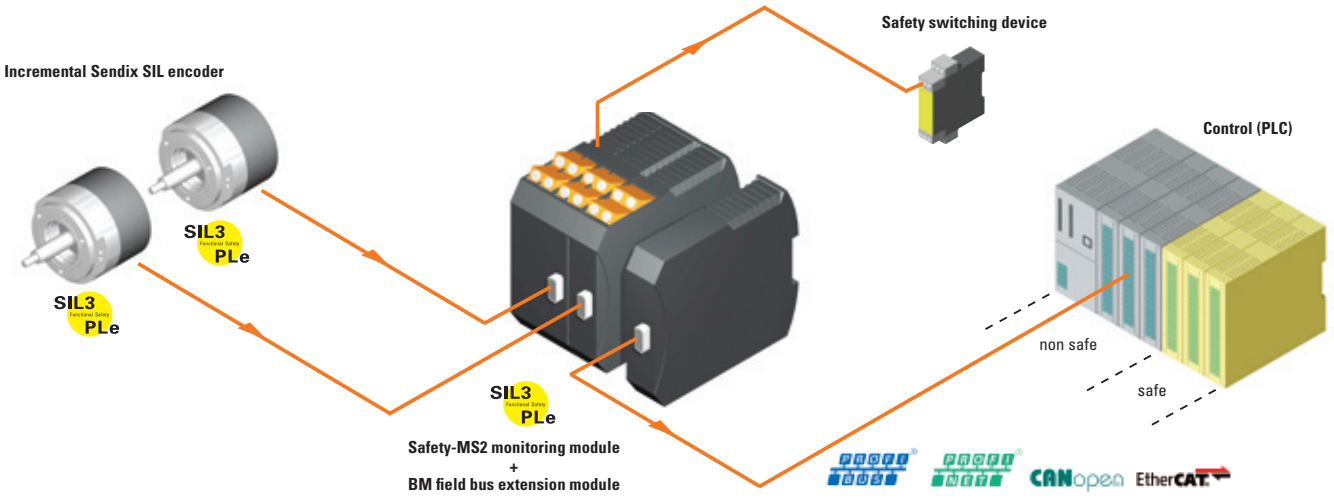
Examples:

Safe motion / position monitoring with Sendix SIL encoders and Safety-M modules

Safe position monitoring / 1 axis
Absolute Sendix SIL encoder + Safety-MSP1 module



Safe motion monitoring / 2 axes
2 x Incremental Sendix SIL encoder + Safety-MS2 module + BM extension module for bus communication



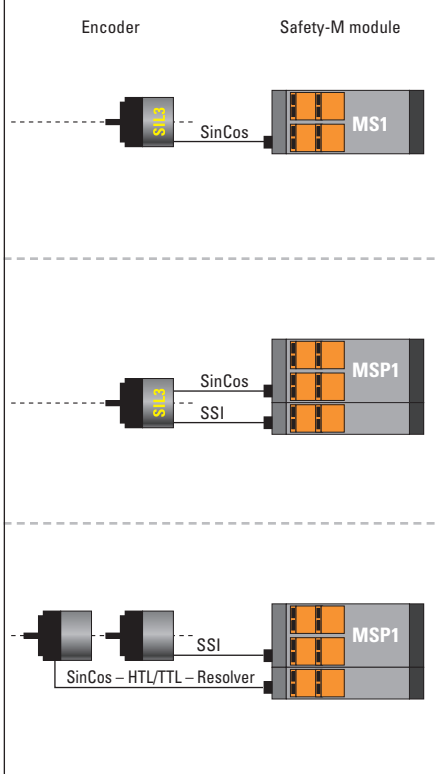
Achievable safety functions up to SIL3 / PLe / Cat. 4

SSX:	Safe Stop 1 or 2	Monitoring of the braking ramp and switch-off of the motor after standstill (SS1) or monitoring of the braking ramp and SOS after standstill (SS2). Corresponds to Stop Category 1 or 2 according to DIN EN 60204-1.
SOS:	Safe Operating Stop	Monitoring of the standstill of the active motor.
SLA:	Safely-Limited Acceleration	Monitoring of an acceleration limit value.
SLS:	Safely-Limited Speed	Monitoring of a speed limit value.
SLT:	Safely-Limited Torque	Monitoring of a torque / force limit value.
SLP:	Safely-Limited Position	The exceeding of a position limit value is monitored.
SEL:	Safe Emergency Limit	Safe monitoring of the minimum and maximum position or of the allowed position range.
SLI:	Safely-Limited Increment	The respect of a specific step value during the movements is monitored.
SDI:	Safe Direction	Monitoring of the unintended direction of movement of the motor.
SBC:	Safe Brake Control	Safe control and monitoring of an external brake.
SCA:	Safe Cam	A safe output signal is generated when the motor position is in a specified range.
SSM:	Safe Speed Monitor	A safe output signal is generated when the motor speed is lower than a specified value.
SAR:	Safe Acceleration Range	Monitoring of the respect of the acceleration of the motor within specified limit values.
ECS:	Encoder Status	Error status of the speed / position sensor.
PDM:	Position Deviation Muting	Muting of the deviation monitoring in case of 2-sensor operation.

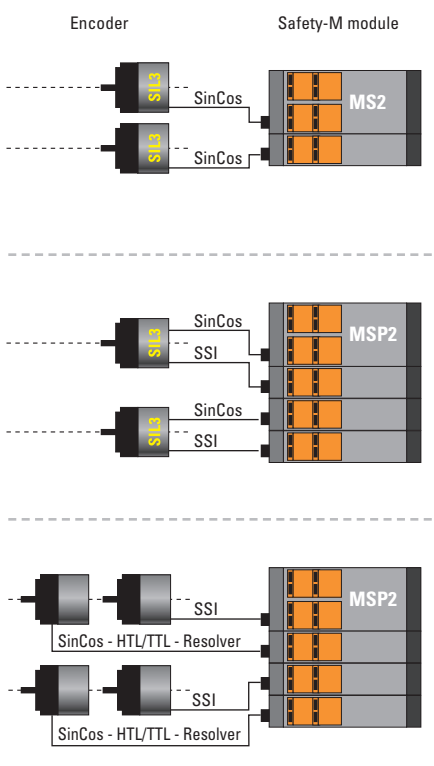
Connection possibilities of the Safety-M modules

Input side

1 axis

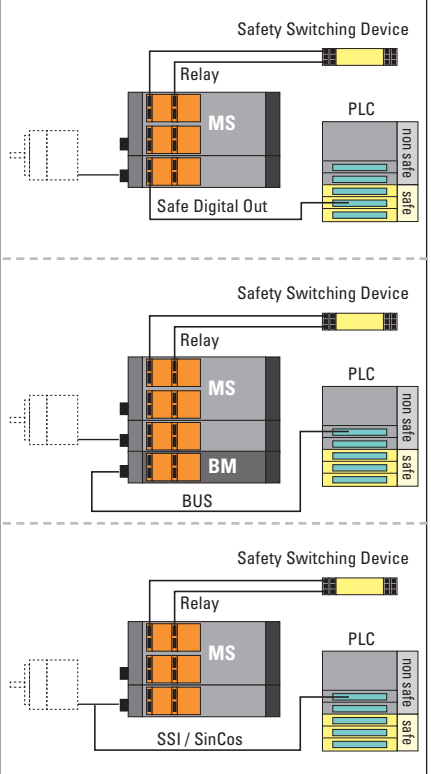


2 axes



- 14 additional safe digital inputs including 8 OSSD inputs
- optional extension modules for additional inputs and outputs

Output side



- 1 safe relay output (2-channel, change-over)
- 2 safe digital outputs
- 2 message outputs
- 2 pulse outputs
- optional extension modules for additional inputs and outputs
- Bus modules for Profibus, PROFINET, CANopen, EtherCat

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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

R.64003.0002 11 400 11 ES

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