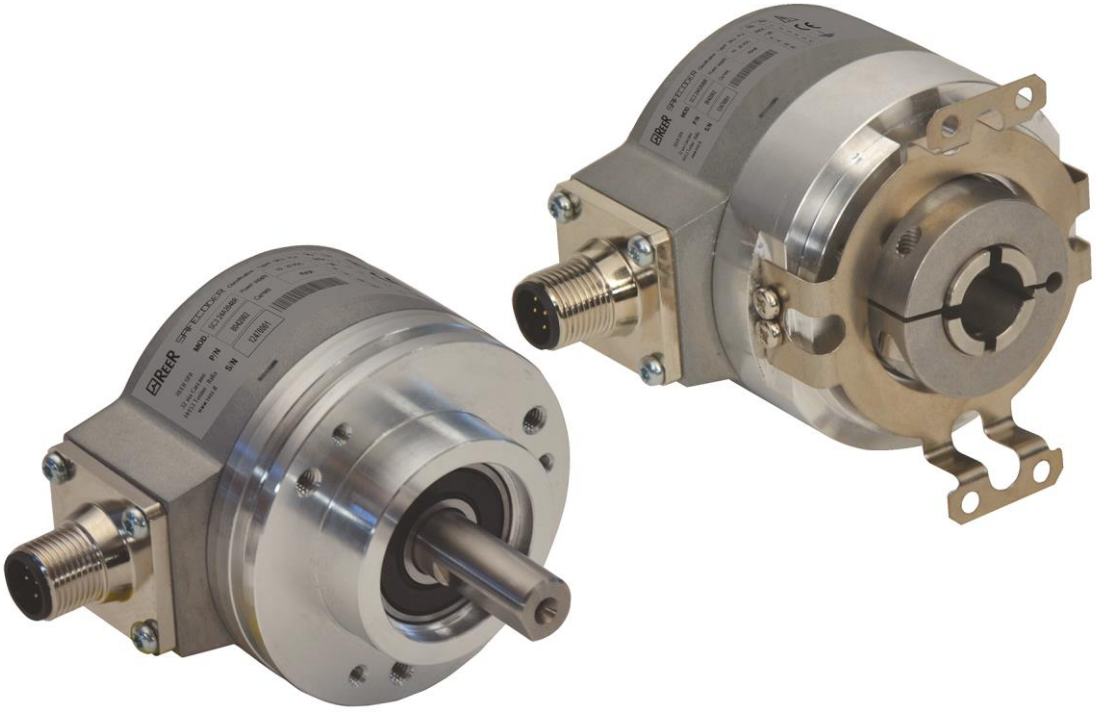
REER

Installation, use and maintenance



(Original Instructions)

Safety Encoder

SAFECODER

SAFETY ENCODER
SAFECODER
INSTALLATION, USE AND MAINTENANCE

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English

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English

WARNINGS

This symbol indicates an important personal safety warning. Failure to comply with the warning may result in very high risk for exposed personnel.

➔ This symbol indicates an important warning.

Please read this document carefully before working with the product, mounting it or starting it up.

Failure to comply with the requirements set out in this manual may lead to very high risks for the operating personnel of the protected machine.

PRELIMINARY REMARK

The following basic safety instructions are intended to avoid personal injuries and damage to property; they relate primarily to the use of the products described herein. If you additionally use further components, also consider their warnings and safety instructions.

TARGET OF THE MANUAL

The device may only be planned, mounted, commissioned, and serviced by persons having the following qualifications and fulfilling the following conditions:

- Technical training.
- Briefing in the relevant safety guidelines.
- Constant access to this documentation.
- In case of electrical equipment for potentially explosive atmospheres, the specialized personnel needs knowledge about the ignition protection category concept.
- For facilities in potentially explosive atmospheres, the authorized person must comply with the applicable country-specific regulations.

TRANSPORT / STORAGE

Check the delivery immediately upon receipt for possible transport damages. If you do not mount the device immediately, store it preferably in its transport package.

When storing the encoder, make sure that the shaft and the cable outlet are always free from any load.

The device must be stored at a dry and dust-free location, in compliance with the technical data, see chapter TECHNICAL DATA (page 9).

USE ACCORDING TO THE INTENDED PURPOSE

The encoder can be used as a rotation angle, position, or speed sensor.

The encoder supports functions based on speed and rotation direction information, e.g., in industrial processes or controls.

As a sensor, the safe encoder supports safety functions regarding speed and rotation direction. The encoder is not able to achieve on its own a safe state in the safety function.

Dangerous situations must be detected and evaluated by a superordinate controller.

English

The measuring system and its evaluation unit must meet the requirements mentioned in chapter TECHNICAL DATA (9).

FORESEEABLE MISUSE

The measuring system is not suitable for the following uses:

- Under water.
- In publicly accessible areas.
- As a standalone, independent safety system.
- Outside of the specifications stated in the data sheet.
- In areas where more serious EMC events may occur than those defined in the standard.

PRODUCT DESCRIPTION

VARIANTS OVERVIEW

SAFECODER MODEL	DESCRIPTION	SAFETY LEVEL
SC3 24A2048R	Sin/Cos incremental encoder 24 VDC. Radial connector Resolution 2048 pulse rate. Solid shaft with key	SIL3 (EN 61800-5-2) PLe (EN ISO 13849-1)
SC3 05A2048R	Sin/Cos incremental encoder 5 VDC. Radial connector Resolution 2048 pulse rate. Solid shaft with key	
SC3 24B2048R	Sin/Cos incremental encoder 24 VDC. Radial connector Resolution 2048 pulse rate. Solid shaft with flat	
SC3 05B2048R	Sin/Cos incremental encoder 5 VDC. Radial connector Resolution 2048 pulse rate. Solid shaft with flat	
SC3 24C1024R	Sin/Cos incremental encoder 24 VDC. Radial connector Resolution 1024 pulse rate. Hollow shaft version 10mm	
SC3 05C2048C	Sin/Cos incremental encoder 5 VDC. Radial cable Resolution 2048 pulse rate. Hollow shaft version 10mm	
SC3 24D2048R	Sin/Cos incremental encoder 24 VDC. Radial connector Resolution 2048 pulse rate. Hollow shaft version 12mm	
SC3 05D2048R	Sin/Cos incremental encoder 5 VDC. Radial connector Resolution 2048 pulse rate. Hollow shaft version 12mm	

Table 1

FUNCTION OF AN ENCODER

An encoder is a measuring device that converts rotational movements into electrical signals. A distinction is drawn between incremental and absolute encoders. Both deliver different output signals:

- Incremental encoders:
  Equivalent pulse sequences whose number is proportional to the travelled rotation angle.
- Absolute encoders:
  Digital information, that is to say that every angular position is a unique bit pattern.
- A combination of incremental and absolute signals is also possible.

Single turn encoders determine the shaft position for every revolution. This results in a position area — with different resolutions according to the type — within 360°.

Compared with the single turn variants, multiturn variants have in addition the possibility to determine the absolute positions over multiple revolutions.

English

This produces a range of positions >360°.

In the encoder system described here, the incremental information is provided by means of an analog sine-cosine (SinCos) signal.

TYPE PLATE

Example of a typeplate on the product:

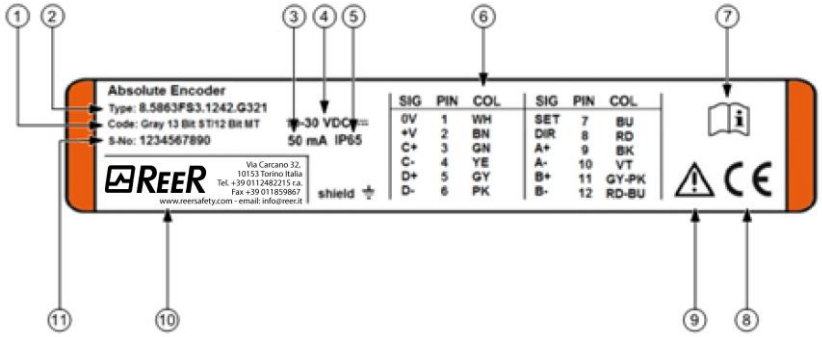


Figure 1

KEY			
1	Interface	**2**	Type and order code
3	Current consumption	**4**	Supply voltage
5	Protection level	**6**	Terminal Assignment
7	Pictogram Observe the operation manual	**8**	CE marking
9	Pictogram Observe the operation manual	**10**	Manufacturer and address
11	Serial number		

Table 2

FUNCTIONAL SAFETY

The encoders are designed for integration in safety-related functions regarding rotational speed, rotation direction and position. For this purpose, a superordinate, safe encoder evaluation device or safety controller is required. Its encoder-internal diagnostics do not allow the encoder to trigger on its own initiative actions such as initiating a safe state. It belongs to the Acquisition / Sensor category in the safety function.

Functional Safety.
In combination with controllers or evaluation systems, the encoders described in these instructions are suitable for use in safety-related system systems up to SIL2 or SIL 3 according to EN 61800-5-2 and up to PLd or PLe according to EN ISO 13849-1.

English

RELEVANT STANDARDS

The safety assessment of the encoder is based on the following standards and safety classes:

STANDARD	SAFETY PARAMETER
EN 61800-5-2	Safety Integrity Level (SIL)
EN ISO 13849-1	Performance Level (PL)

Table 3

ENCODER TYPES AND SAFETY

SAFE INCREMENTAL ENCODER FUNCTION

To obtain safe incremental information with the encoder, the encoder evaluation unit must check the validity of the analog signals. For a speed determination with the correct algebraic sign, as well as for correct incremental information, both the sine signal and the cosine signal must be evaluated, e.g., using the function $\sin^2(x) + \cos^2(x) = 1$ and quadrant monitoring of the resulting unit circle, e.g., by means of permanent speed monitoring.

SAFE ABSOLUTE ENCODER FUNCTION

Loss of safety.
The digital absolute information is not part of the certification. The digital absolute position cannot be used alone to realize safety functions.

To obtain safe information on the absolute position with the encoder, the encoder evaluation unit must also count the incremental information (relative position) and compare it with the absolute position also provided by the encoder.

The comparison of the digital position data with the sine and cosine signals allows continuously checking the reported position and detecting a deviation of the two signals. Since this function requires both the incremental information and the rotation direction information for the check, the achievable safety level is limited to this.

Before switching the facility off, the absolute position value must be saved by the encoder evaluation unit. When switching it back on, the encoder evaluation unit must compare the saved value with the absolute value newly measured after switching on. If both values are identical, the position is still safe. If the position values are not identical, the position is not safe and must be newly verified.

FUNCTIONAL SPECIFICATION: INCREMENTAL VALUE

The incremental sin-cos signals are safety-assessed. The monitoring of the unit circle allows achieving a diagnostic coverage of 99 %. The function can be examined at any time. This means that, for an encoder resolution of 2048 sine-cosine periods, the validity can be checked by the encoder evaluation unit 2048 times per revolution. With a tolerance of the $\sin^2(x) + \cos^2(x)$ function of ± 0.5, the max. possible error path will be 10 % of a signal period (36° electrically).

Typical limits and tolerances see chapter TECHNICAL DATA (page 9).

The sine-cosine signal alone does not allow realizing absolute safety sub-functions and a safe rotation direction can achieve at the maximum SIL2. Additional signal paths are required to be able to use both to a full extent up to SIL3.

English

ENCODER EVALUATION

Only operate the encoder together with a safe encoder evaluation unit / controller. Only this equipment can monitor the proper function and achieve a safe system.

Monitoring in the encoder evaluation unit must be carried out directly on the encoder signal. Previous processing, e.g., interpolation, is not allowed.

The encoder cannot prevent the automated restarting of the facility after a malfunction. If this is necessary, it must be ensured by the encoder evaluation unit.

The technical requirements for the encoder evaluation unit are described in chapter WARNINGS (page 4).

ENCODER MOUNTING

The mechanical interface has been dimensioned so that failure exclusion can be assumed as a result of over dimensioning and / or diagnosis.

The connection of the encoder and the drive unit must be assessed from a safety-related point of view. This relates both to the connection with the rotary element (shafts connection) and to the stationary section (stator connection).

To this purpose, ReeR provides the corresponding mechanical interfaces.

Shaft connection

- Solid shaft with feather key
- Solid shaft with flat
- Hollow shaft with clamping ring
- Tapered shaft with central fastening

Stator connection

The provided tether arms, stator couplings and torque stops are assessed from a safety-related point of view.

The encoder mechanics and its connection elements can be included as failure-safe in the safety assessment if the mechanical limits in chapter TECHNICAL DATA (page 9) and the proper assembly in chapter MECHANICAL INSTALLATION (page11) have been complied with.

SAFETY FUNCTIONS

The encoder allows supporting safety subfunctions according to EN 61800-5-2 with regard to rotational speed, direction of rotation, standstill, and relative position, for example:

- SS1, SS2, SOS, SLS, SSM, SSR, SDI, SLA, SAR, SLI

SAFETY ASSESSMENT

You will find the characteristic safety values to be used for your own determination of the safety level of your machine in chapter TECHNICAL DATA (page 9).

English

TECHNICAL DATA

➔ **Reference to the data sheet.**
All technical data, as well as the mechanical and electrical characteristics, are specified in the data sheets of the corresponding device variant, for special versions in the corresponding customer drawing of the product.

➔ **Observe the configuration.**
The performance characteristics and the mechanical design of the product depend on the selected configuration (according to order code).

Extracts of the main technical data are listed below. All other characteristic values can be found in the corresponding product data sheets.

MECHANICAL CHARACTERISTICS	
Maximum rotational speed **	12000 min^{-1}
Maximum angular acceleration	$5x10^5$ rad/s²
Operating temperature **	-40 °C ... +90 °C [-40 °F … +194 °F]
Protection level according to EN 60529	IP65 / IP67
Pollution degree according to EN 61010	2
Installation height	< 2000 m [6562 ft]
Weight	ca. 0,45 kg [15.87 oz]
Shock resistance according to EN 60068-2-27	1000 m/s², 6 ms
Vibration resistance according to EN 60068-2-6	8,7 … 200 Hz, 30 m/s² 200 ... 2000 Hz, 200 m/s²

**** See chapter Limitations (page 23)**

ELECTRICAL CHARACTERISTICS	
Supply voltage	5 V DC, ± 10 % 10 … 30 V DC
Supply voltage according to UL 1310	Class 2
Current consumption (no load) 5 V DC 10 … 30 V DC	 max. 80 mA max. 50 mA
Protection class according to EN 61140	III (PELV)
Smallest safe measuring step	10 % of a SinCos period

GENERAL TECHNICAL DATA OF THE SinCos INTERFACE	
Max. frequency -3dB	400 kHz
Short-circuit resistance	Si
Number of pulses	1024 / 2048 ppr
Offset	2,5 V (± 100 mV)
Offset difference between A and B	max. 25 mV
Amplitude	1 V_{pp} (± 10%)
Amplitude difference between A and B	max. 40 mV
Phase position A vs. B	90° (± 10%)
Terminating resistor	120 Ω

SAFETY DATA	
Relevant standards	EN ISO 13849-1:2015 EN ISO 13849-2:2012 EN 61800-5-2:2007
Classification	PLe / SIL3
System structure	2 channels (cat. 4)
PFH_d value	1,09 x 10^{-8} h^{-1}
Service life	20 years

English

SAFETY ASSESSMENT OF THE STANDARD PART OF THE ENCODERS	
$MTTF_d$ value	90 years
Diagnostic coverage	0 %
Category	1-channel

EMC	
Relevant standards	EN 55011 Class B:2009 / A1:2010 EN 61326-1:2013 EN 61326-3-1:2008

UL - Underwriters Laboratories	
Relevant standards	UL 61010-1
Operating environment	Indoor use, outdoor use possible, not designed for direct UV radiation.
Maximum air humidity	93 %, 40°C [104°F]
Environment	Dry / Wet

APPROVALS

The product meets the following criteria:

- Approval for applications with increased functional safety requirements.
- Compliance with the European Directives:
  - EMC Directive 2014/30/EU
  - RoHS Directive 2011/65/EU
  - Machinery Directive 2006/42/EC

English

INSTALLATION

MECHANICAL INSTALLATION

➔ **Damage to the device due to transport or storage**
Device failure, malfunction, device lifetime reduction.
- Check the packaging and the device for possible damages.
- In the event of visible damages, do not use the device and do not put it into operation.
- Do not install the device after falling or being dropped.
- Send damaged devices back to the manufacturer with a completed returns form (RMA), see last page of the manual.

GENERAL INFORMATION FOR THE MOUNTING OF ENCODERS

➔ **Do not disassemble or open the device.**
The function of the measuring system might be lost partly or entirely.
Do not open or disassemble the measuring system. Otherwise, the warranty will be nullified.

➔ **Do not modify the encoder and do not change the shaft.**
Encoder accuracy will be impaired, and the function of the bearings and seal may be lost partly or entirely.
Do not machine the shaft or the housing subsequently (e.g., grinding, sawing, drilling, etc.).

➔ **Do not subject the encoder to shocks or overload it.**
- This would impair encoder accuracy and bearings and seal reliability.
- Do not use a hammer to align the encoder.
- Absolutely avoid impact stress.
- Do not subject the encoder shaft to axial or radial loads exceeding the values specified in the data sheet.

➔ **Do not connect the stator and the rotor rigidly to the application.**
The encoder would be mechanically constrained and thus damaged.
- For solid shaft encoders always use a suitable tolerance-compensating coupling element between the drive shaft and the encoder shaft.
- For tapered or hollow shaft encoders, always use the pre-assembled coupling element between the drive flange and the encoder flange.

➔ **Offset between drive and encoder.**
- Axial offset: < ± 0.25 mm [0.01]
- Radial offset: < ± 0.20 mm [0.008]

The values specified for the radial and axial offset are maximum values, which must not be exceeded. If shaft displacements occur simultaneously, their sum must not exceed 100% of the maximum values.

➔ **Procedure in the event of soiling.**
Clean and degrease the encoder shaft and the drive shaft before installation.

➔ **Tools.**
For assembly, use only checked and calibrated tools subjected to a quality system.

SCREWS AND SCREWED CONNECTIONS

Unless otherwise specified, a friction coefficient of 0.14 is required for all screwed connections. Unless otherwise specified, a strength class of 8.8 (metric) or grade 5 (imperial) is required for all screws.

The screws must be secured against loosening as described in chapter SCREW RETENTION (page 15).

English

COUPLINGS

For the tapered and hollow shaft encoders, the coupling elements, e.g., a stator coupling, or a compensating torque stop are factory-mounted.

For solid shaft encoders, imperatively use a shaft coupling that meets the requirements of the application.

The coupling element affects the system accuracy of the drive unit. It must therefore be made sure that the coupling is sufficiently rigid, without any slipping.

Make sure that the shaft couplings are designed so that a breakage of the connection can be excluded. As the integrator, it is up to you to conduct a risk analysis considering the following aspects:

- Counter torque of the encoder
- Maximum permissible shocks and vibrations
- Maximum permissible acceleration
- Permissible geometrical deviations in the ideal orientation of the shafts
- Permissible temperature and humidity ranges
- Required angular accuracy

➔ **Failure exclusion coupling element.**
A safe mechanical connection of the encoder is necessary. Standard EN 61800-5-2 defines the loosening of the mechanical connection (between the encoder and the drive) as a as a fault that requires con-sideration. Fault exclusion is required for the coupling elements if the control cannot detect this fault.

DIMENSIONS AND MOUNTING STEPS

➔ **Dimensions.**
The technical drawing with complete dimensioning can be found in the data sheets of the corresponding variant of the device, for special versions in the corresponding customer drawing of the product.
The illustrations below only show a selection of examples. All values without unit in the picture are given in mm [inch].
In order to simplify the drawings and information, unless otherwise specified, the general tolerances with tolerance class m (medium) according to ISO 2768-1 apply.

English

SOLID SHAFT ENCODERS

Dimension	Code: 1100104 - 1100105 (Incremental Encoder)	
a	38 [1.50]	
D = Shaft diameter	**Shaft fit**	**L = Shaft length**
10 [0.39]	f7	20 [0.79]

Clamping flange, solid shaft with key

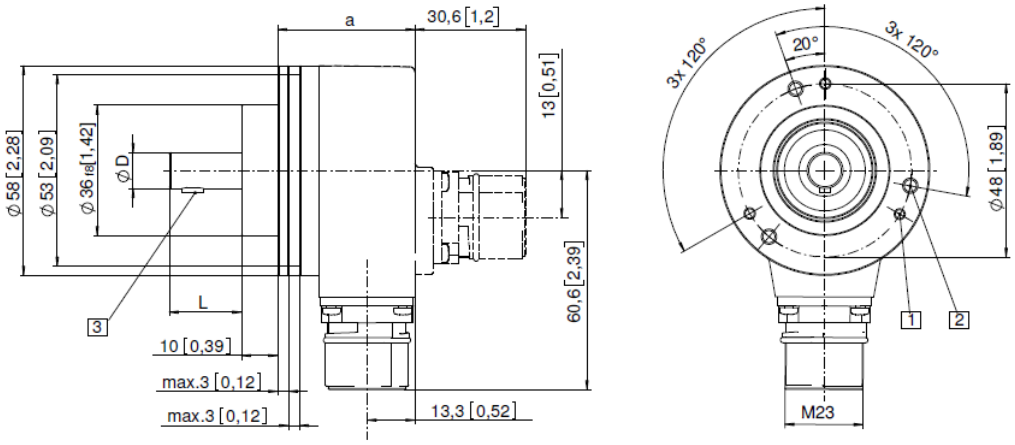


Figure 2

1 3xM3, 6 [0.24] deep

2 3xM4, 8 [0.32] deep

3 Feather key DIN 6885 - A - 3x3x6

Clamping flange, solid shaft with flat

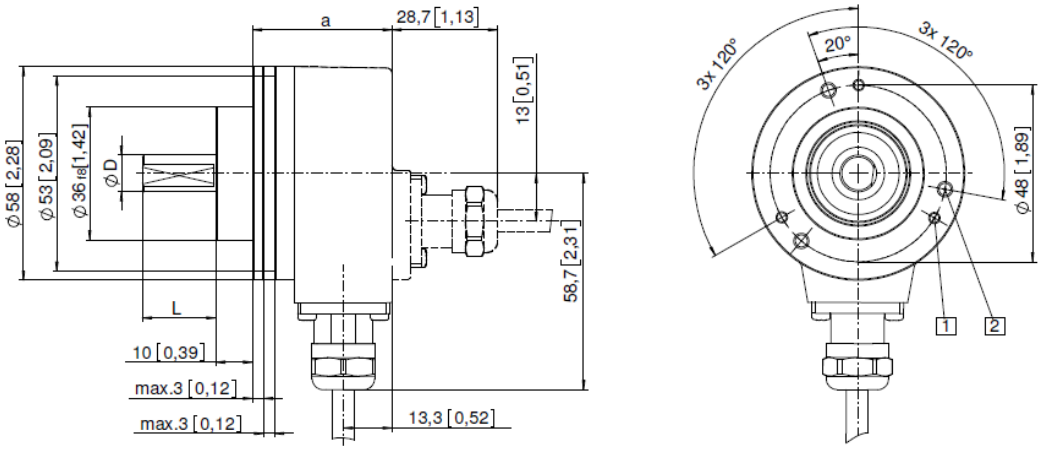


Figure 3

1 3xM3, 6 [0.24] deep

2 3xM4, 8 [0.32] deep

English

Assembly Instructions for Solid Shaft Encoders

a) Fasten the encoder using three M3 screws in the tapped holes provided in the flange.

b) Tighten the screws.

c) Check the shafts for offset. The maximum permissible tolerances depend on the selected shaft coupling.

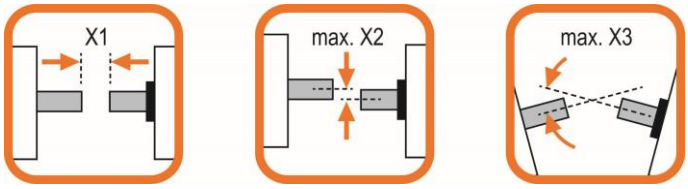


Figure 4

d) Connect the encoder and drive shafts via a tolerance-compensating element (coupling).

e) During assembly, protect the tolerance-compensating element against too important bending and damages.

f) Align the coupling on the shafts, screw the coupling without preload.

g) Secure the screws against loosening, see chapter SCREW RETENTION (page 15).

HOLLOW SHAFT ENCODERS

Dimension	**Code: 1100102 - 1100103 (Incremental Encoder)**	
a	56 [2.2]	
d = Shaft diameter	**Shaft fit**	**L = Shaft insertion depth**
10 [0.39] 12 [0.47]	H7	> 34 [1.34]

Flange with stator coupling

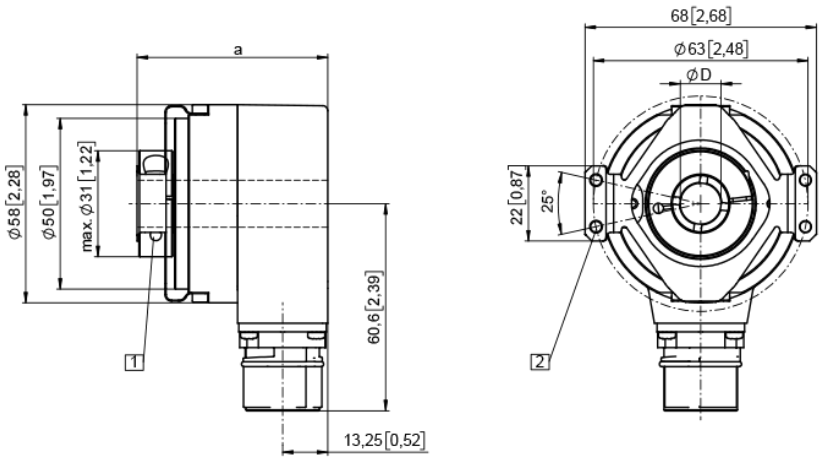


Figure 5

1 SW 3

2 for (4x) M3 screw

English

Assembly Instructions for Hollow Shaft Encoders

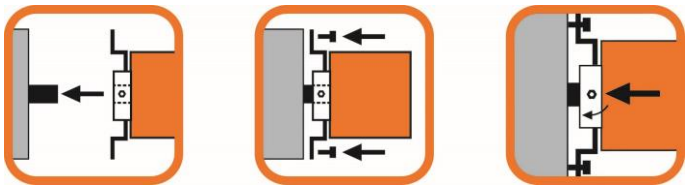


Figure 6

a) Slide the encoder on the shaft.
b) Comply with the minimum and maximum insertion depth of the shaft in the encoder.
c) Comply with the maximum permissible shaft offset.
d) Screw the stator coupling or the torque stop without preload on the drive flange.
e) Tighten the screw on the clamping ring.
f) Secure the screws against loosening, see chapter SCREW RETENTION (page 15).

APPLICATION SIDE

Requirements for the application side for the mounting of the encoders.

For hollow shaft encoders

Material: Steel, stainless

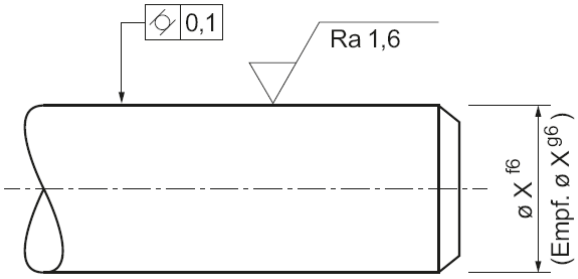


Figure 7

➔ **Encoder damage.**
Device failure, device lifetime reduction.
- Comply with the minimum insertion depth of the drive in the hollow shaft encoder.

SCREW RETENTION

Secure the fastening screws against loosening.
This is achieved, depending on the application, using e.g.:

- Coated screws
- Threadlocker
- Schnorr washers

ReeR recommends a threadlocker, e.g., Loctite.

We recommend an additional protection against manipulation by marking the fastening screws with locking varnish or similar.

English

CABLE ROUTING

➔ **Cable routing.**
Route the sensor cable free of any tension, so that no additional force is applied on the measuring system. Consider the minimum bending radii of the connection cable.
Comply with the instructions in chapter Information for EMC-Compliant Installation.

➔ **Wiring.**
When wiring the facility, pay attention to proper cable routing.
- Separate the wiring into power groups such as motor/power supply lines and signal and data lines.
- Route the signal and data lines as close as possible to ground surfaces (frames, metal rails, cabinet sides) and not parallel to motor and power supply lines or other lines carrying high interference levels.
- Do not connect other users with high interference levels (such as frequency converters, solenoid valves, contactors) to the power supply of the device.

Cable Bending Radius

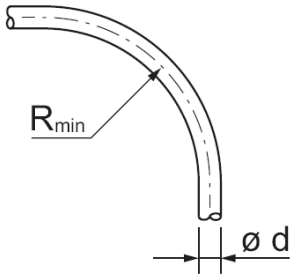


Figure 8

The following minimum values apply for encoders with cable outlet (R_{min}):

	R_{min}
Fixed installation	75 [2.95]
Flexible use	110 [4.33]

English

ELECTRICAL INSTALLATION

GENERAL INFORMATION FOR THE CONNECTION

➔ **Risk of device destruction**.
Before connecting or disconnecting the signal cable, always disconnect the power supply and secure it against switching on again.

➔ **General safety instructions.**
- Make sure that the whole plant remains switched off during the electrical installation.
- Make sure that the operating voltage is switched on or off simultaneously for the device and the downstream device.

➔ **Other operating instructions applicable for the installation.**
- To connect the device, refer to the corresponding operating and safety instructions of the external drive system / evaluation system / control.
- When assembling a mating connector, comply with the instructions attached to the connector.

➔ **No open cable wires.**
- Connect all required cable wires / connectors before commissioning. Insulate individually all unused ends of the output signals to avoid short-circuits.
- Electrostatic discharges at the contacts of the connector or at the cable ends could damage or destroy the device. Take appropriate precautionary measures.

➔ **Traction relief.**
Always mount all cables with traction relief.

INFORMATION FOR EMC-COMPLIANT INSTALLATION

Requirements for cables

- Use exclusively shielded twisted-pair cables to connect the device.
- Comply with the maximum permissible connection cables length.

Shielding and equipotential bonding

- Apply the cable shield on a large contact area - ideally 360°.
  Use for example, a shield terminal to this purpose.
- Pay attention to proper cable shield fastening.
- Preferably connect the shield on both sides with low impedance to the protective earth (PE), e.g., on the device and/or on the evaluation unit. In the event of potential differences, the shield must only be applied on one side.
- If shielding is not possible, appropriate filtering measures must be taken.
- If the protective earth should be connected to the shield on one side only, it must be made sure that no short-time overvoltage can appear on the signal and supply voltage lines.

Unused signals

Connect the unused input signals of the sensor (SET, DIR) to 0 V (Ground GND).

CONNECTION COLOR CODING

Part of the cables are identified by a colour coding, part of them by a numerical coding.
Abbreviation of the colours:

Abbreviation	Colour	Abbreviation	Colour
WH	White	BU	Blue
BN	Brown	RD	Red
GN	Green	BK	Black
YE	Yellow	VT	Violet
GY	Gray	GY-PK	Gray-Pink
PK	Pink	RD-BU	Red-Blue

➔ **Destruction of the electronics (Electrostatic Discharge).**
When confectioning the sensor cable, always take care to ensure sufficient ESD protection.

CONNECTION LEGEND

SIGNAL	MEANING
+V	Encoder supply voltage +V DC
0V	Encoder ground GND (0V)
A, /A	Cosine signal
B, /B	Sine signal
PH ⏚	Connector housing (cable shield is applied on the connector housing), protective earth

TERMINAL ASSIGNMENT INCREMENTAL ENCODER

Output circuit	Type of connection	Cable							
1, 2	1, 2, A, B, E, F	**Signal:**	0V	+V	A	/A	B	/B	⏚
		Cable colour:	WH	BN	GN	YE	GY	PK	Shield

Table 4

Output circuit	Type of connection	M12 connector, 8-pin								Connector
1, 2	5, 6	**Signal:**	0V	+V	A	/A	B	/B	⏚	
		Pin:	1	2	3	4	5	6	PH	

Table 5

CONNECTING THE WIRES

- Before connecting the connecting wires, check the assignment of the single wires.
- After connecting, check the proper presence of the supply voltage and the proper functioning.

If the supply voltage is reversed, the measuring system does not function.

- Check the proper presence of the sine and cosine signals and their amplitude level, polarity, and phase position.

English

- In the event of an error in the SinCos path, the function $\sin^2(x) + \cos^2(x) = 1$ is no longer fulfilled or the rotation direction is wrong, e.g., due to the reversing of sine and cosine (wrong phase position).

COMMISSIONING AND OPERATION

GENERAL INFORMATION FOR COMMISSIONING

STATUS LED (OPTIONAL)

The LED (red) displays various alarm and error messages. The LED is off in normal operation. A lighted LED (status output LOW) indicates:

- Sensor error, singleturn or multiturn (soiling, glass breakage, etc.).
- LED error, failure, or aging.
- Over or under temperature.
- Please not that in SSI mode the error indication can only be reset by switching off the voltage supply.
- The indications are not safety-assessed and only serve for diagnosis.

OPERATIONAL READINESS WHEN SWITCHING ON

The sine and cosine signals are immediately available after switching on the voltage supply.

Wait at least 150 ms until the encoder is ready for operation, that is to say until the interfaces are ready for communication. The encoder will communicate with the outside through the digital interface only after this period.

MAINTENANCE

In harsh environments, we recommend regular inspections for firm seating and possible damages at the device. Repair work may only be carried out by the manufacturer, see chapter Contact.

Prior to the work

- Switch off the power supply and secure it against switching on again.
- Then disconnect the power supply lines physically.
- Remove operating and auxiliary materials and remaining processing materials from the measuring system.

DISASSEMBLY

➔ **Attention.**
When disassembling, take care not to damage the parts necessary for housing tightness.
In no case reuse damaged devices.

To dismount the device, proceed in the reverse order of the assembly, see ELECTRICAL INSTALLATION (page 17) and MECHANICAL INSTALLATION (page 11).

REASSEMBLY

Reassembling the device is only permitted under the following conditions:

- The device is not damaged.
- The screws can be newly secured against loosening.
- All safety instructions of chapter INSTALLATION (page 11) can be complied with.
- All assembly steps described in chapter INSTALLATION (page 11) can be performed.

TRACEABILITY

➔ **Identification of errors in the field.**
A traceability of these products is recommended. This can be achieved for example by means of the serial number on the typeplate. Complete traceability is decisive for fast and targeted reaction in the market.

DISPOSAL

Always dispose of unusable or irreparable devices in an environmentally sound manner, ac-cording to the country-specific provisions and in compliance with the waste disposal regulations in force. We will be glad to help you dispose of the devices, see last page of the manual.

➔ **Environmental damage in case of incorrect disposal.**
Electrical waste, electronic components, lubricants, and other auxiliary materials are subject to hazardous waste treatment.
Problem substances may only be disposed of by licensed specialist companies.

Dispose of disassembled device components as follows:

- Metal components in the scrap metal.
- Electronic components in the electrical waste.
- Plastic parts in a recycling center.
- Sort and dispose of the other components depending on the material type.

ANNEX

REQUIREMENTS FOR AN ENCODER EVALUATION DEVICE

CHARACTERISTIC VALUES OF THE ENCODER EVALUATION DEVICE FOR SIL3 ENCODERS

Designation	Value
Safety requirement	≥ SIL3 (compliant with IEC 61508)
Diagnostic coverage DC	≥ 99 %
Error presumptions**	according to EN 61800-5-2

** see chapter SIGNAL MONITORING (page 23).

DATA TRANSMISSION

Sine and Cosine Signals

A; /A = Cosine; B; /B = Sine

Each of the signals A, /A, B, /B has an amplitude of 0.5 V_{PP} with an offset of +2.5 V against GND.

The analog signals must be measured differentially, i.e. A minus /A gives Cosine, B minus /B gives Sine. Measured differentially, the sine and cosine signals have an amplitude of 1 V_{PP}, with a phase position of 90°.

RECOMMENDED LINE TERMINATION AND SHIELDING

A 120 Ω terminating resistor must be connected to the Sine data line and to the Cosine data line at the input of the encoder evaluation device. Otherwise, the characteristic values of the transmission will change.

In order to ensure independence from manufacturers, we give the following recommendations for the dimensioning of the interface:

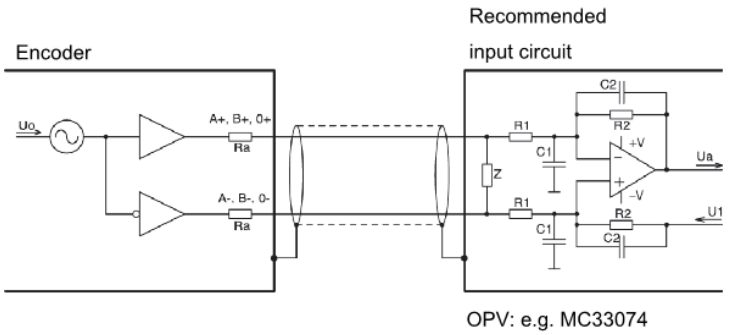


Figure 9

Component	Value	Component	Value
U_0	= 2,5 V ± 0,5 V	Z	= 120 Ω
U_1	= U_0	R_a	= 10 Ω
C_1	= 150 pF	R_1	= 10 kΩ
C_2	= 10 pF	R_2	= 33 kΩ

Table 6

English

SIGNAL MONITORING

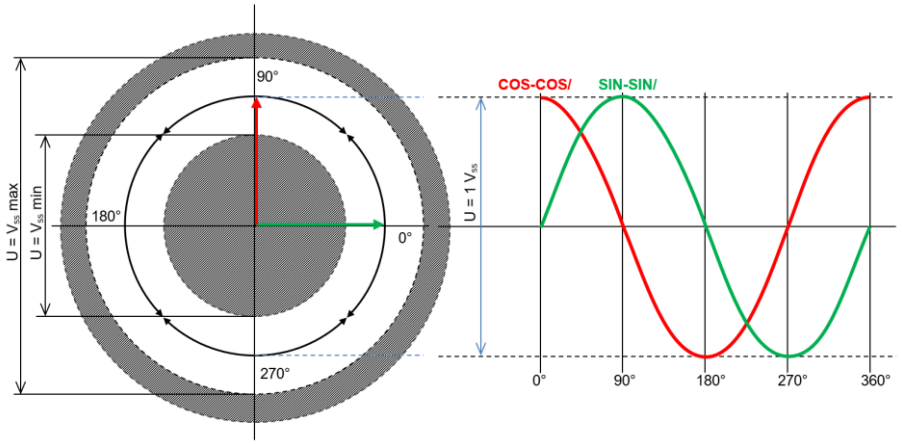


Figure 10

IMG-ID: 94365835

The graphic above shows a Lissajous figure of the SinCos signals. With optimal signals, the figure is an optimal circle having the diameter of the amplitude (unit circle).

The limits to be monitored are shown in grey, so that all error presumptions according to EN 61800-5-2 can be detected.

Requirements

To make sure that all unit circle quadrants are passed through and that there is no hold error (stuck-at-fault), the number of periods of the sine signal must be equal to the number of periods of the cosine signal.

The minimum and maximum limits of the Lissajous figure must be monitored in way suitable for the application. Chapter TECHNICAL DATA (page 9) lists the technical characteristics of the SinCos output.

LIMITATIONS

➔ **Encoders with cable outlet.**
Due to the cable material (PVC as standard), encoders with direct cable outlet can only be used up to -30°C [-22°F]. If you need a wider temperature range, please contact us, see last page of the manual.

DEFINITION TEMPERATURE MEASUREMENT

Under specific conditions, the maximum permissible ambient temperature must be limited. Therefore, one also refers for encoders to a maximum operating temperature, which is composed of several components.

An encoder is a mechatronic system that heats up differently according to the variant. For critical applications close to the maximum values, we recommend measuring the actual temperature of the encoder in operation.

English

Measuring point at the flange:

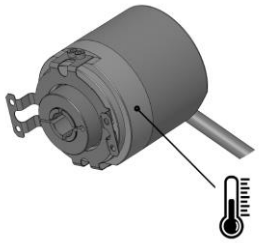


Figure 11

Both the ambient temperature and the mechanical and electrical self-heating are included when measuring the temperature on the flange. Therefore, the temperature measured on the flange gives the operating temperature of the encoder.

➔ **Temperature range of connectable components.**
When choosing the accessories, in particular the connectors, observe the maximum temperature of these components.

TEMPERATURE / SPEED CURVES

Hollow shaft encoder

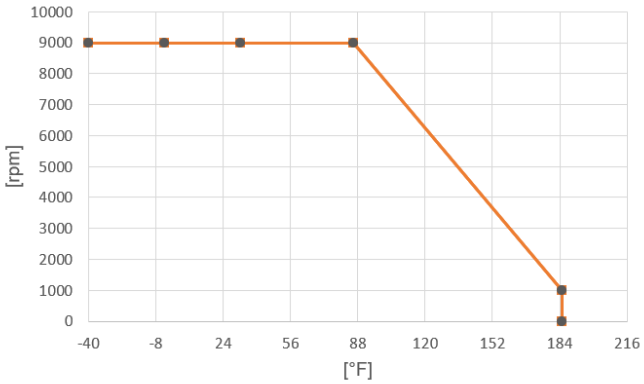


Figure 12

Solid shaft encoder

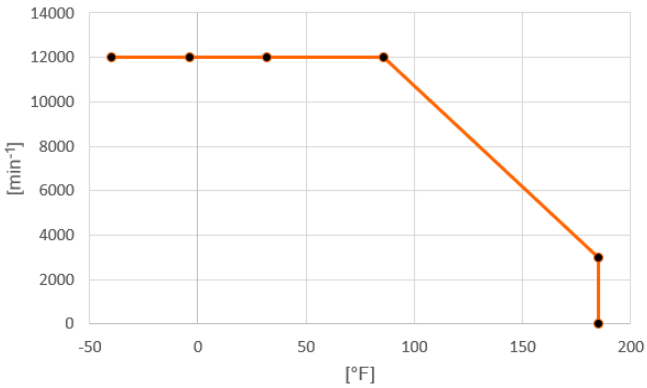


Figure 13

English

WARRANTY

ReeR warrants that each SAFECODER unit in new ex-factory condition, in conditions of normal use, is free of defects in the materials and of manufacturing defects for a period of 12 (twelve) months.

In this period, ReeR undertakes to eliminate any faults in the product through repair or replacement of the faulty parts, completely free of charge as regards material and labour. However, ReeR reserves the right to replace the entire faulty appliance with another equivalent appliance or with the same characteristics instead of repairing this.

Validity of this warranty is regulated by the following conditions:

- The user must inform ReeR of the fault within twelve months from the date of delivery of the product.
- The appliance and its components must be in the conditions in which they were delivered by ReeR.
- The serial numbers must be clearly legible.
- The fault or defect has not been caused directly or indirectly by:
  - Improper use;
  - Non-compliance with instructions for use;
  - Carelessness, inexperience, incorrect maintenance;
  - Repairs, modifications, adaptations not carried out by ReeR personnel, tampering, etc.;
  - Accidents or impacts (also due to transportation or causes of force majeure);
  - Other causes not to be ascribed to ReeR.

Repairs will be carried out at the ReeR laboratories to which the material must be delivered or dispatched: transport risks and the risks of any damage or loss of the material during shipment are the responsibility of the user.

All products and components replaced become the property of ReeR.

ReeR does not recognize any other warranties or rights except for those specifically described above; therefore, no claims for damages may be submitted for expenses, interruption of business or other factors or circumstances in any way related to failure of the product or of one of its parts.

Precise, complete compliance with all the rules, instructions and prohibitions indicated in this handbook is an essential requirement for correct functioning of the device.

ReeR s.p.a. therefore declines any responsibility for all and anything resulting from failure to comply, even partially, with such indications.

Characteristics subject to change without notice. • Total or partial reproduction is forbidden without the prior authorization of ReeR.

English

EC DECLARATION OF CONFORMITY

CE

Dichiarazione CE di conformità
EC declaration of conformity

Torino, 29/04/2021

REER SpA
via Carcano 32
10153 – Torino
Italy

dichiara che gli encoder incrementali della famiglia **Safecoder** sono dispositivi di sicurezza il cui livello di sicurezza può arrivare fino a:

LIVELLO DI SICUREZZA	SE UTILIZZATI IN ABBINAMENTO CON
▪ **SIL 3** (secondo la Norma **EN 61800-5-2: 2007**) ▪ **PL e** (secondo la Norma **EN ISO 13849-1:2015**)	controllore di sicurezza **MOSAIC** e moduli di espansione **MV1, MV2**

*declares that the **Safecoder** family incremental encoders are safety devices whose safety level is up to:*

SAFETY LEVEL	*IF USED IN COMBINATION WITH*
▪ ***SIL 3** (according the Standard **EN 61800-5-2: 2007**)* ▪ ***PL e** (according the Standard **EN ISO 13849-1:2015**)*	***MOSAIC** safety controller and **MV1, MV2** expansion modules*

che sono realizzati in conformità alle seguenti Direttive Europee:
that they are complying with the following European Directives:

▪ **2006/42/EC** ▪ ***EN 62061:2005/A2:2015***	"Direttiva Macchine" / "Machine Directive" *"Safety of machinery. Functional safety of safety-related electrical, electronic and programmable electronic control systems"*
▪ **2014/30/EU** ▪ ***EN 61326-1:2013***	"Direttiva Compatibilità Elettromagnetica" / "Electromagnetic Compatibility Directive" *"Electrical equipment for measurement, control and laboratory use. EMC requirements. General requirements"*
▪ **2011/65/EU** ▪ ***EN 50581:2012***	"Direttiva RoHS" / "RoHS Directive" *"Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances"*

e sono identiche all'esemplare esaminato ed approvato con esame di tipo CE da:
and are identical to the specimen examined and approved with a CE - type approval by:

TÜV Rheinland (NB 0035)

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English

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English

All REER product manuals are available at URL https://www.reersafety.com/it/en/download/manuals