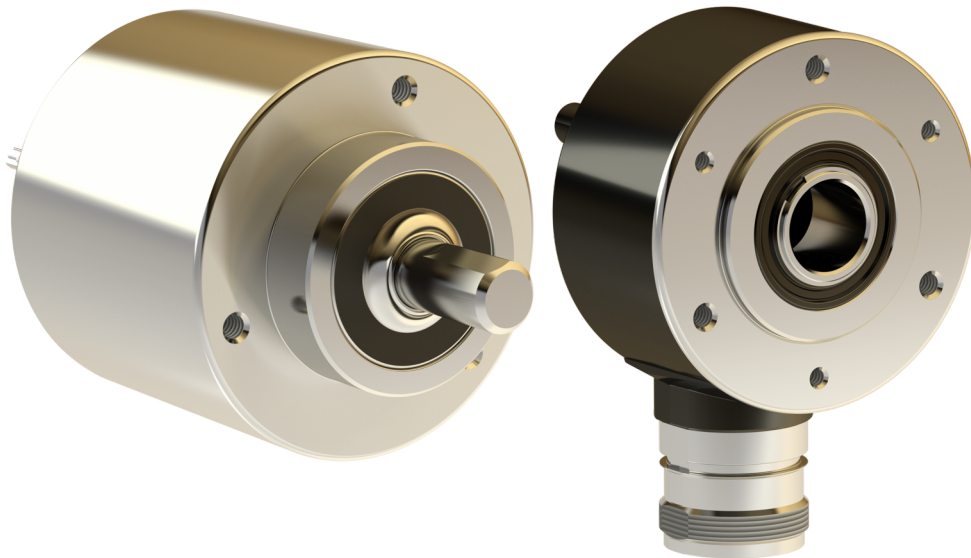


USER MANUAL



SIL3 FUNCTIONAL SAFETY SENSOR
IEC 61508

PLe FUNCTIONAL SAFETY SENSOR
ISO 13849

INCREMENTAL SAFETY

IMPORTANT INFORMATION (SAFETY INSTRUCTIONS)

Scope

This user manual is valid exclusively for the following incremental rotary encoder:

- SOI58/S3 with aluminium / coated zinc alloy housing and with solid shaft
- SOI59/S3 with stainless steel housing and with solid shaft
- SOI58-T/S3 with aluminium / coated zinc alloy housing and with through hollow shaft
- SOI90-T/S3 with aluminium / powder coated aluminium or stainless steel housing and with through hollow shaft
- SOI58-H/S3 with aluminium / coated zinc alloy / cast zinc alloy housing and with blind hollow shaft or tapered blind hollow shaft

Documentation

The following documents must be observed:

- The owner's system-specific operating instructions
- This user manual
- Data sheet numbers:
 - SOI58/S3: [SOI17171](#)
 - SOI59/S3: [SOI17172](#)
 - SOI58-T/S3: [SOI17173](#)
 - SOI90-T/S3: [SOI17174](#)
 - SOI58-H/S3: [SOI17198](#)
- The connection assignment TYxxxxx enclosed with every device
- Assembly instructions [AN16169](#) (in addition to the assembly instruction described in this manual)
- The EC Type-Examination Certificate* [ZE17204](#) and the EC Declaration of Conformity* [ZE17199](#) are available on www.twk.de.

Proper use

The TWK-ELEKTRONIK GmbH absolute encoders and linear transducers are used to register angular or linear positions and make their measured value available in the form of an electrical output signal. As part of a system, they have to be connected to the downstream electronics and must only be used for this purpose.

Commissioning

- The device may only be set up and operated in combination with this manual (especially [chapter 1: „Safety Information“](#)) and the documentation specified above
- Protect the device against mechanical damage during installation and operation
- Device commissioning and operation may only be undertaken by a specialist electrician
- Do not operate the device outside of the limit values specified in the data sheet
- Check all electrical connections before commissioning the system

* Available as soon as the certification has been completed

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SAFETY INFORMATION

1. SAFETY INFORMATION

1.1 Qualification of personnel

Only appropriately trained persons who are familiar with and understand the contents of this manual and all other pertinent product documentation are authorized to work on and with this product. In addition, these persons must have received safety training to recognize and avoid hazards involved. These persons must have sufficient technical training, knowledge and experience to be able to foresee and detect potential hazards that may be caused by using the product. They must also have sufficient knowledge and experience to understand the operational risks of the mechanical, electrical and electronic equipment of the entire system in which the product is used.

All persons working on and with the product must be fully familiar with all applicable standards, directives, and accident prevention regulations when performing such work.

1.2 Intended use

The product may only be used in compliance with all applicable safety regulations and directives, the specified requirements and the technical data.

Prior to using the product, a risk assessment must be performed in view of the planned application. Based on the results, the appropriate safety measures must be implemented.

Since the product is used as a component in an entire system, the safety of persons must be ensured by means of the design of this entire system (for example, machine design).

Any use other than the use explicitly permitted is prohibited and can result in a safety hazard.

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel.

1.3 Hazard categories

Safety instructions are highlighted by safety alert symbols in the manual.

Depending on the seriousness of the hazard, the safety instructions are divided into two hazard categories.

WARNING

WARNING indicates a potentially hazardous situation, which, if not avoided, can result in death, serious injury, or equipment damage.



CAUTION

CAUTION indicates a recommendation, which, if not followed, may eventually result in death, serious injury, or equipment damage depending on the context.



1.4 Standards and terminology

Technical terms, terminology and the corresponding descriptions in this manual are intended to use the terms or definitions of the pertinent standards.

Among others, these standards include:

- IEC 61508: "Functional safety of electrical/electronic/programmable electronic safety-related systems"
- EN 62061: "Safety of machinery - Functional safety of safety-related electrical, electronic and programmable electronic control systems"
- EN ISO 13849: "Safety of Machinery, Safety-related parts of control systems"

Also see the glossary („Definitions“) at the end of this manual.

TECHNICAL FEATURES

2. TECHNICAL FEATURES

2.1 Range presentation

See datasheets for all currently available versions:

- [SOI17171](#) for SOI58/S3 with aluminium / coated zinc alloy housing and with solid shaft
- [SOI17172](#) for SOI59/S3 with stainless steel housing and with solid shaft
- [SOI17173](#) for SOI58-T/S3 with aluminium / coated zinc alloy housing and with through hollow shaft
- [SOI17174](#) for SOI90-T/S3 with aluminium / powder coated aluminium or stainless steel housing and through hollow shaft
- [SOI17198](#) for SOI58-H/S3 with aluminium / coated zinc alloy / cast zinc alloy housing and with blind hollow shaft or tapered blind hollow shaft

Other versions may be available on request. Please contact our technical staff.

2.2 Mechanical specifications

2.2.1 Generalities

Encoder must be mounted using good mechanical assembly processes and correct tooling in accordance with the details in this manual. Standard IEC 61800-5-2 must also be applied, taking into account encoder's fastening precautions as listed in the table D.16 (motion and position feedback sensors).

All parts (Shaft, flange) must mate properly with the correct hardware without requiring any excessive external applied load (i.e. hammer, arbor press).

The coupling mounting must be done without deforming the coupling devices while avoiding mechanical contact between mating shafts which would invalidate the coupling function.

CAUTION



For a secure connection use shaft keys and key seats for the shaft coupling for a shafted encoder and in the hollow shaft bore for a hollow through shaft type of encoder.

When mounting a gear, wheel or pulley on the encoder, use a key for securing the shaft against angular rotation and design your device in order to limit any axial and radial loads up to the permissible value defined in the encoder data sheet.

CAUTION



Secure fasteners (on flange, shaft, clamping rings, couplings, etc. by using a screw with the appropriate torque and lock the treads with thread locker Loctite 243 or equivalent.

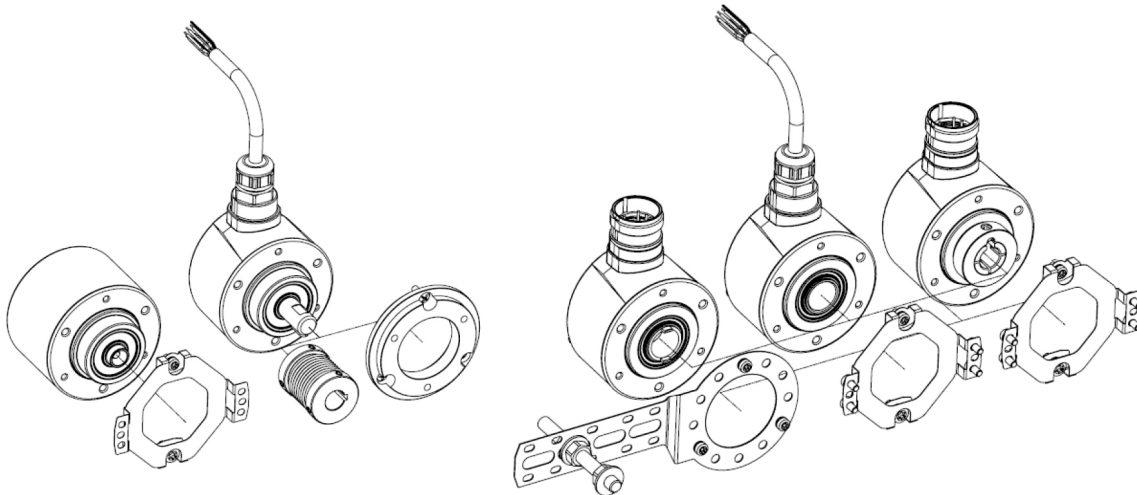
In case of leakage currents on the driving shaft, a common occurrence with the use of Variable Frequency Drives (VFD's) or industrial DC motors, use the insulated SRS sleeve. Refer to [chapter "2.2.5.3 Sleeves"](#).

If possible, mount the encoder shaft horizontal or facing downward with the cable-glands or the connector facing downward.

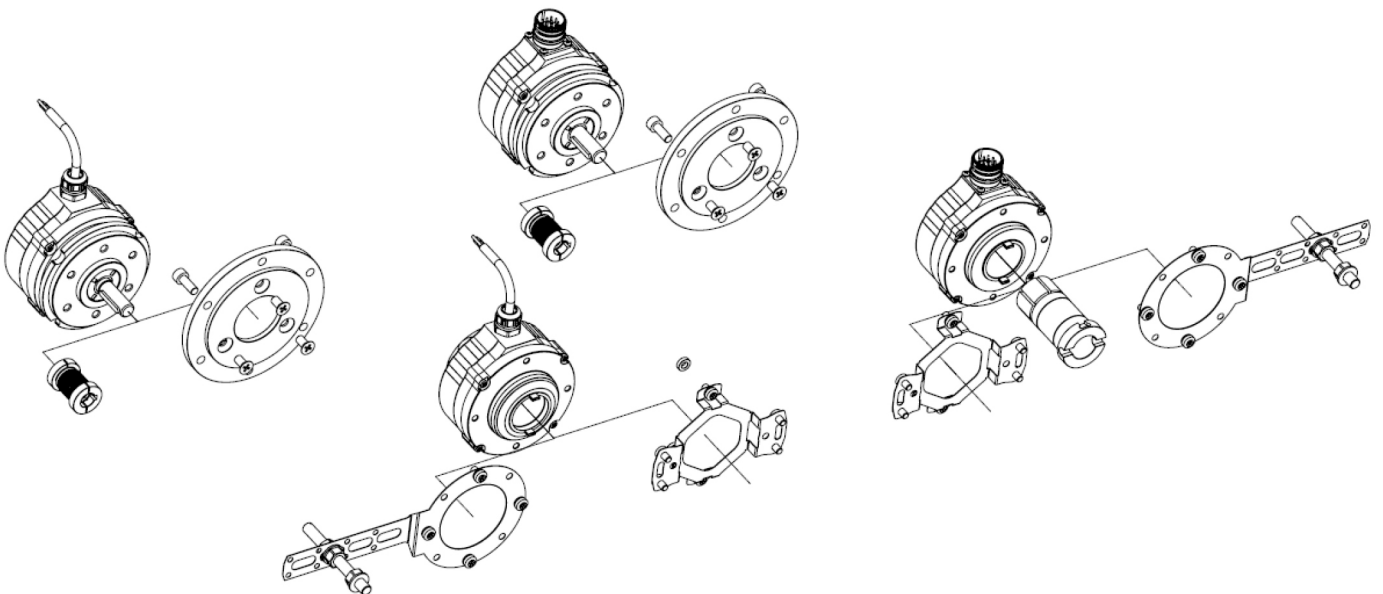
Mounting cautions and mechanical interface configurations are described in detail in the next sections.

TECHNICAL FEATURES**2.2.2 Mechanical configurations possibilities**

Design form 58 mm



Design form 90 mm



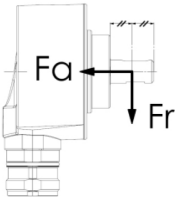
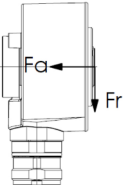
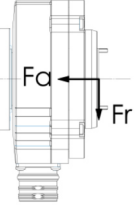
Generic mechanical outline drawings for design form 58 mm, 59 mm and 90 mm are available in the datasheets [SOI17171](#), [SOI17172](#), [SOI17173](#), [SOI17174](#) and [SOI17198](#) and specific configurations drawings are available on request.

TECHNICAL FEATURES

2.2.3 Mechanical specifications

Mechanical specifications depend on the product configuration. Consequently, refer to datasheets [SOI17171](#), [SOI17172](#), [SOI17173](#), [SOI17174](#) and [SOI17198](#) for detailed information.

2.2.4 Bearings lifetime

Scheme	Model	Axial/radial load (N) (Fa/Fr)	Continuous speed (rpm)	Lifetime, L ₁₀ h* (hours)
	SOI58 with solid shaft and SOI58-HK with tapered blind hollow shaft	40 / 80	6000	36,392
		20 / 40	6000	82,365
	SOI59 with solid shaft	50 / 100	3000	26,150
	SOI58-T with through hollow shaft and SOI58-HB with blind hollow shaft	20 / 40	6000	>100,000
		10 / 20	6000	>100,000
	SOI90-T with through hollow shaft	25 / 50	3000	> 100,000
		12.5 / 25	3000	> 100,000

* According to ISO 281: 1990, L₁₀. Values are calculated based on the complete temperature range of the encoder.

TECHNICAL FEATURES

2.2.5 Accessories

2.2.5.1 Stator couplings

Stator couplings are designed to provide a high degree of angular stability while at the same time allowing compensation for the driving shaft runout and dimensional errors as well as any normal axial shaft movement.

CAUTION

Exceeding the values listed below drastically reduces the expected life time of the products. Avoid working at or near the load limits and take into account the relation between misalignment and lifetime expectancy.



CAUTION

Stator couplings have limited angular rigidity. High shocks or vibrations at low frequency may induce temporary angle shifts, depending on constraint level and connection output direction.

Avoid orienting the connection output 90° from the expected direction of shocks in the application.



If shocks/vibrations levels around the specification limit are expected in the application, consider using a cable output or compact M12 connection.

The complete mounting set for stator couplings including all fasteners are available under the following part numbers described in the next few pages.

Stator coupling set for design form 58 and 59

Part Number (P/N)		Included fasteners
on request		5x Torx M3x6mm 1x Torx M4x6mm + ribbed washers
Permissible misalignments	Axial	+/-1 mm
	Radial	+/-0.2 mm
	Perpendicularity	+/-2°
	Runout	0.1 mm
Angular rigidity		>600 Nm/rad

Tether arm set for design form 58 and 59

Part Number (P/N)		Included fasteners
on request (compatible with all 58mm housings models)		3x Torx M3x6mm + ribbed washers 3x M6 nuts + washers 1x M6x60mm threaded rod
Permissible misalignments	Axial	+/-1 mm
	Radial	+/-0.2 mm
	Perpendicularity	+/-5°
	Runout	0.1 mm
Angular rigidity		>100 Nm/rad

TECHNICAL FEATURES

Stator coupling set for design form 90

Part Number (P/N)		Included fasteners
on request		6x Torx M5x8mm 4x Hex M5x8mm + ribbed washers
Permissible misalignments	Axial	+/-1.5 mm
	Radial	+/-0.3 mm
	Perpendicularity	+/-3°
	Runout	0.1 mm
Angular rigidity		>500 Nm/rad

Tether arm set for design form 90

Part Number (P/N)		Included fasteners
on request		4x Torx M5x8mm + ribbed washers 3x M8 nuts + washers 1x M8x80mm threaded rod
Permissible misalignments	Axial	+/-2 mm
	Radial	+/-0.3 mm
	Perpendicularity	+/-5°
	Runout	0.1 mm
Angular rigidity		>500 Nm/rad

TECHNICAL FEATURES

2.2.5.2 Flanges

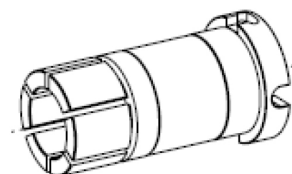
Adapter flanges are available on request.

2.2.5.3 Sleeves

The use of Variable Frequency Drives (VFD's) or industrial DC motors often results in leakage currents on the driving shaft. Use an insulated sleeve "SRS" Safety Reduction Sleeve" to prevent these leakage currents from damaging the encoder bearings and reducing their service life.

Reduction sleeve minimum insulation: 2,5 kV.

Sleeves are available on request.



2.2.5.4 Cable-connector assemblies

For safety applications, we recommend using qualified cable-connector assemblies. Refer to dedicated specification sheet for details.

TWK-ELEKTRONIK is not responsible for cable-connector assemblies not supplied by the company.

2.3 Electrical specifications

2.3.1 Power supply

	5V electronics	11-30V electronics
Supply voltage +V, minimum current	5VDC +/-5%, 250mA	11V to 30VDC, 250mA
Ripple	±250mV	
Consumption without load	Sin/cos: 70mA max. Digital: 100mA max.	
Consumption with load	Sin/cos: 100mA max. Digital (TTL & HTL): 220mA max.	
Output current	Sin/cos: 10mA max by pair Digital (TTL&HTL): 40mA max by pair	
Min max load	Sin/cos & TTL: 100 ohms – 240 ohms	HTL at 30V: 750 ohms – 3k ohms HTL at 24V: 600 ohms – 3k ohms HTL at 11V: 275 ohms – 3k ohms Sin/cos & TTL: 100 ohms – 240 ohms
Supply type	Power supply according to SELV/PELV with a maximum 60VDC fault. The power supply voltage must be monitored.	Power supply according to SELV/PELV with a maximum 60VDC fault.

TECHNICAL FEATURES

2.3.2 Electrical protections

	11-30 V, sin/cos and TTL	5 V, sin/cos and TTL and 11-30 V, HTL
Polarity inversions	Yes	Yes
Short circuits	0V = yes +V = no To other signals = yes	0V = yes +V = yes To other signals = yes
Overvoltages	Exceeding the nominal supply voltage range may definitely damage the encoder (stay in safe mode up to 60V in both cases).	
Surges/transients	Yes	

For further details on electrical immunity, refer to [chapter "2.4.4 EMC"](#).

2.3.3 Output signals

Digital	Sine/Cosine
<p>The safety encoders digital signal:</p> <ul style="list-style-type: none"> • A first safety channel named "channel 1" composed of a signal A and a signal inverted A/ • A second safety channel named "channel 2" composed of a signal B and a signal inverted B/ • A third channel not for safety named "channel 0" composed of a signal index Z and a signal inverted Z/ <p>Channel 2 (B) before channel 1 (A) (90° period phase shift), clockwise shaft rotation viewed from flange side.</p>	<p>The safety encoders analog signal:</p> <ul style="list-style-type: none"> • A first safety channel named "channel 1" composed of a Sine signal and a Sine inverted signal • A second safety channel named "channel 2" composed of a Cosine signal and Cosine inverted signal • A third channel not for safety named "channel 0" composed of a signal Index and a signal inverted Index <p>Channel 2 (cosine) before channel 1 (sine) (90° period phase shift), clockwise shaft rotation viewed from flange side.</p>
<p>Response time 4µs typical</p>	<p>Response time 2µs typical</p>
<p>Initialization time Refer to chapter "3.1 Safety Encoder function / Safe state"</p>	

TECHNICAL FEATURES

Output signal specifications (typical data, not relevant for safety purpose):

	Digital	Sine/cosine
Phasing tolerance	90° +/-10°	90° +/-10°
Harmonics	N/A	< -45 dB
Output signal frequency	300kHz max. depending on cable length. Refer to chapter "4.1.2 General electrical and wiring precautions" for further details.	
Amplitude tolerance per signal	N/A	500 mVpp +/-20 %
Amplitude difference between signals	N/A	<=50mV
Offset value per signal	N/A	2.5 V +/-500 mV
Offset difference between signals	N/A	<=50 mV
Duty cycle	50 % +/-5 %	N/A
Jitter	<2 %	N/A

Safety monitoring:

	Digital	Sine/cosine
Safety monitoring tolerance	Digital signals are computed from sine/cosine signals (1 Vpp) which are internally monitored in a Lissajous diagram by a conformity area defined between two circles of amplitude: Vmin=0.5 V Vmax=1.3 V	Sine/cosine signals (1 Vpp), minimum and maximum alarms are determined in a Lissajous diagram by a conformity area defined between two circles of amplitude: Vmin=0.4 V Vmax=1.3 V

2.3.4 Recommended receiver circuitry

Refer to [chapter "3.2 Prerequisites for safe system loop"](#) on the present manual for the external monitoring needed.

Refer to [chapter "2.3.1 Power supply"](#) on the present manual for the interface loads considerations.

2.4 Environmental specifications

2.4.1 Ingress protection

Refer to the datasheets [SOI17171](#), [SOI17172](#), [SOI17173](#), [SOI17174](#) and [SOI17198](#) for the IP rating in each product configuration.

TECHNICAL FEATURES

CAUTION

Overheating of the encoder could cause irreversible mechanical damage leading to a potential loss of seal. Any encoder which has been subjected to temperatures outside its rated specifications loses its safety rating.



CAUTION

IP rating provided in encoder specs sheets applies to the encoder's envelop only. For encoders equipped with cable, the cable extremity is not included in the IP rating and depends on the end of cable configuration (flying leads, connector type, terminals...). If any IP level is required in the end of cable area, consult TWK.



2.4.2 Operating temperatures

Working temperature range for all encoders of model SOI is from -20 °C to +85 °C. This temperature range corresponds to the housing surface temperature. The de-rating parameters listed below must be taken into account when estimating the maximum permissible ambient temperature range in the application.

CAUTION

Operating admissible ambient temperature is dependent on the parameters listed in the table below.



De-rating parameters	Value
Power supply*	Typically, higher voltage and current ratings on power supplies have a higher power dissipation of the input stage of the encoder.
Electrical loads*	The lower the output load is, the more heating will occur due to higher current flow. However, never exceed the highest value of output load given in the documentation.
Mechanical loads*	Mechanical heating is influenced by the load on the bearing block and speed as noted below.
Application power dissipation*	Encoder's surface temperature is dependent on the configuration of the area around the device: heat transmission with other parts (frame, shaft, radiator...), to the air (air flow)/liquid/dust.
Encoder speed*	<p>The temperature given on the following charts is to add to the ambient temperature. It must never exceed the maximum T°C given by the datasheets SOI17171, SOI17172, SOI17173, SOI17174 and SOI17198.</p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Model SOI58 and SOI58-HK</p> </div> <div style="text-align: center;"> <p>Model SOI58-T and SOI58-HB</p> </div> </div> <div style="text-align: center; margin-top: 20px;"> <p>Model SOI90-T</p> </div> <p style="text-align: center; margin-top: 20px;">Model SOI59: on request</p> <p>These temperature elevations are typical values which should be considered as indications only.</p>

* For further information on de-rating parameters, please contact TWK.

TECHNICAL FEATURES

2.4.3 Chemical protection

Standard housings have been submitted to salt spray test – EN 60068-2-11 / Part 2, Test type Ka - according to their respective datasheet. Chromated zinc alloy cover option has not been tested per salt spray test.

Aluminum covers are protected by coating (liquid or epoxy powder).

All shafts are AISI 303 stainless steel, except at model SOI59: AISI 316.

Connectors and cable glands are nickel-plated brass or stainless steel.

Rotary seals and O-rings are in Nitrile. Detailed specifications are available on request.

Several cable jacket materials are available (PVC, PUR (on req.) or Silicone). Environmental specifications are available on request.

2.4.4 EMC

All encoders of model SOI are compliant with EMC as detailed below:

2.4.4.1 Emission

According to general standard **EN 61000-6-4**

Phenomenon	Basic standard	Level
Radiated emission	EN 5016-2-3	Test from 30MHz to 1GHz, 3m distant antenna

2.4.4.2 Immunity

According to general standard **EN 61000-6-2**.

The increased levels are in accordance with the IEC 62061 (2005) & IEC 61800-5-2:2016.



Port	Phenomenon	Basic standard	Increased value for additional tests for SRECS performance
Enclosure	Electrostatic discharge (ESD) - Contact	IEC 61000-4-2	6 kV 8 kV onto cabinet/enclosures, 3x discharges
	Electrostatic discharge (ESD) - Air	IEC 61000-4-2	8 kV 15 kV onto cabinet/enclosures, 3x discharges
	Electromagnetic (EM) field	IEC 61000-4-3	20 V/m (80 MHz - 1 GHz) 10 V/m (1.4 GHz - 2 GHz) 1 V/m (2 GHz - 2.7 GHz) 1 V/m (2.7 GHz-6 GHz)
	Rated power frequency magnetic field	IEC 61000-4-8	30 A/m
VDC Power	Burst	IEC 61000-4-4	4 kV 5x duration
	Surge	IEC 61000-4-5	2 kV line-to-ground 3x pulses
	Conducted RF	IEC 61000-4-6	20 V
	Voltage dips / Supply interruptions (remaining Voltage)	IEC 61000-4-29 IEC 61496-1	40 % @0.5 periods 70 % @0.5 periods
I/O signals / Control lines	Burst	IEC 61000-4-4	2 kV 5x duration
	Surge	IEC 61000-4-5	2 kV line-to-ground
	Conducted RF	IEC 61000-4-6	20 V
Functional earth	Burst	IEC 61000-4-4	2 kV

To fully comply with the EMC performance test done, the encoder body and the cable shield must be grounded.

FUNCTIONAL SAFETY

3. FUNCTIONAL SAFETY

3.1 Safety Encoder function / Safe state

Digital	Sine/Cosine
<p>Safety function</p> <p>The safety function ensured by the device is to convert a mechanical rotation into secured electrical information readable by electronics.</p> <p>If a fault is detected, the internal monitoring of the encoder, switches all the outputs to the safe state.</p> <p>Due to the monitoring tolerances in the diagnosis of the sine/cosine wave signals, there is an uncertainty angle in the safety function. This uncertainty angle is less than one quarter of the period of the encoder resolution.</p>	
<p>Safe state</p> <p>One or more of the outputs in high-impedance, with or without power supply encoder consumption.</p> <p>High-impedance output leakage current: +/-10 µA.</p> <p>In case of error, the internal monitoring is able to switch off the outputs in less than 200 ms.</p>	<p>Safe state</p> <p>One or more of the outputs in high impedance, with or without power supply encoder consumption.</p> <p>High-impedance output leakage current: +/-1 µA.</p> <p>In case of error, the internal monitoring is able to switch off the outputs in less than 50 µs.</p>
<p>Initialization time</p> <p>After a power-up, the initialization time for outputs signal activation is around 30ms, and around 250 ms (560 ms maximum) for internal monitoring activation.</p> <p>WARNING</p> <p>During the initialization time, the output signals are not under internal monitoring. </p> <p>The external monitoring needs to be tolerant to that unsafe initialization time, which does not exceed 560ms.</p>	<p>Initialization time</p> <p>After a power-up, the initialization time for outputs signal and internal monitoring activation is around 30 ms.</p>
<p>Reset</p> <p>When a fault is detected the following procedure must be followed:</p> <ul style="list-style-type: none"> Analyze the reason of the fault If it is not linked to exposure to a parameter over its absolute maximum rating, fault may be reset by switching off and switching on the device again <p>WARNING</p> <p>In case of exposure to an environmental parameter over its absolute maximum rating, or if the fault repeats without a verifiable and clearly identified reason, the use of the unit may result in a potentially hazardous situation. Replace encoder immediately. </p>	

FUNCTIONAL SAFETY

3.2 Prerequisites for safe system loop

In **speed applications not using the direction feature**, the channels 1 and 2 can be considered as redundant.

In **positioning applications** or in **speed applications using the direction feature**, the requirements for diagnostic are increased because the channels 1 and 2 cannot be considered as redundant.

According to these statements and depending on the intended level of the safety loop:

External Safety Loop Prerequisites								
Electrical Encoder Version	Form-fit	Cable break detection	Safe voltage supply with monitoring	Vector length monitoring	Speed comparison	Zero crossing detection	Inverse signal monitoring	Exclusive bit check
5 V, sin/cos	O	O	X ⁽¹⁾	X	X	X		
11-30 V, sin/cos	O	O		X	X	X		
5 V, TTL	O	O	X		X		X	X ⁽¹⁾
11-30 V, HTL	O	O			X		X	X ⁽¹⁾
11-30 V, TTL	O	O			X		X	X ⁽¹⁾

O: Prerequisite for all safety levels

X: Additional prerequisite for SIL3/PLe.

(1): Not needed in case of SIL3/PLe speed **without** direction.

FUNCTIONAL SAFETY

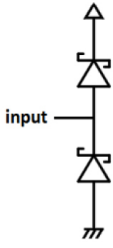
Detailed external safety loop prerequisites description:

<p>Form-fit (Digital and sine/cosine versions)</p>	<p>The form-fit (or fault exclusion for mechanic connections) means that the encoder shaft must be safely and firmly coupled with the driving shaft, to avoid any uncontrolled slippage phenomena.</p> <p>The mechanical precautions and mounting procedure must be followed to prevent accidental encoder rotation/destruction caused by a stator coupling, tether arm or synchro flange failure.</p> <p>Form-fit prerequisite is achieved by the use of a key locking construction (Key/Keyway) or "Positive locks".</p>
<p>Cable breakage control (Digital and sine/cosine versions)</p>	<p>Cable break detection is essential because all internally detected faults within the encoder as well as any loss of connection to the encoder will have to be detected on the external interface by this method.</p> <p>High impedance in one or more of the inputs of the safety PLC means a dangerous fault.</p>
<p>Safe voltage supply with monitoring (Digital and sine/cosine versions)</p>	<p>A SELV/PELV power supply is mandatory. In case of power supply failure, the voltage must never exceed 60 VDC.</p> <p>The 5 VDC +/-5 % power supply voltage must be monitored.</p>
<p>Vector length monitoring (Sine/cosine versions)</p>	<p>The analogue signals are evaluated according to the equation $k \cdot \sin^2(\alpha) + k \cdot \cos^2(\alpha) = k \pm \Delta k$, with $\sin(\alpha) = (S-S/)$ and $\cos(\alpha) = (C-C/)$.</p>
<p>Speed comparison (Digital and sine/cosine versions)</p>	<p>Speed comparison means that channel 1 and channel 2 are considered as to be redundant and shall have the same frequency within a tolerance.</p>
<p>Zero crossing detection (Sine/cosine versions)</p>	<p>This differential monitoring measures the offset of the inverted and non-inverted signals.</p> <p>A difference in the offset measurement means that the signals cannot cross together, meaning they are corrupted. Not operational in stationary state.</p>
<p>Inverse signal monitoring (Digital versions)</p>	<p>In each safety digital channel, the non-inverted (A and B) and inverted (A/ and B/) signals must at all times, have an opposite signal level.</p> <p>During the transition state, a very short period of a few microseconds showing the same signal level is allowed.</p>
<p>Exclusive bit check (Digital versions)</p>	<p>The code formed by the safety digital signal A (from channel 1) and B (from channel 2) is comparable to a 2 bit Gray code: at any time, there is only one bit changing.</p> <p>In case of a simultaneous bit changing, it must be considered as a dangerous fault.</p> <p>The same is true for the 2 bit code formed by the inverted ones A/ and B/.</p> <p>This diagnostic method is required for positioning applications and for speed applications with direction.</p>

FUNCTIONAL SAFETY

Additional precautions for safe system loop:

Digital							
Output voltage levels							
Insure that the PLC is compatible with the Low Level and High Level of the output encoder signal displayed on the table below:							
Version	+V	Low Level signal (20 mA)			Low Level signal (20 mA)		
		Min.	Typ.	Max.	Min.	Typ.	Max.
11-30 V, HTL	11 V to 30 V	0 V	0.5 V	2.5 V	+V – 3 V	+V – 0.5 V	+V
11-30 V, TTL	11 V to 30 V	0 V	0.5 V	2.5 V	3.5 V	4.8 V	5.4 V
5 V, TTL	5 V+/-5 %	0 V	0.5 V	2.5 V	3.5 V	+V – 0.5 V	+V
Power supply voltage, frequency, cable length, wire cross-section, receiver input impedance may have effects on the transmitted signals.							

Digital	Sine/Cosine
Interpolation Digital output signals cannot be interpolated.	Interpolation The output signals must not be interpolated in safety relevant applications.
User inputs protection A dual power Schottky diode combination is recommended at each user input in order to clamp the signal to 0 V-5 V range in case of devices with 5 V TTL, 11-30 V TTL, 5 V sin/cos and 11-30 sin/cos electronics or 0 V-11/30 V range in case of 11-30 V HTL electronics.	
<p>WARNING</p> <p>Direction The shaft direction can be deduced by the 90° phase between channel 1 and channel 2. The use of this feature adds requirements. Check “External Safety Loop Prerequisites” table above.</p> <p>Index channel The encoder may deliver an impulse signal, one time per revolution. The index channel (Z, Z/) is not part of the safety function.</p>	

3.3 Safety related figures

Safety incremental encoders with electronics: 5 V, TTL	PFDavg 1/h	PFH 1/h	MTTFd years	DCavg %	Mission Time	SIL	PL
Speed sensing applications (partly redundant) @40 °C	5.63E-05	6.42E-10	1547	96.49	20 years	SIL3	PLe Cat. 4
Speed sensing applications (partly redundant) @80 °C	2.53E-04	2.89E-09	340	96.31			
Positioning applications (single channel) @40 °C	7.51E-05	8.58E-10	1331	99.00			
Positioning applications (single channel) @80 °C	3.45E-04	3.94E-09	290	99.00			

FUNCTIONAL SAFETY

Safety incremental encoders with electronics: 5 V, sin/cos	PFDavg 1/h	PFH 1/h	MTTFd years	DCavg %	Mission Time	SIL	PL
Speed sensing applications (partly redundant) @40°C	4.29E-05	4.90E-10	2328	99.00	20 years	SIL3	PLe Cat. 4
Speed sensing applications (partly redundant) @80°C	1.93E-04	2.20E-09	519	99.00			
Positioning applications (single channel) @40°C	4.29E-05	4,90E-10	2328	99.00			
Positioning applications (single channel) @80°C	1.93E-04	2.20E-09	519	99.00			

Safety incremental encoders with electronics: 11-30 V, TTL	PFDavg 1/h	PFH 1/h	MTTFd years	DCavg %	Mission Time	SIL	PL
Speed sensing applications (partly redundant) @40°C	7.63E-05	8.72E-10	1180	97.02	20 years	SIL3	PLe Cat. 4
Speed sensing applications (partly redundant) @80°C	3.46E-04	3.95E-09	258	96.88			
Positioning applications (single channel) @40°C	9.52E-05	1.09E-09	1050	99.00			
Positioning applications (single channel) @80°C	4.38E-04	5.00E-09	228	99.00			

Safety incremental encoders with electronics: 11-30 V, HTL	PFDavg 1/h	PFH 1/h	MTTFd years	DCavg %	Mission Time	SIL	PL
Speed sensing applications (partly redundant) @40°C	7.63E-05	8.72E-10	1180	97.02	20 years	SIL3	PLe Cat. 4
Speed sensing applications (partly redundant) @80°C	3.46E-04	3.95E-09	258	96.88			
Positioning applications (single channel) @40°C	9.52E-05	1.09E-09	1050	99.00			
Positioning applications (single channel) @80°C	4.38E-04	5.00E-09	228	99.00			

Safety incremental encoders with electronics: 11-30 V, sin/cos	PFDavg 1/h	PFH 1/h	MTTFd years	DCavg %	Mission Time	SIL	PL
Speed sensing applications (partly redundant) @40°C	6.60E-05	7.53E-10	1515	99.00	20 years	SIL3	PLe Cat. 4
Speed sensing applications (partly redundant) @80°C	2.97E-04	3.39E-09	336	99.00			
Positioning applications (single channel) @40°C	6.60E-05	7.53E-10	1515	99.00			
Positioning applications (single channel) @80°C	2.97E-04	3.39E-09	336	99.00			

FUNCTIONAL SAFETY

3.4 Examples of safety functions

In order to achieve one or more safety functions in a system, a safe drive or PLC needs a Safe Encoder as a safe speed sensor and/or as a safe relative position sensor and/or as a safe direction sensor.

The combination of a safe encoder from TWK-ELEKTRONIK GmbH with an appropriate drive or PLC can achieve the following functions amongst others (up to SIL3 / PLe / Cat. 4):

Safety function	Description (purpose of the encoder in the particular safety function)
SLS (Safely-Limited Speed)	Speed limit value supervision
SSM (Safe Speed Monitor)	Speed actual value supervision
SLA (Safely-Limited Acceleration)	Acceleration limit value supervision
SAR (Safe Acceleration Range)	Acceleration actual value supervision
SDI (Safe Direction)	The phase between channels 1 and 2 is monitored
SS1 (Safe Stop 1) / SS2 (Safe Stop 2)	Monitoring/controlling of the braking ramp by speed value supervision
SOS (Safe Operating Stop)	Position at standstill value is monitored
SLP (Safely-Limited Position)	Position limit value is monitored
SEL (Safe Emergency Limit)	Position limit value is monitored
SLI (Safely-Limited Increment)	Position counting limit value is monitored
SCA (Safe Cam)	Position limit value is monitored

CAUTION

Safe stop applications With a Digital encoder version, there is a small angle rotation which does not generate change on A A/ or B B/. The amplitude of this angle is equal to a quarter period of safety signal. The user has to check if this small angle is compatible or not with his safety stop needs.



3.5 Certifications

This product has been certified by TÜV Rheinland Industrie Service GmbH, Am Grauen Stein, 51105 Köln

Assessment number:



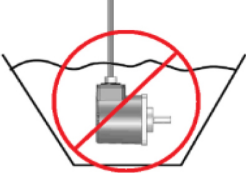

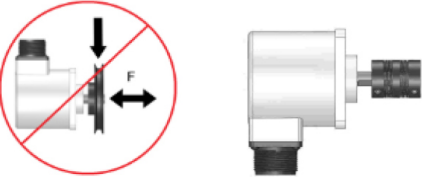





INSTALLATION AND START UP

4. INSTALLATION AND START UP


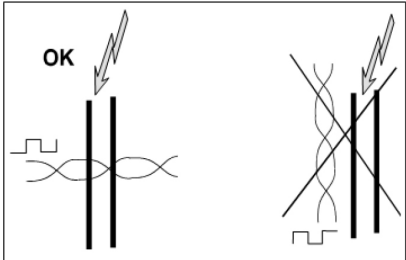
4.1 General cautions

4.1.1 General mechanical precautions

 <p>No shocks nor excessive stresses</p>	 <p>Do not alter the part with any tool</p>	 <p>Do not dip encoder into water, check encoder IP code</p>
 <p>Do not drop</p>	 <p>Do not hard couple encoder to driving shaft. Instead use flexible couplings to minimize stress on encoder bearings</p>	 <p>Do not dismantle nor repair</p>
 <p>Do not carry the encoder by the cable</p>	 <p>Avoid installing with shaft upright, liquid may pool and eventually cause internal leaking. If encoder's shaft is orientated vertically, it is recommended to use a protective cap to avoid liquid retention in sealing areas.</p>	

INSTALLATION AND START UP



4.1.2 General electrical and wiring precautions

Generalities	General parameters given in the datasheet or in this manual (electrical and environmental) may never be exceeded.			
	Respect the standard recommendations governing the use of cables and other connection devices in industrial applications, including all the recommendations listed in this table.			
Mechanical precautions	Identify the axis along which the most critical shocks/vibrations are expected. For limiting stress on stator coupling, the connection should be orientated along that axis.			
	The connection should be oriented to avoid liquid retention: pointing downwards is preferred, but not above a horizontal orientation.			
	Protect the cables to avoid a cut or damage during operation, otherwise protection degree could be compromised.			
	Do not pull cable during mounting and operation.			
	Avoid loads generated on the encoder by eventual cable tension. Always provide a service loop between encoder and the first cable clamp.			
	Bending radius:			
	Cable type <small>(refer to datasheets for SOI for details)</small>	Jacket material	Smallest bending radius <small>(static use)</small>	Smallest bending radius <small>(dynamic use)</small>
8230 / 020 and 8230 / 005 (8-wire cable)	020: PVC 005: Silicone	020: 30 mm 005: 30 mm	020: Not recommended 005: 60 mm	
Electrical precautions	WARNING			
	Never connect the encoder to mains (115 V, 220 V...)! 			
	Never operate with a cable which is totally or partially coiled. It could lead to EMC disturbances or irreversible electrical damage on the installation.			
	Never connect outputs together.			
	Never connect outputs to a potential.			
	Never use the same cable for driving power and encoder signals: separate output data signal cables (low voltage) and potentially interfering signal cables (higher voltage, such as power supply, frequency drive, etc.) with a grounded metal screen. Do not let power and signal cables run parallel – Cross them perpendicularly.			
Power supply wires section				
When using 5 V power supplies, care must be taken on conductor cross-section. A small conductor cross-section can cause power supply voltage drop on the cable, on 0V and +V wires.				
TWK Sensors cable-connectors assemblies are recommended. If using another cable type, contact customer service for more information.				
Ensure that cable impedance is meets the following parameter for connection to the encoder:				
Max. impedance		100 ohms/km		

INSTALLATION AND START UP

Electrical precautions	Signal wires section	
	A section of 0.14 mm ² up to 0.22 mm ² is recommended in order to avoid heavy capacitance between signals causing coupling.	
	Max. impedance	150 ohms/km
	Max. capacitance between wires	100 pF/m
	Max. capacitance wires to shield	150 pF/m
	Check that the user electrical input interface is compliant with the external loads required on chapter "2.3 Electrical specifications" .	
	Check that the required external monitoring is available on the Safe PLC/drive.	
	Check that cable length is adapted to your application in terms of max. frequency and electronics type:	
	Electronics	Electrical operating area (for TWK Sensors cables)
	5 V, sin/cos, 11-30 V, sin/cos, 5 V, TTL, 11-30 V, TTL	<p>In 5 V power supply versions with long cables, a power voltage sensing feedback may be needed to maintain a 5 V voltage on the encoder side due to voltage drop on the power supply lines.</p>
11-30 V, HTL @ 11 V		
11-30 V, HTL @ 24 V		
11-30 V, HTL @ 30 V		

INSTALLATION AND START UP

<p>Wiring precautions</p> <p>Installation precautions</p>	<p>WARNING</p> <p>The safety encoder function requires that the four safety signals (AA/ and BB/ in digital versions or SS/ and CC/ in sine versions) are connected to the safe PLC.</p> <p>Never leave one of these signals unused! They must always be connected and used in the safety loop.</p> 
	<p>CAUTION</p> <p>The channel 0 (Z and Z/) is not a part of the safety function!</p> <p>In case Z and Z/ are not used in the application, connect each of them to pull down 3 kohms resistors connected to 0 V.</p> 
	<p><u>Shield connection</u></p> <p>Ensure that encoder's body and cable shield extremity are both connected to the same potential grounds.</p> <p>Do not cut nor leave the ground point unconnected.</p> <p>In the cabinet, connect the encoder cable surrounding screen to the ground point if available, otherwise to the 0 V (signal common).</p> <p>To avoid destructive electrostatic discharging shaft phenomena, always ground the encoder housing.</p> <p>If a metallic connector is assembled by the user on the encoder cable, ensure a 360° contact on that connector.</p> <p>When using a shielded pair cable, always connect signals of the same channel to the same twisted pair: A with A/, B with B/ and Z with Z/.</p>
	<p>Verify that all electrical devices are switched off before starting the installation.</p>
	<p>Check that you have all the necessary information on wiring connections: refer to the encoder label.</p>
	<p>Check that you have the right power supply.</p>

INSTALLATION AND START UP

4.2 Mechanical mounting procedure

4.2.1 Encoder preparation before installation

Before installation, define driving shaft design and material.

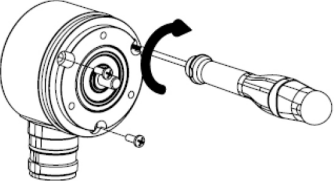
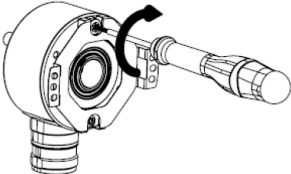
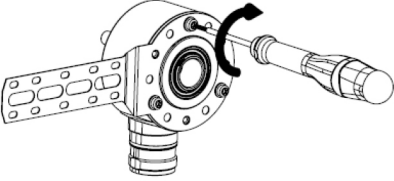
For a proper installation, driving shaft and coupling interface design (dimensions and tolerances) are recommended in the next sections dedicated to each model.

To avoid mechanical damage, driving shaft materials must be selected depending on various parameters:

- Shock/Vibration levels and direction and other environmental parameters.
- Encoder weight and other mechanical characteristics.

If additional technical information is required for defining encoder interfacing, contact TWK.

1- When delivered separately, install the flange mounting interface (flange / stator coupling / tether arm) on the encoder. Secure the fasteners (screws + ribbed lock washers) provided in the kit with threadlocker Loctite 243 or equivalent.

Flange	Stator coupling	Tether arm
		

Recommended tightening torques: **M3: 1.8 Nm / M4: 2.5 Nm / M5: 4.5 Nm**

2- For versions with connector:

CAUTION

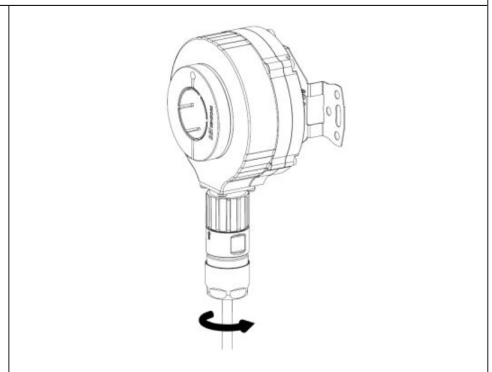
For M23 connector:

- Check that the O-ring is in place into the connector housing

For any connector version:

- If a deformation of the connector is detected do not try to plug it in

The IP rating is no longer ensured and the electrical connection can be affected if these recommendations are not followed.



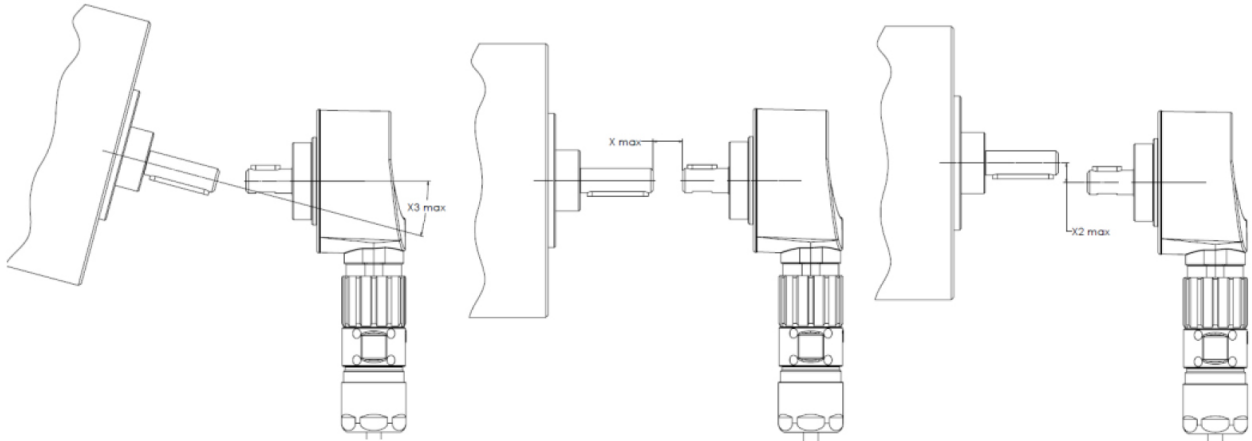
Make sure that the mating connector is well seated to ensure good electrical and mechanical contact and avoid loosening of the connection over time.

INSTALLATION AND START UP
4.2.2 Solid shaft at SOI58 and SOI59 - mounting instructions

1-2- Refer to [chapter "4.2.1 Encoder preparation before installation"](#).

3- Coupling:

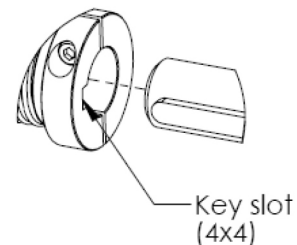
Before mounting, check the shaft run out and alignment. These parameters must be in accordance with the coupling's specifications.



Lateral misalignment has a negative effect on the service life of the couplings. Exact alignment of the coupling considerably increases the service life of the encoder. By reducing or eliminating lateral misalignment, the radial load on the adjacent bearing is reduced while increasing service life and reducing heat generation (see [chapter "2.2.4 Bearings lifetimes"](#)). It is important to remain within the coupling supplier Technical Specifications to operate within the permissible values for the three types of misalignment limits. This ensures long life and proper operation of the coupling.

Encoder shafts are machined with a key slot. Use a keyed coupling to secure rotation transmission.

Coupling dimensions and tolerances must comply with the shaft dimensions and tolerances given in the encoder's datasheet. It is recommended to use diameter XXmm H7 and Ra 0.4-1.6.

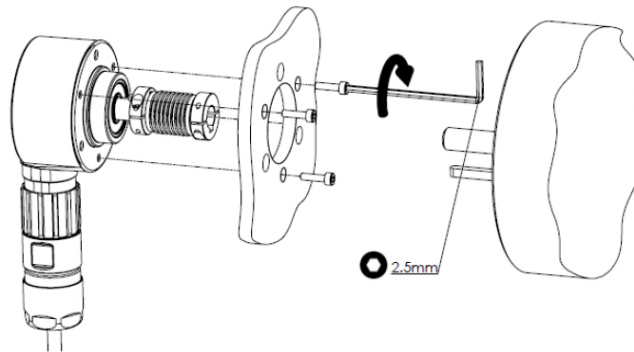
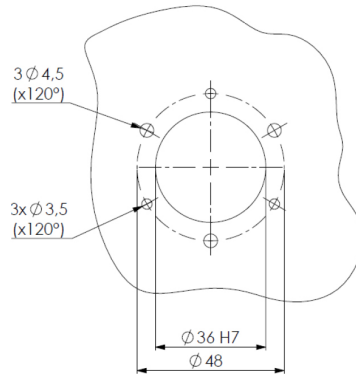


INSTALLATION AND START UP

4- Mount encoder on a mechanical frame (bell, bracket etc.).

Hole pattern

Use at least three M3 or three M4 screws for a safe assembly. Minimal screwing depth 5 mm for M3 and 6 mm for M4.



For a safe mounting secure the screws with appropriate washers and Threadlocker Loctite 243 or equivalent.

CAUTION

Design form 59: Specific caution: Shaft is 2.5 mm longer than at design form 58.

Be careful to take this into account in order to avoid any contact and wear of the sealing IP69K lip.


CAUTION

For mounting a gear, wheel or pulley refer to [chapter "2.2.1 Generalities"](#).


CAUTION

Refer to the Mechanical Precautions of [chapter "4.1.2 General electrical and wiring precautions"](#) for details about connection installation advices.



Respecting the precautions increases the sealing and the stator coupling lifetime.

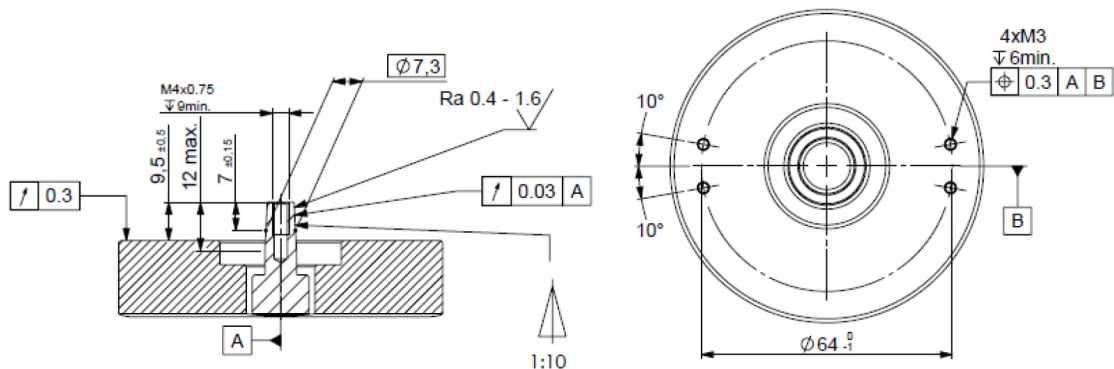
INSTALLATION AND START UP
4.2.3. Tapered blind hollow shaft at SOI58-HK - mounting instructions

 1-2- Refer to [chapter "4.2.1. Encoder preparation before installation"](#)

3- Mechanical interface configuration:

Check the driving shaft runout and tolerance: tapering 10 % at 7.3 mm diameter and insertion depth

Clean the shaft interfaces (avoid particles and burrs)



4- Install the encoder on driving shaft.

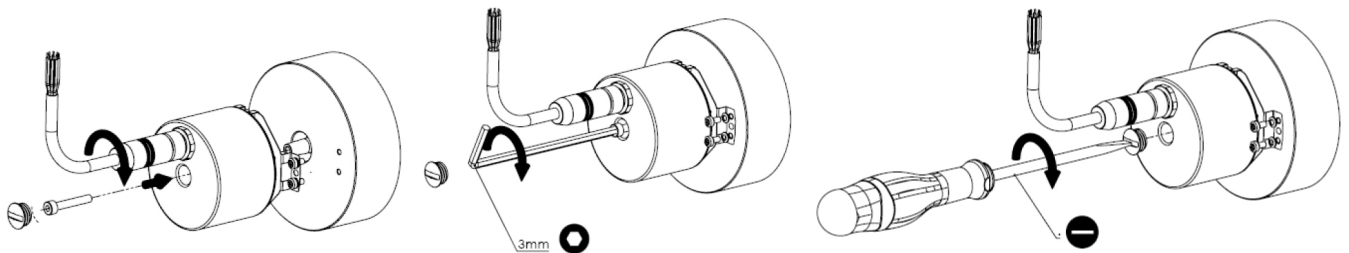
Plug the encoder and driving shafts together.

For a safe mounting secure the CHc M4x25mm screw with threadlocker Loctite 243 or equivalent.

Tighten the M4 shaft screw with recommended torque: 3.5 Nm +/-10%.

Tighten the axial sealing plug for insuring the IP protection with recommended torque:

- Slotted head (for axial covers): 3 Nm +/-10%
- Hex 8mm head (for radial covers): 4 Nm +/-10%


CAUTION

Check if the O-ring is in place into the plug groove
 The o-ring is lubricated, do not dry it
 If the plug can't be tightened smoothly, do not force

The IP rating is no longer insured if these recommendations are not followed



INSTALLATION AND START UP

5- Fasten the encoder on the frame

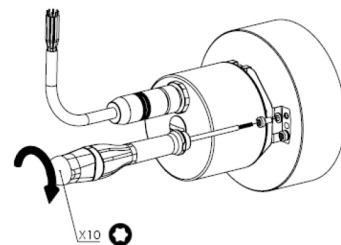
If encoder is equipped with a tether arm, replace this step by the instructions given in the [chapter „4.2.7. Tether arm – mounting instructions“](#).

Check the position of the stator coupling. Avoid compressing or extending it to insure a minimal load on the bearing block.

Tighten the 2 central or 4 shifted M3

screws at 1.8 Nm +/-10% with the ribbed lock washers.

For a safe mounting secure the screws with threadlocker Loctite 243 or equivalent.



CAUTION

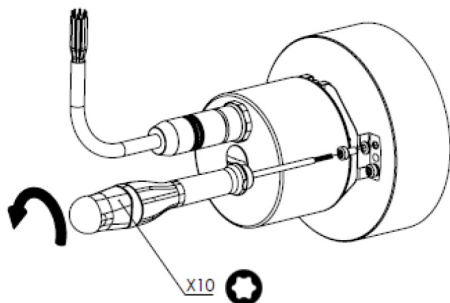
Refer to the Mechanical Precautions of [chapter “4.1.2. General Electrical and wiring precautions”](#) for details about connection installation advices.



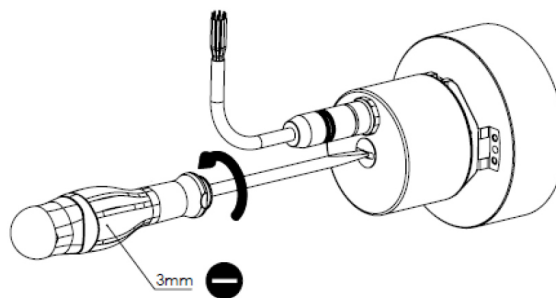
Respecting the precautions increases the sealing and the stator coupling lifetime.

Encoder extraction procedure:

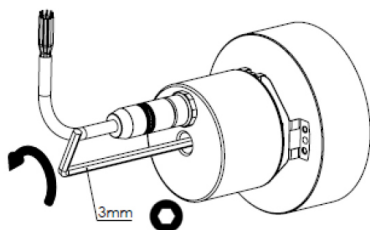
1- Unscrew the anti-rotation device



2- Remove the cover plug

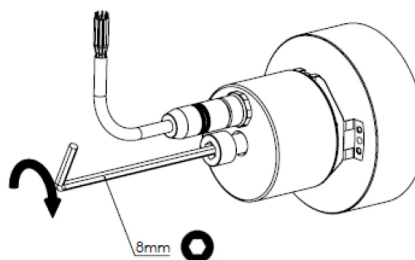


3- Unscrew slightly the CHc M4x25mm shaft screw (1 to 2 turns only)

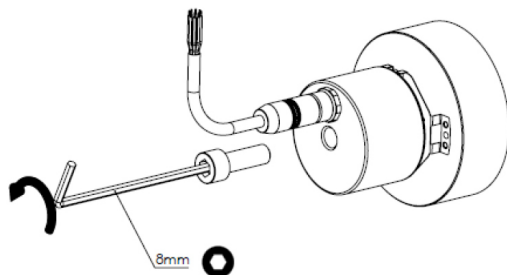


4- Screw a CHc M10x30mm (mini) extraction screw into encoder shaft.

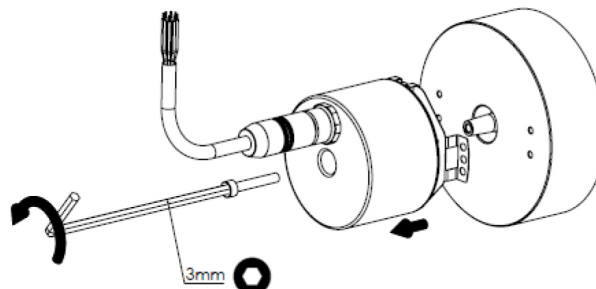
Apply progressive torque until encoder releases from driving shaft



5- Remove the CHc M10 extraction screw



6- Remove the CHc M4x25mm shaft screw



INSTALLATION AND START UP

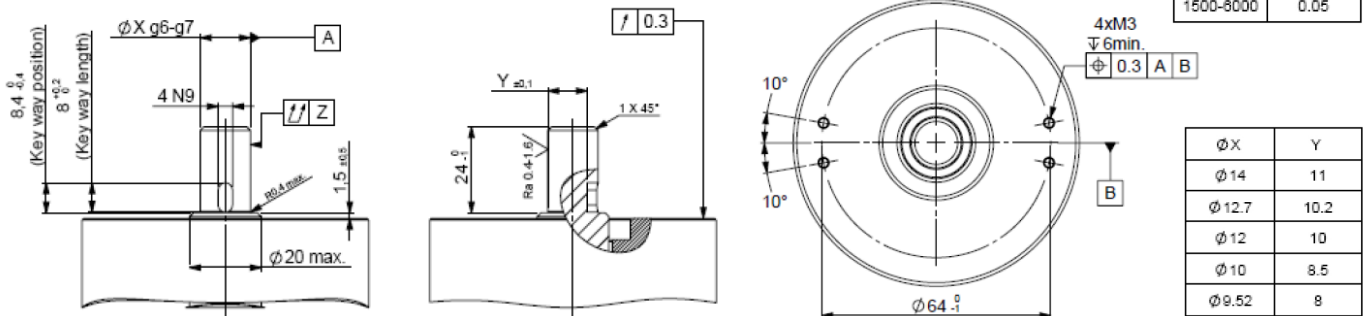
4.2.4 Blind hollow shaft at SOI58-HB - mounting instructions

1-2- Refer to [chapter "4.2.1. Encoder preparation before installation"](#)

3- Mechanical interface configuration:

Check the driving shaft runout and tolerance: diameter X H7
Clean the shafts interfaces (avoid particles and burrs)

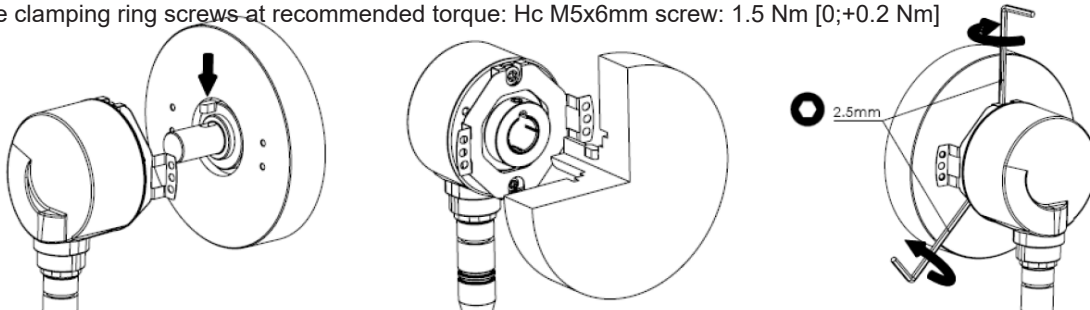
Speed (RPM)	Permissible runout Z
0-100	0.5
100-1500	0.3
1500-8000	0.05



4- Install the encoder on the driving shaft

For a safe mounting secure the screws 1 & 2 with threadlocker Loctite 243 or equivalent

- Install the key in the driving shaft key slot
- Align clamping ring and encoder shaft key slots together
- Slide encoder on driving shaft. Check that the key is fully engaged in the encoder key slot
- Tighten the clamping ring screws at recommended torque: Hc M5x6mm screw: 1.5 Nm [0;+0.2 Nm]



WARNING

This model can't be mounted with a retainer at the end of the driving shaft. An insufficient tightening of the clamping ring screw can lead to encoder axial sliding when coupled with axial shocks/vibrations. This case can lead to a dangerous situation (Stator coupling break). In any case, never exceed 10g of axial shock/vibrations on this configuration.



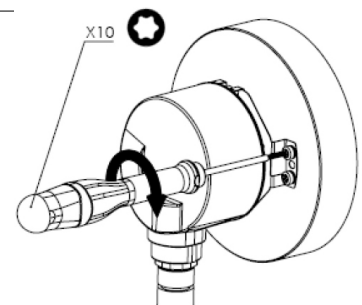
5- Fasten the encoder on the frame

If encoder is equipped with a tether arm, replace this step by the instructions given in the [chapter "4.2.7. Tether arm – mounting instructions"](#).

Check the position of the stator coupling. Avoid compressing or extending it to insure a minimal load on the bearing block.

Tighten the 2 central or 4 shifted M3 screws at 1.8 Nm +/-10% with the ribbed lock washers.

For a safe mounting secure the screws with threadlocker Loctite 243 or equivalent.



CAUTION

Refer to the Mechanical Precautions of [chapter "4.1.2. General Electrical and wiring precautions"](#) for details about connection installation advices. Respecting the precautions increases the sealing and the stator coupling lifetime.



INSTALLATION AND START UP

4.2.5 Through hollow shaft at SOI58-T - mounting instructions

1-2- Refer to [chapter "4.2.1 Encoder preparation before installation"](#)

3- Mechanical interfaces configuration:

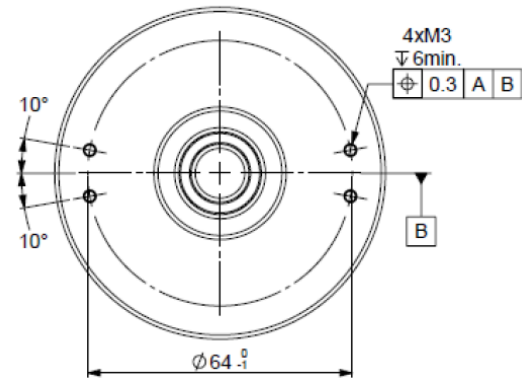
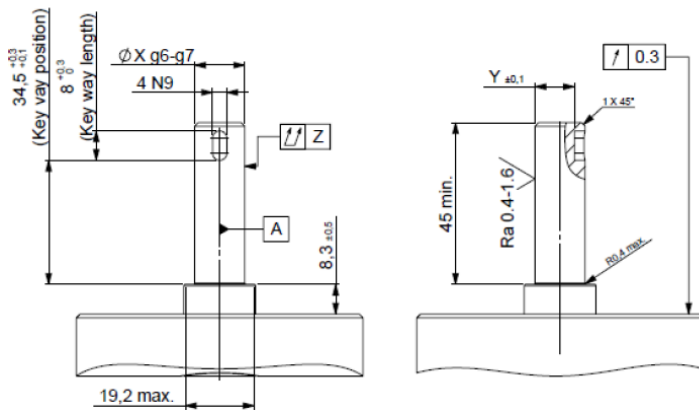
Check the driving shaft runout and tolerance: diameter X H7'.

Clean the shafts interfaces (avoid particles and burrs).

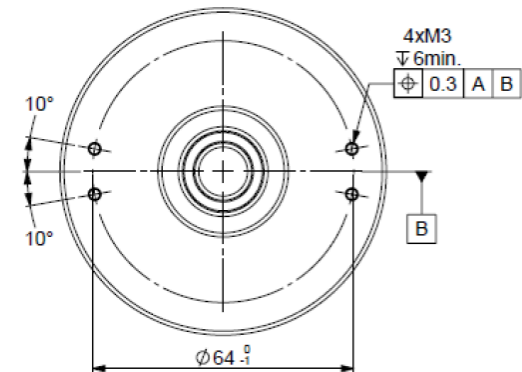
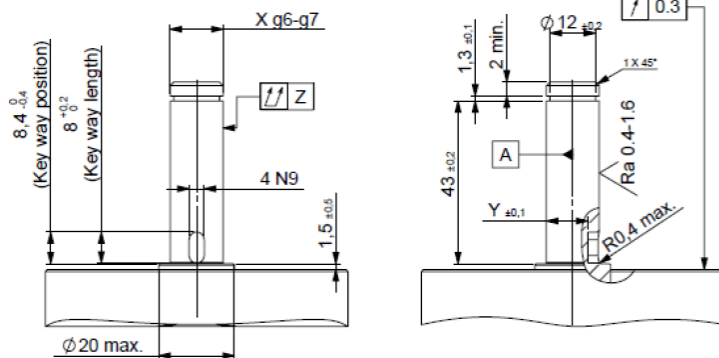
Speed (RPM)	Permissible runout Z
0-100	0.5
100-1500	0.3
1500-8000	0.05

ØX	Y
Ø14	11
Ø12.7	10.2
Ø12	10
Ø10	8.5
Ø9.52	8

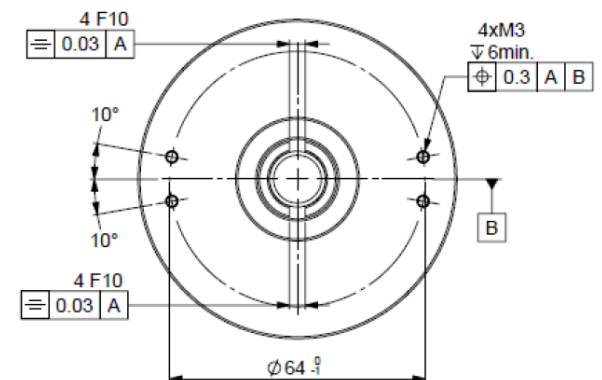
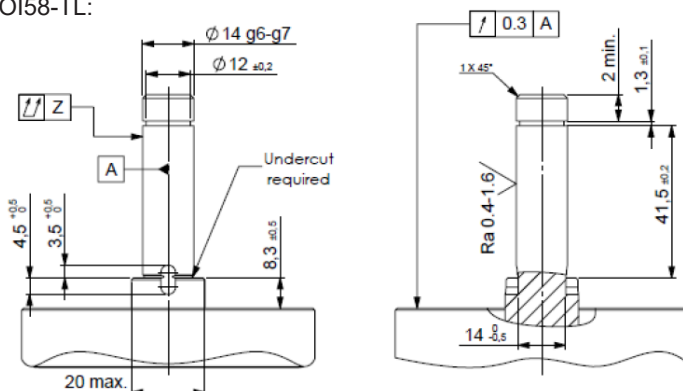
SOI58-T:



SOI58-TV:



SOI58-TL:

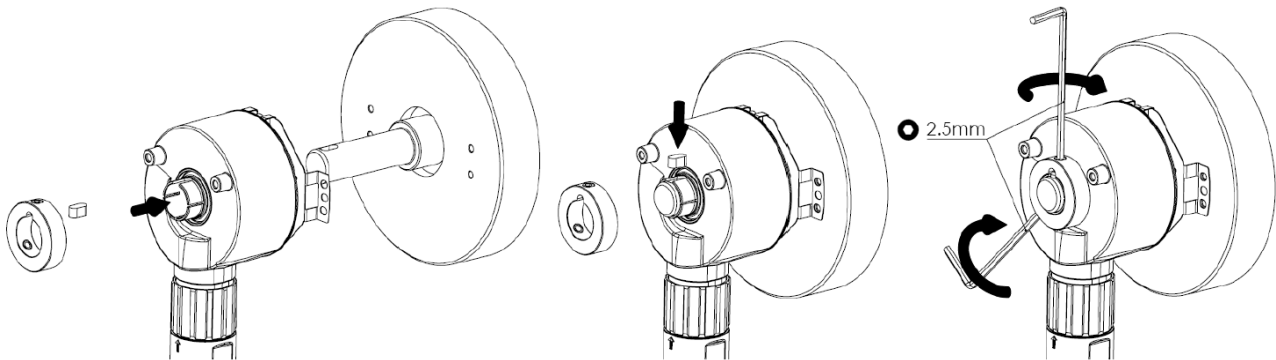


INSTALLATION AND START UP
4- Install the encoder on the driving shaft

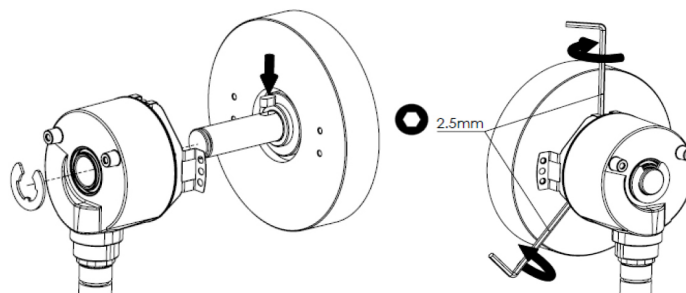
For a safe mounting secure all screws with threadlocker Loctite 243 or equivalent.

SOI58-T:

- Remove the clamping ring from the encoder shaft
- Align encoder and driving shaft key slots
- Slide the encoder on driving shaft
- Install the key
- Slide the clamping ring. Clamping ring is guided by the key
- Tighten the clamping ring screws at recommended torque: Hc M5x6 mm screw: 1.5 Nm [0;+0.2 Nm]


SOI58-TV:

- Install the key in the driving shaft key slot
- Align clamping ring and encoder shaft key slots together
- Slide encoder on driving shaft. Check that the key is fully engaged in the encoder key slot
- Tighten the clamping ring screws at recommended torque: Hc M5x6 mm screw: 1.5 Nm [0;+0.2 Nm]


CAUTION

For securing axial sliding in applications with high axial shocks/vibs, it is recommended to add a retainer at the end of the shaft (retaining ring, screwed washer, bolt, etc. – not included).

If a retainer is not used, an insufficient tightening of the clamping ring screw can lead to encoder axial sliding when coupled with axial shocks/vibrations. This case can lead to a dangerous situation (Stator coupling break).

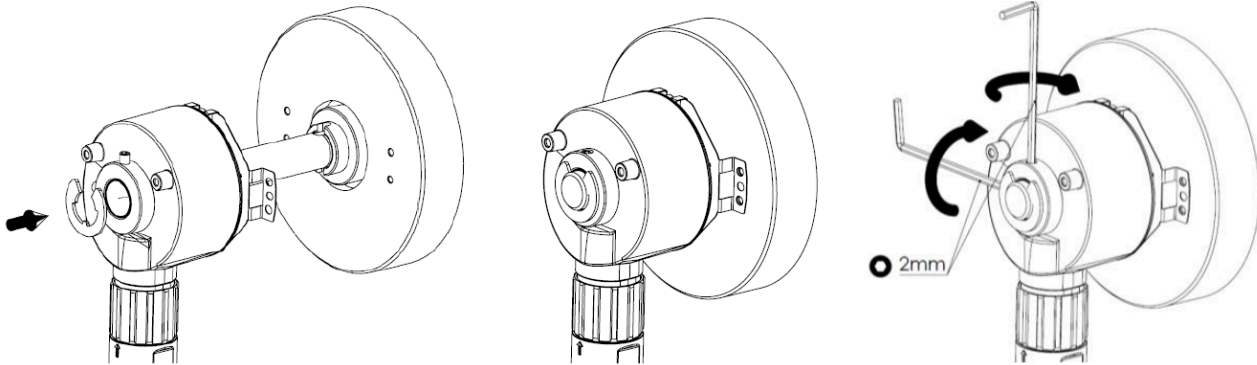
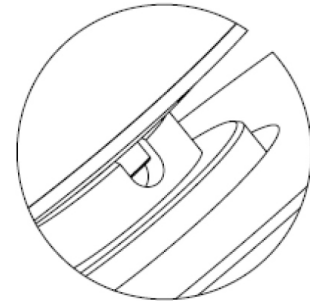


INSTALLATION AND START UP

SOI58-TL:

- Align encoder shaft positive locks with driving shaft slots
- Slide encoder on driving shaft. Check that the positive locks are fully engaged in the driving shaft slots
- Tighten the clamping ring screws at recommended torque:
 Hc M4x6 mm screw: 1.8 Nm [0;+0.2 Nm]

For securing axial sliding in applications with high axial shocks/vibs, it is recommended to add a retainer at the end of the shaft (retaining ring, screwed washer, bolt, etc. – not included).



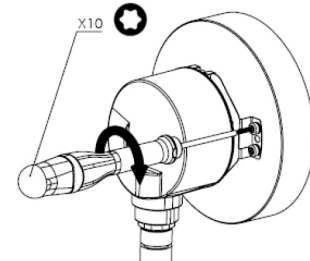
5- Fasten the encoder on the frame

If encoder is equipped with a tether arm, replace this step by the instructions given in the [chapter "4.2.7 Tether arm – mounting instructions"](#).

Check the position of the stator coupling. Avoid compressing or extending it to insure a minimal load on the bearing block.

Tighten the 2 central or 4 shifted M3 screws at 1.8 Nm +/-10% with the ribbed lock washers.

For a safe mounting secure the screws with threadlocker Loctite 243 or equivalent.



CAUTION

Refer to the Mechanical Precautions of [chapter "4.1.2 General electrical and wiring precautions"](#) for details about connection installation advices.



Respecting the precautions increases the sealing and the stator coupling lifetime.

INSTALLATION AND START UP

4.2.6. Through hollow shaft at SOI90-T - mounting instructions

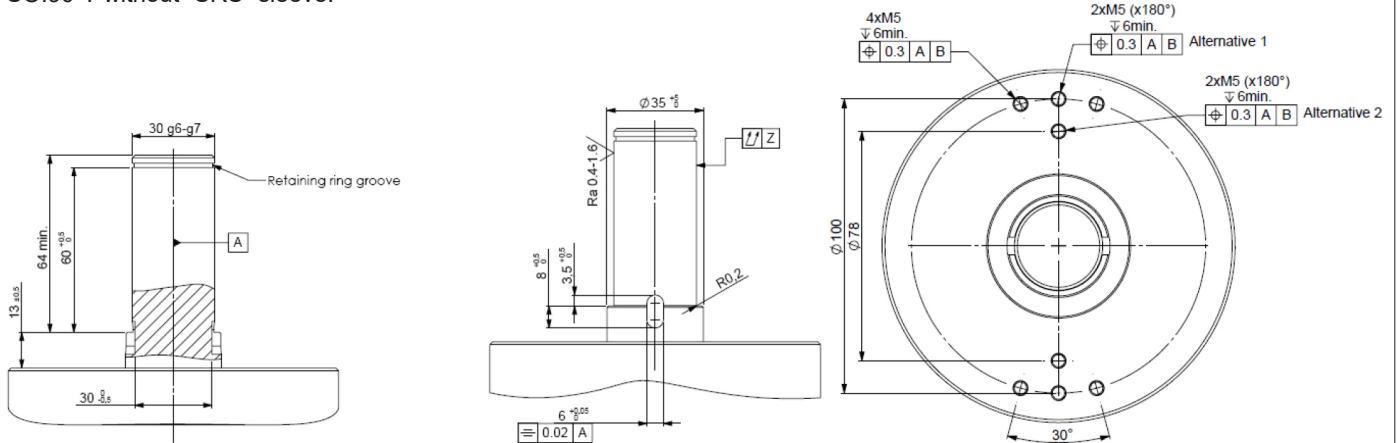
1-2- Refer to [chapter "4.2.1. Encoder preparation before installation"](#)

3- Mechanical interfaces configuration:

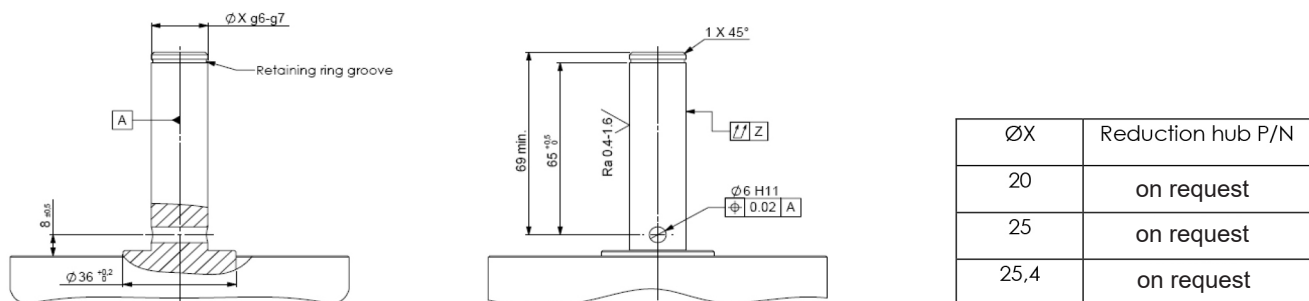
Check the driving shaft runout and tolerance: diameter A H7.
Clean the shafts interfaces (avoid particles and burrs).

Speed (RPM)	Permissible runout X
0-100	0.2
100-1500	0.05
1500-3000	0.02

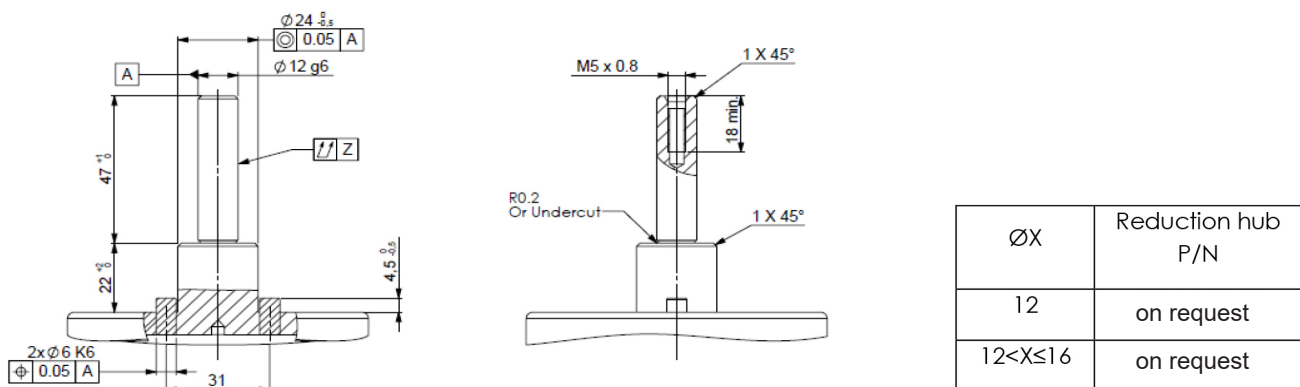
SOI90-T without "SRS" sleeve:



SOI90-T with standard "SRS" sleeve (on request):



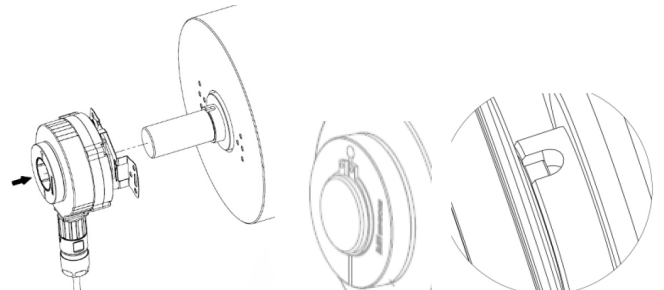
SOI90-T with shouldered "SRS" sleeve (mounting with tether arm, on request):



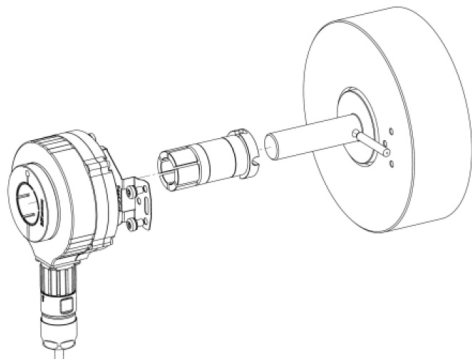
INSTALLATION AND START UP
4- Install the encoder on the driving shaft
For model SOI90-T without reduction sleeve only:

Slide the encoder on the shaft. Check that the positive locks are in the correct position for proper engagement.

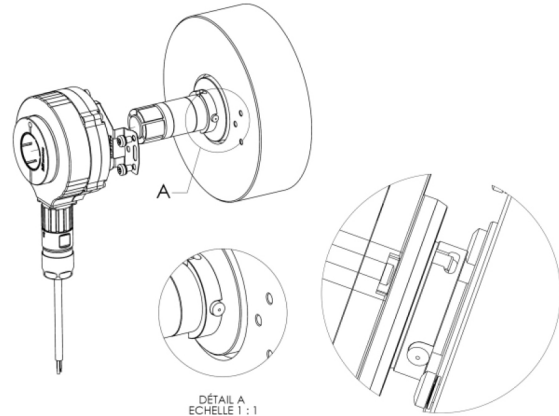
Secure the encoder in axial translation by an appropriate mechanical stop (retaining ring, nut, pins...) on the driving shaft.


For model SOI90-T with "SRS" sleeve only*:

4a- To secure the connection between the driving shaft and the encoder, mount a 6mm pin centered in the shaft (length: 30mm min. and 40mm max.). Pin must be secured by press fit mounting or glue.



4b- Put the reduction sleeve on the shaft. Be sure that the pin fits in the reduction sleeve slot.


CAUTION

"SRS" sleeve ensures insulation between driving shaft and encoder. To avoid leakage currents that could damage encoder bearing block, the retaining ring (when used) must not be in contact with encoder shaft.



* For model SOI90-T with shouldered "SRS" sleeve (on request), installation drawing is available upon request: consult TWK.

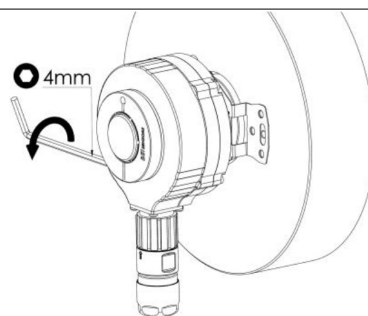
For all models SOI90-T:

For safe clamping verify the driving shaft extends at least 2mm from encoder.

For a safe mounting secure the clamping ring screw with threadlocker Loctite 243 or equivalent.

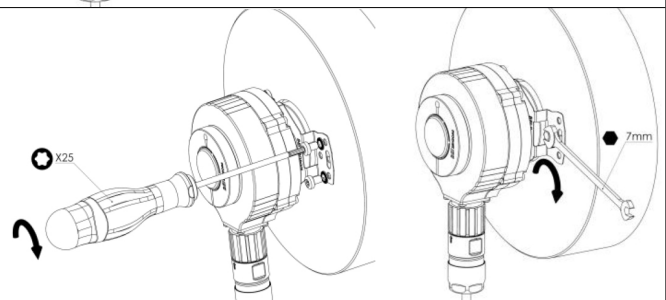
Tighten the screw at recommended torque:

CHc M5: 4.5 Nm +/-10 %.


5- Fasten the encoder on the frame:

If encoder is equipped with a tether arm, replace this step by the instructions given in the [chapter „4.2.7 Tether arm – mounting instructions“](#).

Check the position of the stator coupling. Avoid compressing or extending it to insure a minimal load on the bearing block.



INSTALLATION AND START UP

Tighten the M5 screws at 4.5 Nm +/-10 % with the ribbed lock washers.

(2 mounting options: by 4 screws on diameter 100 mm, or by 2 screws on diameter 78 mm)

For a safe mounting secure the screws with threadlocker Loctite 243 or equivalent.

CAUTION

Refer to the Mechanical Precautions of [chapter "4.1.2. General Electrical and wiring precautions"](#) for details about connection installation advices.



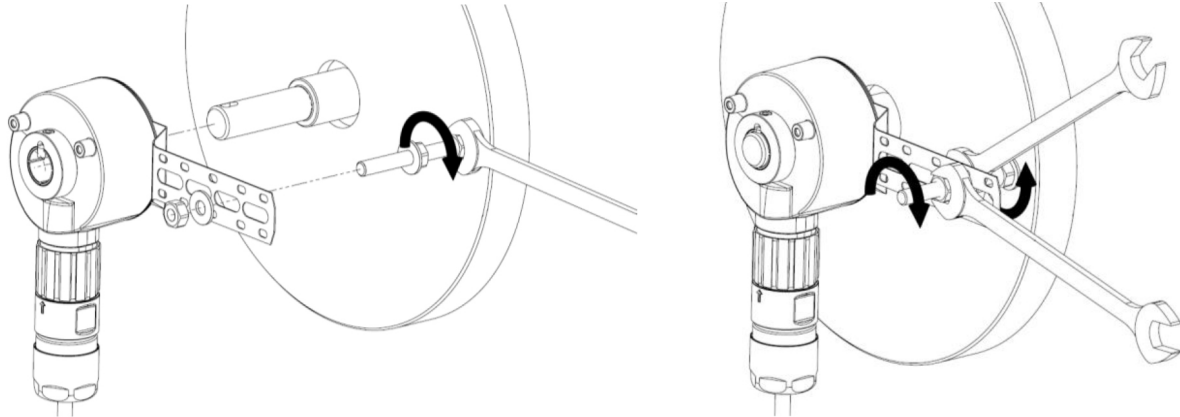
Respecting the precautions increases the sealing and the stator coupling lifetime.

4.2.7. Tether arm - mounting instructions

For a safe mounting secure the fasteners with threadlocker Loctite 243 or equivalent.

Tighten the threaded rod into the frame hole.

Screw the nuts with the washers on the tether arm. The mounting must be done without deforming the coupling devices.



PACKAGING, STORAGE AND TRANSPORT

5. PACKAGING, STORAGE AND TRANSPORT

5.1 Box content

Each encoder is delivered in an individual package. Identification of the box is ensured by a label. Each box contains:

- 1 Encoder
- 2 Connecting diagram TY
- 3 Optional accessories on request.

5.2 Storage conditions

Take into account ambient conditions which are listed in encoders' datasheet.

Storage in original package is recommended. Prevent exposure from dust, humidity and dirty environment.

The connectors are protected by a cap. Remove the cap just before connecting the mating connector in order to avoid any dust or liquid in contact with the connection pins. The IP protection of the encoder is only applicable when it is correctly connected.

5.3 General cautions for transport

Encoders must always be transported in their original packaging. The package contents must be maintained in its original position in the box. Do not remove shaft, coupling or connector protections during transport.

Prevent package from shocks and falls.

CAUTION

If external damage is detected on the box, inspect encoder carefully before mounting (connector, shaft, stator coupling...). Damage due to transport may lead to dangerous fault. In case of doubt, unit must be replaced.



SERVICE, MAINTENANCE AND RECYCLING

6. SERVICE, MAINTENANCE AND RECYCLING

6.1 Company's contacts

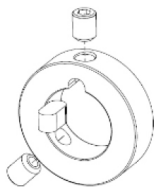

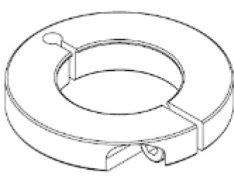
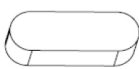
Headquarter	Germany TWK-ELEKTRONIK GmbH Bismarckstraße 108 40210 Düsseldorf Tel. +49 211 96117-0 info@twk.de www.twk.de
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6.2 Maintenance

No specific maintenance is required during encoder's life time. In case of any unexpected product behavior, send the part back to TWK's aftersales service for analysis.

6.3 Spare parts

Available spare parts are mainly listed in [chapter "2.2.5 Accessories"](#). In addition, the following products can be ordered:

Picture	Accessory	Part number (P/N)
	Clamping ring for SOI58-T, SOI58-TV and SOI58-HB	on request
	Clamping ring for SOI58-TL	on request
	Clamping ring for SOI90-T	on request
	Key for SOI58 with solid shaft 10 mm (4 x 4 x 12 mm)	on request
	Key for hollow shaft at SOI58-T, SOI58-TV and SOI58-HB (4 x 4 x 8 mm)	on request

6.4 Recycling

Devices are constituted of various materials which can be recycled. Discard products according to local recommendations and regulations.

WARRANTY

7. WARRANTY

Please refer to twk.de/en/gtc or twk.de/agb (General Terms and Conditions) for the applicable warranty conditions.

DEFINITIONS

8. DEFINITIONS

8.1 Definition of terms

C	CC:	Continuous Current
	CCW:	Counter ClockWise direction, view from flange side.
	Channel:	A channel is constituted of two complementary outputs. Standard incremental encoders provide three channels: channel 1 (A & A/), channel 2 (B & B/), channel 0 (Z & Z/).
	CW:	ClockWise direction, view from flange side.
D	DC (definition 1):	Duty Cycle
	DC (definition 2):	Diagnostic Coverage. Refer definition in EN 13849-1.
E	EMC:	Electromagnetic Compatibility
F	Form fit:	Mechanical interlocking between driving and driven shafts.
G	Ground:	Ground or Earth potential is different from common (0V). Both potentials are not connected together inside the encoder. Common (0V) is corresponding to zéro volt relative to power supply +V.
H	Hazard:	Potential source of injury or damage to health.
I	Initialization time:	Time between effective power-on and fully operational state of the encoder (output signals availability and control by monitoring).
	Interpolation:	Method for increasing encoder's resolution by subdividing sine/cosine signals.
	IP:	Ingress Protection. Level of sealing of encoder's enclosure. IP level is tested according to standard IEC 60529.
K	Keyway:	Form fit for solid shaft. A keyway must be used with the suitable key.
M	MTTFd:	Mean Time To dangerous Failure
P	PFD:	Probability of Failure on Demand
	PFH:	Probability of Failure per Hour
	PLC:	Programmable Logic Controller
	PL:	Performance Level according to EN 13849
	Positive Locks:	Form-fit for hollow shaft especially designed by TWK-ELEKTRONIK GmbH for safety applications.
	Ppr:	Pulses Per Revolution. Encoder's resolution.
R	Reset:	Action of switching off and switching on of the encoder's power supply. Each reset action generates an initialization time.
	Response time:	Time between instantaneous physical position or speed and corresponding effect on electrical output signals.
	Rpm:	Encoder's shaft angular speed in Revolution Per Minute.
S	Safe state:	State which is clearly determined and interpretable by an external monitoring. Encoder's safe state is described in chapter „3.1 Safety Encoder function / Safe state“ .
	SFF:	Safe Failure Fraction is similar to diagnostic coverage (DC) but also takes account of any inherent tendency to fail towards a safe state. SFF is defined in standard IEC 61508.
	SIL:	Safety Integrity Level according to IEC 61508.
	SRECS:	Safety-Related Electrical Control System
	SRS:	Safety Reduction Sleeve. Sleeve permitting to insulate and reduce the diameter of hollow shaft encoders. This sleeve includes positive locks.
	Stator coupling:	Anti-rotating device which maintains encoder's housing in an angular position and compensates for mechanical misalignments.

DEFINITIONS

T	Tether arm:	Anti-rotating device which maintains encoder's housing in an angular position and compensates for mechanical misalignments.
V	+V:	Power supply voltage provided by the user and applied to the encoder relatively to 0 V.
	VDC:	Voltage - Direct Current
	Vpp:	Voltage peak-to-peak characterizing sine/cosine signals.

REVISION HISTORY

9. REVISION HISTORY

Version	Date	Change
SOI17141AE	19.09.2024	Creation of the manual
SOI17141BE	29.10.2024	Model SOI90-T added, several small corrections
SOI17141CE	28.11.2024	Model SOI58-H (-HB and -HK) added, several corrections

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