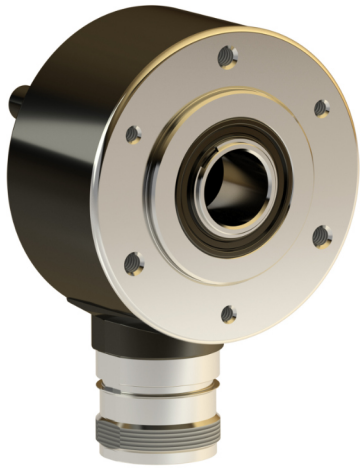
SUPREME SENSORING

Incremental rotary encoder
Model SOI58-T/S3 - SIL3, PLe/CAT4
Interface: Digital pulses or SIN/COS

Document no.:
SOI 17173 DE
20.02.2025



INCREMENTAL SAFETY

SIL3 IEC 61508 FUNCTIONAL SAFETY SENSOR

PLe ISO 13849 FUNCTIONAL SAFETY SENSOR

- **SIL3 / PLe (CAT4) certification**
- **UL® certification on request**
- **Robust mechanical construction with high vibration and shock resistance**
- **Housing: Design form 58, aluminium, coated zinc alloy**
- **Shaft type: Through hollow shaft, AISI 303 stainless steel, 10 or 12 or 14 mm diameter**
- **Output:**
  - **Digital TTL (RS422) or HTL**
  - **SIN/COS 1 Vpp**
- **Resolution: 250 to 2500 counts / 360°**
- **Operating temperature: - 20 °C to + 85 °C**
- **Protection grade: IP65**
- **Suitable for safe motor feedback systems**

KEY INFORMATION OVERVIEW

DESIGN & FUNCTION

Sensing the angle position and signal processing including the generation of the SIN/COS signals or the square-wave pulses respectively. Digital signals TTL and HTL are computed from sine/cosine signals.

The safety function ensured by the device is to convert a mechanical rotation into secured electrical information readable by electronics.

Functional safety design due to IEC 61508: SIL3 and ISO 13849: PLe (CAT4) in an robust housing made of aluminium and coated zinc alloy with protection grade IP65.

Optionally a UL® certificate can be provided.

- Design form 58 with through hollow shaft
- Suitable for safe motor feedback according to IEC 61800-5-2
- Radial electrical connection via connectors M12, M23 or cable
- Adapted anti-rotation system available (stator coupling, tether arm)

INTERFACE FEATURES

- Output: square-wave pulses A, A/, B, B/, Z, Z/
- Level: TTL (RS422) or HTL
- Output: Sine / Cosine S, S/, C, C/, Z, Z/
- Level SIN/COS: 1 Vpp
- 250 to 2500 counts per 360°

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TECHNICAL DATA

ELECTRICAL DATA

Operating voltage	5 VDC (± 5 %) or 11 to 30 VDC, reverse polarity protected and short-circuit proof *
Supply type	Power supply according to Class 2 LPS or SELV/PELV limited energy source ≤ 60V
Supply ripple max.	250 mV
Electrical connection	Via connector M12, M23 or cable - radial

OUTPUT: PULSES

Supply current max.	100 mA with no load 220 mA with load
Output current max.	40 mA by pair
Output	Digital TTL (RS422) Digital HTL (only Vs = 11 to 30 VDC)
Output signal frequency	300 kHz depending on cable length
Load @ TTL	100 to 240 ohms
Load @ HTL	750 to 3000 ohms @ 30 VDC 600 to 3000 ohms @ 24 VDC 275 to 3000 ohms @ 11 VDC
Response time	4 µs typical
Phasing tolerance	90° ±10°
Duty cycle	50% ±5%
Jitter	< 2 %
Output voltage levels TTL	Low: min. 0 V, typ. 0.5 V, max. 2.5 V High: min. 3.5 V, typ. 4.8 V (+Vs-0.5 V @ 5 VDC), max. 5.4 V (+Vs @ 5 VDC)
Output voltage levels HTL	Low: min. 0 V, typ. 0.5 V, max. 2.5 V High: min. +Vs - 3V, typ. +Vs - 0.5 V, max. +Vs

OUTPUT: SIN/COS

Supply current max.	70 mA with no load 100 mA with load
Output current max.	10 mA by pair
Output	SIN/COS with 1 Vpp
Output signal frequency	300 kHz depending on cable length
Load	100 to 240 ohms
Response time	2 µs typical
Phasing tolerance	90° ±10°
Harmonics	<-45 db
Amplitude tolerance per signal	500 mVpp ±20 %
Amplitude difference between signals	≤ 50 mV
Offset value per signal	2.5 V ±500 mV
Offset difference between signals	≤ 50 mV

MECHANICAL DATA

Operating speed max.	9000 rpm
Operation speed cont.	6000 rpm
Static torque	0.025 Nm
Dynamic torque	0.120 Nm
Shaft inertia	< 72 gcm²
Perm. shaft load	20 N axial 40 N radial
Theoretical mechanical lifetime $L_{10}h$	24.0 x 10^9 turns / 100,000 hours **
Material	Body: aluminium Cover: coated zinc alloy Shaft: stainless steel 1.4305 (AISI 303)
Bearings	6803 series - sealed
Mass	~0.28 kg

* Not to +Vs at TTL and SIN/COS @ 11 to 30 VDC each. Vs = 5 VDC (±5%) must be monitored

** Continuous max. speed – ½ max. load – according to ISO 281: 1990, L_{10}

TECHNICAL DATA

ENVIRONMENTAL DATA

Operating temperature	-20 to +85 °C (encoder T°)
Storage temperature	-20 to +85 °C
Humidity	93 % @ 65 °C (EN 60068-2-38)
Resistance against shock	≤ 500 m/s² (EN 60068-2-27, during 6 ms)
Resistance against vibration	≤ 200 m/s² (EN 60068-2-6, 10 … 2000 Hz)
Protection grade	IP65
Isolation	1000 V_{eff}
EMC immunity test	EN 61000-6-2,increased levels
EMC emission test	EN 61000-6-4, increased levels
Salt spray test	96 h (EN 60068-2-11, part 2)

SAFETY DATA

Z and Z/ are not safety signals (@ pulses and SIN/COS)

Applied functional safety standards	IEC 61508 IEC 62061 ISO 13849-1 IEC 61800-5-2
Maximum operating life	20 years
Further safety data	See handbook SOI17141

OUTPUT: SQUARE-WAVE PULSES FOR POSITION SENSING APPLICATIONS (@+40 °C, SINGLE CHANNEL)

Time for output signal initialization after power on	~30 ms
Time for internal monitoring activation after power on	250 ms (560 ms max.)
Time to switch off outputs in case of error	< 200 ms
High impedance output leakage current	±10 µA

Vs = 5 VDC (± 5 %):

PFD (IEC 61508, 1/h)	7.51×10^{-5}
PFH (IEC 61508, 1/h)	8.58×10^{-10}
MTTFd (ISO 13849, years)	1331
DC	99 %

Vs = 11 to 30 VDC:

PFD (IEC 61508, 1/h)	9.52×10^{-5}
PFH (IEC 61508, 1/h)	1.09×10^{-9}
MTTFd (ISO 13849, years)	1050
DC	99 %

OUTPUT: SINCOS FOR POSITION SENSING APPLICATIONS (@+40 °C, SINGLE CHANNEL)

Time for output signal initialization after power on	~30 ms
Time for internal monitoring activation after power on	~30 ms
Time to switch off outputs in case of error	< 50 µs
High impedance output leakage current:	±1 µA

Vs = 5 VDC (± 5 %):

PFD (IEC 61508, 1/h)	4.29×10^{-5}
PFH (IEC 61508, 1/h)	4.90×10^{-10}
MTTFd (ISO 13849, years)	2328
DC	99 %

Vs = 11 to 30 VDC:

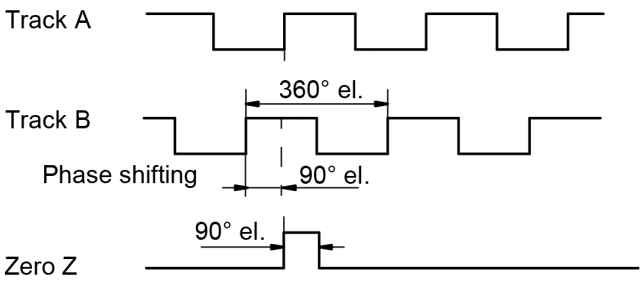
PFD (IEC 61508, 1/h)	6.60×10^{-5}
PFH (IEC 61508, 1/h)	7.53×10^{-10}
MTTFd (ISO 13849, years)	1515
DC	99 %

PRODUCT CHARACTERISTICS - SIGNAL OUTPUT

First safety channel with signal A or S and inverted signal A/ or S/. Second safety channel with signal B or C and inverted signal B/ or C/. Third channel not for safety with signal Z and inverted signal Z/.

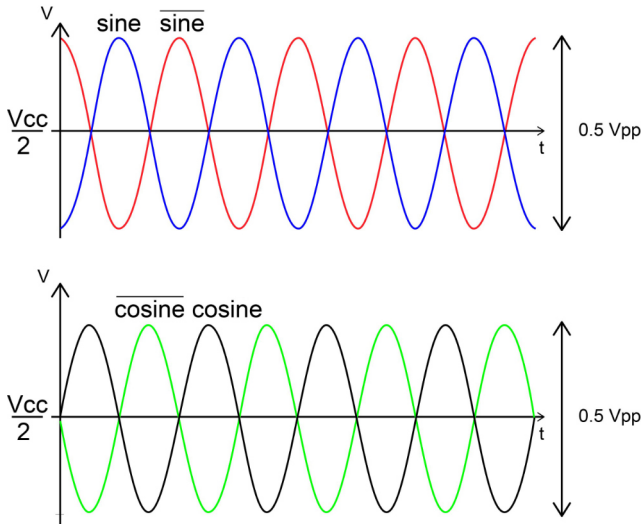
SQUARE-WAVE PULSES

Channel 2 (B) before channel 1 (A) (90° period phase shift), clockwise shaft rotation viewed from flange side.



SIN/COS

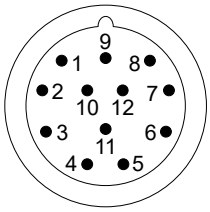
Channel 2 (cosine) before channel 1 (sine) (90° period phase shift), clockwise shaft rotation viewed from flange side.



ELECTRICAL CONNECTION - PINOUT

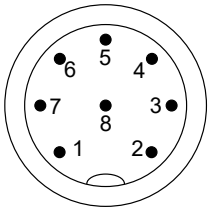
CONNECTOR OUTPUT M23, 12-PIN, MALE, CCW

PIN.	Function
1	A/ or S/
2	+ V_S
3	Z
4	Z/
5	B or C
6	B/ or C/
7	n.c.
8	A or S
9	n.c.
10	- V_S (0 V / GND)
11	- V_S (0 V / GND)
12	+ V_S
Connector body	Ground



CONNECTOR OUTPUT M12, 8-PIN, MALE, A-CODED

PIN.	Function
1	- V_S (0 V / GND)
2	+ V_S
3	A or S
4	B or C
5	Z
6	A/ or S/
7	B/ or C/
8	Z/
Connector body	Ground



ELECTRICAL CONNECTION CABLE OUTPUT - PVC, 8-WIRES, 8230 / 020 (FURTHER CABLES ON REQUEST)

Colour	Function
WH white	- V_S (0 V / GND)
BN brown	+ V_S
GN green	A or S
YE yellow	B or C
GY grey	Z
PK pink	A/ or S/
BU blue	B/ or C/
RD red	Z/
General shielding	Ground

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ORDER CODE FORMAT

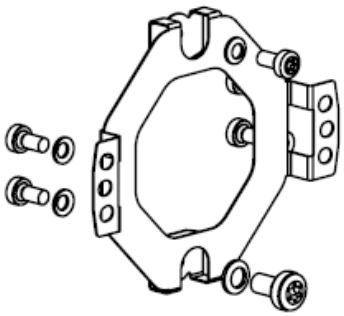
SOI	58	T	14	1	1	0	A	1024	2	6	S3	H	01	STANDARD VERSION

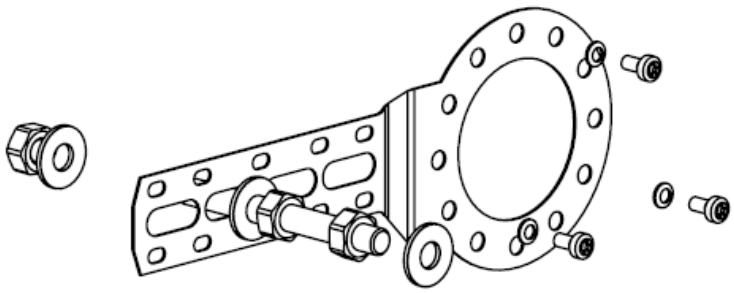
SOI	Incremental rotary encoder - SIL3 / PLe/CAT4		
58	Design form Ø	58	Design form 58
T	Flange	T TV TL	Flange with through hollow shaft and back clamping ring Flange with through hollow shaft and face clamping ring Flange with through hollow shaft and positive locks
14	Hollow shaft Ø	10 12 14	10 mm 12 mm 14 mm (other values, e.g. 9.52 mm or 12.7 mm on request)
1	Protection grade	1	IP65
1	Electrical connection	1 4 5	1 x connector M23, CCW, radial 1 x cable, PVC, 8-wire, radial (further cables on request) 1 x connector M12, radial
0	Cable length	0 2 5 10	Insert 0 at connector output 2 m 5 m 10 m (e.g. 0,15 for 15 cm or 1,5 for 1.5 m)
A	Housing material	A	Aluminium, coated zinc alloy
1024	Resolution	250 256 360 500 512 1000 1024 1500 2000 2048 2500	Square-wave pulses or nr. of SIN/COS per 360°
2	Supply voltage	1 2	5 VDC (±5 %) 11 to 30 VDC
6	Output signal	6	A, A/, B, B/, Z, Z/ (signal form T or H) or S, S/, C, C/, Z, Z/ (signal form S)
S3	Profile (Certificate)	S3	SIL3 and PLe/CAT4 certified as specified in this data sheet
H	Signal form	T H S	TTL (RS422) HTL (only at Vs = 11 to 30 VDC) SIN / COS (1 Vpp)
01	Electrical and mechanical variants*	01	Standard version

* The basic versions according to the data sheet bear the number 01. Deviations are identified with a variant number and are documented in the factory.

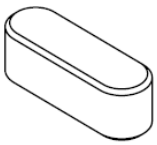
ACCESSORIES (SELECTION)

STATOR COUPLING AND TETHER ARM FOR DESIGN FORM SOI58-T - ON REQUEST





FEATHER KEY 9435/009 (4 MM x 8 MM) FOR DESIGN FORM SOI58-T - ON REQUEST



CONNECTING CABLE FOR CONNECTORS M12, 8-PIN, A-CODED AND M23, 12-PIN, CCW - ON REQUEST

Please ask our technical staff for detailed drawings for the accessories.

DOCUMENTATION

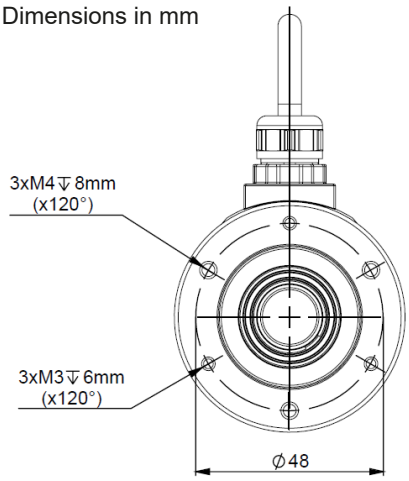
The following documents can be found in the Internet under www.twk.de in the documentation area, model SOI58-T/S3.

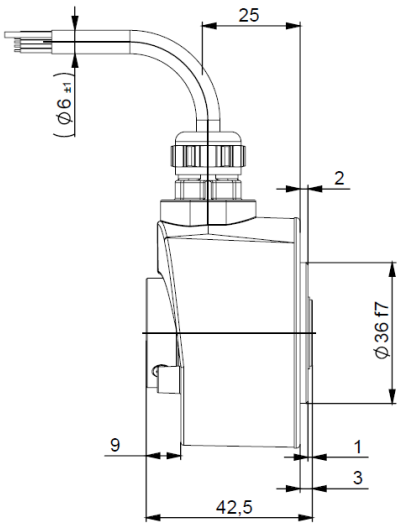
Data sheet SOI17173
Manual SOI17141
Installation instructions AN16169
SIL3 / PLe certificate SOI17204
EC Declaration of Conformity ZE17199
Reach compliant QS15286
RoHS compliant QS13284

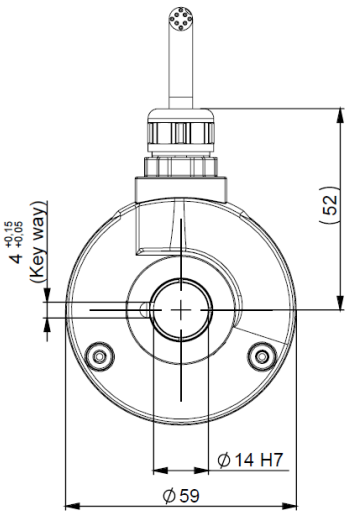
INSTALLATION DRAWINGS

MODEL SOI58T14142A102426S3H01

Dimensions in mm

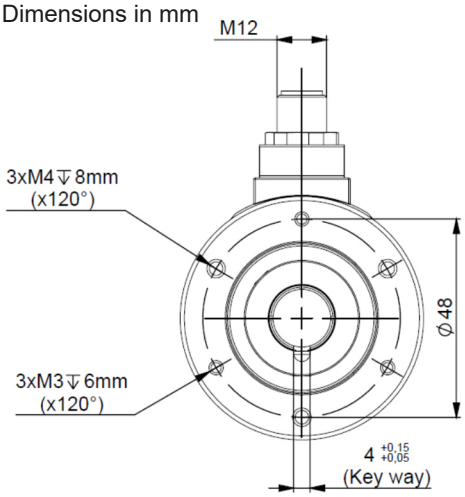


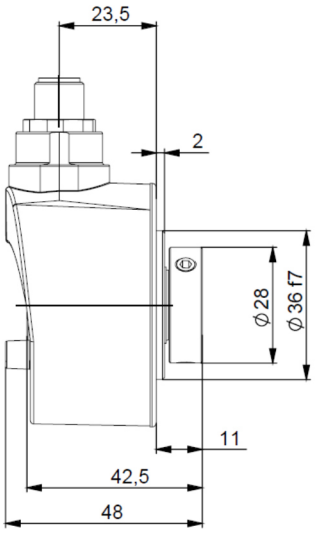


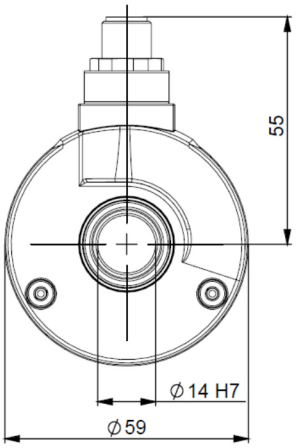


MODEL SOI58TV14150A102426S3H01

Dimensions in mm







MODEL SOI58TL14110A102426S3H01

Dimensions in mm