

TorksIM torque sensor with integrated AksIM™-4 encoder

COMPACT AND
LIGHTWEIGHT

TORQUE
FEEDBACK

HARMONIC
GEARING
READY

The torque sensor is a strain-gauge-based device with an integrated AksIM-4 encoder, a non-contact, high-performance off-axis absolute rotary encoder.

The system is designed for installation in applications with limited space where torque and position measurement are required. The design allows integration with harmonic (strain wave) gearing.



Features and benefits

- ▶ Integrated torque and position sensing
- ▶ Strain-gauge-based torque measurement
- ▶ Integrated absolute encoder
- ▶ Compact low-profile design
- ▶ Harmonic gearing compatible
- ▶ Space-saving integration
- ▶ High-precision feedback
- ▶ Improved motion control
- ▶ Reduced assembly complexity
- ▶ Reliable real-time measurement



ROBOTIC ARM JOINTS



PRECISE GEARBOXES



EXOSKELETONS



HUMANOIDS



INDUSTRIAL AUTOMATION

Technical specifications

Position system data

Reading type	Axial reading
Communication	BiSS C or other digital protocol
Resolution	up to 21 bit

Torque sensor system data

Resolution	16 bit
Accuracy	1 % nominal range
Bandwidth	1 kHz
Nominal range	± 100 Nm
Maximum measured torque	± 140 Nm

Electrical data

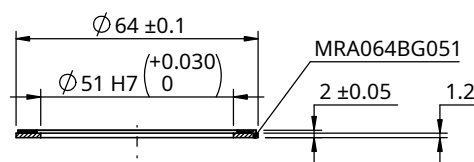
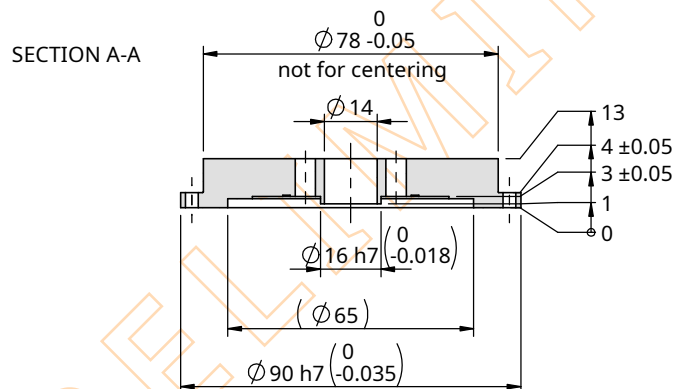
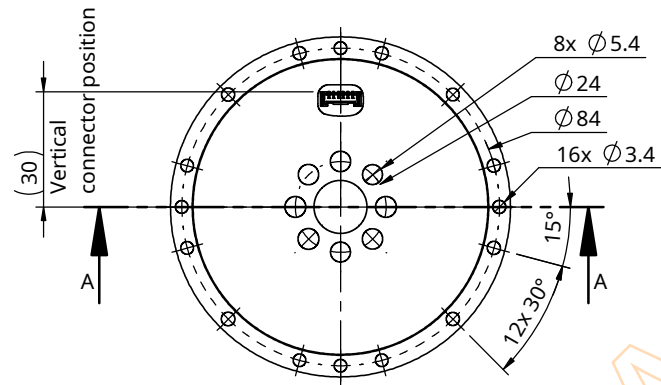
Supply voltage (V_{DD})	5 V (± 0.5 V) at the connector
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Environmental data

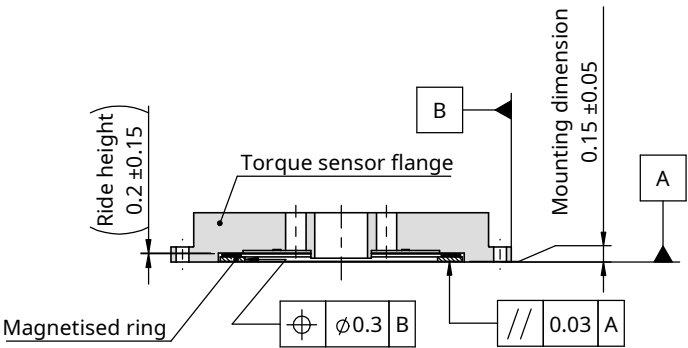
Operating and storage temperature	From 0 °C to +85 °C
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Dimension drawing

Dimensions and tolerances are in mm. Dimensions without tolerance values are in accordance with ISO 2768-m.



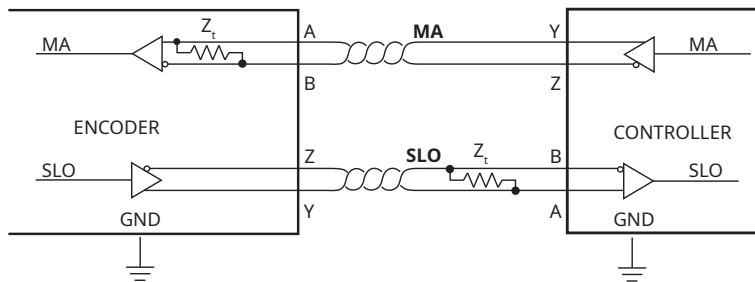
Installation drawing



BiSS C interface

Encoder position in up to 21 bit natural binary code and encoder status are available via the BiSS C protocol. The sensor data is followed by two status bits (active low) followed by CRC (inverted). BiSS is implemented for point-to-point operation, multiple slaves are not supported. Communication is bidirectional, the readhead is user programmable. Additional data can be read from the readhead.

Electrical connection

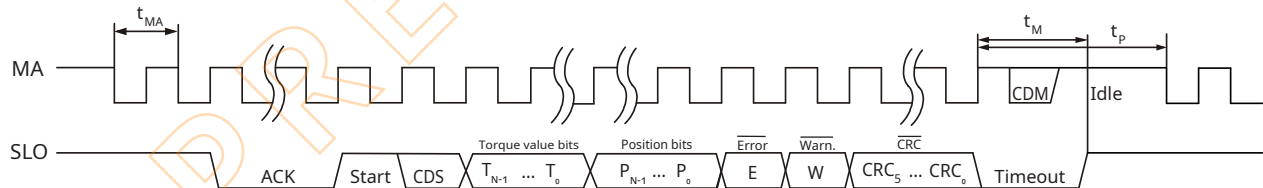


The signal MA is Master Clock with a maximum frequency of 5 MHz and SLO is Slave Out, whose data is transmitted on the rising edges on the line MA. The MA and SLO lines are 5 V RS422 compatible differential pairs. The RC termination on the MA line is built into in the encoder. If the total cable length exceeds 5 m, termination on the controller is required. The nominal impedance of the cable should be 120 Ω .

Output protection

Excessive output current and power dissipation caused by faults or bus conflicts are prevented by two mechanisms. A foldback current limit at the output stage provides immediate protection against short circuits. In addition, a thermal shutdown circuit forces the driver outputs into a high-impedance state, if the chip temperature becomes too high.

BiSS C timing diagram



Data package description

Data	Length (N)	Description
$T_{N-1} - T_0$	16 bits	Torque value bits
$P_{N-1} - P_0$	20 bits	Absolute position inside one revolution (for 20 bit resolution)
E	1 bit	Error status bit; inverted
W	1 bit	Warning status bit; inverted
$CRC_5 - CRC_0$	6 bits	Cyclic redundancy check; polynomial 0x43; inverted

Communication parameters

Parameter	Symbol	Min	Typ	Max
MA period	t_{MA}	200 ns		2.5 μ s
MA frequency	$f_{MA} = 1/t_{MA}$	400 kHz		5 MHz
ACK length	ACK		13 bits	
Transfer timeout	t_M		13 μ s	
Pause time	t_P	$t_M + 1 \mu$ s		

If number of clocks from master is less than specified, SLO within timeout is not necessarily in low state.

First valid frame is expected after encoder set-up time.

The request cycle starts with MA in idle state (MA is high). Its first falling edge initiates communication. The encoder responds by setting SLO to low on the second rising edge on the MA line and generating the ACK signal (Acknowledge). When the encoder is ready for the next request cycle, it indicates this to the master by setting SLO to high. The absolute position and the CRC data are available in binary format and are initially transmitted in MSB format.

Sensor data packet structure

b28 : b43	Torque value
b27 : b8	Encoder position – MSB first (for 20 bit resolution)
b7	Error – If low, the encoder position data is not valid.
b6	Warning – If low, the encoder position data is valid, but some operating conditions are close to limits.
b5 : b0	Inverted CRC, calculated by using 0x43 polynomial

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Document issues

Issue	Date	Page	Description
1	21. 10. 2026	-	New document

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