Inclinometer MEMS / capacitive | **IN88, 1- and 2-dimensional** | **SAE J1939**

The inclinometers of the IN88 series allow measuring 2-dimensional inclinations in the range of ±85° or 1-dimensional inclinations up to 360°.

With their high robustness, their protection level up to max. IP69k and their wide temperature range from -40°C to +85°C, these devices are ideally suitable for outdoor use – e.g. for mobile automation applications.

SAE J1939

High protection level | Shock / vibration resistant | Reverse polarity protection | Redundancy | Temperature range

Robust

- High protection rating IP67 and IP69k in one device.
- Highest robustness thanks to metal housing.
- Stable accuracy over the whole temperature range from -40°C up to +85°C.
- Non long-term drift thanks to sensor array technique.

Versatile

- Parameterizable filter.
- Measuring direction 1- or 2-dimensional.
- With 1 x M12 connector or 2 x M12-connector.
- Stacked installation possible for redundancy.

Order code

8.IN88	.	X	X	3	1	.	1	2	X
Type		a	b	c				d	e

a *Measuring direction*
1 = 1-dimensional
2 = 2-dimensional

b *Measuring range*
6 = ±85° [1]
7 = 0° ... 360° [2]

c *Interface*
3 = SAE J1939

d *Power supply*
2 = 10 ... 30 V DC

e *Type of connection*
1 = 1 x M12 connector, 5-pin
3 = 2 x M12 connector, 5-pin

Connection technology		Order no.
Cordset, pre-assembled	M12 female connector with coupling nut for Bus in, 5-pin 5 m [16.40'] PVC cable	**05.00.6091.A211.005M**
	M12 male connector with external thread for Bus out, 5-pin 5 m [16.40'] PVC cable	**05.00.6091.A411.005M**
Connector, self-assembly (straight)	M12 female connector with coupling nut for Bus in, 5-pin	**05.B-8151-0/9**
	M12 male connector with external thread for Bus out, 5-pin	**05.BS-8151-0/9**

Further accessories can be found in the accessories section or in the accessories area of our website at: www.kuebler.com/accessories
Additional connectors can be found in the connection technology section or in the connection technology area of our website at: www.kuebler.com/connection_technology

1) Can only be ordered in conjunction with measuring direction 2-dimensional.
2) Can only be ordered in conjunction with measuring direction 1-dimensional.

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Technical data

General electrical characteristics

Power supply		10 ... 30 V DC
Current consumption (no load)		max. 70 mA
Reverse polarity protection of the power supply		yes
Measuring axes		1 or 2
Measuring range	1-dimensional 2-dimensional	360°, no limit stop ±85°
Resolution		0.01°
Accuracy at 25°C [1]	1-dimensional 2-dimensional	typ. ±0.2° typ. ±0.4°
Repeat accuracy		±0.2°
Transverse sensitivity [2]		typ. ±0.3°
Temperature coefficient		typ. ±0.006° / K
Sampling rate		50 Hz (20 ms)
Limit frequency	with Butterworth filter factory setting	0.1 ... 10 Hz, 8th order typ. 10 Hz
CE compliant acc. to		EMC guideline 2014/30/EU RoHS guideline 2011/65/EU
UL approval [3]		file 224618
E1 type-approval		10R-058255

EMC

Relevant standards	EN 61326-1	Electrical equipment for measurement, control and laboratory use
	EN 61000-6-2	Immunity for industrial environments
	EN 55011 Klasse B, EN 61000-6-3	Emitted interferences for residential environments
	EN ISO 14982	Agricultural and forestry machinery, electromagnetic compatibility, test methods and acceptance criteria
	EN 13309:2010-07	Construction machinery - Electromagnetic compatibility of machines with internal power supply

Mechanical characteristics

Connection CAN	1 x M12 connector 2 x M12 connector	5-pin, male connector 5-pin, male connector / 5-pin, female connector
Weight		approx. 185 g [6.53 oz]
Protection acc. to EN 60529		IP67 / IP69k [3]
Working temperature range		-40°C ... +85°C [-40°F ... +185°F]
Material	housing	aluminum
Shock resistance		1000 m/s², 6 ms
Vibration resistance		100 m/s², 10 ... 2000 Hz
Dimensions		80 x 60 x 23 mm [3.15 x 2.36 x 0.91"]

Interface characteristics SAE J1939

Interface	CAN high-speed acc. to ISO 11898, CAN specification 2.0 B
Baud rate	250 kbit/s, switchable by software to 500 kbit/s
Node address	software configurable
Termination switchable	software configurable

General information concerning SAE J1939

The protocol J1939 originates from the international Society of Automotive Engineers (SAE) and operates on the physical layer with high speed CAN as per ISO11898. The application emphasis lies in the area of the power train and chassis of commercial vehicles. It serves to transfer diagnostic data (for example, motor speed, position, temperature) and control information. The inclinometers IN88 support the total functionality of J1939.

This protocol is a multimaster system with decentralized network management that does not involve channel-based communication.

It supports up to 254 logic nodes and 30 physical control devices per segment. The information is described as parameters (signals) and combined on 4 memory pages (data pages) into parameter groups (PGs). Each parameter group can be identified via a unique number, the parameter group number (PGN). Independently of this, each signal is assigned a unique SPN (suspect parameter number).

The major part of the communication occurs cyclically and can be received by all control devices without the explicit request for data (Broadcast). Furthermore the parameter groups are optimized to a length of 8 data bytes. This enables very efficient utilization of the CAN protocol. If greater amounts of data need to be transferred, then transport protocols (TP) can be used: BAM (broadcast announce message) and CMDT (connection mode data transfer). With BAM TP the transfer of data occurs as a broadcast.

Inclinometer implementation SAE J1939

- PGNs that are adaptable to the customer's application.
- Resolution of address conflicts -> Address Claiming (ACL).
- Continuous checking whether control addresses have been assigned twice within a network.
- Change of control device addresses during run-time.
- Unique identification of a control device with the help of a name that is unique worldwide. This name serves to identify the functionality of a control device in the network.
- Predefined PGs for position, speed and alarm.
- 250 kbit/s, 29 bit identifier.
- Watchdog controlled device.

A two-color LED signals the operating and fault status of the SAE J1939 protocol, as well as the status of the internal diagnostics.

1) Over the whole temperature and max. measuring range
1-dimensional ≤ ±0.4°; 2-dimensional ≤ ±1°.
2) Only for 2-dimensional measuring direction.
3) The IP protection class is not UL-tested. Verified by Kübler.
A full description of the technical data can be found in the relevant product manual at **www.kuebler.com.**

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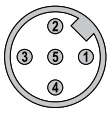
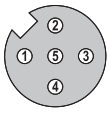
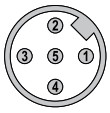
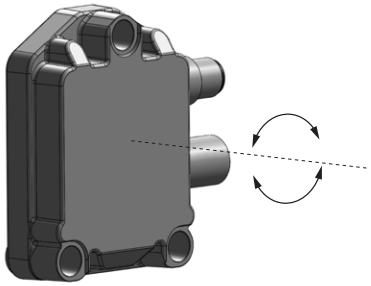
Terminal assignment

Interface	Type of connection	1 x M12 connector, 5-pin					
3	1		Bus IN				
		Signal:	+V	0 V	CAN_GND	CAN_H	CAN_L
		Pin:	2	3	1	4	5

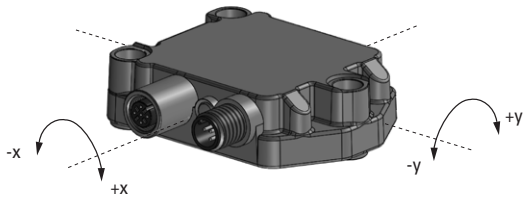
Interface	Type of connection	2 x M12 connector, 5-pin					
3	3		Bus OUT				
		Signal:	+V	0 V	CAN_GND	CAN_H	CAN_L
		Pin:	2	3	1	4	5
			Bus IN				
		Signal:	+V	0 V	CAN_GND	CAN_H	CAN_L
		Pin:	2	3	1	4	5

Direction of inclination

1-dimensional



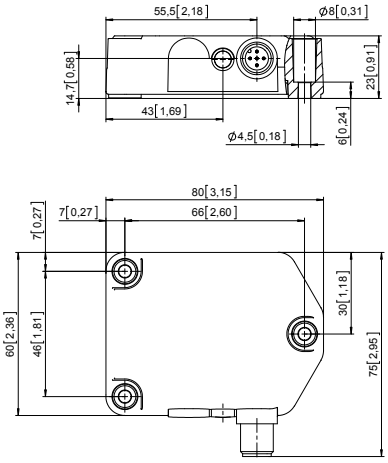
2-dimensional



Dimensions

Dimensions in mm [inch]

1 x M12 connector 5-pin, male contacts



1 x M12 connector 5-pin, male contacts
1 x M12 connector 5-pin, female contacts