

Inclinometers

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

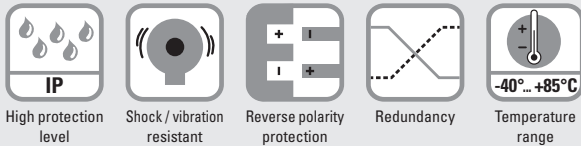


The inclinometers of the IN88 series allow measuring 2-dimensional inclinations in the range of $\pm 85^\circ$ or 1-dimensional inclinations up to 360° .

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



SAE J1939



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 $+85^\circ\text{C}$.
- 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	.XX31	.12X
Type	a b c	d e

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

b Measuring range
6 = $\pm 85^\circ$ ¹⁾
7 = $0^\circ \dots 360^\circ$ ²⁾

c Interface
3 = SAE J1939

d Supply voltage
2 = 10 ... 30 V DC

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

Accessories		Order no.
Adapter plate	for installation identical to Kübler inclinometer IS40	8.0010.4062.0000
Cables and connectors		Order no.
Preassembled cables	M12 female connector with coupling nut for Bus in, 5-pin, A coded, straight single ended 5 m [16.40'] PVC cable	05.00.6091.A211.005M
	M12 male connector with external thread for Bus out, 5-polig, A coded, straight single ended 5 m [16.40'] PVC cable	05.00.6091.A411.005M
	M12 female connector with coupling nut for Bus in, 5-polig, A coded, straight Deutsch connector, 6-pin, DT04 1 m [3.28'] PVC cable	05.00.6091.22C7.001M
Connectors	M12 female conn. with coupling nut for Bus in, 5-pin, A coded, straight (metal/plastic)	05.B-8151-0/9
	M12 male conn. with external thread for Bus out, 5-pin, A coded, straight (metal/plastic)	05.BS-8151-0/9

Further Kübler accessories can be found at: kuebler.com/accessories
Further Kübler cables and connectors can be found at: 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.

Inclinometers

**Inclinometer
MEMS / capacitive**

IN88, 1- and 2-dimensional

SAE J1939

Technical data

General electrical characteristics

Supply voltage	10 ... 30 V DC	
Current consumption (no load)	max. 70 mA	
Reverse polarity protection of the supply voltage	yes	
Measuring axes	1 or 2	
Measuring range	1-dimensional	360°, no limit stop
	2-dimensional	±85°
Resolution	0.01°	
Accuracy at 25 °C¹⁾	1-dimensional	typ. ±0.2°
	2-dimensional	typ. ±0.4°
Repeat accuracy	±0.2°	
Transverse sensitivity²⁾	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 approval³⁾	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 supply voltage

Mechanical characteristics

Connection	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 acc. to EN 60068-2-27	1000 m/s ² , 6 ms	
Vibration resistance acc. to EN 60068-2-6	100 m/s ² , 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 CMTD (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.

Inclinometers

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

Configuration data signals PG				
Configuration data	Data length in byte	Hex value	Hex value in decimal	Endian hex value
INCLIN_CFG_Resolution	2	0x0064	100	0x6400
INCLIN_CFG_LongOperatingPar	1	0x02	2	0x02
INCLIN_CFG_SlopeLongPreset_Activate	1	0x01	1	0x01
INCLIN_CFG_SlopeLongPresetValue	2	0x0000	0	0x0000
INCLIN_CFG_LatOperatingPar	1	0x02	2	0x02
INCLIN_CFG_SlopeLatPreset_Activate	1	0x01	1	0x01
INCLIN_CFG_SlopeLatPresetValue	2	0x0000	0	0x0000
INCLIN_CFG_TxCycleTime	2	0x0032	50	0x3200
INCLIN_CFG_NodeID	1	0x20	32	0x20
INCLIN_CFG_BitRate	1	0x00	0	0x00
INCLIN_CFG_CAN_Termination	1	0x01	1	0x01
INCLIN_CFG_FilterConfig	1	0x06	6	0x06

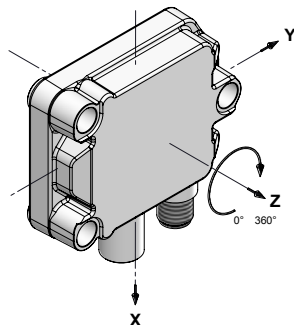
Terminal assignment

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

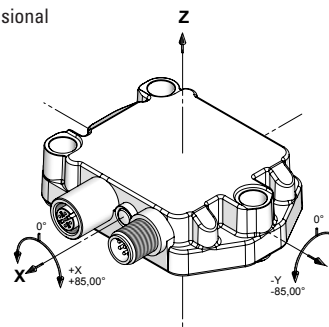
Interface	Type of connection	2 x M12 connector, 5-pin						
		Bus OUT						
		Signal:	+V	0 V	CAN_GND	CAN_H		CAN_L
		Pin:	2	3	1	4		5
		Bus IN						
3	3	Signal:	+V	0 V	CAN_GND	CAN_H	CAN_L	
		Pin:	2	3	1	4	5	

Direction of inclination

1-dimensional



2-dimensional



Inclinometers

**Inclinometer
MEMS / capacitive**

IN88, 1- and 2-dimensional

SAE J1939

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

