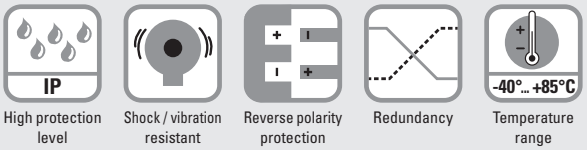
Inclinometer MEMS / capacitive	IN88, 1- and 2-dimensional	CANopen

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.



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	2	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*
2 = CANopen

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 IS60	**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.

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

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 2-dimensional	360°, no limit stop ±85° (see order code)
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 10 Hz

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/s², 6 ms
Vibration resistance acc. to EN 60068-2-6		100 m/s², 10 ... 2000 Hz
Dimensions		80 x 60 x 23 mm [3.15 x 2.36 x 0.91"]

Approvals

E1 compliant in accordance with		ECE guideline
UL compliant in accordance with [3]		File no. E224618
CE compliant in accordance with		
	EMC Directive	2014/30/EU
	RoHS Directive	2011/65/EU
UKCA compliant in accordance with		
	EMC Regulations	S.I. 2016/1091
	RoHS Regulations	S.I. 2012/3032

Interface characteristics CANopen

Interface	CAN high-speed acc. to ISO 11898, Basic- and Full-CAN CAN specification 2.0 B
Protocol	CANopen profile DS410 V1.3 with manufacturer-specific add-ons, communication profile DS301 V4.2
Baud rate	10 kbit/s, 20 kbit/s, 50 kbit/s, 125 kbit/s, 250 kbit/s, 500 kbit/s, 800 kbit/s, 1 Mbit/s software configurable
Node address	1 ... 127 software configurable
Termination switchable	software configurable
LSS protocol	DS305 layer setting services 2.2

General information on CANopen

The CANopen inclinometers support the latest CANopen communications profile according to DS301. In addition, device-specific profiles such as the inclinometer profile DS410 and DS305 (LSS) are available.

The following operating modes may be selected: Polled Mode, Cyclic Mode, Sync Mode. Moreover, scale factors, preset values and many other additional parameters can be programmed via the CAN bus. When switching the appliance on, all parameters are loaded from a flash memory. These parameters have previously been stored in a zero-voltage secure manner. The output values **position, position raw value, sensor temperature and sensor information** can be combined very variably as a PDO (PDO mapping). The inclinometers are available with one or two connectors.

The device address and baud rate can be set/modified by means of the software.

The two-color LED indicates the operating or fault status of the CAN bus, as well as the status of the internal diagnostics.

LSS layer setting services DS305 V2.2

- Global command support for node address and baud rate configuration.
- Selective protocol via identity object (1018h).

CANopen communication profile DS301 V4.2

Among others, the following functionality is integrated (Class C2 functionality):

- NMT slave.
- Heartbeat protocol.
- Identity object.
- Error behavior object.
- Variable PDO mapping, 2 sending PDO's.
- Node address, baud rate and programmable CANbus termination.

CANopen inclinometer profile DS410 V1.3

The following parameters can be programmed:

- Variable PDO mapping of position, position raw value, sensor temperature and sensor information.
- Extended failure management.
- User interface with visual display of bus and failure status - 1 LED two-color.
- Customer-specific protocol.
- "Watchdog controlled" device.

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.**

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

CANopen object dictionary

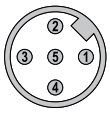
Index (hex)	Sub Index	Data type	Name	Default value
1005h	0	U32	COB-ID Sync	80h
1014h	0	U32	COB-ID Emcy	BEh
1017h	0	U32	Producer heartbeat time	0
	1	U8	Communication Error	0
	2	U8	Sync Error	0
	3	U8	Internal Device Error	0
1800h			TPDO1 Communication Parameter	
	1	U32	COB-ID	1BEh
	2	U8	Transmission Type	255
	5	U16	Event timer	0 [step 1 ms]
1801h			TPDO2 Communication Parameter	
	1	U32	COB-ID	2BEh
	2	U8	Transmission Type	1
	5	U16	Event timer	0 [step 1 ms]
Mapping at 2-dimensional				
1A00h			TPDO1 Mapping	
	0	U8	Number of Entries	3
	1	U32	1.Mapped Object	0x60100010
	2	U32	2.Mapped Object	0x60200010
	3	U32	3.Mapped Object	0x50000010
	4	U32	4.Mapped Object	0
1A01h			TPDO2 Mapping	
	0	U8	Number of Entries	3
	1	U32	1.Mapped Object	0x60100010
	2	U32	2.Mapped Object	0x60200010
	3	U32	3.Mapped Object	0x50000010
	4	U32	4.Mapped Object	0
Mapping at 1-dimensional				
1A00h			TPDO1 Mapping	
	0	U8	Number of Entries	2
	1	U32	1.Mapped Object	0x60100010
	2	U32	2.Mapped Object	0x50000010
	3	U32	3.Mapped Object	0
	4	U32	4.Mapped Object	0
1A01h			TPDO2 Mapping	
	0	U8	Number of Entries	2
	1	U32	1.Mapped Object	0x60100010
	2	U32	2.Mapped Object	0x50000010
	3	U32	3.Mapped Object	0
	4	U32	4.Mapped Object	0

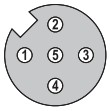
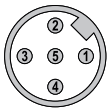
Index (hex)	Sub Index	Data type	Name	Default value
Profile DS410 Inclinometer				
6000h	0	U16	Resolution	0
6011h	0	U8	Slope long16 operating parameter	0
6012h	0	I16	Slope long16 preset value	0
6013h	0	I16	Slope long16 offset	0
6014h	0	I16	Differential Slope long16 offset	0
6021h .. 6024h only at 2-dimensional				
6021h	0	U8	Slope lateral16 opera- ting parameter	0
6022h	0	I16	Slope lateral16 preset value	0
6023h	0	I16	Slope lateral16 offset	0
6024h	0	I16	Differential Slope late- ral16 offset	0
Manufacturer specific objects				
2100h	0	U8	Baudrate	5 (250 kBit/s)
2101h	0	U8	Node Number	0x3E (62d)
2102h	0	U8	Termination	1 = ON
2105h	0	U32	Save All Bus Parameters	0x65766173
3000h	0	U16	Digital Filter Active	1 = ON
3001h	0	F32	Digital Filter Coefficient	10.0

Uxx = UNSIGNED
Ixx = SIGNED
Fxx = FLOAT
Name = Name of the object

Inclinometer MEMS / capacitive	IN88, 1- and 2-dimensional	CANopen

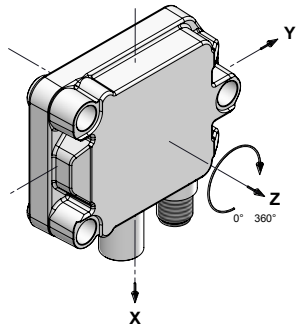
Terminal assignment

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

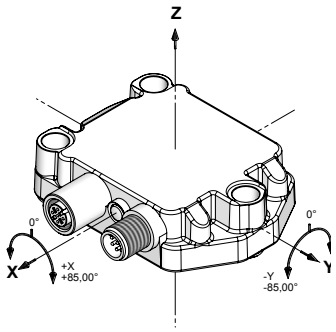
Interface	Type of connection	2 x M12 connector, 5-pin					
2	3		Bus OUT				
		Signal:	+V	0 V	CAN_GND	CAN_H	CAN_L
		Pin:	2	3	1	4	5
			Bus IN				
		Signal:	+V	0 V	CAN_GND	CAN_H	CAN_L
		Pin:	2	3	1	4	5

Direction of inclination

1-dimensional



2-dimensional

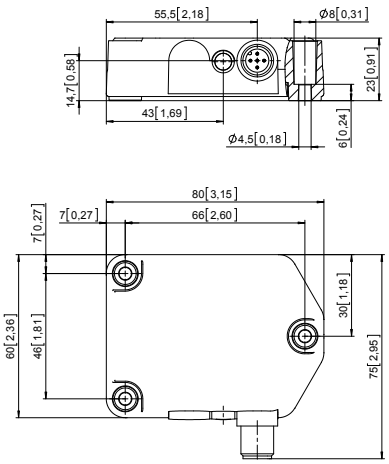


Inclinometer MEMS / capacitive	IN88, 1- and 2-dimensional	CANopen

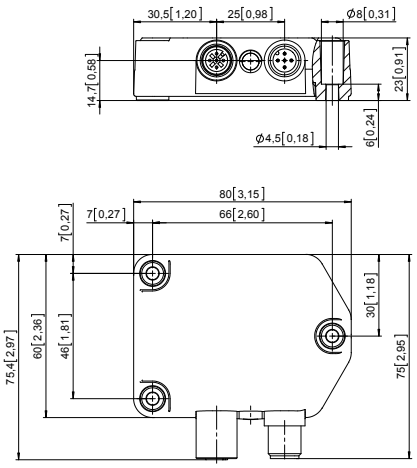
Dimensions

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



Adapter plate

for installation identical to Kübler inclinometer IS60