

# Inclinometers

<b>Inclinometer MEMS / capacitive</b>	<b>IN88, 1- and 2-dimensional</b>	<b>CANopen</b>
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The inclinometers of the IN88 series allow measuring 2-dimensional inclinations in the range of  $\pm 85^\circ$  or 1-dimensional inclinations up to  $360^\circ$ .

With their high robustness, their protection level up to max. IP69k and their wide temperature range from  $-40^\circ\text{C}$  to  $+85^\circ\text{C}$ , 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 $-40^\circ\text{C} \dots +85^\circ\text{C}$

## Robust

- High protection rating IP67 and IP69k in one device.
- Highest robustness thanks to metal housing.
- Stable accuracy over the whole temperature range from  $-40^\circ\text{C}$  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.XX21.12X**  
Type                      a   b   c                      d   e

- |  |   |                                   |   |   |
|--|---|-----------------------------------|---|---|
| <b>a</b> Measuring direction<br>1 = 1-dimensional<br>2 = 2-dimensional | <b>b</b> Measuring range<br>6 = $\pm 85^\circ$ <sup>1)</sup><br>7 = $0^\circ \dots 360^\circ$ <sup>2)</sup> | <b>c</b> Interface<br>2 = CANopen | <b>d</b> Supply voltage<br>2 = 10 ... 30 V DC | <b>e</b> Type of connection<br>1 = 1 x M12 connector, 5-pin<br>3 = 2 x M12 connector, 5-pin |
|--|---|-----------------------------------|---|---|

Accessories		Order no.
<b>Adapter plate</b>	for installation identical to Kübler inclinometer IS60	<b>8.0010.4062.0000</b>
Cables and connectors		Order no.
<b>Preassembled cables</b>	M12 female connector with coupling nut for Bus in, 5-pin, A coded, straight single ended 5 m [16.40'] PVC cable	<b>05.00.6091.A211.005M</b>
	M12 male connector with external thread for Bus out, 5-polig, A coded, straight single ended 5 m [16.40'] PVC cable	<b>05.00.6091.A411.005M</b>
	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	<b>05.00.6091.22C7.001M</b>
<b>Connectors</b>	M12 female conn. with coupling nut for Bus in, 5-pin, A coded, straight (metal/plastic)	<b>05.B-8151-0/9</b>
	M12 male conn. with external thread for Bus out, 5-pin, A coded, straight (metal/plastic)	<b>05.BS-8151-0/9</b>

Further Kübler accessories can be found at: [kuebler.com/accessories](http://kuebler.com/accessories)  
Further Kübler cables and connectors can be found at: [kuebler.com/connection-technology](http://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		
<b>Supply voltage</b>		10 ... 30 V DC
<b>Current consumption (no load)</b>		max. 70 mA
<b>Reverse polarity protection of the supply voltage</b>		yes
<b>Measuring axes</b>		1 or 2
<b>Measuring range</b>	1-dimensional 2-dimensional	360°, no limit stop ±85° (see order code)
<b>Resolution</b>		0.01°
<b>Accuracy at 25 °C <sup>1)</sup></b>	1-dimensional 2-dimensional	typ. ±0.2° typ. ±0.4°
<b>Repeat accuracy</b>		±0.2°
<b>Transverse sensitivity <sup>2)</sup></b>		typ. ±0.3°
<b>Temperature coefficient</b>		typ. ±0.006°/K
<b>Sampling rate</b>		50 Hz (20 ms)
<b>Limit frequency</b> with Butterworth filter factory setting		0.1 ... 10 Hz, 8th order 10 Hz
<b>CE compliant</b> acc. to		EMC guideline 2014/30/EU RoHS guideline 2011/65/EU
<b>UL approval <sup>3)</sup></b>		file 224618
<b>E1 type-approval</b>		10R-058255

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

Mechanical characteristics		
<b>Connection</b>	1 x M12 connector 2 x M12 connector	5-pin, male connector 5-pin, male connector / 5-pin, female connector
<b>Weight</b>		approx. 185 g [6.53 oz]
<b>Protection</b> acc. to EN 60529		IP67 / IP69k <sup>3)</sup>
<b>Working temperature range</b>		-40 °C ... +85 °C [-40 °F ... +185 °F]
<b>Material</b>	housing	aluminum
<b>Shock resistance</b> acc. to EN 60068-2-27		1000 m/s <sup>2</sup> , 6 ms
<b>Vibration resistance</b> acc. to EN 60068-2-6		100 m/s <sup>2</sup> , 10 ... 2000 Hz
<b>Dimensions</b>		80 x 60 x 23 mm [3.15 x 2.36 x 0.91"]

Interface characteristics CANopen	
<b>Interface</b>	CAN high-speed acc. to ISO 11898, Basic- and Full-CAN CAN specification 2.0 B
<b>Protocol</b>	CANopen profile DS410 V1.3 with manufacturer-specific add-ons, communication profile DS301 V4.2
<b>Baud rate</b>	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
<b>Node address</b>	1 ... 127 software configurable
<b>Termination switchable</b>	software configurable
<b>LSS protocol</b>	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.

<sup>1)</sup> Over the whole temperature and max. measuring range  
1-dimensional ≤ ±0.4°; 2-dimensional ≤ ±1°.

<sup>2)</sup> Only for 2-dimensional measuring direction.

<sup>3)</sup> 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](http://www.kuebler.com).

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CANopen object dictionary					CANopen object dictionary				
Index (hex)	Sub Index	Data type	Name	Default value	Index (hex)	Sub Index	Data type	Name	Default value
1005h	0	U32	COB-ID Sync	80h	<b>Profile DS410 Inclinometer</b>				
1014h	0	U32	COB-ID Emcy	BEh	6000h	0	U16	Resolution	0
1017h	0	U32	Producer heartbeat time	0	6011h	0	U8	Slope long16 operating parameter	0
	1	U8	Communication Error	0	6012h	0	I16	Slope long16 preset value	0
	2	U8	Sync Error	0	6013h	0	I16	Slope long16 offset	0
	3	U8	Internal Device Error	0	6014h	0	I16	Differential Slope long16 offset	0
1800h			TPDO1 Communication Parameter		<b>6021h .. 6024h only at 2-dimensional</b>				
	1	U32	COB-ID	1BEh	6021h	0	U8	Slope lateral16 operating parameter	0
	2	U8	Transmission Type	255	6022h	0	I16	Slope lateral16 preset value	0
	5	U16	Event timer	0 [step 1 ms]	6023h	0	I16	Slope lateral16 offset	0
1801h			TPDO2 Communication Parameter		6024h	0	I16	Differential Slope lateral16 offset	0
	1	U32	COB-ID	2BEh	<b>Manufacturer specific objects</b>				
	2	U8	Transmission Type	1	2100h	0	U8	Baudrate	5 (250 kBit/s)
	5	U16	Event timer	0 [step 1 ms]	2101h	0	U8	Node Number	0x3E (62d)
<b>Mapping at 2-dimensional</b>					2102h	0	U8	Termination	1 = ON
1A00h			TPDO1 Mapping		2105h	0	U32	Save All Bus Parameters	0x65766173
	0	U8	Number of Entries	3	3000h	0	U16	Digital Filter Active	1 = ON
	1	U32	1.Mapped Object	0x60100010	3001h	0	F32	Digital Filter Coefficient	10.0
	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					
<b>Mapping at 1-dimensional</b>									
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					

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

# Inclinometers

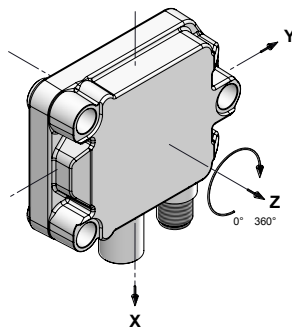
<b>Inclinometer MEMS / capacitive</b>	<b>IN88, 1- and 2-dimensional</b>	<b>CANopen</b>
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## Terminal assignment

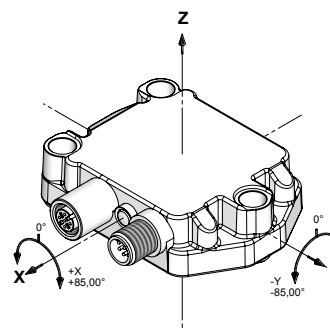
Interface	Type of connection	1 x M12 connector, 5-pin						
2	1	Bus IN						
		Signal:	+V	0 V	CAN_GND	CAN_H		CAN_L
		Pin:	2	3	1	4		5
Interface	Type of connection	2 x M12 connector, 5-pin						
2	3	Bus OUT						
		Signal:	+V	0 V	CAN_GND	CAN_H		CAN_L
		Pin:	2	3	1	4		5
		Bus IN						
		Signal:	+V	0 V	CAN_GND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

## Direction of inclination

1-dimensional



2-dimensional



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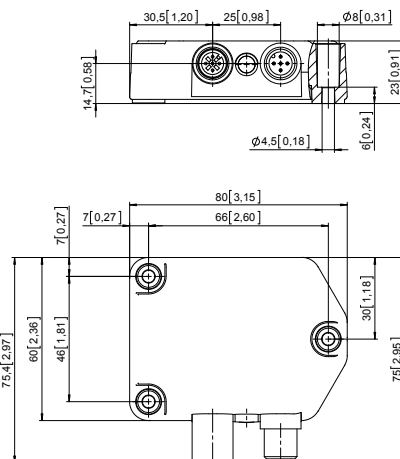
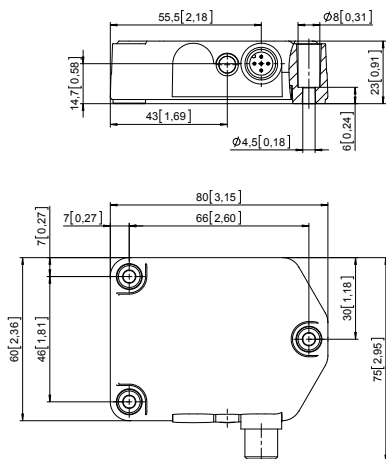
## Dimensions

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

