

# Inclinometers

**Inclinometer  
MEMS / capacitive**

**IN81, 1- and 2-dimensional**

**Analog**



The inclinometers of the IN81 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.



Analog  
output



High protection level



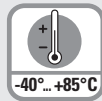
Shock / vibration resistant



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  $-40^\circ\text{C}$  up to  $+85^\circ\text{C}$ .
- Non long-term drift thanks to sensor array technique.

## Versatile

- Preset and teach function.
- Measuring direction 1- or 2-dimensional.
- With switch outputs.
- Stacked installation possible for redundancy.

## Order code

8.IN81 . XXXX . X2X  
Type      a   b   c   d      e   f   g

### a Measuring direction

- 1 = 1-dimensional
- 2 = 2-dimensional

### b Measuring range

- 1 =  $\pm 10^\circ$  <sup>1)</sup>
- 2 =  $\pm 15^\circ$  <sup>1)</sup>
- 3 =  $\pm 30^\circ$  <sup>1)</sup>
- 4 =  $\pm 45^\circ$  <sup>1)</sup>
- 5 =  $\pm 60^\circ$  <sup>1)</sup>
- 6 =  $\pm 85^\circ$  <sup>1)</sup>
- 7 = 0 ...  $360^\circ$  ( $\pm 180^\circ$ ) <sup>2)</sup>
- 8 = 0 ...  $180^\circ$  ( $\pm 90^\circ$ ) <sup>2)</sup>

### c Interface

- 1 = 4 ... 20 mA / 12 bit
- 2 = 0.1 ... 4.9 V / 12 bit
- 3 = 0.5 ... 4.5 V / 12 bit
- 4 = 0 ... 5 V / 12 bit
- 5 = 0 ... 10 V / 12 bit

### d Filter

- 1 = no filter
- 2 = filter value 0.1 Hz
- 3 = filter value 0.3 Hz
- 4 = filter value 0.5 Hz
- 5 = filter value 1.0 Hz
- 6 = filter value 2.0 Hz
- 7 = filter value 5.0 Hz
- 8 = filter value 10.0 Hz

### e Optional switching outputs

- 1 = none
- 2 = 2 switch outputs <sup>3)</sup>

### f Power supply

- 2 = 10 ... 30V / 40 mA
- 15 ... 30 V for interface 5

### g Type of connection

- 1 = 1 x M12 connector, 8-pin
- 3 = 2 x M12 connector, 8-pin + 5-pin <sup>4)</sup>


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

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

3) Can only be ordered in connection with type of connection 3.

4) Can only be ordered in connection with option 2 switching outputs.

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<b>Accessories</b>			Order no.
<b>Teach adapter</b>		for controlling the control inputs for the following functions: - Preset (reference point setting) - Teaching (measuring range) - Filter setting - Switching points setting	<b>8.0010.9000.0017</b>
<b>Connection technology</b>			Order no.
<b>Cordset, pre-assembled</b>	M12 female connector with coupling nut, 8-pin 5 m [16.40'] PVC cable		<b>05.00.6041.8211.005M</b>
	M12 male connector with external thread, 5-pin <sup>1)</sup> 5 m [16.40'] PVC cable		<b>05.00.6091.A411.005M</b>
<b>Connector, self-assembly (straight)</b>	M12 female connector with coupling nut, 8-pin M12 male connector with external thread, 5-pin <sup>1)</sup>		<b>05.CMB 8181-0</b> <b>8.0000.5111.0000</b>

Further accessories can be found in the accessories section or in the accessories area of our website at: [www.kuebler.com/accessories](http://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](http://www.kuebler.com/connection_technology)

Technical data			
Electrical characteristics current interface		Electrical characteristics voltage interface	
<b>Power supply</b>	10 ... 30 V DC	<b>Power supply</b>	0.1 ... 4.9 V / 0.5 ... 4.5 V / 0 ... 5 V    10 ... 30 V 0 ... 10 V    15 ... 30 V
<b>Current consumption (no load)</b>	max. 40 mA	<b>Current consumption (no load)</b>	max. 40 mA
<b>Reverse polarity protection of the power supply</b>	yes	<b>Reverse polarity protection of the power supply</b>	yes
<b>PowerON Time (PowerOn until valid output value)</b>	< 0.5 s	<b>PowerON Time (PowerOn until valid output value)</b>	< 0.5 s
<b>Measuring axes</b>	1 or 2	<b>Measuring axes</b>	1 or 2
<b>Measuring range</b>	1-dimensional 180° / 360° 2-dimensional max. ±85° (see order code)	<b>Measuring range</b>	1-dimensional 180° / 360° 2-dimensional max. ±85° (see order code)
<b>Resolution</b>	12 bit	<b>Resolution</b>	0 ... 5 V / 0 ... 10 V    12 bit 0.1 ... 4.9 V / 0.5 ... 4.5 V    11 bit
<b>Absolute accuracy at 25°C <sup>2)</sup></b>	version 2 dim, ±10°, ±15°, ±30°    typ. ±0.4° version 2 dim, ±45°, ±60°    typ. ±0.5° version 2 dim, ±85°    typ. ±0.5° version 1 dim, 0 ... 180°    typ. ±0.5° version 1 dim, 0 ... 360°    typ. ±0.5°	<b>Absolute accuracy at 25°C <sup>4)</sup></b>	version 2 dim, ±10°, ±15°, ±30°    typ. ±0.4° version 2 dim, ±45°, ±60°    typ. ±0.5° version 2 dim, ±85°    typ. ±0.5° version 1 dim, 0 ... 180°    typ. ±0.5° version 1 dim, 0 ... 360°    typ. ±0.5°
<b>Temperature coefficient</b>	2 dim up to ±30°    typ. ±0.015°/K 2 dim up to ±60°    typ. ±0.018°/K 2 dim ±85°    typ. ±0.023°/K 1 dim    typ. ±0.03°/K	<b>Temperature coefficient</b>	1 dim    typ. ±0.005°/K 2 dim    typ. ±0.01°/K
<b>Repeat accuracy</b>	±0.2°	<b>Repeat accuracy</b>	±0.2°
<b>Transverse sensitivity <sup>3)</sup></b>	max. ±0.6°	<b>Transverse sensitivity <sup>3)</sup></b>	max. ±0.6°
<b>Output load</b>	at 10 VDC    max. 200 Ohm at 24 VDC    max. 900 Ohm at 30 VDC    max. 1200 Ohm	<b>Output load</b>	max. 10 mA
<b>Setting time</b>	< 1 ms (R <sub>Burden</sub> = 900 Ohm, 25°C)	<b>Setting time</b>	< 1 ms (R <sub>Burden</sub> = 1000 Ohm, 25°C)
<b>Sampling rate</b>	50 Hz (20 ms)	<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>Limit frequency</b> with Butterworth filter factory setting	0.1 ... 10 Hz, 8th order 10 Hz
<b>CE compliant acc. to</b>	EMC guideline 2014/30/EU RoHS guideline 2011/65/EU	<b>CE compliant acc. to</b>	EMC guideline 2014/30/EU RoHS guideline 2011/65/EU
<b>E1 type-approval</b>	in preparation	<b>E1 type-approval</b>	in preparation

1) For variant with switching outputs.  
2) Over the whole temperature and measuring range; 1 dim ≤ ±2.3°, 2 dim ≤ ±1.9°.  
3) Only for 2-dimensional measuring direction.

4) Over the whole temperature and measuring range; 1 dim ≤ ±1.2°, 2 dim ≤ ±0.8°.  
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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Mechanical characteristics		
<b>Connection</b>	1 x M12 connector 2 x M12 connector	8-pin, male connector 8-pin, male connector / 5-pin, female connector
<b>Weight</b>	approx. 185 g	
<b>Protection acc. to EN 60529</b>	IP67 + IP69k	
<b>Working temperature range</b>	-40°C ... +85°C [-40°F ... +185°F]	
<b>Material</b>	housing	aluminum
<b>Shock resistance</b>	1000 m/s <sup>2</sup> , 6 ms	
<b>Vibration resistance</b>	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"]	

EMC		
<b>Relevant standards</b>	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 <sup>1)</sup>
	EN 13309	Construction machinery - Electromagnetic compatibility of machines with internal power supply <sup>1)</sup>

### Control inputs

- Functions:
- Preset (reference point setting)
  - Teaching (measuring range)
  - Filter setting
  - Switching points setting

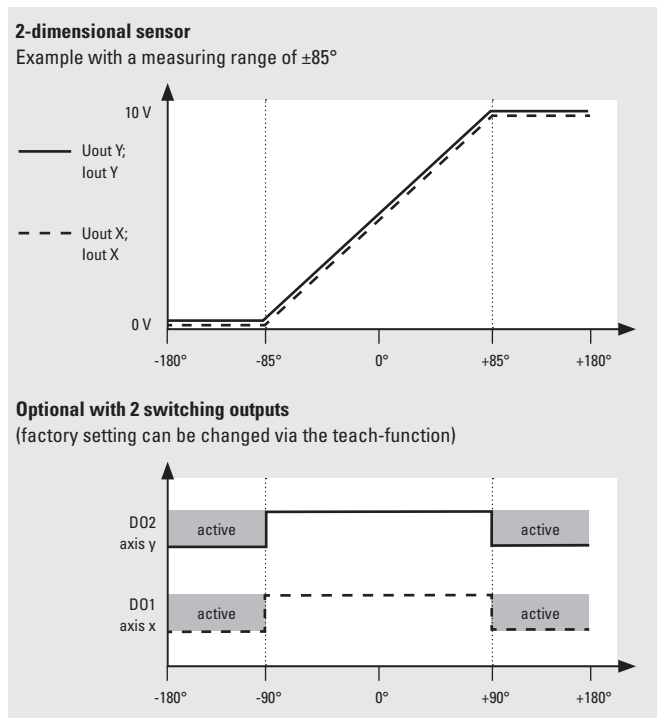
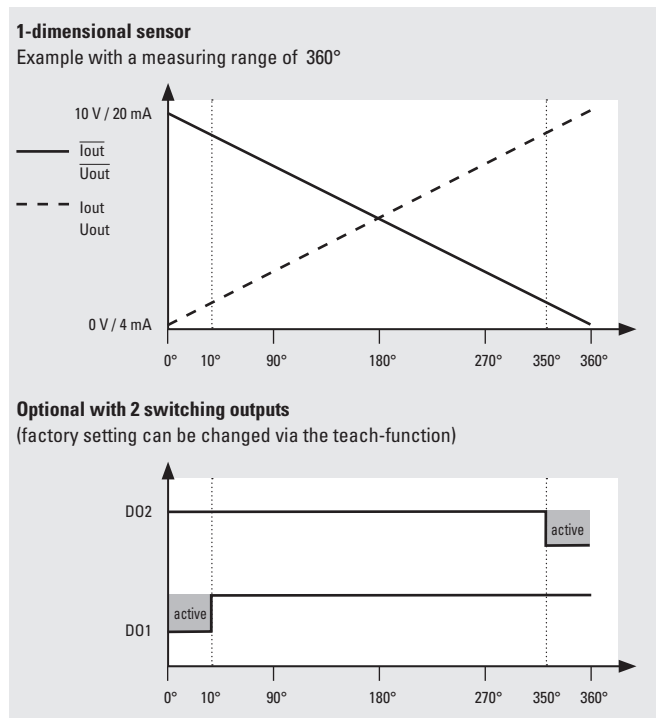
### Switch output

optional: 2 switch outputs

Electrical characteristics	
<b>Input</b>	active HIGH
<b>Signal level</b>	High min. 60% of +V, max. +V Low max. 30% of +V
<b>Min. pulse duration</b>	+V for min. 1 s

Electrical characteristics	
<b>Permissible load</b>	max. 100 mA
<b>Signal level (under max. load)</b>	High min. +V - 2,0 V Low max. 0,5 V
<b>Short circuit proof outputs</b>	yes

## Course of the output signal – factory setting









1) Without pulse 5.







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## Terminal assignment, 1 dimensional

Interface 1 current	Type of connection 1	M12 connector, 8-pin									
		Signal:	0 V	+V	Iout+	Iout-	Iout+	Iout-	Teach 1		Teach 2
		Pin:	1	2	3	4	5	6	7	8	
Interface 1 current	Type of connection 3	M12 connector, 8-pin									
		Signal:	0 V	+V	Iout+	Iout-	Iout+	Iout-	Teach 1		Teach 2
		Pin:	1	2	3	4	5	6	7	8	
		Switching outputs option – M12 connector, 5-pin									
Signal:	n.c.	DO1	DO2	n.c.	0 V						
Pin:	1	2	3	4	5						
Interface 2, 3, 4, 5 voltage	Type of connection 1	M12 connector, 8-pin									
		Signal:	0 V	+V	Uout+	Uout-	Uout+	Uout-	Teach 1		Teach 2
		Pin:	1	2	3	4	5	6	7	8	
Interface 2, 3, 4, 5 voltage	Type of connection 3	M12 connector, 8-pin									
		Signal:	0 V	+V	Uout+	Uout-	Uout+	Uout-	Teach 1		Teach 2
		Pin:	1	2	3	4	5	6	7	8	
		Switching outputs option – M12 connector, 5-pin									
Signal:	n.c.	DO1	DO2	n.c.	0 V						
Pin:	1	2	3	4	5						

## Terminal assignment, 2 dimensional

Interface 1 current	Type of connection 1	M12 connector, 8-pin									
		Signal:	0 V	+V	Iout+ X	Iout- X	Iout+ Y	Iout- Y	Teach 1		Teach 2
		Pin:	1	2	3	4	5	6	7	8	
Interface 1 current	Type of connection 3	M12 connector, 8-pin									
		Signal:	0 V	+V	Iout+ X	Iout- X	Iout+ Y	Iout- Y	Teach 1		Teach 2
		Pin:	1	2	3	4	5	6	7	8	
		Switching outputs option – M12 connector, 5-pin									
Signal:	n.c.	DO1	DO2	n.c.	0 V						
Pin:	1	2	3	4	5						
Interface 2, 3, 4, 5 voltage	Type of connection 1	M12 connector, 8-pin									
		Signal:	0 V	+V	Uout+ X	Uout- X	Uout+ Y	Uout- Y	Teach 1		Teach 2
		Pin:	1	2	3	4	5	6	7	8	
Interface 2, 3, 4, 5 voltage	Type of connection 3	M12 connector, 8-pin									
		Signal:	0 V	+V	Uout+ X	Uout- X	Uout+ Y	Uout- Y	Teach 1		Teach 2
		Pin:	1	2	3	4	5	6	7	8	
		Switching outputs option – M12 connector, 5-pin									
Signal:	n.c.	DO1	DO2	n.c.	0 V						
Pin:	1	2	3	4	5						

+V: Power supply +V DC  
 0V: Power supply ground GND (0 V)

Teach 1: Input 1 for various teaching functions  
 Teach 2: Input 2 for various teaching functions

Uout+ X: X axis voltage output  
 Uout- X: X axis voltage output GND  
 Uout+ Y: Y axis voltage output  
 Uout- Y: Y axis voltage output GND

Iout+ X: X axis current output  
 Iout- X: X axis current output GND  
 Iout+ Y: Y axis current output  
 Iout- Y: Y axis current output GND

DO1: Digital output 1  
 DO2: Digital output 2

1-axis version  
 Uout+: Voltage output  
 Uout-: Voltage output GND  
 Uout+: Inverted voltage output  
 Uout-: Inverted voltage output GND

1-axis version  
 Iout+: Current output  
 Iout-: Current output GND  
 Iout+: Inverted current output  
 Iout-: Inverted current output GND

# Inclinometers

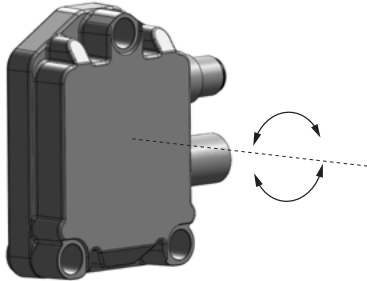
**Inclinometer  
MEMS / capacitive**

**IN81, 1- and 2-dimensional**

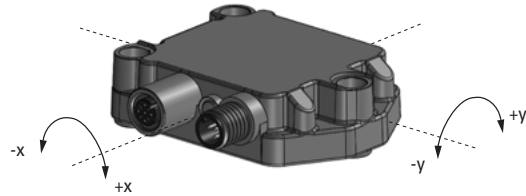
**Analog**

## Direction of inclination

1-dimensional



2-dimensional



## Dimensions

Dimensions in mm [inch]

1 x M12 connector 8-pin, male contacts

1 x M12 connector 8-pin, male contacts

1 x M12 connector 5-pin, female contacts

