

Inclinometers

Inclinometer MEMS / capacitive	IN88, 1- and 2-dimensional	Modbus
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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° .

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 or solar applications.

IP High protection level	Shock / vibration resistant	Reverse polarity protection	Redundancy	Temperature range $-40^\circ\text{C} \dots +85^\circ\text{C}$
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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	.	X	X	6	1	.	1	2	X
		Type			a	b	c			d	e	
a Measuring direction	b Measuring range	c Interface	d Power supply	e Type of connection								
1 = 1-dimensional 2 = 2-dimensional	6 = $\pm 85^\circ$ ¹⁾ 7 = $0^\circ \dots 360^\circ$ ²⁾	6 = Modbus RTU	2 = 10 ... 30 V DC	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
Power consumption		max. 70 mA
Reverse polarity protection		yes
Measuring axes		1 or 2
Measuring range	1-dimensional 2-dimensional	360°, no limit stop ±85°
Resolution		0.01°
Absolute accuracy (at 25°C over the whole measuring range) ¹⁾	1-dimensional 2-dimensional	±0,2° ±0,4°
Transverse sensitivity ²⁾		max. ±0.6°
Repeat accuracy		±0.2°
Temperature drift		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
E1 type-approval		10R-057989

Interface characteristics Modbus	
Code	binary
Interface	Modbus V1.02
Protocol	Modbus RTU V1.1b3
Baud rate	4800 ... 115200 kbit/s software configurable
Node address	1 ... 63 software configurable
Termination	software configurable

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	Construction machinery - Electromagnetic compatibility of machines with internal power supply

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

A full description of the technical data can be found in the relevant product manual at www.kuebler.com.

1) Over the whole temperature and measuring range
1-dimensional ≤ ±0,4°; 2-dimensional ≤ ±1°.
2) Only for 2-dimensional measuring direction.

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Modbus communication profile V 1.02

Node number, baudrate and bus termination programmable.

Modbus application protocol V1.1b3

Read Holding Register – Function code 03 ¹⁾				
Reg.	Data name	ATT	Value	Default
00001	LOTWINKEL X-ACHSE	I16	Inclination angle in 0.01 °	-85.00 ... +85.00
00002	LOTWINKEL Y-ACHSE	I16	Rotation angle in 0.01 °	-85.00 ... +85.00
00003	EULERWINKEL X-ACHSE	I16	Euler angle (1 axis)	0 ... 180.99°
00004	EULERWINKEL Y-ACHSE	U16	Euler angle (1 axis)	0 ... 359.99°
00007	VERSORGUNG VCC	U16	VCC in 0.1 VDC	240
00008	TEMPERATURE IN 0.1°C	U16	Temp. in 0.1°	210
00016	SIDEVIEW	U16	Back = 0, Front = 1	0
00023	SYSTEM STATE	U16	No errors = 0	0
00140	BAUDRATE	U16	Current baudrate	19200 Baud (2)
00144	NODE-ID	U16	Current node address	63
00145	TERMINIERUNG	U16	Termination on/off	2 (on)
00146	FILTER AKTIVIERUNG	U16	Filter on/off	1 (on)
00147	FILTER EINSTELLUNG	F32	Filter value in HZ	5.0
00148	SERIENNUMMER	U32	Serial number	16DDNNNNNN
00149	PRODUCT CODE	U32	Device type	x88616100
00150	AUFLÖSUNG	U16	Resolution X/Y axis	0.01° (10)
00151	OPERATING PARAMETER	U16	Setting X axis	0
00152	PRESET X-ACHSE	U16	Preset X axis	0
00153	OFFSET X-ACHSE	U16	Offset X axis	0
00154	DIFF.OFFSET X-ACHSE	U16	Differential offset	0
00155	Operating Parameter	U16	Setting Y axis	0
00156	PRESET Y-ACHSE	U16	Preset Y axis	0
00157	OFFSET Y-ACHSE	U16	Offset Y axis	0
00158	DIFF.OFFSET Y-ACHSE	U16	Differential offset	0
00159	OFFSET EULERWINKEL	U16	Offset Euler axis Y	0

Write Holding Register – Function code 16 (0x10)					
Reg.	Value	R/W	Format	Content	Default
300	VAR	W	U16	Baudrate	19200 Baud (2)
301	VAR	W	U16	Parity	1 = none 2 = odd 3 = even
302	VAR	W	U16	Stopbit	1 = 1 Stopbit 3 = 2 Stopbit
304	VAR	W	U16	Node Number	0x3F (63d)
305	VAR	W	U16	Termination	2 = ON 1 = Off
306	VAR	W	U16	Digital Filter Active	1 = ON
307	VAR	W	F32	Digital Filter Coefficient	5.0
310	VAR	W	U16	Resolution of axis	10
311	VAR	W	U16	Slope long16 operating parameter	0
312	VAR	W	I16	Slope long16 preset value	0
313	VAR	W	I16	Slope long16 offset	0
314	VAR	W	I16	Differential Slope long16 offset	0
315	VAR	W	U16	Slope lateral16 operating parameter	0
316	VAR	W	I16	Slope lateral16 preset value	0
317	VAR	W	I16	Slope lateral16 offset	0
318	VAR	W	I16	Differential Slope lateral16 offset	0
320	VAR	W	U16	Preset Euleraxis (only 0)	0
261	VAR	W	U16	Delaytime for Transmission	1
360	VAR	W	U16	Save All Application Parameters	0x1010
361	VAR	W	U16	Load All Parameters (Factory default)	0x10101

1) Reads the binary contents of holding registers (4XXXX references) in the encoder slave. Broadcast is not supported.

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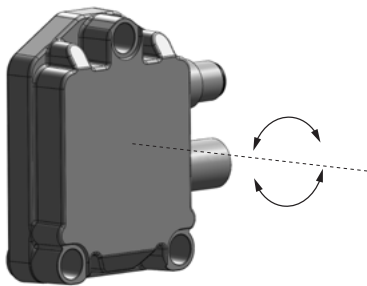
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Terminal assignment

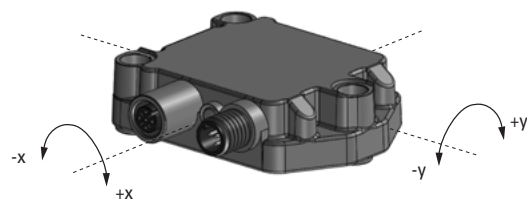
Interface	Type of connection	1 x M12 connector, 5-pin						
6	1	Bus IN						
		Signal:	+V	0 V	D0	D1		TG
		Pin:	2	3	5	4		1
Interface	Type of connection	2 x M12 connector, 5-pin						
6	3	Bus OUT						
		Signal:	+V	0 V	D0	D1		TG
		Pin:	2	3	5	4		1
		Bus IN						
		Signal:	+V	0 V	D0	D1		TG
		Pin:	2	3	5	4		1

Direction of inclination

1-dimensional



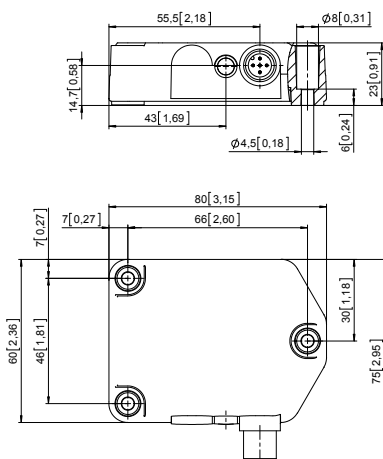
2-dimensional



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

