Датчики угла наклона для статических применений IN61, IN62, IN68, IN81, IN88, IS40

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For static applications
1- and 2-axis, compact design | **IS40** | **Analog**

The inclination sensors in the IS40 series can be used to measure 2-axis inclinations in the measuring range of ±10°, ±45° or ±60° as well as 1-axis inclinations of up to 360°.

The compact and robust design makes the sensor a suitable angle measuring device in harsh environments.

RoHS

Analog Output

Features and benefits

- **Analog sensor for precise measurement**
  - Stable accuracy over the entire temperature range
  - Analog interface for current and voltage ranges
- **Individual "Easy-Teach" settings via Teach Adapter**
  - Define preset (zero point / midpoint position)
  - Scaling of the analog measuring range (start/end position)
  - Resetting to factory settings
- **Robust, compact design**
  - Also suitable for the smallest installation spaces
  - Robust design with high shock resistance
- **Versatile use**
  in vehicle technology, solar installations, cranes and hoists or in commercial vehicles.

Order code 1-axis

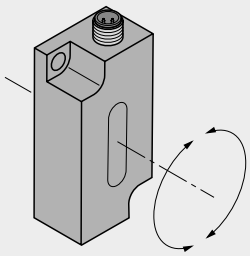
8.IS40	.	1	4	X	2	1
Type			a	b	c	d

a *Measuring range*
4 = 0 ... 360° (±180°)

b *Interface*
1 = 4 ... 20 mA
3 = 0.1 ... 4.9 V DC

c *Power supply*
2 = 10 ... 30 V DC

d *Type of connection*
1 = M12 connector, 5-pin



Order code 2-axis

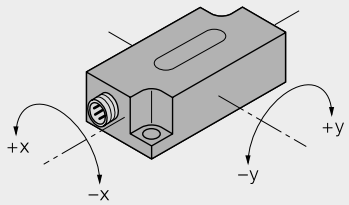
8.IS40	.	2	X	X	X	1
Type			a	b	c	d

a *Measuring range*
1 = ±10°
2 = ±45°
3 = ±60°

b *Interface*
1 = 4 ... 20 mA [1]
3 = 0.1 ... 4.9 V DC [1]
4 = ratiometric 2 % ... 98 % [2]

c *Power supply*
1 = 5 V DC
2 = 10 ... 30 V DC

d *Type of connection*
1 = M12 connector, 5-pin



1) Available only in combination with power supply 10 ... 30 V DC
2) In relation to the power supply 5 V DC (available only in combination with power supply 5 V DC)

For static applications 1- and 2-axis, compact design	IS40	Analog

Accessories		Order no.
Teach-Adapter 	for activating the control inputs for the following functions: - Reset to factory setting - Center point of the measurement - Start and end point for 1-axis measurement	**05.TX40.1**

Cables and connectors		Order no.
Preassembled cables	M12 female connector with coupling nut, 5-pin, A coded, straight single ended 2 m [6.56'] PVC cable	**05.00.6021.E211.002M**
Connectors	M12 female connector with coupling nut, 5-pin, A coded, straight (metal)	**8.0000.5116.0000**
	M12 female connector with coupling nut, 5-pin, A coded, straight (stainless steel V4A)	**8.0000.5116.0000.V4A**

Further Kübler accessories can be found at: /accessories
Further Kübler cables and connectors can be found at: /connection-technology

For static applications
1- and 2-axis, compact design | **IS40** | **Analog**

Technical data

General data 1-axis measurement

Measuring range	0 ... 360°
Resolution	≤ 0.14°
Repeat accuracy	≤ 0.2 % of measuring range
Linearity deviation	≤ 0.6 %
Temperature coefficient	≤ ± 0.05 %/K
Reaction time	0.1 s – Time for the output signal to reach 90% of the adjusted measuring range

General data 2-axis measurement

Measuring range		±10°, ±45°, ±60°
Resolution	for version ±10°	≤ 0.04°
	for version ±45°	≤ 0.1°
	for version ±60°	≤ 0.14°
Repeat accuracy		≤ 0.2 % of measuring range
Linearity deviation		
	for version ±10°	≤ 1 %
	for version ±45° and ±60°	≤ 0.5 %
Temperature coefficient		
	for version ±10°	≤ ± 0.05 %/K
	for version ±45°	≤ ± 0.04 %/K
	for version ±60°	≤ ± 0.025 %/K
Reaction time		0.1 s – Time for the output signal to reach 90% of the adjusted measuring range, if the angle is changed over the whole measuring range
Zero point adjustment		
	for version ±10°	±5°
	for version ±45° and ±60°	±15°

Approvals

CE compliant in accordance with EMC Directive	2014/30/EU

Electrical characteristics

Power supply		10 ... 30 V DC
Power consumption	1-axis	50 ... 105 mA (depending on voltage)
	2-axis	50 mA
Isolation test voltage		≤ 0.5 kV
Short-circuit protection		yes
Wire breakage	1-axis	yes
	2-axis	no
Overvoltage protection	2-axis	-48 ... 48 VDC
Reverse polarity protection		yes

Mechanical characteristics

Connection		M12 connector
Weight		50 g
Protection acc. to EN 60529		IP68 / IP69k
Working temperature range		-30 °C ... +70 °C [-22 °F ... +158 °F]
Material	housing	plastic, PC
Shock resistance		30 g (11 ms)
Vibration resistance		55 Hz (1 mm)
MTTF		203 years acc. to SN 29500 (Ed. 99) 40 °C
Dimensions		60 x 30 x 20 mm [2.36 x 1.18 x 0.79“]

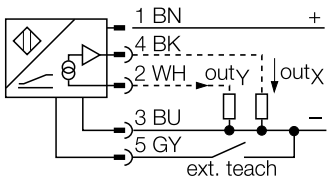
Characteristic voltage output

Voltage output	0.1 ... 4.9 V DC for 1-axis: 1x each for cw and ccw
Load resistance	≥ 40 kΩ

Characteristic current output

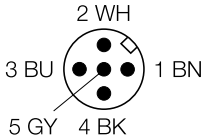
Current output	4 ... 20 mA for 1-axis: 1x each for cw and ccw
Load resistance	≤ 0.2 kΩ

Connections



ext. teach: if this input is connected to 0 V, then the output of the inclinometer is reset to 0°.

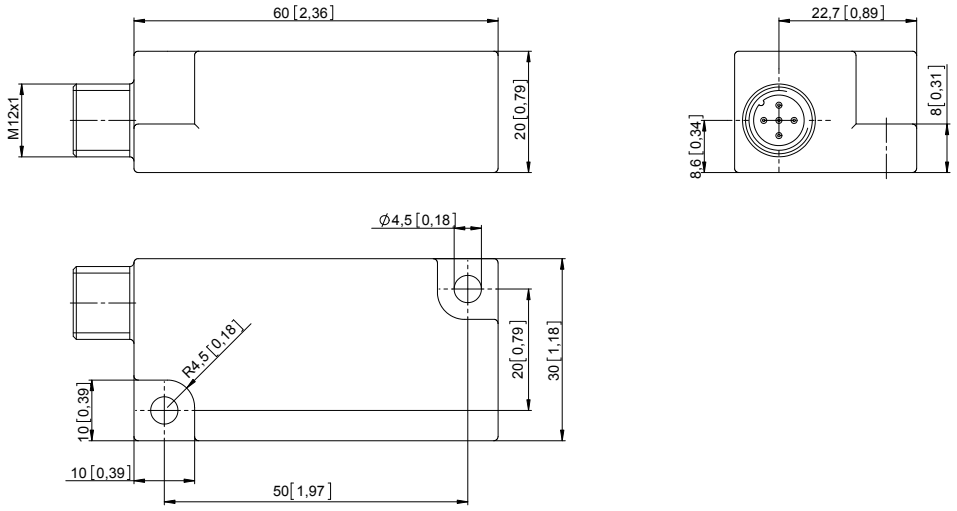
Terminal assignment



For static applications
1- and 2-axis, compact design | **IS40** | **Analog**

Dimensions

Dimensions in mm [inch]



For static applications
1- and 2-axis, metal housing | **IN88** | **Fieldbus**

The inclinometers of the IN88 series allow measuring 2-axis inclinations in the range of ±85° or 1-axis 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.

Features and benefits

- **For different fieldbus systems**
  Variants for CANopen, SAEJ1939 or Modbus
- **Individual settings via the fieldbus interface**
  - Define preset (zero point / midpoint position)
  - Setting the sensor filter
  - Resetting to factory settings
- **Redundant measurement**
  The housing offers the option of mounting sensors in stacks in order to easily implement redundant measurement in the application.
- **Simple start-up and diagnostics**
  - LED display for quick and visual detection of the operating status.
  - Optimum integration and loop-through in bus networks thanks to 2x M12 connector options
- **Precise measurement even under harsh environmental conditions**
  - Temperature range -40 °C ... +85 °C and protection class IP67 / IP69k
  - Protection against the influence of salt spray and rapid temperature changes
  - E1-approval
- **Maximum robustness**
  The robust metal housing also protects the electronics from extreme mechanical influences.

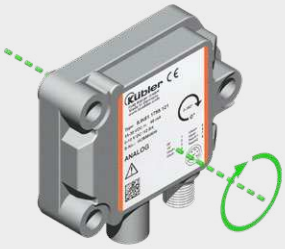
Order code 1-axis

8.IN88	.	1	7 (a)	X (b)	1	.	1	2	X (e)
Type									

(a) *Measuring range*
7 = 0 ... 360° (±180°)

(b) *Interface*
2 = CANopen
3 = SAE J1939
6 = Modbus RTU

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



Order code 2-axis

8.IN88	.	2	6 (a)	X (b)	1	.	1	2	X (e)
Type									

(a) *Measuring range*
6 = ± 85°

(b) *Interface*
2 = CANopen
3 = SAE J1939
6 = Modbus RTU

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

For static applications 1- and 2-axis, metal housing	IN88	Fieldbus

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**

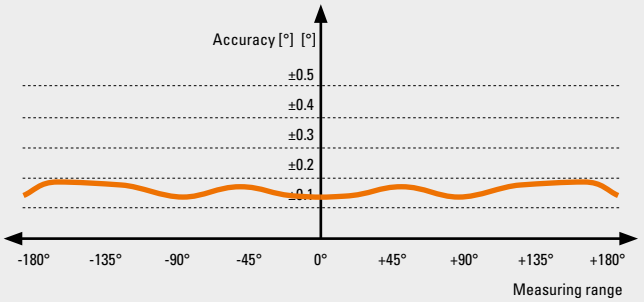
Further Kübler accessories can be found at: /accessories
Further Kübler cables and connectors can be found at: /connection-technology

For static applications
1- and 2-axis, metal housing | **IN88** | **Fieldbus**

Technical data

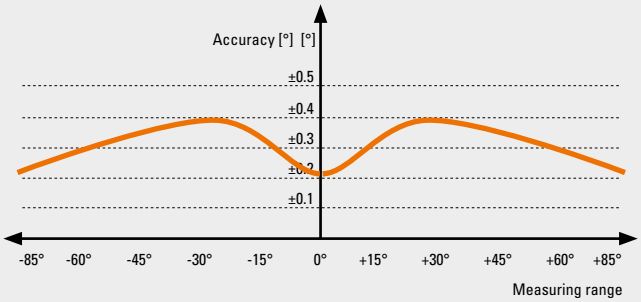
General data 1-axis measurement

Measuring range	0 ... 360°
Resolution	0.01°
Repeat accuracy	±0.2°
Temperature coefficient	typ. ±0.006° / K
Accuracy (at 25°C)	±0.1 ... ±0.2° depending on the measuring range



General data 2-axis measurement

Measuring range	-85 ... +85°
Resolution	0.01°
Repeat accuracy	±0.2° .... ±0.4°
Temperature coefficient	typ. ±0.006° / K
Transverse sensitivity	typ. ±0.3°
Accuracy (at 25°C)	±0.5° ... ±1.0° depending on the measuring range



General electrical characteristics

Supply voltage	10 ... 30 V DC
Current consumption (no load)	max. 70 mA
Reverse polarity protection of the supply voltage	yes
Sampling rate	50 Hz (20 ms)
Limit frequency with Butterworth filter	0.1 ... 10 Hz, 8th order
factory setting	typ. 10 Hz

Mechanical characteristics

Connection	1 x M12 connector	5-pin, male connector
	2 x M12 connector	5-pin, male connector / 5-pin, female connector
Weight		approx. 185 g [6.53 oz]
Protection acc. to EN 60529		IP67 / IP69k [1]
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“]

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

Approvals

E1 compliant in accordance with	ECE guideline
UL compliant in accordance with [1]	File no. E224618
CE compliant in accordance with	
EMC Directive	2014/30/EU
RoHS Directive	2011/65/EU

1) The IP protection class is not UL-tested. Verified by Kübler.

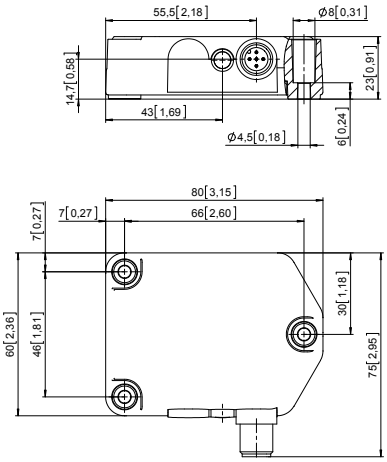
For static applications
1- and 2-axis, metal housing

IN88 | **Fieldbus**

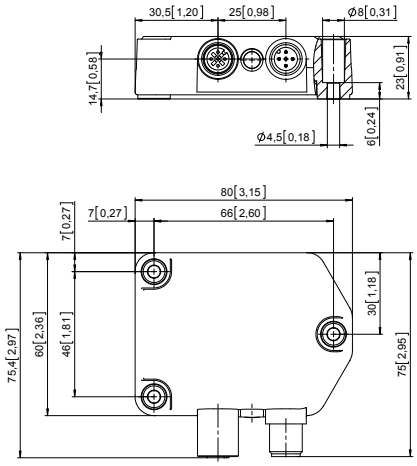
Dimensions

Dimensions in mm [inch]

1 x M12 connector 5-pin, male contacts

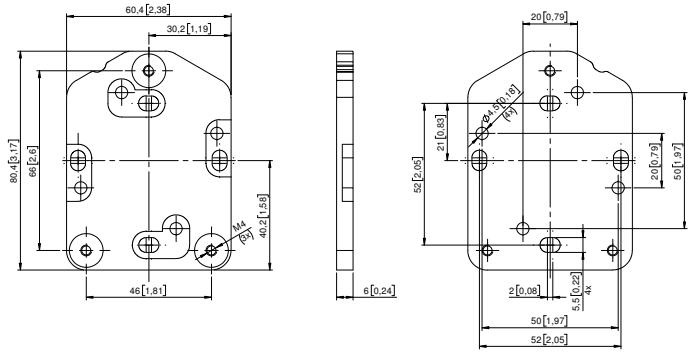


1 x M12 connector 5-pin, male contacts
1 x M12 connector 5-pin, female contacts



Adapter plate

for installation identical to Kübler inclinometer IS60



For static applications
1- and 2-axis, metal housing | **IN88** | **Fieldbus / CANopen**

Interface characteristics CANopen

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.

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

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):

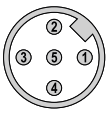
- NMT slave.
- Heartbeat protocol.
- Identity object.
- Error behavior object.
- Variable PDO mapping, 2 sending PDO's.
- Node address, baud rate and programmable CANbus termination.

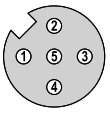
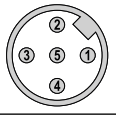
CANopen Inclinometer profile DS410 V1.3

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.

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

For static applications
1- and 2-axis, metal housing | **IN88** | **Fieldbus / CANopen**

Interface characteristics 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

For static applications
1- and 2-axis, metal housing | **IN88** | **Fieldbus / SAEJ1939**

Interface characteristics SAE J1939

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 CMDT (connection mode data transfer). With BAM TP the transfer of data occurs as a broadcast.

Inclinometer implementation SAE J1939

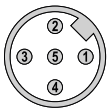
- PGNs that are adaptable to the customer's application.
- Resolution of address conflicts -> Address Claiming (ACL).
- Continuous checking whether control addresses have been assigned twice within a network.
- Change of control device addresses during run-time.
- Unique identification of a control device 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.

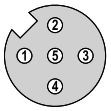
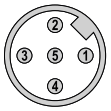
A two-color LED signals the operating and fault status of the SAE J1939 protocol, as well as the status of the internal diagnostics.

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

Terminal assignment

Interface	Type of connection	1 x M12 connector, 5-pin					
3	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					
3	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

For static applications 1- and 2-axis, metal housing	IN88	Fieldbus / SAEJ1939

Interface characteristics 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

For static applications
1- and 2-axis, metal housing | **IN88** | **Fieldbus / Modbus**

Interface characteristics Modbus

General information on Modbus

Modbus communication profile V 1.02

Node number, baudrate and bus termination programmable.

Modbus application protocol V1.1b3

Characteristics Modbus

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

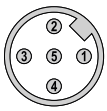
Read Holding Register – Function code 03 [1)]

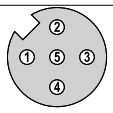
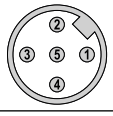
Reg.	Data name	ATT	Value	Default
00001	LOTWINKEL X-ACHSE	I16	Inclination angle in 0.01 °	-85.00 ... +85.00
00002	LOTWINKEL Y-ACHSE	I16	Rotation angle in 0.01 °	-85.00 ... +85.00
00003	EULERWINKEL X-ACHSE	I16	Euler angle (1 axis)	0 ... 180.99°
00004	EULERWINKEL Y-ACHSE	U16	Euler angle (1 axis)	0 ... 359.99°
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	16DDDNNNNN
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 = even 3 = odd
302	VAR	W	U16	Stoppbit	1 = 1 Stoppbit 3 = 2 Stoppbits
304	VAR	W	U16	Node Number	0x3F (63d)
305	VAR	W	U16	Termination	2 = ON 1 = Off
306	VAR	W	U16	Digital Filter Active	0 = Off 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

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

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

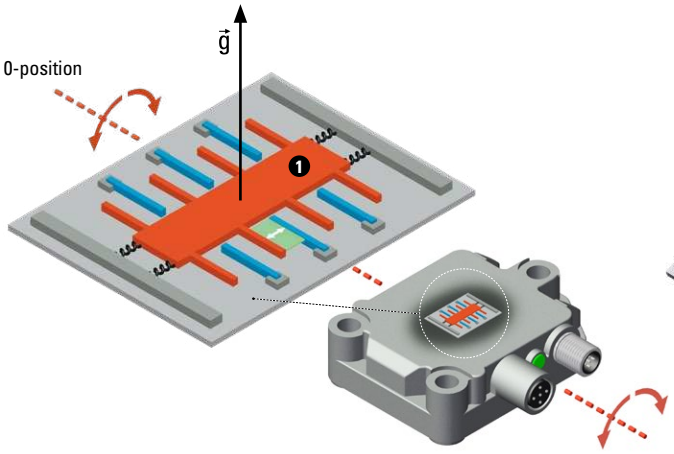
For static applications
1- and 2-axis, metal housing | **IN88** | **Fieldbus**

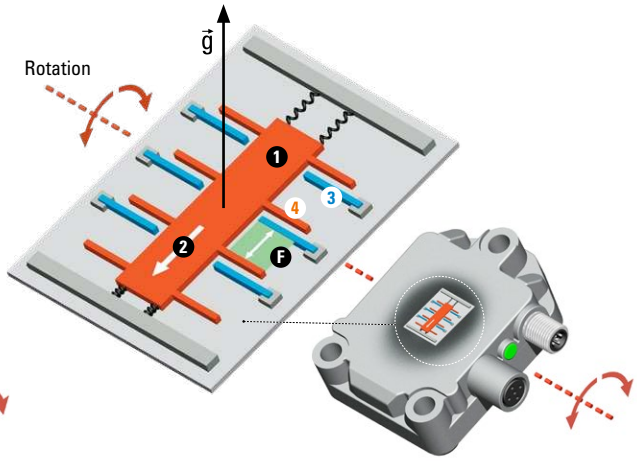
Technology in detail

Position angulaire exacte grâce à la mesure de l'accélération

Mesure de l'accélération
Dans la cellule de mesure d'accélération, la position angulaire absolue par rapport à l'accélération de la pesanteur $\vec{g}$ est déterminée de manière capacitive..

Le déplacement ❷ d'une masse d'essai ❶ modifie la distance et donc la capacité Ⓕ entre les électrodes fixes ③ et électrodes mobiles ④ dans la cellule de mesure. Cette capacité mesurée est en relation directe avec l'inclinaison du capteur.

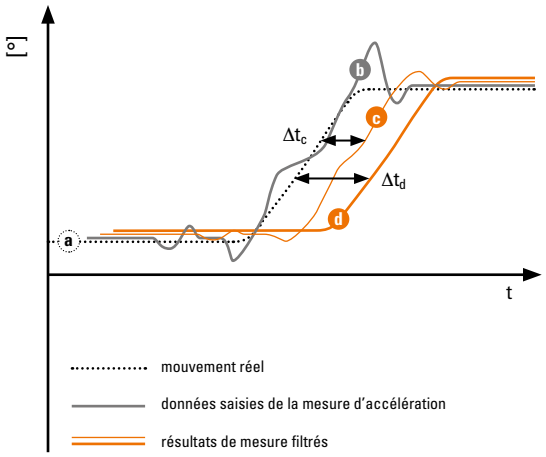




Optimisation de la mesure grâce aux fonctions de filtrage
L'inertie de la masse d'essai, notamment en cas de rotation rapide ou de changement rapide de rotation ainsi que de vibrations, peut entraîner des imprécisions dans les données de mesure ⓑ saisies par rapport au mouvement réel ⓐ. Pour compenser ces effets indésirables, différents filtres ⓒ + ⓓ peuvent être paramétrés dans le inclinomètre.

Restrictions dues aux filtres
Cependant, cela entraîne un délai ($\Delta t_c + \Delta t_d$) pour la sortie du résultat de la mesure (plus la mesure souhaitée est précise, plus le délai est important).

Optimisation supplémentaire grâce aux inclinomètres dynamiques
Pour de nombreuses applications statiques (comme les panneaux solaires, les mâts de grue...), ce délai n'est pas important. Mais pour les applications dynamiques (comme les véhicules en mouvement), cela peut poser des problèmes, car la réaction au mouvement peut également être retardée. Il est alors recommandé d'utiliser un inclinomètre dynamique IN72 avec fusion intelligente des capteurs de Kübler afin d'optimiser encore davantage le résultat de mesure.

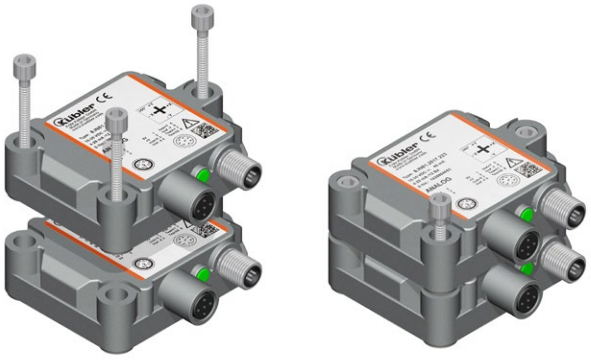


For static applications
1- and 2-axis, metal housing | **IN88** | **Fieldbus**

Technology in detail

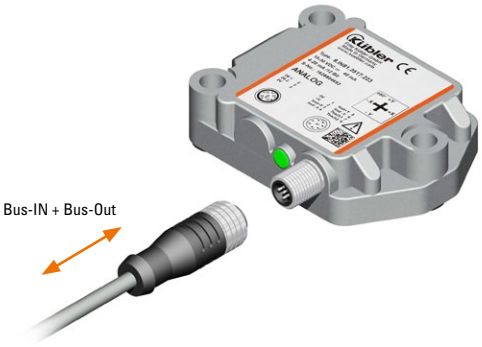
Simple redundancy thanks to stackability

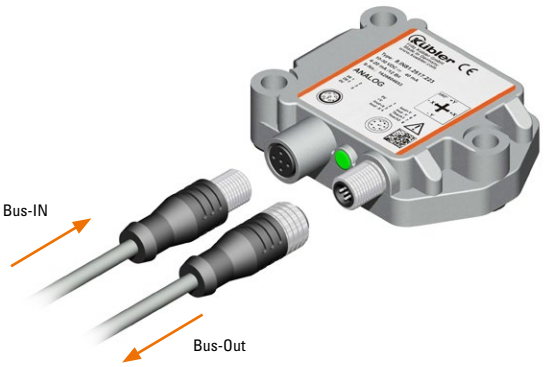
Using the same fastening devices on the application,
2 inclinometers type IN88 can be mounted stacked.



Flexible use in different network topologies

1- or 2-connector technology for bus-in/bus-out





For static applications
1- and 2-axis, metal housing | **IN81** | **Analog**

The inclinometers of the IN81 series allow measuring 2-axis inclinations in the range of ±85° or 1-axis 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.

Analog Output

Analog Output

Features and benefits

- **Analog sensor for precise measurement**
  - Stable accuracy over the entire temperature range
  - Analog interface for different current and voltage ranges
- **Individual "Easy-Teach" settings via Teach Adapter**
  - Define preset (zero point / midpoint position)
  - Scaling of the analog measuring range (start/end position)
  - Setting the sensor filter
  - Setting the switching points of the optional switching outputs
  - Resetting to factory settings
- **Redundant measurement**
  The housing offers the option of mounting sensors in stacks in order to easily implement redundant measurement in the application.
- **Simple start-up and diagnostics**
  LED display for quick and visual detection of the operating status.
- **Precise measurement even under harsh environmental conditions**
  - Temperature range -40 °C ... +85 °C and protection class IP67 / IP69k
  - Protection against the influence of salt spray and rapid temperature changes
  - E1-approval
- **Maximum robustness**
  The robust metal housing also protects the electronics from extreme mechanical influences.

For static applications
1- and 2-axis, metal housing

IN81 | **Analog**

Order code 1-axis

8.IN81.1XXXX.XX2X
Type

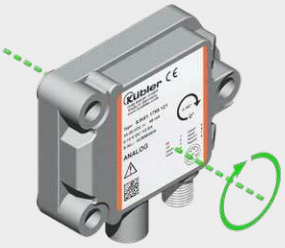
a *Measuring range*
7 = 0 ... 360° (±180°)
8 = 0 ... 180° (±90°)

b *Analog interface*
1 = 4 ... 20 mA / 12 bit
2 = 0.1 ... 4.9 V / 11 bit
3 = 0.5 ... 4.5 V / 11 bit
4 = 0 ... 5 V / 11 bit
5 = 0 ... 10 V / 12 bit

c *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

d *Optional switching outputs*
1 = none
2 = 2 switch outputs [1]

e *Type of connection*
1 = 1 x M12 connector, 8-pin
2 = 1 x M12 connector, 5-pin
3 = 2 x M12 connector, 8-pin + 5-pin [2]



Order code 2-axis

8.IN81.2XXXX.XX2X
Type

a *Measuring range*
1 = ± 10°
2 = ± 15°
3 = ± 30°
4 = ± 45°
5 = ± 60°
6 = ± 85°

b *Analog interface*
1 = 4 ... 20 mA / 12 bit
2 = 0.1 ... 4.9 V / 11 bit
3 = 0.5 ... 4.5 V / 11 bit
4 = 0 ... 5 V / 11 bit
5 = 0 ... 10 V / 12 bit

c *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

d *Optional switching outputs*
1 = none
2 = 2 switch outputs [1]

e *Type of connection*
1 = 1 x M12 connector, 8-pin
2 = 1 x M12 connector, 5-pin
3 = 2 x M12 connector, 8-pin + 5-pin [2]

1) Can only be ordered in conjunction with type of connection **e** = 3.
2) Can only be ordered in conjunction with optional switching output **d** = 2.

Accessories		Order no.
Teach-Adapter 	for controlling the control inputs for the following functions: - Preset (reference point setting) - Teaching (measuring range) - Filter setting - Switching points setting	**8.0010.9000.0017**
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, 8-pin, A coded, straight single ended 5 m [16.40'] PVC cable	**05.00.6041.8211.005M**
	M12 male connector with external thread, 5-pin, A coded, straight single ended 5 m [16.40'] PVC cable	**05.00.6091.A411.005M**
Connectors	M12 female connector with coupling nut, 8-pin, A coded, straight (metal)	**05.CMB 8181-0**
	M12 male connector with external thread, 5-pin, A coded, straight (metal)	**8.0000.5111.0000**

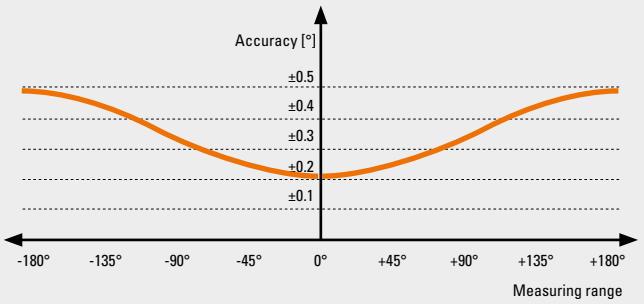
Further Kübler accessories can be found at: /accessories
Further Kübler cables and connectors can be found at: /connection-technology

For static applications
1- and 2-axis, metal housing | **IN81** | **Analog**

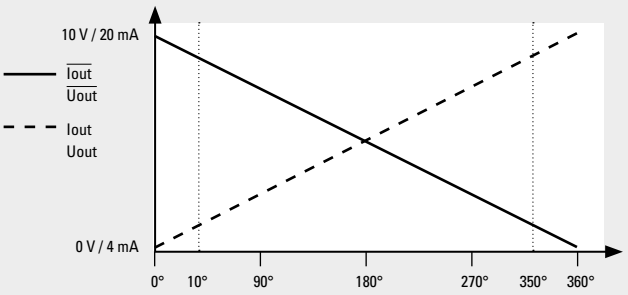
Technical data

General data 1-axis measurement

Measuring range		0 ... 360°
Resolution		
	current interface	0.01° internal sensor
		12 bit D/A converter
	voltage interface	12 bit 0 ... 10 V
		11 bit 0 ... 5 V / 0.1 ... 4.9 V / 0.5 ... 4.5 V
Repeat accuracy		±0.2°
Temperature coefficient		
	current interface	typ. ±0.005 % / K
	voltage interface	typ. ±0.0015 % / K
Accuracy (at 25°C)		±0.2 ... ±0.5° depending on the measuring range

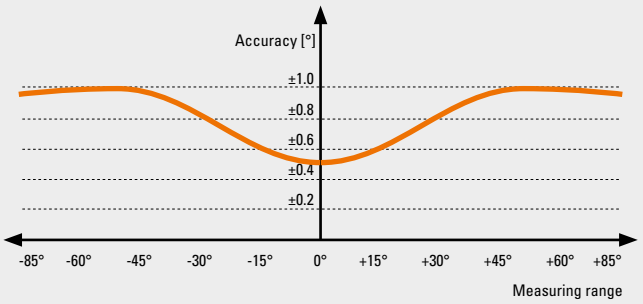


Course of the output signal – factory setting

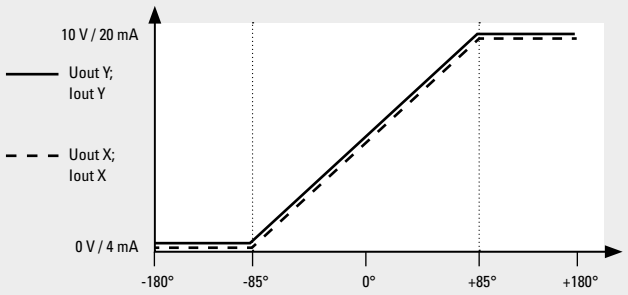


General data 2-axis measurement

Measuring range		-85 ... +85°
Resolution		
	current interface	0.01° internal sensor
		12 bit D/A converter
	voltage interface	12 bit 0 ... 10 V
		11 bit 0 ... 5 V / 0.1 ... 4.9 V / 0.5 ... 4.5 V
Repeat accuracy		±0.2°
Temperature coefficient		
	current interface	typ. ±0.015 % / K
	voltage interface	typ. ±0.005 % / K
Transverse sensitivity		typ. ±0.3°
Accuracy (at 25°C)		±0.5° ... ±1.0° depending on the measuring range



Course of the output signal – factory setting



For static applications
1- and 2-axis, metal housing

IN81 | **Analog**

Electrical characteristics current interface

Supply voltage		10 ... 30 V DC
Current consumption (no load)		max. 40 mA [1]
Reverse polarity protection of the supply voltage		yes
PowerON Time (PowerOn until valid output value)		< 0.5 s
Output load	at 10 VDC at 24 VDC at 30 VDC	max. 200 Ohm max. 900 Ohm max. 1200 Ohm
Setting time		< 1 ms (R_{Burden} = 900 Ohm, 25 °C)
Sampling rate		50 Hz (20 ms)
Limit frequency	with Butterworth filter	0.1 ... 10 Hz, 8th order

Electrical characteristics voltage interface

Supply voltage 4 ... 20 mA / 0.1 ... 4.9 V / 0.5 ... 5 V / 0 ... 5 V 0 ... 10 V		10 ... 30 V 15 ... 30 V
Current consumption (no load)		max. 40 mA [1]
Reverse polarity protection of the supply voltage		yes
PowerON Time (PowerOn until valid output value)		< 0.5 s
Output load		max. 10 mA
Setting time		< 1 ms (R_{Burden} = 1000 Ohm, 25 °C)
Sampling rate		50 Hz (20 ms)
Limit frequency	with Butterworth filter	0.1 ... 10 Hz, 8th order

Mechanical characteristics

Connection	1 x M12 connector 1 x M12 connector 2 x M12 connector	8-pin, male connector 5-pin, female connector 8-pin, male / 5-pin, female connector
Weight		approx. 185 g [6.53 oz]
Protection acc. to EN 60529		IP67 + IP69k [2]
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"]

Characteristic optional switching outputs

Number		2
Permissible load		max. 100 mA
Signal level (under max. load)	High Low	min. +V - 3.0 V max. 0.5 V
Short circuit proof outputs		yes

Characteristic control inputs

Funktions		Preset (reference point setting) Teaching (measuring range) Filter setting Switching points setting
Input		active HIGH
Signal level	High Low	min. 60% von +V, max. +V max. 30% von +V
Min. pulse duration		+V for min. 1 s

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 [3]
	EN 13309	Construction machinery - Electromagnetic compatibility of machines with internal supply voltage [3]

Approvals

E1 compliant in accordance with	ECE guideline
UL compliant in accordance with [2]	File no. E224618
CE compliant in accordance with	
EMC Directive	2014/30/EU
RoHS Directive	2011/65/EU

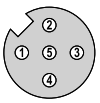
1) Max. 270 mA under full load on both switching outputs.
2) The IP protection class is not UL-tested. Verified by Kübler.
3) Without pulse 5.

For static applications 1- and 2-axis, metal housing | IN81 | Analog

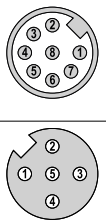
Terminal assignment, 1 dimensional

Type of connection	M12 connector, 8-pin								
1	Signal – Interface 1 (current):	0 V	+V	Iout+	Iout-	$\overline{\text{Iout+}}$	$\overline{\text{Iout-}}$	Teach 1	Teach 2
	Signal – Interface 2, 3, 4, 5 (voltage):	0 V	+V	Uout+	Uout-	$\overline{\text{Uout+}}$	$\overline{\text{Uout-}}$	Teach 1	Teach 2
	Pin:	1	2	3	4	5	6	7	8

Type of connection	M12 connector, 5-pin					
2	Signal – Interface 1 (current):	+V	$\overline{\text{Iout+}}$	0 V	Iout+	Teach
	Signal – Interface 2, 3, 4, 5 (voltage):	+V	$\overline{\text{Uout+}}$	0 V	Uout+	Teach
	Pin:	1	2	3	4	5



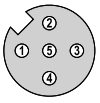
Type of connection	M12 connector, 8-pin								
3	Signal – Interface 1 (current):	0 V	+V	Iout+	Iout-	$\overline{\text{Iout+}}$	$\overline{\text{Iout-}}$	Teach 1	Teach 2
	Signal – Interface 2, 3, 4, 5 (voltage):	0 V	+V	Uout+	Uout-	$\overline{\text{Uout+}}$	$\overline{\text{Uout-}}$	Teach 1	Teach 2
	Pin:	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			



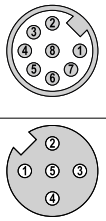
Terminal assignment, 2 dimensional

Type of connection	M12 connector, 8-pin								
1	Signal – Interface 1 (current):	0 V	+V	Iout+ X	Iout- X	Iout+ Y	Iout- Y	Teach 1	Teach 2
	Signal – Interface 2, 3, 4, 5 (voltage):	0 V	+V	Uout+ X	Uout- X	Uout+ Y	Uout- Y	Teach 1	Teach 2
	Pin:	1	2	3	4	5	6	7	8

Type of connection	M12 connector, 5-pin					
2	Signal – Interface 1 (current):	+V	Iout+ Y	0 V	Iout+ X	Teach
	Signal – Interface 2, 3, 4, 5 (voltage):	+V	Uout+ Y	0 V	Uout+ X	Teach
	Pin:	1	2	3	4	5



Type of connection	M12 connector, 8-pin								
3	Signal – Interface 1 (current):	0 V	+V	Iout+ X	Iout- X	Iout+ Y	Iout- Y	Teach 1	Teach 2
	Signal – Interface 2, 3, 4, 5 (voltage):	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: Supply voltage +V DC
0V Supply voltage ground GND (0 V)

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

DO1 Digital output 1
DO2 Digital output 2

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

1-axis version
Uout+ Voltage output
Uout- Voltage output GND
$\overline{\text{Uout+}}$ Inverted voltage output
$\overline{\text{Uout-}}$ Inverted 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

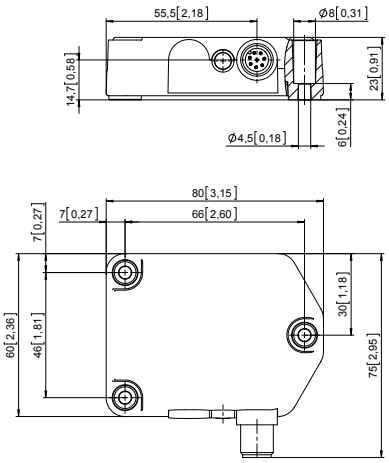
1-axis version
Iout+ Current output
Iout- Current output GND
$\overline{\text{Iout+}}$ Inverted current output
$\overline{\text{Iout-}}$ Inverted current output GND

For static applications
1- and 2-axis, metal housing

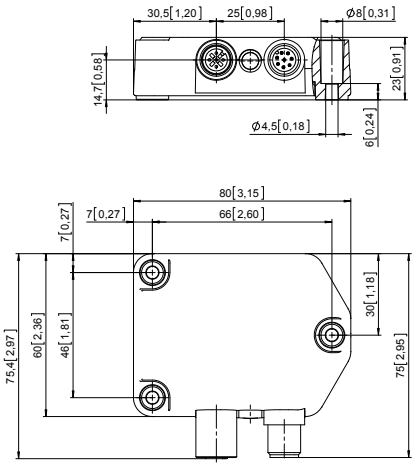
IN81 | **Analog**

Dimensions
Dimensions in mm [inch]

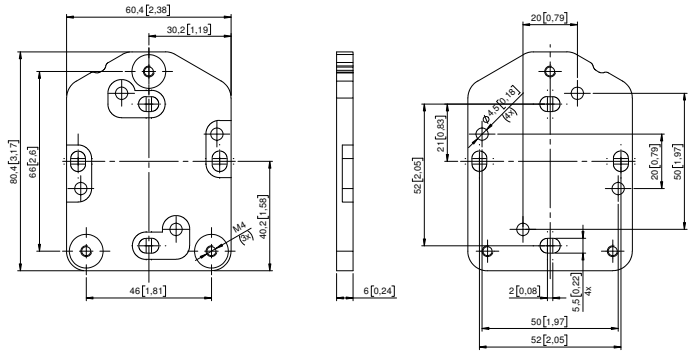
1 x M12 connector 8-pin, male contacts



1 x M12 connector 8-pin, male contacts
1 x M12 connector 5-pin, female contacts



Adapter plate
for installation identical to Kübler inclinometer IS40



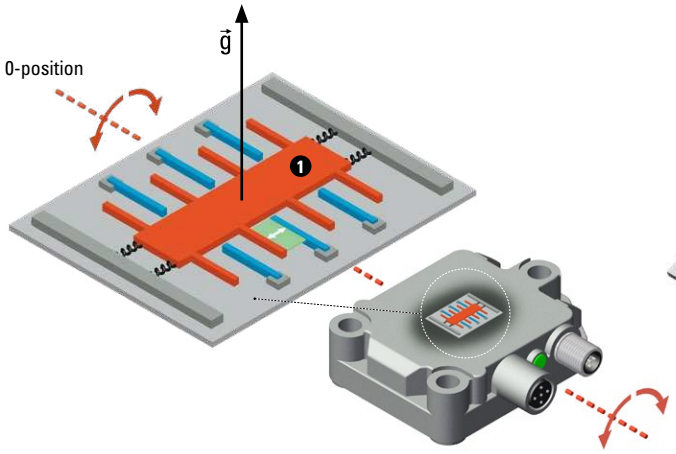
For static applications
1- and 2-axis, metal housing | **IN81** | **Analog**

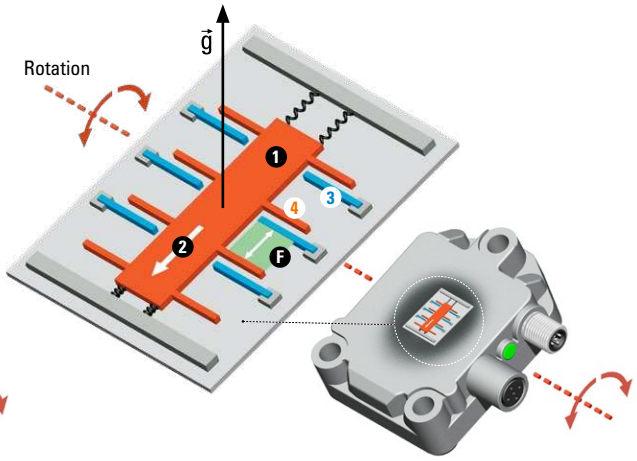
Technology in detail

Exact angular position via acceleration measurement

Acceleration measurement
In the acceleration measuring cell, the absolute angular position is determined capacitively in relation to the gravity acceleration $\vec{g}$.

The displacement ❷ of a test mass ❶ changes the distance and therefore also the capacity Ⓕ between fixed ③ and moving ④ electrodes in the measuring cell. This measured capacity is directly related to the inclination of the sensor.

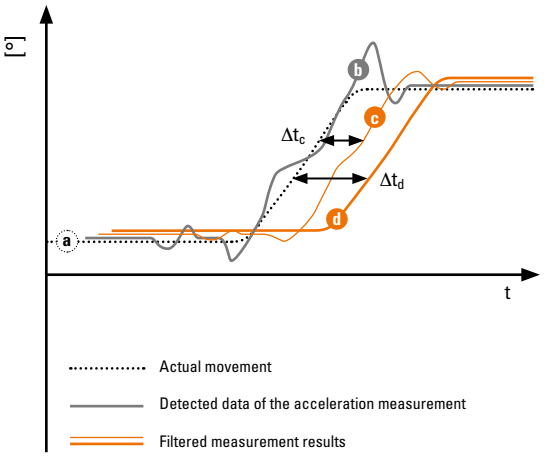




Optimization of the measurement using filter functions
The inertia of the test mass, particularly in the case of fast or rapidly changing rotations and vibrations, can lead to inaccuracies in the detected measurement data ⓑ compared to the actual movement ⓐ. To compensate for these undesirable effects, various filters ⓒ + ⓓ can be parameterized in the inclinometer.

Restrictions due to filters
However, this leads to a time delay ($\Delta t_c + \Delta t_d$) for the output of the measurement result (the more precise the desired measurement, the greater the time delay).

Further optimization with dynamic inclinometers
This time delay is not relevant for many static applications (such as solar panels, crane masts, etc.). In dynamic applications (e.g. vehicles in motion), however, this can lead to problems, as a reaction to the movement can only occur with a delay. In this case, it is advisable to use a dynamic inclinometer IN71 with intelligent sensor fusion from Kübler for further optimization of the measurement result.

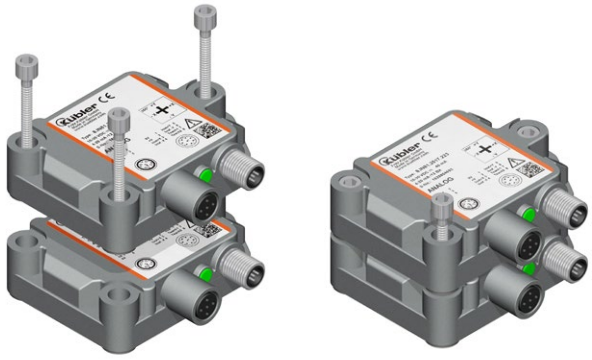


For static applications 1- and 2-axis, metal housing	IN81	Analog

Technology in detail

Simple redundancy thanks to stackability

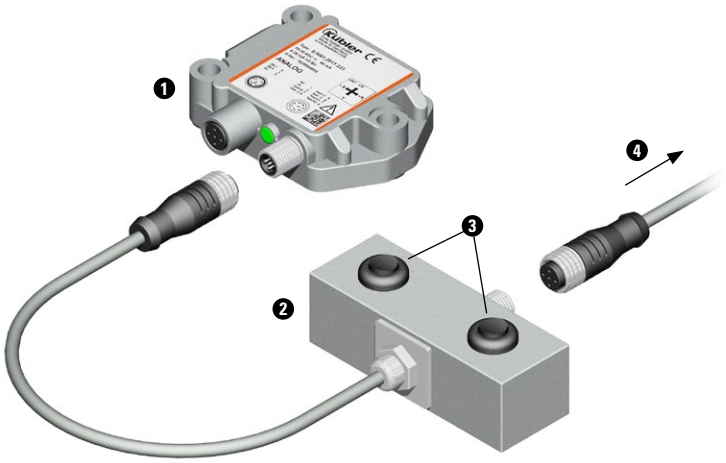
Using the same fastening devices on the application,
2 inclinometers type IN81 can be mounted stacked.



Quick setting options via the Easy-Teach function with teach adapter

Connection
The teach adapter ❷ is connected between the sensor ❶ and the connection cable to the application ❹.

Parameterization
The following settings can be made quickly and easily by pressing the toggle switches ❸ :
- Define preset (zero point / midpoint position)
- Scaling of the analog measuring range (start/end position)
- Setting the sensor filter
- Setting the switching points of the optional switching outputs
- Resetting to factory settings



For static applications
1- and 2-axis measurement | **IN68** | **IO-Link**

The inclinometers in the IN68 series are used to detect 2-axis inclinations in the measuring range of ±85° or 1-axis inclinations of up to 360° via an acceleration measuring cell. Various parameters can be customized for individual requirements (e.g. via the PACTware software).
Thanks to their high robustness, the inclinometers are also ideally suited for outdoor use.

Features and benefits

- **IO-Link interface**
  For easy integration into Industry 4.0 / IIoT networks.
- **Individual setting options via IO-Link Master**
  - Reset to factory setting
  - Center of the measurement as well as start and end point for 1-axis measurement
  - Switching the spirit level function on/off
  - Settings on the measuring range
  - Filtereinstellungen
- **Simple start-up and diagnostics**
  LED display for operating status and FDT/IODD communication as well as for setting the center point position (spirit level function).
- **Precise measurement even under harsh environmental conditions**
  - Temperature range -40 °C ... +85 °C and protection level IP68 / IP69k
  - Protection against the influence of salt spray and rapid temperature changes

Order code 1-axis

8.IN68	.	1	7 (a)	4 (b)	1	.		114
Type								

(a) *Measuring range*
7 = 0° ... 360° (±180°)

(b) *Interface*
4 = IO-Link

Stock types
8.IN68.1741.114

Order code 2-axis

8.IN68	.	2	6 (a)	4 (b)	1	.		114
Type								

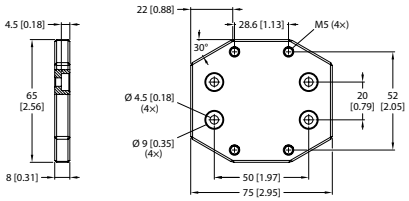
(a) *Measuring range*
6 = ± 85°

(b) *Interface*
4 = IO-Link

Stock types
8.IN68.2641.114

For static applications 1- and 2-axis measurement	IN68	IO-Link

Accessories

		Order no.
IO-Link Master USB 	For parameterizing device settings via FDT/IODD communication. USB interface for easy connection to a PC and for power supply. Adapter cable suitable for IN68: 05.00.6061.6462.002M (see below)	**IOL1A. 1K1341.ZZ1UU1**
Adapter plate 	For using existing mounting holes when replacing with an IS40 inclinometer	**8.0010.4066.0000**
EMC shield terminal 	For an EMC-compliant installation of the cable - top-hat rail mounting - spring steel, galvanized - shield diameter 3.0 ... 12.0 mm	**8.0000.4G06.0312**

Cables and connectors

		Order no.
Preassembled cables	M12 female connector with coupling nut, 4-pin, A coded, straight single ended 2 m [6.56'] PUR cable	**05.00.6061.6211.002M**
	M12 female connector with coupling nut, 4-pin, A coded, straight M12 male connector with external thread, 4-pin, A coded, straight 2 m [6.56'] PUR cable	**05.00.6061.6462.002M**
Connectors	M12 female connector with coupling nut, 4-pin, A coded, straight (plastic)	**05.B8141-0**

Further Kübler accessories can be found at: /accessories
Further Kübler cables and connectors can be found at: /connection-technology

For static applications 1- and 2-axis measurement	IN68	IO-Link

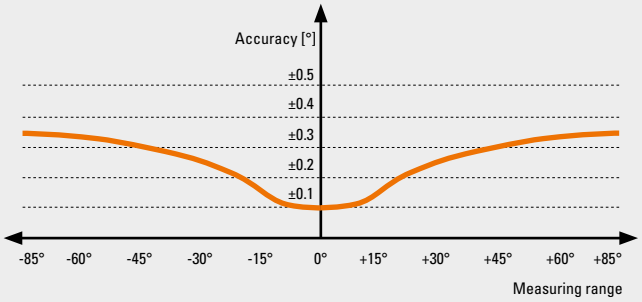
Technical data

General data 1-axis measurement

Measuring range	0 ... 360°
Resolution	0.01°
Repeat accuracy	≤0.2°
Temperature drift	≤ ±0.02 %/K
Linearity deviation	≤ ±0.2%
Accuracy (at 25°C)	≤ ±0.72°

General data 2-axis measurement

Measuring range (max.)	-85 ... +85°
Resolution	0.01°
Repeat accuracy	≤0.2°
Temperature drift	≤ ±0.02 %/K
Linearity deviation	≤ ±0.2%
Accuracy (at 25°C)	≤ ±0.1° depending on the measuring range



Mechanical characteristics

Electrical connection	M12 connectors, 4-pin
Weight	89 g [3.14 oz]
Protection acc. to EN 60529	IP68 / IP69k
Working temperature range	-40 °C ... +85 °C [-40 °F ... +185 °F]
Material housing	Plastic, polyetherimide
Vibration resistance (EN 60068-2-6)	20 g; 5 h/axis; 3 axes
Shock resistance (EN 60068-2-27)	150 g; 4 ms 1/2 sine
MTTF	548 years
Dimensions	71.6 x 62.6 x 20 mm [2.82 x 2.46 x 0.79"]

Electrical characteristics

Supply voltage	18 ... 30 V DC
Residual ripple	≤ 10 % Uss
Isolation test voltage	≤ 0.5 kV
Wire breakage / Reverse polarity protection	yes
Current consumption	max. 50 mA

Interface characteristics IO-Link

Communication mode	COM 3 (230.4 kBaud)
Minimum cycle time	1.3 ms
Function pin 4	IO-Link

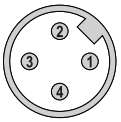
Approvals

UL compliant in accordance with	File-Nr. E539414
CE compliant in accordance with	
EMV Directive	2014/30/EU
RoHS Directive	2011/65/EU

For static applications
1- and 2-axis measurement | **IN68** | **IO-Link**

Terminal assignment

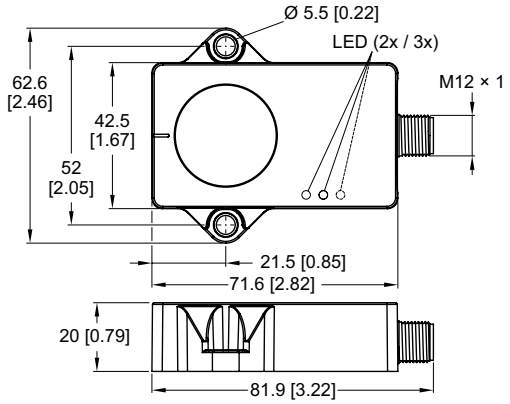
Interface	M12 connector, male contacts, 4-pin, A-coded				
4 IO-Link	Signal:	+V	n.c.	0 V	IOL
	Pin:	1	2	3	4



+V : Supply voltage +V DC
0 V : Supply voltage ground GND (0 V)
IOL : IO-Link input

Dimensions

Dimensions in mm [inch]



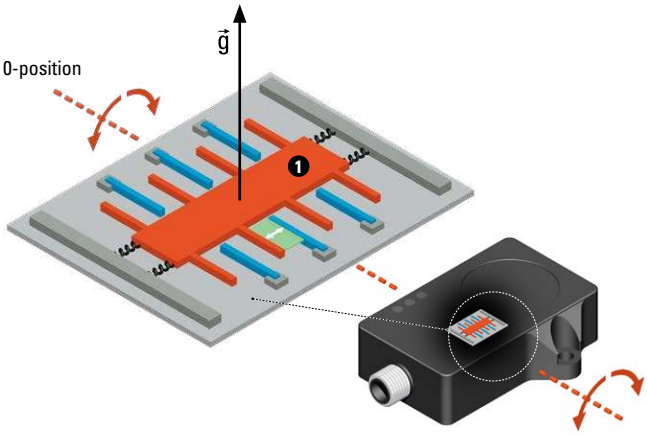
For static applications
1- and 2-axis measurement | **IN68** | **IO-Link**

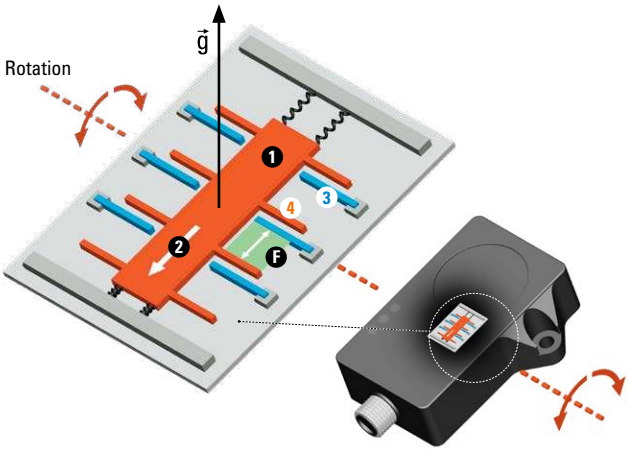
Technology in detail

Exact angular position via acceleration measurement

Acceleration measurement
In the acceleration measuring cell, the absolute angular position is determined capacitively in relation to the gravity acceleration $\vec{g}$.

The displacement ❷ of a test mass ❶ changes the distance and therefore also the capacity Ⓕ between fixed ③ and moving ④ electrodes in the measuring cell. This measured capacity is directly related to the inclination of the sensor.

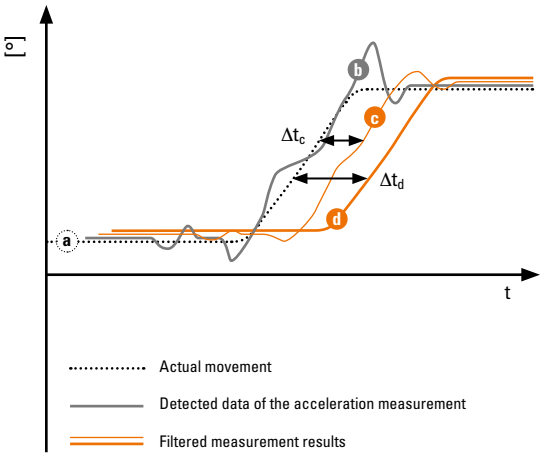




Optimization of the measurement using filter functions
The inertia of the test mass, particularly in the case of fast or rapidly changing rotations and vibrations, can lead to inaccuracies in the detected measurement data ⓑ compared to the actual movement ⓐ. To compensate for these undesirable effects, various filters ⓒ + ⓓ can be parameterized in the inclinometer.

Restrictions due to filters
However, this leads to a time delay ($\Delta t_c + \Delta t_d$) for the output of the measurement result (the more precise the desired measurement, the greater the time delay).

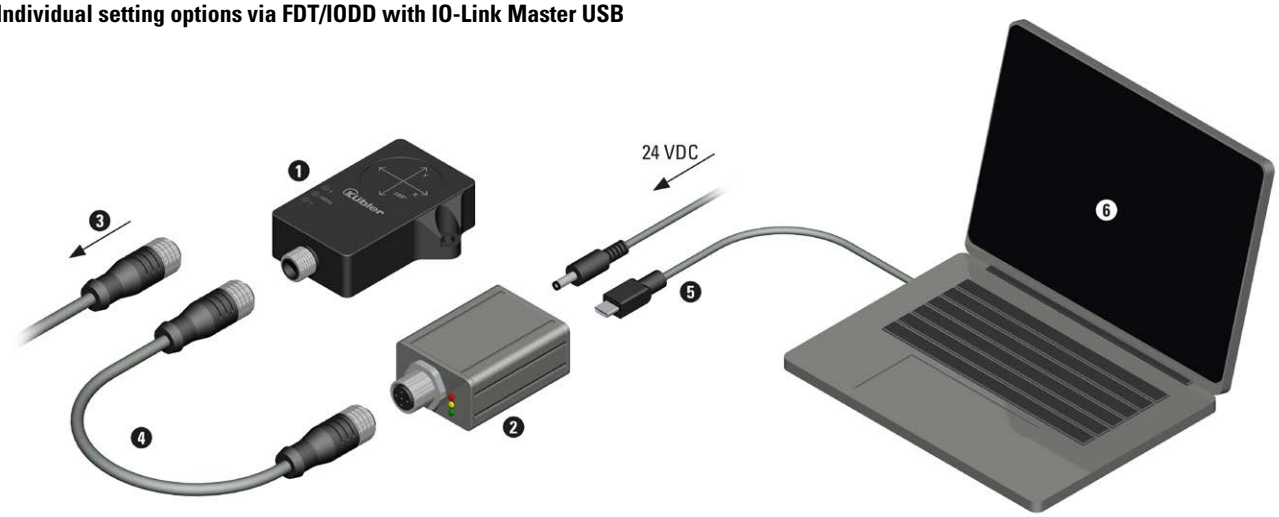
Further optimization with dynamic inclinometers
This time delay is not relevant for many static applications (such as solar panels, crane masts, etc.). In dynamic applications (e.g. vehicles in motion), however, this can lead to problems, as a reaction to the movement can only occur with a delay. In this case, it is advisable to use a dynamic inclinometer IN78 with intelligent sensor fusion from Kübler for further optimization of the measurement result.



For static applications
1- and 2-axis measurement | **IN68** | **IO-Link**

Technology in detail

Individual setting options via FDT/IODD with IO-Link Master USB



Connection

The inclinometer ❶ is or will be disconnected from the application ❸. The IO-Link Master USB ❷ is connected to the inclinometer with the adapter cable ❹ and connected to the PC via the USB interface ❺. The following parameters can be set using the appropriate software ❻ (e.g. PACTware):

Setting options

Spirit level function	Can be activated as an assembly aid
Center point	Set current inclination as new measuring range center point
Direction of rotation	Setting the direction of rotation of the axes. Output of the increasing analog values clockwise or counterclockwise.
Configuring process data	The process data is structured in accordance with the IO-Link Smart Sensor Profile. For 1-axis measurement, the angle value is transmitted twice (inverted once). Angle information can be transmitted with a sign (1 bit - sign / 15 bit - angle information) or without a sign (16 bit) with an accuracy of 0.01°.
Filters	Balanced (factory setting) Slow

Easy start-up

Operating status – LED green

Permanent light	Appliance ready for operation
Blinking	FDT/IODD communication

Spirit level function – LED(s) yellow

Permanent light	Center position reached
Blinking with increasing frequency	Approaching the center position
Blinking with decreasing frequency	Move away from center position

1-axis = 2 LEDs

2-axis = 3 LEDs

For static applications
1- and 2-axis measurement | **IN62** | **2 switching outputs (PNP/NPN)**

The inclinometers in the IN62 series are used to detect 2-axis inclinations in the measuring range of ±85° or 1-axis inclinations of up to 360° via an acceleration measuring cell. Various parameters can be customized for individual requirements (e.g. via the PACTware software).
Thanks to their high robustness, the inclinometers are also ideally suited for outdoor use.

PNP NPN

Features and benefits

- **Two freely parameterizable switching outputs/ranges (PNP/NPN)**
  - Simple setting of the required end position / ranges via integrated IO-Link interface.
  - Two different switching ranges or redundant output of the same switching range possible
- **Individual setting options via IO-Link Master**
  - Reset to factory setting
  - Configuration of the switching outputs - NC or NO contact, switching range via input or current tilt angle.
  - Switching the spirit level function on/off
  - Filter settings
- **Simple start-up and diagnostics**
  LED display for operating status and FDT/IODD communication as well as for setting the center point position (spirit level function).
- **Precise measurement even under harsh environmental conditions**
  - Temperature range -40 °C ... +85 °C and protection level IP68 / IP69k
  - Protection against the influence of salt spray and rapid temperature changes

Order code 1-axis

Type	8.IN62	.	1	7 (a)	1 (b)	1	.		114

(a) *Measuring range*
7 = 0° ... 360° (±180°)

(b) *Switching outputs*
1 = PNP + NPN

Stock types
8.IN62.1711.114

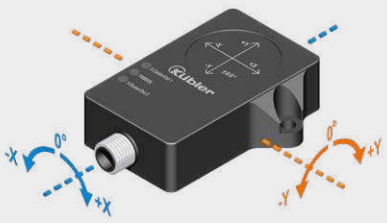
Order code 2-axis

Type	8.IN62	.	2	6 (a)	1 (b)	1	.		114

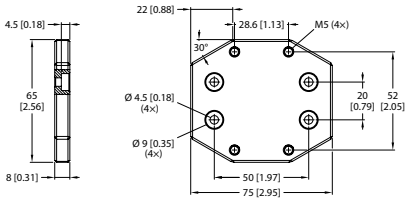
(a) *Measuring range*
6 = ± 85°

(b) *Switching outputs*
1 = PNP + NPN

Stock types
8.IN62.2611.114



For static applications 1- and 2-axis measurement	IN62	2 switching outputs (PNP/NPN)

Accessories		Order no.
IO-Link Master USB 	For parameterizing device settings via FDT/IODD communication. USB interface for easy connection to a PC and for power supply. Adapter cable suitable for IN62: 05.00.6061.6462.002M (see below)	**IOL1A. 1K1341.ZZ1UU1**
Adapter plate	For using existing mounting holes when replacing with an IS40 inclinometer 	**8.0010.4066.0000**
EMC shield terminal 	For an EMC-compliant installation of the cable - top-hat rail mounting - spring steel, galvanized - shield diameter 3.0 ... 12.0 mm	**8.0000.4G06.0312**

Cables and connectors		Order no.
Preassembled cables	M12 female connector with coupling nut, 4-pin, A coded, straight single ended 2 m [6.56'] PUR cable	**05.00.6061.6211.002M**
	M12 female connector with coupling nut, 4-pin, A coded, straight M12 male connector with external thread, 4-pin, A coded, straight 2 m [6.56'] PUR cable	**05.00.6061.6462.002M**
Connectors	M12 female connector with coupling nut, 4-pin, A coded, straight (plastic)	**05.B8141-0**

Further Kübler accessories can be found at: /accessories
Further Kübler cables and connectors can be found at: /connection-technology

For static applications
1- and 2-axis measurement | **IN62** | **2 switching outputs (PNP/NPN)**

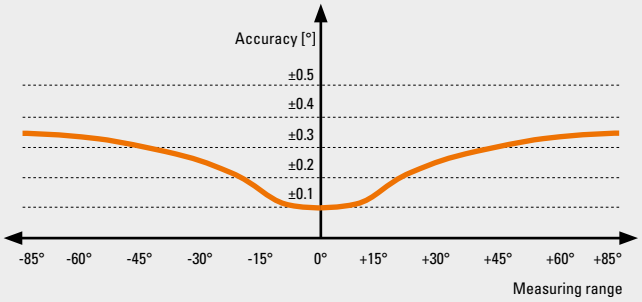
Technical data

General data 1-axis measurement

Measuring range	0 ... 360°
Resolution	0.01°
Repeat accuracy	≤ 0.05 % v. E.
Temperature drift	≤ ±0.006 %/K
Linearity deviation	≤ ±0.2%
Accuracy (at 25°C)	≤ ±0.72°

General data 2-axis measurement

Measuring range (max.)	-85 ... +85°
Resolution	0.01°
Repeat accuracy	≤ 0.1 % v. E.
Temperature drift	≤ ±0.012 %/K
Linearity deviation	≤ ±0.2%
Accuracy (at 25°C)	≤ ±0.1° depending on the measuring range



Mechanical characteristics

Electrical connection	M12 connectors, 4-pin
Weight	89 g [3.14 oz]
Protection acc. to EN 60529	IP68 / IP69k
Working temperature range	-40 °C ... +85 °C [-40 °F ... +185 °F]
Material housing	Plastic, polyetherimide
Vibration resistance (EN 60068-2-6)	20 g; 5 h/axis; 3 axes
Shock resistance (EN 60068-2-27)	150 g; 4 ms 1/2 sine
MTTF	548 years
Dimensions	71.6 x 62.6 x 20 mm [2.82 x 2.46 x 0.79"]

Electrical characteristics

Supply voltage	10 ... 30 V DC
Residual ripple	≤ 10 % Uss
DC rated operational current	≤ 200 mA
Isolation test voltage	≤ 0.5 kV
Wire breakage / Reverse polarity protection	yes
Current consumption	max. 50 mA

Switching outputs

Output function	NO/NC, PNP/NPN

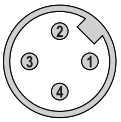
Approvals

UL compliant in accordance with	File-Nr. E539414
CE compliant in accordance with	
EMV Directive	2014/30/EU
RoHS Directive	2011/65/EU

For static applications
1- and 2-axis measurement | **IN62** | **2 switching outputs (PNP/NPN)**

Terminal assignment

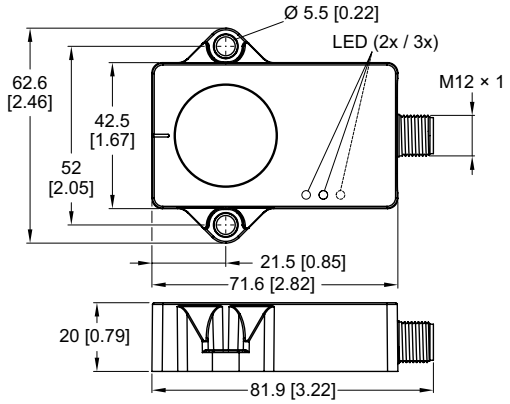
Interface	M12 connector, male contacts, 4-pin, A-coded				
Switching outputs	Signal:	+V	Out 2	0 V	Out 1/IOL
	Pin:	1	2	3	4



+V : Supply voltage +V DC
0 V : Supply voltage ground GND (0 V)
Out 1 / Out 2 : Switching outputs
IOL : IO-Link Master USB input

Dimensions

Dimensions in mm [inch]



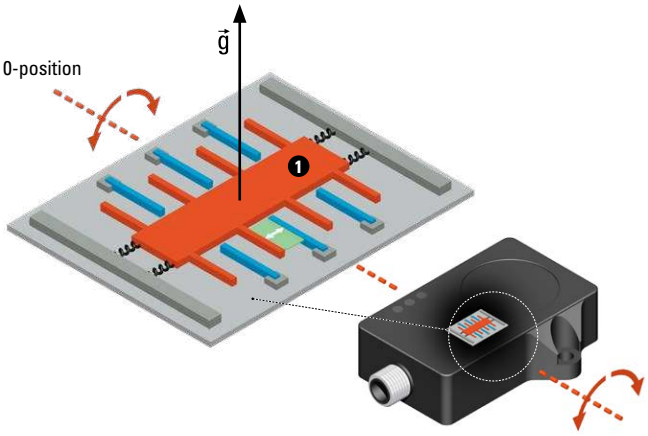
For static applications
1- and 2-axis measurement | **IN62** | **2 switching outputs (PNP/NPN)**

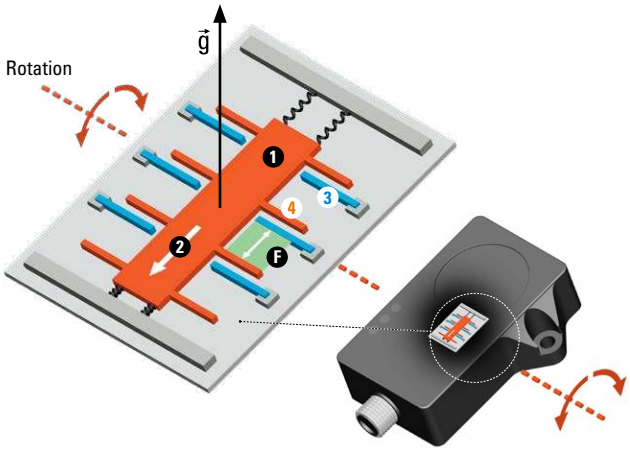
Technology in detail

Exact angular position via acceleration measurement

Acceleration measurement
In the acceleration measuring cell, the absolute angular position is determined capacitively in relation to the gravity acceleration $\vec{g}$.

The displacement ❷ of a test mass ❶ changes the distance and therefore also the capacity Ⓕ between fixed ③ and moving ④ electrodes in the measuring cell. This measured capacity is directly related to the inclination of the sensor.

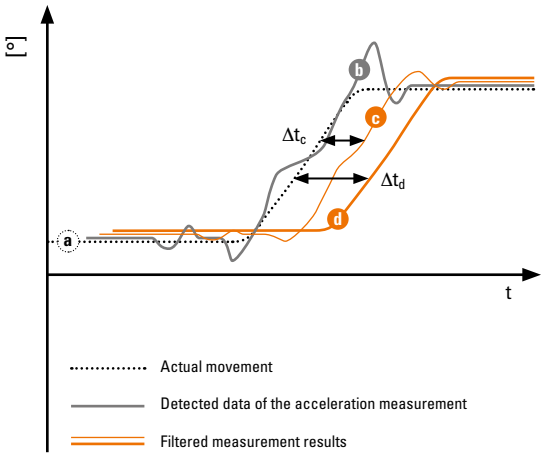




Optimization of the measurement using filter functions
The inertia of the test mass, particularly in the case of fast or rapidly changing rotations and vibrations, can lead to inaccuracies in the detected measurement data ⓑ compared to the actual movement ⓐ. To compensate for these undesirable effects, various filters ⓒ + ⓓ can be parameterized in the inclinometer.

Restrictions due to filters
However, this leads to a time delay ($\Delta t_c + \Delta t_d$) for the output of the measurement result (the more precise the desired measurement, the greater the time delay).

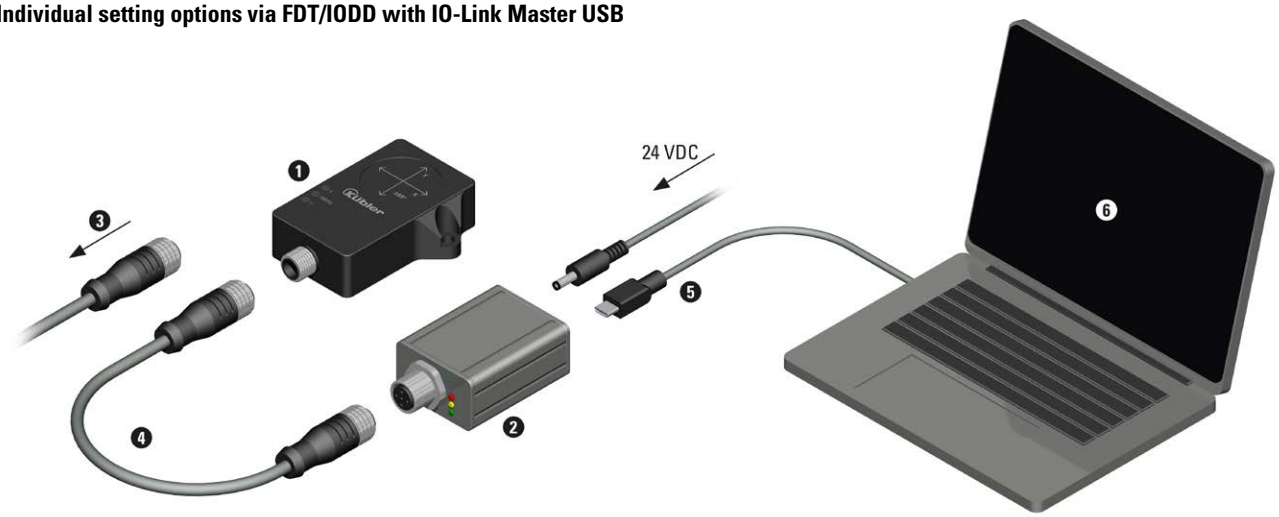
Further optimization with dynamic inclinometers
This time delay is not relevant for many static applications (such as solar panels, crane masts, etc.). In dynamic applications (e.g. vehicles in motion), however, this can lead to problems, as a reaction to the movement can only occur with a delay. In this case, it is advisable to use a dynamic inclinometer IN72 with intelligent sensor fusion from Kübler for further optimization of the measurement result.



For static applications 1- and 2-axis measurement	IN62	2 switching outputs (PNP/NPN)

Technology in detail

Individual setting options via FDT/IODD with IO-Link Master USB



Connection

The inclinometer ❶ is or will be disconnected from the application ❸. The IO-Link Master USB ❷ is connected to the inclinometer with the adapter cable ❹ and connected to the PC via the USB interface ❺. The following parameters can be set using the appropriate software ❻ (e.g. PACTware):

Setting options

Spirit level function	Can be activated as an assembly aid
Center point	Set current inclination as new measuring range center point
Switching outputs	Configurable as PNP or NPN
Axes	The detection axis can be adjusted (2-axis devices)
Starting point / End point	The start and end point of the switching window can be set by input or via the current tilt angle. The switching area must be > 1°.
Hysteresis	The area of the hysteresis behavior can be set. The hysteresis must be smaller than the switching area.
Filters	Balanced (factory setting) Slow

Easy start-up

Operating status – LED green

Permanent light	Appliance ready for operation
Blinking	FDT/IODD communication

Switching status – LEDs yellow

Permanent light	Switching output active

Spirit level function – LEDs yellow

Permanent light	Center position reached
Blinking with increasing frequency	Approaching the center position
Blinking with decreasing frequency	Move away from center position

1-axis = 3 LEDs

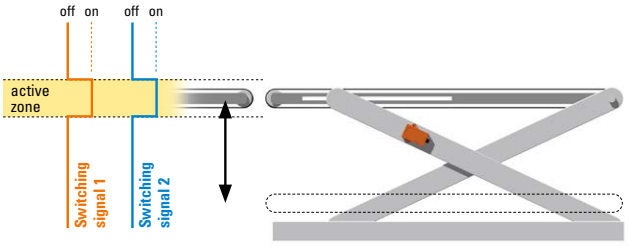
2-axis = 3 LEDs

For static applications 1- and 2-axis measurement	IN62	2 switching outputs (PNP/NPN)

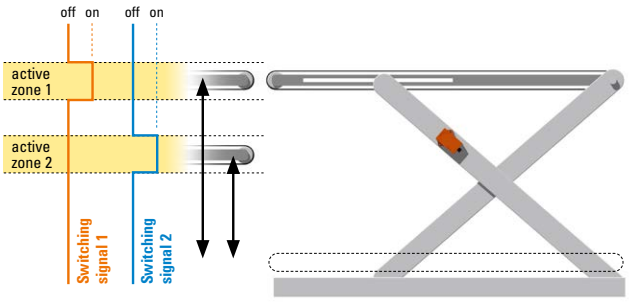
Technology in detail

Two freely parameterizable switching outputs/ranges (Example)

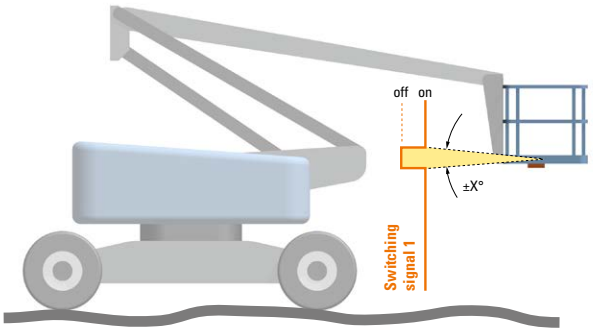
1-axis measuring / two identical switching ranges (redundancy)



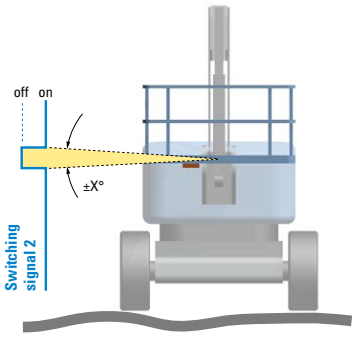
1-axis measuring / two different switching ranges



2-axis measuring / switching range X-axis



2-axis measuring / switching range Y-axis



For static applications
1- and 2-axis measurement | **IN61** | **Analog**

The inclinometers in the IN61 series are used to detect 2-axis inclinations in the measuring range of ±85° or 1-axis inclinations of up to 360° via an acceleration measuring cell. Various parameters can be customized for individual requirements (e.g. via the PACTware software). Thanks to their high robustness, the inclinometers are also ideally suited for outdoor use.

Analog Output Analog Output

Features and benefits

- **Analog sensor with integrated IO-Link communication**
  - Configurable interfaces
  - Parameterization via IO-Link
  - Redundant / counter-rotating signals possible (1-axis)
- **"Easy-Teach" settings via Teach Adapter**
  - Reset to factory setting
  - Center of the measurement as well as start and end point for 1-axis measurement
- **Individual setting options via IO-Link Master**
  In addition to the „Easy-Teach" functions:
  - Switching the spirit level function on/off
  - Settings on the measuring range
  - Type of output signals
  - Filter settings
- **Simple start-up and diagnostics**
  LED display for operating status and FDT/IODD communication as well as for setting the center point position (spirit level function).
- **Precise measurement even under harsh environmental conditions**
  - Temperature range -40 °C ... +85 °C and protection level IP68 / IP69k
  - Protection against the influence of salt spray and rapid temperature changes

Order code 1-axis

8.IN61	.	1	7	X	1	.	112
Type			ⓐ	ⓑ			

ⓐ *Measuring range*
7 = 0° ... 360° (±180°)

ⓑ *Analog interface (as factory setting)*
1 = 4 ... 20 mA
5 = 0 ... 10 V

Stock types
8.IN61.1711.112

Order code 2-axis

8.IN61	.	2	X	X	1	.	112
Type			ⓐ	ⓑ			

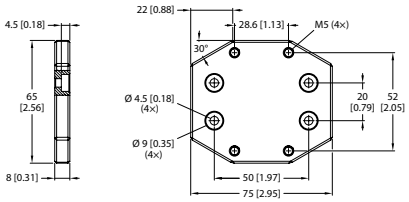
ⓐ *Measuring range*
1 = ± 10°
2 = ± 15°
A = ± 20°
3 = ± 30°
4 = ± 45°
5 = ± 60°
6 = ± 85°

ⓑ *Analog interface (as factory setting)*
1 = 4 ... 20 mA
5 = 0 ... 10 V

Stock types
8.IN61.2111.112
8.IN61.2211.112
8.IN61.2411.112
8.IN61.2611.112
8.IN61.2651.112

For static applications 1- and 2-axis measurement	IN61	Analog

Accessories

		Order no.
Teach adapter 	for activating the control inputs for the following functions: - Reset to factory setting - Center point of the measurement - Start and end point for 1-axis measurement	**05.TX40.1**
IO-Link Master USB 	For parameterizing device settings via FDT/IODD communication. USB interface for easy connection to a PC and for power supply. **Can only be used for IN61 in conjunction with adapter cable 05.00.60H1.H4H2.01M5.S004.**	**IOL1A. 1K1341.ZZ1UU1**
Adapter cable 	For connecting the sensor to the IO-Link Master USB.	**05.00.60H1.H4H2.01M5.S004**
Adapter plate 	For using existing mounting holes when replacing with an IS40 inclinometer	**8.0010.4066.0000**
EMC shield terminal 	For an EMC-compliant installation of the cable - top-hat rail mounting - spring steel, galvanized - shield diameter 3.0 ... 12.0 mm	**8.0000.4G06.0312**

Cables and connectors

		Order no.
Preassembled cables	M12 female connector with coupling nut, 5-pin, A coded, straight single ended 2 m [6.56'] PVC cable	**05.00.6021.E211.002M**
Connectors	M12 female connector with coupling nut, 5-pin, A coded, straight (metal)	**8.0000.5116.0000**
	M12 female connector with coupling nut, 5-pin, A coded, straight (stainless steel V4A)	**8.0000.5116.0000.V4A**

Further Kübler accessories can be found at: /accessories
Further Kübler cables and connectors can be found at: /connection-technology

For static applications
1- and 2-axis measurement | **IN61** | **Analog**

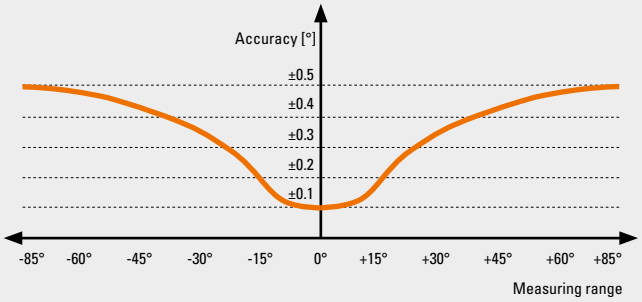
Technical data

General data 1-axis measurement

Measuring range	0 ... 360°
Resolution	16 bit
Repeat accuracy	≤ 0.05 % v. E.
Temperature drift	≤ ± 0.006 %/K
Linearity deviation	≤ ±0.2%
Accuracy (at 25°C)	≤ ±0.7°

General data 2-axis measurement

Messbereich (max.)	-85 ... +85°
Resolution	16 bit
Repeat accuracy	≤ 0.1 % v. E.
Temperature drift	≤ ±0.012 %/K
Linearity deviation	≤ ±0.3%
Accuracy (at 25°C)	≤ ±0.12° depending on the measuring range



Specifications for preset measuring ranges (see order code ⓐ)

Measuring range	Repeat accuracy	Temperature drift	Linearity deviation	Accuracy
±10°	≤ 0.90 % v. E.	≤ ±0.1 %/K	≤ ±0.6 %	≤ ±0.12°
±15°	≤ 0.65 % v. E.	≤ ±0.07 %/K	≤ ±0.6 %	≤ ±0.15°
±20°	≤ 0.50 % v. E.	≤ ±0.05 %/K	≤ ±0.6 %	≤ ±0.20°
±30°	≤ 0.35 % v. E.	≤ ±0.035 %/K	≤ ±0.5 %	≤ ±0.30°
±45°	≤ 0.20 % v. E.	≤ ±0.025 %/K	≤ ±0.5 %	≤ ±0.45°
±60°	≤ 0.15 % v. E.	≤ ±0.02 %/K	≤ ±0.35 %	≤ ±0.42°
±85°	≤ 0.10 % v. E.	≤ ±0.012 %/K	≤ ±0.3 %	≤ ±0.51°

Mechanical characteristics

Electrical connection	M12 connectors, 5-pin
Weight	89 g [3.14 oz]
Protection acc. to EN 60529	IP68 / IP69k
Working temperature range	-40 °C ... +85 °C [-40 °F ... +185 °F]
Material housing	Plastic, polyetherimide
Vibration resistance (EN 60068-2-6)	20 g; 5 h/axis; 3 axes
Shock resistance (EN 60068-2-27)	150 g; 4 ms 1/2 sine
MTTF	297 years
Dimensions	71.6 x 62.6 x 20 mm [2.82 x 2.46 x 0.79"]

Electrical characteristics

Supply voltage	15 ... 30 V DC
Residual ripple	≤ 10 % Uss
Isolation test voltage	≤ 0.5 kV
Short-circuit protection	yes
Wire breakage / Reverse polarity protection	yes
Current consumption	max. 80 mA

Interface characteristics analog output

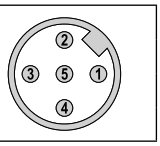
Current/voltage output	
factory setting	4 ... 20 mA or 0 ... 10 V
adjustable	0 ... 20 mA 0.1 ... 4.9 V / 0.5 ... 4.5 V / 0 ... 5 V
Load resistance voltage output	≥ 4.7 kΩ
Load resistance current output	≤ 0.4 kΩ

Approvals

UL compliant in accordance with	File-Nr. E539414
CE compliant in accordance with	
EMV Directive	2014/30/EU
RoHS Directive	2011/65/EU

For static applications
1- and 2-axis measurement | **IN61** | **Analog**

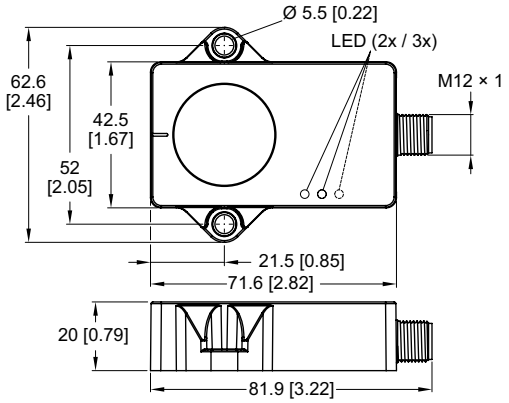
Terminal assignment

Interface	M12 connector, male contacts, 5-pin, A-coded						
Analog	Signal 1-axis:	+V	Out $_{ccw}$	0 V	Out $_{cw}$	Teach/IOL	
	Signal 2-axis:	+V	Out y	0 V	Out x	Teach/IOL	
	Pin:	1	2	3	4	5	

+V : Supply voltage +V DC
0 V : Supply voltage ground GND (0 V)
Out x / Out y : Current/voltage output for 2-axis measurement
Out $_{ccw}$ / Out $_{cw}$: Redundant current/voltage output for 1-axis measurement
Teach/IOL : Teach input/ IO-Link Master USB input

Dimensions

Dimensions in mm [inch]



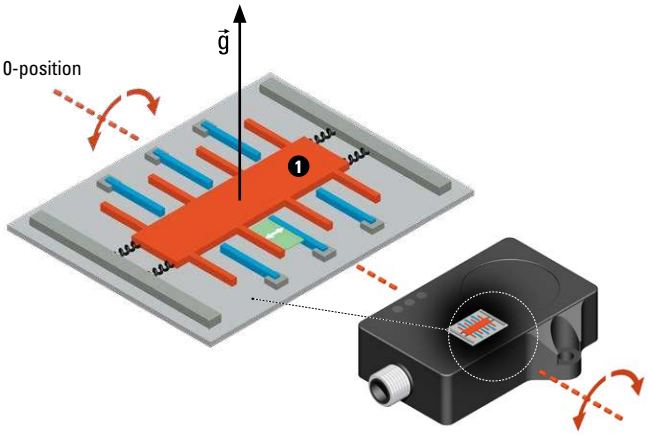
For static applications
1- and 2-axis measurement | **IN61** | **Analog**

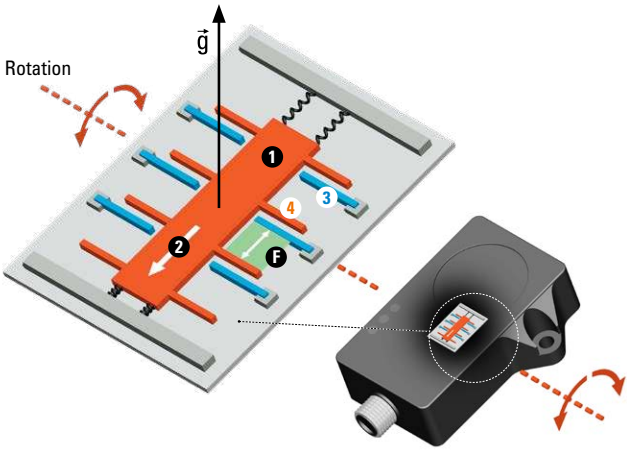
Technology in detail

Exact angular position via acceleration measurement

Acceleration measurement
In the acceleration measuring cell, the absolute angular position is determined capacitively in relation to the gravity acceleration $\vec{g}$.

The displacement ❷ of a test mass ❶ changes the distance and therefore also the capacity Ⓕ between fixed ③ and moving ④ electrodes in the measuring cell. This measured capacity is directly related to the inclination of the sensor.

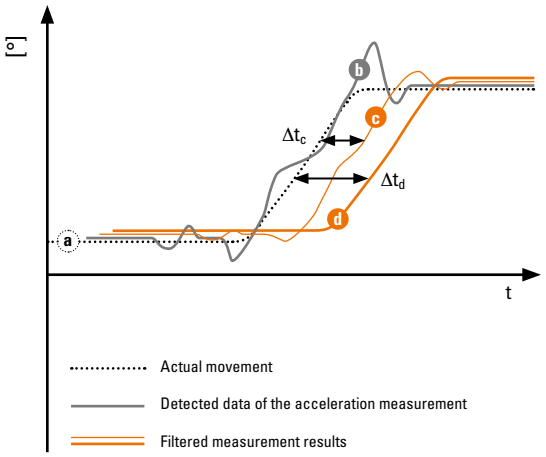




Optimization of the measurement using filter functions
The inertia of the test mass, particularly in the case of fast or rapidly changing rotations and vibrations, can lead to inaccuracies in the detected measurement data ⓑ compared to the actual movement ⓐ. To compensate for these undesirable effects, various filters ⓒ + ⓓ can be parameterized in the inclinometer.

Restrictions due to filters
However, this leads to a time delay ($\Delta t_c + \Delta t_d$) for the output of the measurement result (the more precise the desired measurement, the greater the time delay).

Further optimization with dynamic inclinometers
This time delay is not relevant for many static applications (such as solar panels, crane masts, etc.). In dynamic applications (e.g. vehicles in motion), however, this can lead to problems, as a reaction to the movement can only occur with a delay. In this case, it is advisable to use a dynamic inclinometer IN71 with intelligent sensor fusion from Kübler for further optimization of the measurement result.



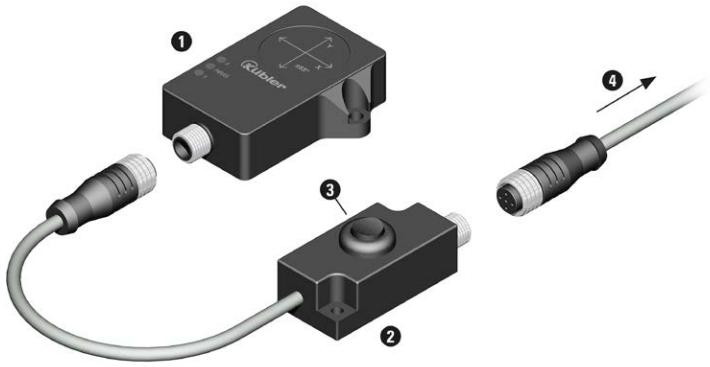
For static applications
1- and 2-axis measurement | **IN61** | **Analog**

Technology in detail

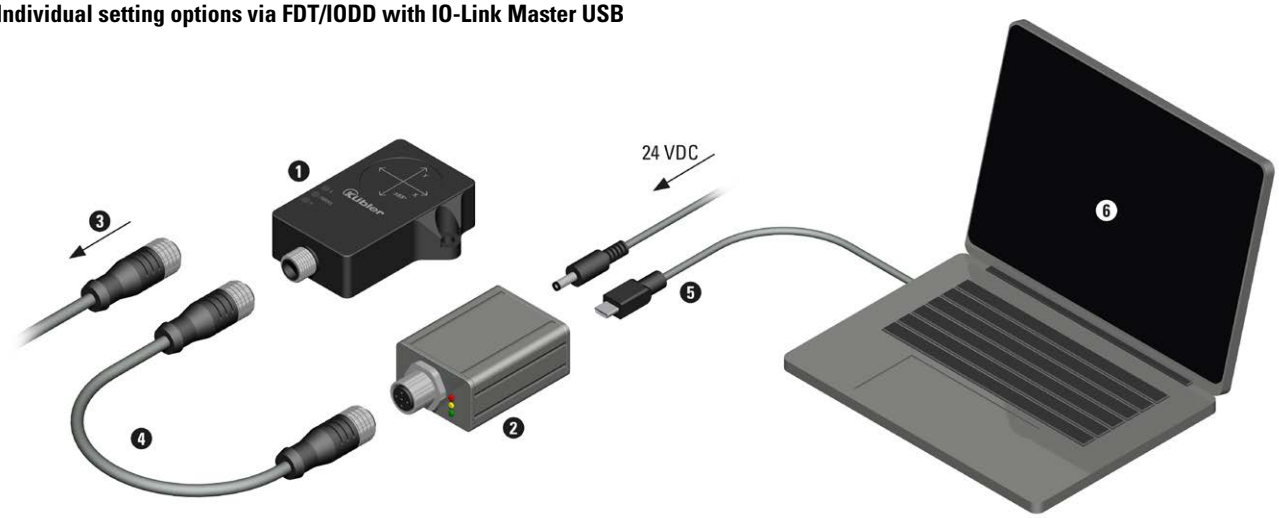
Quick setting options via the Easy-Teach function with teach adapter

Connection
The teach adapter ❷ is connected between the sensor ❶ and the connection cable to the application ❹.

Parameterization
The following settings can be made quickly and easily by pressing the toggle switch ❸:
- Start/end point of the measuring range (for 1-axis measurement)
- Midpoint of the measuring range
- Reset to factory setting



Individual setting options via FDT/IODD with IO-Link Master USB



Connection
The inclinometer ❶ is or will be disconnected from the application ❸. The IO-Link Master USB ❷ is connected to the inclinometer with the adapter cable ❹ and connected to the PC via the USB interface ❺. The following parameters can be set using the appropriate software ❻ (e.g. PACTware):

Setting options

Spirit level function	Can be activated as an assembly aid
Easy Teach	Parameterization via Easy Teach can be deactivated
Direction of rotation	Setting the direction of rotation of the axes. Output of the increasing analog values clockwise or counterclockwise.
Analog output	Possible analog outputs independent of the factory setting: Current outputs: 0 ... 20 mA 4 ... 20 mA Voltage outputs: 0.1 ... 4.9 V 0.5 ... 4.5 V 0 ... 5 V 0 ... 10 V
Starting point / End point	The start/end point of the output characteristic curve can be defined by entering the angle or the current tilt angle; for 2-axis devices, a different measuring range can be set using this function.
Filters	Balanced (factory setting) Slow

For static applications 1- and 2-axis measurement	IN61	Analog

Technology in detail

Easy start-up

Operating status – LED green

Permanent light	Appliance ready for operation
Blinking	FDT/IODD communication

Spirit level function – LED(s) yellow

Permanent light	Center position reached
Blinking with increasing frequency	Approaching the center position
Blinking with decreasing frequency	Move away from center position

1-axis = 2 LEDs

2-axis = 3 LEDs

По вопросам продаж и поддержки обращайтесь:

Алматы (727)345-47-04
Ангарск (3955)60-70-56
Архангельск (8182)63-90-72
Астрахань (8512)99-46-04
Барнаул (3852)73-04-60
Белгород (4722)40-23-64
Благовещенск (4162)22-76-07
Брянск (4832)59-03-52
Владивосток (423)249-28-31
Владикавказ (8672)28-90-48
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Иркутск (395)279-98-46
Казань (843)206-01-48
Калининград (4012)72-03-81
Калуга (4842)92-23-67
Кемерово (3842)65-04-62
Киров (8332)68-02-04
Коломна (4966)23-41-49
Кострома (4942)77-07-48
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Красноярск (391)204-63-61
Курск (4712)77-13-04
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Новокузнецк (3843)20-46-81
Ноябрьск (3496)41-32-12
Новосибирск (383)227-86-73
Омск (3812)21-46-40
Орел (4862)44-53-42
Оренбург (3532)37-68-04
Пенза (8412)22-31-16
Петрозаводск (8142)55-98-37
Псков (8112)59-10-37
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Ростов-на-Дону (863)308-18-15
Рязань (4912)46-61-64
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Севастополь (8692)22-31-93
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