Датчики угла наклона для динамических применений IN71, IN72, IN78

Технические характеристики

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For dynamic applications
1- and 2-axis measurement | **IN78** | **IO-Link**

The inclinometers of the IN78 series are used to determine 2-axis inclinations in the measuring range of ±85° or 1-axis inclinations up to 360° via a sensor fusion of acceleration and rotation rate measuring cell (gyroscope). 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
- **Fast measurement result and high accuracy**
  Thanks to sensor fusion of acceleration and rotation rate measuring cell (gyroscope). This also minimizes the effects of vibrations and interfering accelerations.
- **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.IN78	.	1	7 (a)	4 (b)	1	.	114
Type							

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

(b) *Interface*
4 = IO-Link

Stock types
8.IN78.1741.114

Order code 2-axis

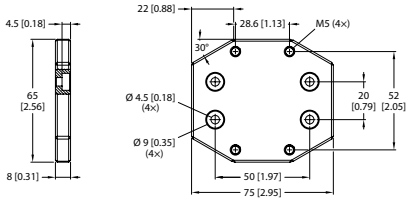
8.IN78	.	2	6 (a)	4 (b)	1	.	114
Type							

(a) *Measuring range*
6 = ± 85°

(b) *Interface*
4 = IO-Link

Stock types
8.IN78.2641.114

For dynamic applications 1- and 2-axis measurement	IN78	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**

For dynamic applications
1- and 2-axis measurement | **IN78** | **IO-Link**

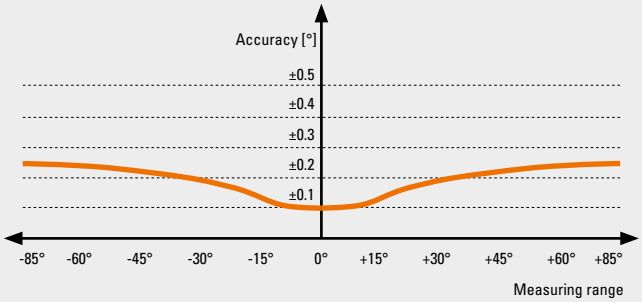
Technical data

General data 1-axis measurement

Measuring range	0 ... 360°
Resolution	0.01°
Repeat accuracy	≤0.1°
Temperature drift	≤ ±0.02 %/K
Linearity deviation	≤ ±0.15%
Accuracy (at 25°C)	≤ ±0.54°

General data 2-axis measurement

Measuring range (max.)	-85 ... +85°
Resolution	0.01°
Repeat accuracy	≤0.1°
Temperature drift	≤ ±0.02 %/K
Linearity deviation	≤ ±0.15%
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

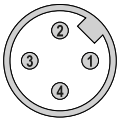
Approvals

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

For dynamic applications
1- and 2-axis measurement | **IN78** | **IO-Link**

Terminal assignment

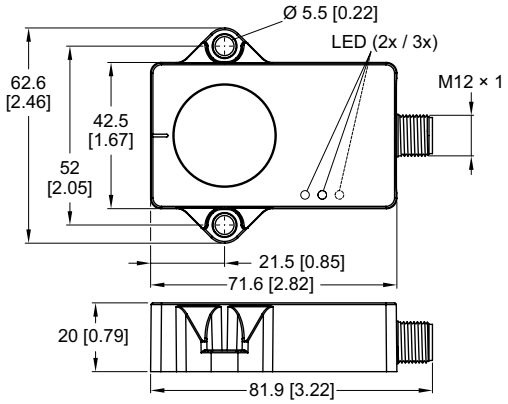
Interface	M12 connector, male contacts, 4-pin, A-coded				
4 IO-Link	Signal 1-axis:	+V	n.c.	0 V	IOL
	Pin:	1	2	3	4



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

Dimensions

Dimensions in mm [inch]



For dynamic applications
1- and 2-axis measurement | **IN78** | **IO-Link**

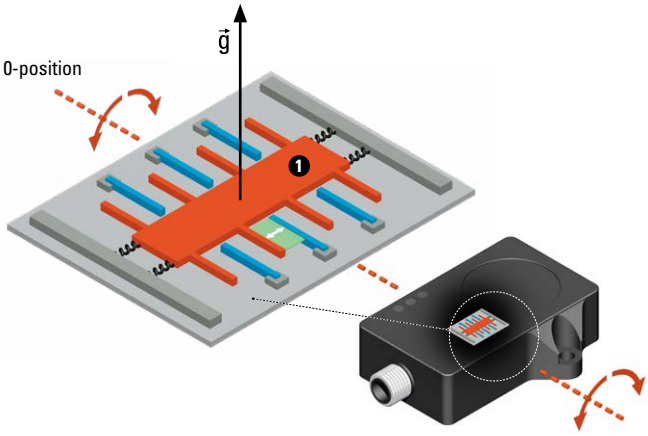
Technology in detail

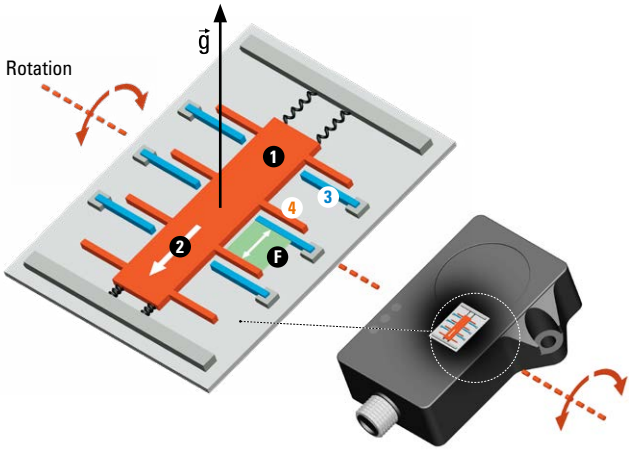
Fast measurement results and maximum accuracy thanks to sensor fusion of acceleration and rotation rate measurement

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.

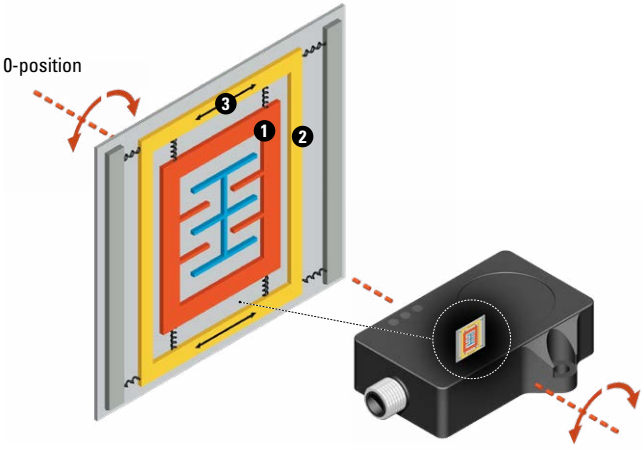


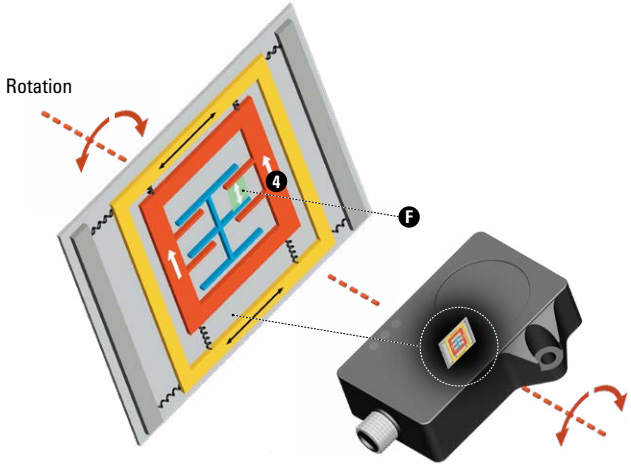


Rotation rate measurement

In the rotation rate measuring cell (gyroscope), the Coriolis force resulting from a rotation is evaluated in order to determine the angle of rotation in relation to the starting position.
An arrangement of frame ❷ and test mass ❶ is in a permanent linear movement ❸ (oscillating).
If this system is brought into rotation, this results in a force (Coriolis force) ❹ that leads to a displacement of the test mass.

This displacement is also determined by the change in capacity Ⓕ between fixed and moving electrodes and is directly related to the rotational speed (rotation rate).
The angle of rotation is determined from the speed of rotation and the duration of rotation.





Intelligent sensor fusion of acceleration and rotation rate measurement

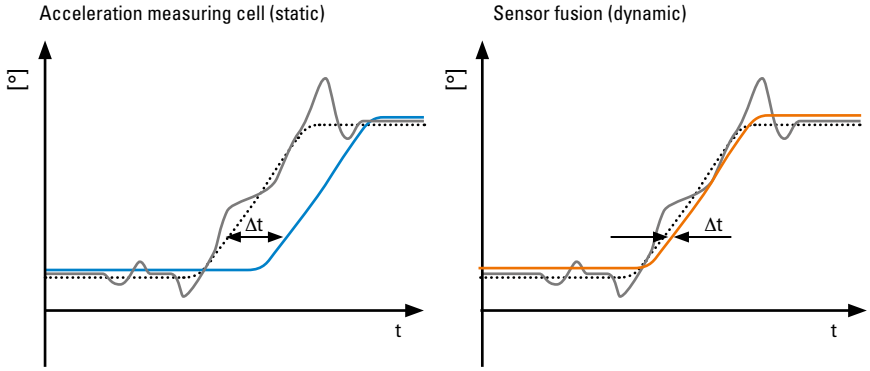
Both measured values are combined in the inclinometers for dynamic applications. The effect is even faster and more accurate output results.

For dynamic applications
1- and 2-axis measurement | **IN78** | **IO-Link**

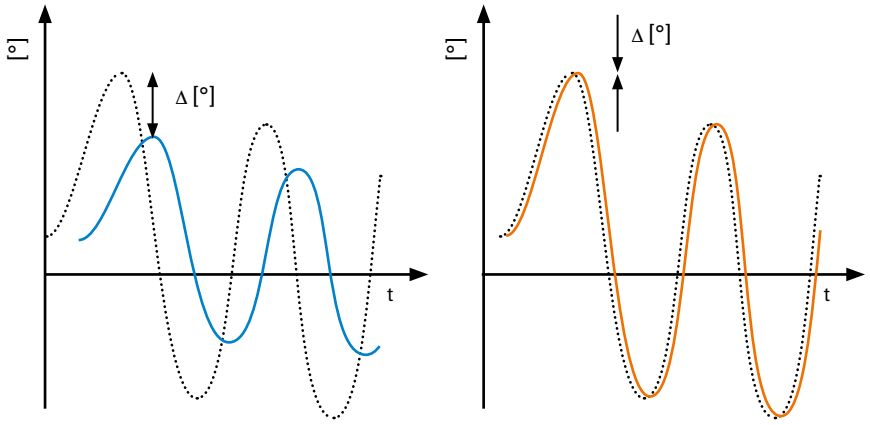
Technology in detail

Comparison static inclinometer (accelerometer only) - dynamic inclinometer (sensor fusion)

Fast measurement
Inaccuracies due to the inertia of the test mass can be compensated for in acceleration measurement via filters. However, there is a time delay Δt for the output of the measurement result. This time delay is minimized with sensor fusion.



Accurate measurement
The sensor fusion leads to more accurate measurement results when changing direction quickly.



- Actual movement
- Detected data of the acceleration measurement
- Filtered measurement results of the acceleration measurement
- Result sensor fusion of acceleration and rotation rate measurement

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

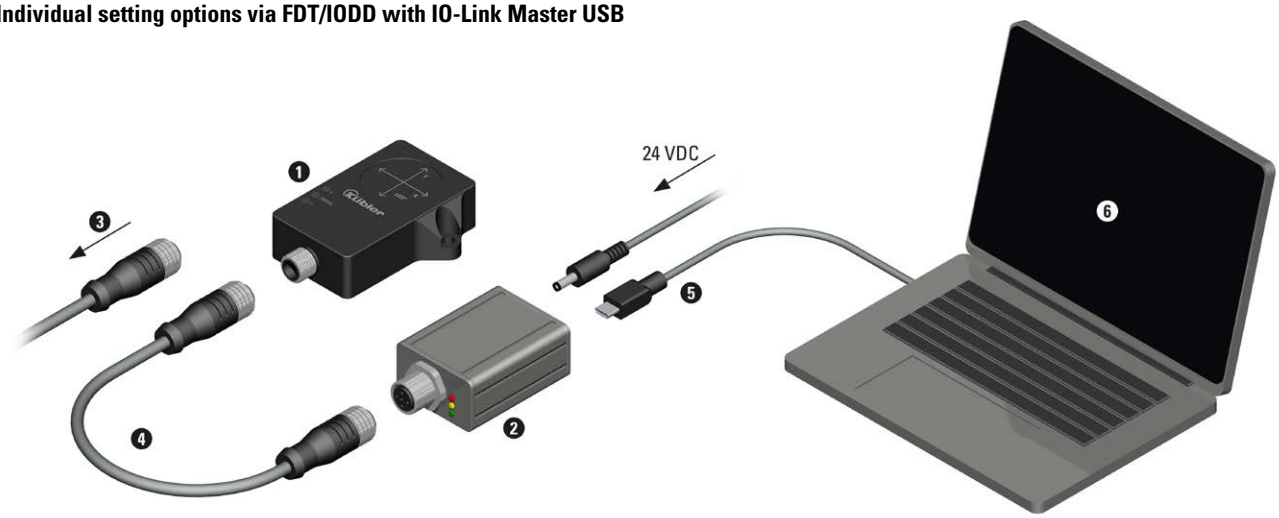
1-axis = 2 LEDs

2-axis = 3 LEDs

For dynamic applications 1- and 2-axis measurement	IN78	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):

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 / Very slow / Slow Fast / Very fast (factory setting)

For dynamic applications
1- and 2-axis measurement

IN72

2 switching outputs (PNP/NPN)

The inclinometers of the IN72 series are used to determine 2-axis inclinations in the measuring range of ±85° or 1-axis inclinations up to 360° via a sensor fusion of acceleration and rotation rate measuring cell (gyroscope). 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
- **Fast measurement result and high accuracy**
  Thanks to sensor fusion of acceleration and rotation rate measuring cell (gyroscope). This also minimizes the effects of vibrations and interfering accelerations.
- **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.IN72	.	1	7	1	1	.		114
Type			ⓐ	ⓑ				

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

ⓑ *Switching outputs*
1 = PNP + NPN

Stock types
8.IN72.1711.114

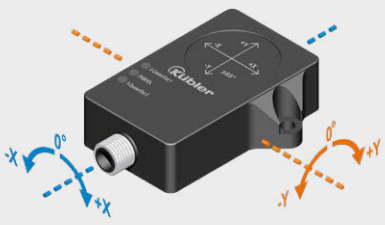
Order code 2-axis

8.IN72	.	2	6	1	1	.		114
Type			ⓐ	ⓑ				

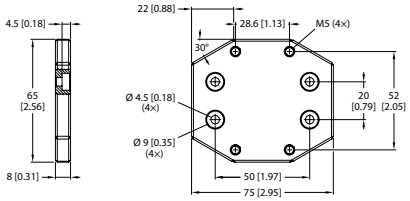
ⓐ *Measuring range*
6 = ± 85°

ⓑ *Switching outputs*
1 = PNP + NPN

Stock types
8.IN72.2611.114



For dynamic applications 1- and 2-axis measurement	IN72	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**

For dynamic applications
1- and 2-axis measurement | **IN72** | **2 switching outputs (PNP/NPN)**

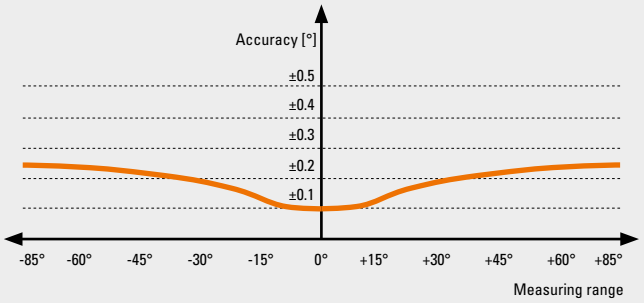
Technical data

General data 1-axis measurement

Measuring range	0 ... 360°
Resolution	0.01°
Repeat accuracy	≤ 0.03 % v. E.
Temperature drift	≤ ±0.006 %/K
Linearity deviation	≤ ±0.15%
Accuracy (at 25°C)	≤ ±0.54°

General data 2-axis measurement

Measuring range (max.)	-85 ... +85°
Resolution	0.01°
Repeat accuracy	≤ 0.06 % v. E.
Temperature drift	≤ ±0.012 %/K
Linearity deviation	≤ ±0.15%
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

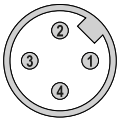
Approvals

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

For dynamic applications
1- and 2-axis measurement | **IN72** | **2 switching outputs (PNP/NPN)**

Terminal assignment

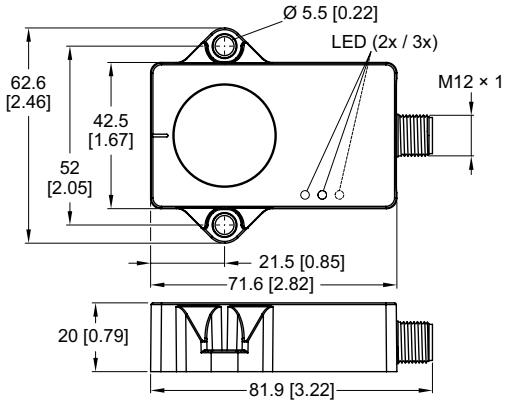
Interface	M12 connector, male contacts, 4-pin, A-coded				
Switching outputs	Signal:	+V	Out 2	0 V	Out 1/IOL
	Pin:	1	2	3	4



+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 dynamic applications
1- and 2-axis measurement | **IN72** | **2 switching outputs (PNP/NPN)**

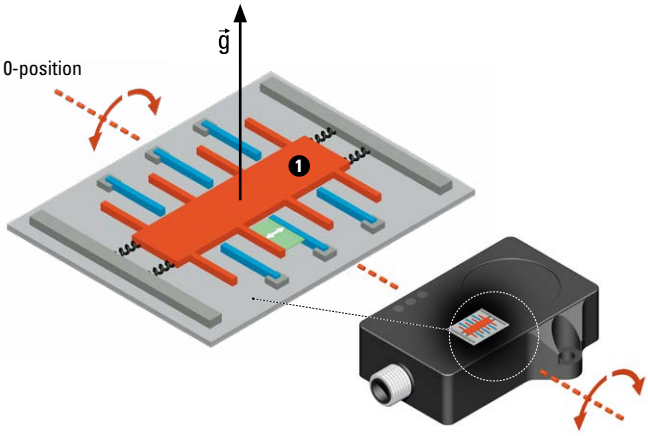
Technology in detail

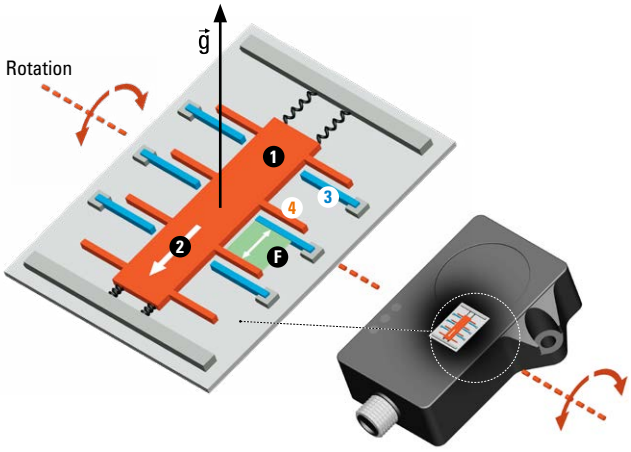
Fast measurement results and maximum accuracy thanks to sensor fusion of acceleration and rotation rate measurement

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.

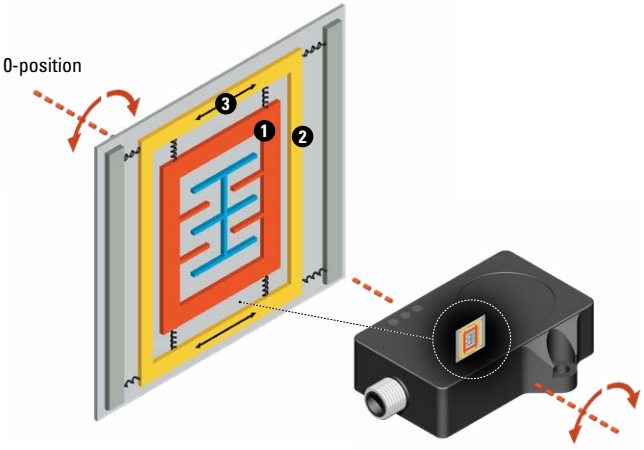


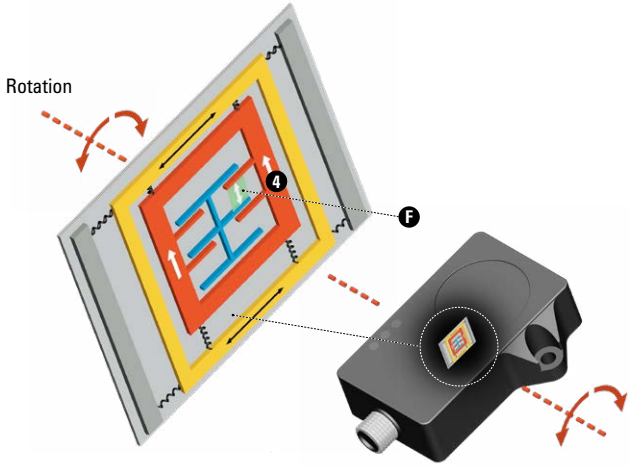


Rotation rate measurement

In the rotation rate measuring cell (gyroscope), the Coriolis force resulting from a rotation is evaluated in order to determine the angle of rotation in relation to the starting position.
An arrangement of frame ❷ and test mass ❶ is in a permanent linear movement ❸ (oscillating).
If this system is brought into rotation, this results in a force (Coriolis force) ❹ that leads to a displacement of the test mass.

This displacement is also determined by the change in capacity Ⓕ between fixed and moving electrodes and is directly related to the rotational speed (rotation rate).
The angle of rotation is determined from the speed of rotation and the duration of rotation.





Intelligent sensor fusion of acceleration and rotation rate measurement

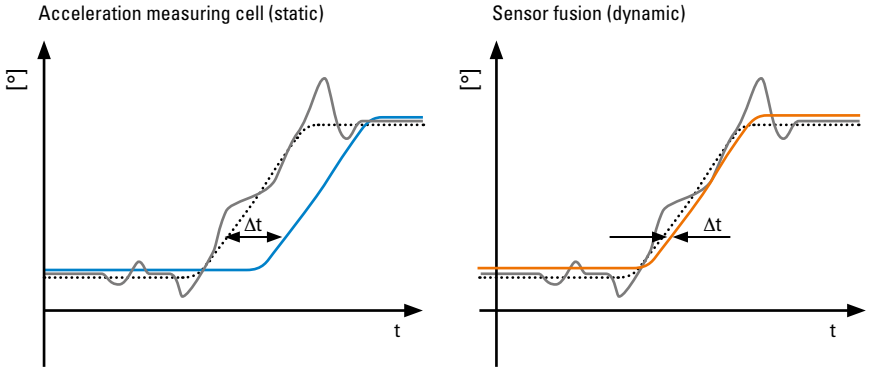
Both measured values are combined in the inclinometers for dynamic applications. The effect is even faster and more accurate output results.

For dynamic applications
1- and 2-axis measurement | **IN72** | **2 switching outputs (PNP/NPN)**

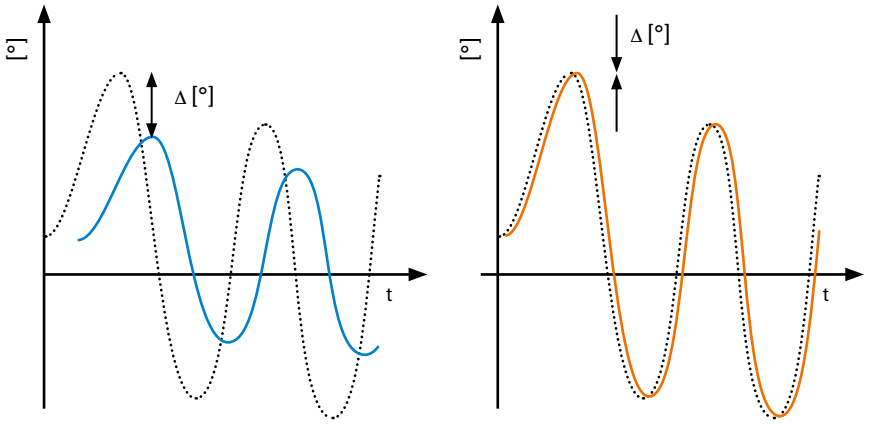
Technology in detail

Comparison static inclinometer (accelerometer only) - dynamic inclinometer (sensor fusion)

Fast measurement
Inaccuracies due to the inertia of the test mass can be compensated for in acceleration measurement via filters. However, there is a time delay Δt for the output of the measurement result. This time delay is minimized with sensor fusion.



Accurate measurement
The sensor fusion leads to more accurate measurement results when changing direction quickly.

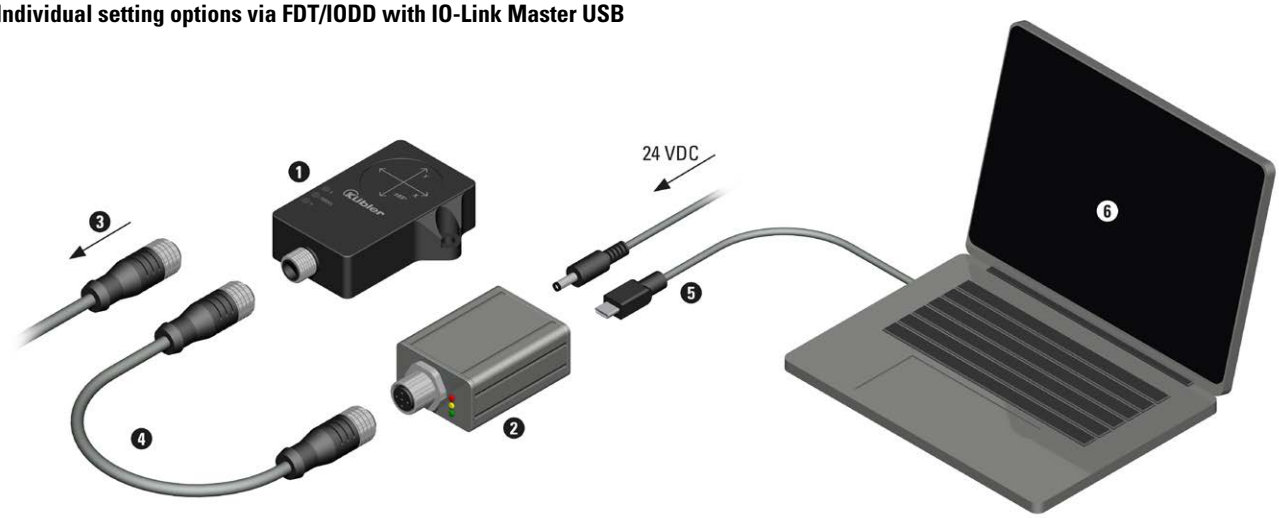


- Actual movement
- Detected data of the acceleration measurement
- Filtered measurement results of the acceleration measurement
- Result sensor fusion of acceleration and rotation rate measurement

For dynamic applications
1- and 2-axis measurement | **IN72** | **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 / Very slow / Slow Fast / Very fast (factory setting)

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 = 2 LEDs

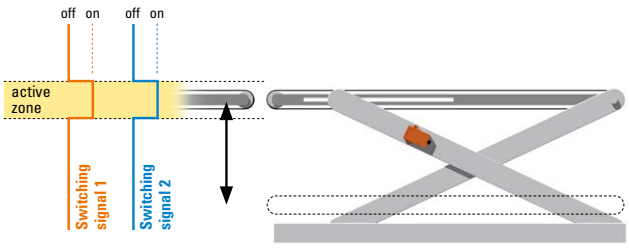
2-axis = 3 LEDs

For dynamic applications 1- and 2-axis measurement	IN72	2 switching outputs (PNP/NPN)

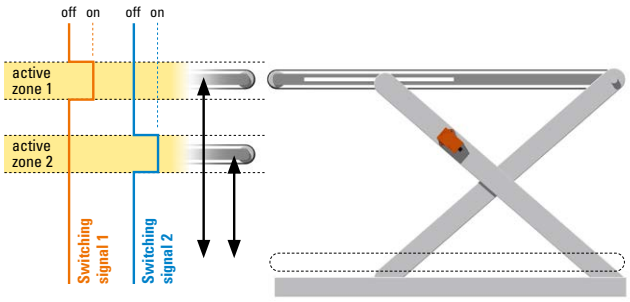
Technology in detail

Two freely parameterizable switching outputs/ranges (Example)

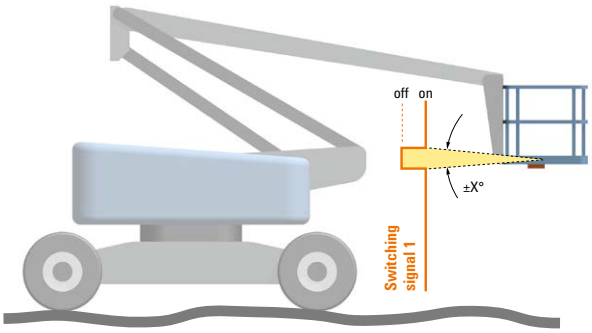
1-axis measuring / two identical switching ranges (redundancy)



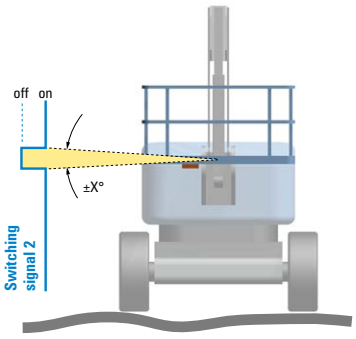
1-axis measuring / two different switching ranges



2-axis measuring / switching range X-axis



2-axis measuring / switching range Y-axis



For dynamic applications
1- and 2-axis measurement | **IN71** | **Analog**

The inclinometers of the IN71 series are used to determine 2-axis inclinations in the measuring range of ±85° or 1-axis inclinations up to 360° via a sensor fusion of acceleration and rotation rate measuring cell (gyroscope). 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
- **Fast measurement result and high accuracy**
  Thanks to sensor fusion of acceleration and rotation rate measuring cell (gyroscope). This also minimizes the effects of vibrations and interfering accelerations.
- **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.IN71	.	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.IN71.1711.112
8.IN71.1751.112

Order code 2-axis

8.IN71	.	2	X	X	1	.	112
Type			ⓐ	ⓑ			

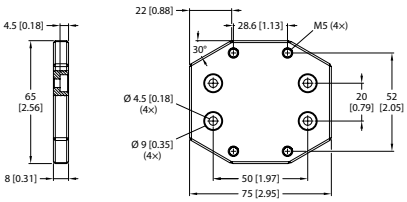
ⓐ *Measuring range*
1 = ± 10°
2 = ± 15°
A = ± 20°
3 = ± 30°
4 = ± 45°
5 = ± 60°
6 = ± 85°

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

Stock types

8.IN71.2111.112	**8.IN71.2211.112**
8.IN71.2411.112	**8.IN71.2611.112**
8.IN71.2651.112	**8.IN71.2A11.112**

For dynamic applications 1- and 2-axis measurement	IN71	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**

For dynamic applications
1- and 2-axis measurement | **IN71** | **Analog**

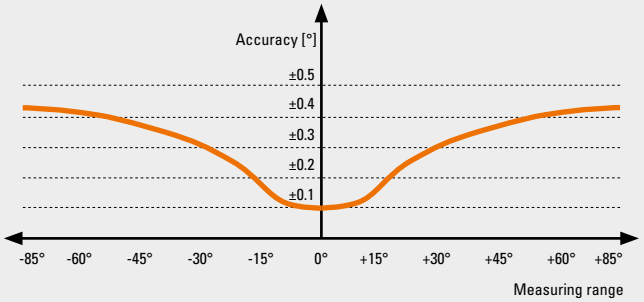
Technical data

General data 1-axis measurement

Measuring range	0 ... 360°
Resolution	16 bit
Repeat accuracy	≤ 0.03 % v. E.
Temperature drift	≤ ± 0.006 %/K
Linearity deviation	≤ ±0.15%
Accuracy (at 25°C)	≤ ±0.54°

General data 2-axis measurement

Measuring range (max.)	-85 ... +85°
Resolution	16 bit
Repeat accuracy	≤ 0.06 % v. E.
Temperature drift	≤ ±0.012 %/K
Linearity deviation	≤ ±0.25%
Accuracy (at 25°C)	≤ ±0.1° depending on the measuring range



Specifications for preset measuring ranges (see order code ⓐ)

Measuring range	Repeat accuracy	Temperature drift	Linearity deviation	Accuracy
±10°	≤ 0.50 % v. E.	≤ ±0.1 %/K	≤ ±0.5 %	≤ ±0.10°
±15°	≤ 0.65 % v. E.	≤ ±0.07 %/K	≤ ±0.5 %	≤ ±0.15°
±20°	≤ 0.50 % v. E.	≤ ±0.05 %/K	≤ ±0.5 %	≤ ±0.20°
±30°	≤ 0.35 % v. E.	≤ ±0.04 %/K	≤ ±0.45 %	≤ ±0.27°
±45°	≤ 0.12 % v. E.	≤ ±0.025 %/K	≤ ±0.4 %	≤ ±0.36°
±60°	≤ 0.085 % v. E.	≤ ±0.020 %/K	≤ ±0.3 %	≤ ±0.36°
±85°	≤ 0.060 % v. E.	≤ ±0.012 %/K	≤ ±0.25 %	≤ ±0.43°

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

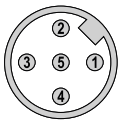
Approvals

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

For dynamic applications
1- and 2-axis measurement | **IN71** | **Analog**

Terminal assignment

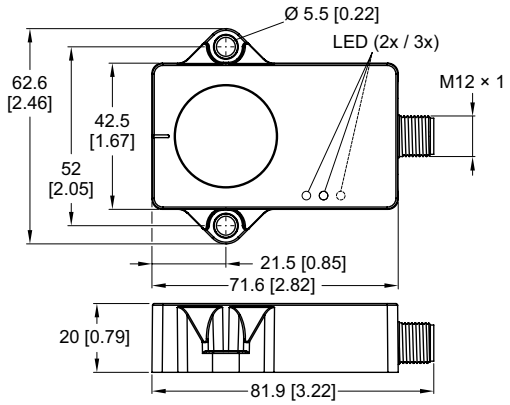
Interface	M12 connector, male contacts, 5-pin, A-coded					
Analog	Signal 1-axis:	+V	Out $_{ccw}$	0 V	Out $_{cw}$	Teach/IOL
	Signal 2-axis:	+V	Out y	0 V	Out x	Teach/IOL
	Pin:	1	2	3	4	5



+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 dynamic applications
1- and 2-axis measurement | **IN71** | **Analog**

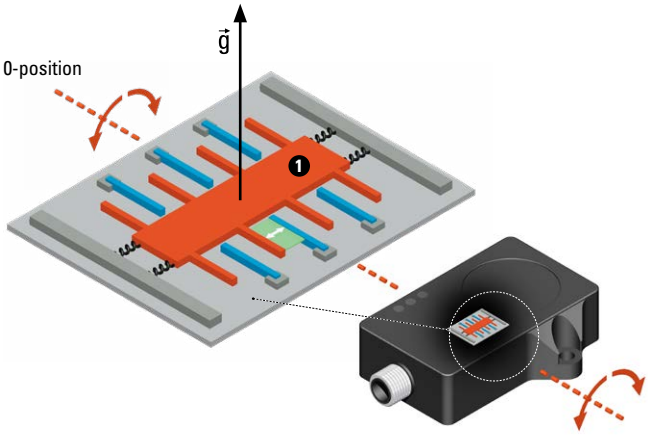
Technology in detail

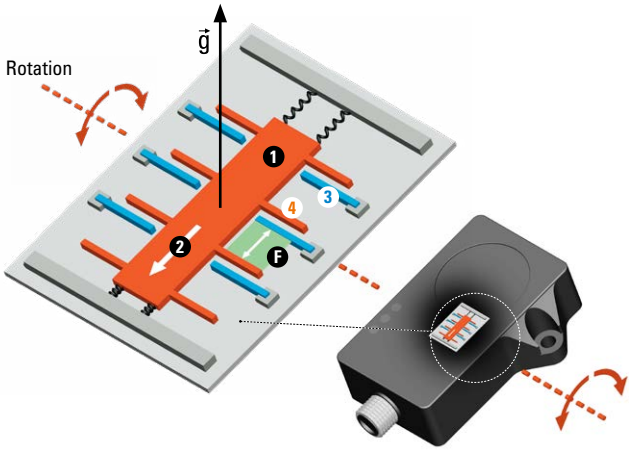
Fast measurement results and maximum accuracy thanks to sensor fusion of acceleration and rotation rate measurement

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.

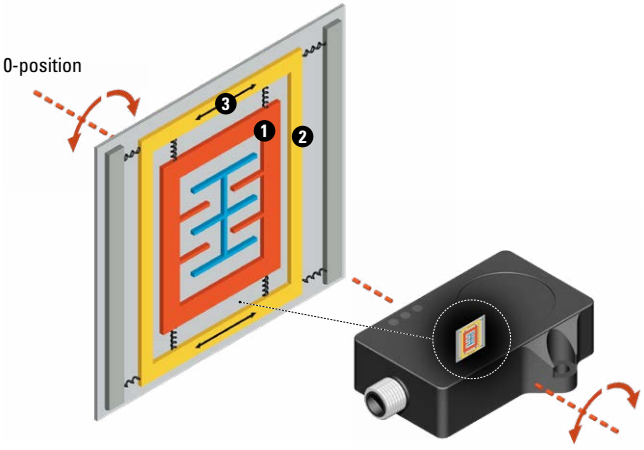


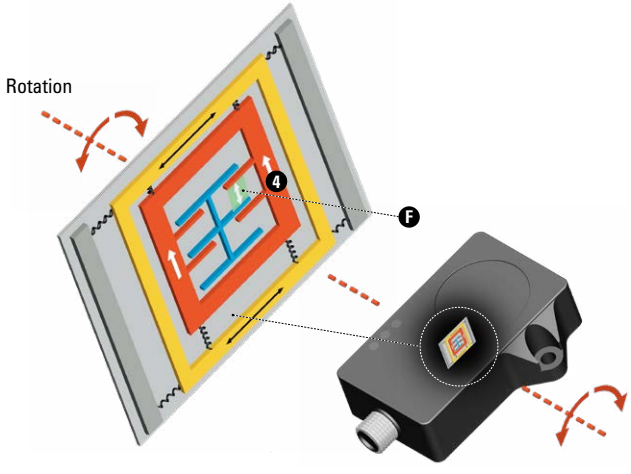


Rotation rate measurement

In the rotation rate measuring cell (gyroscope), the Coriolis force resulting from a rotation is evaluated in order to determine the angle of rotation in relation to the starting position.
An arrangement of frame ❷ and test mass ❶ is in a permanent linear movement ❸ (oscillating).
If this system is brought into rotation, this results in a force (Coriolis force) ❹ that leads to a displacement of the test mass.

This displacement is also determined by the change in capacity Ⓕ between fixed and moving electrodes and is directly related to the rotational speed (rotation rate).
The angle of rotation is determined from the speed of rotation and the duration of rotation.





Intelligent sensor fusion of acceleration and rotation rate measurement

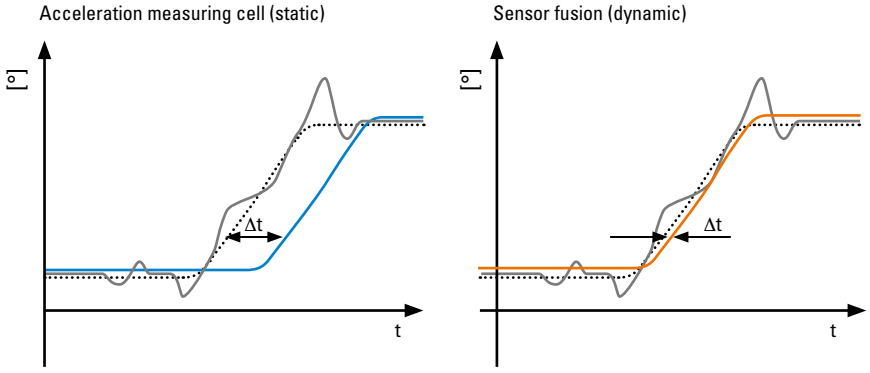
Both measured values are combined in the inclinometers for dynamic applications. The effect is even faster and more accurate output results.

For dynamic applications
1- and 2-axis measurement | **IN71** | **Analog**

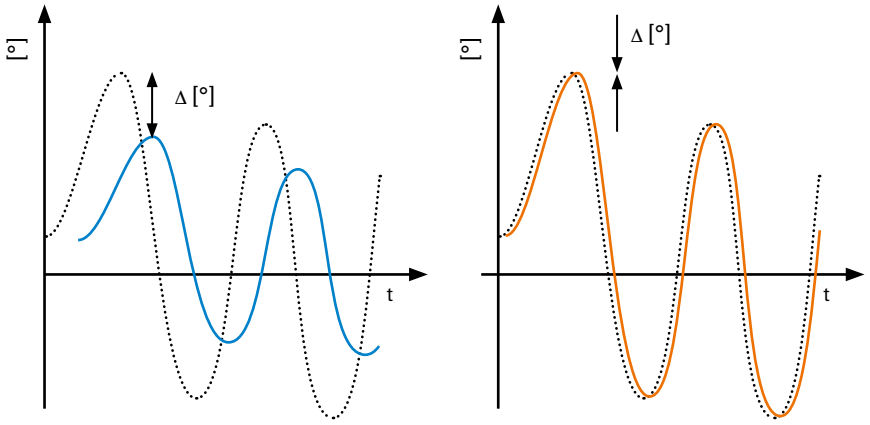
Technology in detail

Comparison static inclinometer (accelerometer only) - dynamic inclinometer (sensor fusion)

Fast measurement
Inaccuracies due to the inertia of the test mass can be compensated for in acceleration measurement via filters. However, there is a time delay Δt for the output of the measurement result. This time delay is minimized with sensor fusion.



Accurate measurement
The sensor fusion leads to more accurate measurement results when changing direction quickly.



- Actual movement
- Detected data of the acceleration measurement
- Filtered measurement results of the acceleration measurement
- Result sensor fusion of acceleration and rotation rate measurement

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

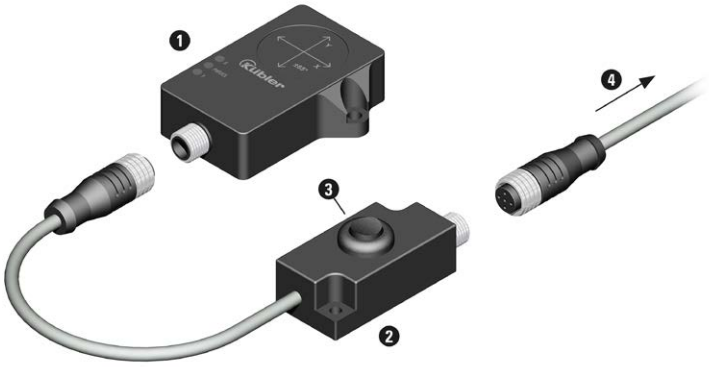
For dynamic applications
1- and 2-axis measurement | **IN71** | **Analog**

Technology in detail

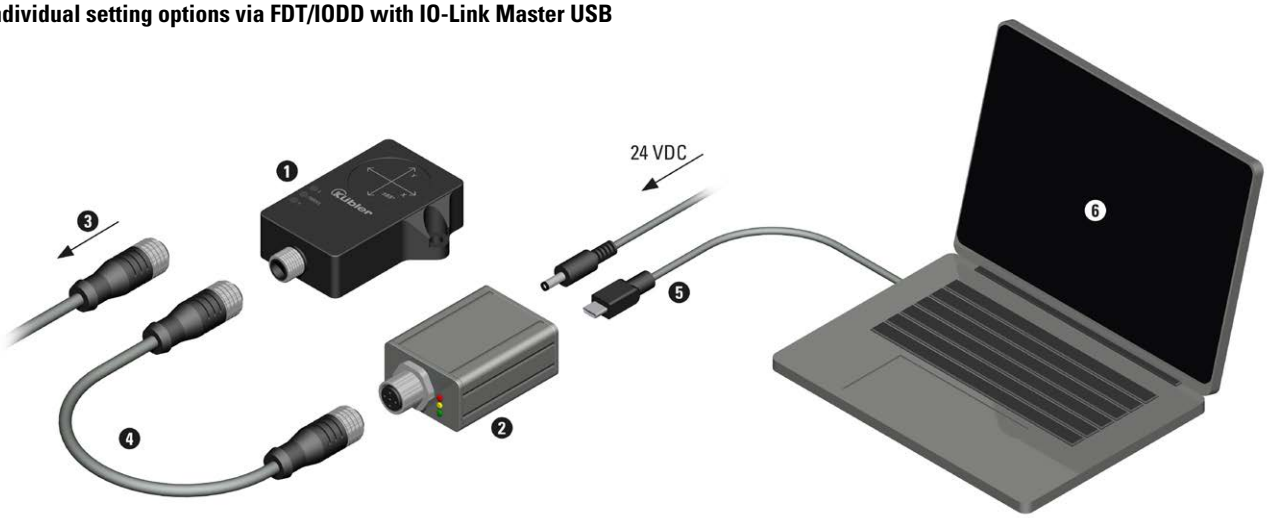
Quick setting options via the Easy-Teach function with teach adapter

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 / Very slow / Slow Fast / Very fast (factory setting)

По вопросам продаж и поддержки обращайтесь:

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