



# Accurate linear, angle and rotational speed measurement



## **Encoders**

Encoders convert rotary motion into digital signals. This rotary motion is the result of linear measurements, for example on conveyor belts, or of angle measurements such as those taken by solar tracking systems to optimally align the solar panels towards the sun.

## **Inclination sensors**





Inclination sensors are also used for angle measurement. They are smaller than encoders and easier to install. The core element is a measuring cell for example based on MEMS technology (Micro Electro Mechanical Systems). This measuring method allows evaluation of two axes in one unit. Inclination sensors are therefore a valuable supplement to encoders. They are frequently used in mobile machines (levelling of cranes or fire engines) or in the field of renewable energies.

## **Speed sensors**

Inductive speed sensors with integrated evaluation electronics do not only measure revolutions, but also monitor overspeed and underspeed. Once the sensor has been taught the desired speed, it works completely independently. It relieves users from the additional burden of programming their PLC: they only need to connect the sensor, teach the rotational speed and start the system. If the speed drops below the set value or exceeds it, the sensor sets a binary switching output as a warning.

## **Systems for pulse evaluation**

By using the matching evaluation systems, sensor pulses can be detected, evaluated, compared and converted into different output signals. The user can choose between binary, analogue (4...20 mA and 0...10 V) and PWM output signals.

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# Robust incremental and absolute encoders



## Encoders



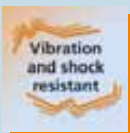
### Robust designs

Industrial standard housings

Cable entry for axial and radial use

Designs with integrated bus interface

Hollow shaft encoders for direct mounting on actuators



### Incremental encoder

They generate a precisely defined number of pulses per revolution. They are a measure of the angular or linear distance moved. The phase difference between the A signal and the B signal, which are shifted by 90 degrees, enables evaluation of the rotational direction.

### Absolute encoders

They provide an absolute numerical value for each angular position. Even in the event of a power failure the present position is quickly and reliably detected.

### Singleturn and multiturn

Singleturn encoders divide a mechanical revolution into a certain number of measuring steps. The measuring values are repeated after one complete revolution. Multiturn encoders additionally count revolutions.


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### Solid shaft encoders, programmable via IO-Link

Type	Resolution	U <sub>b</sub> [V]	f [kHz]	I <sub>load</sub> [mA]	Shaft [mm]	Ambient temperature [°C]	Cable entry	Drawing no.	Order no.
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M12 connector · 5-pole · Output function HTL 50 mA (preset at the factory) / TTL 50 mA

	1...10000	4.75...30	1000	50	6	-40...85	radial / axially	1	<b>RB3100</b>
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Cable 2 m · Output function HTL 50 mA (preset at the factory) / TTL 50 mA

	1...10000	4.75...30	1000	50	6	-40...80	radial / axially	2	<b>RB3500</b>
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M12 connector · 5-pole · Output function HTL 50 mA (preset at the factory) / TTL 50 mA

	1...10000	4.75...30	1000	50	6	-40...85	radial / axially	3	<b>RU3100</b>
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Cable 2 m · Output function HTL 50 mA (preset at the factory) / TTL 50 mA

	1...10000	4.75...30	1000	50	6	-40...80	radial / axially	4	<b>RU3500</b>
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M12 connector · 5-pole · Output function HTL, TTL 50 mA

	1...10000	4.75...30	1000	50	10	-40...85	radial / axially	5	<b>RV3100</b>
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Cable 2 m · Output function HTL, TTL 50 mA


	1...10000	4.75...30	1000	50	10	-40...80	radial / axially	6	<b>RV3500</b>
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### Hollow shaft encoders, programmable via IO-Link

Type	Resolution	U <sub>b</sub> [V]	f [kHz]	I <sub>load</sub> [mA]	Shaft [mm]	Ambient temperature [°C]	Cable entry	Drawing no.	Order no.
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M12 connector · 5-pole · Output function HTL 50 mA (preset at the factory) / TTL 50 mA

	1...10000	4.75...30	1000	50	6 H7	-40...85	radial / axially	7	<b>RA3100</b>
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	1...10000	4.75...30	1000	50	6 H7	-40...85	radial / axially	8	<b>RA3101</b>
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M12 connector · 8 pole · Output function HTL 50 mA (preset at the factory) / TTL 50 mA · Connector groups 16, 17






	1...10000	4.75...30	1000	50	12 H7	-40...85	radial / axially	9	<b>RA3102</b>
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Type	Resolution	U <sub>b</sub> [V]	f [kHz]	I <sub>load</sub> [mA]	Shaft [mm]	Ambient temperature [°C]	Cable entry	Drawing no.	Order no.
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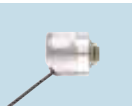
## Cable 2 m · Output function HTL 50 mA (preset at the factory) / TTL 50 mA

	1...10000	4.75...30	1000	50	6 H7	-40...80	radial / axially	10	RA3500
	1...10000	4.75...30	1000	50	6 H7	-40...80	radial / axially	11	RA3501

## M12 connector · 5-pole · Output function HTL 50 mA (preset at the factory) / TTL 50 mA

	1...10000	4.75...30	1000	50	12 F7	-40...85	radial / axially	12	RO3100
	1...10000	4.75...30	1000	50	12 F7	-40...85	radial / axially	13	RO3101
	1...10000	4.75...30	1000	50	15 F7	-40...85	radial / axially	14	RO3102
	1...10000	4.75...30	1000	50	9.525 F7	-40...85	radial / axially	15	RO3103
	1...10000	4.75...30	1000	50	15.875 F7	-40...85	radial / axially	16	RO3104




## Cable 2 m · Output function HTL 50 mA (preset at the factory) / TTL 50 mA

	1...10000	4.75...30	1000	50	12 F7	-40...80	radial / axially	17	RO3500
	1...10000	4.75...30	1000	50	12 F7	-40...80	radial / axially	18	RO3501

## Encoders with display, programmable via IO-Link or pushbuttons

Type	Resolution	U <sub>b</sub> [V]	f [kHz]	I <sub>load</sub> [mA]	Shaft [mm]	Ambient temperature [°C]	Cable entry	Drawing no.	Order no.
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## M12 connector · 8 pole · Output function HTL 50 mA (preset at the factory) / TTL 50 mA · Connector groups 16, 17





	1...10000	4.75...30	1000	50	6	-40...85	radial / axially	19	RUP500
	1...10000	4.75...30	1000	50	10	-40...85	radial / axially	20	RVP510
	1...10000	4.75...30	1000	50	12 F7	-40...85	radial / axially	21	ROP520




## Sensors for motion control

Type	Resolution	U <sub>b</sub> [V]	f [kHz]	I <sub>load</sub> [mA]	Shaft [mm]	Ambient temperature [°C]	Cable entry	Drawing no.	Order no.
<b>M12 connector · 8 pole · Output function HTL 50 mA (preset at the factory) / TTL 50 mA · Connector groups 16, 17</b>									
	1...10000	4.75...30	1000	50	12 F7	-40...85	radial / axially	22	<b>ROP521</b>
	1...10000	4.75...30	1000	50	15 F7	-40...85	radial / axially	23	<b>ROP522</b>
	1...10000	4.75...30	1000	50	9.525 F7	-40...85	radial / axially	24	<b>ROP523</b>
	1...10000	4.75...30	1000	50	15.875 F7	-40...85	radial / axially	25	<b>ROP524</b>

### Absolute multiturn encoders (SSI)

Type	Resolution	U <sub>b</sub> [V]	f [kHz]	I <sub>load</sub> [mA]	Shaft [mm]	Ambient temperature [°C]	Cable entry	Drawing no.	Order no.
<b>Cable 2 m · Output function SSI data interface</b>									
	4096	4.5...30	–	–	6	-40...85	axial	26	<b>RM8001</b>
	4096	4.5...30	–	–	10	-40...85	axial	27	<b>RM8002</b>
	4096	4.5...30	–	–	12	-40...85	axial	28	<b>RM8003</b>
<b>M12 connector · Output function CANopen interface · Connector group 205</b>									
	24 bits	9...30	–	–	12	-40...85	axial	29	<b>RM8004</b>




### Absolute singleturn-encoders (Profibus)

Type	Resolution	U <sub>b</sub> [V]	f [kHz]	I <sub>load</sub> [mA]	Shaft [mm]	Ambient temperature [°C]	Cable entry	Drawing no.	Order no.
<b>Terminals · Output function Profibus data interface</b>									
	13 bits	10...30	–	–	10	-40...85	–	30	<b>RN3001</b>

## Absolute multiturn encoders (Profibus)

Type	Resolution	U <sub>b</sub> [V]	f [kHz]	I <sub>load</sub> [mA]	Shaft [mm]	Ambient temperature [°C]	Cable entry	Drawing no.	Order no.
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## Terminals · Output function Profibus data interface

	25 bits	10...30	–	–	6	-40...85	–	31	RM3006
	25 bits	10...30	–	–	10	-40...85	–	32	RM3007
	25 bits	10...30	–	–	12	-40...85	–	33	RM3008

## Absolute multiturn encoders (ProfiNet)

Type	Resolution	U <sub>b</sub> [V]	f [kHz]	I <sub>load</sub> [mA]	Shaft [mm]	Ambient temperature [°C]	Cable entry	Drawing no.	Order no.
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## M12 connector · Output function Profinet IO data interface · Connector groups 8, 9, 10, 11, 18, 19, 21, 23, 25, 148, 149, 150, 151, 153, 154, 184, 188, 190, 193, 202, 203, 204

	25 bits	10...30	–	–	10	-40...85	–	34	RM3011
	25 bits	10...30	–	–	12	-40...85	–	35	RM3010

## Absolute singleturn-encoders (CANopen)

Type	Resolution	U <sub>b</sub> [V]	f [kHz]	I <sub>load</sub> [mA]	Shaft [mm]	Ambient temperature [°C]	Cable entry	Drawing no.	Order no.
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## Terminals · Output function CANopen interface

	13 bits	10...30	–	–	6	-40...85	–	36	RN7011
	13 bits	10...30	–	–	10	-40...85	–	30	RN7012







## Sensors for motion control

### Absolute multiturn-encoders (CANopen)

Type	Resolution	U <sub>b</sub> [V]	f [kHz]	I <sub>load</sub> [mA]	Shaft [mm]	Ambient temperature [°C]	Cable entry	Drawing no.	Order no.
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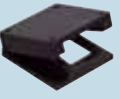
#### Terminals · Output function CANopen interface

	25 bits	10...30	–	–	6	-40...85	–	31	RM7011
	25 bits	10...30	–	–	10	-40...85	–	32	RM7012


#### M12 connector · Output function CANopen interface · Connector group 205





	4096	9...30	–	–	10	-40...85	axial	37	RM9010
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### Fixing accessories for encoders

Type	Description	Order no.
	Resilient base for angle flanges · Housing materials: aluminium black anodised	E60036
	Angle bracket · for encoders · for type RB, RC, RM, RN, RU · Housing materials: aluminium black anodised	E60033
	Angle bracket · for encoders · for type RM, RMU, RN, RU · Housing materials: aluminium black anodised	E60034
	Angle bracket · for encoders · for type RMV, RV · Housing materials: aluminium black anodised	E60035
	Angle bracket · for encoders · for type RM · Housing materials: aluminium black anodised	E60302
	Fastening clamp · for solid shaft encoders · Housing materials: steel	E60041



### Couplings for encoders

Type	Description	Order no.
	Flexible coupling with clamp connection [KV] · Ø 6 mm / 1/4" / 1/4 inch / [6.35 mm] · Housing materials: aluminium	E60206









Type	Description	Order no.
	Flexible coupling with clamp connection [KV] · Ø 6 mm / Ø 3/8" / 3/8 inch / [9.525 mm] · Housing materials: aluminium	E60207
	Flexible coupling with clamp connection [KV] · Ø 10 mm / Ø 1/2" / 1/2 inch / [12.7 mm] · Housing materials: aluminium	E60208
	Flexible coupling with clamp connection [KV] · Ø 10 mm / Ø 3/8" / 3/8 inch / [9.525 mm] · Housing materials: aluminium	E60209
	Flexible coupling with clamp connection [KV] · Ø 4 mm / Ø 6 mm · Housing materials: aluminium	E60119
	Flexible coupling with clamp connection [KV] · Ø 6 mm / Ø 6 mm · Housing materials: aluminium	E60064
	Flexible coupling with clamp connection [KV] · Ø 6 mm / Ø 6 mm · Housing materials: aluminium	E60065
	Flexible coupling with clamp connection [KV] · Ø 6 mm / Ø 8 mm · Housing materials: aluminium	E60120
	Flexible coupling with clamp connection [KV] · Ø 6 mm / Ø 10 mm · Housing materials: aluminium	E60066
	Flexible coupling with clamp connection [KV] · Ø 10 mm / Ø 10 mm · Housing materials: aluminium	E60067
	Flexible coupling with adjusting screw connection [SV] · Ø 4 mm / Ø 6 mm · Housing materials: aluminium	E60062
	Flexible coupling with adjusting screw connection [SV] · Ø 6 mm / Ø 6 mm · Housing materials: aluminium	E60063
	Flexible coupling with adjusting screw connection [SV] · Ø 6 mm / Ø 8 mm · Housing materials: aluminium	E60027
	Flexible coupling with adjusting screw connection [SV] · Ø 6 mm / Ø 10 mm · Housing materials: aluminium	E60028
	Flexible coupling with adjusting screw connection [SV] · Ø 10 mm / Ø 10 mm · Housing materials: aluminium	E60022
	Spring disc coupling electrically isolating · Ø 6 mm / Ø 6 mm · Housing materials: diecast zinc / PA	E60121
	Spring disc coupling electrically isolating · Ø 6 mm / Ø 10 mm · Housing materials: diecast zinc / PA	E60117




## Sensors for motion control



Type	Description	Order no.
	Spring disc coupling electrically isolating · Ø 10 mm / Ø 10 mm · Housing materials: diecast zinc / PA	<b>E60118</b>
	Plastic beam coupling with stainless steel hub · Ø 10 mm / Ø 10 mm · Housing materials: PA 6.6 / stainless steel 316L / 1.4404	<b>E60193</b>

## Measuring wheels for encoders

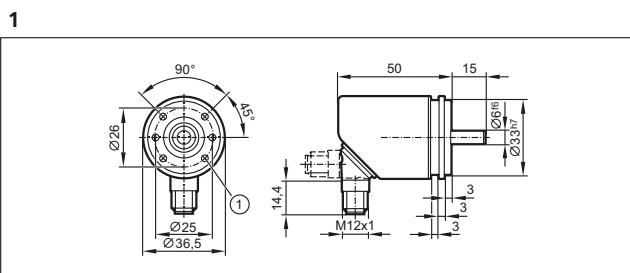
Type	Description	Order no.
	Measuring wheel · Ø 63.6 mm / Ø 6 mm · cross-knurl · Housing materials: wheel: aluminium / surface characteristics: aluminium	<b>E60006</b>
	Measuring wheel · Ø 63.6 mm / Ø 10 mm · cross-knurl · Housing materials: wheel: aluminium / surface characteristics: aluminium	<b>E60095</b>
	Measuring wheel · Ø 63.66 ±0.1 mm / Ø 6 mm · smooth plastic · Housing materials: wheel: aluminium / surface characteristics: PU	<b>E60111</b>
	Measuring wheel · Ø 63.66 ±0.1 mm / Ø 10 mm · smooth plastic · Housing materials: wheel: aluminium / surface characteristics: PU	<b>E60112</b>
	Measuring wheel · Ø 63.66 ±0.1 mm / Ø 6 mm · grooved plastic · Housing materials: wheel: aluminium / surface characteristics: PU	<b>E60137</b>
	Measuring wheel · Ø 63.66 ±0.1 mm / Ø 10 mm · grooved plastic · Housing materials: wheel: aluminium / surface characteristics: PU	<b>E60138</b>
	Measuring wheel · Ø 159.15 mm / Ø 10 mm · cross-knurl · Housing materials: wheel: aluminium / surface characteristics: aluminium	<b>E60098</b>
	Measuring wheel · Ø 159.16 mm / Ø 10 mm · rubber · Housing materials: wheel: aluminium / surface characteristics: PU	<b>E60076</b>
	Measuring wheel · Ø 159.15 mm / Ø 10 mm · smooth plastic · Housing materials: wheel: aluminium / surface characteristics: PU	<b>E60110</b>

## Connectors for encoders

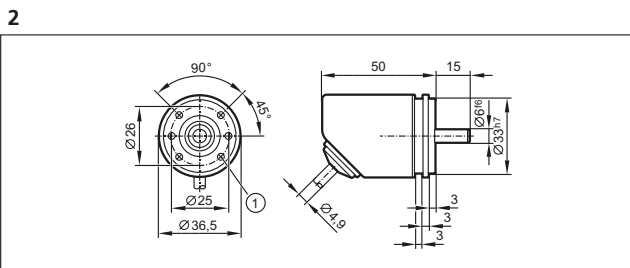
Type	Description	Order no.
	Socket · angled · Free from silicone · Free from halogen · Gold-plated contacts · For applications in particularly harsh environments · M12 connector · 2 m · Housing materials: housing: TPU orange / sealing: FKM	<b>EVM039</b>

Type	Description	Order no.
	Socket · angled · Free from silicone · Free from halogen · Gold-plated contacts · M12 connector with integrated CAN terminating resistor (120 ohm) · 5 m · Housing materials: housing: TPU black / sealing: FKM	EVC492
	Socket · straight · Free from silicone · Free from halogen · Gold-plated contacts · For applications in particularly harsh environments · M12 connector · 2 m · Housing materials: housing: TPU orange / sealing: FKM	EVM036
	Socket · straight · M12 connector · 2 m · Housing materials: TPU	E12402
	Jumper · straight / straight · Free from halogen · 0.3 m · Housing materials: PUR	E12432

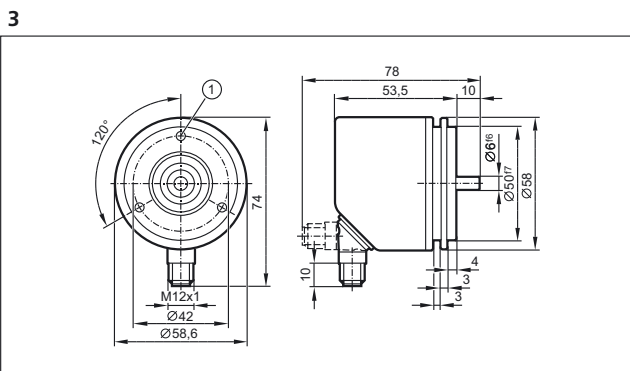
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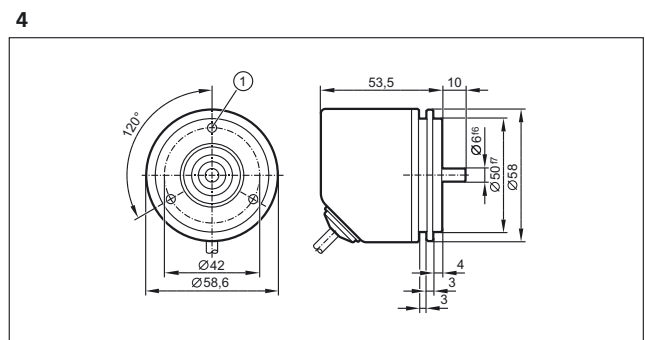
1: M3 x 0.5 6 mm deep



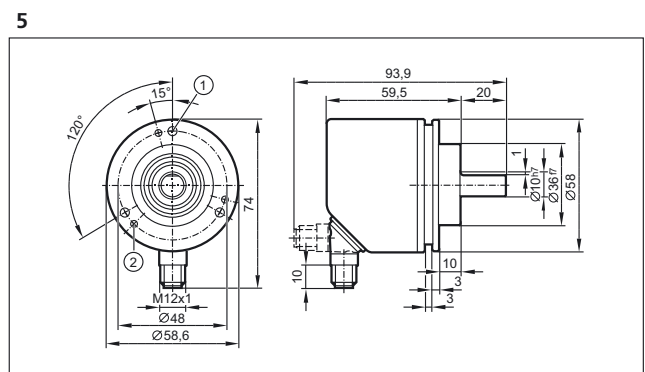
1: M3 x 0.5 6 mm deep



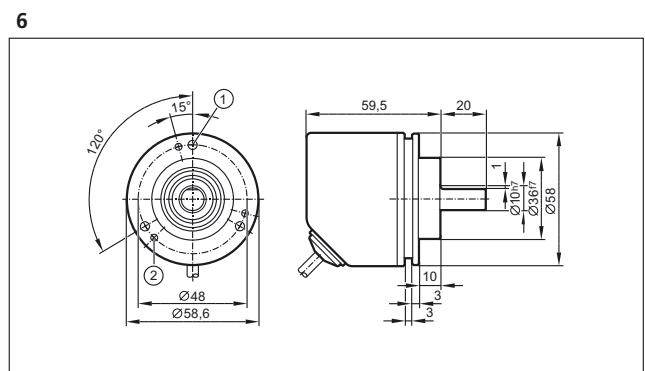
1: M4 x 0.7 6 mm deep



1: M4 x 0.7 6 mm deep



1: M4 x 0.7 6 mm deep, 2: M3 x 0.5 6 mm deep



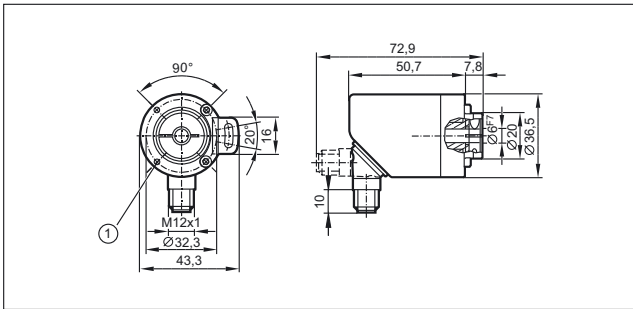
1: M4 x 0.7 6 mm deep, 2: M3 x 0.5 6 mm deep



## Sensors for motion control

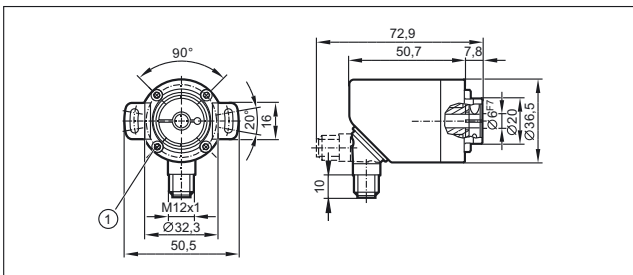
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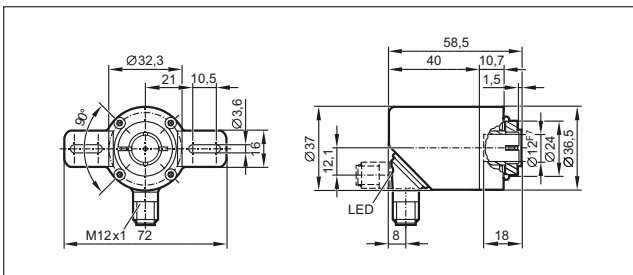
M2.5 x 0.45 6mm deep

8

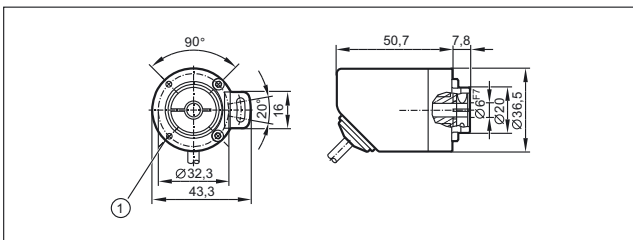


1: M3 x 0.5 6 mm deep

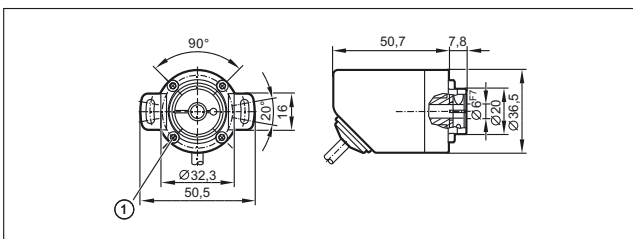
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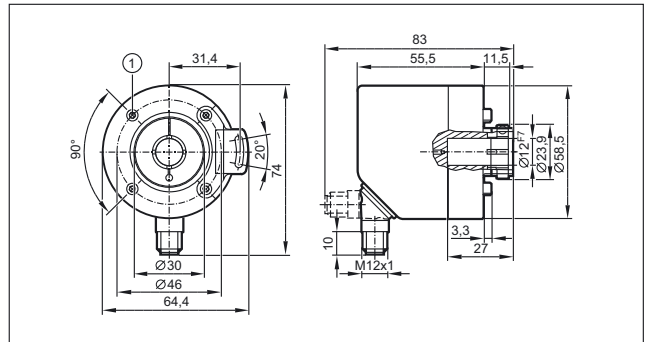
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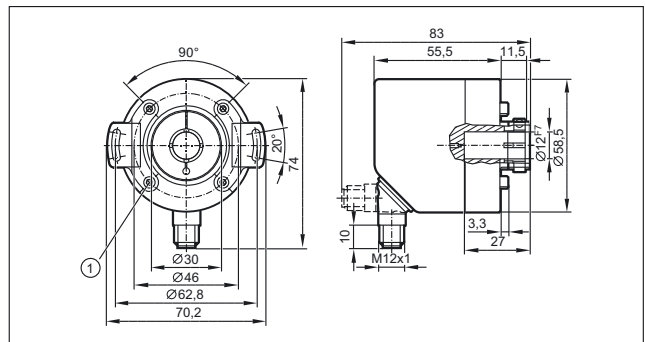


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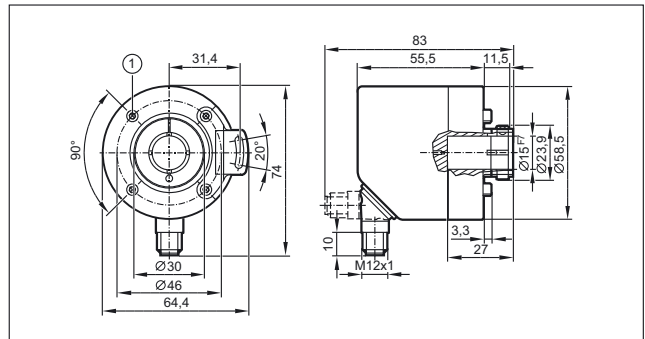


1: M3 x 0.5 6 mm deep

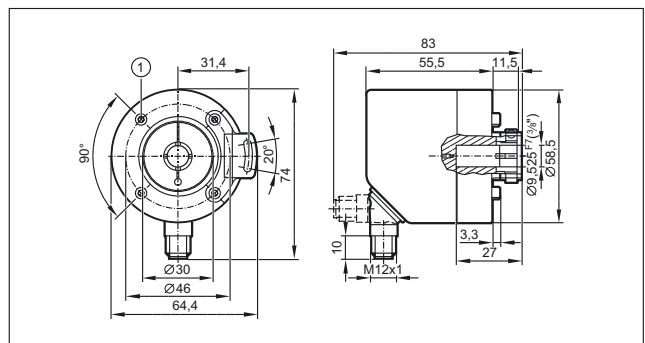
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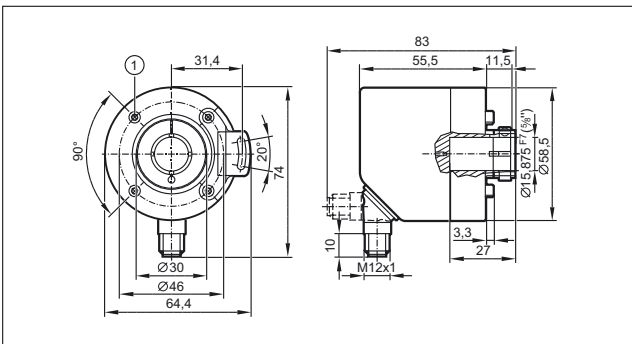


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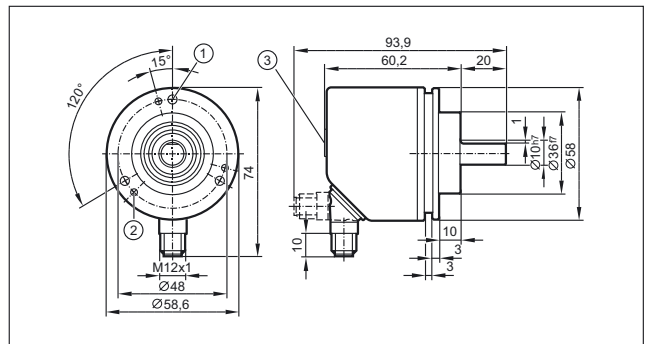


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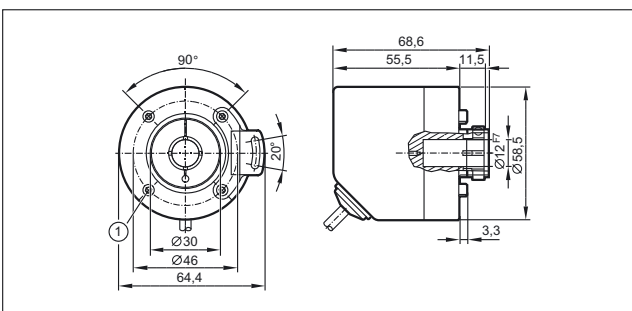


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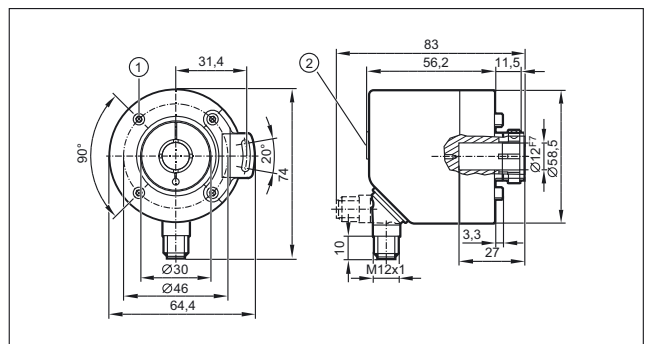


1: M4 x 0.7 6 mm deep, 2: M3 x 0.5 6 mm deep, 3: display

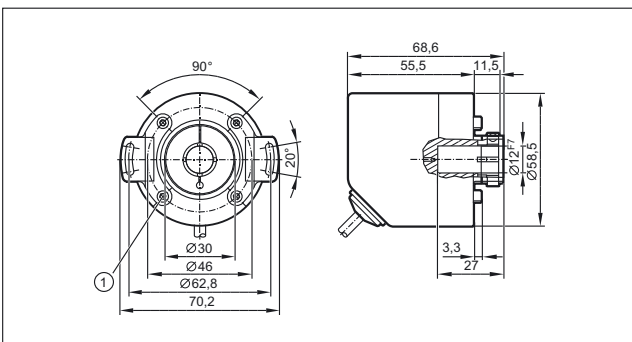
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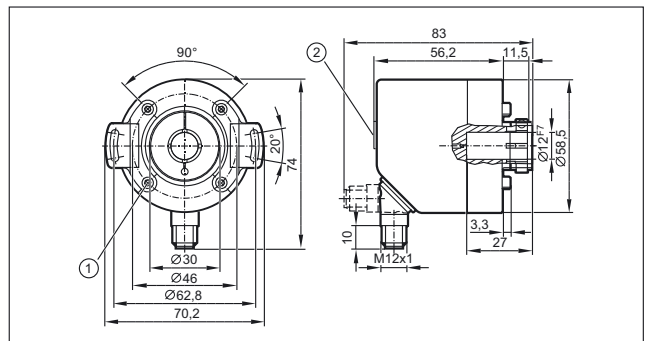
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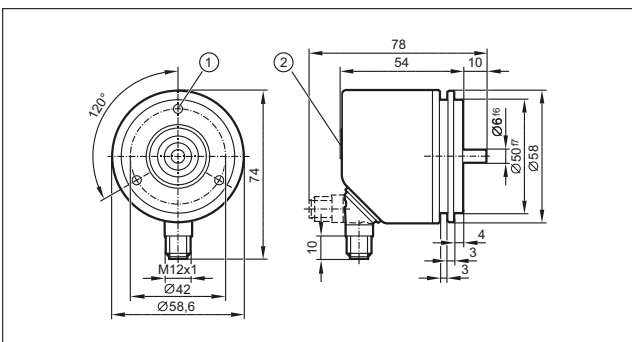
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22

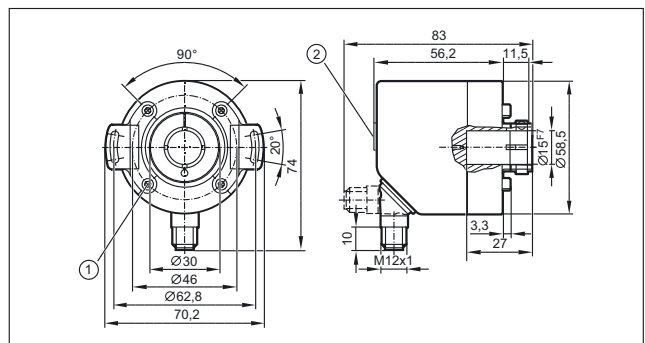


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1: M4 x 0.7 6 mm deep, 2: display

23

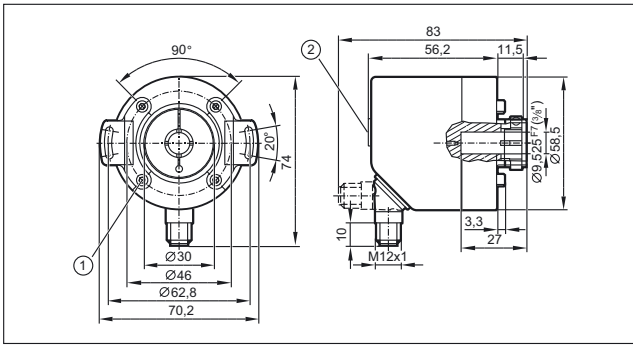




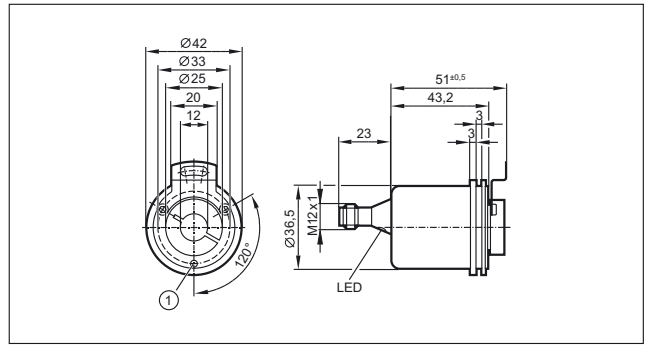
**Sensors for motion control**

Scale drawings / drawing no. – CAD download: [www.ifm.com](http://www.ifm.com)

**24**

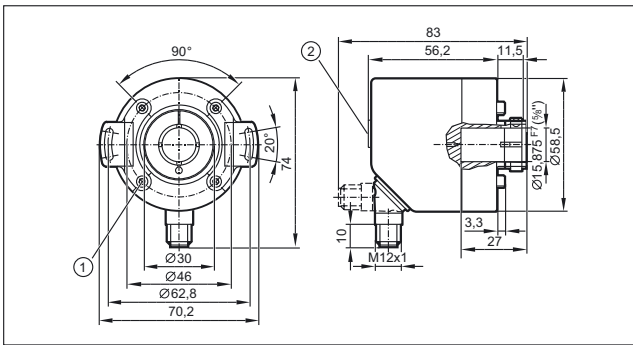


**29**

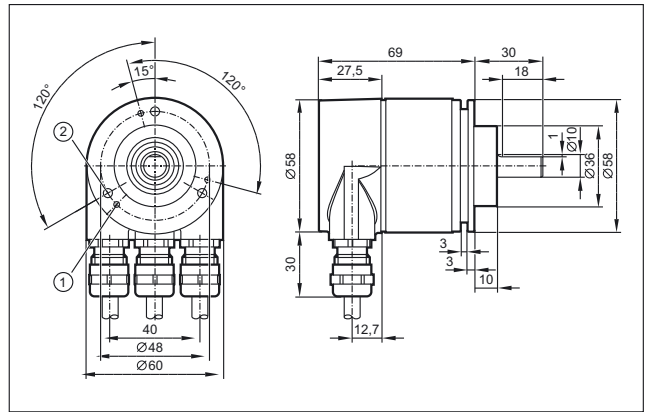


1: M3 x 6

**25**

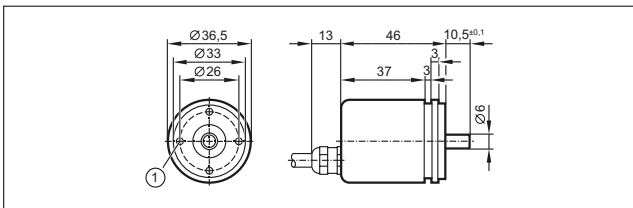


**30**



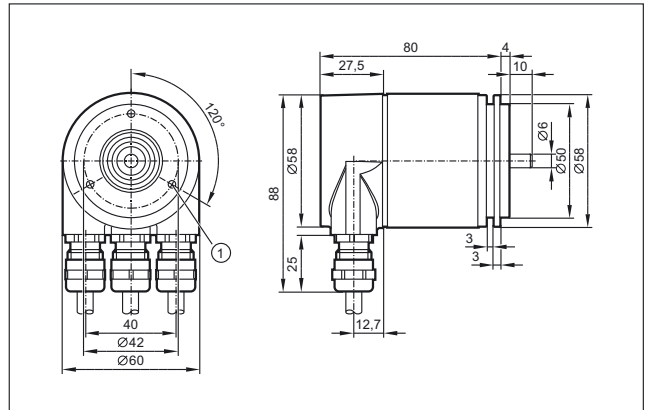
1: M3 6 mm deep, 2: M4 6 mm deep

**26**

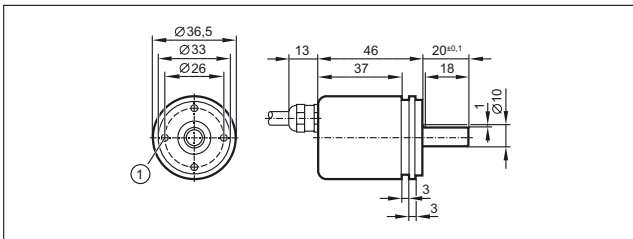


M3 6 mm deep

**31**

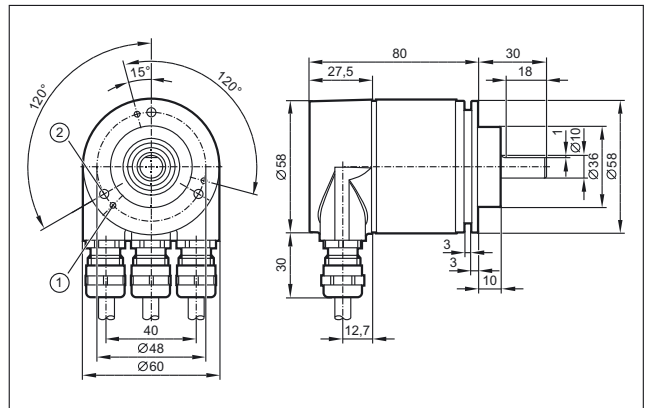


**27**



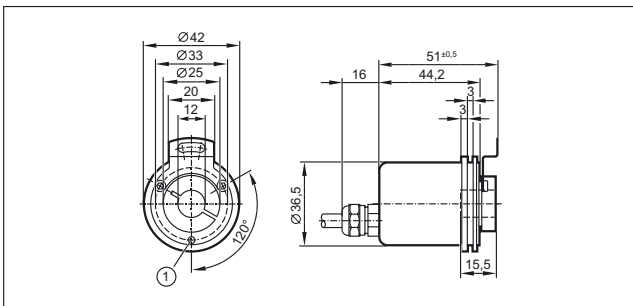
M3 6 mm deep

**32**



1: M3 6 mm deep, 2: M4 6 mm deep

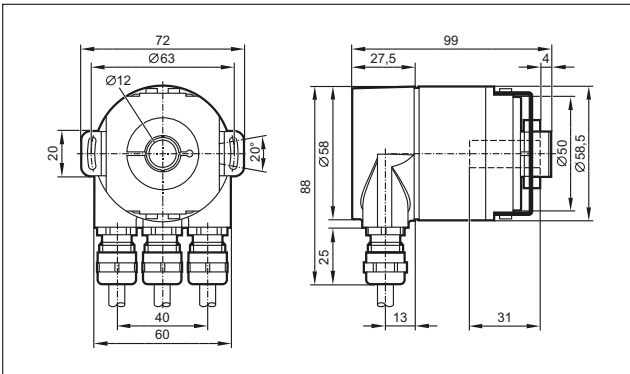
**28**



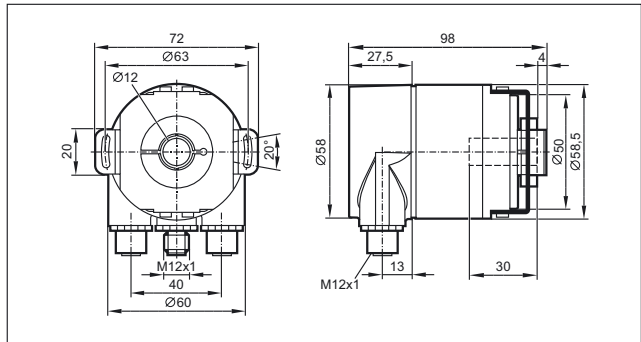
1: M3 x 6

Scale drawings / drawing no. – CAD download: [www.ifm.com](http://www.ifm.com)

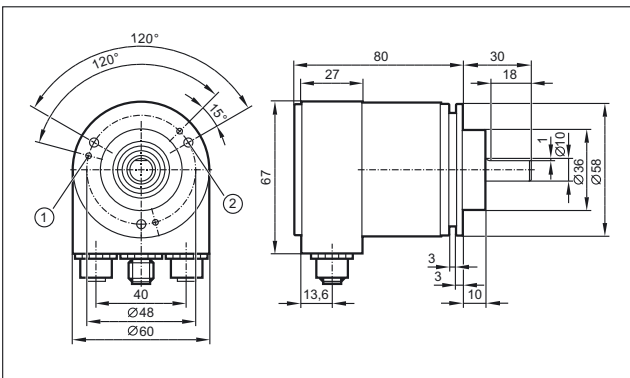
33



35

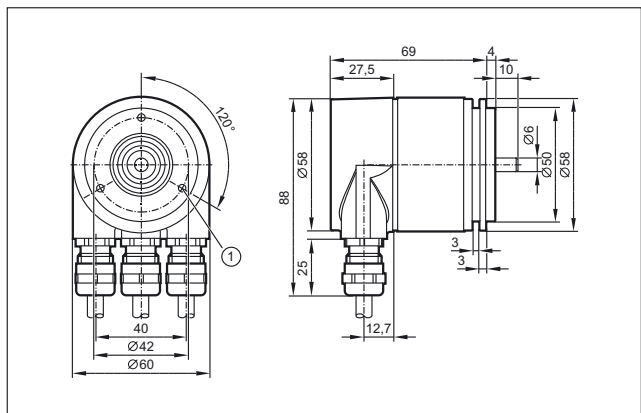


34

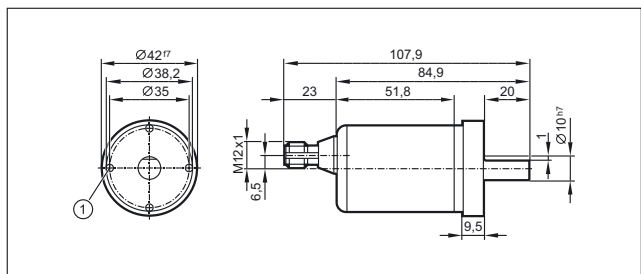


1: M3 6 mm deep, 2: M4 6 mm deep

36



37



1: M4 8 mm deep





# Sensor with integrated speed evaluation



## Speed sensors

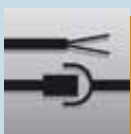


**2 in 1: speed sensor and evaluation in one compact housing**

**Space-saving design**

**Easy to fit**

**Easy parameter setting by potentiometer or pushbutton**



### Inductive sensor with integrated speed evaluation

In many industrial applications drives need to be monitored for rotational speed or standstill. A typical application in building automation is V-belt monitoring on fans. In conveying, standstill monitoring is used to detect belt break on conveyors. A similar principle is applied in agricultural engineering to monitor elevator drives or detect failure of screw conveyors.

The compact DI series speed monitor offers a specially low-cost and reliable solution. In principle it is an inductive sensor with integrated speed evaluation. Advantage: the condition information of the drive is directly transferred to the control system.


















The nominal speed is easily set by potentiometer or pushbutton.

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Wiring diagrams	362 - 363
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## Sensors for motion control

### Speed monitor with integrated sensor

Type	Dimensions [mm]	Sensing range [mm]	Electrical design	U <sub>b</sub> [V]	Setting range [puls. / min.]	Start-up delay [s]	Draw- ing no.	Order no.
<b>Output function</b>  · <b>Wiring diagram no. 1</b> · Connector groups 8, 10, 11, 18, 19, 21, 23, 25, 148, 149, 150, 153, 154, 184, 188, 190, 193, 202, 203, 204								
	M18 / L = 68	12 nf	DC PNP	10...36 DC	3...6000	0...15	1	<b>DI6001</b>
<b>Output function</b>  · <b>Wiring diagram no. 2</b>								
	M30 / L = 80	10 f	AC/DC	20...250 AC/DC	5...3600	< 0.5	2	<b>DI1014*</b>
	M30 / L = 80	10 f	AC/DC	20...250 AC/DC	5...3600	12	2	<b>DI1011*</b>
<b>Output function</b>  · <b>Wiring diagram no. 3</b> · Connector groups 8, 10, 11, 18, 19, 21, 23, 25, 148, 149, 150, 153, 154, 184, 188, 190, 193, 202, 203, 204								
	M30 / L = 82	10 f	DC PNP	10...36 DC	5...300	15	3	<b>DI5009</b>
<b>Output function</b>  · <b>Wiring diagram no. 4</b>								
	M30 / L = 80	10 f	DC PNP	10...36 DC	5...3600	0	2	<b>DI5022</b>
	M30 / L = 80	10 f	DC PNP	10...36 DC	5...3600	15	2	<b>DI5020</b>
<b>Output function</b>  · <b>Wiring diagram no. 5</b>								
	M30 / L = 80	10 f	DC PNP	10...36 DC	5...3600	5	2	<b>DI5021</b>
<b>Output function</b>  · <b>Wiring diagram no. 4</b>								
	M30 / L = 80	10 f	DC PNP	10...36 DC	5...3600	15	2	<b>DI520A</b>
<b>Output function</b>  · <b>Wiring diagram no. 6</b>								
	M30 / L = 80	10 f	DC PNP/NPN	10...36 DC	5...3600	0...30	2	<b>DI5026</b>
	M30 / L = 80	10 f	DC PNP/NPN	10...36 DC	5...3600	0...30	2	<b>DI523A</b>

f = flush / nf = non flush / qf = quasi-flush

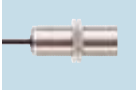
#### \* Note on use of miniature fuses for electrical connection

Miniature fuse to IEC60127-2 sheet 1, ≤ 2 A (fast acting) Recommendation: check the unit for reliable function after a short circuit.


## Speed monitors with integrated sensor, ATEX category 3D



Type	Dimensions [mm]	Sensing range [mm]	Electrical design	U <sub>b</sub> [V]	Setting range [puls. / min.]	Start-up delay [s]	Draw- ing no.	Order no.
------	--------------------	--------------------------	----------------------	-----------------------	------------------------------------	--------------------------	---------------------	--------------


Output function  · Wiring diagram no. 2

	M30 / L = 80	10 f	AC/DC	20...250 AC/DC	5...3600	12	2	DI103A*
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Output function  · Wiring diagram no. 3 · Connector group --

	M30 / L = 82	10 f	DC PNP	10...36 DC	5...300	15	4	DI505A
	M30 / L = 82	10 f	DC PNP	10...36 DC	5...300	5	4	DI506A

Output function  /  · Wiring diagram no. 1 · Connector group --

	M18 / L = 68	8 nf	DC PNP	10...36 DC	3...6000	0...15	5	DI602A
--	--------------	------	--------	------------	----------	--------	---	--------

f = flush / nf = non flush / qf = quasi-flush



## \* Note on use of miniature fuses for electrical connection


Miniature fuse to IEC60127-2 sheet 1, ≤ 2 A (fast acting) Recommendation: check the unit for reliable function after a short circuit.


## Speed sensors with magnetic measuring principle

Type	Dimensions [mm]	Sensing range [mm]	Electrical design	U <sub>b</sub> [V]	Connection	Ambient temperature sensor [°C]	Draw- ing no.	Order no.
------	--------------------	--------------------------	----------------------	-----------------------	------------	--	---------------------	--------------


## Wiring diagram no. 7

	∅ 15 / L = 49.5	1.7	DC NPN	15	PUR cable	-32...140	6	MX5015
	∅ 15 / L = 50	1.7	DC NPN	15	PUR cable	-32...140	7	MX5017

Output function  · Wiring diagram no. 8 · Connector groups 8, 10, 19, 21, 23, 25, 148, 149, 153, 184, 188, 193, 202

	∅ 15 / L = 60	1.7	DC PNP	10...30 DC	PUR cable	-32...85	8	MX5050
---	---------------	-----	--------	------------	-----------	----------	---	--------

## Wiring diagram no. 9


	–	1.7	DC NPN	7...30 DC	AMP Junior Timer connector (282 1921)	-32...140	9	MX5004
---	---	-----	--------	-----------	--	-----------	---	--------



## Sensors for motion control

Type	Dimensions [mm]	Sensing range [mm]	Electrical design	U <sub>b</sub> [V]	Connection	Ambient temperature sensor [°C]	Drawing no.	Order no.
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### Wiring diagram no. 9

	–	1.7	DC NPN	7...30 DC	AMP Junior Timer connector (282 1921)	-32...140	10	<b>MX5000</b>
---	---	-----	--------	-----------	---------------------------------------	-----------	----	---------------

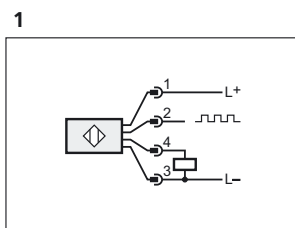
## Accessories

Type	Description	Order no.
	Angle bracket · for type M18 · Housing materials: stainless steel	<b>E10736</b>
	Angle bracket · for type M30 · Housing materials: stainless steel	<b>E10737</b>
	Mounting clamp · Ø 20 mm · Ø 18 mm · with reducing bush · for type M18 · Housing materials: PBT	<b>E10076</b>
	Mounting clamp · Ø 34 mm · Ø 30 mm · with reducing bush · for type M30 · Housing materials: PBT	<b>E10077</b>
	Target wheel · Plastic disk with 8 screws as "target" · Centered drill holes	<b>E89010</b>
	Target for pulse pickups · Strap dimensions 7 x 145 mm	<b>E89013</b>
	Cable plug · straight · 10 m	<b>E60303</b>
	Amplifier · 1-channel · selectable for pnp and npn switching sensors · Output 24 V DC / 300 mA · short-circuit and overload protection · Housing materials: plastics: PC GF20	<b>DN0210</b>

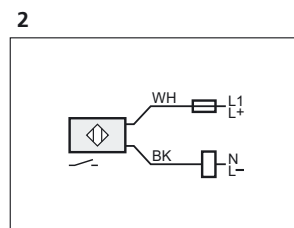
## Wiring diagrams

### Core colours

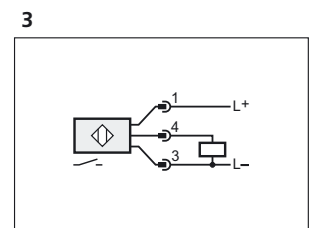
BK	black
WH	white
BN	brown
BU	blue



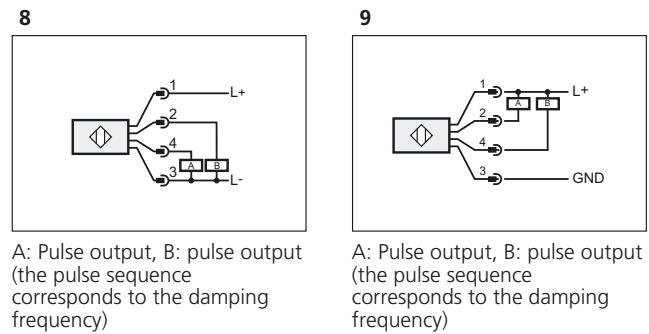
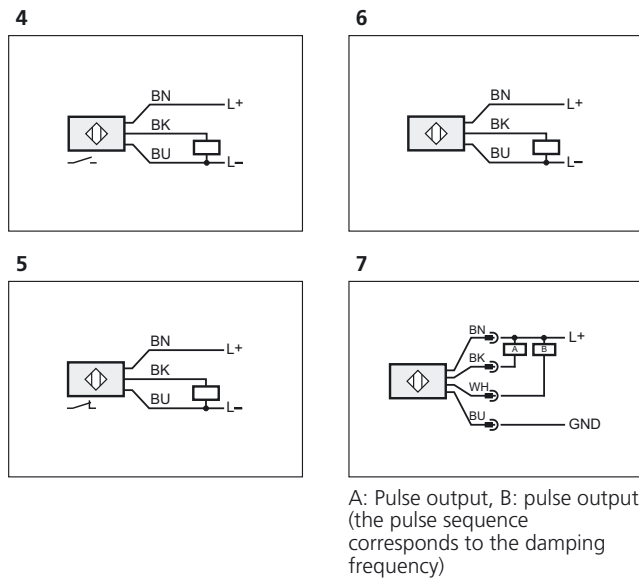
2: pulse output (the pulse sequence corresponds to the damping frequency),  
4: switching output (adjustable)



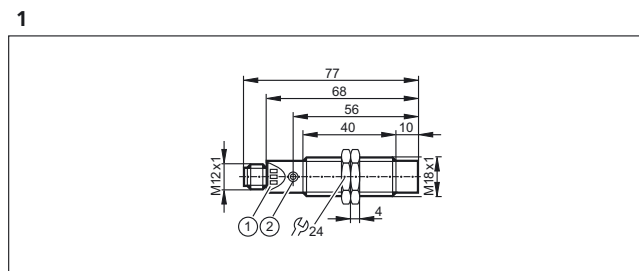
Note: miniature fuse to IEC60127-2 sheet 1, ≤ 2 A (fast acting)



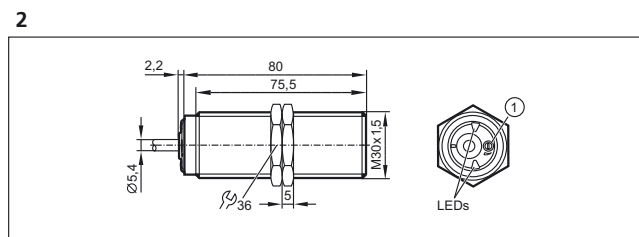
Wiring diagrams



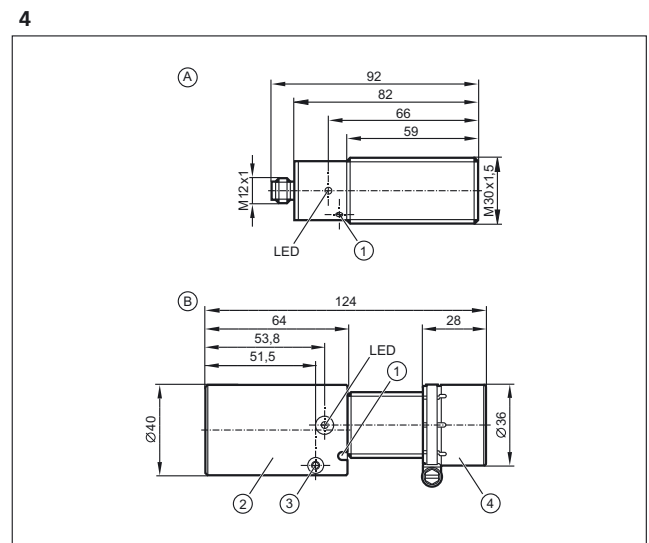
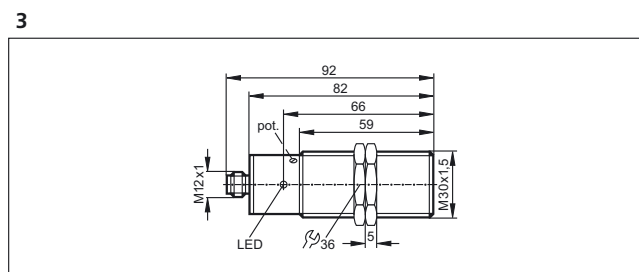
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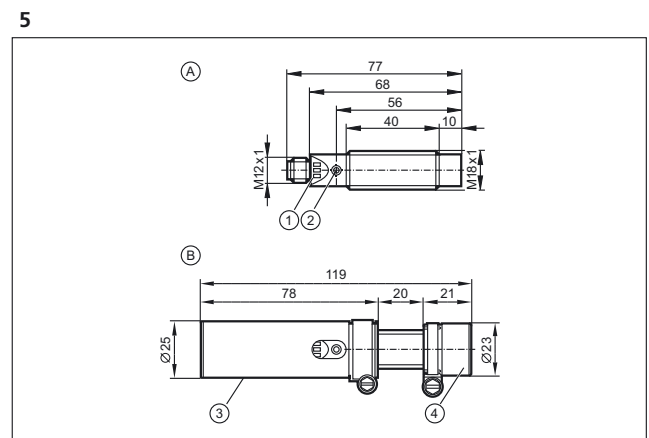
1: 3 LED, 2: setting pushbutton



1: potentiometer



A: Sensor, B: sensor with impact protection housing, 1: potentiometer, 2: impact protection housing for the connector, 3: clamping screw, 4: impact protection housing for the sensor



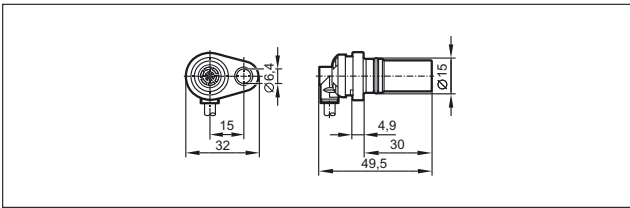
A: Sensor, B: sensor with impact protection housing, 1: 3 LED, 2: setting pushbutton, 3: impact protection housing for the connector, 4: impact protection housing for the sensor



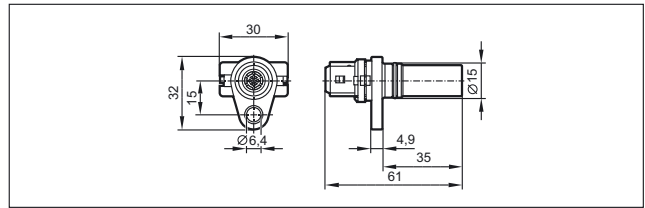
## Sensors for motion control

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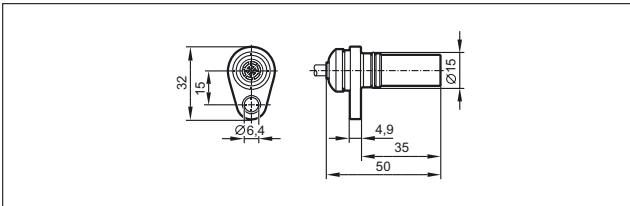
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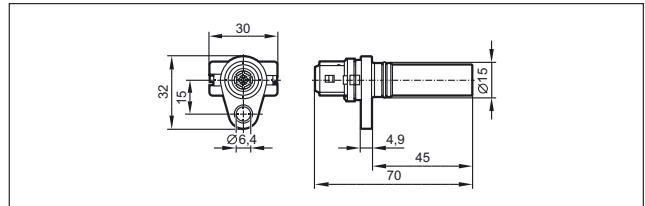
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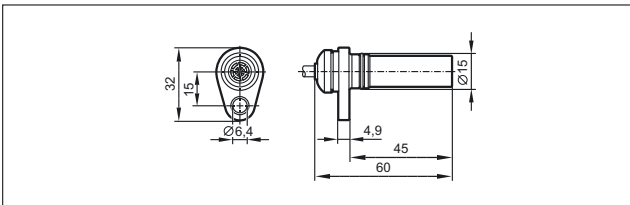
7



10



8









# Inclination sensors measure each angle with precision



## Inclination sensors



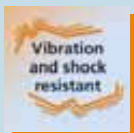
**Compact and robust design**

**Wide angle range and high accuracy**

**Sensor types for signal output via CANbus, IO-Link as digital or analogue signal**

**High protection rating IP 65 to IP 69K**

**CAN and IO-Link sensors are freely configurable**



### Inclination detection

Often the horizontal alignment of machines or machine parts is an important requirement for reliable operation.

Typical applications are cranes, access platforms or outriggers.

ifm inclination sensors differ by their signal outputs, number of measurement axes, the measuring range and the connection type. Depending on the sensor type, signal output is via CANbus, IO-Link, analogue or digital.

If only a switch point is to be detected, the mercury-free tilt sensor is used. Due to its design, it has the same good switching characteristics as a conventional mercury switch. Due to the harmless filling of the switching element with alcohol it has considerable ecological advantages in case of damage or disposal.

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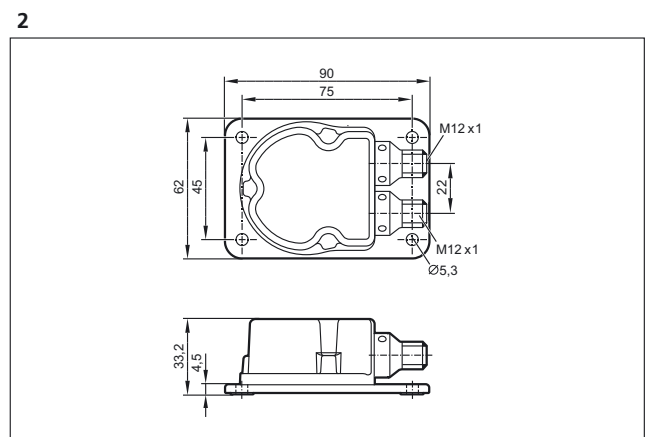
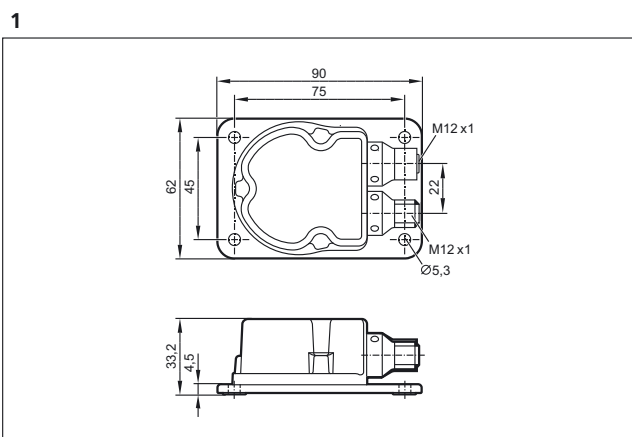


## Sensors for motion control

### Inclination sensors

Type	Description	Draw- ing no.	Order no.
	Inclination sensor · 0...360° / ± 180° · CANopen interface · Self-test function · Heartbeat · Emergency messages available · housing: diecast zinc nickel-plated	1	<b>JN2100</b>
	Inclination sensor · ± 180° · Self-test function · IO-Link interface · Analogue interfaces (voltage / current) · Analogue / binary outputs · housing: diecast zinc nickel-plated	2	<b>JN2200</b>
	Inclination sensor · 0...360° / ± 180° · SAE J1939 interface · Self-test function · Diagnostic Trouble Code (DTC) available · housing: diecast zinc nickel-plated	1	<b>JN2300</b>
	Inclination sensor · ± 45° · CANopen interface · Self-test function · Heartbeat · Emergency messages available · housing: diecast zinc nickel-plated	1	<b>JN2101</b>
	Inclination sensor · ± 45° · Self-test function · IO-Link interface · Analogue interfaces (voltage / current) · Analogue / binary outputs · housing: diecast zinc nickel-plated	2	<b>JN2201</b>
	Inclination sensor · ± 45° · SAE J1939 interface · Self-test function · Diagnostic Trouble Code (DTC) available · housing: diecast zinc nickel-plated	1	<b>JN2301</b>
	Inclination sensor · ± 90° · 15...30 V DC · Output 0...10 V · Cable	3	<b>EC2019</b>
	Inclination sensor · ± 90° · Input 8...30 V DC · Output 0.5...4.5 V · Cable	3	<b>EC2045</b>
	Inclination sensor · ± 20° · Analogue output · 4...20 mA	3	<b>EC2060</b>
	Inclination sensor · ± 90° · Analogue output · 4...20 mA · Cable with connector	3	<b>EC2082</b>
	Tilt sensor · free from mercury · semi-conductor output · 10...30 V DC · Cable	4	<b>EC2061</b>

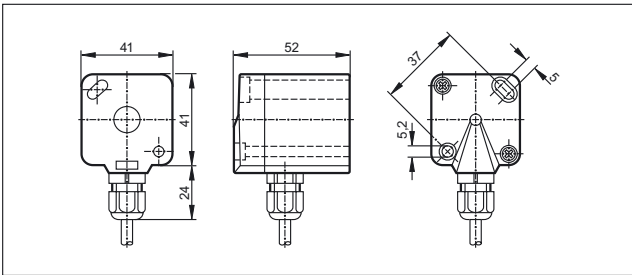
Scale drawings / drawing no. – CAD download: [www.ifm.com](http://www.ifm.com)



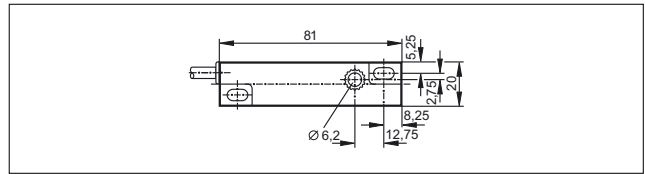
Product selectors and further information can be found at: [www.ifm.com](http://www.ifm.com)

Scale drawings / drawing no. – CAD download: [www.ifm.com](http://www.ifm.com)

3



4





# Versatile pulse evaluation systems



## Pulse evaluation systems



### Easy parameter setting

Primary voltage 24V DC or 110 / 230V AC, wide-range input

Programmable switching characteristics

Standstill, overspeed, direction, slip and frequency conversion, counter

Switching relays and transistor outputs, scalable analogue output

PLe

Vibration and shock resistant



Broad measurement dynamics

OLED

Display

UL US LISTED

### Evaluation systems

Although PLC applications in industrial automation are becoming more and more versatile, there are still numerous processes which require decentralised monitoring.

#### For this purpose, ifm offers various pulse evaluation systems:

- speed monitors
- standstill monitor
- slip / synchronous monitors
- direction monitor
- frequency-to-current converter
- threshold relay
- displays with frequency and analogue input
- counter
- processing of analogue standard signals

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## Sensors for motion control

### Universal speed monitors

Type	U <sub>b</sub> [V]	In-puts	Input function	Setting range [puls. / min.]	Setting range [Hz]	Out-puts analogue	Out-puts relays	Out-puts transist.	Draw-ing no.	Order no.
------	-----------------------	---------	----------------	---------------------------------	-----------------------	-------------------	-----------------	--------------------	--------------	-----------


#### FR-1 · 2 switch points for monitoring overspeed/underspeed and acceptable range

	110...240 AC (50...60 Hz)/ 27 DC (typ. 24 DC)	1	PNP / NPN / Namur	1...60000	0.1...1000	1	2	2	1	DD2503
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### Universal speed monitors with sensor wire monitoring

Type	U <sub>b</sub> [V]	In-puts	Input function	Setting range [puls. / min.]	Setting range [Hz]	Out-puts analogue	Out-puts relays	Out-puts transist.	Draw-ing no.	Order no.
------	-----------------------	---------	----------------	---------------------------------	-----------------------	-------------------	-----------------	--------------------	--------------	-----------


#### FR-1N · 2 switch points for monitoring overspeed/underspeed and acceptable range

	110...240 AC (50...60 Hz)/ 27 DC (typ. 24 DC)	1	Namur 8.2 V	1...60000	0.1...1000	1	2	4	1	DD2603
---	--	---	-------------	-----------	------------	---	---	---	---	--------

### Dual speed monitors

Type	U <sub>b</sub> [V]	In-puts	Input function	Setting range [puls. / min.]	Setting range [Hz]	Out-puts analogue	Out-puts relays	Out-puts transist.	Draw-ing no.	Order no.
------	-----------------------	---------	----------------	---------------------------------	-----------------------	-------------------	-----------------	--------------------	--------------	-----------


#### FR-2 · 1 switch point each for monitoring overspeed/underspeed and acceptable range

	110...240 AC (50...60 Hz)/ 27 DC (typ. 24 DC)	2	PNP / NPN / Namur	1...60000	0.1...1000	–	2	2	1	DD2505
---	--	---	-------------------	-----------	------------	---	---	---	---	--------

### Dual speed monitors with sensor wire monitoring

Type	U <sub>b</sub> [V]	In-puts	Input function	Setting range [puls. / min.]	Setting range [Hz]	Out-puts analogue	Out-puts relays	Out-puts transist.	Draw-ing no.	Order no.
------	-----------------------	---------	----------------	---------------------------------	-----------------------	-------------------	-----------------	--------------------	--------------	-----------


#### FR-2N · 1 switch point each for monitoring overspeed/underspeed and acceptable range

	110...240 AC (50...60 Hz)/ 27 DC (typ. 24 DC)	2	Namur 8.2 V	1...60000	0.1...1000	–	2	4	1	DD2605
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### Standard speed monitors / standstill monitor

Type	U <sub>b</sub> [V]	In-puts	Input function	Setting range [puls. / min.]	Setting range [Hz]	Out-puts analogue	Out-puts relays	Out-puts transist.	Draw-ing no.	Order no.
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#### D200 · evaluation of pulse sequences with regard to overspeed and underspeed; rotational speed monitoring

	110...240 AC / 27 (24) DC	1	PNP	0.1...10 / 10...1000	–	–	1	–	2	DD0203
	110...240 AC / 27 (24) DC	1	PNP	0.2...20 / 20...2000	–	–	1	–	2	DD0296

### Level monitoring relays

Type	U <sub>b</sub> [V]	In-puts	Input function	Setting range [puls. / min.]	Setting range [Hz]	Out-puts analogue	Out-puts relays	Out-puts transist.	Draw-ing no.	Order no.
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#### L200 · protection of a tank against overflow or running dry

	110...240 AC / 27 (24) DC	1	PNP	–	–	–	1	–	3	DL0201
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### Level control relays

Type	U <sub>b</sub> [V]	In-puts	Input function	Setting range [puls. / min.]	Setting range [Hz]	Out-puts analogue	Out-puts relays	Out-puts transist.	Draw-ing no.	Order no.
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#### L200 · two point level control

	110...240 AC / 27 (24) DC	1	PNP	–	–	–	1	–	4	DL0203
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### Slip monitors

Type	U <sub>b</sub> [V]	In-puts	Input function	Setting range	Out-puts relays	Out-puts transist.	Draw-ing no.	Order no.
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#### FS-1 · 1 switching output for slip monitoring; 1 switching output for overspeed/underspeed and acceptable range

	110...240 AC (50...60 Hz) / 27 DC (typ. 24 DC)	1	PNP / NPN / Namur	slip: 0.1...99.9 % rotational speed (frequency): 1...60000 pulses/min (0.1...1000)	2	2	1	DS2503
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## Sensors for motion control

### Slip monitors with sensor wire monitoring

Type	U <sub>b</sub> [V]	In-puts	Input function	Setting range	Out-puts relays	Out-puts transist.	Draw-ing no.	Order no.
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#### FS-1N · 1 switching output for slip monitoring; 1 switching output for overspeed/underspeed and acceptable range

	110...240 AC (50...60 Hz)/ 27 DC (typ. 24 DC)	1	Namur 8.2 V	slip: 0.1...99.9 % rotational speed (frequency): 1...60000 pulses/min (0.1...1000)	2	2	1	DS2603
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### Slip / synchronous monitors

Type	U <sub>b</sub> [V]	In-puts	Input function	Setting range	Out-puts relays	Out-puts transist.	Draw-ing no.	Order no.
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#### FS-2 · 2 switch points for slip/synchronous monitoring

	110...240 AC (50...60 Hz)/ 27 DC (typ. 24 DC)	1	PNP / NPN / Namur	pulse differences: 1...999 reset time: 0.0...1000.0 s	2	2	1	DS2505
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#### FS-3 · 2 switch points for synchronous monitoring

	110...240 AC (50...60 Hz)/ 27 DC (typ. 24 DC)	1	PNP / NPN / Namur	pulse differences: 1...999 hysteresis: 1...999	2	2	1	DS2506
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### Slip / synchronous monitors with sensor wire monitoring

Type	U <sub>b</sub> [V]	In-puts	Input function	Setting range	Out-puts relays	Out-puts transist.	Draw-ing no.	Order no.
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#### FS-2N · 2 switch points for slip/synchronous monitoring

	110...240 AC (50...60 Hz)/ 27 DC (typ. 24 DC)	1	Namur 8.2 V	pulse differences: 1...999 reset time: 0.0...1000.0 s	2	2	1	DS2605
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### Combined direction and speed monitors

Type	U <sub>b</sub> [V]	In-puts	Input function	Setting range	Out-puts relays	Out-puts transist.	Draw-ing no.	Order no.
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#### FD-1 · 1 switching output for indication of direction; 1 switching output for overspeed/underspeed and acceptable range

	110...240 AC (50...60 Hz)/ 27 DC (typ. 24 DC)	1	PNP / NPN / Namur	cycle time: 0.0...1000 s rotational speed (frequency): 1...60000 pulses/min (1...1000)	2	2	1	DR2503
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#### FD-2 · 2 switching outputs for separate indication of direction; adjustable reset times for standstill monitoring

	110...240 AC (50...60 Hz)/ 27 DC (typ. 24 DC)	1	PNP / NPN / Namur	reset time: 0.0...1000 s	2	2	1	DR2505
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### Frequency-to-current converters

Type	U <sub>b</sub> [V]	In-puts	Input function	Setting range [puls. / min.]	Setting range [Hz]	Out-puts analogue	Out-puts relays	Out-puts transist.	Draw-ing no.	Order no.
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#### FA-1 · Conversion of pulse sequences into analogue standard signals

	110...240 AC (50...60 Hz)/ 27 DC (typ. 24 DC)	1	PNP / NPN / Namur	0...600000	0...10000	2	1	1	1	DW2503
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### 2-channel threshold relay for analogue standard signals

Type	U <sub>b</sub> [V]	In-puts	Input function	Setting range [puls. / min.]	Setting range [Hz]	Out-puts analogue	Out-puts relays	Out-puts transist.	Draw-ing no.	Order no.
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#### AL-3 · 2-channel analogue threshold relay for analogue standard signals

	110...240 AC (50...60 Hz)/ 27 DC (typ. 24 DC)	2	2 x 0/4...20 mA	–	–	1	1	1	1	DL2503
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### Safety standstill monitors, SIL 3, PL e

Type	U <sub>b</sub> [V]	In-puts	Input function	Setting range [puls. / min.]	Setting range [Hz]	Out-puts analogue	Out-puts relays	Out-puts transist.	Draw-ing no.	Order no.
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#### Monitoring rotational or linear movements for minimum switch point not reached (standstill)

	24 DC	1	PNP	–	0.2 / 0.5 / 1.0 / 2.0	–	2	1	5	DA102S
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### Safety speed monitor, SIL 3, PL e

Type	U <sub>b</sub> [V]	In-puts	Input function	Setting range [puls. / min.]	Setting range [Hz]	Out-puts analogue	Out-puts relays	Out-puts transist.	Draw-ing no.	Order no.
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#### Monitoring of rotational or linear movements for adherence to a maximum setpoint (overspeed)

	24 DC	1	PNP	–	-40...70	–	2	1	6	DD110S
	24 DC	1	PNP	–	-40...70	–	2	1	6	DD111S





#### Monitoring of rotational or linear movements for underspeed (minimum switch point not reached)

	24 DC	1	PNP	–	-40...70	–	2	1	6	DU110S
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## Sensors for motion control


### Multifunctional displays for digital signals / frequency input

Type	Inputs / outputs	Description	Drawing no.	Order no.
<b>AX460 · universal unit for displaying and monitoring analogue signals (e.g. pressure sensors, temperature sensors or flow sensors)</b>				
	2 x analogue in	Digital display · Multi-functional display and evaluation system · for analogue standard signals · Ambient temperature -20...60 °C · screw terminals · Operating voltage 115...230 AC (50...60 Hz) / 18...30 V DC · IP 65	7	<b>DX2041</b>
	2 x analogue in 4 x digital out	Digital display · Multi-functional display and evaluation system · for analogue standard signals · Ambient temperature -20...60 °C · screw terminals · Operating voltage 115...230 AC (50...60 Hz) / 18...30 V DC · IP 65	7	<b>DX2042</b>
	2 x analogue in	Digital display · Multi-functional display and evaluation system · for analogue standard signals · Ambient temperature -20...60 °C · screw terminals · Operating voltage 18...30 V DC · IP 65	7	<b>DX2051</b>
	2 x analogue in 4 x digital out	Digital display · Multi-functional display and evaluation system · for analogue standard signals · Ambient temperature -20...60 °C · screw terminals · Operating voltage 18...30 V DC · IP 65	7	<b>DX2052</b>

### Multifunctional displays for analogue standard signals


Type	Inputs / outputs	Description	Drawing no.	Order no.
<b>FX460 · universal evaluation and display for all physical units which can be derived from pulse sequences</b>				
	–	Digital display · Multi-functional display and evaluation system · Can be used for example as: · frequency meter/tachometer · processing time/baking time display · industrial timer · position and event counter · display of speed measured from elapsed time · Ambient temperature -20...60 °C · screw terminals · Operating voltage 115...230 AC (50...60 Hz) / 18...30 V DC · IP 65	7	<b>DX2021</b>
	–	Digital display · Multi-functional display and evaluation system · Can be used for example as: · frequency meter/tachometer · processing time/baking time display · industrial timer · position and event counter · display of speed measured from elapsed time · Analogue output · Ambient temperature -20...60 °C · screw terminals · Operating voltage 115...230 AC (50...60 Hz) / 18...30 V DC · IP 65	7	<b>DX2022</b>
	–	Digital display · Multi-functional display and evaluation system · Can be used for example as: · frequency meter/tachometer · processing time/baking time display · industrial timer · position and event counter · display of speed measured from elapsed time · Ambient temperature -20...60 °C · screw terminals · Operating voltage 115...230 AC (50...60 Hz) / 18...30 V DC · IP 65	7	<b>DX2023</b>
	–	Digital display · Multi-functional display and evaluation system · Can be used for example as: · frequency meter/tachometer · processing time/baking time display · industrial timer · position and event counter · display of speed measured from elapsed time · Ambient temperature -20...60 °C · screw terminals · Operating voltage 18...30 V DC · IP 65	7	<b>DX2031</b>
	–	Digital display · Multi-functional display and evaluation system · Can be used for example as: · frequency meter/tachometer · processing time/baking time display · industrial timer · position and event counter · display of speed measured from elapsed time · Analogue output · Ambient temperature -20...60 °C · screw terminals · Operating voltage 18...30 V DC · IP 65	7	<b>DX2032</b>
	–	Digital display · Multi-functional display and evaluation system · Can be used for example as: · frequency meter/tachometer · processing time/baking time display · industrial timer · position and event counter · display of speed measured from elapsed time · Ambient temperature -20...60 °C · screw terminals · Operating voltage 18...30 V DC · IP 65	7	<b>DX2033</b>

### Decentralised display, preprocessing and conversion of 4...20 mA analogue signals

	normally open / closed programmable	Threshold display · 4...20 mA analogue input · transistor output · IO-Link interface · 4-digit alphanumeric display / alternating indication of red and green · Conversion of analogue measured values to an IO-Link communication · Analogue input 4...20 mA · Ambient temperature -25...60 °C · Operating voltage 18...30 V DC · IP 67	8	<b>DP2200</b>
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Type	Inputs / outputs	Description	Drawing no.	Order no.
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scalable display for sensors with analogue output (e.g. pressure sensors, flow sensors)

	-	LC display · LCD 3½ digits; 15 mm high · Supply from the current loop · Input 4...20 mA · Ambient temperature 0...60 °C · terminals up to 2.5 mm <sup>2</sup> · IP 65	9	E89150
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Universal counters



Type	U <sub>b</sub> [V]	In-puts	Input function	Setting range	Out-puts relays	Out-puts transist.	Drawing no.	Order no.
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preset counter with 2 presets

	90...260 AC	1	PNP / NPN	-	2	-	10	E89005
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Accessories pulse divider / pulse stretcher

Type	Description	Drawing no.	Order no.
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	Pulse divider · Ratio input/output pulse 10:1 · Housing for DIN rail mounting · Terminals · Housing materials: plastics	11	E80100
	Pulse stretcher · Pulse length · IN (min): > 0.2 ms / OUT: 25 ms · Housing for DIN rail mounting · Terminals · Housing materials: plastics	11	E80110
	Pulse divider · Division 1...255	12	E80102




Accessories

Type	Description	Order no.
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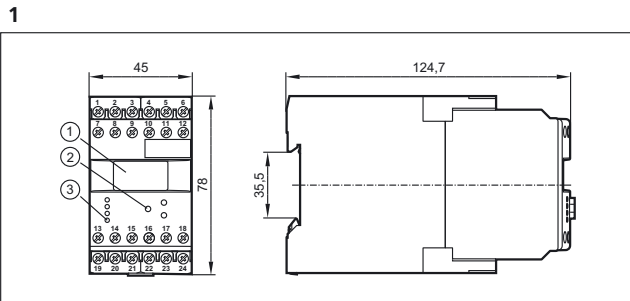
	Angle bracket · for type M18 · Housing materials: stainless steel	E10736
	Angle bracket · for type M30 · Housing materials: stainless steel	E10737
	Mounting clamp · Ø 20 mm - Ø 18 mm · with reducing bush · for type M18 · Housing materials: PBT	E10076
	Mounting clamp · Ø 34 mm - Ø 30 mm · with reducing bush · for type M30 · Housing materials: PBT	E10077



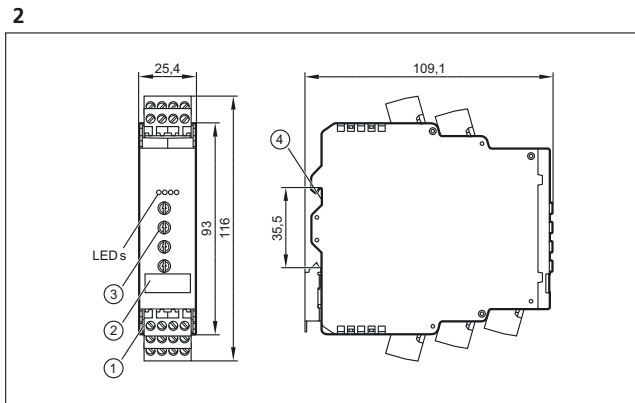
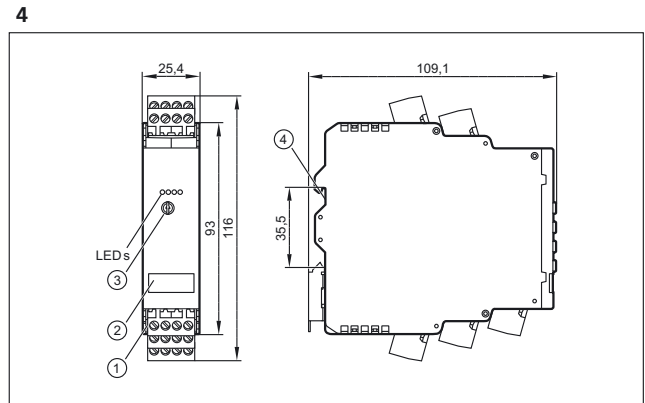
## Sensors for motion control

Type	Description	Order no.
	mounting clip · Housing materials: 2.1247	<b>E89208</b>
	Target wheel · Plastic disk with 8 screws as "target" · Centered drill holes	<b>E89010</b>
	Target for pulse pickups · Strap dimensions 7 x 145 mm	<b>E89013</b>

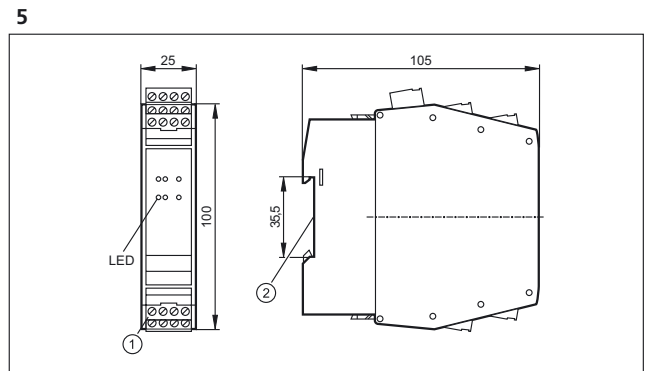
Scale drawings / drawing no. – CAD download: [www.ifm.com](http://www.ifm.com)



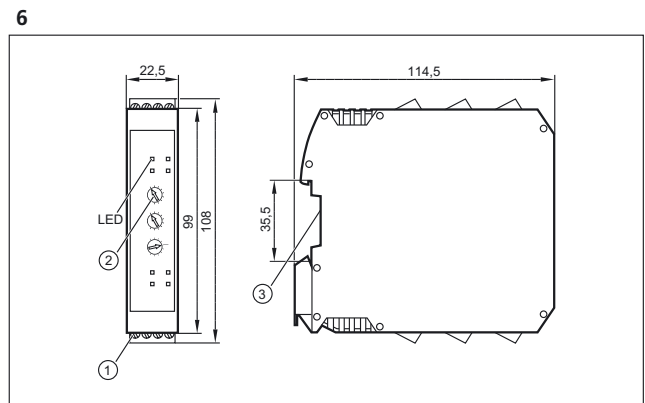
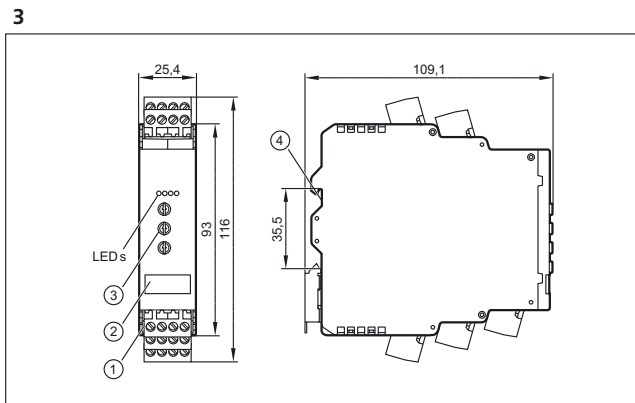
1: OLED display, 2: Programming buttons, 3: LEDs



1: plug-in screw terminals, 2: label, 3: potentiometer, 4: Mounting on DIN rail



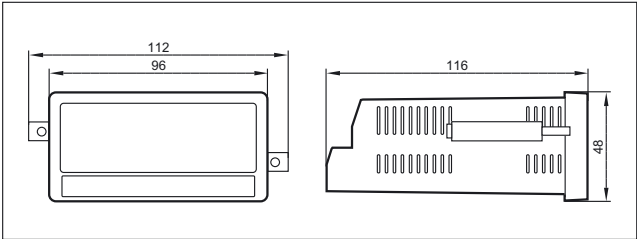
1: Combicon connector with screw terminals, 2: Mounting on DIN rail



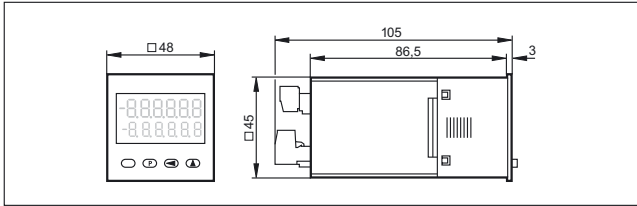
1: screw terminals, 2: Rotary switch, 3: Mounting on DIN rail

Scale drawings / drawing no. – CAD download: [www.ifm.com](http://www.ifm.com)

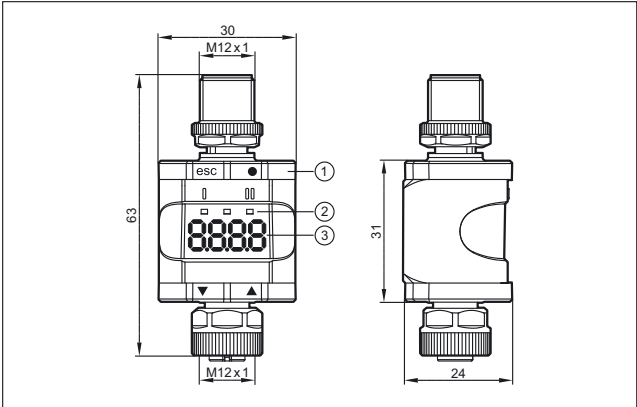
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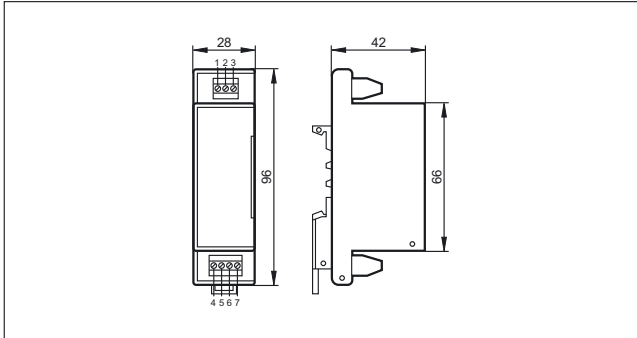


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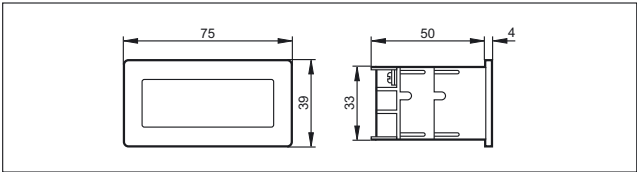


1: Push ring, 2: LEDs, 3: Display

11



9



control panel cutout: 68 x 33 mm (according to DIN)

12

