Inductive Sensors

Accessories for inductive sensors

We offer special accessories for our inductive sensors.
With products optimally suited to each other. Alongside switching devices, there are also assembly aids and protective equipment for the most varied inductive sensors.

Accessories for Inductive Sensors
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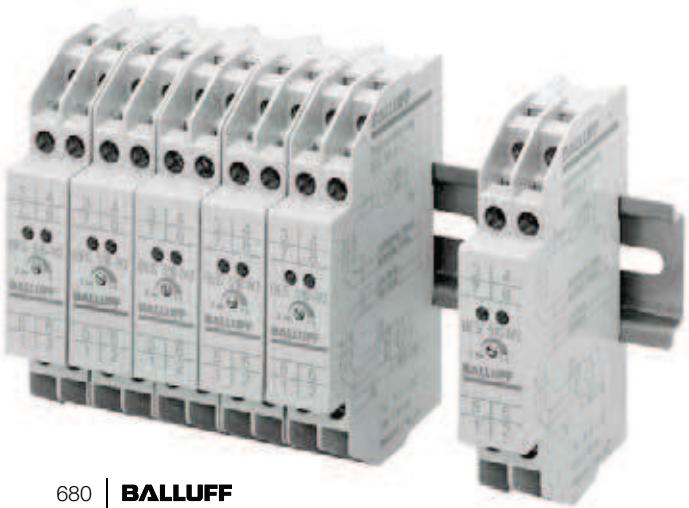
Basic information and definitions can be found on **page 884.**

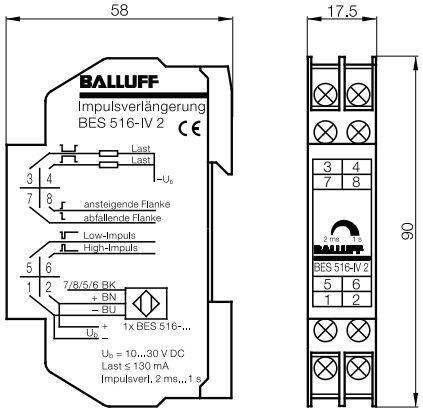
Pulse stretching

Detecting fast motion
Rapid motions on machines mean that the sensors are only actuated for a short time. Therefore, the sensor pulse can be too short to guarantee a secure evaluation. Due to its cycle time, the controller does not detect the output signal, with the consequence that important information in the controller sequence is lost. This can pose a risk to your machine!

The solution is the Balluff pulse extender **BES 516-IV 2**.
For controlling this device, the rising or falling edge of the sensor output signal is sufficient to generate a pulse that your controller can recognize. The length is adjustable from 2 ms to 1 sec. Small and space-saving, the device can be snapped onto a rail in accordance with EN 50022-35.

Description		**Pulse stretching**
Use		Ensures secure output signals from inductive, capacitive or optoelectronic sensors to the controller
Ordering code		**BAE0073**
Part number		BES 516-IV 2
Output (display by LEDs)		Positive-switching (PNP), complementary
Adjustable pulse stretching		2 ms...1 s
Set value		200 ms (+50 ms)
Input 7/8		Referenced to the respective edge of the input signal
Input 5/6		Referenced to the pulse end of the input signal
Repeatability		< 10 %
Input		1 PNP or 1 NPN - NO or NC
Min. input pulse length		1.5 ms
Supply voltage U_S		10...30 V DC (input voltage = output voltage)
Residual ripple		≤ 15 %
No-load current		Approx. 20 mA
Output current		≤ 130 mA
Permissible load capacity		≤ 0.5 µF/24 V
Ambient temperature T_a		0...60 °C
Housing attachment		DIN rail EN 50022-35
Max. conductor cross-section		2×2.5 mm²
Polarity reversal protected		Yes
Short-circuit protected		Yes
Degree of protection as per IEC 60529		Housing IP 40/terminals IP 20
Output	3	Low-pulse, extended
	4	High-pulse, extended
Input	7	Falling edge
	8	Rising edge
	5	Low pulse
	6	High pulse
	1	$-U_S$
	2	$+U_S$
Falling edge		Output signal is triggered by rising edge
Rising edge		Output signal is triggered by rising edge
Low pulse		PNP-NC/NPN-NO short damped PNP-NO/NPN-NC short undamped
High pulse		PNP-NC/NPN-NO short damped PNP-NO/NPN-NC short undamped





Accessories for Inductive Sensors
Function diagnostics unit

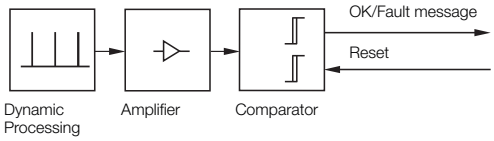
The **BES 113-FD-1** function diagnostics unit monitors a proximity switch with dynamic function diagnostics and its cable. A logic circuit polls the sensor signals for the presence of test pulses and also monitors for proper function of the device. For the machine control system, it emits a high level signal on the "Status/Output" message output when there is no fault and a low signal when faults are present. LEDs indicate the switching state of the sensor.

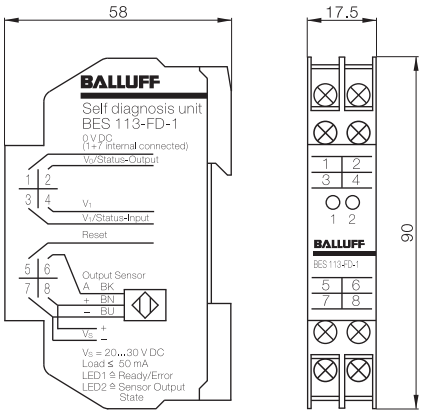
Faults that occur are stored by the device. They must be reset using a reset function (low signal on 5).

If the BES 113-FD-1 is used as a single unit, terminals VI (3 and 4) must be bridged together.

Description		**Function diagnostics unit** with electronic output
Use		Monitoring the dynamic function diagnostics and connection cable for function diagnostics sensors BES 113-356-SA 6-..., BES 113-3019-SA 1-..
Ordering code		**BAE006W**
Part number		BES 113-FD-1
Supply voltage U_S		20...30 V DC
No-load current		Approx. 20 mA
Output voltage U_0	Low	0...(0.1×U_S) when the sensor or diagnostics unit has a fault)
(referenced to 0 V)	High	(0.5×U_S)...U_S when functioning properly
Output current max.		50 mA
Ambient temperature T_a		0...+60 °C
LED 1 green		"Ready/Error" – when functioning properly, the LED is on bright. When there is a fault, the LED illuminates dimly.
LED 2 yellow		"Sensor Output State" indicates the switching state of the sensor.
Degree of protection as per IEC 60529		Housing IP 40, terminals IP 20
Housing attachment		Rail mount according to DIN EN 50022-35
Conductor cross-section max.		2×2.5 mm²

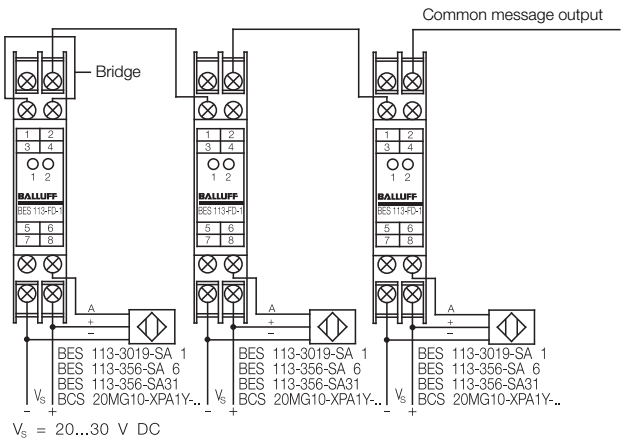
Function principle





Cascading

When cascading several BES 113-FD-1 (series connection), the output (2) must be connected to the input (3) of the downstream device. The jumper between VI is not needed except for the first device. When there is a malfunction, the message appears on the last device. The defective sensor is indicated by the first weakly illuminated LED
in the cascade.
Small and space-saving, the BES 113-FD-1 can be mounted in a DIN rail according to DIN EN 50022-35.



Sensor tester, testing and setting device

Tester BES 516-7

The sensor tester BES 516-7, in the Balluff design, is flat, handy, and visually appealing. The testing device is a simple manual testing device for PNP/NPN, normally open and normally closed sensors.

Benefits

- Integrated steel measuring plate for testing sensors
- Automatic shut-off after 30 s of non-use
- Power provided by a 9V battery
- Visual and acoustic signal

Note

Tester is not suitable for 2-wire and Desina sensors

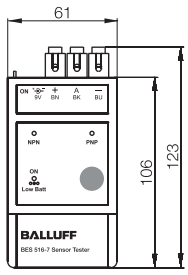
Testing and setting device BES 516-4

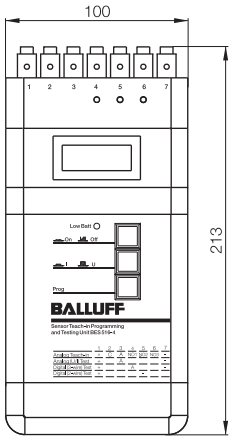
With this programming device, the following testing and setting functions can be carried out on the sensors:

- Programming the switching distance of analog sensors.
- Sensors with teachable switching points can also be programmed.
- Testing 3-wire sensors.
- Testing 2-wire sensors.

Sensor tester, testing and setting device

Description	Sensor tester	Testing and setting device
Use	For DC PNP/NPN 3-wire sensors	For DC PNP/NPN 2/3-wire sensors and analog sensors
Ordering code	**BAE002C**	**BAE0029**
Part number	BES 516-7	BES 516-4
Output voltage	18 V DC	18 V DC
LED indicators	1 operating indicator	3 function indicators, 1 operating indicator
Battery type	1× 9 V battery	2× 9 V batteries
Sensor connection	3 spring-loaded terminals	7 spring-loaded terminals
Degree of protection as per IEC 60529	IP 40	IP 40
Housing material	Plastic	Plastic
	Acoustic and visual signal, built-in steel measuring plate	





Inductive sensors
Global DC 3-wire
DC 3-/4-wire
DC 2-wire
AC/DC 2-wire
AC 2-wire
Special properties
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Accessories
Pulse Extension
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Clamping holder overview

Analog switching device for onsite assembly for inductive distance sensors BAW

Analog switching device for onsite assembly

This switching device allows you to easily program sensors which have an analog output signal, such as the BOD family, with three switching thresholds, onsite.

In this, the sensor connected to the switching device is brought into the desired switching distance from the object. Then connecting the control line to the (+) side of the supply voltage enables a "Teach-in" mode; in other words, the set distance is assigned to the signal level present and these values are stored in the evaluation device. This procedure is supported with LEDs. During operation, these LEDs are available as switching state indicators.

For sensors with a temperature output, the analog temperature signal is made available in unchanged form on the device output.

Size		**M18×1**
Use		For analog sensors
PNP analog and PNP NO	**Ordering code**	**BAE0070**
	Part number	BES 516-615-PS-1-PU-05
PNP analog and NPN NO	**Ordering code**	**BAE006Z**
	Part number	BES 516-615-NS-1-PU-05
Rated operating voltage U_e		15...30 V DC
Supply voltage U_S		15...30 V DC
Residual ripple		≤ 15% of U_e
Rated insulation voltage U_i		75 V DC
Rated operating current I_e per output		100 mA
No-load supply current I_0 max.		≤ 20 mA
Residual current I_r		≤ 10 µA
Polarity reversal protected		Only against ±-reversal
Short-circuit protected		Yes
Ambient temperature T_a		–10...+70 °C
Switching frequency f		2 kHz
Utilization category		DC 13
Function indicator for each output		Yes
Analog input		
Input voltage U_{in}		0...10 V (implemented to output A)
Input impedance		4.2 kΩ
Switching outputs		
Freely programmable switching outputs		3
Hysteresis H		500 mV
Temperature drift		≤ 2 % of U_{in} max.
Degree of protection as per IEC 60529		IP 67
Housing material		CuZn coated
Connection	Input	M12 connector, 5-pin
	Output	5 m PUR cable, 7×0.25 mm²

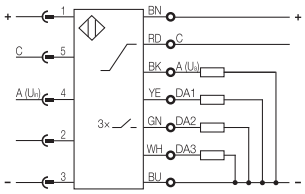
Connection example

Analog sensors — **Analog switching amplifier**

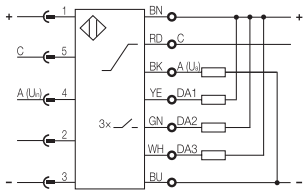
e.g. BOD... — BES 516-615-PS-1-PU-05

Wiring diagrams

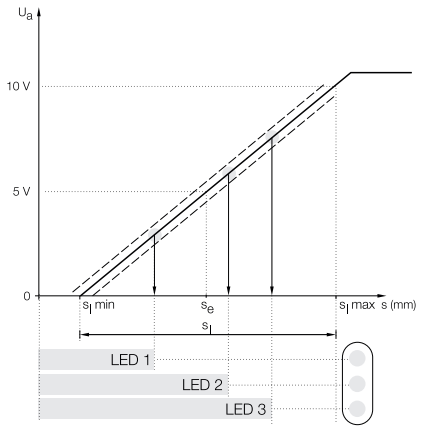
PNP analog and PNP normally open

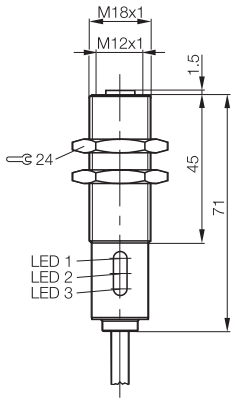


PNP analog and NPN normally open



Approach curve





Analog switching device for control cabinet installation for inductive distance sensors BAW

Analog switching device for control cabinet installation

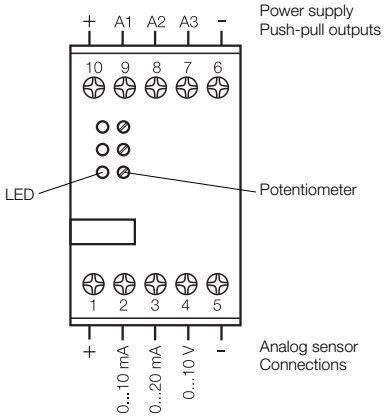
The analog switching device is operated with 24 V and provides the supply voltage for analog sensors such as the Balluff BOD. The device is controlled directly by the current signals (2) or voltage signals (4).

From this signal, separate push-pull final stages (PNP/NPN) are used to create three switch points (A1...A3) which can be set independently using the potentiometer (on the front side). The respective switching state is indicated by LEDs. The operating direction (rising/falling) can be set using DIP switches inside the unit. This circuit allows width-adjustable "ranges" to be defined (cascading).

The voltage signal (4) proportional to the current can be used to drive additional analog switching devices (expansion for additional switching points).

The signal inputs on the analog switching device are protected against polarity reversal and the push-pull output stages against short circuit (internal fuses).

Description	**Analog switching amplifier** for analog current and voltage signals
Use	Switching point setting on analog sensors, e.g. BOD, BAW
Ordering code	**BAE006Y**
Part number	BES 516-611-A-1
Supply voltage U_S	24 V DC ±10 %
Residual ripple	≤ 10 %
Input circuit	
Current input, terminal 2/3	0...10 mA/0...20 mA
Input resistance	308 Ω/154 Ω
Voltage input terminal 4	0...10 V
Input resistance	13 kΩ
Setting range	3...100 %
Hysteresis (referenced to set value)	3 %
Output current circuit	
Voltage drop PNP-transistor	≤ 3.5 V
Voltage drop NPN-transistor	≤ 2.5 V
Operating current per push-pull stage	≤ 200 mA
Housing material	PC (glass fiber reinforced)
Housing dimensions	74×45×120 mm
Connection type	Screw terminals
max. conductor cross-section	Up to 2.5 mm²
Housing attachment	Snap-mount on DIN rail
Ambient temperature T_a	0...+50 °C
Degree of protection as per IEC 60529	Terminals IP 20, housing IP 40



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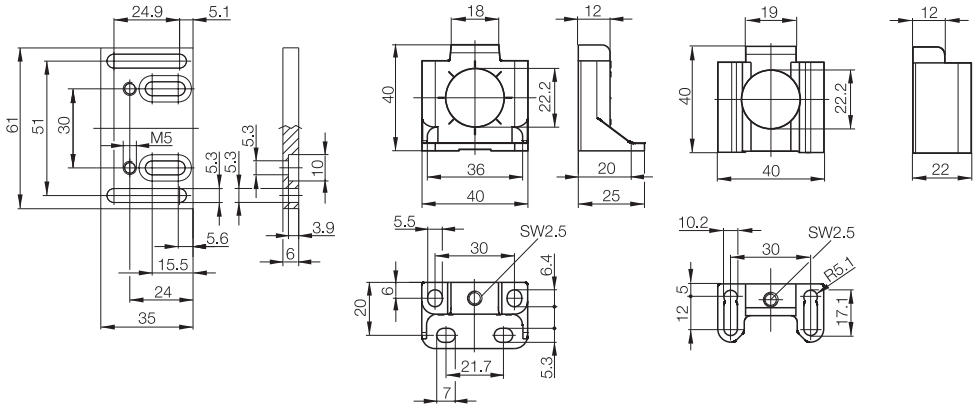
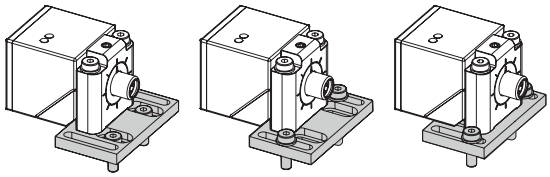
Assembly aids for Unicompact sensors

Description	Unicompact mounting bracket	Unicompact mounting base	Unicompact mounting base
Use	for BES Q40KFU-... Unicompact sensors (40×40 mm)	for BES Q40KFU-... Unicompact sensors (40×40 mm)	for BES Q40KFU-... Unicompact sensors (40×40 mm)
Ordering code	**BAM00JW**	**BAM00JY**	**BAM00JZ**
Part number	BES Q40-HW-1	BES Q40-HW-2	BES Q40-HW-3
Material	Anodized aluminum	Anodized aluminum	Anodized aluminum

Please note permissible installation options!



3 different mounting options

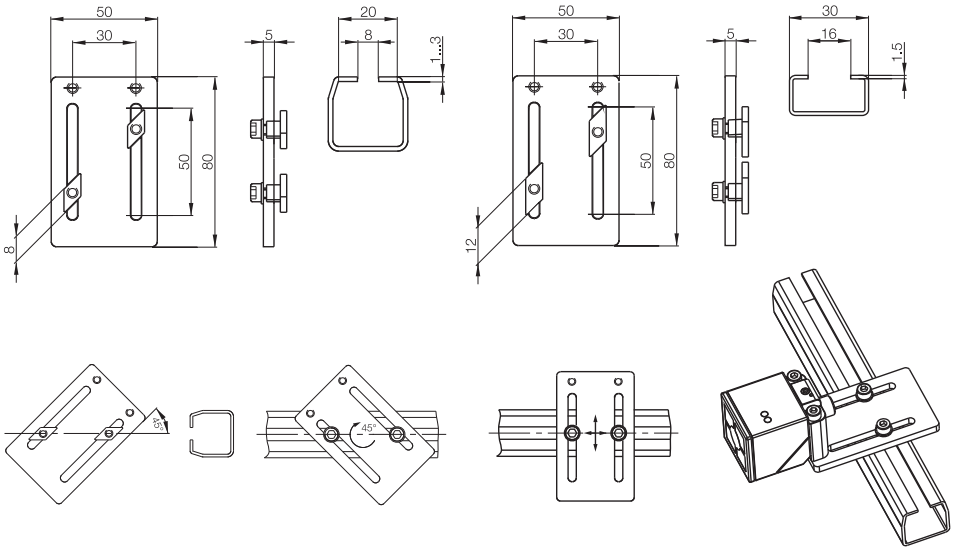


Assembly aids for Unicompact sensors

Description	**Unicompact holding system**	**Unicompact holding system**
Use	Unicompact sensors for fastening to profile rails (groove width: 8 mm)	Unicompact sensors for fastening to profile rails (groove width: 16 mm)
Ordering code	**BAM00JU**	**BAM00JT**
Part number	BES HS-01-P1-C8/Q40	BES HS-01-P1-C16/Q40
Material	Al anodized, CuZn	Al anodized, CuZn

The fastener set consists of:

- 1 mounting plate
- 2 slot nuts
- 2 cheese head screws M5×10 DIN 912
- 2 washers Ø 5.3, DIN 533
- 2 cheese head screws M5×40, ISO 4762



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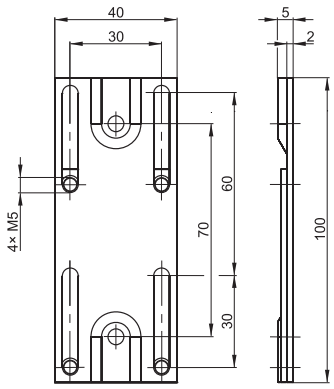
Assembly aid for Uni sensors and Unicompact sensors

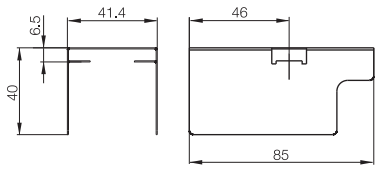
Description	**Mounting plate - Unisensor and Unicompact**
Use	For Unisensor and Unicompact sensors (40×40 mm)
Ordering code	
Part number	Montageplatte B 4 - 2057
Material	Anodized aluminum

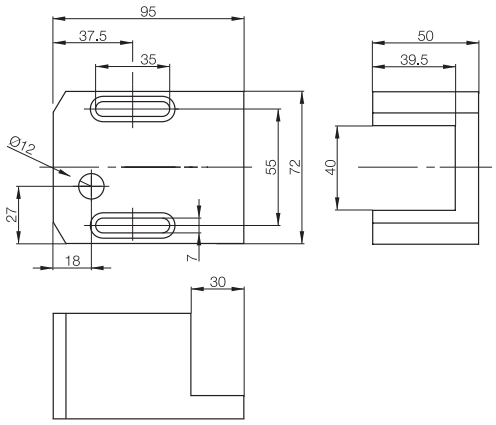


Uni sensors can be moved on this assembly plate in a wired state up to 30 mm. Loosening the sensor mounting screws (M5×25; included in scope of delivery) allows the sensor to be easily repositioned at the desired location. Tighten screws!

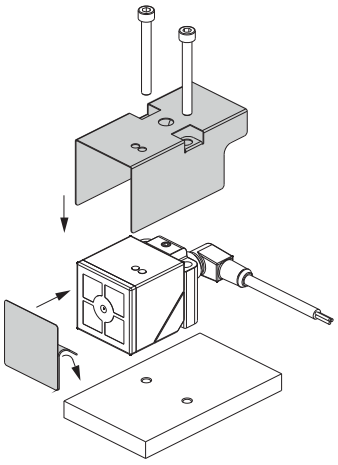
Protective coverings for Unicompact sensors

Description	Weld protection - Unicompact	Protective cover - Unicompact
Use	For BES Q40KFU-... magnetic field resistant Unicompact sensors (40×40 mm)	for BES Q40KFU-... Unicompact sensors (40×40 mm)
Ordering code	**BAM00K0**	**BAM00K1**
Part number	BES Q40-SH-1	BES Q40-SH-2
Material	Anodized aluminum	PA 6





The weld protection consists of a protective cover and a self-adhering PTFE film for protecting the active surface. If the sensor head is replaced, the welding protection must not be removed.



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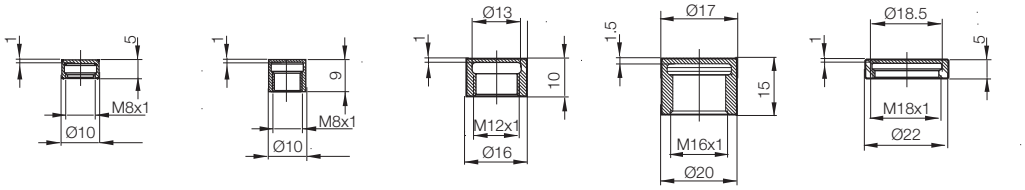
Protective nuts

Description	Cover nut	Cover nut	Cover nut	Cover nut	Cover nut	
Use	For M8 sensors	For M8 sensors	For M12 sensors	For M16 sensors	For M18 sensors	
Ordering code	**BAM009Z**	**BAM00A0**	**BAM00C2**	**BAM00EP**	**BAM00EZ**	
Part number	BES 08-SM-1	BES 08-SM-1F	BES 12-SM-2	BES 16-SM-2	BES 18-SM-1	
Reduction of the rated switching distance	1 mm	1 mm	1 mm	1.5 mm	1 mm	
Material	PTFE	PTFE	POM	PTFE	PTFE	



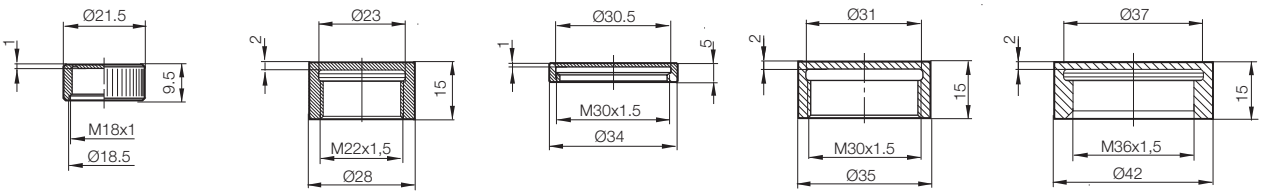
These protective nuts are screwed onto sensors. They are made of PTFE or POM and are used when there is increased mechanical stress.

The protective nuts are also used to protect the sensing surface from weld splatter. They can also be used at high temperatures and are particularly resistant against chemical influences.

Material	POM	PTFE
Ambient temperature T_a	–20...+90 °C	–20...+100 °C

Please note!
The rated switching distance of sensors is reduced to the wall thickness of the nut when the protective nut is installed.

	Cover nut	**Cover nut**	**Cover nut**	**Cover nut**	**Cover nut**
	For M18 sensors	For M18 sensors	For M30 sensors	For M30 sensors	For M36 sensors
	BAM00F0	**BAM00H8**	**BAM00HJ**	**BAM00HK**	**BAM00JL**
	BES 18-SM-2	BES 22-SM-2	BES 30-SM-1	BES 30-SM-2	BES 36-SM-2
	1 mm	2 mm	1 mm	2 mm	2 mm
	POM	PTFE	POM	POM	POM



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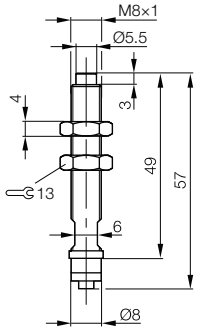
Positive stop

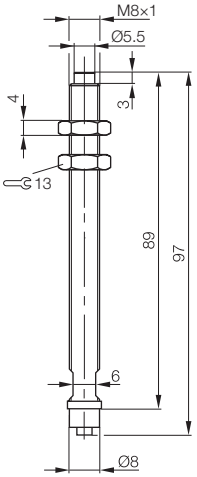
Positive stops for sensors with diameters of 4 mm or 8 mm
A positive stop that is combined with the corresponding mounting cuff can be added to inductive sensors with housing Ø 4 mm or Ø 8 mm. The desired switching point between the proximity switch and the trigger pin can be set wherever needed.

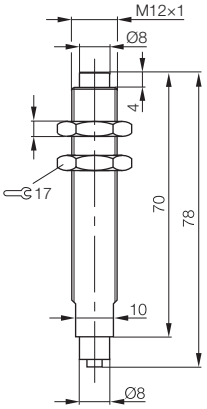
Description	**Positive stop**	
Use	For inductive sensors for mechanical protection	
Ordering code	**BAM009L**	
Part number	BES 08-FA-49	
Ordering code		
Part number		
Temperature resistance	–25...+100 °C	
Spring force	3 N	
Impact force $F^{max.}$ (N)	100	
Spring deflection	2 mm	
Permissible torque	15 Nm	
Material	Stainless steel	

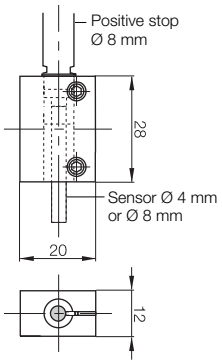


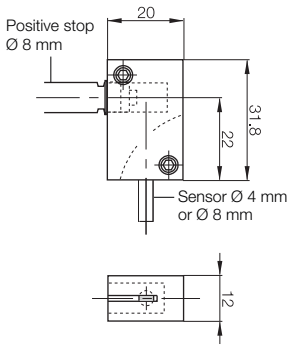
Positive stop, mounting cuff for positive stop

	Positive stop	Positive stop	Mounting cuff - straight for positive stop	Mounting cuff - angled for positive stop
	For inductive sensors for mechanical protection	For inductive sensors for mechanical protection	For sensors with Ø 4 mm or Ø 8 mm	For sensors with Ø 4 mm or Ø 8 mm
	BAM009M	**BAM00AZ**	**BAM009N**	**BAM009P**
	BES 08-FA-89	BES 12-FA-70	BES 08-FA-BS-**4.0**-G	BES 08-FA-BS-**4.0**-W
			BAM009R	**BAM009T**
			BES 08-FA-BS-**8.0**-G	BES 08-FA-BS-**8.0**-W
	–25...+100 °C	–25...+100 °C	–25...+100 °C	–25...+100 °C
	3 N	4 N		
	100	100		
	2 mm	32 mm		
	15 Nm	25 Nm	15 Nm	15 Nm
	Stainless steel	Stainless steel	Anodized Al	Anodized Al









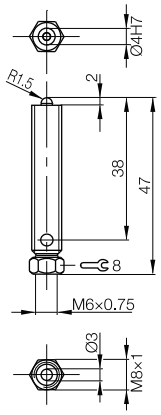
Tube switch

- Mechanical actuation – non-contact switching
- Protects the sensor from mechanical damage
- Plug and safe

Rapid application – high reliability

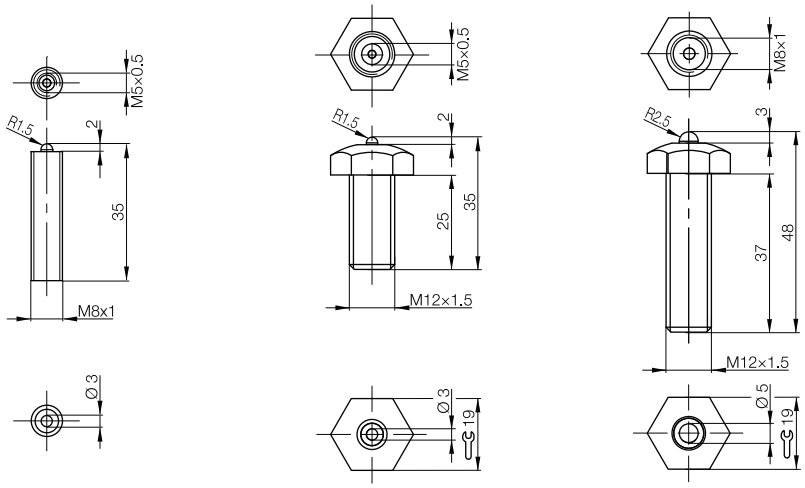
The set includes a pre-assembled tube switch, which means you only need to set up the sensor. The tube switch also combines the advantages offered by mechanical and inductive switches. Manufactured from stainless steel, it is extremely robust and very reliable, even under difficult conditions.

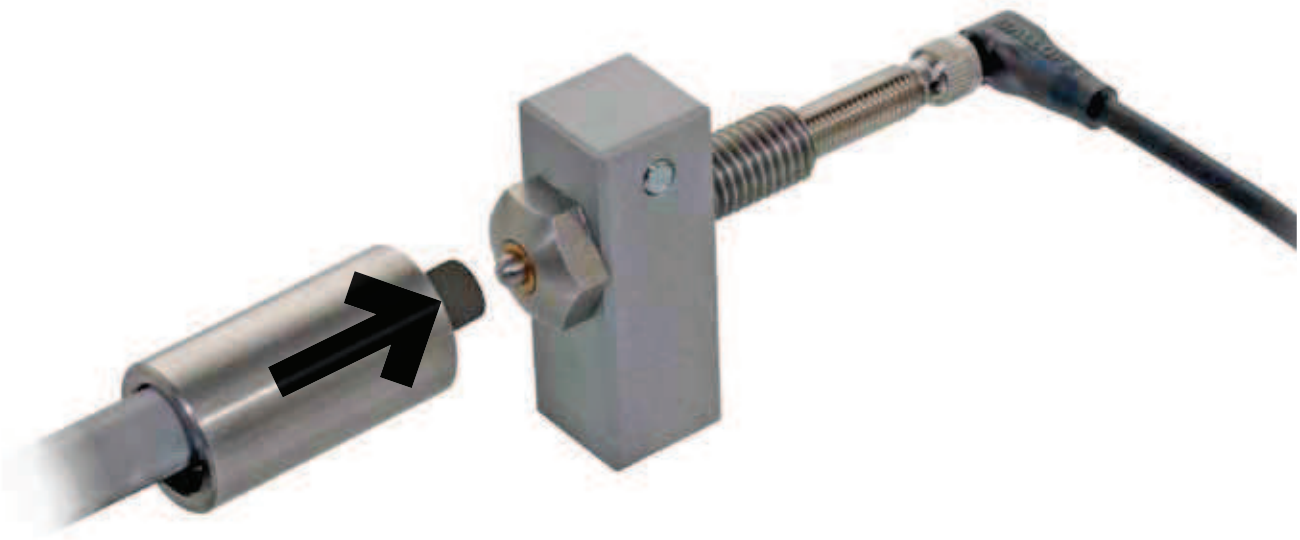
Description	**Tube switch**	
Use	For sensors **dia. 4 mm** for mechanical protection	
Ordering code	**BAM01C0**	
Part number	BAM FS-XE-002-D4-4	
Spring force F (N)	3	
Impact force $F_{max.}$ (N)	400	
Switching operations min. (with $F_{max.}$)	500000	
Housing material	Stainless steel	





	Tube switch	**Tube switch**	**Tube switch**
	For **M5** sensors for mechanical protection	For **M5** sensors for mechanical protection	For **M8** sensors for mechanical protection
	BAM01AZ	**BAM019Y**	**BAM019W**
	BAM FS-XE-001-M5-4	BAM FS-XE-003-M5-4	BAM FS-XE-004-M8-4
	3	3	4
	400	400	400
	500000	500000	500000
	Stainless steel	Stainless steel	Stainless steel





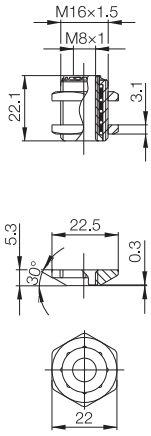
Inductive sensors
Global DC 3-wire
DC 3-/4-wire
DC 2-wire
AC/DC 2-wire
AC 2-wire
Special properties
Analog distance measurement
Accessories
Pulse Extension
Function Diagnostics Unit
Sensor tester, testing and setting device
Analog switching device
Assembly aids for Uni and Unicompact sensors
Protective covering for Unicompact sensors
Protective nuts
Positive stop
Tube switch
Contact protector
Clamping holder overview

Contact protector

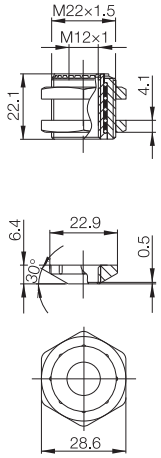
Contact protector for sensors

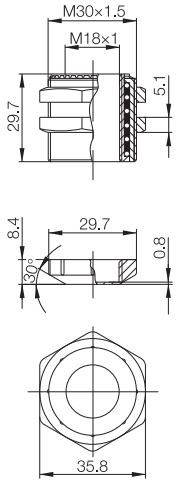
The contact protector absorbs contacts with displacement of up to 15 mm without the sensor being damaged. The object strikes an attached protective cap and then pushes the sensor back. Damage to the sensor or coil is thereby prevented.

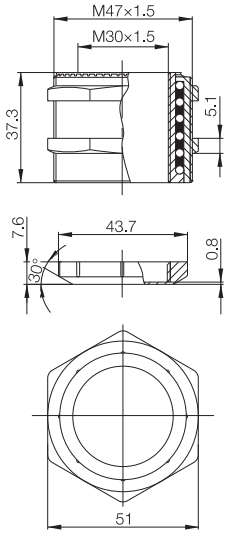
Description	**Contact protector**	
Use	For **M8** sensors for mechanical protection	
Ordering code	**BAM015U**	
Part number	BESA-08-CM	
WAF	22	
Ambient temperature	–45...+85 °C	
Material	Anodized Al, POM	

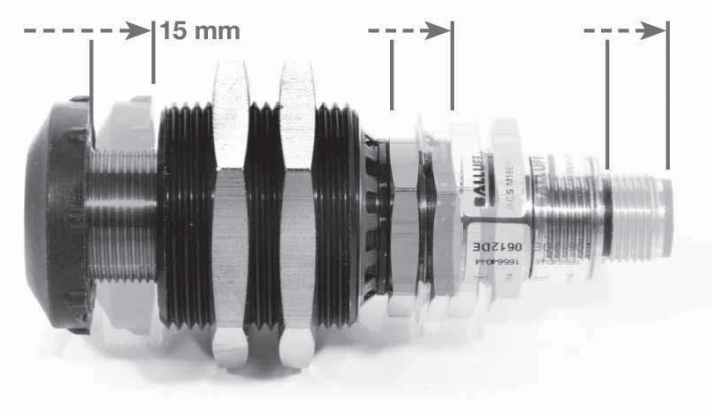


	Contact protector	**Contact protector**	**Contact protector**	
	For **M12** sensors for mechanical protection	For **M18** sensors for mechanical protection	For **M30** sensors for mechanical protection	
	BAM015W	**BAM015Y**	**BAM015Z**	
	BESA-12-CM	BESA-18-CM	BESA-30-CM	
	29	35	51	
	–45...+85 °C	–45...+85 °C	–45...+85 °C	
	Anodized Al, POM	Anodized Al, POM	Anodized Al, POM	









Inductive sensors
Global DC 3-wire
DC 3-/4-wire
DC 2-wire
AC/DC 2-wire
AC 2-wire
Special properties
Analog distance measurement
Accessories
Pulse Extension
Function Diagnostics Unit
Sensor tester, testing and setting device
Analog switching device
Assembly aids for Uni and Unicompact sensors
Protective covering for Unicompact sensors
Protective nuts
Positive stop
Tube switch
Contact protector
Clamping holder overview

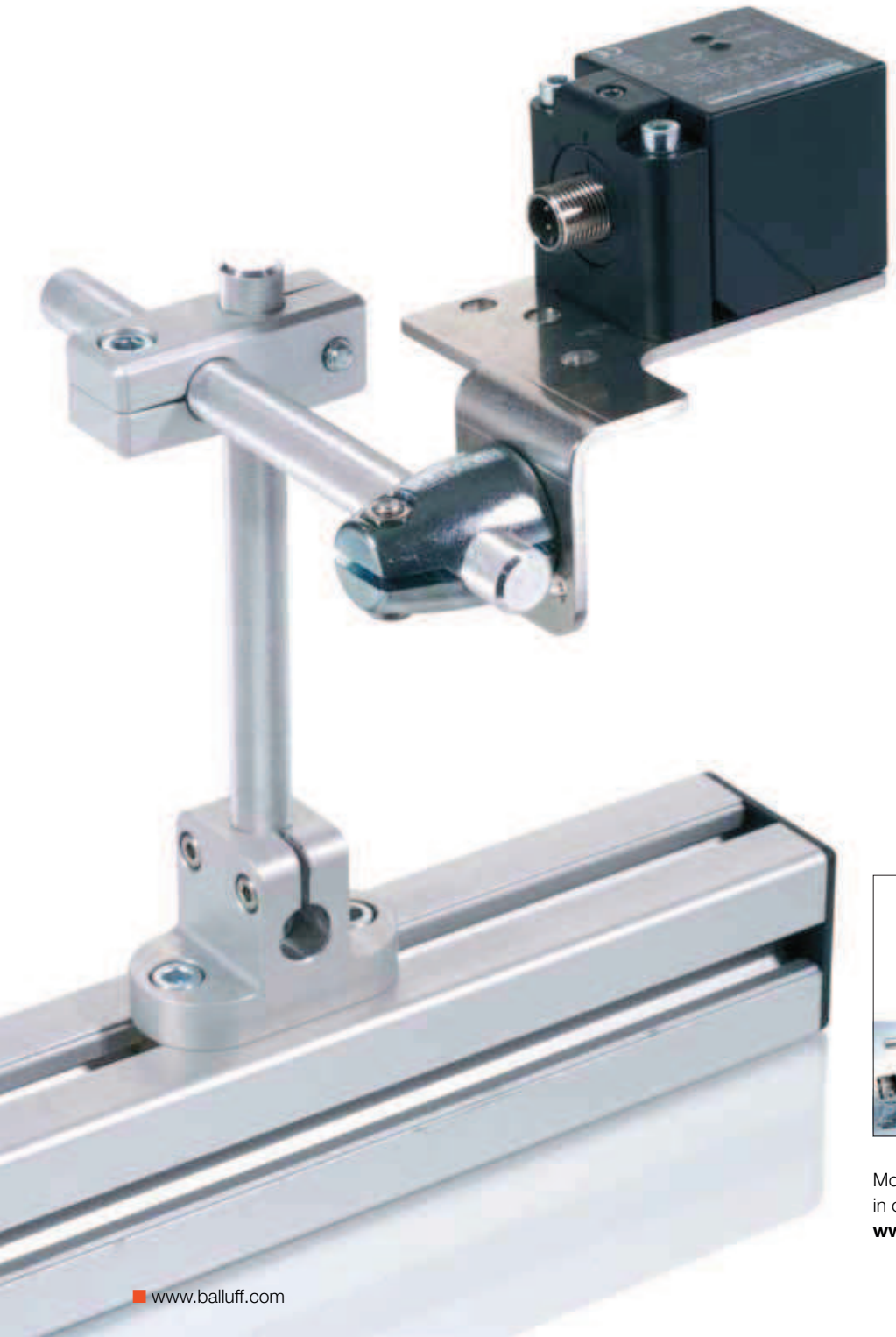
17× Standard
3× Stainless steel
10× PTFE-coated, weld-immune

12× Standard with latch
6× Standard with latch
PTFE-coated, weld-immune
6× Stainless steel with latch
6× Stainless steel with latch
PTFE-coated, weld-immune

5× For installation in containers

65 Clamping holder variants!

Balluff has revolutionized methods for attaching sensors with the new latch clamping principle. The sensor is inserted into the clamps and secured in position by folding over the latch. The latch can secure any sensor in all areas of the automation sector without the use of tools.



More mounting accessories can be found in our "Accessories Line" catalog or online at:
www.balluff.com

Inductive sensors
Global DC 3-wire
DC 3-/4-wire
DC 2-wire
AC/DC 2-wire
AC 2-wire
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Protective nuts
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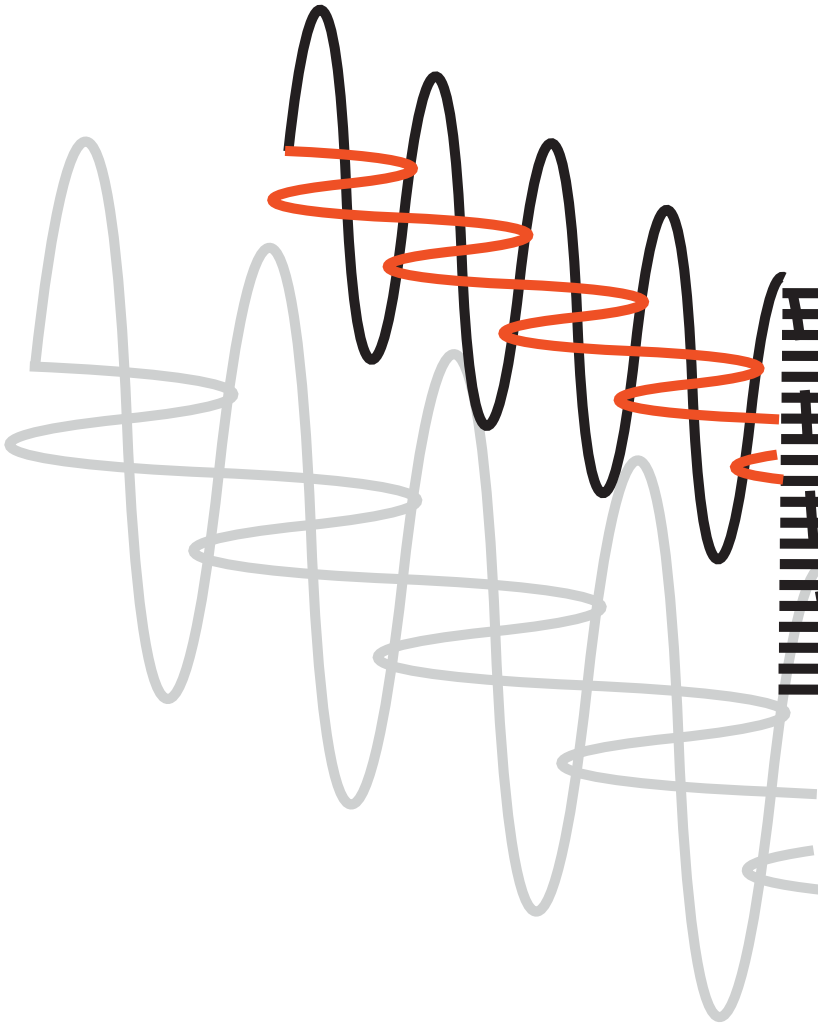
Contact protector
Clamping holder overview

Basic Information and Definitions



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Specific basic information

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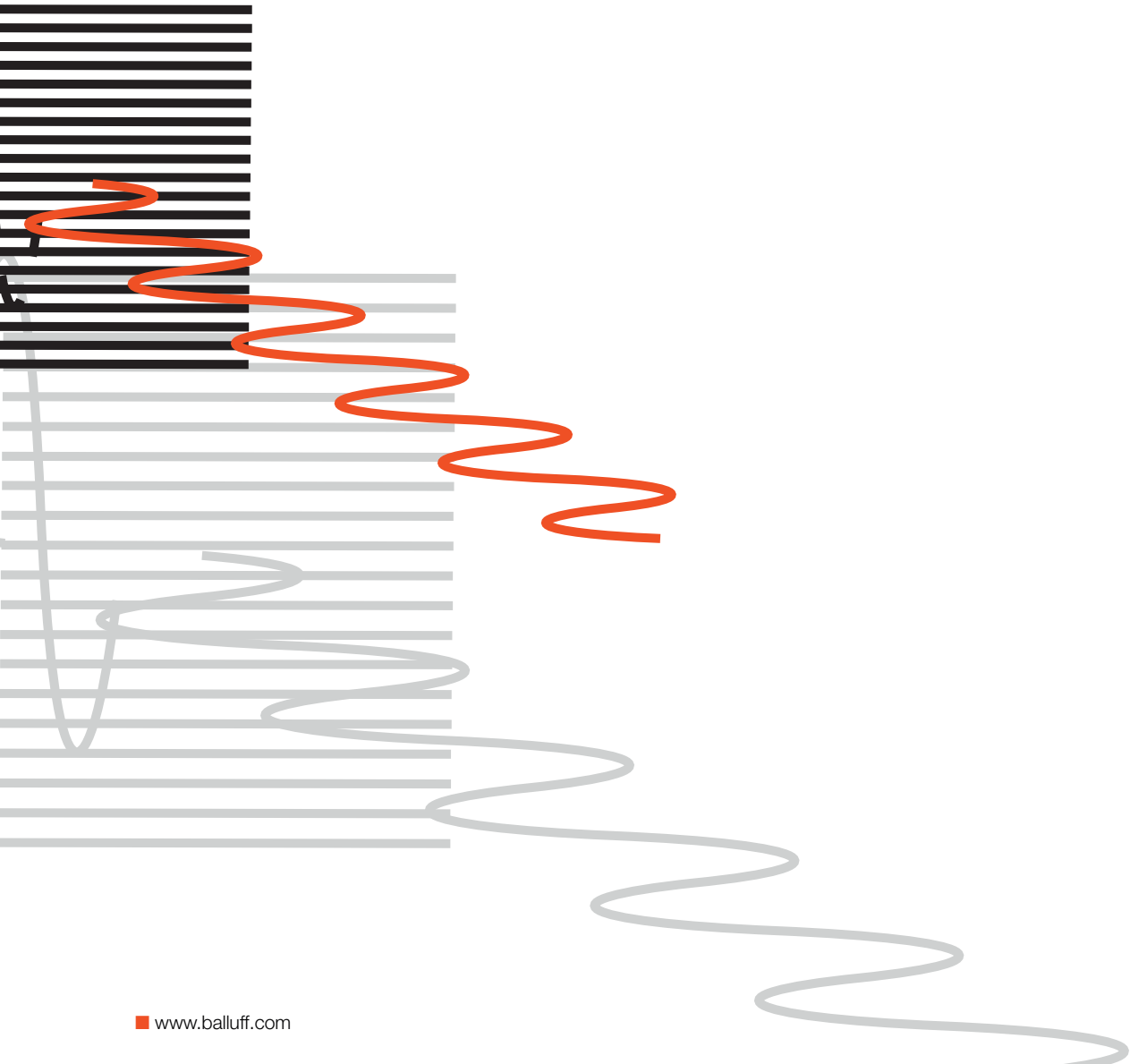


Cable properties

Cable types

PUR cable, PUR insulated

No. of wires × conductor cross-section	Outside diameter typical
2×0.08 mm²	3...4 mm
2×0.14 mm²	3...4.1 mm
2×0.34 mm²	4...5.5 mm
3×0.06 mm²	2...2.5 mm
3×0.09 mm²	2.5...3 mm
3×0.14 mm²	2.5...3.5 mm
3×0.25 mm²	3.5...4.5 mm
3×0.34 mm²	4...5.5 mm
3×0.75 mm²	6.5...7 mm
4×0.14 mm²	3...4 mm
4×0.25 mm²	4...5.5 mm
8×0.25 mm²	6...8 mm

PVC cable, PVC insulated

No. of wires × conductor cross-section	Outside diameter typical
2×0.14 mm²	2.5...3.5 mm
2×0.34 mm²	4.5...5.5 mm
3×0.14 mm²	2.7...4.5 mm
3×0.25 mm²	4...5 mm
3×0.34 mm²	4.5...5.5 mm
4×0.25 mm²	4.5...5.5 mm

Smallest bending radius

tensioned	untensioned	drag chain and roll deflection
4×D	3×D	4×D...7.5×D only with "SP" wire

Special cable

The SP- cable is a irradiated cross-linked PUR- cable that has good resistance to weld splatter. A special connection cable is used for sensors that need to be used at higher ambient temperatures.

Tightening torques

The permitted tightening torque is indicated in the data sheets or on the sensor packaging.

Quality and the environment

Quality management system as per DIN EN ISO 9001:2008

Balluff companies	
Balluff GmbH	Germany
Balluff SIE Sensorik GmbH	Germany
Balluff Controles Elétricos Ltda.	Brazil
Balluff Sensors (Chengdu) Co., Ltd.	China
Balluff Ltd.	Great Britain
Balluff Automation S.R.L.	Italy
Balluff Canada Inc.	Canada
Balluff de México S.A. de C.V.	Mexico
Balluff GmbH	Austria
Balluff Sp. z o.o.	Poland
Balluff Hy-Tech AG	Switzerland
Balluff Sensortechnik AG	Switzerland
Balluff S.L.	Spain
Balluff CZ, s.r.o	Czech Republic
Balluff Elektronika Kft.	Hungary
Balluff Inc.	USA

Reg.Nr.: 19279-03

Environmental management system as per DIN EN ISO 14001:2009

Balluff companies	
Balluff GmbH	Germany
Balluff Sensors (Chengdu) Co., Ltd.	China
Balluff Elektronika KFT	Hungary

Testing laboratory

The Balluff testing laboratory operates in accordance with ISO/IEC 17025 and is accredited by DAkks for testing electromagnetic compatibility (EMC).

DAkkS Deutsche Akkreditierungsstelle D-PL-12017-01-01

Balluff products comply with EU directives

Products that require labeling are subject to a conformity evaluation process according to the EU directive and the product is labeled with the CE marking.
Balluff products fall under the following EU directive:

2004/108/EC	EMC directive
2006/95/EC	Low Voltage Directive valid for products with supply voltage ≥ 75 V DC/≥ 50 V AC
94/9/EC	ATEX-directive valid for products with Ex-label

Product approvals

Product approvals are awarded by domestic and international institutions. Their symbols affirm that our products meet the specifications of these institutions.

"US Safety System" and "Canadian Standards Association" under the auspices of Underwriters Laboratories Inc. (cUL).

CCC-Code by the Chinese CQC.

Standards

Sensors	Low-voltage switchgear and controlgear	EN 60947-5-2/IEC 60947-5-2
	NAMUR-sensors	EN 60947-5-6/IEC 60947-5-6
Protection class	II ⧈	EN 60947-5-2/IEC 60947-5-2
Degree of protection	IP 60...67	EN 60529/IEC 60529
	IP 68 per BWN Pr. 20	Balluff factory standard (BWN): Temperature storage 48 h at 60 °C, 8 temperature cycles according to EN 60068-2-14/IEC 60068-2-14 between the benchmark temperatures according to the data sheet, 1 h storage in water, insulation inspection, 24 h storage in water, insulation test, 8 temperature cycles according to EN 60068-2-14 IEC 60068-2-14 between the benchmark temperatures according to the data sheet, 7 days storage in water, insulation test.
	P 68 according to BWN Pr. 27	Balluff Factory Standard (BWN): Testing products for use in the foods industry.
	IP 69K	DIN 40050 part 9: Protection against entry of water under high pressure- or steam jet cleaning.
EMC (Electromagnetic Compatibility)	Emissions, RF noise voltage and RF noise radiation from electrical equipment	EN 55011
	Interference immunity against discharging static electricity (ESD)	EN 61000-4-2/IEC 61000-4-2
	Radio frequency immunity against high-frequency electromagnetic fields (RFI)	EN 61000-4-3/IEC 61000-4-3
	Immunity to fast transients (bursts)	EN 61000-4-4/IEC 61000-4-4
	Interference immunity against conducted interference, induced by high-frequency fields	EN 61000-4-6/IEC 61000-4-6
	Immunity to voltage dips and voltage interruptions	EN 61000-4-11/IEC 61000-4-11
	Surge-voltage stability	EN 60947-5-2/IEC 60947-5-2
Environmental simulation	Vibration, sinusoidal	EN 60068-2-6/IEC 60068-2-6
	Shock	EN 60068-2-27/IEC 60068-2-27
	Continuous shock	EN 60068-2-29/IEC 60068-2-29
EX area	Electrical equipment for explosive atmospheres, general requirements.	EN 50014
	Succeeded by: Electrical equipment for gas explosive atmospheres, general requirements.	EN 60079-0
	Electrical apparatus for explosive areas – intrinsic safety "i".	EN 50020

For conformity, see product marking.

Mounting torques

The following torques are to be followed so that the sensors are not mechanically destroyed during installation, as long as no other information is indicated on the data sheet or the sensor packaging.

Size	Material	Tightening torque
M5×0.5	Stainless steel	3 Nm
M8 × 1	Stainless steel	15 Nm
M12×1	Stainless steel	40 Nm
M18×1	PBT	1 Nm
M18×1	Stainless steel	60 Nm
M30×1.5	PBT	3 Nm
M30×1.5	Stainless steel	90 Nm

Housing tolerances for unthreaded cylindrical sensors

Diameter	Tolerance
Ø 3 mm	–0.1
Ø 4 mm	–0.1
Ø 6.5 mm	–0.15
Ø 8 mm	–0.15

Degree of protection

The degrees of protection are given according to IEC 60529. Code letters IP (International Protection) designate protection for electrical equipment against shock hazard, ingress of solid foreign bodies and water.

IP 69K
Protection against ingress of water at high pressure and steam cleaning per DIN 40050 Part 9.

First digit:
2 Protection against penetration of solid bodies larger than 12 mm, shielding from fingers and objects
4 Protection against penetration of solid bodies larger than 1 mm, shielding from tools and wires
5 Protection against damaging dust deposits, complete contact protection
6 Protection against penetration of dust, complete contact protection

Second digit:
0 No special protection
4 Protection against water, which is sprayed from all directions against the equipment
5 Protection against a stream of water from a nozzle which hits the equipment from all directions
7 Protection against water, if the equipment (housing) is temporarily submerged
8 Protection against water when submerged for some time

Materials

Material	Use and characteristics
Plastics	
ABS Acrylonitrile-Butadiene-Styrene	Impact-resistant, stiff, limited chemical resistance. Some types flame-retardant. Used for housings.
AES/CP Acrylonitrile-Ethylene-Propylene-Styrene	Impact-resistant, stiff, limited chemical resistance. Used for housings.
EP Epoxy resin	Duromer, molded plastic material, highest mechanical strength and temperature resistance. Very good dimensional stability. Cannot be melted.
Epoxy resin - hollow glass spheres	Hollow glass spheres can be treated with epoxy resins. They are used for manufacturing converters with low thickness and high pressure rating.
Tetrafluorethylene-perfluorpropylene	High temperature resistance up to 180 °C, insulation material for cable.
LCP Liquid Crystalline Polymer	High mechanical strength and temperature resistance. Very good chemical resistance. Inherently non-flammable.
PA Polyamide	High impact resistance, good chemical resistance.
PA 6, PA 66, PA mod., PA 12 Polyamide	Good mechanical strength. Temperature resistance. PA 12 approved for food industry applications.
PA transp. Transparent polyamide	Transparent, hard, inflexible. Good chemical resistance.
PBT Polybutylene terephtalate	High mechanical strength and temperature resistance. Some types flame-retardant. Good chemical resistance. Good oil resistance.
PC Polycarbonate	Clear, hard, elastic and impact resistant. Good temperature resistance. Limited chemical resistance.
PEEK Polyetheretherketone	Thermoplastic. Very high strength and temperature resistance. Good chemical resistance. Can be sterilized, good resistance to ionizing radiation.
PEI Polyetherimide	High mechanical strength and good temperature resistance. Good chemical resistance even with many solvents. Transparent with amber-yellow inherent color (not pigmented).
PET Polyethylene terephtalate	High resistance to breakage, good dimensional stability. Frequently used in the food industry.
PMMA Polymethylmethacrylate	Clear, transparent, hard, scratch-resistant, UV-resistant, mainly for optical applications.
POM Polyoxymethylene	High impact resistance, good mechanical strength. Good chemical resistance.

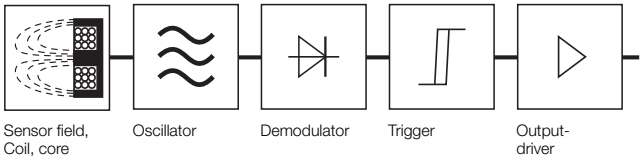
Mechanical properties

Material	Use and characteristics
Plastics	
PP Polypropylene	Very good electrical properties. Impact resistant, tough, mechanically resilient. Very low water uptake. Good to very good chemical resistance.
PPE Polyphenylene ether	Tough, inflexible, high mechanical strength over a wide temperature range. Good chemical resistance. Good hot water resistance.
PSU Polysulfone	High temperature resistance, high impact resistance, good chemical resistance, FDA approved (food grade).
PTFE Polytetrafluoroethylene	Best temperature and chemical resistance, FDA approved (food grade).
PUR Polyurethane	Elastic, abrasion-resistant, impact-resistant. Good resistance to oils, greases, solvents (used for gaskets and cable jackets).
PVC Polyvinyl chloride	Good mechanical strength and chemical resistance (cable).
PVDF Polyvinylidene fluoride	Thermoplastic. High mechanical strength and temperature resistance. Good chemical resistance (similar to PTFE).
Metal	
Wrought aluminum alloy	Standard-aluminum for machined cutting. Can be anodized. Used for housings and mounting components.
CuZn Brass	Standard-housing material with surface protection.
Stainless steel	Excellent corrosion resistance and strength. **Quality 1.4034, 1.4104:** Standard-material; **quality 1.4305, 1.4301:** Standard-material for the food industry; **quality 1.4401, 1.4404, 1.4571:** With increased requirements on chemical resistance at elevated temperatures for the food industry.
GD-Al die-cast aluminum-	Low specific gravity. Good strength and resistance. Some types can be anodized.
GD-Zn die-cast zinc-	Good resistance and strength. Usually with protective surface coating.
Other	
Glass	Good chemical resistance and strength. Used primarily in optical applications (lenses, cover lenses).
Ceramic	Very good strength and chemical resistance. Electrically insulating. Excellent temperature resistance.

Principle

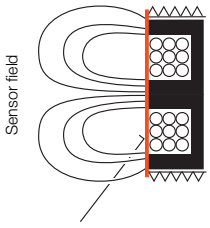
Inductive sensors affect the interaction of metallic targets with the electromagnetic alternating field of the sensor. Eddy currents are induced in the metallic damping material, which removes energy from the field and reduces the height of the oscillation amplitude. This change is processed in the inductive sensor, which changes its output state accordingly.

The functional groups of Balluff sensors are:



Sensing surface

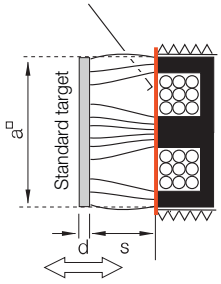
The sensing surface is the area through which the high-frequency sensor field enters the air space. It is determined primarily by the base of the shell core and corresponds roughly to the surface area of the shell core cap.



Standard target

The standard target is a grounded, square plate made of Fe 360 (ISO 630), with the switching distance determined per EN 60947-5-2. The thickness is d = 1 mm; and the side length a corresponds to

- The diameter of the registered circle of the "sensing surface" or
- 3 s_n, if the value is greater than the nominal diameter.



Correction factor

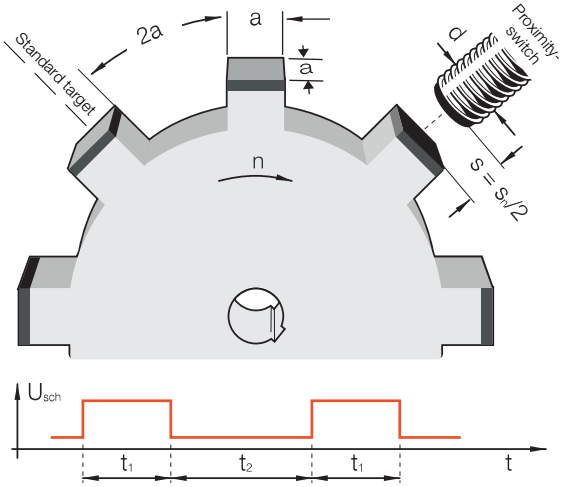
The correction factor indicates the reduction of the switching distance in damping materials which deviate from Fe 360.

Material	Factor
Steel	1.0
Copper	0.25...0.45
Brass	0.35...0.50
Aluminum	0.30...0.45
Stainless steel	0.60...1.00
Nickel	0.65...0.75
Cast iron	0.93...1.05

Switching frequency f

The switching frequency corresponds to the maximum possible number of switching sequences per second. Damping is done according to EN 60947-5-2 with standard targets on a rotating, non-conductive washer. The surface relationship of iron to non-conductive material is 1 : 2.

The measured value of the switching frequency is reached if the switching signal is t_1 = 50 µs or the turn-off signal is t_2 = 50 µs.



Delay times

Stand-by delay t_v

The stand-by delay is the time between switching on the supply voltage and the beginning of operational readiness of the sensor. This time must not be longer than 300 ms. During this time, there must be no fault signal longer than 2 ms.

Temperature effects and limits

Temperature drift

The temperature drift is the deviation of the real switching distance within the temperature range of –25 °C ≤ Ta ≤ +70 °C.
According to EN 60947-5-2: $\Delta s_r/s_r \leq 10$ %

Ambient temperature T_a

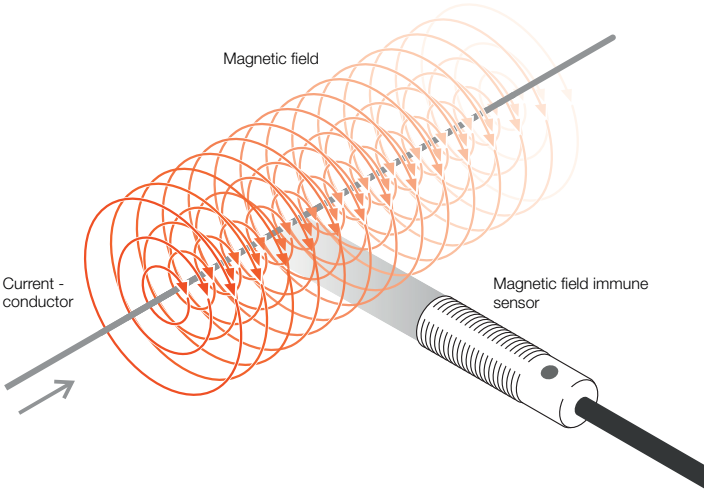
The ambient temperature is the temperature range in which the function of the photoelectric switch is guaranteed.

Magnetic field immunity

Operating principle

Error-free function depends on the magnitude of the welding current and the distance of the sensor from the current-carrying line.

Through constructive and switching technological measures, magnetic field immune sensors are not influenced by magnetic fields.



General basic information
Specific basic information
Photoelectric sensors
Inductive sensors
Capacitive sensors
Magnetic cylinder sensors

Supply voltage U_S

The supply voltage is the permitted voltage range, including residual ripple, in which a secure operation is guaranteed.

Measured supply voltage U_e

To determined measured- and limit values, the sensor is operated with U_e. It is:
- DC switches **U_e = 24 V DC**
- AC and AC/DC-switches **U_e = 110 V AC**

Voltage drop U_d

The voltage drop is the voltage on the interconnected sensor at a load current of I_e.

Rated insulation voltage U_i

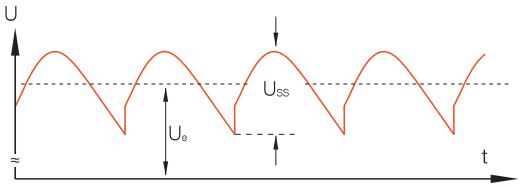
The rated insulation voltage of a sensor is the voltage to which the insulation checks and the air- and creepage distances are related. For sensors, the highest rated operating voltage is considered the rated insulation voltage.

Rated supply frequency

The rated frequency of the supply network is 50 or 60 Hz.

Residual ripple σ (%)

The residual ripple is the alternating current overlying the direct current U_e (point to point from U_e). It is given in %.
To operate DC switches, a filtered DC voltage having a ripple of max. 15 % (per DIN 41755) is required.



U_e = rated operational voltage
U_{ss} = Oscillation width

$$\text{Residual ripple } \sigma = \frac{U_{ss}}{U_e} \times 100\ [\%]$$

Rated operating current I_e

The rated operating current is the permitted continuous output voltage, which flows through the load R_L.

Off-state current I_r

The residual current is the current which flows through a blocked sensor in the load circuit.

Short-term current carrying capacity I_k

The short-term current carrying capacity indicates the short-term permitted current I_k (A_{eff}) with alternating current during a specified switching period t_k (ms) and repeatability frequency f (Hz).

Limited rated short-circuit current

The limited short-circuit current is 100 A; meaning that, according to EN 60947-5-2, the supply device in short-circuit operation has to provide a current of at least 100 A during the type test for a short time. This current is prescribed in the standard in order to test the short-circuit strength of sensors.

No-load supply current I_0

The no-load supply current is the current that flows without a load being attached (only with 3- and 4-wire switches). This current supplies the sensor electronics.

Minimum operational current I_m

The smallest operating current is the current that is necessary in the ON-state to maintain the conductibility of the switching element.

Output resistance R_a

The output resistance is the resistance between the output and the supply voltage which is built into the switch; see "Output circuits".

Load capacitance

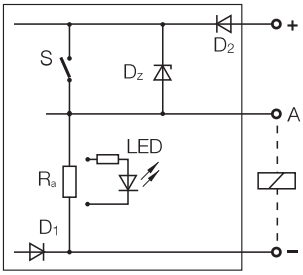
The load capacity is the permitted total capacity at the sensor output, including line capacity.

Output circuits

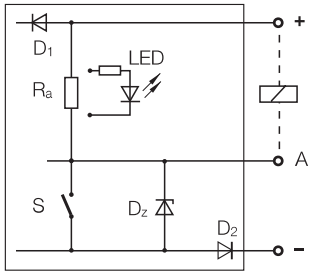
Driver stages

3-wire DC-switch

PNP, positive switching (current source)



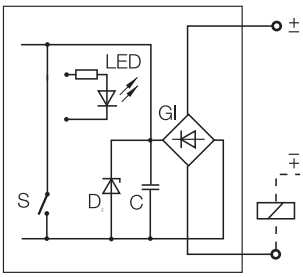
NPN, negative switching (current sink)



S = Semiconductor switch
R_a = output resistance
LED = Light diode
D_z = Z-diode, delimiter
D_1 = Polarity reversal-protected diode
D_2 = Polarity reversal-protected diode in the load circuit (only with short-circuit protected version)

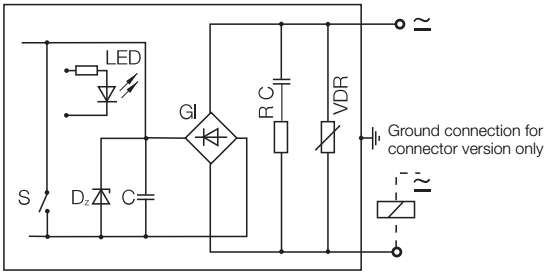
2-wire DC-switch

Non-polarized

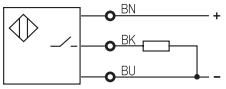
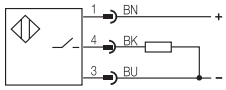
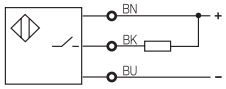
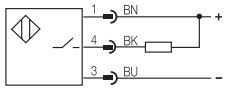
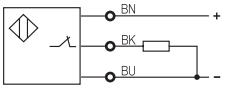
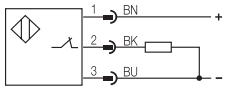
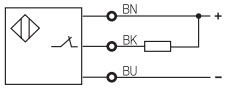
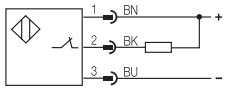
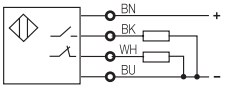
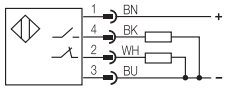
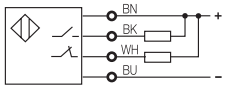
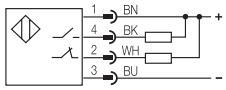
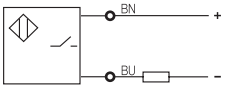
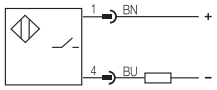
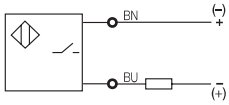
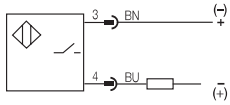
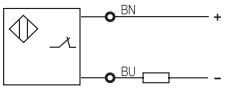
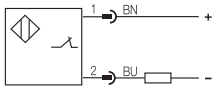
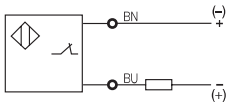
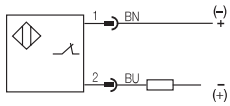
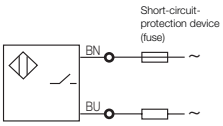
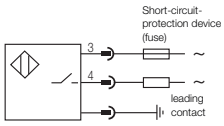
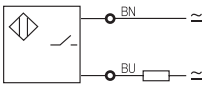
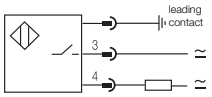
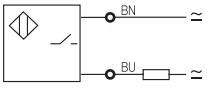
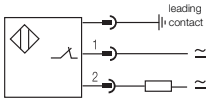
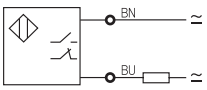


S = semiconductor switch
Dz = Z-diode, delimiter
C = capacitor
GI = bridge rectifier
LED = light emitting diode

2-wire AC- and AC/DC-switch (all current switch)



S = Semiconductor switch
D_z = Z-diode, delimiter
C = Sieve condenser
RC = HF-points-limit
GI = bridge rectifier
LED = Light diode
VDR = Voltage point limiter

	Cable/terminals	Connector	Cable/terminals	Connector
DC 3/4 wire	**PNP (+) sourcing**		**NPN (–) sinking**	
NO				
NC				
Complementary				
DC 2-wire	**Polarized**		**Non-polarized**	
NO				
NC				
AC sensors	**Protection isolated (Protection Class II ⧈)**		**with protection ground (insulation class I)**	
NO				
AC/DC sensors	**Protection isolated (Protection Class II ⧈)**		**with protection ground (insulation class I)**	
NO				
NC				
NO/NC, programmable				

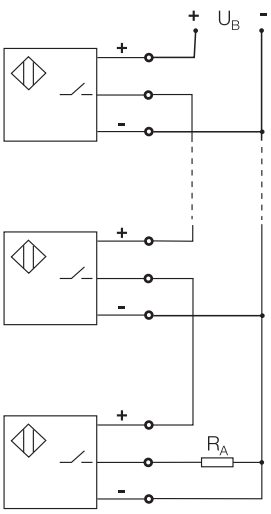
Wire colors
(labeling
according to DIN IEC 60757)

Description	Color
BN	brown
BK	black
BU	Blue
OG	orange
WH	White
RD	Red
GY	Gray

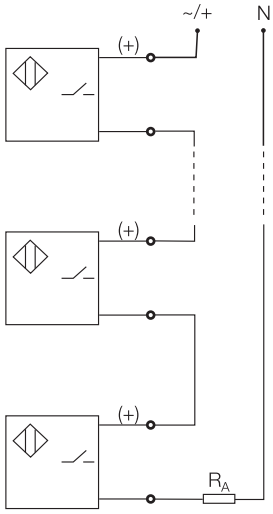
Series connection

With a series connection, a time delay (e.g. ready delay time) can occur. The number of linkable sensors is limited by the total voltage drop (sum of all U_d).
With 2-wire-sensors, it is limited by the addition of the minimum supply voltage levels.
With 3-wire DC-switches, the load rating of the output stage presents an additional limitation, because the no-load supply current I_0 of all switches adds up to rated operating current I_e.
The ready delay time t_v is the ready delay of a sensor × (number of sensors n–1).

3-wire DC-switch



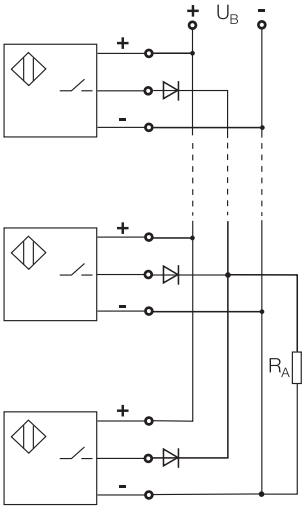
2-wire DC-switch (AC/DC)



Parallel switching

With a parallel switching of sensors with function indicator, it is recommended to couple the outputs of the individual switches with diodes (as plotted). Through this, all LEDs are prevented from lighting if an output stage is at full modulation.

3-wire DC-switch



2-wire DC-switch

Parallel wiring of 2-wire-sensors is not recommended, since missed pulses can be caused by the build-up of oscillations.

Usage category

according to EN 60947-5-2/ IEC 60947-5-2

Category		Typical load applications
AC 12	AC-switch	Resistance- and semiconductor loads, optocouplers
AC 140	AC-switch	small electromagnetic load $I_a \leq 0.2$ A; e.g. contactor
DC 12	DC-switch	Resistance- and semiconductor loads, optocouplers
DC 13	DC-switch	Electromagnets

General basic information
Specific basic information
Photoelectric sensors
Inductive sensors
Capacitive sensors
Magnetic cylinder sensors

Polarity reversal protected

Sensors with short-circuit protection are polarity reversal-protected against reversal of all connections.
Sensors without short-circuit protection are polarity reversal-protected against reversal of the positive/negative cable.

Cable break protection

The cable break protection prevents a malfunction by cable break in 3-wire switches. An installed diode has a power input through output line A.

Short circuit protected (sensors with a maximum voltage of 60 V DC)

The short-circuit protection is achieved in Balluff sensors with clocked or thermal short-circuit switches. The output stage is thereby protected against overload and short circuit.
The release current of the short-circuit protection is above the rated operating current I_e.
Currents from switching and load capacitance do not trigger this function, but rather are masked by a short delay time.

Short-circuit protected/overload protected (sensors for operation optional with AC or DC power supply)

Short-circuit protected/overload protected sensors are often operated with relays or contactors as load. At switch-on, alternating current switching devices (protection contactor/relay) for the sensor are briefly a substantially higher load (6...10x rated current) than later in the later static operation, because their core is still open.
The static value of the load (current) is only reached after several milliseconds. Not until the magnetic field is closed does the max. permissible rated operating current I_e listed in the data sheet flow through the sensor. The release value for a short-circuit in these sensors therefore has to be substantially higher. If, for example, the contactor would no longer be able to be closed entirely for mechanical or electrical reasons, this could lead to an overload of the sensors. This is where the overload protection comes into play. It is designed as slow-acting (time-delayed). Its trigger threshold lies only slightly above the maximum permissible I_e. A reaction (in other words, shutoff) occurs, depending on the height of the overload, only after more than 20 ms. With this, it is ensured that the intact relay and contactor can be switched, but defective switching devices cannot lead to destruction of the Balluff sensors. The short-circuit/overload protection usual has a bistable design and has to be reset after triggering by switching the supply voltage.

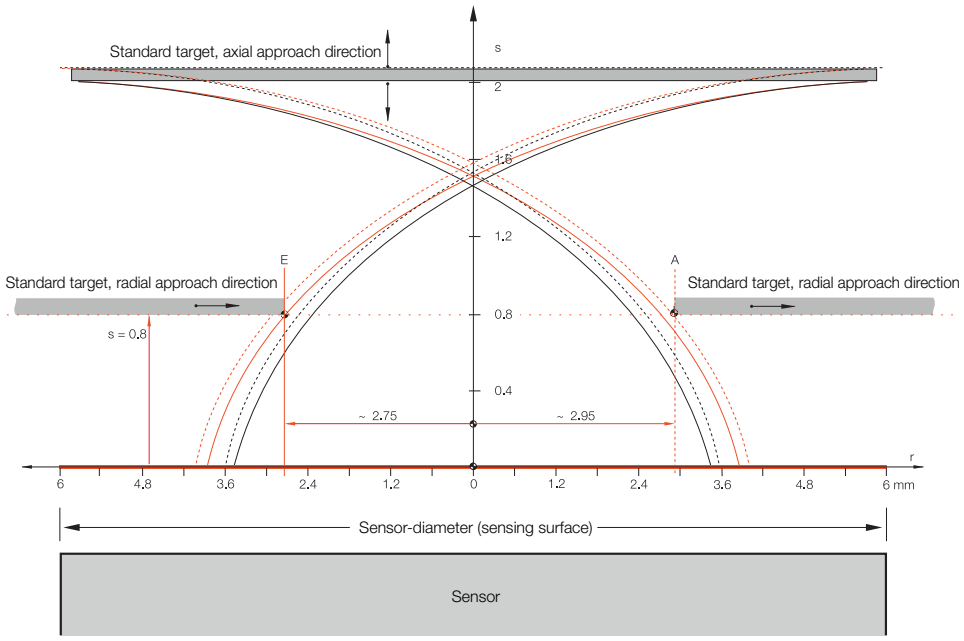
Response curves

Axial and radial damping:
When damping in an **axial direction**, the standard target is moved concentric to the system axis. The switchpoint is thereby determined only by the distance "s" from the sensing surface of the sensor.
When damping in the **radial direction**, the location of the switchpoint is additionally affected by the radial distance "r" of the target from the system axis.
The diagram shows the response curves, which indicate the dependency of the switchpoint on "s" and "r". The primary purpose of this drawing is to show the possibility of damping using a lateral approach and the difference compared with axial approach.

Application:
Due in part to manufacturing tolerances within a production run, the exact switchpoint must in any case be established on site. The solid lines represent the respective switch-on point (E); the dashed lines indicate the turn-off point (A). The red lines apply to switches with a clear zone, and the black lines for flush mount types. Since the switching operation can be induced from either direction, the curves are shown mirrored from the system axis.

Examples:
Passing objects on conveyor lines generate a signal change when their front edge crosses the turn-on curve on the entry side. The signal reverses again when the back edge of the passing object crosses the (mirrored) turn-off curve on the opposite side.
In the case of **reversing parts** (e. g. end of travel), the signal reversal occurs at the turn-off curve on the same side.

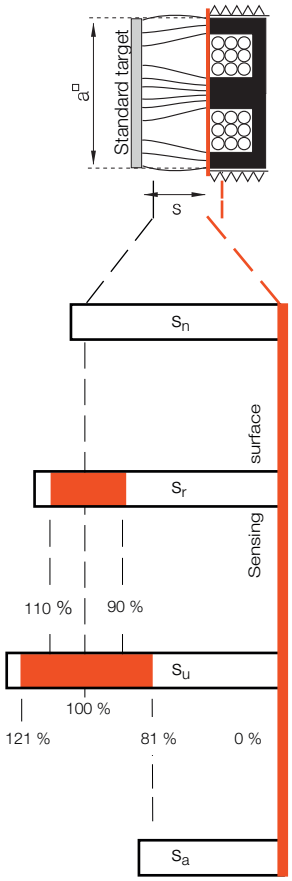
Typical response curve based on the example of an M12 sensor with s_n 2 mm



The **vertical axis** in the diagram shows the distance of the switchpoint from the sensing surface. It is based on the rated switching distance sn. At a distance of 0.8 mm, a laterally approaching target reaches the solid line turn-on curve at point "E" and leaves the turn-off curve at point "A".
The **horizontal axis** in the diagram is based on the radius of the sensing surface. The zero point of this axis lies in the center of the shell core cap. In our example for the M12 switch, the radius is r = 6 mm.

Example: The distance of the switch on- and switch off point (from the system axis) is typically:
On ~ 2.75 mm
Off ~ 2.95 mm.

Switching distances



Switching distance s

The switching distance is the distance between the standard target and the sensing surface of the sensor at which a signal change is triggered according to EN 60947-5-2. When normally open, it is from OFF to ON, and when normally closed, from ON to OFF.

Rated switching distance s_n

The rated switching distance is a data cluster without taking manufacturing tolerances, parameter scatter and external influences such as temperature and voltage into account.

Real switching distance s_r

The real switching distance is the switching distance of an individual sensor which is measured under defined conditions, e.g. installation type flush, rated operating voltage U_e, temperature T_a = +23 °C ±5 °C (0.9 $s_n \leq s_r \leq$ 1.1 s_n).

Usable switching distance s_u

The usable switching distance is the permitted switching distance within fixed voltage- and temperature limits (0.81 $s_n \leq s_u \leq$ 1.21 s_n).

Assured operating distance s_a

The assured switching distance is the switching distance in which a secure operation of the sensor is guaranteed at a defined voltage- and temperature range (0 $\leq s_a \leq$ 0.81 s_n).

Switching distance identifier

Switching distance		Size	Switching distance
■	Standard-switching distance according to EN 60947-5-2		
■■	**2x** switching distance compared to standard	Ø 3 mm*	1 mm flush
		Ø 4 mm/M5*	1.5 mm flush
		Ø 6.5 mm...M30	1.5...2-x
■■■	**3x** switching distance compared to standard	Ø 3 mm*	3 mm non-flush
		Ø 4 mm/M5*	5 mm non-flush
		Ø 6.5 mm...M12	2.2...3-x
		M18...M30	depending on version
■■■■	**4x** switching distance compared to standard		

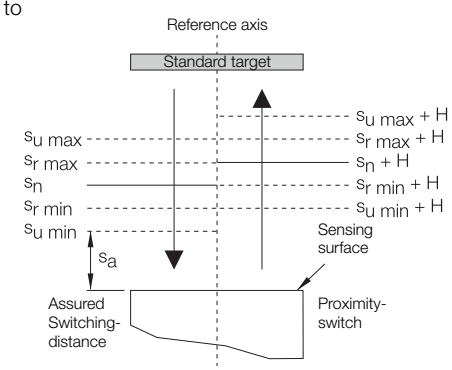
*Information for switching distance in mm. The switching distances of these sensors are not standardized.

Repeat accuracy R

The repeat accuracy of s_r is determined at rated operating voltage U_e under the following conditions: Temperature: T = +23 °C ±5 °C Relative humidity: ≤ 90 % Measurement duration: t = 8 h. The permitted deviation is R ≤ 0.-1 s_r, according to EN 609475-2.

Hysteresis H (switching hysteresis when target is backed off)

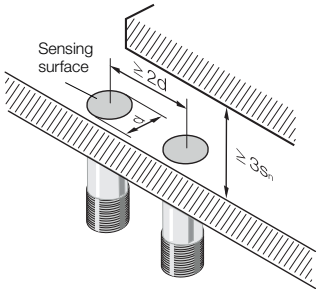
The hysteresis is specified as a percentage of the real switching distance s_r. It is measured at an ambient temperature of +23 °C ±5 and at the rated supply voltage. It must be less than 20 % of the effective switching distance (s_r).
H ≤ 0.2 s_r



Installation in metal: Sensors with standard switching distance

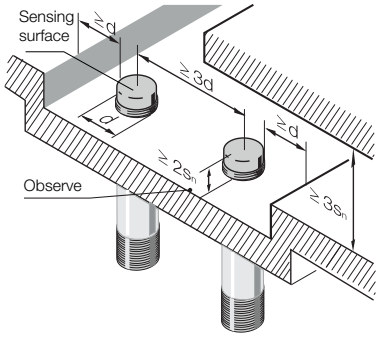
Flush mountable sensors

Flush mountable sensors can be installed with their sensing surfaces flush to the metal. The distance to the opposite metal surfaces has to be ≥ 3 s_n, and the distance between two sensors (with row mounting) has to be ≥ 2d.



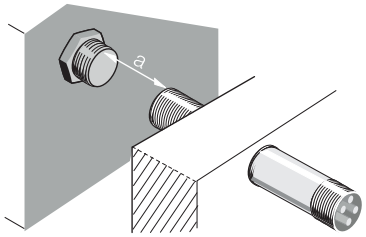
Non-flush mountable sensors

Non-flush mountable sensors can be identified by their "caps", since they have no metal housing surrounding the area of the sensing face. The sensing face must extend ≥ 2s_n from the metallic installation medium. The distance to the opposite metal surfaces has to be ≥ 3 s_n, and the distance between two sensors (with row mounting) has to be ≥ 3d.



Opposing installation of two sensors

An opposing installation of two sensors requires a minimum distance of a ≥ 3d between the sensing faces.



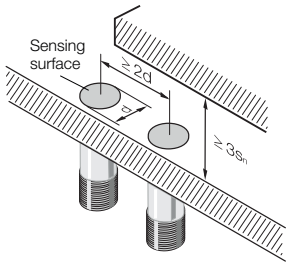
Installation medium

Materials	Description
Ferromagnetic materials	Iron, steel or other magnetizable materials.
Non-ferrous metal	Brass, aluminum or other non-magnetizable materials.
Other materials	Plastics, electrical non-conductive materials

Installation in metal: Sensors with switching distance ■ ■

Flush mountable sensors

Flush mountable sensors can be embedded flush up to their sensing surfaces in non-ferrous materials. Installation in non-ferrous metal may result in a reduction of the switching distance.
The distance to the opposing metal surfaces has to be ≥ 3 s_n and the distance between two sensors (with row mounting) has to be ≥ 2d. In order to install the sensor in ferromagnetic materials, the following guidelines are used for dimension "x".

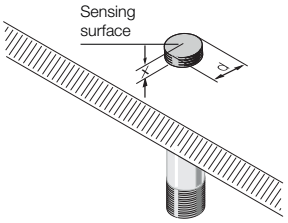


Size d	Dimension x
Ø 3 mm	1 mm
Ø 4 mm	1.5 mm
M5	1.5 mm
Ø 6.5 mm	0 mm
M8	0 mm
M12	1.5 mm
M18	2.5 mm
M30	3.5 mm

For DC 2-wire sensors, the following apply:

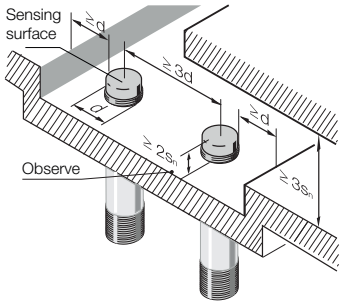
Size d	Dimension x
M8	0 mm
M12	0 mm
M18	0.7 mm
M30	3.5 mm

In the Factor 1 and ATEX NAMUR sensor family, dimension x is not needed when installing in metal.



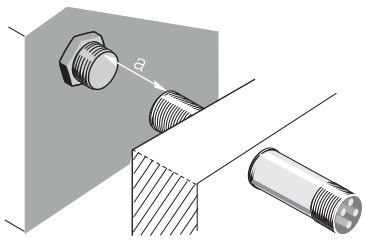
Non-flush mountable sensors

Non-flush mountable sensors can be identified by their "caps", since they have no metal housing surrounding the area of the sensing face. The sensing face must extend 2s_n from the metallic installation medium. The distance to the opposite metal surfaces has to be ≥ 3 s_n, and the distance between two sensors has to be ≥ 3d.



Opposing installation of two sensors

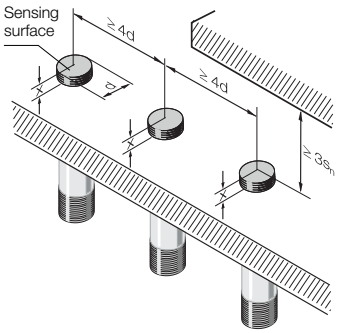
An opposing installation of two sensors requires a minimum distance of a ≥ 4d between the sensing faces.

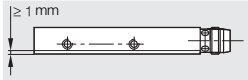


Installation in metal: Sensors with switching distance ■ ■ ■ and ■ ■ ■ ■

Quasi-flush mountable sensors

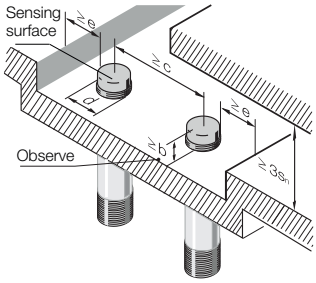
Quasi-flush mountable sensors require space behind the sensing surface which is free of conductive materials. Under this condition the specified switching distance is available without limitation. Dimension "×" (see fig.) indicates the shortest distance between the sensing face and the conductive material behind it.



	Switching distance ■ ■ ■		Switching distance ■ ■ ■ ■	
Size d	**Dimension x for installation in**		**Dimension x for installation in**	
	Ferro magnetic material	Other metals	Ferro magnetic material	Other metals
Ø 6.5 mm	2 mm	1 mm	3 mm	2 mm
M8	2 mm	1 mm	3 mm	2 mm
M12	2.5 mm	2 mm	4 mm	3 mm
M18	4 mm	2.5 mm		
M30	8 mm	4 mm		
8×8 mm				

Non-flush mountable sensors

Non-flush mountable sensors can be identified by their "caps", since they have no metal housing surrounding the area of the sensing face. The distance to the opposing metal surface has to be ≥ 3 s_n.



Installation conditions:

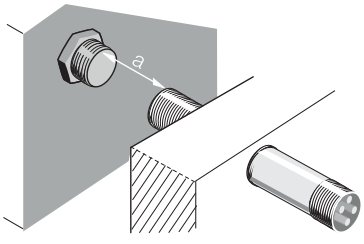
Size d	Dimension b	Dimension c	Dimension e
Ø 3 mm	≥ 10 mm	≥ 30 mm	≥ 10 mm
Ø 4 mm	≥ 15 mm	≥ 40 mm	≥ 20 mm
M5	≥ 15 mm	≥ 40 mm	≥ 20 mm
Ø 6.5 mm	≥ 8 mm	≥ 32 mm	≥ 8 mm
M8	≥ 8 mm	≥ 32 mm	≥ 8 mm
M12	≥ 10 mm	≥ 48 mm	≥ 12 mm
M18	≥ 20 mm	≥ 72 mm	≥ 18 mm
M30	≥ 35 mm in steel ≥ 25 mm in non-ferrous metal ≥ 20 mm in stainless steel	≥ 120 mm	≥ 30 mm

Opposing installation of two sensors

The opposing installation of two sensors requires a minimum distance of a ≥ 5d between the sensing surfaces.

For exceptions see table:

Size d	Dimension a
Ø 3 mm	20 mm
Ø 4 mm	45 mm
M5	45 mm



Inductive distance sensors

Distance sensors with analog output

The distance sensors with analog output are sensors which generate a continuously varying output signal that depends on the distance between their sensing surface and the damping element.

Effective distance s_e

The effective distance is the point in the center of the linearity range s_l, and serves as a reference point for other information.

Linear range s_l

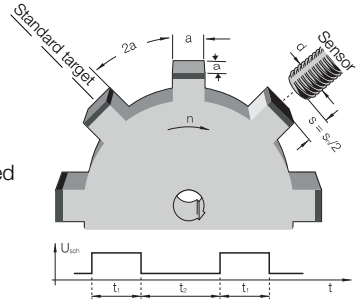
The linear range corresponds to the working range in which the distance sensor demonstrates a defined linearity.

Non-linearity

The non-linearity indicates the maximum deviation of the characteristic of a straight reference. This value applies to the linear range.

Limit frequency (–3 dB)

The limit frequency corresponds to the maximum possible number of switching operations per second. Damping is done according to EN 60947-5-2 with standard targets on a rotating, non-conductive washer. The surface relationship of iron to non-conductive material is 1 : 2. The rated value of the limit frequency (–3 dB-limit) is reached if the output signal has sunk to approx. 70 % of the former signal strength.

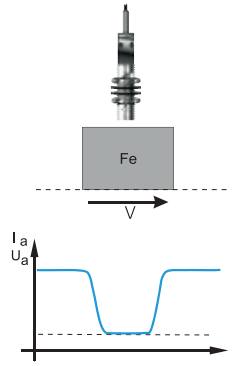


Measuring speed

Through the measurement speed, the distance of a linearly moved object can be requested accurately. The direction of movement of the object is parallel to the sensing face of the sensor.

Response time

The response time is the time a sensor requires to reliably and steadily change the output signal. The specified time, which has been determined at the maximum measuring speed, includes both the electrical response time of the sensor and the time for the mechanical change of the damping state.



Slope

The slope is a measure of the sensitivity of the sensor with respect to a distance change. This physical relationship can be calculated for distance sensors as follows:

$$\text{Slope S [V/mm]} = \frac{U_a\,\text{max} - U_a\,\text{min}}{s_l\,\text{max} - s_l\,\text{min}}$$

or

$$\text{Slope S [mA/mm]} = \frac{I_a\,\text{max} - I_a\,\text{min}}{s_l\,\text{max} - s_l\,\text{min}}$$

Temperature drift

The temperature drift is the shift a point experiences on the actual output curve at different temperatures. The temperature drift is described by the temperature coefficient.

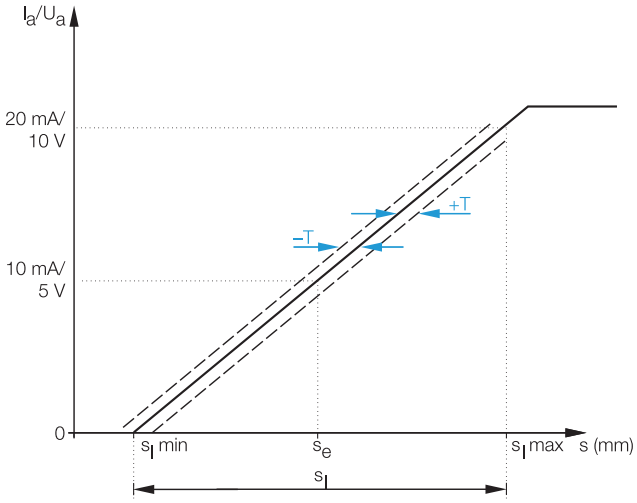
Temperature coefficient TC

The temperature coefficient describes the deviation in the sensor output signal under the effect of a temperature change.

Tolerance T

Tolerance T is a variable that defines the manufacturing tolerance band of the output curve, thereby determining the maximum sample deviation.

Size	"T" for flush sensors	"T" for non-flush sensors
Ø 6.5 mm	±0.125 mm	
M8	±0.1 mm	±0.15 mm
M12	±0.125 mm	±0.25 mm
M18	±0.3 mm	±0.5 mm
M30	±0.6 mm	±0.8 mm
PG 36	±0.1 mm	
20×30×8 mm	±0.125 mm	
80×80×40 mm	±1.0 mm	



Repeat accuracy R

Repeat accuracy is the value of the change to the output signal under specified conditions, expressed as a percentage of the upper distance. The measurement must be taken in the lower, upper and middle area of the linear range. It corresponds to the repeat accuracy R of proximity switches and is determined under the same standardized conditions (EN 60947-5-2).
Displacement sensors with analog output achieve the value R of ≤ 5% defined in the standard.

Repeat accuracy R_{BWN}

Repeat accuracy describes the precision an analog sensor achieves when moving to a measuring point multiple times. The value specified on the basis of the Balluff Factory Standard (BWN Pr. 44) describes the maximum deviation from this measuring point.

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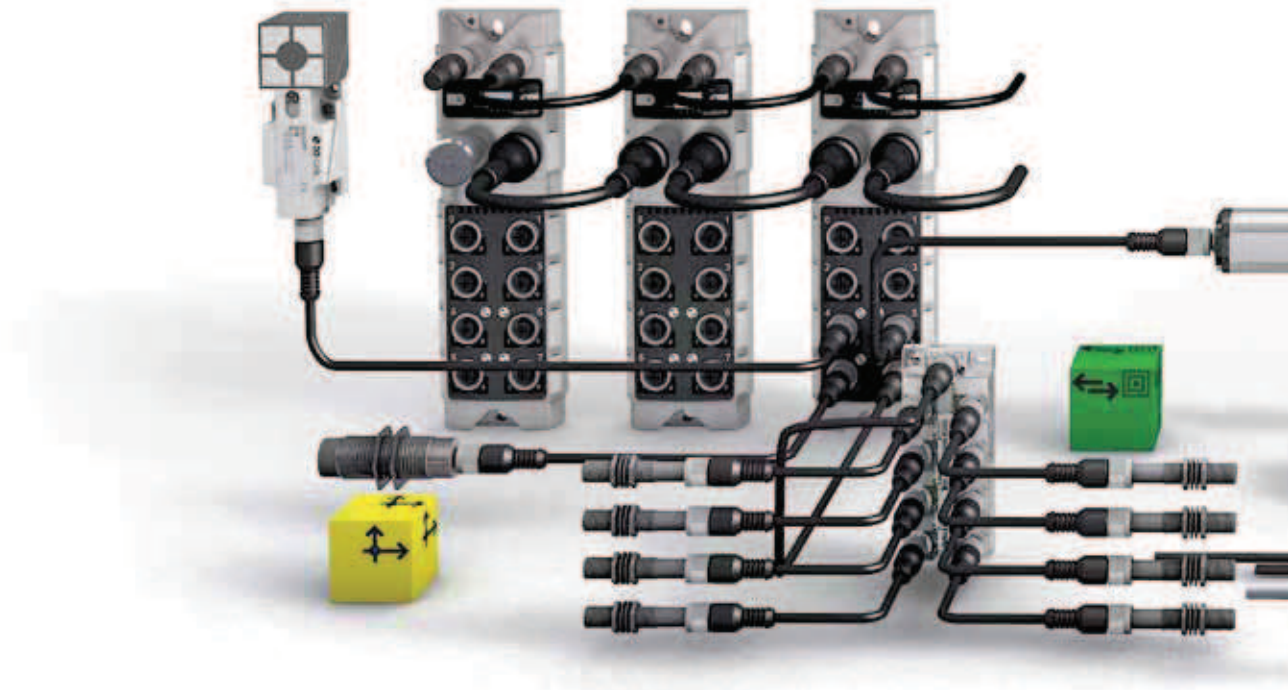

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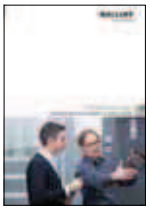

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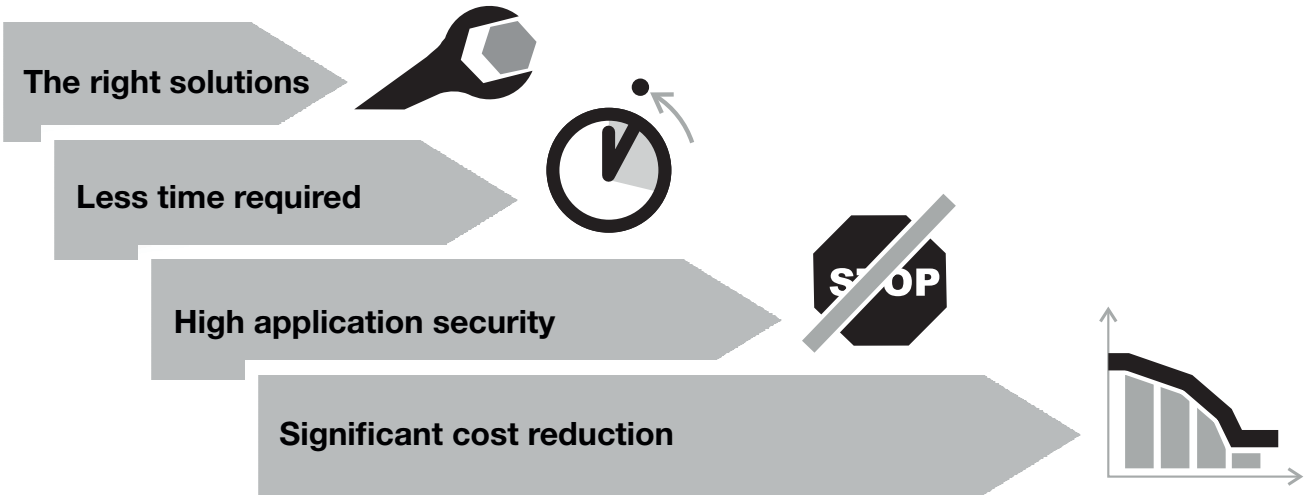
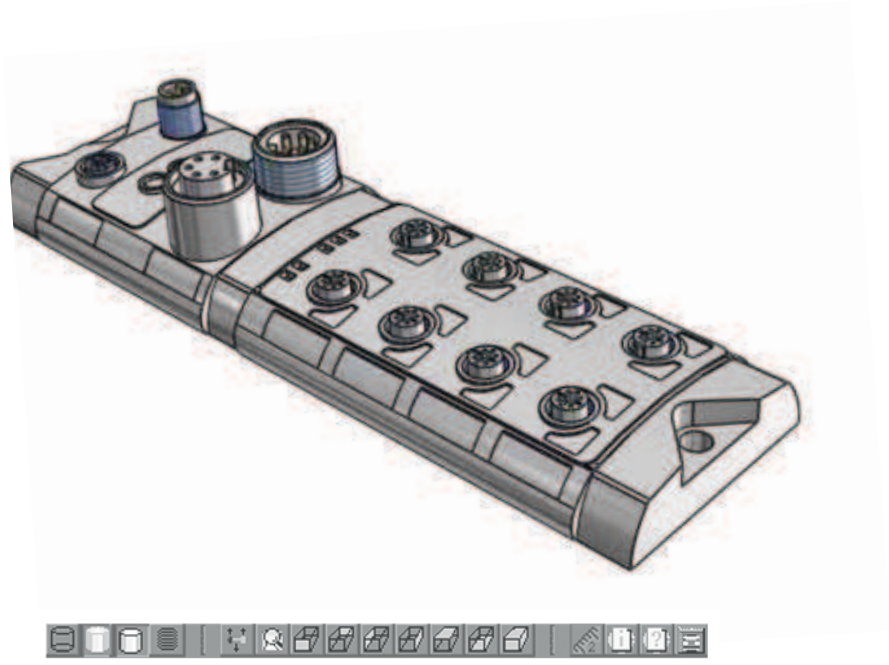
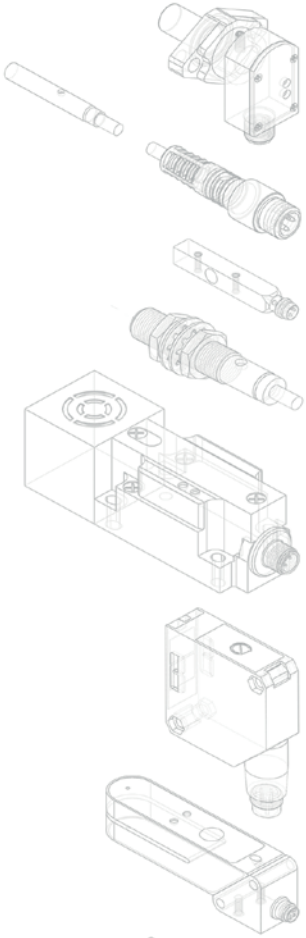


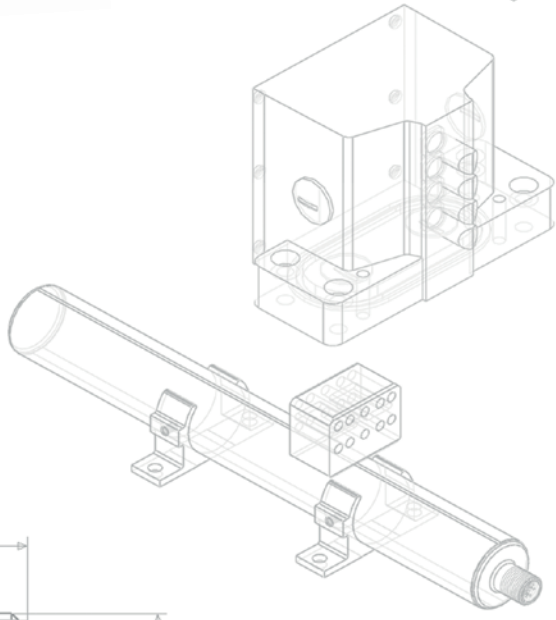
Application advice through our TecSupport: Discuss your technical requirements. And take advantage of our expertise.	Real-world examples: ■ Selection of the correct identification procedure for an assembly line ■ IO-Link concept as a cost-effective alternative to conventional wiring ■ System consulting for radio frequency identification (RFID): identification of large steel pipes in adverse environments ■ Recognizing multiple containers on a pallet in goods receiving
Commissioning: Order expert knowledge. And benefit from a quick start of production.	Real-world examples: ■ Setting up an optical checkpoint with the BVS vision sensor ■ Consulting and support during the programming of BIS RFID systems ■ Installation and commissioning of a color detection application with the BFS color sensor
Fully customized products: Order individual versions according to your requirements: from preassembly to engineering services. And take advantage of the optimum.	Real-world examples: ■ Extending the housing of a BHS high-pressure resistant inductive sensor ■ Extra threads for the housing cover of a micropulse transducer BTL ■ Customer-specific holder for an RFID data carrier ■ Adaptation of the characteristics for analog sensors BAW
Workshops: make use of well-founded manufacturer knowledge. And benefit from application security.	■ **Professional sensor use:** Select operating principles, install sensors professionally and ensure the reliable operation of your application. ■ **Linear position sensing:** This is how you measure precisely and wear-free. ■ **RFID:** The right data at the right time at the right place. ■ **Vision sensor:** Using an image processing sensor, ensure manufacturing quality in three steps. ■ **Vision sensor identification:** Reliably identify data matrix codes with an image-processing sensor. ■ **Industrial networking with IO-Link:** Manage signals intelligently and cost-effectively.

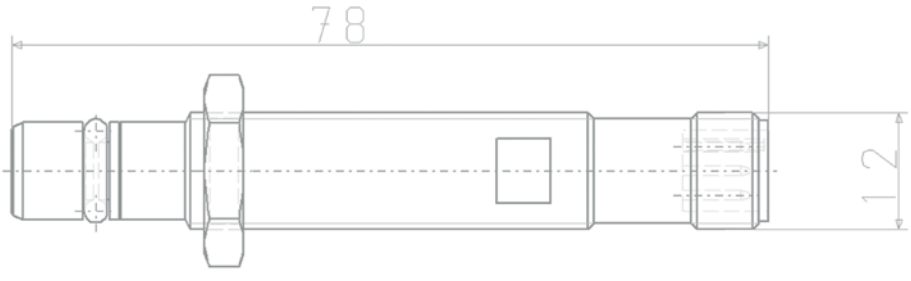
Balluff Products in 3D





- All catalog products are available: inductive sensors, photoelectric sensors, sensors for pneumatic cylinders, micropulse transducers, industrial RFID systems, vision sensors BVS, mechanical single and multiple position switches, industrial networking and connectivity, and so on.
- sizephics reduced to the essentials for optimized performance

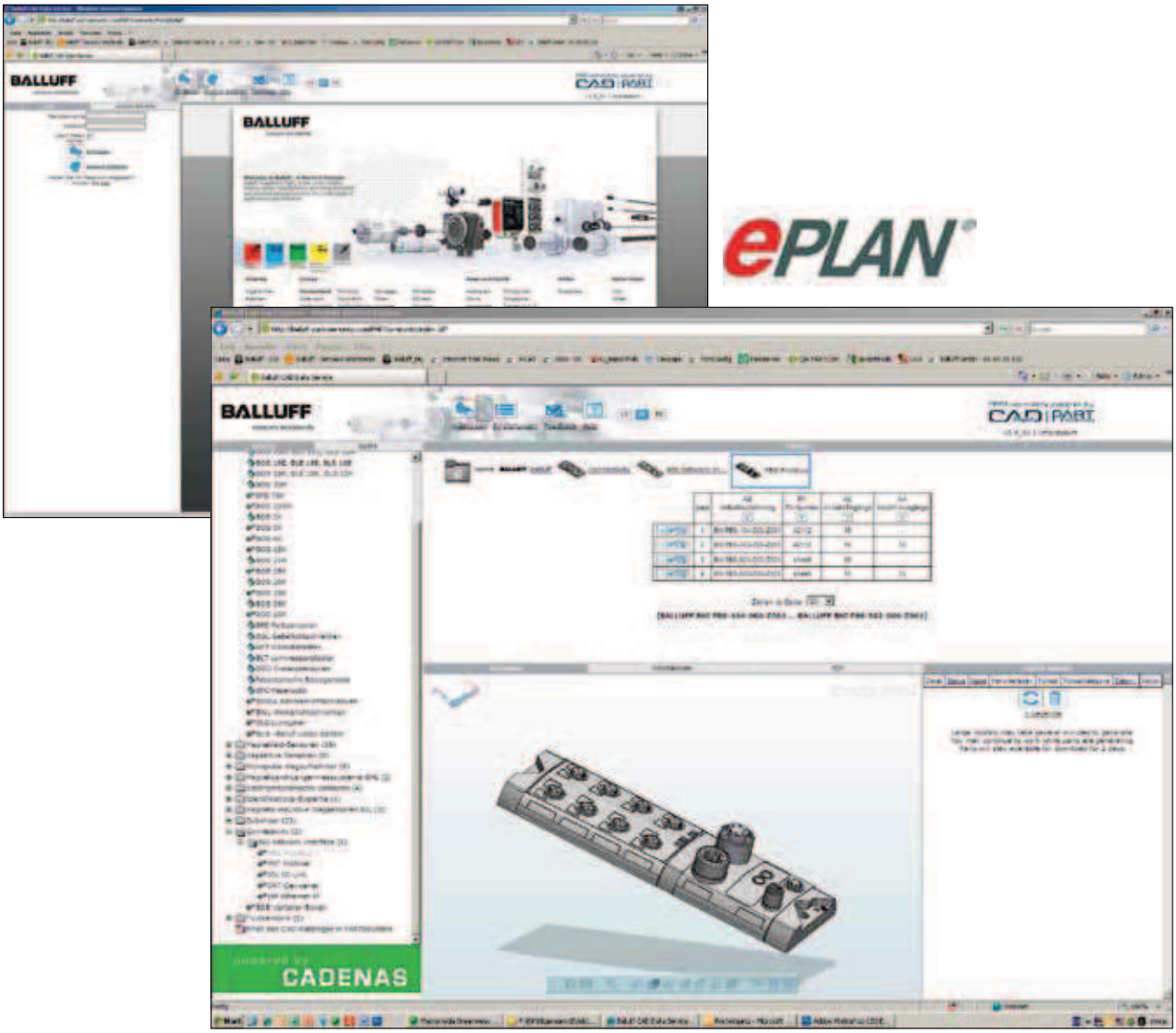




CAD formats on the Cadenas PARTserver

Retrieving Product Information Online

Various CAD and electronic diagram formats available



The benefits to you

- Faster and more efficient designing
- Free availability of all Balluff catalog products
- All common CAD formats
- Convenient preview in 3D
- Configurable products

And here is how it works

- Go to the 3D data at **www.balluff.com**
- You are redirected to the Cadenas PARTserver
- Select a sensor and perform an optional check via 3D preview
- Add it to the shopping cart
- Once you have entered your details, the CAD files of your choice are sent to you by e-mail

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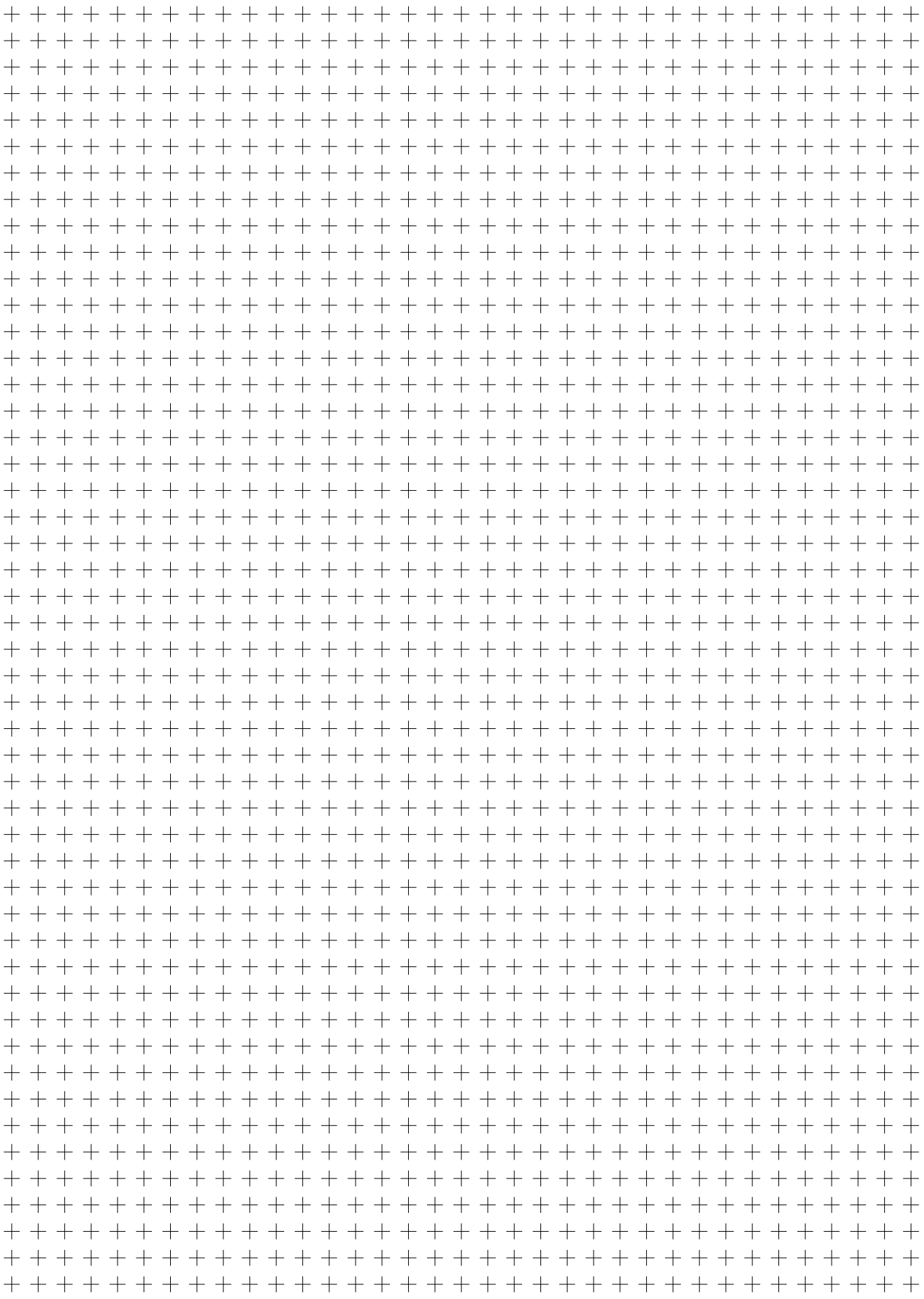
And now users of EPLAN electrical project planning software can also profit from this free service. On our Web site planners and designers can download macros for selected Balluff products at no charge and implement them in their design. These macros include all the necessary graphics, technical and commercial information for the electrical design and documentation. Benefit from significant time and cost savings.



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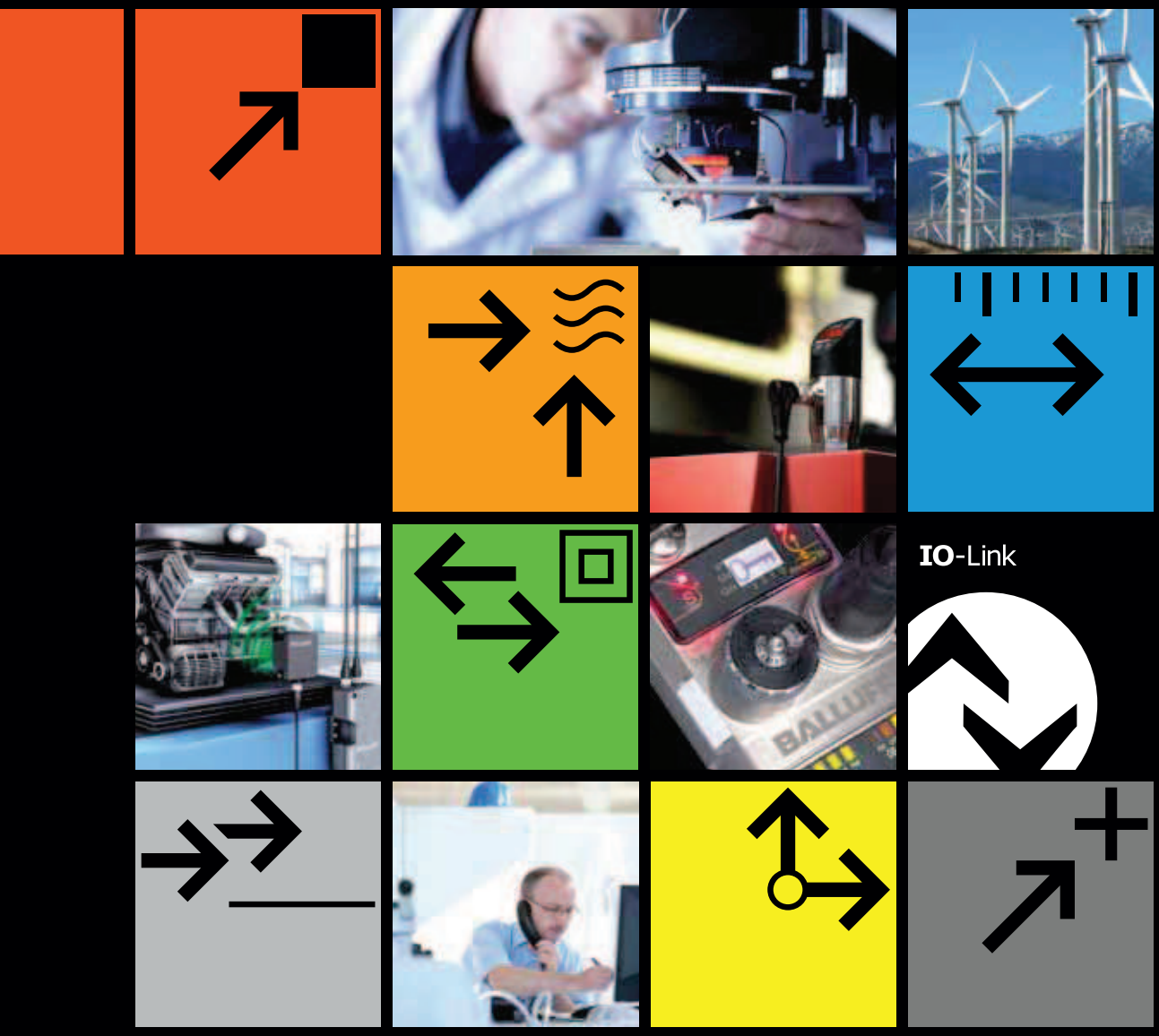
As a recognized partner in all sectors of the automation industry, Balluff offers comprehensive expertise in sensor technology and networking. We supply advanced technology and state-of-the-art electronics to our customers, who benefit from excellent service, application-specific solutions and individual consultation. You too can benefit from the excellent quality of our products and services.



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Doc. No. 862399/Mat No. 163386 E
Edition 1302; subject to changes.
Replaces edition 0811.