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Capacitive BEROs

Introduction

Area of application

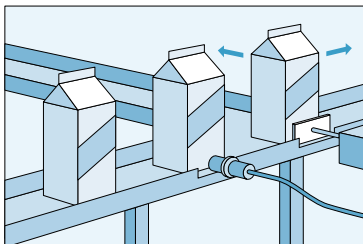


BERO 3RG16 capacitive proximity switches are position switches that operate without contact. They detect electrically conductive or non-conductive materials that are in a solid, powder or liquid state, e.g. glass, ceramics, plastic, wood, oil, water, cardboard and paper. The BERO switches when the material is at a specific distance from the sensor.

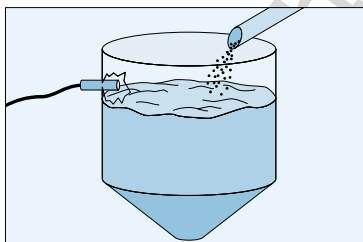
Standard applications for BERO capacitive proximity switches are

- Level control in plastic or glass containers
- Level monitoring in transparent packaging
- Winding wire breakage signaling
- Tape breakage signaling
- Bottle counting
- Tape loop control and tape tension control
- Item counting of any kind.

Examples



Recognition of milk in cartons



Level control for bulk material in vessel

Standards

The same standards are applicable as for the inductive BEROs.

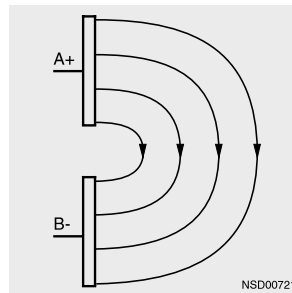
Design

The BEROs are available in DC or AC versions.

- The DC versions can activate electronic controllers (SIMATIC) or relays directly.
- With the AC version, the load (contactor relay, solenoid valve) is connected directly to the AC supply network (preferably 230 V, 50 Hz) in series with the BERO.

Functions

The sensing face of a capacitive sensor is formed by two concentrically arranged metal electrodes that are equivalent to the electrodes of an unwound capacitor. The electrode surfaces A and B are connected into the feedback branch of a high-frequency oscillator that is tuned such that it does not oscillate when the surface is free.



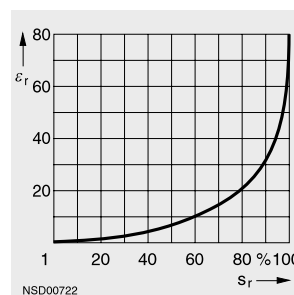
When an object approaches the active face of the sensor, it enters the electric field in front of the electrode surfaces and causes a change in the coupling capacitance. The oscillator starts to oscillate; the amplitude is recorded by an evaluation circuit and converted into a switching command.

Switching frequency

The build-up characteristics specific to other pulse/interval conditions may result in higher switching frequencies than those specified.

Operating distance

The stated values are applicable to a target of metal which is grounded and whose area corresponds to the sensing face of the BERO. The real operating distance s_r for non-conductive targets is dependent on the relative dielectric constant ϵ_r and the characteristic value (see characteristic curve).



Dielectric constants of various materials

| Material | ϵ_r | Material | ϵ_r |
|---------------------------|--------------|-------------------|--------------|
| Alcohol | 25.8 | Polyethylene | 2.3 |
| Araldite | 3.6 | Polypropylene | 2.3 |
| Bakelite | 3.6 | Polystyrene | 3 |
| Glass | 5 | Polyvinylchloride | 2.9 |
| Mica | 6 | Porcelain | 4.4 |
| Vulcanized rubber | 4 | Pressboard | 4 |
| Hard paper | 4.5 | Quartz glass | 3.7 |
| Wood | 2 ... 7 | Quartz sand | 4.5 |
| Cable insulating compound | 2.5 | Silicone rubber | 2.8 |
| Air, vacuum | 1 | Teflon | 2 |
| Marble | 8 | Turpentine oil | 2.2 |
| Oiled paper | 4 | Transformer oil | 2.2 |
| Paper | 2.3 | Vacuum, air | 1 |
| Paraffin | 2.2 | Water | 80 |
| Petroleum | 2.2 | Soft rubber | 2.5 |
| Plexiglas | 3.2 | Celluloid | 3 |
| Polyamide | 5 | | |

Built-in protection

The protective circuits built into the DC versions make them easy to handle and protect the devices from damage.

- Spurious signal suppression
- Short-circuit and overload protection
- Polarity reversal protection for connections
- Inductive interference protection

Technical specifications

| Type | DC | AC |
|--|------------------------------|---------------|
| Operating voltage | 10 ... 65 (30) V | 20 ... 250 V |
| • Residual ripple | Max. 10 % | – |
| No-load supply current I_0 | 6 ... 12 mA | Max. 1.7 mA |
| Switching frequency f | 100 Hz | 20 Hz |
| Repeat accuracy R | Max. 2 % | |
| Differential travel H | 0.02 to 0.2 s_r | |
| Outputs: | | |
| Rated operating current I_e | | |
| • For DC | 200 mA | – |
| • For AC 230 V (contactor up to size S3) | – | 500 mA 5 A |
| • Continuous | | |
| • Up to 20 ms | | |
| Smallest operating current I_m | – | 10 mA 5 mA |
| • Mainly inductive load | | |
| • Mainly resistive load | | |
| Residual current I_r | 6 ... 12 mA | Max. 1.7 mA |
| Voltage drop | Max. 1.8 V | Max. 7 V |
| Lead length, max. permissible | 300 m | |
| Degree of protection | IP67 | |
| Ambient temperature | | |
| • Operation | –20 ... +70 °C | |
| • Storage | –40 ... +85 °C | |
| Shock resistance | 30 × g, 11 ms duration | |
| Resistance to vibration | 10 ... 55 Hz, 1 mm amplitude | |

Circuit diagrams

DC

Fig. 1

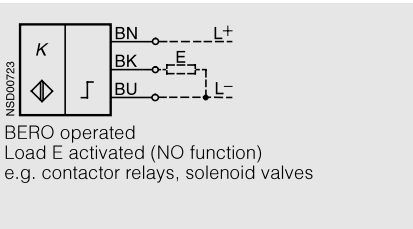


Fig. 2

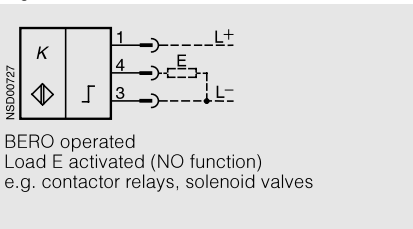


Fig. 3

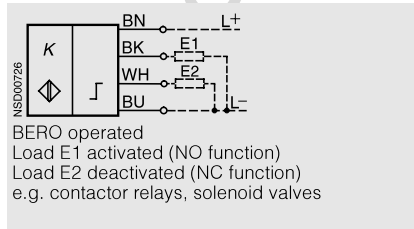
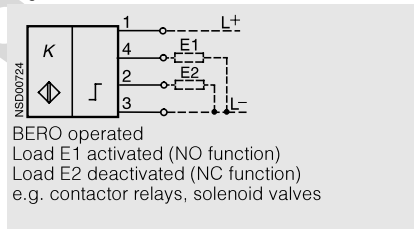


Fig. 4



AC

Fig. 5

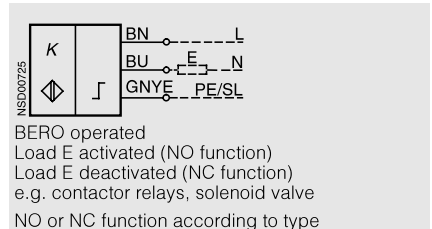
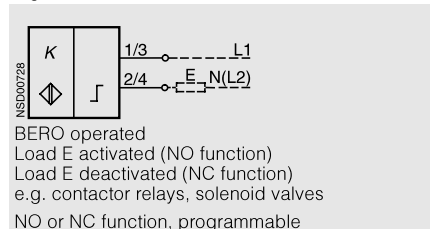


Fig. 6



Capacitive BEROs

DC 10 to 65 V

Technical specifications

| No. of onnecting wires | 3 | 3 | 4 |
|--|-----------------|----------------------------|--------------------------------|
| Design | M 18 | Cubic 20 mm × 32 mm | M 30 |
| Embeddable in metal | Shielded | Shielded | Shielded |
| Rated operating distance s_n ¹⁾ | 5 mm | 5 mm | 10 mm |
| Real operating distance s_r ²⁾ | Adjustable | Fixed comparison | Adjustable |
| Enclosure material | Molded plastic | Metal | Metal with molded-plastic head |
| Operational voltage (DC) | V 10 ... 65 | 10 ... 30 | 10 ... 65 |
| Rated operating current I_e | mA 200 | 200 | 200 |
| Displays | | | |
| • Switching status | Red LED | Yellow LED | Red LED |
| • Operating voltage range | – | Green LED | – |
| Degree of protection | IP67 | IP67 | IP67 |
| Type | 3RG16 13-0AB00 | 3RG16 73-.AG00 | 3RG16 14-0AC00 |

1) For target made of earthed metal.

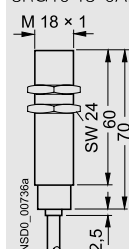
2) With an alignment $s_r > s_n$, the differential travel can increase significantly.

Selection and ordering data

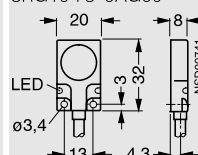
| Switching output | Circ. diag. No. | Con- nector type | DT | Order No. | PS | Approx. weight per PU | DT | Order No. | PS | Approx. weight per PU | DT | Order No. | PS | Approx. weight per PU |
|--|-----------------|------------------|----|-------------------------|--------|-----------------------|----|--------------------------|--------|-----------------------|----|--------------------------|--------|-----------------------|
| | | | | | | kg | | | | kg | | | | kg |
| With 2 m cable, LiYY | | | | 3 × 0.5 mm ² | | | | 3 × 0.25 mm ² | | | | 4 × 0.34 mm ² | | |
| NO contact, pnp | 1 | | A | 3RG16 13-0AB00 | 1 unit | 0.121 | A | 3RG16 73-0AG00 | 1 unit | 0.075 | A | – | | |
| NO and NC contacts, 3 pnp (antivalent) | | | | – | | | | – | | | | 3RG16 14-0AC00 | 1 unit | 0.238 |
| With connector, Ø 8 mm | | | | | | | | | | | | | | |
| NO contact, pnp | 2 | A, C | | – | | | A | 3RG16 73-7AG00 | 1 unit | 0.032 | | – | | |

Dimension drawings

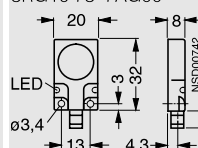
3RG16 13-0AB00



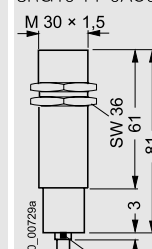
3RG16 73-0AG00



3RG16 73-7AG00

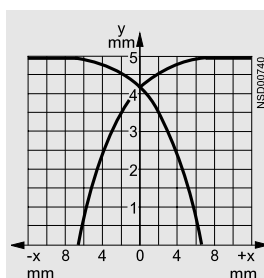


3RG16 14-0AC00

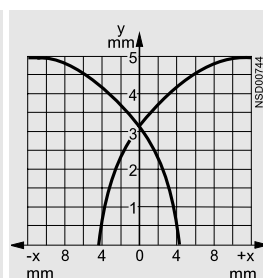


Wherever you find the abbreviation SW in dimension drawings please note that SW means "spanner width" and Sg means "connecting thread".

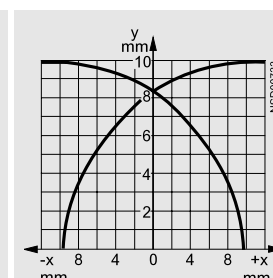
Characteristics



Standard target:
metal, 20 mm × 20 mm × 1 mm,
with direct connection to earth



Standard target:
metal, 20 mm × 20 mm × 1 mm,
with direct connection to earth



Standard target:
metal, 30 mm × 30 mm × 1 mm,
with direct connection to earth

Technical specifications

| | | | |
|--|----------------|----------------|---------------------|
| No. of connecting wires | 4 | 4 | 4 |
| Design | M 30 | Ø 40 mm | Cubic 40 mm × 40 mm |
| Embeddable in metal | Shielded | Shielded | Shielded |
| Rated operating distance s_n ¹⁾ | 10 mm | 20 mm | 20 mm |
| Real operating distance s_r ²⁾ | Adjustable | Adjustable | Adjustable |
| Enclosure material | Molded plastic | Molded plastic | Molded plastic |
| Operational voltage (DC) V | 10 ... 65 | 10 ... 65 | 10 ... 65 |
| Rated operating current I_e mA | 200 | 200 | 200 |
| Displays | | | |
| • Switching status | Yellow LED | Yellow LED | Yellow LED |
| • Operating voltage range | Green LED | Green LED | Green LED |
| Degree of protection | IP67 | IP67 | IP67 |
| Type | 3RG16 14-6AC00 | 3RG16 55-6AC00 | 3RG16 30-6AC00 |

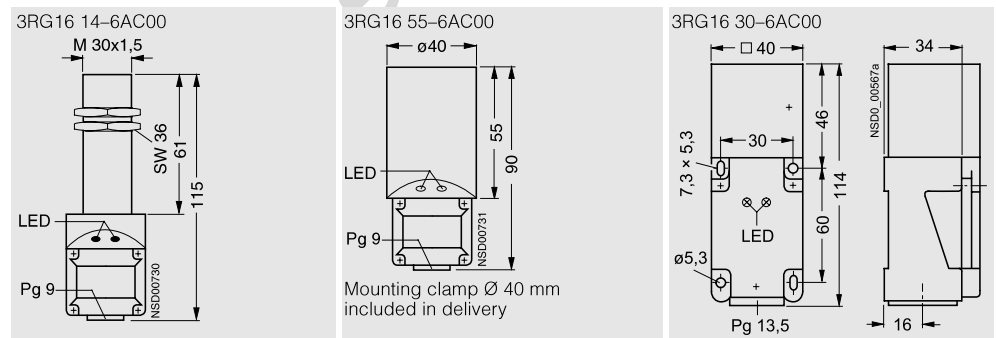
1) For target made of earthed metal.

2) With an alignment $s_r > s_n$, the differential travel can increase significantly.

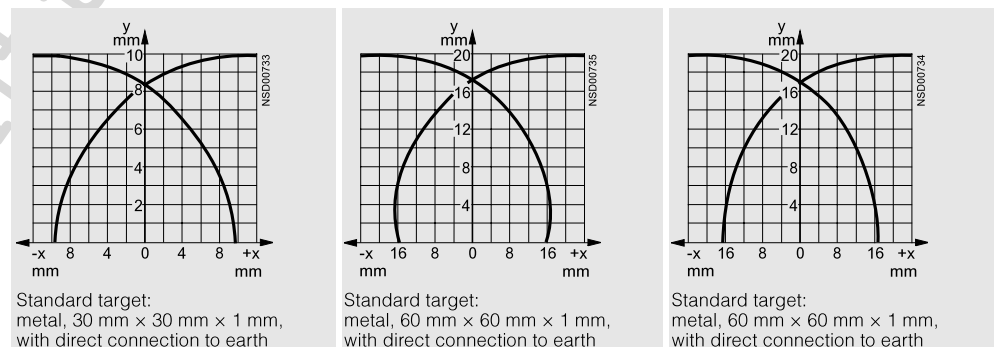
Selection and ordering data

| Switching output | Circ. diag. No. | Con- nector type | DT | Order No. | PS | Approx. weight per PU kg | DT | Order No. | PS | Approx. weight per PU kg | DT | Order No. | PS | Approx. weight per PU kg |
|--|-----------------|------------------|----|---------------------------|--------|--------------------------|---------------------------|----------------|--------|--------------------------|---------------------------|----------------|--------|--------------------------|
| With terminal compartment | | | | Up to 2.5 mm ² | | | Up to 2.5 mm ² | | | | Up to 2.5 mm ² | | | |
| NO and NC contacts, 4 pnp (compatible) | | | A | 3RG16 14-6AC00 | 1 unit | 0.127 | A | 3RG16 55-6AC00 | 1 unit | 0.171 | A | 3RG16 30-6AC00 | 1 unit | 0.220 |

Dimension drawings



Characteristics



Capacitive BEROs

AC 20 to 250 V

Technical specifications

| No. of connecting wires | 2 + PE | 2 | 2 | 2 |
|--|--------------------------------|----------------|-----------------|----------------------------|
| Design | M 30 | | Ø 40 mm | Cubic 40 mm × 40 mm |
| Embeddable in metal | Shielded | | Shielded | Shielded |
| Rated operating distance s_n ¹⁾ | 10 mm | | 20 mm | 20 mm |
| Real operating distance s_r ²⁾ | Adjustable | | Adjustable | Adjustable |
| Enclosure material | Metal with molded-plastic head | Molded plastic | Molded plastic | Molded plastic |
| Operational voltage (DC) | V | 20 ... 250 | 20 ... 250 | 20 ... 250 |
| Rated operating current I_e | mA | 500 | 500 | 500 |
| Displays | | | | |
| • Switching status | Red LED | Red LED | Red LED | Red LED |
| • Operating voltage range | – | Green LED | Green LED | Green LED |
| Degree of protection | IP67 | | IP67 | IP67 |
| Type | 3RG16 14-0LB00, 3RG16 14-0LA00 | | 3RG16 55-6LD00 | 3RG16 30-6LD00 |

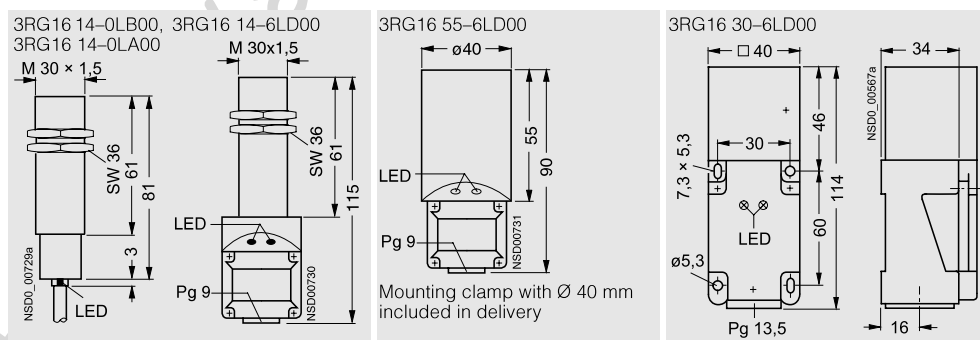
1) For target made of earthed metal.

2) With an alignment $s_r > s_n$, the differential travel can increase significantly.

Selection and ordering data

| Switching output | Circ. diag. No. | Con- nector type | DT | Order No. | PS | Approx. weight per PU | DT | Order No. | PS | Approx. weight per PU | DT | Order No. | PS | Approx. weight per PU |
|----------------------------------|-----------------|------------------|----|---------------------------|--------|-----------------------|----|-----------------------|--------|-----------------------|----|-----------------------|--------|-----------------------|
| | | | | | | kg | | | | kg | | | | kg |
| With 2 m cable, LiYY | | | | 3 × 0.5 mm ² | | | | | | | | | | |
| NO contact | 5 | | A | 3RG16 14-0LB00 | 1 unit | 0.246 | – | | | | – | | | |
| NC contact | 5 | | A | 3RG16 14-0LA00 | 1 unit | 0.244 | – | | | | – | | | |
| With terminal compartment | | | | Up to 2.5 mm ² | | | | | | | | | | |
| NO or NC contact programmable | 6 | | A | 3RG16 14-6LD00 | 1 unit | 0.128 | A | 3RG16 55-6LD00 | 1 unit | 0.171 | A | 3RG16 30-6LD00 | 1 unit | 0.222 |

Dimension drawings



Characteristics

