

# ICS12, ICS18 and ICS30



## Proximity inductive sensors with E1-type approval



### Description

ICS E1 series is a complete family of high performance inductive sensors which represents Carlo Gavazzi standard solution for outdoor mobile applications.

Since they are installed on vehicles such as trucks or earth-moving equipments, they have to survive harsh environmental conditions, such as very high level of shock and vibrations, low and high temperature, high level radio frequency noise, and frequent washing cycles with liquid cleaners and degreasers to remove grease and oils.

This family is available in M12, M18 and M30 housings, with extended sensing ranges (2x), stainless steel housing and it is characterized by very high durability.

### Benefits

- **A complete family.** Available in M12, M18 and M30 housings with an operating distance from 4 to 22 mm.
- **Less machine downtime.** Lower risk of mechanical damage thanks to the extended range sensors with 2 times the standard operating distance.
- **E1-type approval** by the German Federal Motor Transport Authority, assures the sensor complies with the automotive standards and is allowed to be mounted on vehicles.
- **High EMC standards** with immunity to false actuation when exposed to radiated noise with field strengths of up to 200 V/m and immunity to conducted RF noise of 10 V.
- **Extended power supply range** from 8 to 60 V DC, to allow reliable operation in mobile equipment, where the power source is often only a conventional vehicle battery, requiring a very low voltage in some particular situations.
- **Load-dump protection** protects the electronics against voltage peaks in the onboard power supply. These damaging voltage surges are typically generated when the alternator is charging the battery, supplying charging current, and the battery connection is lost, generally due to corrosion or poor connection.
- **Easy to install.** ICS12 and ICS18 sensors have a milled section for wrench grip. The LED also indicates when there is a short circuit or overload condition. The user can choose between 2 m PUR cable and M12-plug versions.
- **High precision.** The onboard advanced microcontroller ensures better stability with respect to environmental influences, with highly repeatable measurements between -40 and +85°C (-40 and +185°F).
- **Easy customization to specific OEM requests** such as pigtail solutions with special cables and connectors used in mobile equipments are possible on request.
- **Product traceability.** Permanently legible part number and serial number, laser engraved on the plastic cap, guarantee the traceability of every sensor.


### Applications

- Trucks, earth-moving equipments, agriculture machines, mobile cranes, buses.

### Main functions

- Non contact detection of metal objects in general position-sensing and presence-sensing in mobile equipment applications
- Integrated diagnostic function with flashing LED in the event of a short circuit or overload

## References

 **Order code**

 ICS  L50     E1

Enter the code option instead of

| Code                     | Option | Description   |
|--------------------------|--------|---|
| I                        | -      | Inductive sensor  |
| C                        | -      | Cylindrical housing   |
| S                        | -      | Stainless steel housing   |
| <input type="checkbox"/> | 12     | M12 housing   |
|                          | 18     | M18 housing   |
|                          | 30     | M30 housing   |
| L50                      | -      | Housing with thread length of 50 mm   |
| <input type="checkbox"/> | F      | Flush   |
|                          | N      | Non-flush   |
| <input type="checkbox"/> | 04     | ICS12 flush: 4mm (extended range)   |
|                          | 08     | ICS12 non-flush: 8 mm (extended range)<br>ICS18 flush: 8mm (extended range) |
|                          | 14     | ICS18 non-flush: 14mm (extended range)                                      |
|                          | 15     | ICS30 flush: 15mm (extended range)  |
|                          | 22     | ICS30 non-flush: 22mm (extended range)                                      |
| <input type="checkbox"/> | NO     | NPN – normally open output  |
|                          | NC     | NPN – normally closed output  |
|                          | PO     | PNP – normally open output  |
|                          | PC     | PNP – normally closed output  |
| <input type="checkbox"/> | B2     | 2 m PUR cable   |
|                          | M1     | M12 plug  |
| E1                       | -      | E1-type approved for mobile equipment                                       |

Additional characters can be used for customized versions.

 Selection guide

## M12 Extended range

| Connection | Detection principle | Output type | Ordering no. Normally Open | Ordering no. Normally Closed |
|------------|---------------------|-------------|----------------------------|------------------------------|
| Cable      | Flush               | NPN         | ICS12L50F04NOB2E1          | ICS12L50F04NCB2E1            |
|            |                     | PNP         | ICS12L50F04POB2E1          | ICS12L50F04PCB2E1            |
|            | Non-flush           | NPN         | ICS12L50N08NOB2E1          | ICS12L50N08NCB2E1            |
|            |                     | PNP         | ICS12L50N08POB2E1          | ICS12L50N08PCB2E1            |
| Plug       | Flush               | NPN         | ICS12L50F04NOM1E1          | ICS12L50F04NCM1E1            |
|            |                     | PNP         | ICS12L50F04POM1E1          | ICS12L50F04PCM1E1            |
|            | Non-flush           | NPN         | ICS12L50N08NOM1E1          | ICS12L50N08NCM1E1            |
|            |                     | PNP         | ICS12L50N08POM1E1          | ICS12L50N08PCM1E1            |

## M18 Extended range

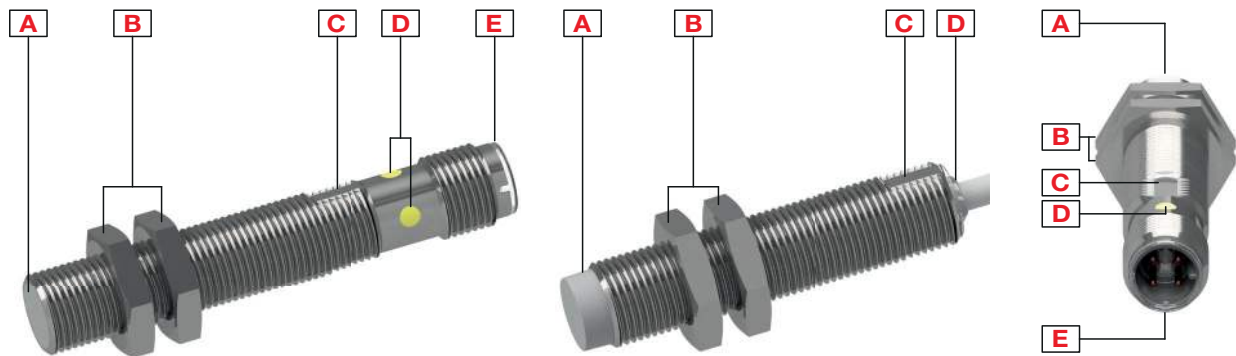
| Connection | Detection principle | Output type | Ordering no. Normally Open | Ordering no. Normally Closed |
|------------|---------------------|-------------|----------------------------|------------------------------|
| Cable      | Flush               | NPN         | ICS18L50F08NOB2E1          | ICS18L50F08NCB2E1            |
|            |                     | PNP         | ICS18L50F08POB2E1          | ICS18L50F08PCB2E1            |
|            | Non-flush           | NPN         | ICS18L50N14NOB2E1          | ICS18L50N14NCB2E1            |
|            |                     | PNP         | ICS18L50N14POB2E1          | ICS18L50N14PCB2E1            |
| Plug       | Flush               | NPN         | ICS18L50F08NOM1E1          | ICS18L50F08NCM1E1            |
|            |                     | PNP         | ICS18L50F08POM1E1          | ICS18L50F08PCM1E1            |
|            | Non-flush           | NPN         | ICS18L50N14NOM1E1          | ICS18L50N14NCM1E1            |
|            |                     | PNP         | ICS18L50N14POM1E1          | ICS18L50N14PCM1E1            |

## M30 Extended range

| Connection | Detection principle | Output type | Ordering no. Normally Open | Ordering no. Normally Closed |
|------------|---------------------|-------------|----------------------------|------------------------------|
| Cable      | Flush               | NPN         | ICS30L50F15NOB2E1          | ICS30L50F15NCB2E1            |
|            |                     | PNP         | ICS30L50F15POB2E1          | ICS30L50F15PCB2E1            |
|            | Non-flush           | NPN         | ICS30L50N22NOB2E1          | ICS30L50N22NCB2E1            |
|            |                     | PNP         | ICS30L50N22POB2E1          | ICS30L50N22PCB2E1            |
| Plug       | Flush               | NPN         | ICS30L50F15NOM1E1          | ICS30L50F15NCM1E1            |
|            |                     | PNP         | ICS30L50F15POM1E1          | ICS30L50F15PCM1E1            |
|            | Non-flush           | NPN         | ICS30L50N22NOM1E1          | ICS30L50N22NCM1E1            |
|            |                     | PNP         | ICS30L50N22POM1E1          | ICS30L50N22PCM1E1            |

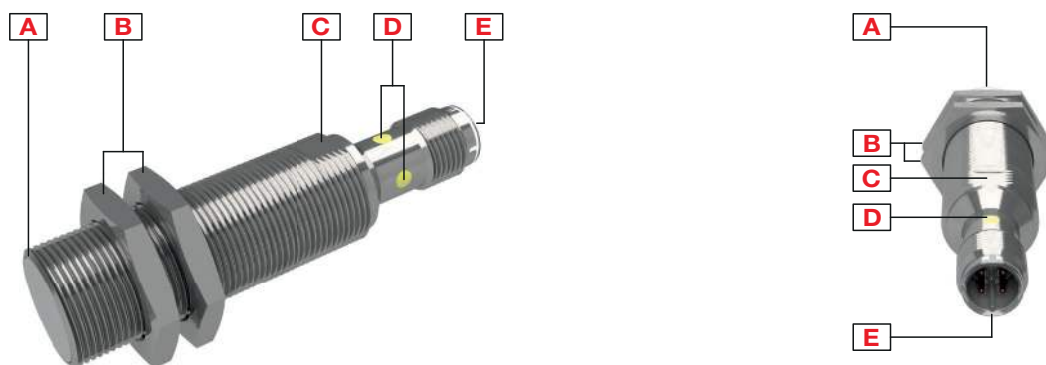
## Structure

### ICS12



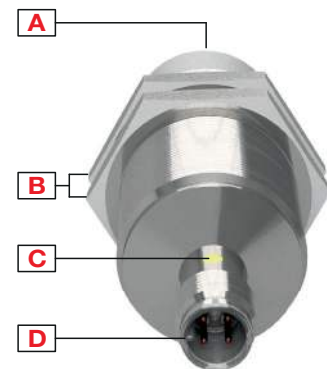
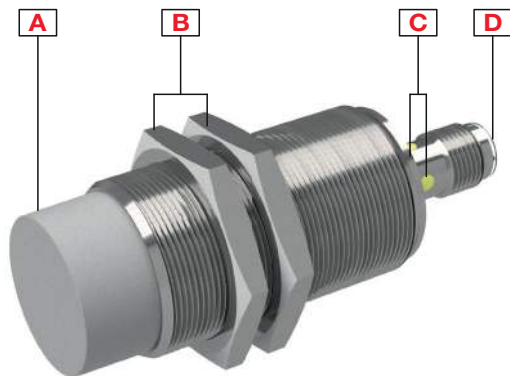
| Element | Component                      | Function   |
|---------|--------------------------------|--|
| A       | Sensing face                   | Flush or non-flush   |
| B       | 2 nuts                         | For sensor mounting  |
| C       | Milled section                 | For wrench grip  |
| D       | LED                            | Green and Yellow LED; Output flashing: short circuit, overload |
| E       | M12 x 1, 4 pin, male connector | For plug versions only   |

### ICS18



| Element | Component                      | Function   |
|---------|--------------------------------|--|
| A       | Sensing face                   | Flush or non-flush   |
| B       | 2 nuts                         | For sensor mounting  |
| C       | Milled section                 | For wrench grip  |
| D       | LED                            | Green and Yellow LED; Output flashing: short circuit, overload |
| E       | M12 x 1, 4 pin, male connector | For plug versions only   |

## ICS30

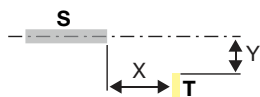


| Element | Component                      | Function   |
|---------|--------------------------------|--|
| A       | Sensing face                   | Flush or non-flush   |
| B       | 2 nuts                         | For sensor mounting  |
| C       | LED                            | Green and Yellow LED; Output flashing: short circuit, overload |
| D       | M12 x 1, 4 pin, male connector | For plug versions only   |

# Sensing

## Detection

|  |  |
|--|--|
| <b>Rated operating distance <math>S_n</math></b>             | 4 to 22 mm: depending on housing diameter and version (flush or non-flush)   |
| <b>Reference target</b>                                      | The operating distance is measured according to EN 60947-5-2, using a standard target moving axially.<br>This target is square shape 1 mm thickness, made of steel e.g. type Fe 360 as defined in ISO 630 and it shall be of the rolled finish.<br>The length of the side of the square is equal to<br>– the diameter of the circle inscribed on the active surface of the sensing face, or<br>– three times the rated operating distance $S_n$ whichever is greater |
| <b>Assured operating sensing distance (<math>S_a</math>)</b> | $0 \leq S_a \leq 0.81 \times S_n$ (e.g. with $S_n$ of 15 mm, $S_a$ is 0 ... 12.15 mm)  |
| <b>Effective operating distance (<math>S_r</math>)</b>       | $0.9 \times S_n \leq S_r \leq 1.1 \times S_n$  |
| <b>Usable operating distance (<math>S_u</math>)</b>          | $0.9 \times S_n \leq S_u \leq 1.1 \times S_n$  |
| <b>Hysteresis (H)</b>  | 1...20%  |



S: sensor  
T: target

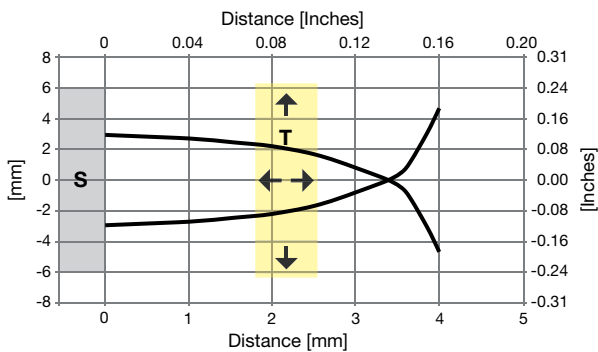


Fig. 1 M12 Flush

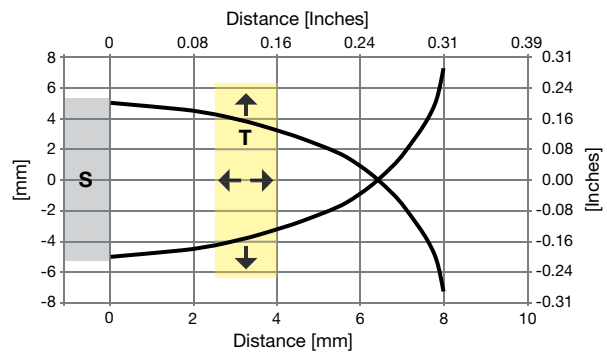


Fig. 2 M12 Non-flush

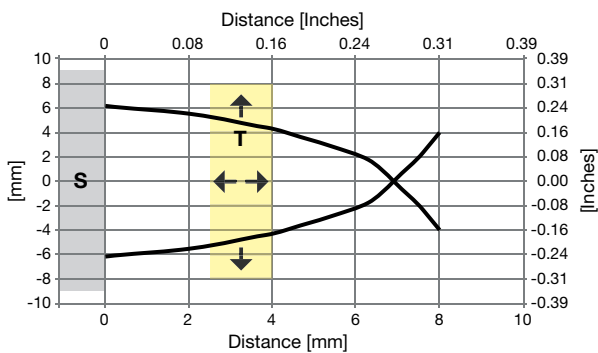


Fig. 3 M18 Flush

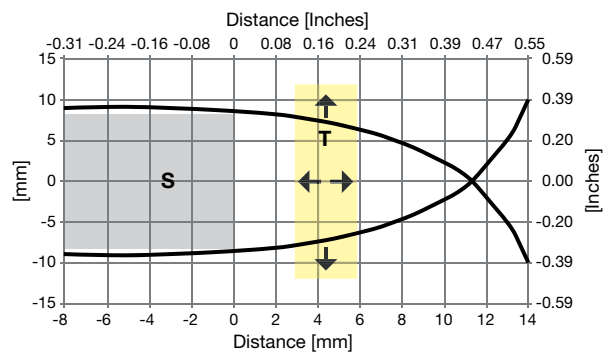


Fig. 4 M18 Non-flush

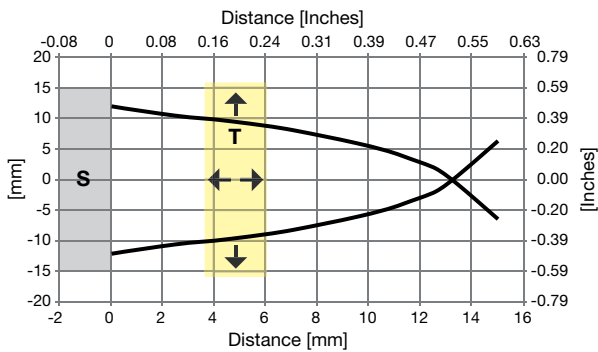


Fig. 5 M30 Flush

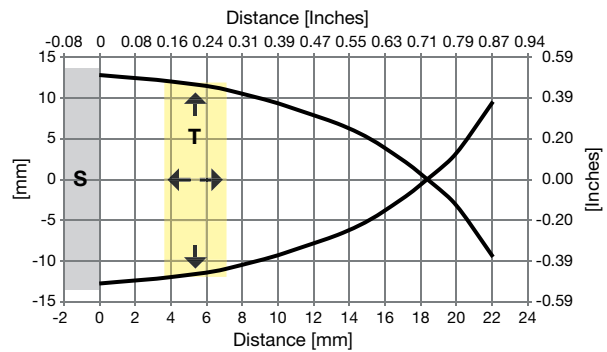


Fig. 6 M30 Non-flush

**Correction factors**

The specific operating distance  $S_n$  refers to defined measuring conditions. The following data have to be considered as general guidelines.

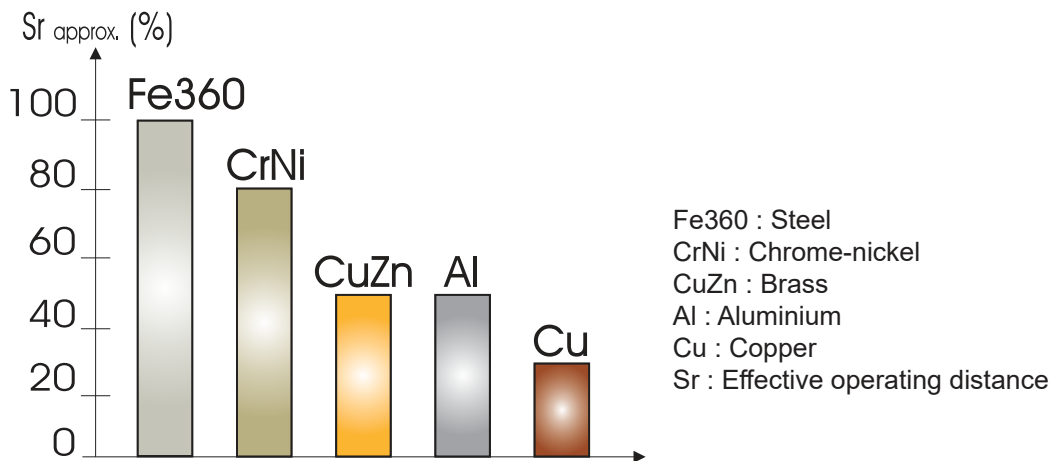


Fig. 7 The rated operating distance is reduced by the use of metals and alloys other than Fe360. The most important reduction factors for inductive proximity sensors are shown in the figure.

**Accuracy**

|                     |       |
|---------------------|-------|
| Repeat accuracy (R) | ≤ 10% |
|---------------------|-------|

## Features

### Power Supply

|                                     |                               |
|-------------------------------------|-------------------------------|
| Rated operational voltage ( $U_B$ ) | 8 to 60 VDC (ripple included) |
| Ripple ( $U_{pp}$ )                 | $\leq 10\%$                   |
| No load supply current ( $I_o$ )    | $\leq 10$ mA                  |
| Power ON delay ( $t_v$ )            | $\leq 50$ ms                  |

### Outputs

|                             |  |
|-----------------------------|--|
| Output functions            | NPN or PNP by sensor type open collector                                 |
| Output configuration        | N.O. and N.C. by sensor type   |
| Output current ( $I_o$ )    | $\leq 200$ mA  |
| OFF-state current ( $I_o$ ) | $< 500$ $\mu$ A  |
| Voltage drop ( $U_d$ )      | $\leq 2,5$ VDC @ 200 mA  |
| Protection                  | Short-circuit, inductive load, overload, reverse polarity and transients |
| Voltage transient           | 1 kV/0.5 J   |

### Response times

|                         |                |                 |
|-------------------------|----------------|-----------------|
| Operating frequency (f) | $\leq 1300$ Hz | ICS12 Flush     |
|                         | $\leq 1000$ Hz | ICS12 Non-flush |
|                         | $\leq 900$ Hz  | ICS18 Flush     |
|                         |                | ICS18 Non-flush |
|                         | $\leq 300$ Hz  | ICS30 Flush     |
|                         |                | ICS30 Non-flush |

### Indication


| Yellow LED | Output | Description  |
|------------|--------|--|
| OFF        | OFF    | N.O. output, target not present<br>N.C. output, target present |
| ON         | ON     | N.O. output, target present<br>N.C. output, target not present |
| Blinking   | f: 2Hz | Short-circuit or overload                                      |






| Green LED | Output | Description               |
|-----------|--------|---------------------------|
| OFF       | -      | Sensor is not operational |
| ON        | -      | Sensor is operational     |




**Environmental**


|   |  |                       |
|---|--|-----------------------|
| <b>Ambient temperature</b>                        | Operating: -40° to +85°C (-40° to +185°F)  |                       |
|   | Storage: -40° to +85°C (-40° to +185°F)  |                       |
| <b>Rapid temperature changes<br/>-40.. +85 °C</b> | TA = -40 °C; TB = 85 °C  | EN 60068-2-14 Na      |
| <b>Salt spray test</b>                            | Test method 5 (4 cycles)   | EN 60068-2-52 Kb      |
| <b>Ambient humidity</b>                           | Operating: ≤ 95%   |                       |
|   | Storage: ≤ 95%   |                       |
| <b>Vibration</b>                                  | 20 g (10...3000 Hz) 50 sweep cycles per frequency; 1 octave per minute in 3 axes | EN 60068-2-6 Fc       |
| <b>Shock resistance</b>                           | 100 g 11 ms half-sine; 3 shocks each in every direction of the 3 coordinate axes | EN 60068-2-27 Ea      |
| <b>Continuous shock resistance</b>                | 40 g 6 ms; 4000 shocks each in every direction of the 3 coordinate axes          | EN 60068-2-27 Ea      |
| <b>Degree of protection</b>                       | IP67, IP68 (2m submersion for 24h), IP69K  | IEC 60529; EN 60947-1 |


**Compatibility and conformity**

|                             |  |  |
|-----------------------------|--|--|
| <b>EMC protection</b>       | <b>ISO 11452-2 Radiated noise</b><br>Sensor immunity to false actuation when exposed to field strengths generated by radio transmitters  | 200 V/m 20 MHz to 2 GHz  |
|                             | <b>EN 61000-4-2 Electrostatic discharge (ESD)</b><br>Sensor resistance against electrostatic disruptions.<br>- CD Contact Discharge test, where a high voltage potential of 8 kV is applied directly to the sensor housing<br>- AD Air Discharge test, the high voltage potential of 8 kV is applied to a plate at a specific distance from the sensor   | CD: 8 kV / AD: 8 kV<br>Severity level IV / IV  |
|                             | <b>EN 61000-4-3 Radiated radiofrequency</b>  | 30 V/m (80...2500 MHz)   |
|                             | <b>EN 61000-4-4 Burst immunity</b><br>Protection against very high voltage bursts, generated by interruption of circuits containing inductive loads  | 4 kV Severity level III  |
|                             | <b>EN 61000-4-5 Surge</b><br>Protection against high energy surge signals that are capable of damaging electronic circuitry. Typically associated with power main switching and lightning strikes.<br>They can be also generated upon ignition/start up in mobile equipment circuitry  | 0,5 kV mains line to line  |
|                             | <b>EN 61000-4-6 HF Conducted radiofrequency.</b><br>Sensors are immune to both damage and spurious output signals when subject to conducted RF limits of 10 V  | 10 V (0.01...80 MHz)<br>Severity level III   |
|                             | <b>EN 61000-4-8 Power frequency magnetic fields</b>  | 300 A/m  |
| <b>Load dump protection</b> | Full protection in case of battery disconnection from alternator   | DIN ISO 7637-2/SAE J1113-11 Pulse 1, 2a, 2b, 3a, 3b, 4, 5a (load dump) degree of level 4 |
| <b>MTTF<sub>d</sub></b>     | M12 PNP: 1678 years @50°C (122°F); M12 NPN: 1903 years @50°C (122°F)<br>M18 PNP: 1813 years @50°C (122°F); M18 NPN: 1955 years @50°C (122°F)<br>M30 PNP: 1812 years @50°C (122°F); M30 NPN: 1949 years @50°C (122°F)   |  |
| <b>Approvals</b>            |      ECE 10R-06 |  |


**Mechanical data**

|                                       |  |   |
|---------------------------------------|--|---|
| <b>Weight (including 2 nuts) max.</b> | <b>M12</b>   | Cable version: 79g;<br>Plug version: 33g.   |
|                                       | <b>M18</b>   | Cable version: flush: 126g; non-flush: 128g;<br>Plug version: flush: 66g; non-flush: 68g.   |
|                                       | <b>M30</b>   | Cable version: flush: 201g; non-flush: 203g;<br>Plug version: flush: 144g; non-flush: 146g. |
| <b>Mounting</b>                       | Flush mountable or non-flush mountable                                       |   |
| <b>Material</b>                       | Housing: stainless steel AISI 304<br>Front cap: Grey thermoplastic polyester |   |
| <b>Max tightening torque</b>          | ICS12: 17.5 Nm<br>ICS18: 27.5 Nm<br>ICS30: 50 Nm                             |   |


**Electrical connection**

|              |   |
|--------------|---|
| <b>Cable</b> | ICS12: 2m, 3 x 0.34 mm <sup>2</sup> , Ø4 mm, PUR, grey, oil proof   |
|              | ICS18: 2m, 3 x 0.34 mm <sup>2</sup> , Ø5.2 mm, PUR, grey, oil proof |
|              | ICS30: 2m, 3 x 0.34 mm <sup>2</sup> , Ø5.2 mm, PUR, grey, oil proof |
| <b>Plug</b>  | M12 x 1, 4 pin, male connector                                      |

## Connection Diagrams

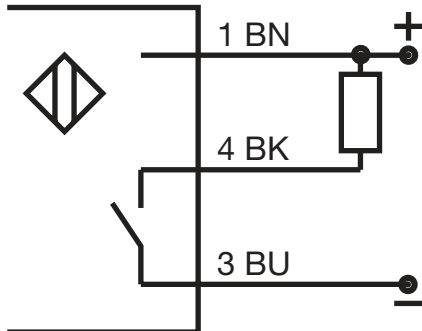


Fig. 8 NPN - Normally open

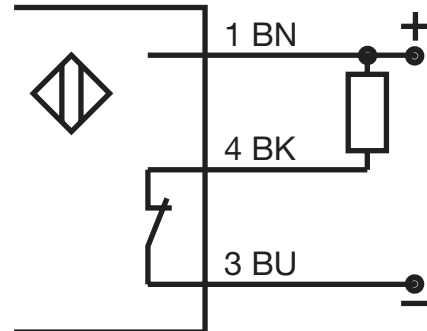


Fig. 9 NPN - Normally closed

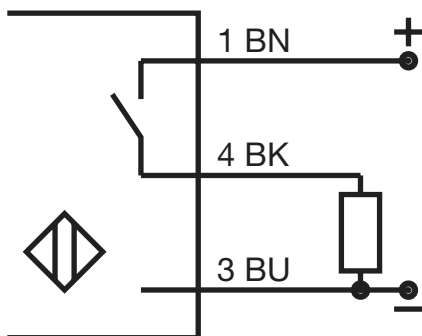


Fig. 10 PNP - Normally open

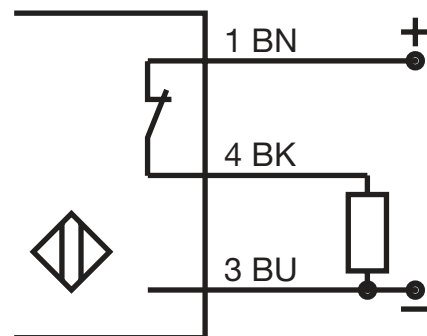


Fig. 11 PNP - Normally closed

| Colour code |           |          |
|-------------|-----------|----------|
| BN: brown   | BK: black | BU: blue |

Wire colors in accordance with EN 60947-5-2

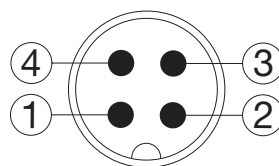


Fig. 12 Plug

## Dimensions

### ICS12 [mm]

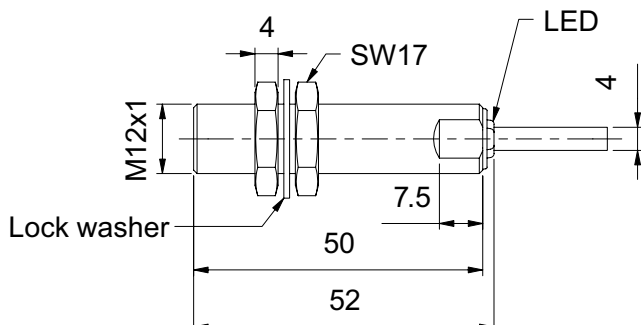


Fig. 13 Long body, flush version, cable

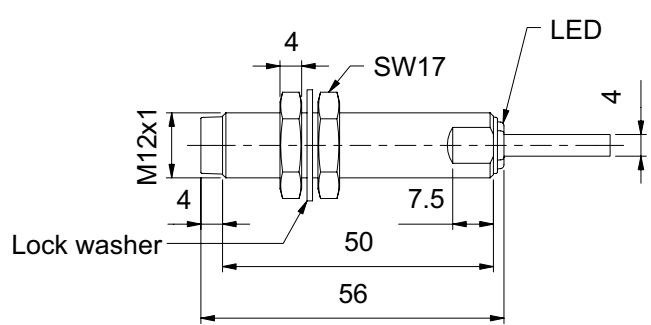


Fig. 14 Long body, non-flush version, cable

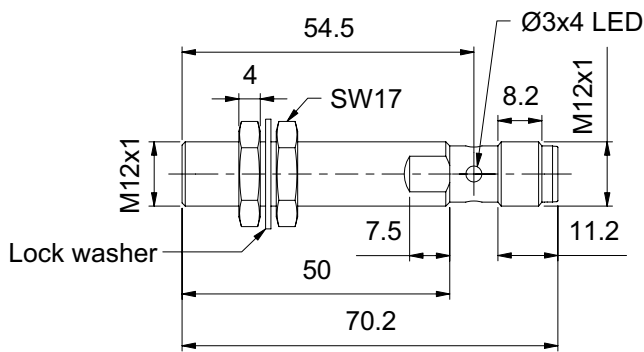


Fig. 15 Long body, flush version, plug

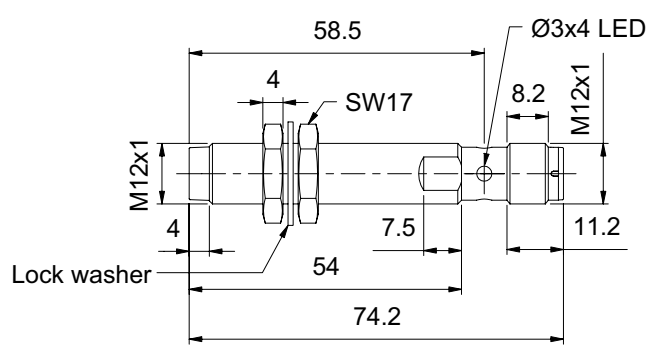


Fig. 16 Long body, non-flush version, plug

### ICS18 [mm]

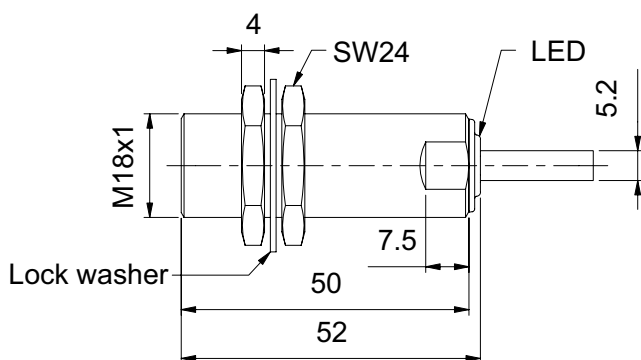


Fig. 17 Long body, flush version, cable

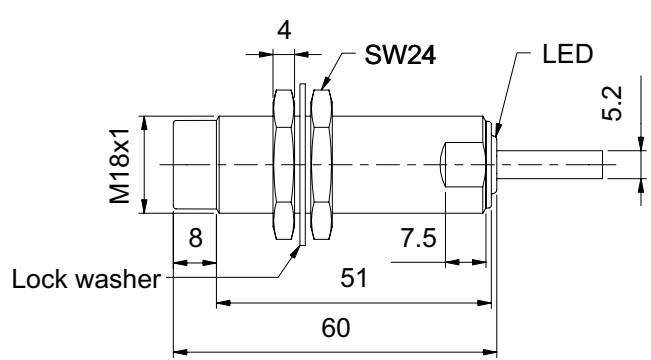


Fig. 18 Long body, non-flush version, cable

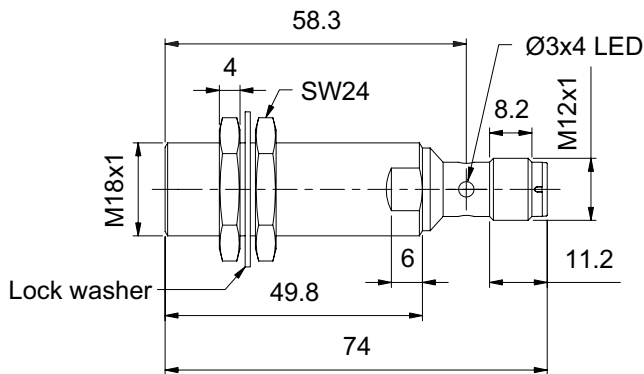


Fig. 19 Long body, flush version, plug

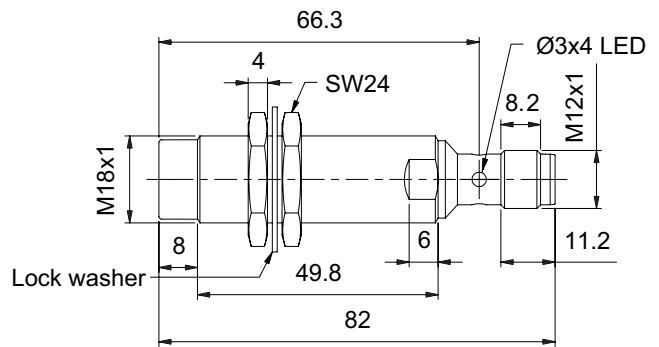


Fig. 20 Long body, non-flush version, plug

ICS30 [mm]

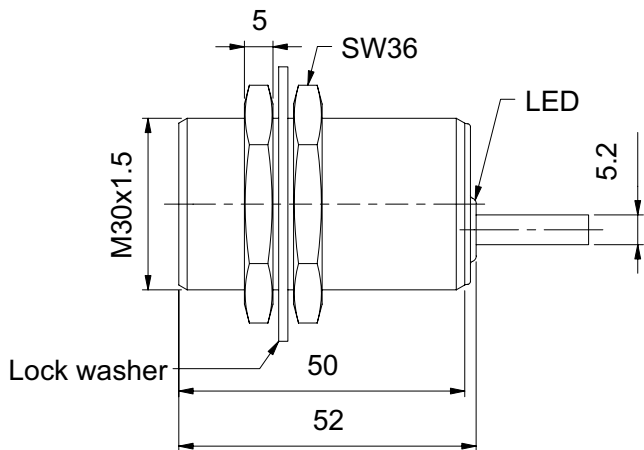


Fig. 21 Long body, flush version, cable

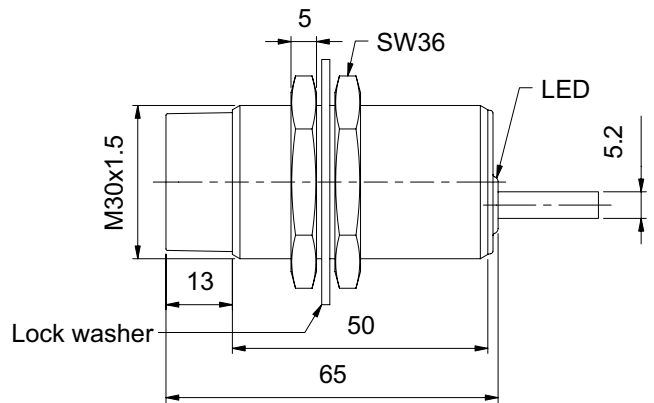


Fig. 22 Long body, non-flush version, cable

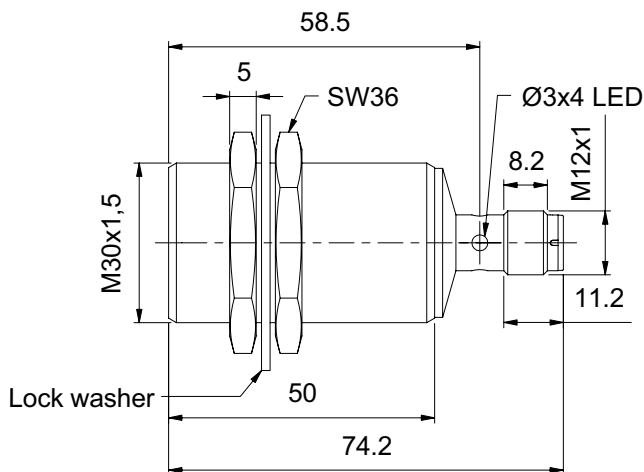


Fig. 23 Long body, flush version, plug

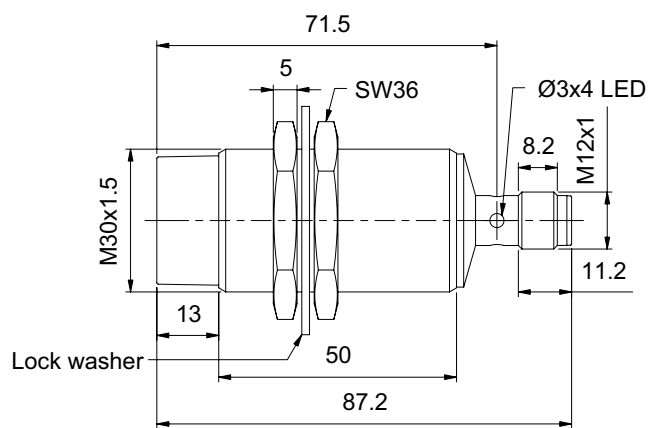


Fig. 24 Long body, non-flush version, plug

# Installation

## M12, M18 and M30 flush

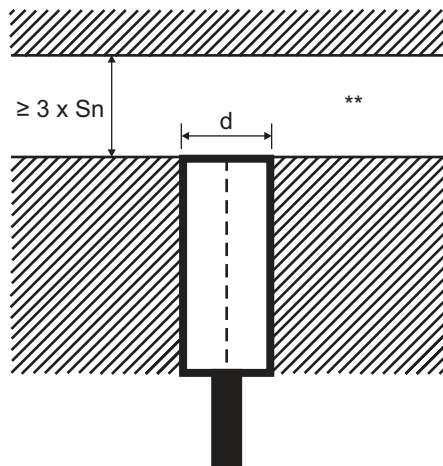


Fig. 25 Flush sensor, when installed in damping material

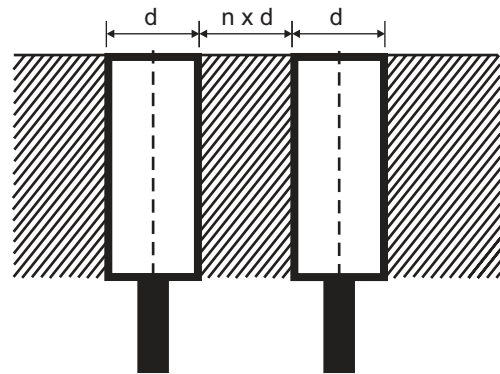


Fig. 26 Flush sensors, when installed together in damping material

## M12, M18 and M30 non-flush

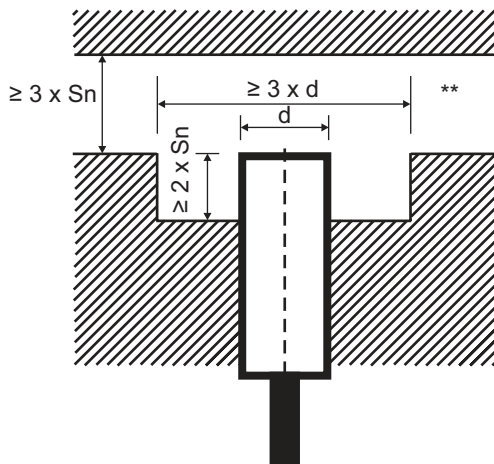


Fig. 27 Non-flush sensor, when installed in damping material

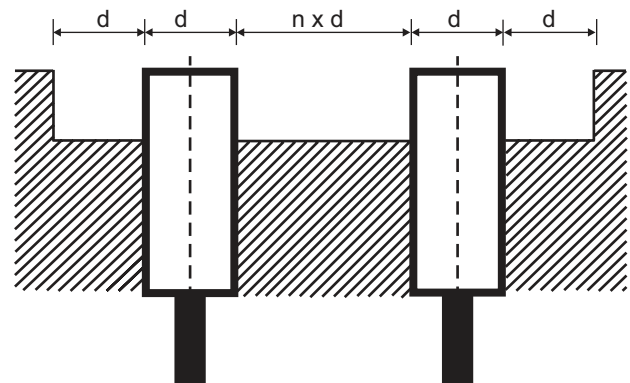
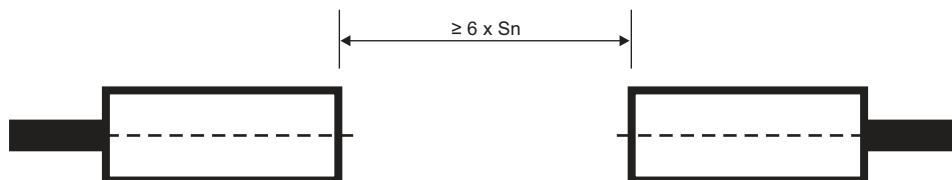


Fig. 28 Non-flush sensors, when installed together in damping material

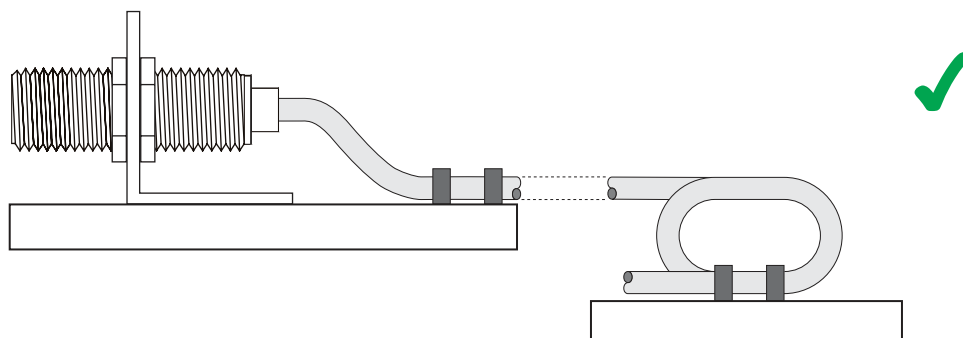
| Sensor          | d     | n |
|-----------------|-------|---|
| ICS12 Flush     | 12 mm | 1 |
| ICS12 Non-flush | 12 mm | 4 |
| ICS18 Flush     | 18 mm | 1 |
| ICS18 Non-flush | 18 mm | 2 |
| ICS30 Flush     | 30 mm | 2 |
| ICS30 Non-flush | 30 mm | 5 |

\*\* Free zone or non-damping material

**Sensors installed opposite each other**

**Fig. 29** For sensors installed opposite each other, a minimum space of  $6 \times S_n$  (the nominal sensing distance) must be observed

$S_n$ : nominal sensing distance

**Cable version**





## Delivery contents and compatible components

### Delivery contents

- Inductive proximity switch
- 2 fixing nuts
- 1 lock washer
- Packaging: plastic bag

### CARLO GAVAZZI compatible components

- Mounting bracket AMB... to be purchased separately
- Connector type: CONx... series to be purchased separately



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