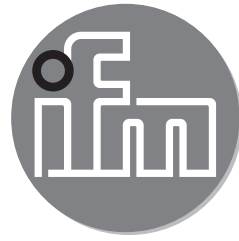


ifm electronic



Original operating instructions
Fail-safe inductive sensor

efector100[®]

GF711S

UK

80005280 / 00 05 / 2013



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1 Preliminary note

The instructions are part of the unit. They are intended for authorised persons according to the EMC and Low Voltage Directives and safety regulations. The instructions contain information about the correct handling of the product. Read the instructions before use to familiarise yourself with operating conditions, installation and operation. Follow the safety instructions.

1.1 Explanation of symbols

▶ Instructions

→ Cross-reference



Important note

Non-compliance can result in malfunction or interference.



Information

Supplementary note.

● LED on

○ LED off

⊗ LED flashes (2 Hz)

⊛ LED flashes quickly (5 Hz)

2 Safety instructions

- Follow the operating instructions.
- Improper use may result in malfunctions of the unit. This can lead to personal injury and/or damage to property during operation of the machine. For this reason note all remarks on installation and handling given in this document. Also adhere to the safety instructions for the operation of the whole installation.
- In case of non-observance of notes or standards, especially when tampering with and/or modifying the unit, any liability and warranty is excluded.
- If the sensor is damaged, the safety function cannot be guaranteed.
- Errors caused by damage cannot be detected by the sensor.
- The unit must be installed, connected and put into operation by a qualified electrician trained in safety technology.
- The applicable technical standards for the corresponding application must be complied with.
- For installation the requirements according to EN 60204 must be observed.
- In case of malfunction of the unit please contact the manufacturer. Tampering with the unit is not allowed.
- Disconnect the unit externally before handling it. Also disconnect any independently supplied relay load circuits.
- After installation, maintenance or repair of the system perform a complete function check.
- Use the unit only in specified environmental conditions (→ 9 Technical data). In case of special operating conditions please contact the manufacturer.
- Use only as described below (→ 4).

2.1 Safety-related requirements regarding the application

It must be ensured that the safety requirements of the respective application correspond to the requirements stated in these instructions.

Observe the following requirements:

- ▶ Take measures to avoid metallic objects being placed on the sensing face unintentionally.
- ▶ Adhere to EN 1088 for interlocking devices associated with guards.

- ▶ Adhere to the specified operating conditions (→ 9 Technical data).
Use of the sensor in the vicinity of chemical and biological media as well as ionising radiation is not permitted.
- ▶ Adhere to the principle of normally closed operation for all external safety circuits connected to the system.
- ▶ In case of faults within the fail-safe sensor which result in the defined safe state: take measures to maintain the safe state when the complete control system continues to be operated.
- ▶ Replace damaged units.

3 Items supplied

1 fail-safe sensor GF711S with 2 M12 fixing nuts,
1 original instructions GF711S, ident no. 80005280.

If one of the above-mentioned components is missing or damaged, please contact one of the ifm branch offices.

4 Functions and features

The fail-safe inductive sensor GF711S detects metal without contact.

Safety function SF: the safe state (output stage switched off; logic "0") is achieved when undamping greater than or equal to the safe switch-off distance s_{ar} (→ 9 Technical data).

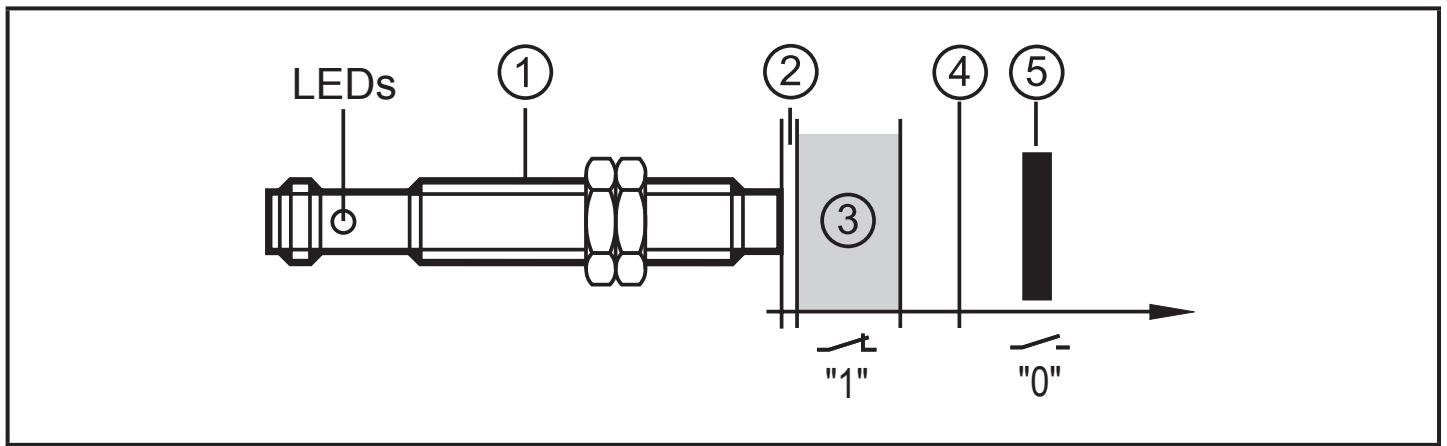
Also observe the notes on installation of the sensor (→ 6 Installation).

The fail-safe sensor conforms to Performance Level d according to EN ISO 13849-1 as well as to the requirements SIL 2 to IEC 61508 and meets SILcl 2 to IEC 62061.

The unit corresponds to the classification I2A12SP2 to IEC 60947-5-2 for non-flush installation (→ 6 Installation).

The fail-safe inductive sensor has been certified by TÜVNord.

5 Function




- 1: fail-safe sensor
- 2: close zone
- 3: enable zone
- 4: safe switch-off distance s_{ar}
- 5: target

Yellow signal LED: switching status
 Green power LED: operating voltage

5.1 Enable zone

The outputs (OSSD) are only enabled when a damping target is present in the enable zone. Outside this enable zone the outputs remain switched off.

The safe switch-off distance s_{ar} is > 6 mm.

 The enable zone is different if damping elements which deviate from the standard target plate in terms of material, form and size are used.

Enable zone for selected materials*:

Material	Enable zone
FE360 (= mild steel)	0.5...4 mm
Stainless steel	0...3.1 mm
AlMg3G22	0...1.8 mm
CuZn37	0...2.0 mm
Copper	0...1.2 mm

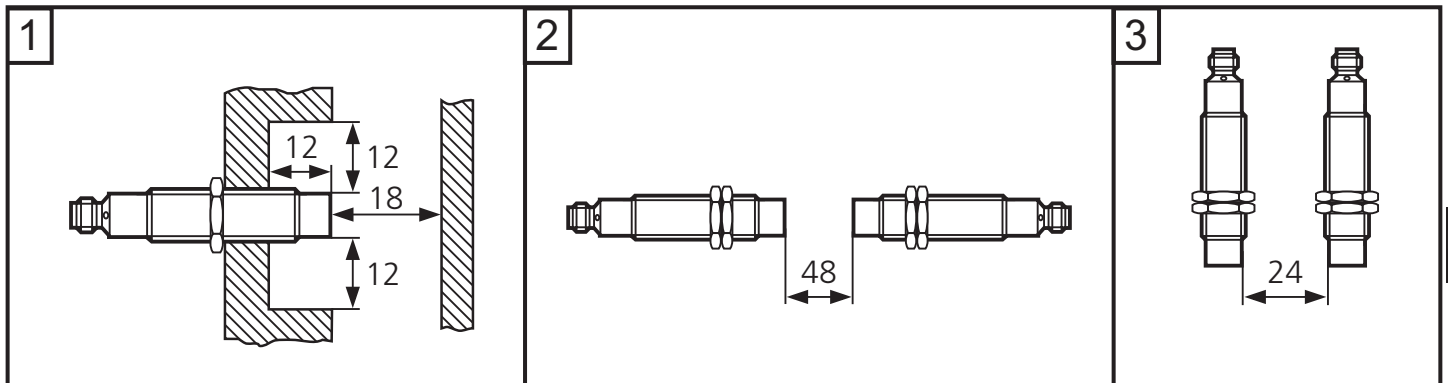
* Typical values for damping with a reference target of 12 x 12 x 1 mm and non-flush installation to EN 60947-5-2 at an ambient temperature of 20 °C.

 Depending on the characteristics of the damping element there may be no close zone.


6 Installation

The unit is **non-flush** mountable according to IEC 60947-5-2, type I2A12SP2.

- ▶ Ensure the unit cannot work loose (tightening torque ≤ 7 Nm).
- ▶ Adhere to the installation conditions in accordance with the figures 1 to 3:




- ▶ Tighten the socket according to the manufacturer's indications. Observe the tightening torque for the ifm socket (e.g. EVxxxx: 0.6...1.5 Nm).

 Flush installation of the fail-safe sensor is not permitted since this can result in an increase of the sensing range up to enabling of the outputs (OSSDs).


6.1 Protection against simple defeating


The fail-safe sensor reacts to metal objects, e.g. the frame of a safety door. Other metal objects that are not intended to enable the sensor must not be allowed to enable the fail-safe sensor unintentionally.

-  ▶ Take measures to prevent metal objects, except the designated target, from being placed on the sensing face or in the enable zone unintentionally.

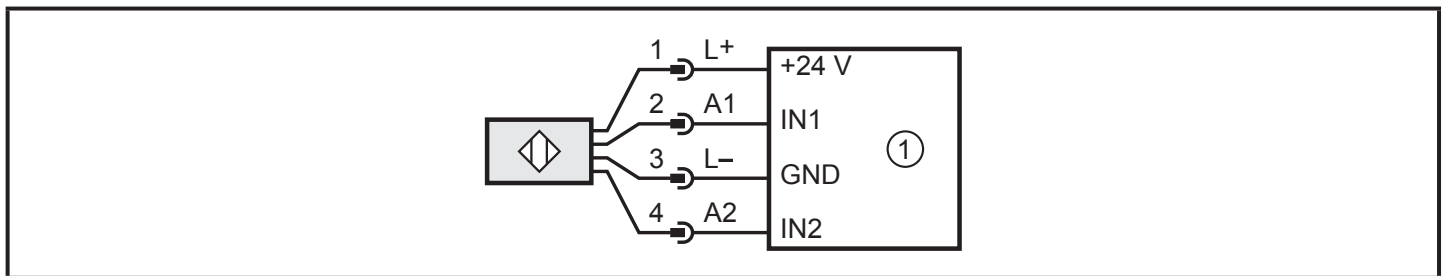
7 Electrical connection

- ▶ Disconnect power. Also disconnect any independently supplied relay load circuits.
- ▶ Supply voltage: connect L+ to pin 1 and L- to pin 3 of the connector.

 The nominal voltage is 24 V DC. This voltage may vary between 19.2 V and 30 V incl. 5 % residual ripple to EN 61131-2.

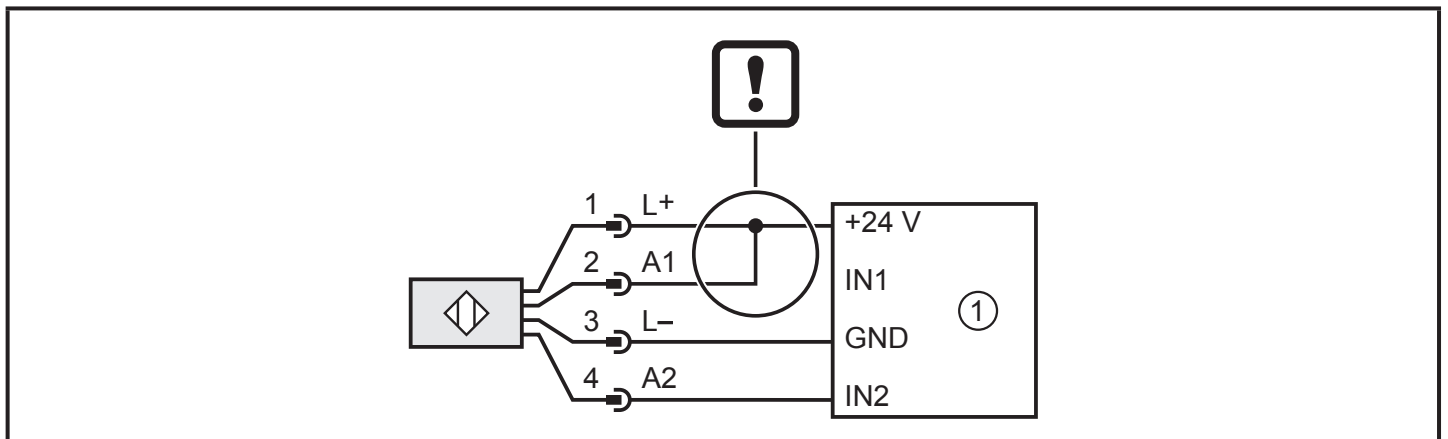
 In case of a single fault the supply voltage must not exceed a maximum of 40 V DC. (This requires the safe separation between power supply and transformer.)

7.1 Operation as 4-wire unit




1: safety-related logic unit *

7.2 Operation as 3-wire unit



1: safety-related logic unit *

* When there is no current flow on the output stage, back feeding > 3.5 V will lead to malfunction.

 In case of operation as 3-wire unit only A2 must be used as output (OSSD). Otherwise the safety function of the sensor will be impaired or prevented.

- ▶ Connect output A1 to supply voltage.



Make absolutely sure to exclude cross faults and short circuits between the supply voltage and output A2 by means of appropriate installation.

The indicated values regarding the safety function (→ 9 Technical data) remain unchanged.

8 Operation

8.1 Switching state of the outputs

8.1.1 The safe state

The safe state is when at least one of the outputs A1 or A2 (OSSDs) is switched off (zero-current state: logic "0").

If one of the outputs A1 or A2 is switched off, the subsequent safety-related logic unit must bring the complete system into the state defined as safe.

8.1.2 The switched state

If the damping element is in the enable zone and if there is no sensor error, both outputs A1 and A2 (OSSDs) are enabled (logic "1").

8.1.3 Output characteristics

The output characteristics are compatible with the input characteristics to EN 61131-2 type 1 or 2:

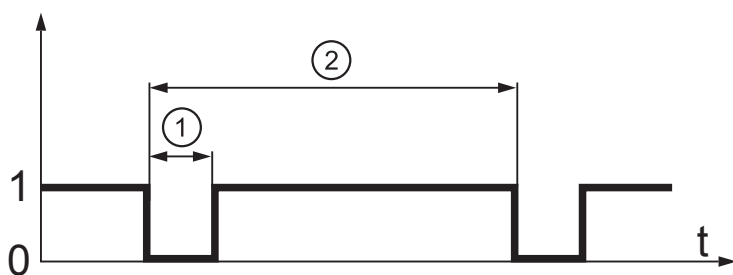
Logic "1"	$\geq 15 \text{ V}$	2...15 mA
	$\geq 11 \text{ V}$	15...30 mA
Logic "0"	$\leq 5 \text{ V}$	leakage current 0.2 mA

8.1.4 Cross fault / short circuit

- A cross fault between both outputs (A1 and A2) is detected by the fail-safe sensor and results in the outputs (OSSD) being switched off at the next safety request. The outputs A1 and A2 remain switched off until the error has been removed or a voltage reset has been carried out.
- A cross fault (short circuit) between output A2 and the supply voltage results in the other output A1 being switched off in case of a safety request. A short circuit of A1 and L+ leads to operation as 3-wire unit (→ 7.2).
- When there is no current flow on the output stage, back feeding > 3.5 V will lead to malfunction.
- The device carries out self-tests for the switch-off capability on A2.

8.2 Response times

Response time on safety request (removal from the enable zone)		$\leq 1 \text{ ms}$
Response time when approaching the enable zone (enable time)		$\leq 1 \text{ ms}$
Risk time / response time for safety-related faults		$\leq 20 \text{ ms}$
Simultaneity of switching on and off of the outputs in case of a safety request		$\leq 1 \text{ ms}$
Duration of switch-off test pulses on output A2 (1)		$\leq 1 \text{ ms}$
Sequence of the switch-off test pulses on A2 (2)	typ. 180 ms max. 300 ms min. 100 ms	



1: switch-off test pulse

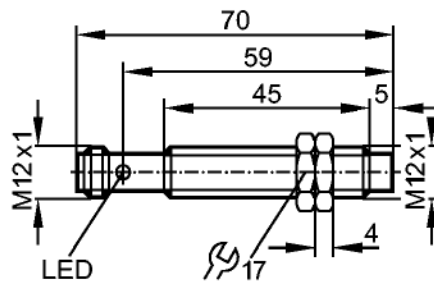
2: sequence of the switch-off test pulses

8.3 LED display

LED	Operating status	Outputs	A1 (OSSD)	A2 (OSSD)
○ Signal ○ Power	No voltage supply	Both outputs switched off	0	0
○ Signal ⊗ Power	Undervoltage		1 0	0 0
○ Signal ⊗ Power	Overvoltage	Both outputs switched off	0	0
	Sensor fault (→ 10 Troubleshooting)	One output or both outputs switched off	0 1 0	1 0 0
● Signal ● Power	Damping element in the enable zone	Both outputs enabled	1	1
	Damping element in the close zone	Output A2 is switched off	1	0

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9 Technical data



Made in Germany

Product characteristics

Fail-safe inductive sensor

Metal thread M12 x 1

M12 connector

Enable zone 0.5...4 mm; [nf] non-flush mountable

Complies with the requirements:

EN ISO 13849-1: 2008 category 2 PL d

IEC 61508: SIL 2

IEC 62061: SILcl 2

Application

Type of operation

continuous operation (maintenance-free)

Electrical data

Electrical design

DC PNP

Operating voltage [V]

24 DC (19.2...30 DC)

Rated insulation voltage [V]

30

Current consumption [mA]

< 20

Protection class

III

Reverse polarity protection

yes

Power-on delay time [s]

1

Outputs

Output function

2 x OSSD (A1 and A2)

Output voltage at 24 V

compatible with EN 61131-2 inputs type 1, 2

Voltage drop [V]

< 2.5; (30 mA)

Current rating [mA]

100

Short-circuit protection

yes

Range

Enable zone [mm]

0.5...4

Safe switching off distance s(ar) [mm]

6

Reaction times

Response time to safety request [ms]

≤ 1

Response time when approaching [ms]
the enable zone (enable time)

≤ 1

Risk time (response time for safety [ms]
-related faults)

≤ 20

Environment	
Applications	Class C to EN 60654-1 weatherproof application
Ambient temperature [°C]	-25...70, for service life ≤ 87600 h 10...40, for service life ≤ 175200 h
Rate of temperature change [K/min]	0.5
Max. relative air humidity [%]	5...95, briefly 5...70, permanently
Air pressure [kPa]	80...106
Height above sea level [m]	≤ 2000
Ionising radiation	not permissible
Salt spray	no
Protection	IP 65 / IP 67

Tests / approvals	
EMC	IEC 60947-5-2
Shock resistance	IEC 60947-5-2
Vibration resistance	IEC 60947-5-2

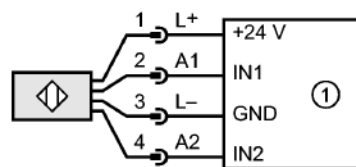
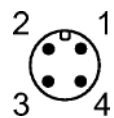
Safety classification	
Mission time TM [h]	≤ 175200, (20 years)
Safety-related reliability PFHd [1/h]	1.0E-07
MTTFd [Years]	2011
DC/CCF/Cat.	87 % / 70 % / 2

Mechanical data	
Mounting	non-flush mountable
Housing materials	stainless steel 316L / 1.4404; PBT
Weight [kg]	0.116

Displays / operating elements	
Display	LED yellow (signal), LED green (power)

Electrical connection	
Connection	M12 connector; Gold-plated contacts

Wiring



1: Safety-related logic unit

Accessories	
Accessories (included)	2 lock nuts

Remarks	
Remarks	Unless stated otherwise, all data refer to the 12x12x1 mm reference target plate to IEC 60947-5-2 (FE360 = mild steel) over the whole temperature range.
Pack quantity [piece]	1

10 Troubleshooting

LED display → 8.3

Problem	Possible cause	Troubleshooting
No LED display	No voltage supply	Apply voltage
Power LED flashes and sensor does not switch	<ul style="list-style-type: none">• Undervoltage• Overvoltage	Correct the voltage (→ 9 Technical data)
Sensor does not switch, not even after undamping and redamping	Sensor was brought into the safe state (logic "0"). Cause: <ul style="list-style-type: none">• cross fault between both outputs A1 and A2• cross fault between output A2 and the supply voltage• error in the sensor detected	<ul style="list-style-type: none">• Remove the cross fault• Replace the unit
	<ul style="list-style-type: none">• 3-wire operation: A1 and A2 reversed	<ul style="list-style-type: none">• Remove L+ from A2 and connect to A1
No close zone	Due to its characteristics (material, form, size), the damping element displaces the enable zone until directly in front of the sensing face	If possible, change the material, form or size of the damping element (→ 5.1 Enable zone)

11 Maintenance, repair and disposal

If used correctly, no maintenance and repair measures are necessary.

Only the manufacturer is allowed to repair the unit.

After use dispose of the unit in an environmentally friendly way in accordance with the applicable national regulations.

12 Approvals / standards

The following standards and directives have been applied:

- 2006/42/EC European Machinery Directive
- 2004/108/EC EMC Directive
- EN ISO 13849-1 PL d (2006) Safety of machinery - Safety-related parts of control systems
- IEC 60947-5-2 (2008) Low-voltage switchgear and controlgear: Control circuit devices and switching elements - Proximity switches
- IEC 61508 (2000)
- IEC 62061 (2005)
- UL 508

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13 Terms and abbreviations

CCF	Common Cause Failure	
DC	Diagnostic Coverage	
MTTF _D	Mean Time To Dangerous Failure	
OSSD	Output Signal Switch Device	
PFH (PFH _D)	Probability of (dangerous) Failure per Hour	
PL	Performance Level	PL to EN ISO 13849-1
SIL	Safety Integrity Level	SIL 1-4 to IEC 61508. The higher the SIL, the lower the probability that a safety function will fail.
SIL _{cl}	Safety Integrity Level _{claim limit}	According to IEC 62061
T _M	Mission time	Lifetime (= max. service life)