



Original operating instructions

Fail-safe inductive sensor

GB

GF854S

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1 Preliminary notes

You will find instructions, technical data, approvals and further information using the QR code on the unit / packaging or at www.ifm.com.

1.1 Symbols used

- ▶ Instruction
- ▷ Reaction, result
- Cross-reference
- LED on
- LED off
- ☀ LED flashes



Important note

Non-compliance can result in malfunction or interference



Information

Supplementary note

1.2 Warnings used



WARNING

Warning of serious personal injury

- ▷ Death or serious irreversible injuries may result.

2 Safety instructions

- The unit described can be installed as a subcomponent in a safety-related system.
 - The operator is responsible for the safety-related system.
 - The system architect undertakes to perform a risk assessment and to create documentation in accordance with legal and normative requirements to be provided to the operator and user of the system. This documentation must contain all necessary information and safety instructions for the operator, the user and, if applicable, for any service personnel authorised by the architect of the system.

- The system manufacturer is responsible for the functioning of the application programs.
 - If the sensor is damaged, the safety-related function cannot be guaranteed. Errors caused by damage will not cause transition to the safe state.
 - If necessary, the system manufacturer has to obtain an approval from the competent supervisory and test organisations for the system's safety-related functions according to the applicable regulations.
 - For applications of functional safety, the system manufacturer must assure the conformity of the system and the corresponding application programs in accordance with the applicable regulations. Certification by a competent organisation may be required.
- Read this document before setting up the product and keep it during the entire service life.
 - The product must be suitable for the corresponding applications and environmental conditions without any restrictions.
 - Only use the product for its intended purpose (→ Intended use).
 - If the operating instructions or the technical data are not adhered to, personal injury and/or damage to property may occur.
 - The manufacturer assumes no liability or warranty for any consequences caused by tampering with the product or incorrect use by the operator.
 - Installation, electrical connection, set-up, operation and maintenance of the product must be carried out by qualified personnel authorised by the machine operator.

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.



WARNING

Failure of the safety function

- ▷ When used outside of the defined environmental conditions, the safety-related function of the sensor cannot be guaranteed.
- ▶ Use only in accordance with the defined environmental conditions (→ Technical data).

Observe the following requirements:

- ▶ Take appropriate measures for a permanent and safe fixing (→ Installation).
- ▶ In case of lateral damping in the area of the safe switch-off distance of $< s_{ao}$, the target must stay there until the safe state of the complete system is achieved. Note the response time for safety-related faults of the sensor!
- ▶ The safe fixing must be regularly maintained at suitable intervals (cyclical inspection). Document maintenance actions (time, persons etc.).
- ▶ Adhere to EN 14,119 for interlocking devices associated with guards.
- ▶ 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 safety sensor with 2 fixing nuts
- 1 original operating instructions

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

4 Functions and features

The device detects metal without contact.

Safety-related function SF: The safe state (output stage switched off; Logic "0") is achieved in case of damping that is shorter than the safe switch-off distance (→ 9 Technical data).

- Observe the notes on the installation (→ 6 Installation).

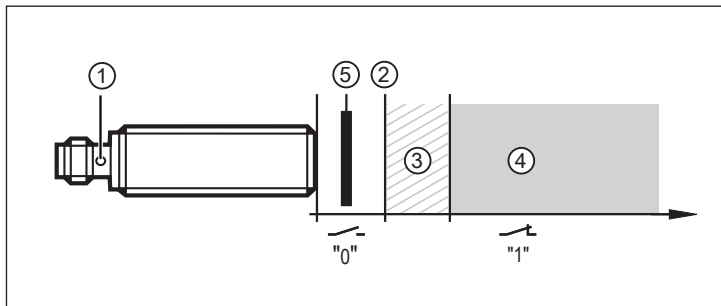
The device is a proximity sensor with defined behaviour under fault conditions (PDDb) according to IEC 60947-5-3.

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

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

The device has been certified by TÜV Nord.

5 Function



- | | |
|----------------------|--------------------------------------|
| 1: LED yellow | 2: Safe switch-off distance s_{ao} |
| 3: Inadmissible zone | 4: Enable zone |
| 5: Target | |

5.1 Enable zone

The outputs (OSSDs) are only enabled when undamping in the enable zone > 6 mm. The change of switching states of the outputs is carried out in the inadmissible zone (3). Below the safe switch-off distance the sensor is damped and the outputs (OSSDs) are switched off.

- Take measures to ensure that the target does not remain in the inadmissible zone.

If damped with a reference target of 12 x 12 mm made of FE360 and flush installation to IEC 60947-5-2, the safe switch-off distance is < 3 mm.



WARNING

Failure of the safety function

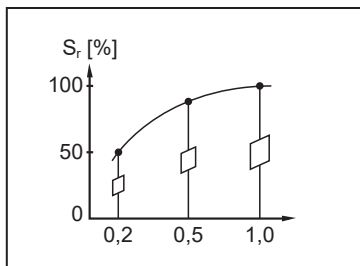
The safe switch-off distance is different if targets which deviate from the reference target in terms of material, form and size are used.

- ▶ Check whether the safety-related function of the sensor is guaranteed under the given operating conditions.

Safe switch-off distance for specific materials*:

Material	Safe switch-off distance s_{ao} (mm)
FE360 (ST37)	0...3
stainless steel	0...2,1
aluminium	0...1,2
brass	0...1,2
copper	0...0,9

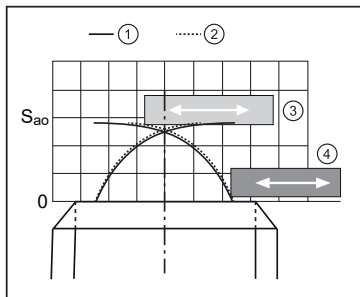
* Typical values for damping with a reference target of 12 x 12 mm and non-flush installation to IEC 60947-5-2 at an ambient temperature of 20 °C.



x axis: ratio actual target / reference target

5.2 Switch-on curve S_{ao}

Good repeatability of the switch point means: the closer the target is positioned to the sensing face, the better.



- 1: Typical switch-on curve
(for slow approach)
- 2: Typical switch-off curve
(for slow approach)
- 3: Poor repeatability
- 4: Good repeatability

6 Mounting

The sensor can be mounted flush according to IEC 60947-5-2, type I2A12SP2.

- ▶ Ensure that the device and the target cannot come loose.
- ▶ Tighten the supplied fastening nuts to a maximum tightening torque of 7 Nm.



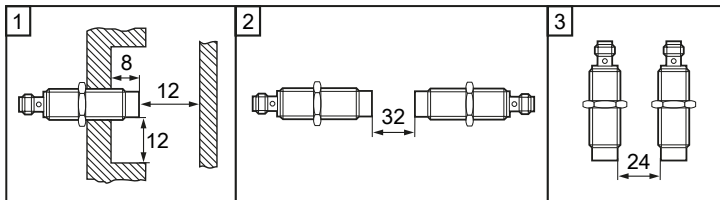
WARNING

Failure of the safety function

If the sensor or the target comes loose in its fixture, the sensor can no longer fulfil its safety function.

- ▶ The mounting position of the sensor must not change due to mechanical stress, vibrations or temperature changes.
- ▶ Ensure that the sensor and target are securely fastened.

Observe the following installation conditions (dimensions in mm):



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

7 Electrical connection



The unit must be connected by a qualified electrician.

The national and international regulations for the installation of electrical equipment must be adhered to.

Voltage supply according to EN 50178, SELV, PELV.

▷ The sensor can be damaged if energized during connection.

- ▶ Disconnect power. Also, disconnect any independently supplied relay load circuits.

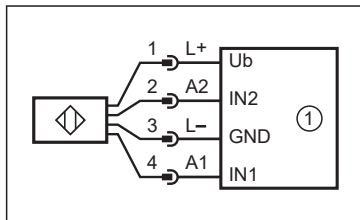
- ▶ Supply voltage: connect L+ to pin 1 and L- to pin 3 of the connector.



If used in accordance with EN 61131-2, the supply voltage including residual ripple must be between 19.2 and 30 V DC.

Use according to DIN EN 12895:2015 Industrial trucks – Electromagnetic compatibility with shielded cable on one side is recommended.

- ▶ Connect the unit as follows:



1: safety-related logic unit

8 Operation

8.1 Switching state of the outputs

8.1.1 The safe state

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

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 target 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 interface of the devices complies with interface type C class 1 according to the ZVEI position paper CB24I Ed. 2.0.x.

	Interface type		Suitable interface type
Source	C1	Receiver	C1

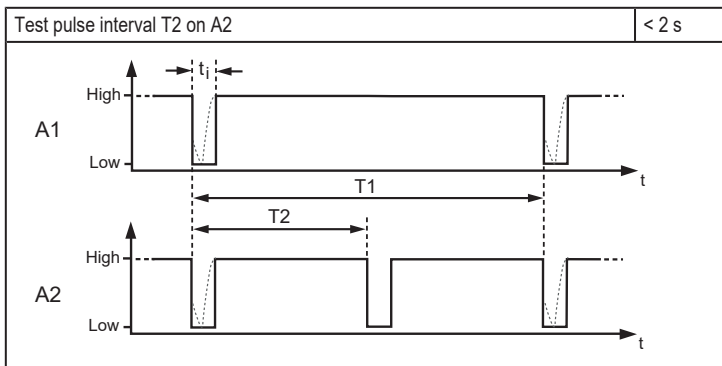
Tab. 1: Identification key

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 after 4 s at the latest. 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 after 4 s at the latest.
- The subsequent safety-related logic unit (e.g. safe PLC or safety relay) must be able to detect faults via dual-channel evaluation (e.g. "stuck-at faults"). The monitored hazardous area may only be enabled if both inputs of the safety-related logic unit were previously switched off at the same time (logic "0").

8.2 Response times

Response time on safety request (removal from the enable zone)	≤ 5 ms
Response time when approaching the enable zone (enable time)	≤ 5 ms
Risk time / response time for safety-related faults	≤ 100 ms
Simultaneity of switching on and off of the outputs in case of a safety request	≤ 1 ms
Test pulse duration t_i on A1 and A2	≤ 1 ms
Test pulse interval T1 on A1	< 4 s



8.3 LED display

LED	Operating status	Outputs	A1	A2
○	no voltage supply	both outputs switched off	0	0
☀	overvoltage	both outputs switched off	0	0
	sensor fault (→ 10 Troubleshooting)	one output or both outputs switched off	0	1
			1	0
	0	0		
○	target is at safe switch-off distance from the sensor	both outputs switched off	0	0
●	target is in the enable zone	both outputs enabled	1	1

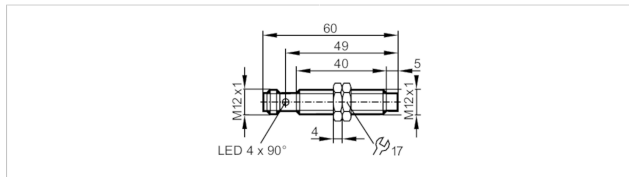
9 Technical data

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Fail-safe inductive sensor

GIFK4004-2PO/SIL2/US



Product characteristics	
Electrical design	PNP
Output function	2 x OSSD (A1 and A2)
Enable zone [mm]	> 6
Housing	threaded type
Dimensions [mm]	M12 x 1 / L = 60
Application	
Special feature	Gold-plated contacts
Type of operation	permanent operation
Safety-related function	safe state when damped correctly
Application	Use in mobile and harsh applications
Electrical data	
Operating voltage [V]	8...32 DC
Rated insulation voltage [V]	60
Current consumption [mA]	< 20
Protection class	III
Reverse polarity protection	yes
Max. power-on delay time [ms]	1000
Outputs	
Electrical design	PNP
Output function	2 x OSSD (A1 and A2)
Max. voltage drop switching output DC [V]	2.5; (30 mA)
Minimum load current [mA]	1
Permanent current rating of switching output DC [mA]	50
Switching frequency DC [Hz]	10
Output data	Interface type C class 1
Output voltage at 24 V	compatible with EN 61131-2 inputs type 1, 2
Short-circuit protection	yes
Overload protection	yes
Max. capacitive load CL_max [nF]	20

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Fail-safe inductive sensor

GIFK4004-2PQ/SIL2/US

Detection zone		
Enable zone [mm]		> 6
Safe switch-off distance s(ao) [mm]		< 3
Accuracy / deviations		
Correction factor		steel: 1 / stainless steel: 0.7 / brass: 0.4 / aluminium: 0.4 / copper: 0.3
Hysteresis [% of Sr]		1...10
Response times		
Response time to safety request [ms]		5
Response time when approaching the enable zone [ms]		5
Risk time (response time for safety-related faults) [ms]		100

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Fail-safe inductive sensor

GIFK4004-2PQ/SIL2/US

Operating conditions	
Ambient temperature [°C]	-40...85
Max. relative air humidity [%]	50; (70 °C; <70 °C: >50 %)
Max. height above sea level [m]	5000
Ionising radiation	not permissible
Protection	IP 65; IP 67; IP 68; IP 69K; (with ifm socket duly screwed on)
	test according to ISO 16750-5
	the following media were tested for 22 hours at 60 °C
	coolants
	(HoughtonHocut4480
	Oemeta
	HYCUT ET 46)
	The following media were tested for 22 hours at 75 °C
	hydraulic fluids
	(Fuchs Renoling B15 VG 46 HLP
	Total BiohydranTMP 4HEES
	Fuchs Hydrotherm 46 M HFC)
	transmission oils
	(Fuchs TITAN ATF 3353 Dexron III)
	diesel
	biodiesel
	urea
	(AdBlue)
	brake fluid
	(K2 TURBO DOT 4)
	the following media were tested for 22 hours at 23 °C
	corrosion protection
	(Sonax special preservation wax)
	cold cleaner
	(Sonax cold cleaner S)
	ammonia-based cleaner
	(Weco Dr. Webers Salmiak-Konzentrat
	(concentrated ammonium chloride)
	battery acid
	the following media were tested for 2 hours at 23 °C
	wheel rim cleaner
	(Sonax Xtreme Plus)
	the following media were tested for 10 minutes at 23 °C
	premium-grade petrol lead-free

Chemical media



Fail-safe inductive sensor

GIFK4004-2PQ/SIL2/US

Tests / approvals


EMC	industrial environments	
	EN 60947-5-3	
	EN 61000-4-2 ESD	6 kV CD / 8 kV AD
	EN 61000-4-3 HF radiated	20 V/m
	EN 61000-4-4 Burst	2 kV
	EN 61000-4-5 Surge	2 kV
	EN 61000-4-6 HF conducted	10 V
	EN 61000-4-8	30 A/m 50/60 Hz / 1000 A/m 0 Hz
	EN 55011	class B
	mobile applications	only for operation with central load-dump suppression (58 V) / not for active operation during motor start phase in 12 V systems
	ISO 10605 ESD	8 kV CD / 15 kV AD
	ISO 11452-2, ISO 11452-5 radiated immunity	100 V/m
	ISO 7637-2, ISO 16750-2 conducted immunity	12 V / 24 V
	pulse	1 2a 3a 3b 4 5b
	severity level	III III III III III III 58V
failure criterion	B B B A A C/B A	
EN 55025		
Vibration resistance	EN 60068-2-6 Fc	20 g (10...3000 Hz) / 50 sweep cycles, 1 octave per minute, in 3 axes
Broadband noise	EN 60068-2-64 h	5,9 g (10...2000 Hz) / effective acceleration for chassis mounting
Shock resistance	EN 60068-2-27 Ea	100 g 11 ms half-sine; 3 shocks each in every direction of the 3 coordinate axes
Continuous shock resistance	EN 60068-2-27 Ea	40 g 6 ms; 4000 shocks each in every direction of the 3 coordinate axes
Fast temperature change	EN 60068-2-14 Na	TA = -40°C; TB = 85°C; t1 = 30 min; t2 = 10 s 100 cycles
Salt spray test	EN 60068-2-52 Kb	severity level 5 (4 test cycles)
UL approval	Ta	< 70 °C
	Enclosure type	Type 1
	voltage supply	Limited Voltage/Current
	File number UL	E174191
Safety classification		
ISO 13849-1		category 2, PL d
IEC 61508		SIL 2
IEC 62061		SIL cl 2
Mission time TM [h]		≤ 87600
Mission time TM (additional indication)		industrial environments Temperature range -25...70 °C ≤ 175200
Safety-related reliability PFHD [1/h]		< 5E-08

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Fail-safe inductive sensor

GIFK4004-2PQ/SIL2/US

Mechanical data		
Weight [g]	86.8	
Housing	threaded type	
Mounting	non-flush mountable	
Dimensions [mm]	M12 x 1 / L = 60	
Thread designation	M12 x 1	
Materials	threaded sleeve: brass white bronze coated; sensing face: LCP; LED window: PEI; lock nuts: brass white bronze coated	
Tightening torque [Nm]	< 7	
Displays / operating elements		
Display	Display switching status	4 LED, yellow
Accessories		
Items supplied	lock nuts: 2	
Remarks		
Remarks	material for secure mounting not supplied; fixing must be done by the user meets the environmental and EMC requirements for operation in agricultural and forestry machinery, earthworks and construction machines as well as in industrial trucks When used in industrial trucks, the screen of the connection cable has to be connected to the sensor. Unless stated otherwise, all data refer to the reference target plate to IEC 60947-5-2 over the whole temperature range. (FE360 = ST37-2K) 12x12x1 mm	
Pack quantity	1 pcs.	
Electrical connection - plug		
Connector: 1 x M12; Contacts: gold-plated		
		

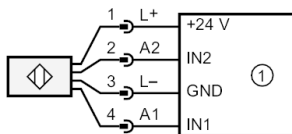
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Fail-safe inductive sensor

GIFK4004-2PQ/SIL2/US



Connection



1: safety-related logic unit

10 Troubleshooting

Problem	Possible cause	Troubleshooting
No LED display	No voltage supply	Apply voltage
The device does not switch, not even after undamping and re-damping	The device 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 one output (A1 or A2) and the supply voltage • Error in the device detected 	<ul style="list-style-type: none"> • Remove the cross fault • Replace device

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 device in an environmentally friendly way in accordance with the applicable national regulations.

12 Terms and abbreviations

OSSD	Output Signal Switching Device	Output signal switch element
PDDb	Proximity devices with defined behaviour under fault conditions	Naherungsschalter mit einem definierten Verhalten unter Fehlerbedingungen
PFH (PFH _b)	Probability of (dangerous) Failure per Hour	Probability of a (dangerous) failure per hour.
PL	Performance Level	PL to EN ISO 13849-1
SIL	Safety Integrity Level	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}	Safety Integrity Level _{claim limit} (according to IEC 62061)
T _M	Mission time	Duration of use according to EN 60947-5-3 (= max. service life)