Baumer

Passion for Sensors

Operating Instructions

AlphaProx

Inductive distance measuring sensors (non-linearized)

Version: 1.0

Contents

1 General information

1.1 Applicability

This document is applicable for Baumer's *AlphaProx* sensors – i.e. inductive distance measuring sensors or analog inductive sensors – with an S-shaped (non-linear) output curve:

- IRxx.DxxS

AlphaProx sensors with a linearized output are described in a dedicated user manual, which can be downloaded at www.baumer.com. The main differences between linearized and non-linearized *AlphaProx* sensors are described in chapter 4.2.

1.2 Concerning the contents of this document

This manual contains information about the installation and commissioning of Baumer analog inductive sensors. It is a supplement to the mounting instructions supplied with each sensor.

Read these operating instructions carefully and follow the safety instructions!

1.3 Intended use

The Baumer analog inductive sensors are able to detect the position of a metallic object within the sensor specific measuring range.
They were especially developed for easy handling, flexible use, and precise measurement.

1.4 Safety notes

NOTE

Provides helpful operating instructions or other general recommendations.

ATTENTION!

Indicates a potentially hazardous situation. Non-adherence can lead to minor or slight injuries and may damage the device.

2 Connection

ATTENTION!

Incorrect supply voltage may destroy the device!

ATTENTION!

Connection, installation and commissioning may only be performed by qualified personnel.

ATTENTION!

The IP protection class is valid only if all connections are connected as described in the technical documentation.

2.1 Connection cable

The sensors do not require a shielded cable in standard conditions. If EMC requirements are higher a shielded cable may be used on the connector versions of these sensors. Depending on the screening concept the shield must be connected accordingly.

2.2 Pin assignment and connection diagram

In the mounting instructions, which are delivered with every sensor and can be downloaded at www.baumer.com, the pin configuration of the connector or the assignment of the wires is defined. In addition, the supply voltage range is also stated there.

3 Installation

ATTENTION!

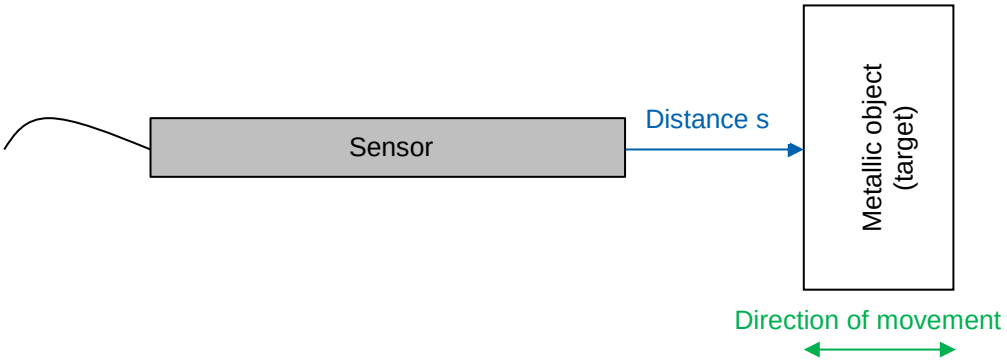
Connection, installation and commissioning may only be performed by qualified personnel.

3.1 Mounting

The sensors have a threaded housing and can be fixed using the nuts which are part of the delivery. The maximal mounting torque depends on the housing material as well as the thread size and is specified in the datasheet. The position and the material of the nuts can have an influence on the analog output curve, see chapter 4.6.

3.2 Sensor alignment

In standard applications the sensor is mounted at a right angle (90°) to the object (standard installation). The sensor axis is oriented to the middle of the target.



NOTE
Angular or axial deviations may affect measuring accuracy.

Other sensor alignments are possible; please contact Baumer for further information.

3.3 Installation accessories

To ensure optimal mounting, various mounting brackets are available as accessories at www.baumer.com.

4 Functions and definitions

4.1 General function

An analog inductive sensor changes its output value (typically current or voltage) depending on the position of electrically conductive material in the vicinity of the sensing head. Hence, it can be used to measure the position of a moving object (called target).

4.2 Properties of sensors with S-shaped output curve

Analog inductive sensors with an S-shaped output characteristic do not have a digital signal processing unit or internal limiter of the output signal. Therefore they excel in terms of response times and resolution. For distances outside the specified measuring range – or if the target properties or the mounting situation differ from the standard conditions – the output signal may exceed the values stated in the datasheet (0…10 VDC or 4…20 mA). The output level of sensors with current output may in the aforementioned situations fall below the minimum specified output current. Nonetheless, the output signal can be processed and used to measure the target's position. The technical specifications such as resolution, repeat accuracy, linearity error, temperature drift, etc. are not valid under these conditions.

Baumer offers also analog inductive sensors with linear output characteristic. The output signal of linearized sensors is guaranteed to stay within the specified signal range independent of external influences. In addition, they are specifically characterized by a smaller linearity error and smaller variation from sensor to sensor.

4.3 Standard conditions

Both the geometry and the material of the target have an influence on the analog output curve of an inductive sensor. In addition, the conductive material which is in the vicinity of the sensor front face might influence the sensor output. Therefore, the standard measurement conditions are defined as follows:

- Standard target (according EN 60947-5-2): The standard target is defined as a square plate, 1 mm thick, made of Fe 360 (mild steel). The length of its side is defined as the larger of either the sensing face diameter or three times the maximal sensing distance as noted in the datasheet. For example: the standard target for an M12 sensor with 6mm sensing range has a side length of 3x6=18mm.
- Standard installation conditions: In order to have repeatable measurement conditions the standard installation of these sensors is non-flush. This means there is no electrically conductive material (except the target) within the vicinity (2x maximal sensing range) of the sensor front face. For an M18 sensor with 8mm sensing range, this means for example that the nut may only be positioned 2x8=16mm away from the sensing face.

The technical data shown on the datasheet (in particular the maximal measuring range) are only valid under these standard conditions.

4.4 Definitions of parameters

In the datasheets of inductive analog sensors certain technical parameters are given which are defined as follows.

4.4.1 Resolution

Resolution represents the smallest possible change in distance which will produce a measurable signal change at the sensor's output.

Static resolution

The static resolution is the smallest distance change which can be measured with a slow measurement device (e.g. volt meter). The static resolution is in general higher than the dynamic resolution as a slow measurement corresponds to a low pass filtering of the measurement noise. The values given in the datasheet are valid for

an averaging period of maximal 1 second. To achieve the maximal resolution in an application the target shall move slowly.

Dynamic resolution

The dynamic resolution is the smallest change in distance which can be measured with a fast measurement device (e.g. oscilloscope). Due to the noise, the dynamic resolution is in general not as good as the static resolution. The dynamic resolution is relevant for measuring fast movements and is limited by the response time of the sensor.

4.4.2 Repeat accuracy

Repeat accuracy defines the difference between the measured values of successive measurements within a period of 8 hours at an ambient temperature of 23 °C ± 5 °C. For many applications of inductive analog sensors this is a very important value.

4.4.3 Linearity error

The linearity error defines the maximal deviation between the output signal and the ideal output within a certain measuring range (sd_min to sd_max). The ideal output signal is a line between the two points defined by the minimal distance (sd_min) and minimal output (out_min) and the corresponding maximal values (sd_max and out_max) as specified in the datasheet. Another interpretation is that the sensor output always lies within two lines which are parallel to the ideal output and shifted by the maximal linearity error.

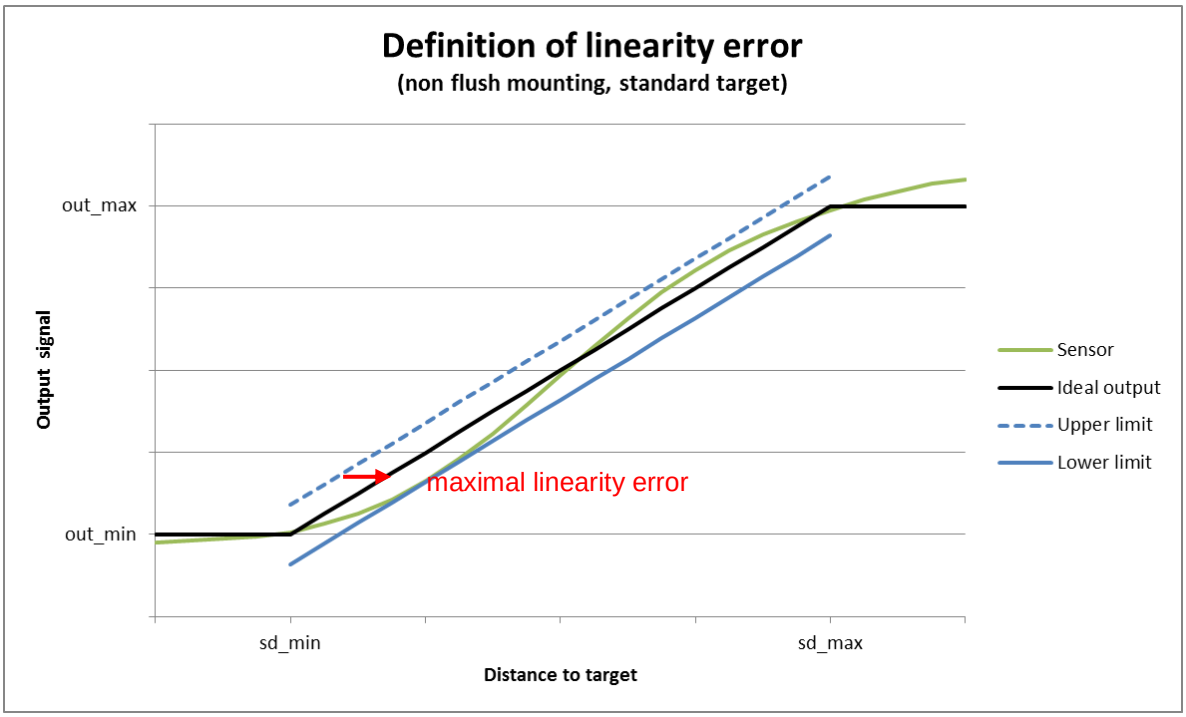


Diagram linearity error: The linearity error is the maximal deviation from an ideal line.

The linearity error is specified for non-flush mounting with the standard target. If either the mounting situation or the target deviates from that, the linearity error will be different. If not otherwise stated, the linearity error mentioned on the datasheet is given for the entire measuring range sd. For certain sensors, where the linearity error is significantly smaller within a reduced range, the linearity error is stated for the full range and the linear region. Baumer also offers linearized inductive sensors, please visit www.baumer.com.

4.5 Target

In practice, the geometry and the material of the target will differ from the standard target. The influences can be estimated as described in the following paragraphs.

4.5.1 Target size

If the target is smaller than the standard target, the maximal sensing range will be reduced. This means that the output will reach its maximum (out_max) at a distance shorter than sd_max. If the target is larger than the standard target, there will be only minimal influences.

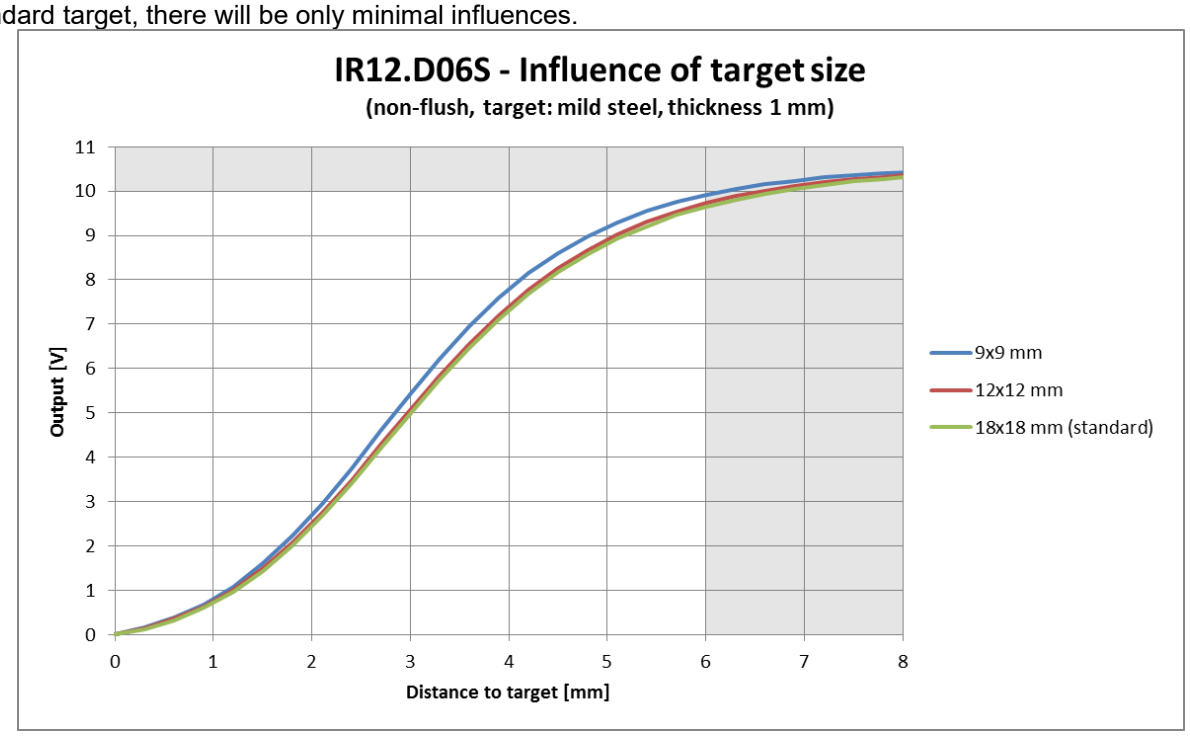


Diagram IR12-D06S sensors: Sensor output (typical values) influenced by targets of different size when the sensor is mounted non-flush.

4.5.2 Target material

Provided the target is not made of mild steel, the sensing range is typically reduced and thus the maximal sensing distance will be smaller. The following diagram shows the influence of the target material:

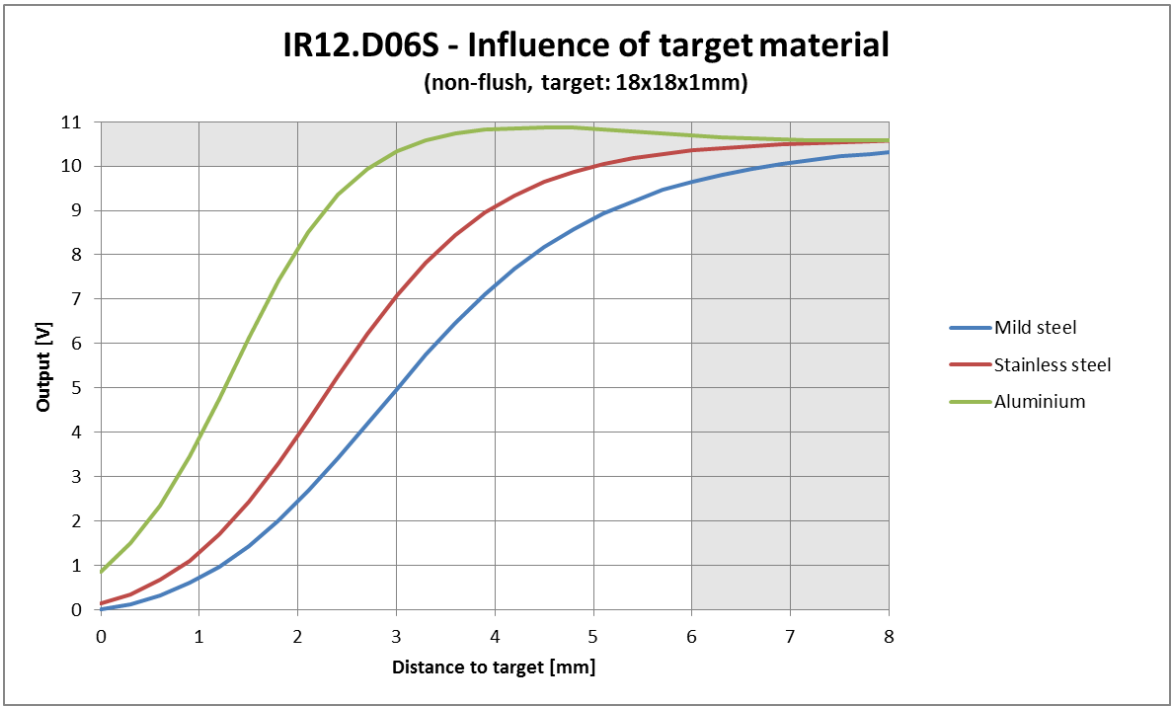
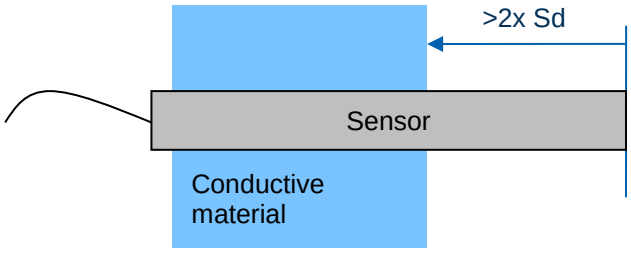


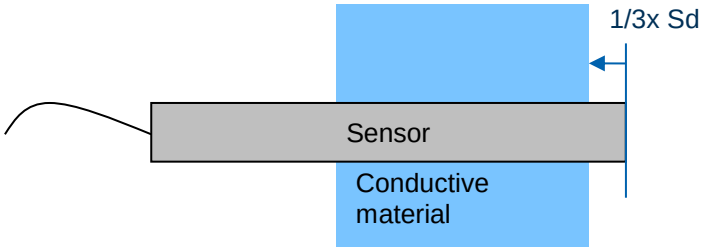
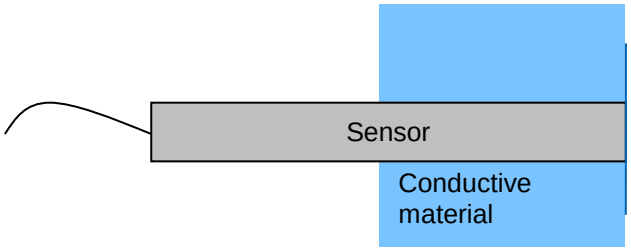
Diagram IR12-D06S sensors: Sensor output (typical values) for different target materials when the sensor is mounted non-flush.

The diagrams above show that the target properties (size and material) have a substantial influence on the output characteristic of inductive sensor and therefore its readings. Standard sensors are optimized for mild steel targets, which can be identified by its distinctive attraction to magnets (magnetically soft, permeability coefficient >>1) – i.e. a magnet sticks to it after contact. Please consult Baumer if you need sensors optimized for other materials.

4.6 Influence of mounting situation

The largest influence on the output of an inductive sensor is conductive material is close to the sensing face. Depending on the material of the sensor housing and the conductivity of the material which is close to the sensor, the output curve is changed more or less. The following mounting situations can be distinguished:

Mounting situation	*Sketch of mounting situation*
Non-flush: There is no conductive material in the vicinity (>2x maximal sensing range) of the sensing face.	

Quasi-flush mounting: There is no conductive material directly surrounding the sensing face, but at a small distance behind (1/3x Sd).	
Flush mounting (in conductive material): The sensor is fully embedded in conductive material. Flush mounting in non-conductive material, e.g. plastic, does not influence the sensing behavior.	

The following diagram shows the influence of the mounting situation in different materials and different distances to the sensing face:

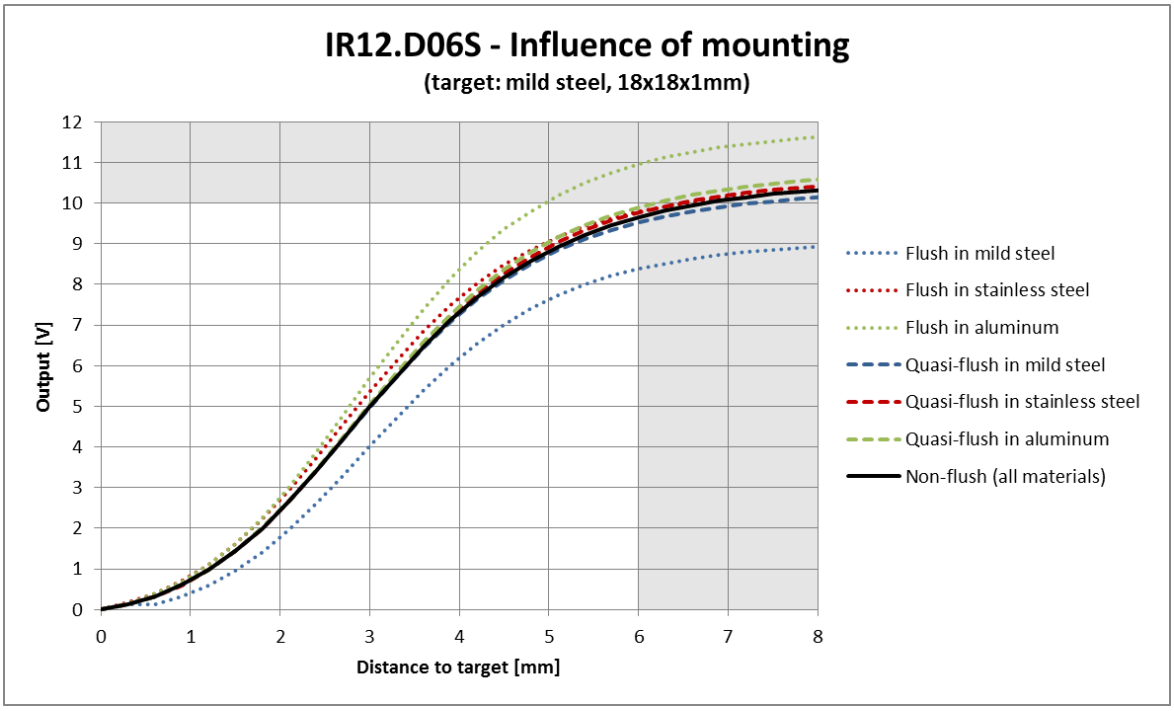


Diagram IR12-D06S sensors: Sensor output (typical values) influenced by different mounting situations (material and position). The mounting material has almost no influence on the output curve for non-flush mounting – as well as quasi-flush mounting and sensing distances up to 50% of Sd. Nonferrous materials, such as brass or copper, show similar results as aluminum.

4.7 Temperature influence

Inductive sensors are susceptible to temperature changes – i.e. the output value at a given distance between sensor and target changes slightly if the temperature varies.

Please note that the values mentioned in the datasheet do also include production tolerances, therefore a single sensor generally shows an even smaller temperature dependency. For limited temperature ranges, further optimization of the temperature drift is possible. Please consult Baumer for further information.

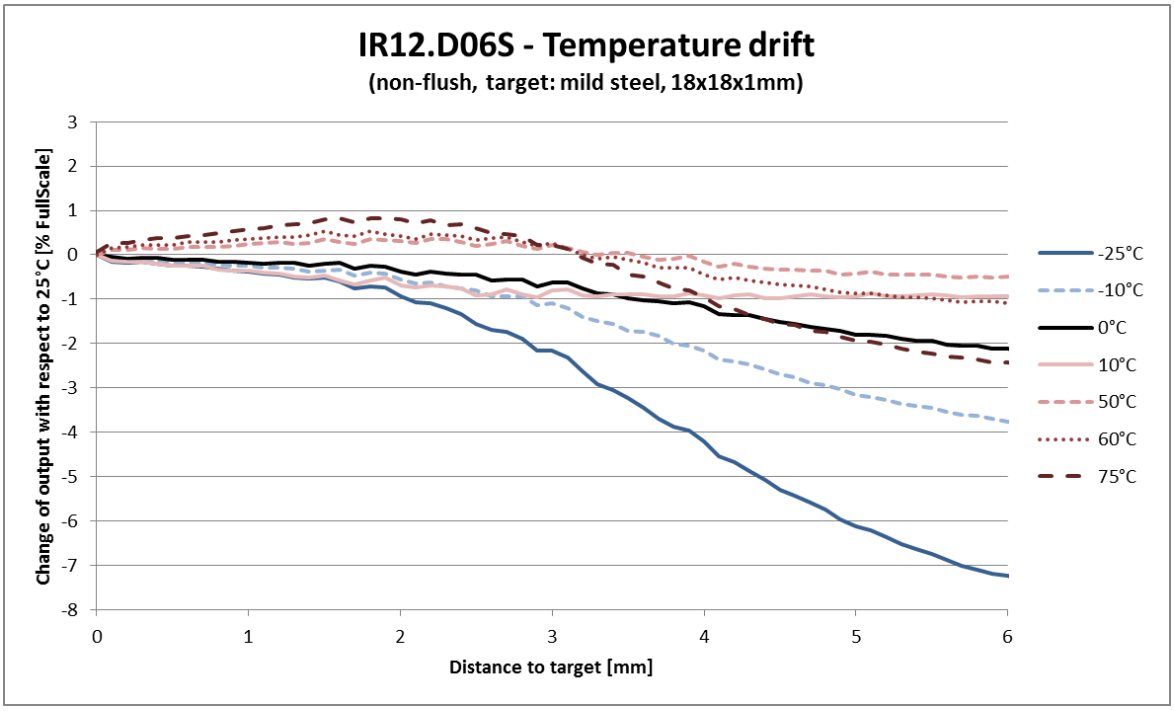


Diagram IR12-D06S sensors: Deviation of the output signal (typical values) at various temperatures and distances relative to the corresponding value at reference temperature (25°C). These sensors show a very small temperature drift for ambient temperatures within 10…60°C.

5 Safety instructions and maintenance

5.1 General safety instructions

Intended use

This product is a precision device and is used for object detection and the preparation and/or provision of measuring values as electrical quantities for a subsequent system. Unless this product is specially labeled, it must not be used for operation in hazardous environments.

Commissioning

Installation, mounting and adjustment of this product may be performed only by a qualified person.

Installation

For mounting, use only the mechanical mountings and mechanical mounting accessories intended for this product. Always comply with admissible cable bending radii. Prior to electrical connection of the product, the system must be disconnected from the power supply. In areas where shielded cables are mandatory, they must be used as protection against electromagnetic interferences. If a connector is added by the customer to a shielded cable, an EMC version of the connectors should be used, and the shield must be connected to the connector housing across a large area.

5.2 Maintenance

Inductive sensors do not require any maintenance or cleaning.

6 Error correction and tips

6.1 Error correction

Error	Error correction
Linearity of the output does not meet the expectations	Change the mounting situation, the material of the mounting device or measurement target to achieve the desired output characteristic. If this is not feasible, use the linearized sensor version from Baumer.
Slope is not steep enough	Use larger target, choose a linearized inductive sensor with 2-point teach or ask Baumer for a customized sensor version.
The output signal exceeds the specified output range.	This is a characteristic property of non-linear sensors and can be used to measure larger distances. This behavior can be reduced by taking the following actions: • Reduce the maximum distance between sensor and target • Change the mounting type or the material of the mounting device • Use a smaller target or a target made of a different material If the above measures are not feasible, use a linearized sensor from Baumer or contact Baumer

7 Change History

2016-07-16	lop	Manual version 1.0 released

Baumer
Passion for Sensors

Baumer Group
International Sales
P.O. Box · Hummelstrasse 17 · CH-8501 Frauenfeld
Phone +41 (0)52 728 1122 · Fax +41 (0)52 728 1144
sales@baumer.com · www.baumer.com