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the sensor people

GS 754B CCD Forked Photoelectric Sensors

Technical description

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TECHNICAL DESCRIPTION

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11/2011

1 General information

1.1 Explanation of symbols

The symbols used in this technical description are explained below.

Attention

This symbol precedes text messages which must strictly be observed. Failure to comply with this information results in injuries to personnel or damage to the equipment.

Notice

This symbol indicates text passages containing important information.

1.2 Declaration of conformity

The GS 754B CCD forked photoelectric sensors have been developed and manufactured in accordance with the applicable European standards and directives.

Notice

A corresponding Declaration of Conformity can be requested from the manufacturer.

The manufacturer of the GS 754B CCD Forked Photoelectric Sensors, Leuze electronic GmbH+Co. in D-73277 Owen/Teck, possesses a certified quality assurance system in accordance with ISO 9001.

2 Safety Notices

2.1 Safety standards

The GS 754B CCD Forked Photoelectric Sensors were developed in accordance with the applicable safety standards and tested by the manufacturer.

2.2 Approved purpose

In connection with a connected control system or evaluation unit, GS 754B CCD forked photoelectric sensors are used to detect and measure small objects in industrial production processes.

Attention

The protection of personnel and the device cannot be guaranteed if the device is operated in a manner not corresponding to its intended use.

Attention

Access and changes to the device, except where expressly described in this operating manual, are not authorized.

2.3 Organizing measures

All information in this technical description, particularly the "Safety Notices" section must be observed without fail.

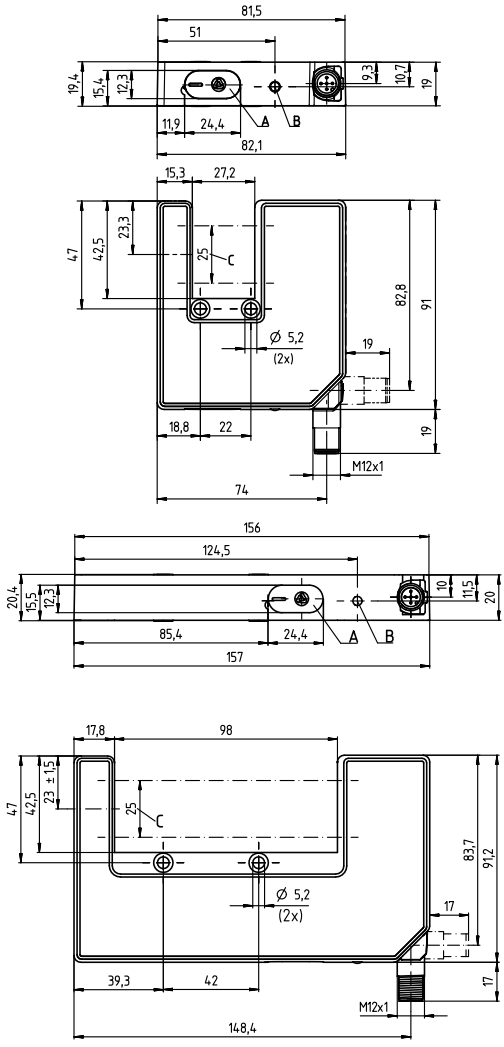
Keep this technical description in a safe place. It should be available at all times.

Observe the locally applicable legal regulations and the rules of the employer's liability insurance association.

Mounting, commissioning and maintenance of the device must only be carried out by qualified personnel. Electrical work must be carried out by a certified electrician.

Repairs, particularly opening the housing, may only be performed by the manufacturer or a person authorized by the manufacturer.

3 Controls and indicators



A Interface
B Indicator diode
C Optical detection area

Figure 3.1: Positioning of the controls and indicators

4 Description

4.1 General description

The central part of the unit is an optical sensor that generates a horizontal band of light (figure 3.1). The band of light illuminates a CCD line array camera. This CCD array produces an output signal that depends on the number of illuminated pixels.

The system has a permanent calibration and guarantees maximum precision and stability at all times.

Every sensor features two interfaces (see figure 3.1).

1. Interface P (standard interface RS 232):
   programming interface for configuring the measurement modes and for visualizing the measurement values.
2. Interface M12 (process interface):
   data for the control system are transmitted via this interface. Depending on the sensor type used, the measurement values are output either in analog or digital form.

Depending on the sensor type used, not all measurement values are available at the P and M12 interfaces.

Example: Analog interface can only output one measurement value at a time. The digital interface can output any number of measurement values.

5 Optical data

	GS 754B	
	Output modes 1 … 5	**Output mode 7**
Measurement range	25 mm	25 mm
Mouth width	27 mm/98 mm	27 mm/98 mm
Mouth depth	42 mm	42 mm
Resolution	≤ 0.1 mm over the entire measurement range	≥ 0.014 mm per measurement level
Smallest object	≥ 0.5 mm	≥ 0.5 mm
Light source	infrared LED	infrared LED
Wavelength	850 nm	850 nm

Table 5.1: Optical data

6 LED indicators

LED	Meaning
green, continuous light	ready
green, flashing	interference

Table 6.1: LED indicators

7 Device configuration

7.1 General information

Parameterization cannot be carried out via the M12 interface. For this purpose, use appropriate cable KB-ODS96-….

To perform the parametrization, you require a PC with an RS 232 interface and a terminal program with the following setting.

7.1.1 Terminal program

To do this, you can use any terminal or modem program that can access the serial interface(s) of your PC directly.

Under Microsoft® Windows® 95/98/NT/2000, you can use the HyperTerminal, for example.

7.2 Basic configuration of the terminal program (interface P)

Transmission rate	9600 bit/s
Data bits	8
Parity	no
Stop bits	1
Protocol	no

Table 7.1: Basic configuration of the terminal program (interface P)

7.3 Configuration of the measurement, analysis and output procedures over interface P

The appropriate configuration is activated by entering ASCII characters. Letters may be entered in either capital or lowercase form.

By entering the ASCII character "R", the state on delivery is restored. However, "R" has no effect on the configuration of the switching output (PNP, NPN, push-pull).

Configuration examples can be found at the end of the document.

7.3.1 Configuration table for GS 754B

ASCII commands		Available for interface
Output mode		
1	output cycle approx. 3 sec.	serial and analog
2	output cycle approx. 1 sec.	serial and analog
3	output cycle approx. 500 msec.	serial and analog
4	output cycle approx. 250 msec.	serial and analog
5	output cycle approx. 100 msec.	serial and analog
7	max. output cycle approx. 12 msec. (default)	serial and analog
Averaging		
M,m	averaging across the specified output cycle period	serial and analog
A,a	output of individual measurement value (default)	serial and analog
Object number		
Q,q	single-object measurement (default)	serial (only modes 1-5)
W,w	measurement of two objects	serial (only modes 1-5)
E,e	measurement of three objects	serial (only modes 1-5)
Evaluation process		
=	diameter detection	serial and analog
-	edge detection (default)	serial and analog
!	non-continuous objects	serial and analog
?	homogeneous objects (default)	serial and analog
F,f	foil detection	serial and analog
Reset		
R,r	reset with config. switching output (7,a,-,o,?) reset with config. teach input (7,a,-,t,?)	serial and analog
Edge assignment for analog output (single-object measurement)		
D,d	object diameter	analog
$	edge middle	analog
(	inner edge (default)	analog
)	outer edge	analog
Changing over teach input / switching output (PIN 2)		
T,t	teach input function	analog
O,o	switching output function	serial and analog

Level changeover for switching output (PIN 2), entries apply to PNP switching output		
<	standard function (default) (chap. 9)	serial and analog
>	standard function, inverted (chap. 9)	serial and analog
*	photoelectric sensor function, dark switching (presence monitoring)	serial and analog
#	photoelectric sensor function, light switching (presence monitoring)	serial and analog
P,p	PNP switching output (default)	serial and analog
N,n	NPN switching output	serial and analog
G,g	push-pull switching output	serial and analog

Table 7.2: Parameterizing commands GS 754B

8 Precision and linearity

The maximum theoretical measuring range is 28.6mm (2048 * 14µm).
The maximum measuring range is dependent on the output mode.

Measurement values of the serial and analog interfaces are linearized.

The sensor makes the measurement values available in the following resolutions, depending on the output mode chosen:

Measurement resolution:

	Output modes 1 … 5	Output mode 7
Serial interface	0.1 mm (ASCII)	0.014 mm (binary)
Analog interface	0.1 mm (current/voltage)	0.014 mm (current/voltage)

Linearity in output modes 1 … 5:

In output modes 1 … 5, the measurement values are scaled. These measurement values are scaled to the standard 4 … 20mA interface via the internal microcontroller. The resulting measurement field for output modes 1 … 5 is 25.3 mm (1807 * 14 µm).

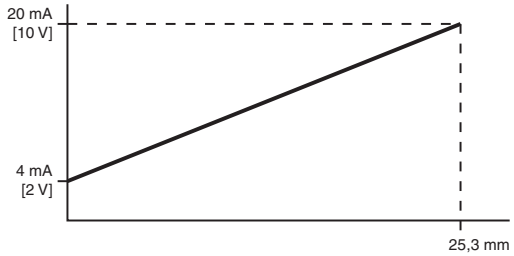


Figure 8.1: Linearity in output modes 1 … 5

Linearity in output mode 7:

In output mode 7, the measurement values are not scaled. Each measurement value is directly output by the internal microcontroller. The resulting measurement field for output mode 7 is 25.3 mm (1807 * 14µm) and the output current 0 … 21.37mA.

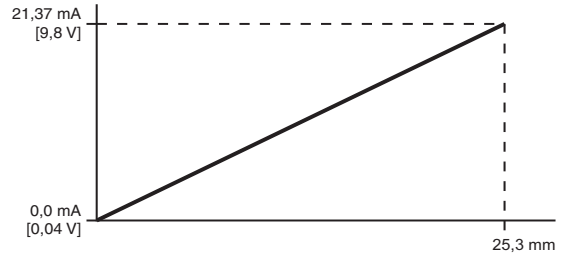


Figure 8.2: Linearity in output mode 7

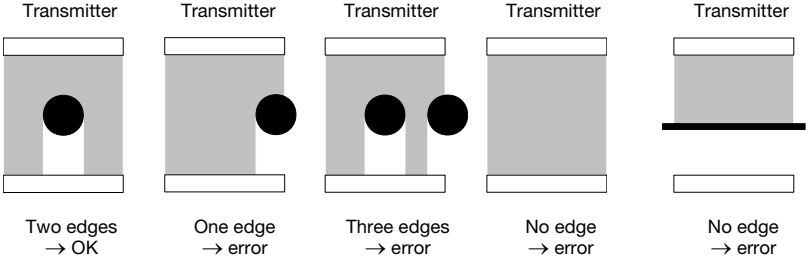
9 Error messages (interfaces P and M12)

Errors vary depending on the configured measurement, analysis and output variants. The errors are output at interfaces P and M12.

		Fewer edges than specified		More edges than specified		Light path fully blocked	
		Middle pos.	Diameter	Middle pos.	Diameter	Middle pos.	Diameter
Serial output	**Modes 1 … 5**	000	000	555	555	999	999
	Mode 7						
Analog current	**Modes 1 … 5**	3.5mA		>20mA		>20mA	
	Mode 7	0mA					
Analog voltage	**Modes 1 … 5**	1.75V		>10V		>10V	
	Mode 7	0V					
Switching output pin 2	**Modes 1 … 5**	High level (+24V)		High level (+24V)		High level (+24V)	

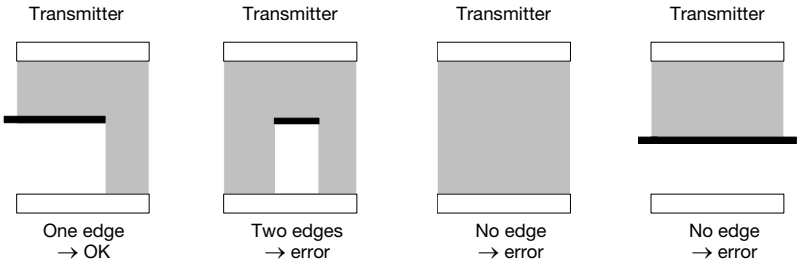
Example of diameter detection:

In this setting, the sensor expects two object edges. If more or fewer object edges are detected, an error message is output.



Example of edge detection:

In this setting, the sensor expects only one object edge. If more or fewer object edges are detected, an error message is output.



10 Dig. measur. value output (P and M 12 interf.)

The measurement value output is dependent on the type of sensor used and the configuration set.

There are a number of different output modes available.

These are divided into two primary output variants:

1. Output modes 1, 2, 3, 4, 5:
   the measurement value output is performed at 0.3Hz, 1Hz, 2Hz, 4Hz or 10Hz. The measurement values are linearized by the sensor and converted to mm values. Conversion of the pixel data is no longer necessary. The sensor transmits the measurement values to interfaces P and M12. The digital information is, in this case, transmitted in ASCII format and can be read using the monitor program. The resolution is 0.1mm.
2. Output mode 7:
   the measurement value output is performed at 80Hz. The sensor transmits the measurement values to interfaces P and M12. In this case, digital information is transmitted in binary format and can be read with the monitor program. The resolution is 0.014mm.
3. Output mode 7 + foil (F):
   measurement value output is performed at 400Hz, otherwise it functions as described under point 2.
4. Foil mode F:
   in foil mode "F", the mode 1 ... 5 output cycles can be selected. This can be useful for specific applications in combination with the determination of average "M". In this case, the cycle times from table 7.2 vary slightly.

The various output formats are explained on the following pages using examples.

10.1 ASCII format for P and M12 interfaces

Readable ASCII data are only output via the digital interfaces in output modes 1, 2, 3, 4, 5. The resolution is 0.1mm.

ASCII commands		Measurement value output in ASCII format
=, q, 5	Diameter detection	Middle-Pos.:125 Diameter:020
-, q, 5	Edge detection	Edge-Pos.:185

Table 10.1: ASCII format for P and M12 interfaces

Example of diameter detection:

Middle-Pos.:	125	(equivalent to 12.5 mm)
Diameter:	020	(equivalent to 2.0 mm)

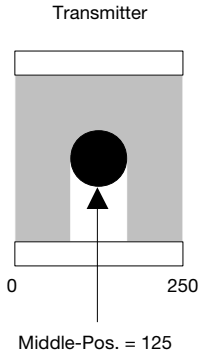


Figure 10.1: Ex. diameter detection (ASCII format)

The middle of the object is located at CCD position 12.5mm.
The object diameter is 2.0mm.

Example of edge detection:

Edge-Pos.: 185 (equivalent to 18.5mm)

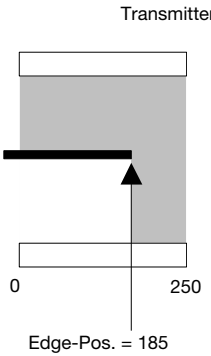


Figure 10.2: Ex. edge detection (ASCII format)

The edge of the object is located at CCD position 18.5mm.

10.2 Binary format for the P and M12 interfaces

Binary data is only output via the digital interfaces in output mode 7. This binary data cannot be displayed by the terminal program.

The resolution is 0.014mm.

ASCII commands	
=, q, 7	Diameter detection
-, q, 7	Edge detection

Table 10.2: Binary format for the P and M12 interfaces

Example of diameter detection:

Measurement value output in binary format								
Data						Byte designator		
D_5	D_4	D_3	D_2	D_1	D_0	P_1	P_0	
Middle-Pos. (low byte)						0	0	byte 0
Middle-Pos. (high byte)						0	1	byte 1
Diameter (low byte)						1	0	byte 2
Diameter (high byte)						1	1	byte 3

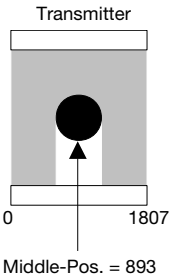


Figure 10.3: Ex. diameter detection (binary format)

The middle of the object is located at CCD pixel 893.

The diameter of the object is 143 pixels.

Measurement value output in binary format									
Data						Byte designator			
D_5	D_4	D_3	D_2	D_1	D_0	P_1	P_0		
1	1	1	1	0	1	0	0	byte 0	001101111101
0	0	1	1	0	1	0	1	byte 1	value: 893 (893 x 0.014mm = 12.5mm)
0	0	1	1	1	1	1	0	byte 2	000010001111
0	0	0	0	1	0	1	1	byte 3	value: 143 (143 x 0.014mm = 2.0mm)

Example of edge detection:

Measurement value output in binary format								
Data						Byte designator		
D_5	D_4	D_3	D_2	D_1	D_0	P_1	P_0	
Edge-Pos. (low byte)						0	0	byte 0
Edge-Pos. (high byte)						0	1	byte 1

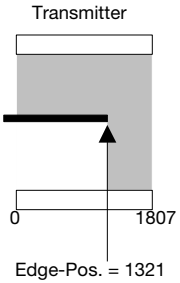


Figure 10.4: Ex. edge detection (binary format)

The edge of the object is located at CCD pixel 1321.

Measurement value output in binary format									
Data						Byte designator			
D_5	D_4	D_3	D_2	D_1	D_0	P_1	P_0		
1	0	1	0	0	1	0	0	byte 0	010100101001
0	1	0	1	0	0	0	1	byte 1	value: 1321 (1321 x 0.014 mm = 18.5 mm)

11 Anal. measur. value output (interf. M12)

The analog current and voltage values are available only at the M 12 interface. These values vary depending on the type used and on the configuration. The measuring range is changed in output modes 1...5 and in output mode 7 (see chapter 8).

	Output modes 1 … 5	Output mode 7
Analog current	0.063 mA / 0.1 mm	11.72 µA / 14 µm
Analog voltage	0.0316 V / 0.1 mm	5.37 mV / 14 µm

Table 11.1: Data formats for analog interface M12

12 Typical areas of application

12.1 Diameter detection

Depending on which interface is used, data for up to three objects can be output. Data for more than one object can only be transmitted via the serial interface. The analog value is always based on the edge or diameter information.

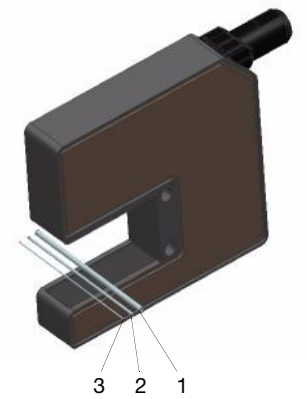


Figure 12.1: Diameter detection application example

12.2 ASCII display via RS 232 (P and M12 interfaces

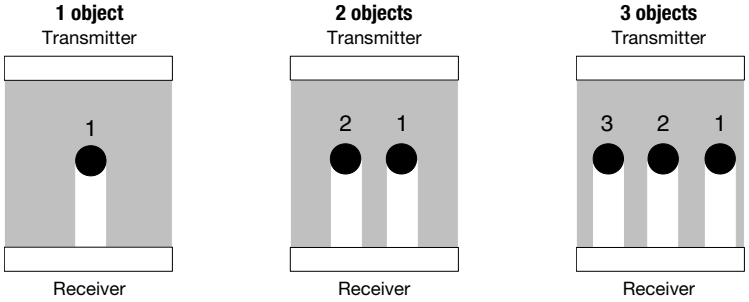
Parameter		ASCII output data via S1 and S2
Q,q	Single-object detection	Middlepos. : xxx Diameter: xxx
W,w	Detection of two objects	Middlepos. : xxx Diameter: xxx Middlepos. : xxx Diameter: xxx
E,e	Detection of three objects	Middlepos. : xxx Diameter: xxx Middlepos. : xxx Diameter: xxx Middlepos. : xxx Diameter: xxx

Table 12.1: ASCII representation, output modes 1 … 5

Example for xxx:123 (12.3mm)

12.2.1 Binary display via RS 232 (P and M12 interfaces)

Due to the fast output of measurement values, only data for single-object detection can be output in this output mode. The measurement values cannot be displayed on the screen (see chapter 10.2).



13 Edge detection and height verification

With this measurement, the sensor expects only one edge within the measurement field. An error message results if more or fewer edges are detected by the system.

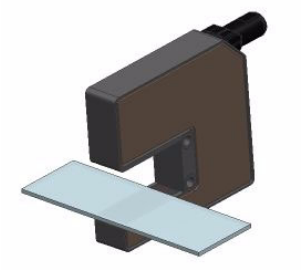
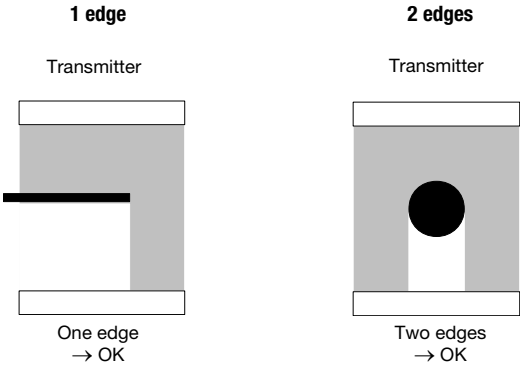


Figure 13.1: Edge detection and height verification



Various configurations are possible with this measurement.
The following only applies to devices with an analog interface:

1. Linear edge measurement over the entire measuring range (s. point 8)
2. Teach-in edge measurement with 5V-output at teaching point

These functions are described in the following.

14 Special configurations

14.1 Teachable single-object- and edge-measurement for devices with analog output

Connection pin 2 of devices with analog output can be configured as a warning output or as a teach input. If pin 2 has been configured as a teach input, edge adjustment is possible here at 5V. In this way, any given point of the measurement field can be assigned the output value 5V. It is no longer necessary to adjust the process software.

14.1.1 Teach-in in the middle of the measurement field

The measurement value is output linearized. As a result, the entire measurement field is available for the measurement.

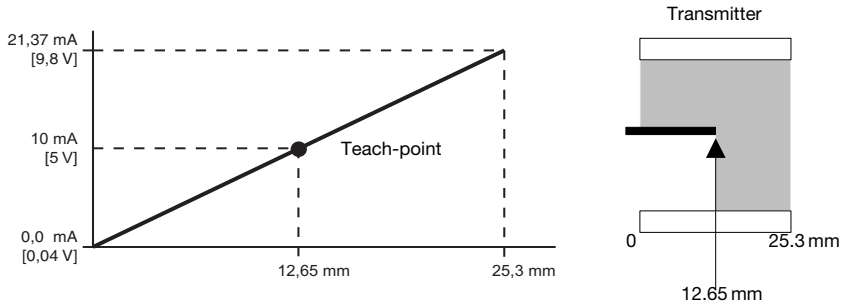


Figure 14.1: Teach-in (edge in the middle of the measurement field)

14.1.2 Teach-in at the end of the measurement field

The measurement value is output linearized. The measurement field range is restricted. A change in measurement value no longer occurs at the beginning of the measurement field.

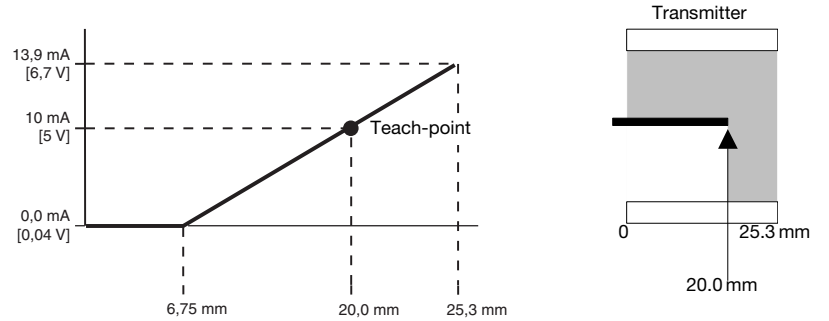


Figure 14.2: Teach-in (edge at the end of the measurement field)

14.1.3 Teach-in at the start of the measurement field

The measurement value is output linearized. The measurement field range is restricted. A change in measurement value no longer occurs at the end of the measurement field.

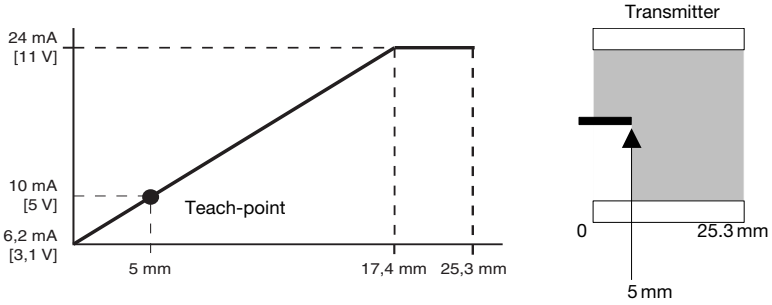
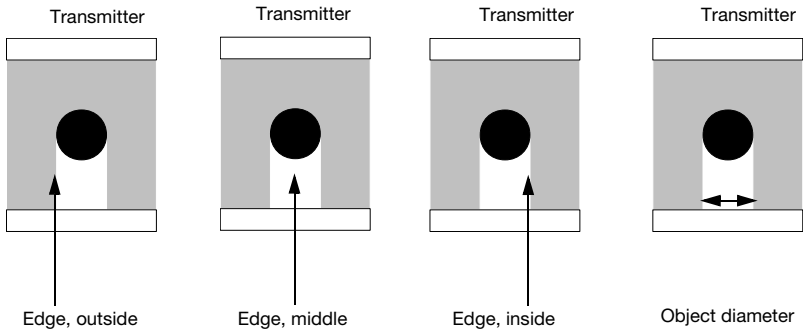


Figure 14.3: Teach-in (edge at start of the measurement field)

14.2 Changeover of the edge assignment for single-object measurement

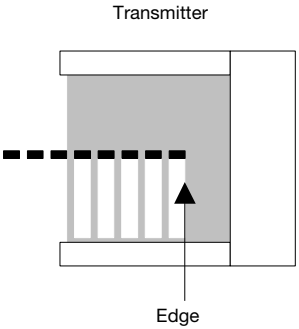
Only one piece of edge information can be output via the analog interface. With single-object measurement, the sensor sees two edges. Using these edges, information such as object diameter and object middle can be calculated. These edge assignments can be configured.



14.3 Edge measurement for non-continuous objects

With this function, net-like objects, e.g. fabric, can be detected.

Here, the first edge of the object is output as the measurement value. All other edges are suppressed. In this configuration the number of edges is not checked. Error messages are not output.



14.4 Level changeover for switching output PIN 2

When PIN 2 is configured as a switching output, various logical functions can be assigned to this switching output. A distinction is made between standard and photoelectric sensor functions/presence monitoring.

		Switching output pin 2		
Configuration	Function	Object partially in measurement field	Object completely in measurement field	Object not in measurement field
<	standard	high	low	high
>	standard inverted	low	high	low
*	dark switching	high	high	low
#	light switching	low	low	high

14.4.1 Standard function

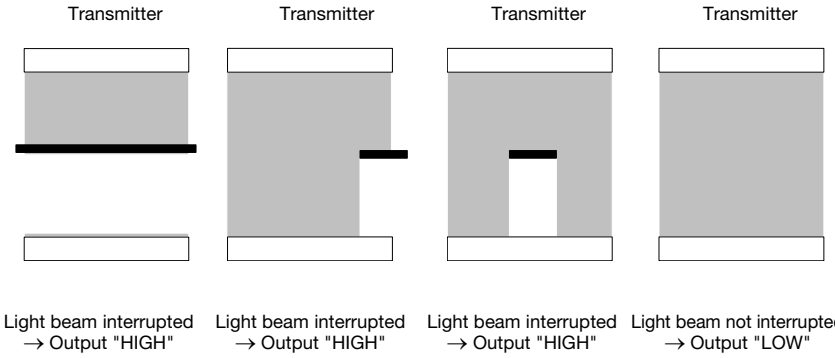
The number of object edges is monitored and output as described in point 9.

14.4.2 Standard function, inverted

The number of object edges is monitored and output inverted as described in point 9.

14.4.3 Photoelectric sensor function, dark switching

When configured for the photoelectric sensor function, the number of edges is not monitored. The entire measuring range is analyzed as a throughbeam photoelectric sensor. The switching output functions on a dark-switching basis.



14.4.4 Photoelectric sensor function, light switching

With photoelectric sensor level, the entire measurement range is analyzed as a throughbeam photoelectric sensor. The switching output functions on a light-switching basis.