User Manual

Line sensor *PosCon*

ZADM 22K..... und ZADM 22H....

Contents

Safety instruction

Safety concept information and limiting parameters as published in the sales documentation applies at all times.

1 Introduction

The *PosCon* is a competitively priced solution for many applications such as the measurement of fabric width, monitoring the position of threads or wires, or positioning web edges for example.

The development aim of the *PosCon* designers was to help end users avoid the complexities found in the application of many currently available sensing methods. So, the engineers maintained a commitment to keeping operation and mounting simple.

In most cases, the measurement of web edge, object width or thickness is carried out by sensing a particular line established as a point on the moving product. Until now, line cameras have been the method of choice for such measurements. A line camera, in simple terms, is a video camera that has a single line of photo-elements instead of a matrix..

The *PosCon* also uses the principle of inline measurement. However, instead of complex camera elements, the PosCon utilizes a line of simple photodiodes. This combination of minimal components and the commitment to trouble-free set-up and use has helped Baumer electric develop a product that performs like an expensive vision system, but retains the cost effectiveness and simplicity of a sensor.

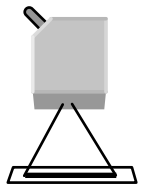
2 Getting started guide

After powering on, the *PosCon* starts in **RUN** mode.

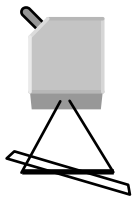
2.1 Mounting and alignment

Mount the sensor at the proper distance to the target according to the datasheet. If the target is presented at a different distance, the range and output changes proportionally. For optimum results, the object should be kept within 10% of specified measuring range.

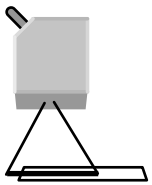
To align the sensor, set programming mode to **Width measurement / Sum of all objects** (see chart 2.2). The analog output will be 4mA when the sensor is properly aligned with the reflective tape.



analog output
I = 4 mA
✓



analog output
I > 4 mA
X



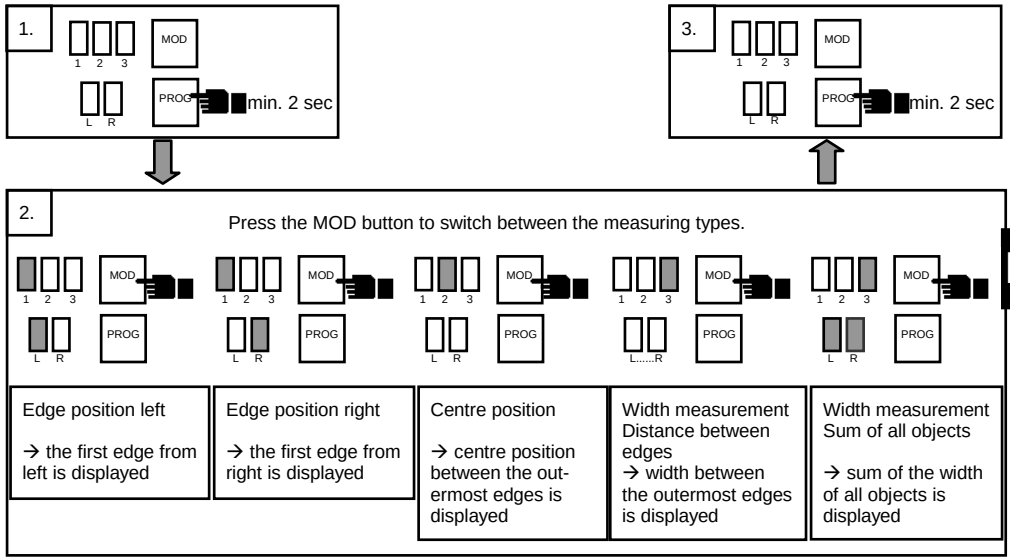
analog output
I > 4 mA
X

Recommended length of reflective tape:

$$\text{Length} = \frac{1.2 \times \text{Measuring range} \times \text{distance tape}}{\text{Measuring distance}}$$

Recommended width of reflective tape:
Measuring range 50 mm → 5 mm
Measuring range 150 mm → 20 mm
Measuring range 350 mm → 35 mm

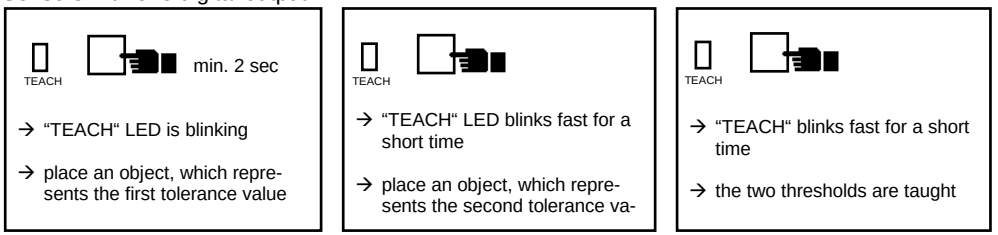
2.2 Programming the type of measurement



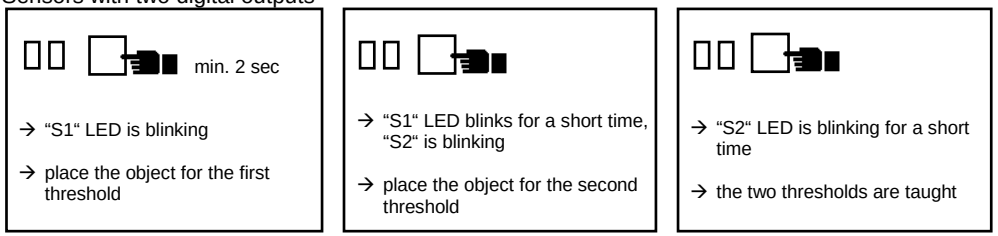
2.3 Teaching the thresholds (set points)

This allows the user to teach the sensor a min-max window of acceptance for targets.

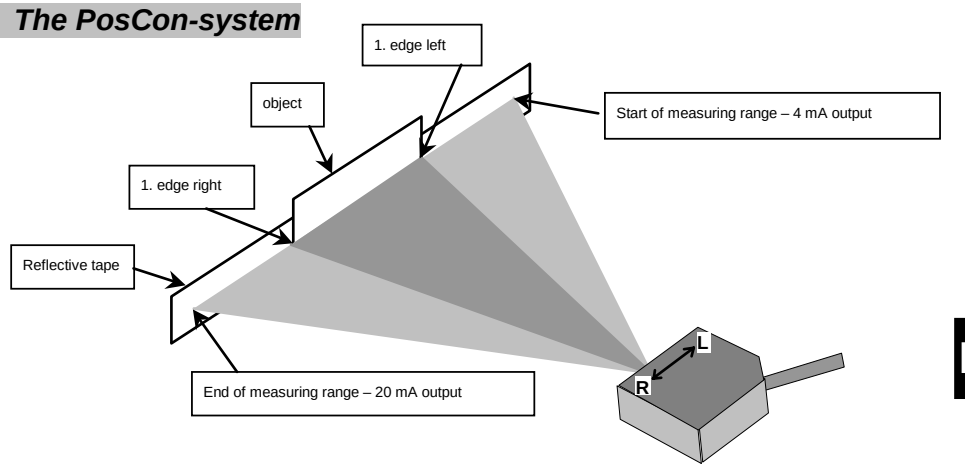
Sensors with one digital output



Sensors with two digital outputs



3 The PosCon-system

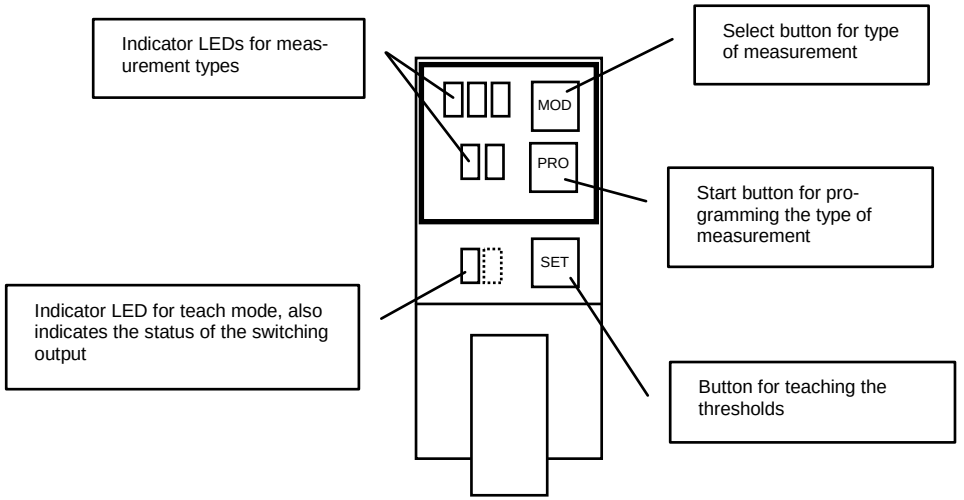


The sensor consists of infrared emitters, a receiver, the electronic components and the interface. In addition, a reflective tape is necessary.

For orientation, the system has a right "R" and a left "L" side and is indicated on the sensor housing. This corresponds to the analog output of the signal, left side equals 4mA while right side equals 20mA

Every change from bright to dark or dark to bright inside the measuring range is an edge for the sensor. Corresponding to the chosen measuring mode the sensor evaluates these edges and displays it on the analogue output.

4 The keypad



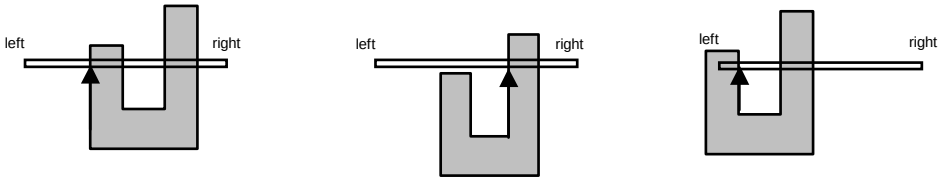
5 Type of measurement

General information

- All dark → bright or bright → dark changes inside the measuring range indicates an edge.
- An uncovered part of the reflective tape inside the measuring range indicates a bright section.
- A covered part of the reflective tape inside the measuring range indicates a dark section.
- No edge inside the measuring range means no object or an object that covers the whole measuring range.

5.1 Edge position, left edge

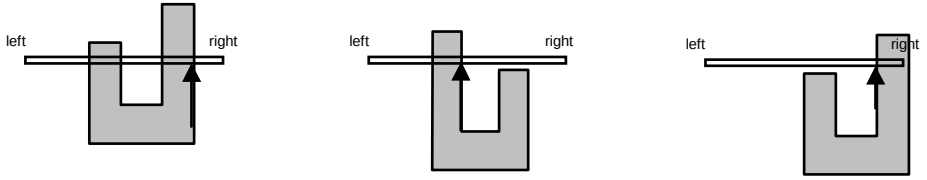
The sensor is measuring the outer most left edge inside the measuring range.



No edge inside the measuring range → analog output = 4 mA

5.2 Edge position, right edge

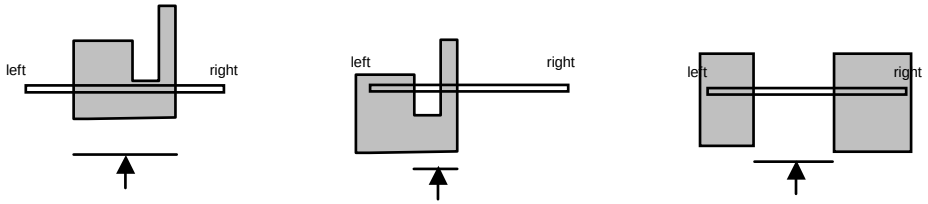
The sensor is measuring the outermost right edge inside the measuring range.



No edge inside the measuring range → analog output = 4 mA

5.3 Center position

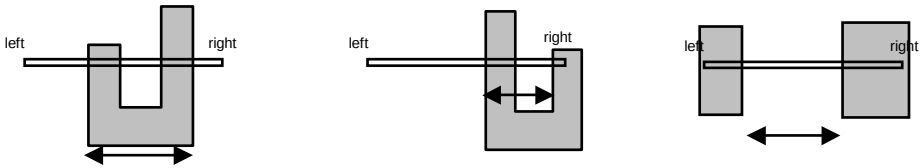
The center position between the two outermost edges inside the measuring range is measured.



No or one edge inside the measuring range → analog output = 4mA

5.4 Width measurement / Distance between edges

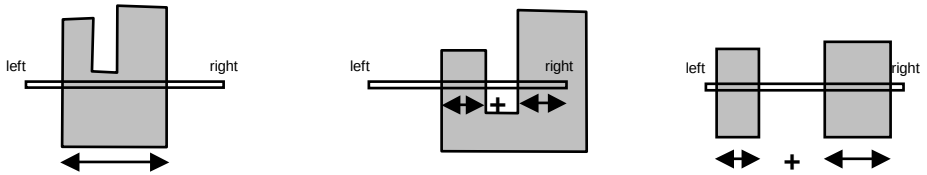
The sensor measures the distance between the outermost edges inside the measuring range.



No or one edge inside the measuring range → analog output = 4mA

5.5 Width measurement / Sum of all objects sizes

The sensor measures the sum of all objects sizes inside the measuring range.



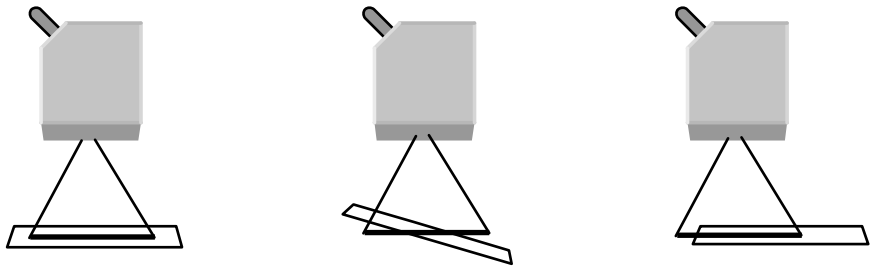
The whole measuring range is covered → analog output = 20 mA
No object inside the measuring range → analog output = 4 mA
This mode is used in initial sensor / reflector orientation

6 Installation

6.1 Alignment

Set the measurement type to Width measurement / Sum of all object sizes

If the reflector is well aligned, the output value will be 4mA.

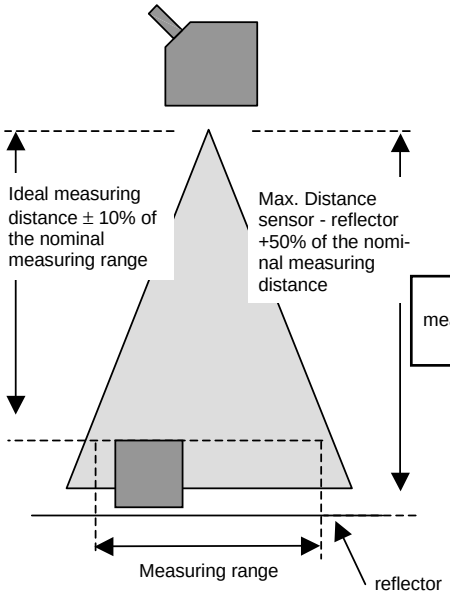


Analog output
I = 4 mA
✓

Analog output
I > 4 mA
X

Analog output
I > 4 mA
X

6.2 Measuring distance – Measuring range – Size of reflector



The nominal measuring range is specified in the datasheet for the particular PosCon model.

If the distance between the object and the sensor differs from the nominal measuring distance, the measuring range will be changed.

The measuring range can be calculated as follows:

$$\text{measuring range} = \frac{\text{nominal measuring range x measuring distance}}{\text{specified measuring distance}}$$

If it is not possible to place the object in the nominal measuring range, please be aware that with deviations of less than ± 10% of the nominal measuring distance, the sensor works at its best.

The correct size of the reflective tape can be calculated as follows:

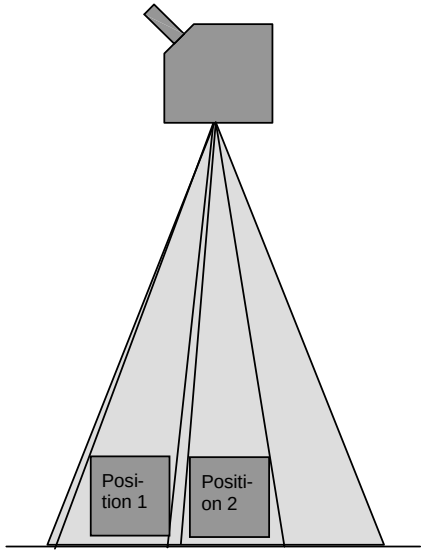
$$\text{length} = \frac{\text{1.2 x nominal measuring range x distance to reflector}}{\text{nominal measuring distance}}$$

recommended width:
measuring distance 50 mm → 5 mm
measuring distance 150 mm → 20 mm
measuring distance 350 mm → 35 mm

The angle of the reflector against the sensor axes must be within ± 20°.

7 Application information

7.1 Extended objects



The sensor recognizes only the outermost edges of an object. When objects extend toward the sensor, this can lead to different values for different positions within the measuring range.

Position 1: one front and one rear edge will be measured.
Position 2: the front edges will be measured.

The measured size of object in Position 1 is bigger than the object in Position 2.

7.2 Reflective tape covered by plexiglass

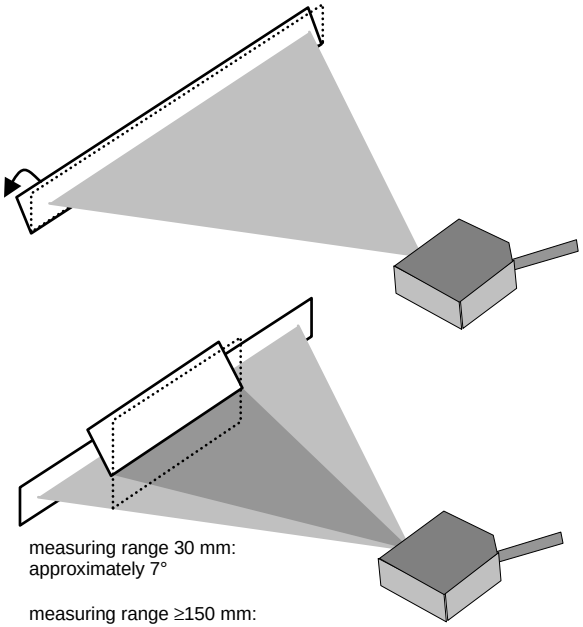
If the reflective tape is covered by glass or plexiglass, the reflector must be tilted, because a reflection from the reflector may disturb the measurement. The angle is approximately 5°.

Attention: The reflector must be tilted as shown in the drawing.

7.3 Glossy objects

If very glossy objects must be measured, a reflection from the object may disturb the measurement. In this case it helps to tilt the object. The reflection will thus be reflected away from the sensor.

Attention: The object must be tilted in the axis shown in the drawing.



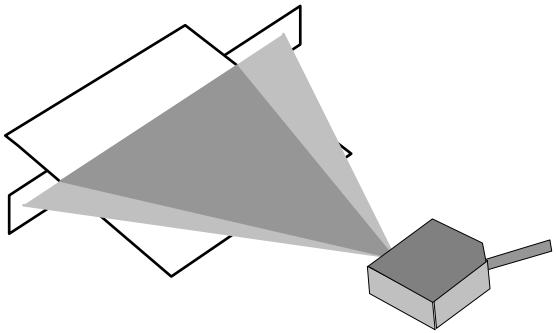
measuring range 30 mm:
approximately 7°

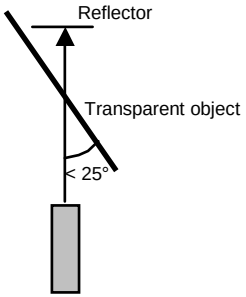
measuring range ≥150 mm:
approximately 3°

7.4 Transparent objects (polarization filter types only)

The sensor with the built in polarization filter detects and measures clear, transparent objects. In this case it is necessary to tilt the object.

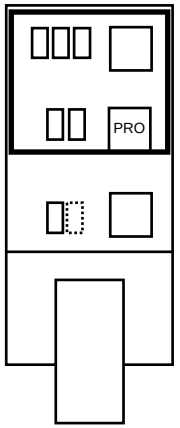
The angle between the sensor and the object must be less then 25°.





8 Programming the measurement type

The *PosCon* starts in Run mode. The LEDs indicate the current type of measurement.



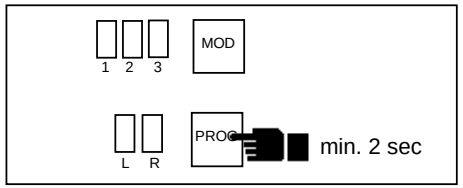
Note: The type of measurement and the tolerance limits for the switching output remain stored even after power down.

Two buttons help to program the sensor easily.

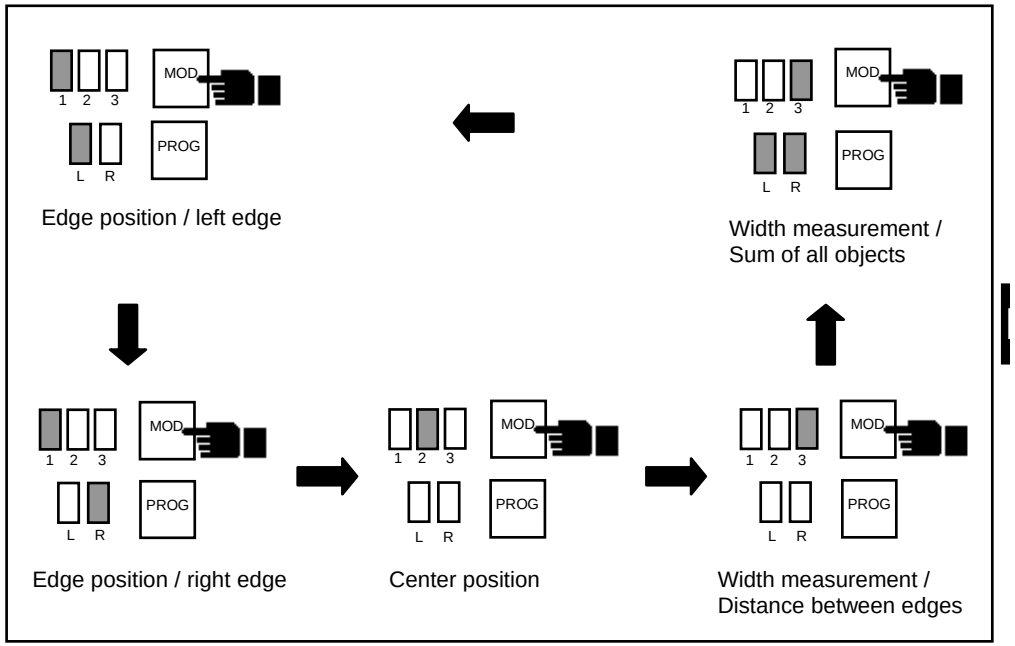
The MOD and PROG buttons are for programming the type of measurement. The SET button is for setting the threshold (set points) of the switching output.

Press the PROG button for more than 2 seconds to enter the programming mode. The measurement type indicator LED is now blinking.

To return to run mode after setting the right type of measurement, press the PROG button again for more than 2 seconds.



Press the MOD button to switch between the measuring types.

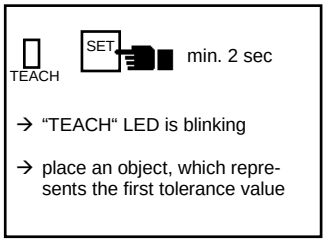


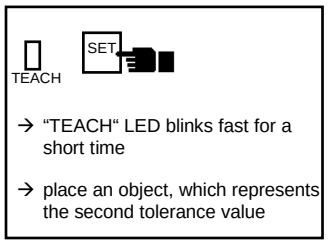
9 Teaching the switching output

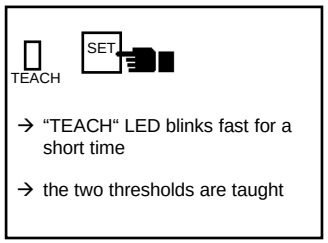
It is possible to set two threshold values inside the analog value of 4 – 20 mA.
Depending upon the values programmed into the switching output, and the status of the actual measured value, the switching output will either be High or Low.

For teaching the threshold value, it is necessary to simulate the tolerance position of the object or the tolerance size of the object.

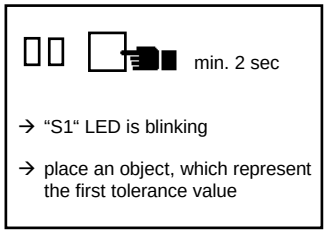
One switching output procedure:





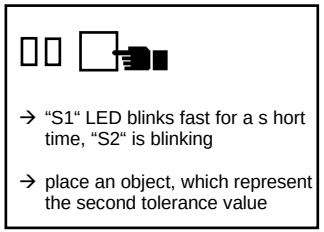


Two switching outputs procedure:



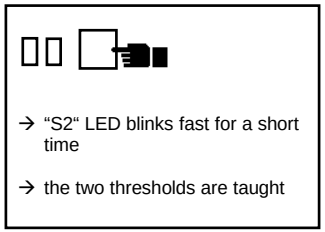
→ "S1" LED is blinking

→ place an object, which represent the first tolerance value



→ "S1" LED blinks fast for a s hort time, "S2" is blinking

→ place an object, which represent the second tolerance value



→ "S2" LED blinks fast for a short time

→ the two thresholds are taught

Logic of the switching output (one switching output)
If threshold 1 < threshold 2; the switching output is ON if the measured value is between threshold 1 and threshold 2, otherwise OFF
If threshold 1 > threshold 2; the switching output is OFF if the measured value is between threshold 1 and threshold 2, otherwise ON

Logic of the switching output (two switching outputs)
If measured value > threshold 1; the switching output S1 is ON, otherwise OFF
If measured value > threshold 2; the switching output S2 is ON, otherwise OFF

10 Inputs / outputs

10.1 Analog output

The zero point of the measuring range is on the left side (written on sensor). Depending on position of the object and the type of measurement, the current is between 4 – 20 mA.

10.2 Switching output

Depending on the threshold values and the measuring value, the switching output (or the two switching output, depending on sensor type) is High or Low.

Logic of the switching output (one switching output)
If threshold 1 < threshold 2; the switching output is ON if the measured value is between threshold 1 and threshold 2, otherwise OFF
If threshold 1 > threshold 2; the switching output is OFF if the measured value is between threshold 1 and threshold 2, otherwise ON

Logic of the switching output (two switching outputs)
If measured value > threshold 1; the switching output S1 is ON, otherwise OFF
If measured value > threshold 2; the switching output S2 is ON, otherwise OFF

10.3 Alarm output

The sensor will compensate for soiled optics to a certain limit. If this limit is reached, the alarm output will be activated (grey wire, pin 5).

10.4 Switching input (Enable)

The switching input (red wire, pin 8), can gate the switching output

<u>Sensor with one switching output</u>

Switching input connected to GND or not connected:	The switching output is active
Switching input connected to +Vs:	The switching output is OFF

<u>Sensor with two switching outputs</u>

Switching input connected to GND or not connected:	The switching outputs are active
Switching input connected to +Vs:	The switching outputs are memorised

11 Serial interface RS 485 (optional)

11.1 General

Certain models of the PosCon contain a serial port (RS 485). Via this port, all data can be acquired, which is available on the analog output. All types of measurements can be set, the buttons can be disabled and enabled and more functions are available.

There are two modes, in which the RS 485 can be run.
- Command mode: The sensor is a single sensor connected to the serial port. No address is necessary. No time consuming protocol overhead.
- Protocol mode: The RS 485 can be run as a bus with one master and several sensors as slaves. Each sensor has his own address.

The sensor comes with a factory set address of $FF. The address can only be changed in protocol mode.

The sensor will start always in command mode, whether it has the address $FF or his own address.

Note: The address remains stored even after power down.

Note: Keypad buttons cannot be pressed during the transmission of data.

Note: When sending $0A8 or $FF to stop continuous data mode ($0A) both the digital and analog outputs will give a brief on/off (digital output), and a current spike (analog output. When using continuous data mode, it is recommended that you ignore both the digital and analog output for a 1 second period after sending ($08 / $FF).

Specification:

Baud rate	Standard 19200 Baud
Start / Stop Bits	1 start bit / 1 stop bit
Data length	8 Bits
Parity	none
Operating mode	Half duplex

Measured data:

	Analog	Digital
Lowest value	4 mA	0
Highest value	20 mA	1023

11.2 Command mode

In a single sensor configuration this mode allows a transmission of the measured values with maximum speed and no protocol overhead. The measuring type cannot be changed in this mode. It must be set before using the button.

There are four commands for master sensor communication

command	Function	Response
$FF	Request for measured value	2 Byte binary 1.Hi Byte 2. Low Byte
$08	Switch to protocol mode	None
$0A	Continuous data	2 Byte binary Hi Byte (data: Bit 0..4, Bit 8 = 1) Low Byte (data: Bit 0..4, Bit 8 = 0) Sensor sends continuously data until the sensor receive $FF or $08
$99 x	Set delay for sensor answer. Factory setting is 0.2ms x is one Byte (binary). It sets the delay in increments of 0.1ms. The value of x may vary from 0 (0.1ms) to 255 (25.6ms). The sensor must have been in command mode for at least 10ms. No further command for the next 20ms.	None

11.3 Protocol mode

This mode allows multi sensor configurations with one master.

Protocol sequence:
In this operating mode, the sensor is always the slave. Every command starts with an ENQ followed by the sensor's address. The sensors response to ENQ is ACK. Next, the master sends data between STX and ETX. The data contains the actual command and, if required, parameters. If the command sent by the master initiates an action, the sensor responds with ENQ followed by its own address. The master then responds with an ACK and the sensor starts transmitting the answer between STX and ETX.

example: Master sends a command which initiates a response from the sensor

Master sends	delay	Sensor with address '2' sends
ENQ '2'		
	T1 (Time between ENQ from master and ACK from sensor)	
		ACK
	T2 (Time between ACK and data transmission to the sensor)	
STX <data> ETX		
	T3 (Time between data transmission from master and ENQ from sensor)	
		ENQ '2'
	T4 (Time between ENQ from sensor and ACK from master)	
ACK		
	T5 (Time between ACK from master and data transmission from sensor)	
		STX <data> ETX

Time: delay of sensor:
T1, T3, T5 can be set from 0.1 ms to 25.6 ms

delay of master
T2, T4 must be < 150 ms

Data coding:
The data values are coded in ASCII hexadecimal numbers. Each byte represents a hexadecimal digit.

Example:
To transmit the value 755 the number is transformed to a hexadecimal number $2F3 (the $ sign indicates a hexadecimal number). Now each digit is transmitted with its ASCII-Code $32 (for 2), $46 (for F), $33 (for 3).

Valid characters:
letter A-Z (capital letters only)
numbers 0 – 9
special character + - . , ; <
ENQ: ASCII character 5, ready to send (enquiry)
ACK: ASCII character 6, ready to receive (acknowledge)
STX: ASCII character 2, start of text
ETX: ASCII character 3, end of text

Commands in protocol mode:

Function	Data	Example		Response
Assign new address	'D' x x = 0 – 9 or 'F' for address $FF	STX 'D3' ETX	Assign address 3 to the sensor	ENQ,new address; ACK will be awaited.
Set type of measurement	'B' x '1' left edge '2' right edge '3' centre position '4' width / distance edges '5' width / sum of objects '6' number of edges	STX 'B3' ETX	Type of measurement is centre position	none
Set threshold level	'F' xxx yyy xxx and yyy are 3 digit hexadecimal numbers between 0 and 1023	STX 'F0C620A' ETX	Set threshold 1 to $0C6 (198) Set threshold 2 to $20A (522)	none
Data request	'A'	STX 'A' ETX	Data request	4 bytes (measured value)
Status request	'H'	STX 'H' ETX	Status request	26 Bytes (see status table))
Keyboard control	'G' x '5' keyboard on ':' keyboard off	STX 'G:' ETX	Switch keyboard off	none
Switch to command mode	'C' '<' = parameter	STX 'C<' ETX		none

Status request, meaning of the bytes

Byte Nr.	meaning	comment
1+ 2	HW/SW version	
3 + 4	First active pixel	Can not be changed by the user
5 + 6	Last active pixel	Can not be changed by the user
7 + 8	Hi-Byte of threshold level 1	
9 + 10	Low-Byte of threshold level 1	
11 + 12	Hi-Byte of threshold level 2	
13 + 14	Low-Byte of threshold level 2	
15 + 16	Duration of exposure	As long as this value is below max. exposure time the sensor is not soiled
17 + 18	Type of measurement	This two bytes represent the actual type of measurement Bit 0: Sensor stays in programming mode Bit 1: Sensor stays in SET-Mode Bit 2: number of edges Bit 3: left edge Bit 4: right edge Bit 5: center position Bit 6: width / distance edges Bit 7: width / sum of objects Example: Sensor sends ASCII-Code $30 $38, = hexadecimal number $08 or binary 0000'1000 → left edge
19 + 20	Internal parameter	Factory use only
21 + 22	Internal parameter	Factory use only
23 + 24	Max. exposure value	Factory set If the value "duration of exposure" reach this limit, the alarm output is set.
25 + 26	Internal parameter	Factory use only

11.4 Examples

Sensor 5, set type of measurement to center position

Master sends	Transmitted bytes in hexadecimal	Sensor sends
ENQ '5'	$05 $35	
	$06	ACK
STX 'B3' ETX	$02 $42 $33 $03	

Sensor 2, data request (actual value 416 or $01A0)

Master sends	Transmitted bytes in hexadecimal	Sensor sends
ENQ '2'	$05 $32	
	$06	ACK
STX 'A' ETX	$02 $41 $03	
	$05 $32	ENQ '2'
ACK	$06	
	$02 $30 $31 $41 $30 $03	STX '01A0' ETX

Sensor 7, set thresholds to 498 and 517, logic of the switching output (the switching output is ON if the measured value is between threshold 1 and threshold 2, otherwise OFF).

Master sends	Transmitted bytes in hexadecimal	Sensor sends
ENQ '7'	$05 $37	
	$06	ACK
STX 'F1F2205' ETX	$02 $46 $31 $46 $32 $32 $30 $35 $03	

11.5 ASCII-Code Table

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	NUL	SOH	STX	ETX	EOT	ENQ	ACK	BEL	BS	HAT	LF	VT	FF	CR	SO	SI
1	DLE	DC1	DC2	DC3	DC4	NAK	SYN	ETB	CAN	EM	SUB	ESC	FS	GS	RS	US
4	SP	!	"	#	$	%	&	'	(	)	*	+	,	-	.	/
3	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
4	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
5	P	Q	R	S	T	U	V	W	X	Y	Z	[	\	]	^	_
6	`	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
7	p	q	r	s	t	u	v	w	x	y	z	{	|	}	~	DEL

examples: ENQ = $05, 'A' = $41

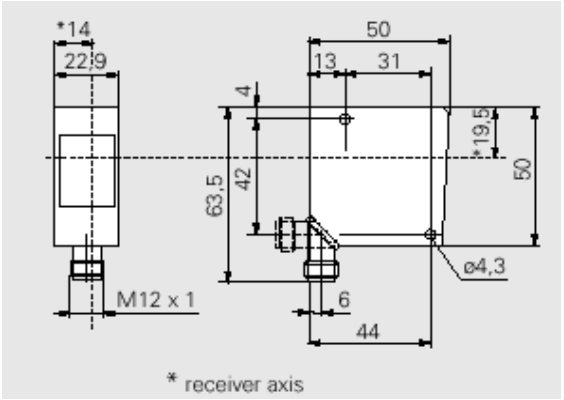
12 Service instruction

Check the measuring system for cleanliness at regular intervals.
Especially keep the front cover (optics) and the reflector clean. Every particle (water drops, heavy dust) on the reflector could be recognized as an object.

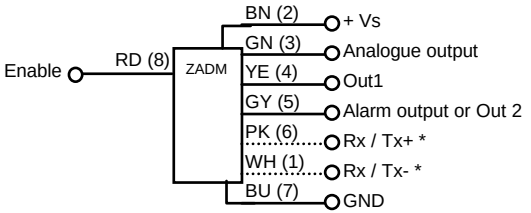
13 Technical data

Technical data	ZADM 022.x300	ZADM 022.x151	ZADM 022.x351	ZADM 022.x871
Measuring range	30 mm	150 mm	350 mm	400...875 mm
Measuring distance to object	50 mm	200 mm	500 mm	640...1400 mm
Smallest recognizable object	0.3 mm	1.2 mm	4 mm	8...18 mm
resolution	0.03 mm	0.15 mm	0.35 mm	0.5...1 mm
Minimum reflector width	3 mm	15 mm	30 mm	50 mm
Light source / wave length	Infrared LED / 880 nm			
Linearity error	max 1%			
Measuring frequency	> 130 / sec > 120 / sec with polarization filter			
Analog output	4 ... 20 mA			
Switching output	NPN or PNP			
Max. switching current	100 mA			
Voltage supply	15 – 28 V			
Current consumption	< 150 mA			
Output: short circuit protection	yes			
Voltage supply: reverse polarity protection	yes			
Temperature range	0 ... + 55 °C			
Front (optics)	glass			
housing	Zinc die-cast			
Protection class	IP 67			

Dimensions



Connection diagram



* only at RS 485

14 Accessories

reflector and reflector tape

	Reflector Active area (mm)		Reflector tape Size (mm)		Reflector tape (on reel)
For measuring range 30 mm	**131245**	5 x 40	**137624**	5 x 40	**136729/..m**
For measuring range150 mm	**131246**	20 x 175	**137625**	20 x 175	**136730/..m**
For measuring range 350 mm	**131247**	35 x 395	**137626**	35 x 395	**136731/..m**
Reflector tape width 630 mm					**144559/..m**

Connector and mounting bracket

connector 8-Pol (M12 x 1)	**ESG 34FP0200B**
Mounting bracket	**126220**