MICRO-EPSILON

Instruction Manual

scanCONTROL 29xx

Laser scanner

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CE

Certified acc. to DIN EN ISO 9001: 2008

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1. Safety

The handling of the sensor assumes knowledge of the instruction manual.

1.1 Symbols

The following symbols are used in this instruction manual:

⚠ CAUTION	Indicates a hazardous situation which, if not avoided, may result in minor or moderate injury.
NOTICE	Indicates a situation which, if not avoided, may lead to property damage.
➪	Indicates a user action.
i	Indicates a user tip.
`Measure`	Indicates a hardware or a button/menu in the software

1.2 Warnings

⚠ CAUTION

The power supply and the display-/output device must be connected in accordance with the safety regulations for electrical equipment
> Danger of injury

> Damage to or destruction of the sensor

NOTICE

Avoid shock and vibration to the sensor.
> Damage to or destruction of the sensor

The power supply may not exceed the specified limits.
> Damage to or destruction of the sensor

Avoid continuous exposure to dust and spray on the sensor by appropriate methods such as blowing or using a protective housing.
> Damage to or destruction of the sensor

Do not touch the protective windows of the optics with the fingers. Wipe off any fingerprints immediately with pure alcohol and a clean cotton cloth with no streaks.

Protect the cable against damage.
> Failure of the measuring device

Do not plug or unplug devices during the operation.

1.3 Notes on CE Identification

The following applies to the scanCONTROL 29xx sensor:
- EU directive 2004/108/EC
- EU directive 2011/65/EC, “RoHS“ category 9

Products which carry the CE mark satisfy the requirements of the quoted EU directives and the European standards (EN) listed therein. The EC declaration of conformity is kept available according to EC regulation, article 10 by the authorities responsible at

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The sensor is designed for use in industry and is in compliance with the following standards
- EN 61326-1: 2006-10
- DIN EN 55011: 2007-11 (Group 1, class B)
- EN 61000-6-2: 2006-03

The sensor fulfills the specifications of the EMC requirements, if the instructions in the manual are followed.

1.4 Proper Use

- The scanCONTROL 29xx sensor is designed for use in industrial and laboratory areas.
- It is used for
  - Profile measurement
  - Length measurement
  - Quality monitoring and inspection of dimensions
- The sensor may only be operated within the limits specified in the technical data, see Chap. 3.2.
- The sensor should only be used in such a way that in case of malfunction or failure personnel or machinery are not endangered.
- Additional precautions for safety and damage prevention must be taken for safety-related applications.

1.5 Proper Environment

- Protection class for sensors: IP 65 (applies only when connected output connectors respectively protective caps)
- Operating temperature: 0 ... +45 °C (+32 ... +113 °F) (with free air circulation)
- Ambient pressure: Atmospheric pressure
- Storage temperature: -20 ... +70 °C (-4 ... +158 °F)
- Humidity: 5 - 95 % (non condensing)
- EMC according to: EN 61326-1: 2006-10
  DIN EN 55011: 2007-11 (group 1, class B)
  EN 61000-6-2: 2006-03

The protection class does not apply for the optical sections during operation as their soiling / contamination results in adversely affecting or failure of the function.

Only use shielded cables or original cables from the range of accessories for the connection to a power supply and for the outputs.

Note also the assembly and installation instructions, see Chap. 5.

The IP 65 protection class is a specification which is limited to the protection with respect to dust and water. Oil, steam and emulsion penetration are not included in this protection class and must be tested separately.

2. Laser Safety

The scanCONTROL 29xx sensors operate with a semiconductor laser having a wavelength of 658 nm (visible/red). The laser operation is indicated visually by the LED on the sensor.

When operating the scanCONTROL 29xx sensors, the relevant regulations according to EN 60825-1 (IEC 60825, Part 1 of 05/2008) and the applicable accident prevention regulations must be followed.

The housings of the scanCONTROL 29xx optical sensors must only be opened by authorized persons, see Chap. 8. For repair and service, the sensors should always be returned to the manufacturer.

2.1 Laser Class 2M

scanCONTROL 29xx sensors with a maximum laser power up to 8 mW, see Chap. 3.2, are classified in Laser Class 2M (IIM).

Accordingly, the following applies:

With laser equipment of the Class 2M, the eye is not put in danger during random, short-term exposure to the laser radiation, i.e. exposure duration up to 0.25 s.

⚠ CAUTION

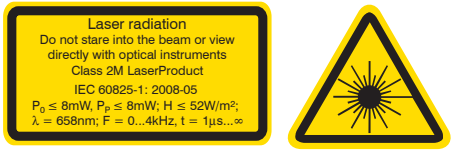
Hazard to the eye via laser radiation! Consciously close the eyes or turn away if the laser radiation impinges on the eye.

A direct glimpse into the beam can be dangerous if the eye-closure reflex is deliberately suppressed, e.g. during adjustment. Direct viewing into the beam with optical aids, e.g. a magnifying glass, is dangerous.

Laser equipment of the Class 2M can be employed without further protective measures, when deliberate viewing into the laser beam or into a beam reflected by mirrors is not longer than 0.25 s.

Since generally the presence of the eye-closure reflex should not be assumed, one should close the eyes or immediately turn away if the laser radiation impinges on the eye.

The following information labels are fitted to the sensor housing (front and rear side):



IEC label

Only for USA

The laser labels for Germany are already printed on. The labels for the EU area and the USA are enclosed and must be fitted by the user for the region applicable in each case before the equipment is put into operation.

Lasers of Class 2M are not subject to notification and a laser protection officer is not required. Mark the laser area recognizable and everlasting.

i If both information labels are hidden in the installed state, the user must ensure that additional labels are fitted at the point of installation.

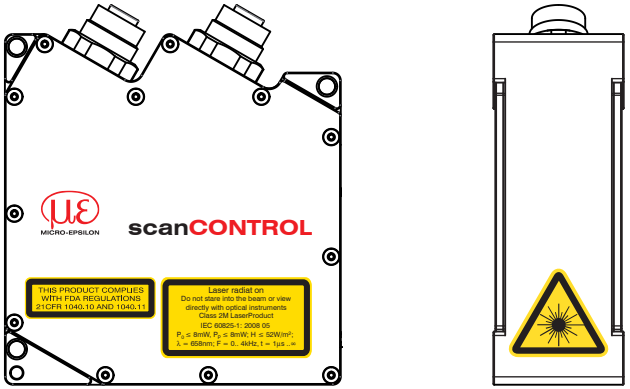


Fig. 1 True reproduction of the sensor with its actual location of the warning label

2.2 Laser Class 3B

⚠ CAUTION

Injury to the eye or the skin via laser radiation! Consciously close the eyes or turn away if the laser radiation impinges on the eye or the skin.

scanCONTROL 29x0 sensors with a maximum laser power up to 20 mW, see Chap. 3.2, are classified in Laser Class 3B (IIIB).

i Sensors of laser class 3B (IIIB) need an external key switch to switch off the laser, see Chap. 5.2.6. Accordingly, the following applies: The available laser radiation is hazardous for the eyes and usually for the skin also. Looking directly into the laser beam is hazardous for the eyes. Also reflections on shining or mirroring surfaces can be hazardous to the eye. Hazards to the skin through the available laser radiation are given by class 3B (IIIB) laser equipment if the values of the maximum permissible exposure are exceeded.

If the sensor is on the laser output can be reduced to 8 mW with the software. Reducing the laser output to 1 mW is not possible. Reducing the laser output from 20 mW to 8 mW with a software affects not the laser class!

The following information label should be fitted to the sensor housing (front and rear side):

IEC label

Only for USA

The laser labels for Germany are already printed on. The labels for the EU area and the USA are enclosed and must be fitted by the user for the region applicable in each case before the equipment is put into operation.

i If both information labels are hidden in the installed state, the user must ensure that additional labels are fitted at the point of installation.

In addition, the following information label must be attached to the laser output on the sensor housing:

Beam attenuator

Fig. 1 scanCONTROL beam attenuator masks aperture

Fig. 2 scanCONTROL beam attenuator in measuring position

Laser products certified as Class 3B products (EN 60825-1) require a beam attenuator, see Fig. 1, see Fig. 2, other then the key-operated control. The beam attenuator prevents access to all laser and collateral radiation.

To open or close the aperture please follow the steps below:

- Unscrew the knurled screw,
- Change the attenuator position and tighten the knurled screw.

The laser aperture must be open during measurement.

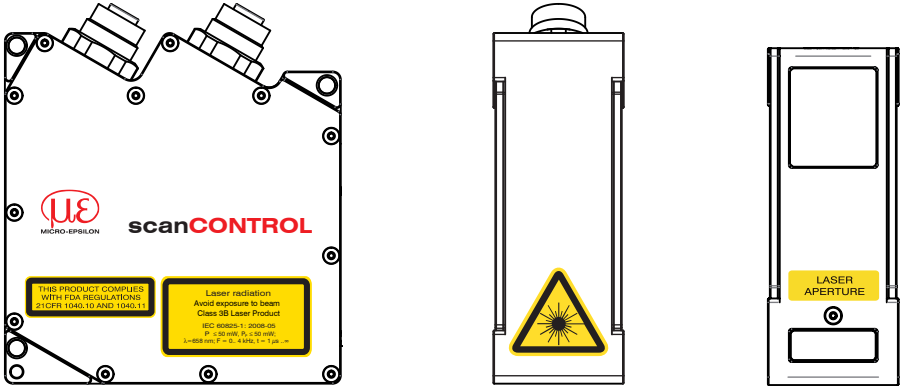


Fig. 3 True reproduction of the sensor with its actual location of the warning label

The user is responsible that the accident prevention regulations are observed. Class 3B (IIIB) laser sensors are notifiable and a laser protection officer is required either. Mark the laser area recognizable and everlasting. During operation the laser area has to be restricted and marked.

Observe the instructions described, see Chap. 5.2.6.

3. Functional Principle, Technical Data

3.1 Short Description

3.1.1 Measuring Principle

The scanCONTROL 29xx sensor operates according to the principle of optical triangulation (light intersection method):

- A laser line is projected onto the target surface via a linear optical system.
- The diffusely reflected light from the laser line is replicated on a sensor array by a high quality optical system and evaluated in two dimensions.

The laser line triangulation corresponds in principle to the triangulation of a laser point. In addition, during the measurement a row of lines are simultaneously illuminated by the laser line. Apart from the distance information (Z-axis), the exact position of each point on the laser line (X-axis) is also acquired and output by the system.

3.1.2 System Setup

The scanCONTROL 29xx sensor is a compact sensor with an integrated controller. All necessary integral parts are combined in one housing.

3.1.3 Special Performance Features

- scanCONTROL 29xx features speed and compact design with simultaneously high measurement accuracy. A special line-scanning optical system ensures uniform exposure of the measuring field.
- The sensor array is arranged in the sensor head according to the Scheimpflug condition which facilitates uniform image focusing over the whole depth of the measurement range (Z-axis).
- The scanCONTROL 2910/2960 series with integrated profile analysis works even without a PC in conjunction with saved configurations. The sensor runs the profile measurement internally and calculates default measured values such as angle or edge position.
  Besides measurement value output via Ethernet (Modbus TCP protocol, UDP protocol) and RS422 (Modbus RTU protocol or ASCII format), additional switching signals (results of the determination of limit values) and analog measurement values can be output. This is done by an optional scanCONTROL Output Unit, which transforms the determined measurement signals in switching and analog signals for further processing in a PLC.

3.1.4 Advantages of the Used Sensor Array (Difference to Conventional Line Scanners)

- A global shutter (high speed shutter) for the whole profile enables a high profile accuracy for fast applications without “tilting”.
- The array enables the simultaneous exposure and reading of the previous image. Thus the exposure time is longer at the same profile frequency. With it also dark objects can be measured with a high rate.

3.1.5 Further Features

- External synchronization and triggering
- Serial interface (RS422) for communication with PLC or PC
- Digital switching inputs, selectable TTL or HTL
- The automatic control of the exposure time enables consistent measurement results with changing surfaces. This function can be switched off on request.
- Ethernet 100/1000 Mbit as fast standard connection to PC

3.2 Technical Data

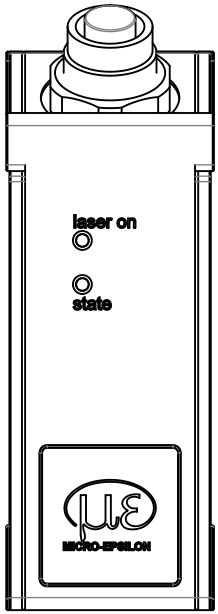
Model	scanCONTROL		
	29xx-25	29xx-50	29xx-100
Measuring range Z-axis	25 mm	50 mm	100 mm
Start of measuring range	53.5 mm	70 mm	190 mm
End of measuring range	78.5 mm	120 mm	290 mm
Start of measuring range, extended, approx.	53 mm	65 mm	125 mm
End of measuring range, extended, approx.	79 mm	125 mm	390 mm
Line length midrange (X-axis)	25 mm	50 mm	100 mm
Linearity [1]	± 0.16 % FSO (3 σ)		
Resolution X-axis	1280 points/profile		
Profile frequency (depending on sensor model)	300 - 2000 Hz		
Light source laser	Semiconductor laser, approx. 658 nm, 20 °... 25 ° aperture angle, laser class 2M: laser power 8 mW, reduced 2 mW Semiconductor laser, approx. 658 nm, 20 °... 25 ° aperture angle, laser class 3B: laser power 20 mW, reduced 8 mW		
Protection class (DIN EN 60529)	IP 65		
Operating temperature	0 °C ... +45 °C (+32 ... +113 °F)		
Storage temperature	-20 °C ... 70 °C (-4 ... +158 °F)		
Outputs/inputs	Ethernet, Laser on/off (optional), 1x RS422 programmable (Half-duplex), 3 switching inputs programmable HTL/TTL, all inputs and outputs galvanically isolated		

Model	scanCONTROL		
	29xx-25	29xx-50	29xx-100
Supply	11 ... 30 VDC, 500 mA IEEE 802.3af Power over Ethernet, class 2		
Displays	1x state / 1x laser on		
Electromagnetic compatibility (EMC)	according to: EN 61326-1: 2006-10 DIN EN 55011: 2007-11 (group 1, class B) EN 61000-6-2: 2006-03		

FSO = Full Scale Output | MMR = Midrange

1) Based on a MICRO-EPSILON Optronic standard target with metallic finished surfaces

3.3 LED Displays



LED “laser on“	Green: Laser on
LED “state“: Two-color LED (red / green)	Green: Measurement Green flashing: data transmission Red flashing: error code, see Chap. 11.

Note:

The LED “state“ flashes green, long during active data transmission and short for controller accesses.

4. Delivery

4.1 Unpacking

- 1 Sensor scanCONTROL 29xx
- 1 Assembly instructions
- 1 Sensor inspection log
- 2 Protective caps
- 1 PC2600/2900-5 Multifunction cable; 5 m long; for power supply, trigger and RS422; Escha screw connector and free cable ends
- Additionally:
  - scanCONTROL 2910/2960 sensors: 1 CD scanCONTROL Configuration Tools with drivers and documentation
  - Other scanCONTROL 29xx sensors: 1 scanCONTROL demo CD with drivers, programs and documentation.

➡ Check for completeness and shipping damage immediately after unpacking.

In case of damage or missing parts, please contact the manufacturer or supplier.

4.2 Accessories

4.2.1 Recommended Accessories

- Power supply PS2020, power supply for DIN rail mounting, input 230 VAC, output 24 VDC/2.5 A for maximum 2 sensors scanCONTROL 29xx at the same time.

4.2.2 Optional Accessories

- Multifunction cable PC2600/2900-x, (length x = 10, 20 m), cable 6x2x0.14 shielded, with integrally cast 12-pole M12x1 screw connector and free cable ends
- Ethernet connection cable SC2600/2900-x (length x = 0.5, 2, 5, 10, 15, 20, 35 m) cable 4x2x0.14; shielded, with integrally cast 8-pole M12x1 screw connector and 8-pole Ethernet cable connector RJ45.

The cables are cable carriers suitable.

4.3 Storage

Storage temperature: -20 ... +70 °C (-4 ... +158 °F)
Humidity: 5 - 95 % (non condensing)

5. Mounting and Installation

5.1 Attachment and Mounting

- using 2 or 3 screws M5, screwed directly
- using 2 or 3 screws M4, screwed pushed through

Depending on the installation position it is recommended to determine the position of the sensor for example by adjusting screws on the specially marked attachment points.

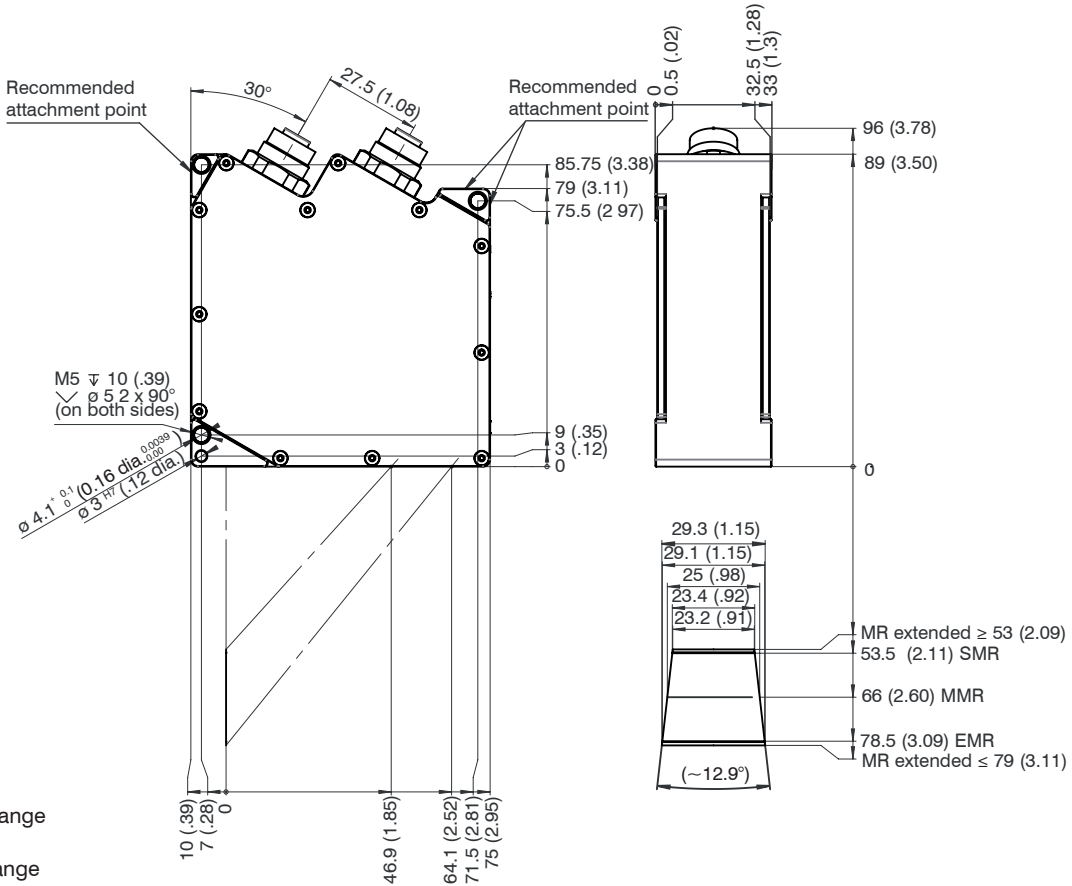
The pin hole ø3H7 is provided for a position locking pin. The sensor can be mounted reproducible and replaceable together with an attachment point, see Fig. 2, see Fig. 3, see Fig. 4.

➡ The mounting dimensions refer to the dimensional drawings.

NOTICE

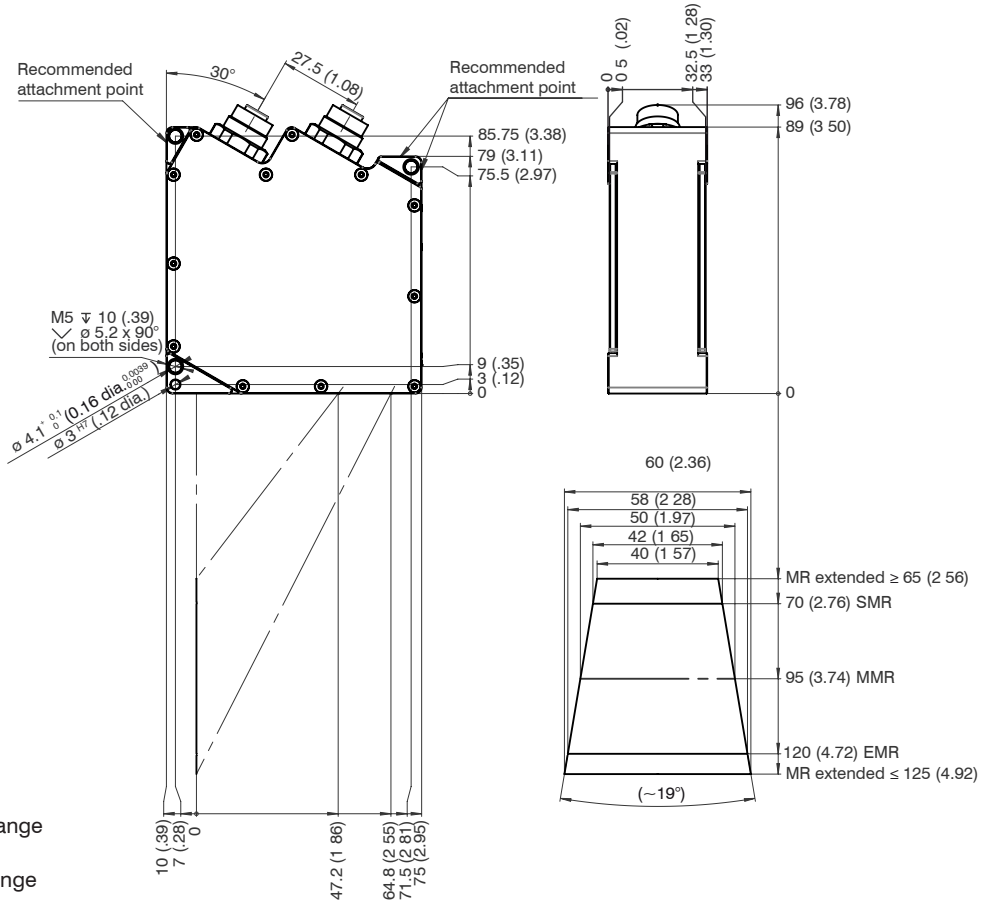
Pay attention to careful handling during mounting and operation.
> Damage to or destruction of the sensor

The laser beam should strike the target surface at right angles. Otherwise, inaccurate measurements cannot be excluded.



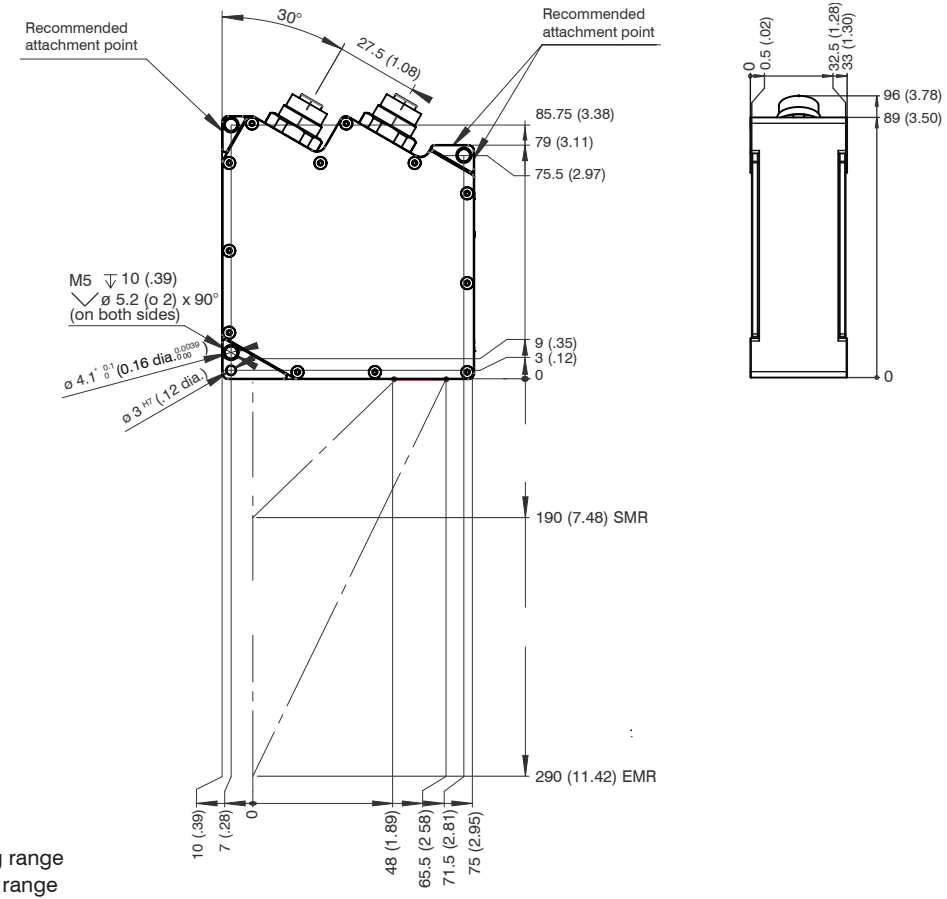
MR = Measuring range
SMR = Start of measuring range
MMR =Midrange
EMR = End of measuring range

Fig. 2 Dimensional drawing sensor scanCONTROL 29xx-25, dimensions in mm (inches), not to scale



MR = Measuring range
SMR = Start of measuring range
MMR = Midrange
EMR = End of measuring range

Fig. 3 Dimensional drawing sensor scanCONTROL 29xx-50, dimensions in mm, not to scale



SMR = Start of measuring range
EMR = End of measuring range

Fig. 4 Dimensional drawing sensor scanCONTROL 29xx-100, dimensions in mm (inches), not to scale

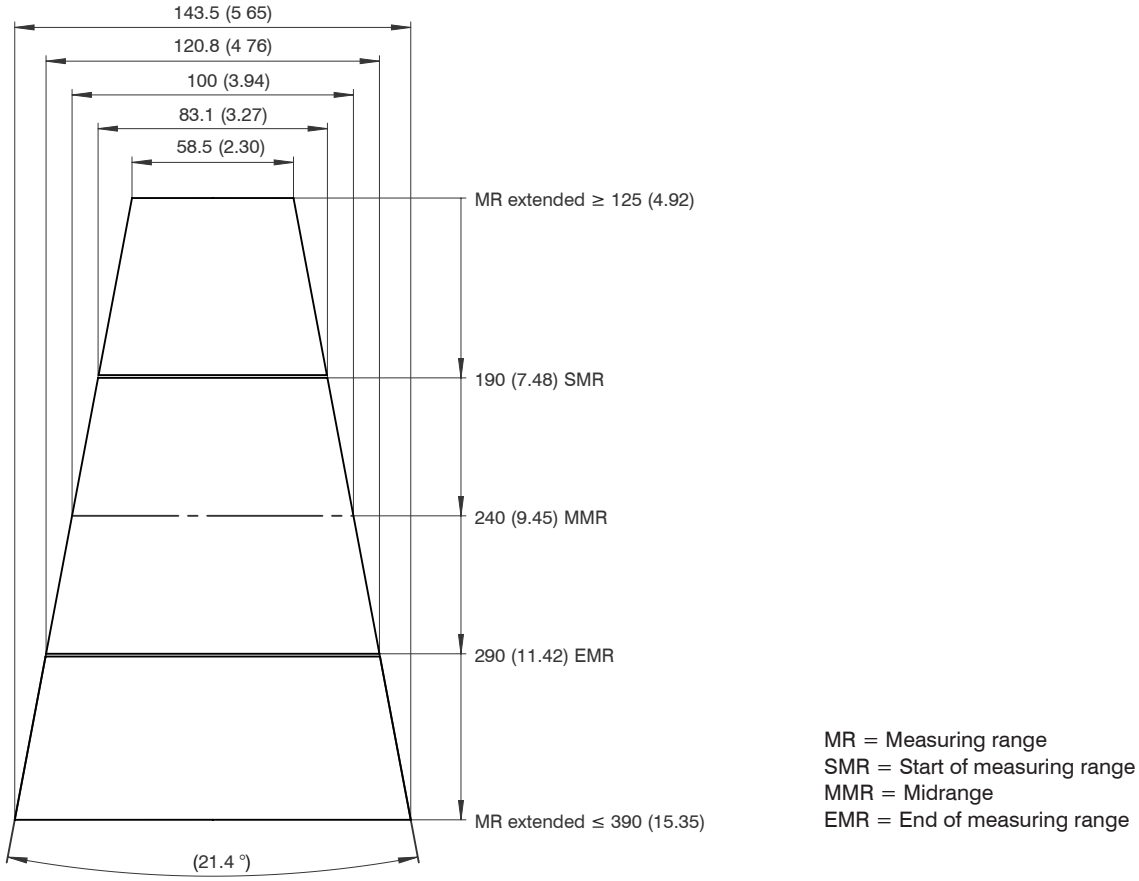
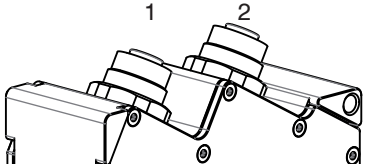


Fig. 5 Measuring field sensor scanCONTROL 29xx-100, dimensions in mm (inches), not to scale

5.2 Connections

5.2.1 General



1 Ethernet socket

2 Multifunction socket (Power supply, IO)

Fig. 6 Output sockets arrangement

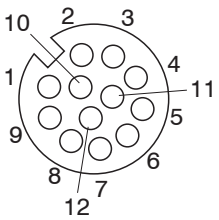
Designation	Sensor connector Pin	Cable color PC2600/2900-x	Notes	Connection view
+Ub	9	red	+ 11 V - 30 V DC (rated value 24 V); max. 500 mA	 screw connector, solder pin side
GND	2	blue	0 V	
+Laser on/off	3	white	optional	
-Laser on/off	1	brown		
RS422	12	red-blue	RS422 input respectively output	
/RS422	11	gray-pink		
In1	6	yellow	Switching input In1	
GND-In1	4	green	Ground connection In1	
In2	5	pink	Switching input In2	
GND-In2	8	gray	Ground connection In2	
In3	10	purple	Switching input In3	
GND-In3	7	black	Ground connection In3	
Screen	Housing	black	DC-insulated from GND	

Fig. 7 Assignment of the multifunction socket on scanCONTROL 29xx

GND: Galvanically isolated from IN1, 2, 3, RS422, Laser on/off
Laser on/off: Input galvanically isolated from GND, IN1…3, RS422
IN1, IN2, IN3, RS422: Inputs galvanically isolated from GND and Laser on/off

NOTICE

Connect the multifunction socket only when switched off the power supply is switched off.

> Damage to or destruction of the sensor

5.2.2 Power Supply

Connector “multifunction socket“, see Fig. 6, pin assignment, see Fig. 7.

Range: 11 V – 30 V (rated value 24 V) DC; Last maximal 500 mA

The operating voltage is protected against reverse polarity.

The cable shield is connected with the connector housing and should be connected to the protective conductor PE of the power supply.

The shielded multifunction cable PC2600/2900-x is recommended.

The operating voltage for the scanCONTROL 29xx measuring device should come from a 24 V power supply, which is only used for measuring equipment and not simultaneously for drives, contactors or similar pulse interference sources. Use a power supply with galvanic isolation.

NOTICE

scanCONTROL 29xx supports Power over Ethernet. If the sensor is connected to a network adapter/ switch that is capable of POE and if you also use the power supply of the multifunction port, these two power supplies have to be galvanically isolated.

5.2.3 RS422, Synchronization

Connector “multifunction socket“, see Fig. 6, pin assignment, see Chap. Fig. 7.

The scanCONTROL 29xx sensor has a RS422 port according to EIA standards, which can be parameterized as input or output via software.

The RS422 port can be used to synchronize multiple sensors with each other, triggering or measured value output (for example Modbus).

The internal terminating resistor (termination R_T = 120 Ohm, see Fig. 8) can be activated or switched off via software. The signals must be operated symmetrically according to the RS422 standard. Primarily use RS422 driver circuits or converters. Alternatively use devices with RS422 connectors, e.g. sensors or PLC‘s.

The RS422 port is galvanically isolated from GND and Laser on/off, but not from GND-In1 ... 3. When used one of the GND-In1 ... 3 should connected to the GND of the remote station in order to avoid potential differences.

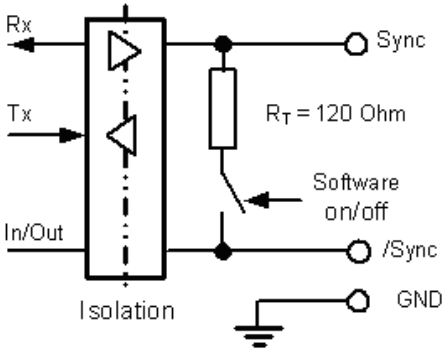


Fig. 8 RS422 synchronization internal circuity

The multifunction socket can be used with either of the following configurations:

	Configuration	Direction	Standard setting for terminating resistor R_T
0	Half-duplex, serial communication with 115200 Baud	input/output	On
1	Half-duplex, serial communication with 57600 Baud	input/output	
2	Half-duplex, serial communication with 38400 Baud	input/output	
3	Half-duplex, serial communication with 19200 Baud	input/output	
4	Half-duplex, serial communication with 9600 Baud	input/output	
5	External trigger input	input	On
6	External trigger output	output	Off
7	CMM trigger output	output	Off

Synchronizing several sensors with each other:

- Connect the output RS422+ (Pin 12) of sensor 1 with the input RS422+ (Pin 12) of sensor 2.
- Connect the output RS422- (Pin 11) of sensor 1 with the input RS422- (Pin 11) of sensor 2.
- Also connect both the GND-In1 - pins (Pin 4) of the sensors to each other.

Software settings:

Setting	Sensor 1	Sensor 2	Sensor 3
RS422 mode	External trigger output	External trigger input	External trigger input
No RS422 termination	No (terminating resistor not active)	Yes (terminating resistor not active)	No (terminating resistor active)

Fig. 9 External synchronization settings

The sensor 1 then synchronizes the sensor 2 and further sensors as master.

5.2.4 Switching Inputs

Connector “multifunction socket“, see Fig. 6, pin assignment, see Fig. 7.

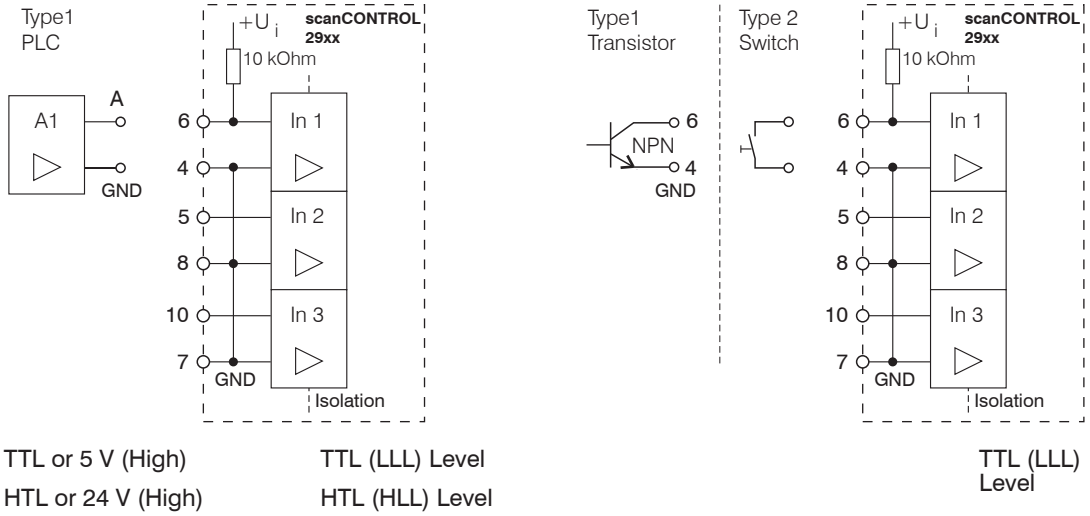


Fig. 10 Switching Inputs

The switching inputs In1 up to In3 can be used for triggering or for connecting an encoder. All switching inputs are identical. The used circuits have an internal electrical isolation. The inputs are galvanically isolated from the GND and Laser on/off .

Each switching input has its own ground connection (Gnd-In1 to 3), which has to be connected with the external ground (synchronization/trigger source or another device).

The multifunction socket can be used with either of the following configurations:

	Configuration	In1	In2	In3
0	Encoder with index, positive edge works with the index [1]	N	A	B
1	Encoder without index, additionally external trigger possible [1]	Trigger	A	B
2	External trigger	Trigger		
3	External trigger, load up to 4 usermodes	Trigger	Mode Bit 0	Mode Bit 1
4	Load up to 8 usermodes	Mode Bit 0	Mode Bit 1	Mode Bit 2
5	Transmit in time stamp, (only 2910/2960)	Bit 0	Bit 1	Bit 2

Signal level (switching level):

The signal levels are switchable for all switching inputs together via software between LLL (low-voltage-, TTL logic) and HLL (high-voltage-, HTL logic):

- LLL level: Low 0 V… 0.8 V, High 2.4 V… 5 V, internal pull-up 10 kOhm to 5 V
- HLL level: Low 0 V… 3 V, High 11 V… 24 V (permitted up to 30 V), internal pull-up 10 kOhm to 24 V
- Pulse duration: ≥ 5 μs

Use a shielded cable with twisted wires, especially the recommended connection cable PC2600/2900-x from the accessories, see Chap. 4.2.2.

Connect the cable shield with the potential equalization PE or the connector housing.

1) The encoder input counts each edge. Encoder output typically 4 edges per encoder step.

5.2.5 Ethernet Connection

Connector “Ethernet“, see Fig. 6.

The Ethernet connection is the standard connection to the PC.

The sensor supports the transmission with 100 Mbit and 1 Gbit.

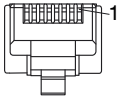
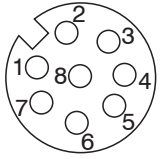
RJ45 connector			**8-pin. screw connector (sensor side)**		
Pin no.	Color stranded hook-up wire SC2600/2900-x		Pin no.	100BaseTX	1000BaseT
1	white (orange)		5	Tx+	D1+
2	orange		6	Tx-	D1-
3	white (green)		8	Rx+	D2+
4	blue		1		D3+
5	white (blue)		2		D3-
6	green		7	Rx-	D2-
7	white (brown)		3		D4+
8	brown		4		D4-
 View on pin side male cable connector			 View on solder pin side screw connector		

Fig. 11 Pin assignment Ethernet connection

We recommend the Gigabit-Ethernet connection cable SC2600/2900-x for the Ethernet connection; cable length x in meters. Characteristics: 4 x 2 x 0.14 mm^2; shielded.

Due to a high data rate, we recommend using a high-quality Ethernet PC plug-in card, for example Intel-Pro/1000 PT. The sensors are to be preferably connected directly to the network connection or by means of a high-quality switch. As a hub would result in a massive data collision it cannot be used. The PC should have one or more network cards only for the sensors.

The operation of the sensor via Ethernet does not require any driver installation. However, the network settings have to be done correctly:

- If more network cards are used, they have to belong to different networks, for example different Class-C-sub networks, however they may not belong to the same Class-B sub network.
- The sensor supports an automatically, sensor-adapted IP address in the link-local-net (169.254.x.x). No collision testing is effected.
- The sensor supports the DHCP protocol. This setting is activated by default and has priority over the retrieval in the link-local-net.
- A fixed IP address can be given.
- Various network settings can interfere the connection to the sensor (for example Firewall or packet filter).
- We recommend using a packet size of 1024 bytes/packet (payload), because network components support such packages by default. The sensor supports jumbo frames up to 4096 bytes/packet (payload), but then all the network components must also support jumbo frames of this size.

Use the program „SensorFinder.exe“ for network configuration. You will find this program on the delivered CD.

NOTICE

scanCONTROL 29xx supports Power over Ethernet. If the sensor is connected to a network adapter/ switch that is capable of POE and if you also use the power supply of the multifunction port, these two power supplies have to be galvanically isolated.

5.2.6 External Laser Switching (optional)

Connector “multifunction socket“, see Fig. 6, pin assignment, see Fig. 7.

Function

- Laser on: Voltage between +laser on/off and -laser on/off 2.8 V… 31 V, I < 5 mA
- Laser off: Voltage between +laser on/off and -laser on/off < 0.8 V or open

Sensors of laser class 3B (IIIB) need an external key switch to switch off the laser.

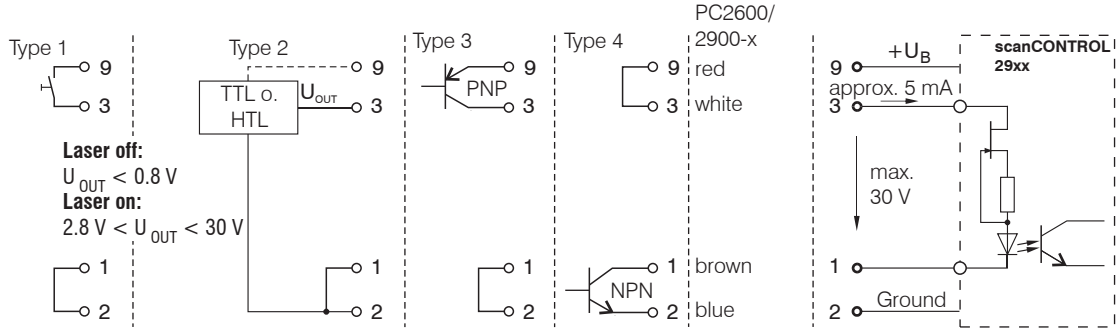


Fig. 12 Options to switch off the laser

Use a serial key switch inside the control circuit to switch off the laser.

If the voltages between pin 3 and pin 1 are < 0.8 V, the laser is off. No external resistor is necessary to the current limitation. Connect pin 1 with 2 and pin 3 with 9 for permanent “laser on“.

The external laser switching-off is implemented as a hardware solution and is a top priority. The laser can be switched off, in addition, also by software.

5.3 Installation Instructions

- Only use shielded cables from the accessories for all connection cables, see Chap. 4.2.2.
- Connect the cable shields to the potential equalization on the evaluation unit (switch cabinet, PC housing, connector housing) and avoid ground loops.
- Lay all connection cables in accordance with the generally applicable measuring technology regulations, i.e. for example not directly next to pulse-carrying lines, preferably in a separate cable duct.
- The minimum bending radii of the recommended cables for flexible laying must not be less 80 mm.
- MICRO-EPSILON recommends the use of the optionally available power supply PS2020, Din rail mounting, input 230 VAC, output 24 VDC/2.5 A.

NOTICE

The sensor must only be connected to the peripheral equipment when disconnected from the power supply, i.e only when the operating voltage is switched off.

5.4 Getting Ready for Operation, Commissioning

- Mount the sensor according to the installation instructions, see Chap. 5.1.
- Connect the sensor to the Ethernet cable.
- Connect the sensor to downstream display or monitoring units and to the power supply.
- Switch on the power supply.

6. Operation of the Sensor with a PC

6.1 Displays

➡ After getting ready for operation, switch on the external direct current power supply (24 VDC).

The “state” LED indicates different error conditions by flashing, see Chap. 11. If several errors occur at the same time, it indicates two of them alternately. Therefore the LED can continue to flash for some time after the rectification of an error. If no flashing occurs for several seconds, no error has occurred.

i The scanCONTROL 29xx sensor needs a running-in time of typically 20 minutes for high precision measurements.

6.2 Operating and Demonstration Programs

A CD-ROM is provided for the operation of the sensor: As well as the installation instructions mentioned above, the CD-ROM also contains various documentation and programs:

- The demonstration program “DeveloperDemo.exe“ in the directory [CD]:\Program\Developer Demo is used for scanner parameterization and simple display of profile data.
- The directory [CD]:\Development\SDK contains a sensor-specific DLL and descriptions and examples for creating your own user programs with the C++ programming language. It can also be used with C, Delphi or other programming languages. The associated descriptions for the DLL in German and in English can be found in the same directory.
- scanCONTROL Configuration Tools is used to analyze typical measurement tasks for scanCONTROL 29xx.
- scanCONTROL 3D-View visualizes three dimensional point data, which are recorded with scanCONTROL 29xx.

The measuring fields are partially used in the demonstration programs, see Chap. 6.4.1.

6.3 Installation

6.3.1 Requirements

The following minimum system specification is necessary for the operation of the scanCONTROL software packages:

- Windows XP SP2 (32 bit), Windows Vista (32 bit), Windows 7 (32 bit and 64 bit)
- Pentium III ≥ 800 MHz
- 512 MB RAM
- Screen resolution: 1024x768

To be able to use the software the following steps must be followed:

1. Install the Ethernet interface hardware, if not already installed.
2. Install the software according to the instructions on the CD.
3. Connect and license the USB dongle, if present.
4. Connect the scanCONTROL 29xx measuring system to the PC via Ethernet.

6.3.2 Connecting scanCONTROL 29xx to the PC

Proceed as follows in order to connect scanCONTROL 29xx via Ethernet with the PC.

➡ Finish the installation of the software completely.

➡ Connect scanCONTROL 29xx via the Ethernet interface to the PC and switch on the power supply.

➡ Please wait until the scanCONTROL 29xx device is recognized by the PC.

This may take a few seconds.

The system is now ready to operate the scanCONTROL 29xx measurement system with the scanCONTROL software packages.

6.4 Instructions for Operation

6.4.1 Measuring Field Selection

The optical design of the sensor satisfies the so-called “Scheimpflug condition” which ensures optimum mapping over the complete measuring range. In doing so, the measuring range is mapped on a rectangular matrix. The distortions resulting from this are shown, see Fig. 13. The usable measuring range is always trapezoidal.

The assigned maximum x-values for the z-coordinates can be found, see Fig. 2, see Fig. 3, see Fig. 4.

Please refer to the sensor acceptance report of your sensor. A slight range shifting of a measuring field is possible and depends on the sensor.

The top edge corresponds to the start of the measuring range and the bottom edge to the end of the measuring range. The corners of the predefined measuring fields are on a grid with grid spacing of 1/8 of the matrix. The sensor matrix used in the scanCONTROL 29xx supports the reading of a restricted measuring field. The following picture, see Fig. 13, shows the predefined view areas and the associated measuring fields.

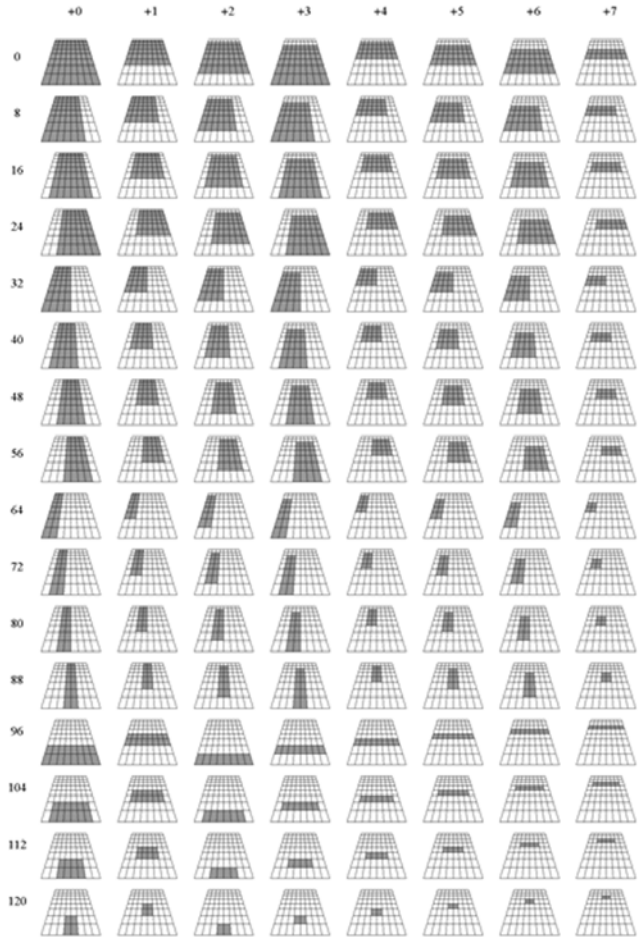


Fig. 13 Predefined measuring fields

The measuring field can be restricted by omitting complete matrix areas in order to suppress interfering image ranges.

The following measuring fields are used in the demonstration program, see Chap. 6.2.

Name	Index
Large	0
Standard	2
Small	7

Fig. 14 Measuring fields used

Measuring field and measuring range must be clearly differentiated in practical use. The measuring field is related to the matrix and the measuring range is related to the measuring object (the object space).

Both do not have to match on account of the optical mapping and the definitions.

i The measuring field “standard“ is larger than the measuring range “standard“. The minimum dimensions can be found in the dimensional drawing, see Fig. 2, see Fig. 3, see Fig. 4.

The scanCONTROL 29xx sensors are distinguished by

- a laser line with 20 ° opening angle (measuring range 25 mm) respectively 25 ° opening angle (measuring ranges 50 mm and 100 mm).
- The receiver has a smaller opening angle (view angle) than the laser line.
- Centered measuring field (symmetrical to the center axis).
- The high resolution sensor image matrix has 1280 x 1024 pixels. The measuring field geometry is fixed.
- Reference for the distance (Z-axis) is the lowest body edge of the sensor, see Fig. 2, see Fig. 3, see Fig. 4.
- Use of the GigE-Vision standard. Further informations for this can be found in the “OpManPartB.html“ file on the CD-ROM.
- Standard GigE Vision implementation from different manufacturers can be used.

6.4.2 Calibration

The calibration of the sensor is performed using the complete matrix and is independent from the selected measuring field.

The trapeze form of the measuring field is produced from the projection onto the sensor matrix. The standard measuring range is framed in the center.

A sensor acceptance report is enclosed for each sensor. Three diagrams for the linearity measurement which are briefly explained in the report are included in the sensor acceptance report. The key diagram in the sensor acceptance report is shown again below, see Fig. 15.

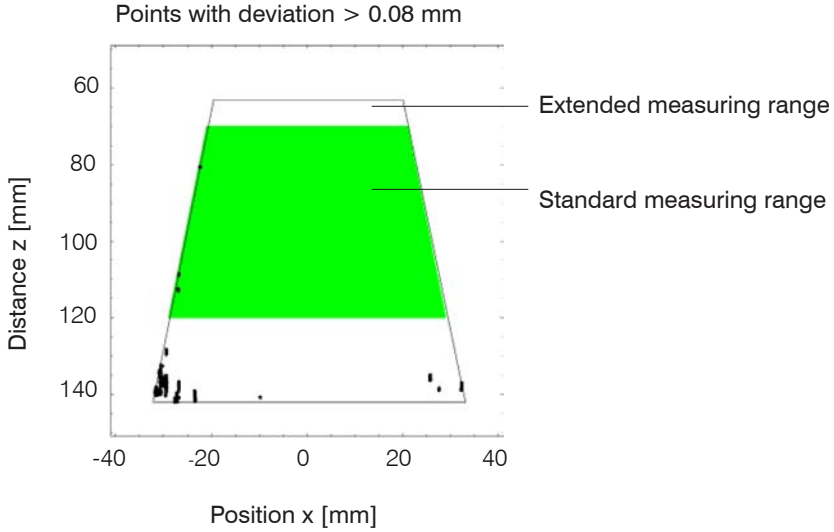


Fig. 15 Linearity deviation, example of an scanCONTROL 29xx-50

The black points show the places where the measurement error exceeds the linearity limit of 0.08 mm (depending on sensor model). The measurement error increases at both ends of the depth range and particularly in the remote corners. These areas should therefore be avoided for the measurement.

6.4.3 Automatic Exposure Time Regulation

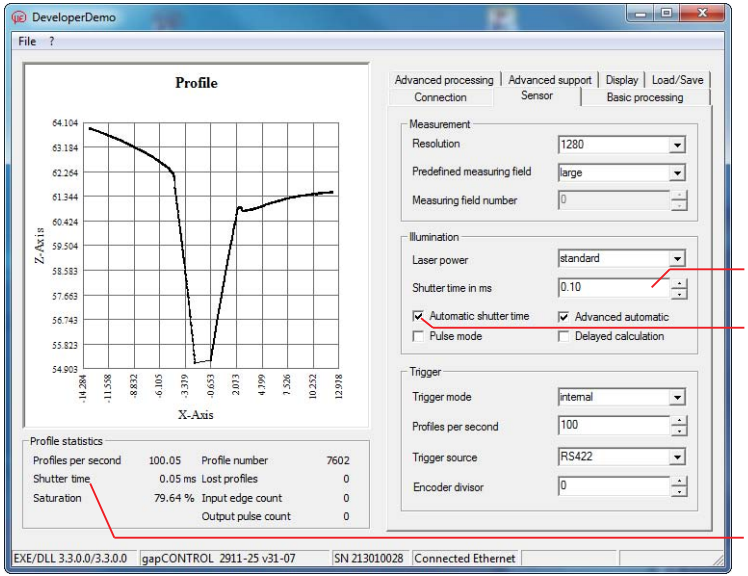
The automatic exposure time regulation facilitates the recording of the profile with optimum exposure time (shutter time).

The “shutter time” preset by the user is used as the starting value for the automatic exposure time regulation. It should be selected so large that still valid measured values can be output at the darkest place of the profile. One of the supplied demonstration programs can be used for determining this. The automatic exposure time regulation can also be deactivated if required.

If there is no object in the measuring range, the “shutter time” stored in the shutter register of the sensor will be used as exposure time. This value must also guarantee reliable recognition of the darkest measurement object.

A previous test is recommended if the target is very dark or has very high contrast. The various demonstration programs are suitable for adjusting and testing the exposure time. In doing so, it is by all means sensible to work with several different exposure times and to observe the effect in the diagrams.

The current exposure time can be calculated from the timestamps of the measured values. It is displayed as “shutter time”, see Fig. 16.



“shutter time“ preset by the user: 0.10 ms
Automatic shutter time is active

Result: The sensor operates with a “shutter time” of 0.06 ms

Fig. 16 Screenshot of the developer demonstration program with automatic shutter

6.5 Error Influences

6.5.1 Reflection of the Target Surface

The sensor basically evaluates the diffuse portion of the laser line reflections. Any statement about a minimum reflection factor is only possible with reservations.

A preliminary examination is necessary for using the sensor on transparent or reflecting objects.

The method of direct reflection on reflecting surfaces as it is successfully applied for the point triangulation cannot be used for the line triangulation on account of the fan-shaped form of the laser line (central projection). Here, the receiving lens would only be able to reach a narrow area near the center. As usually curved surfaces should also be measured for the profile measurement, this range will be further narrowed.

6.5.2 Color Differences

Color differences of measurement objects have effects. However, these color differences are often also combined with different penetration depths of the laser light into the material. Different penetration depths in turn result in apparent changes of the line thickness. Therefore, color changes, combined with penetration depth changes, can result in inaccurate measurements.

As the exposure parameters can only be changed as a whole for one profile, careful matching of the exposure to the target surface is recommended.

6.5.3 Temperature Influences

A running-in time of at least 20 minutes during start-up is required in order to achieve a uniform temperature spread in the sensor.

If measurements with accuracy in the μm range are made, the effect of temperature fluctuations on the mounting must also be observed by the user.

Due to the damping effect of the thermal capacity of the sensor, fast temperature changes are only measured after a delay.

6.5.4 External Light

An interference filter in the sensor is present for suppression of external light.

In general, the shielding of external light directly emitted on the target or reflected in the sensor must be ensured using protective covers or similar.

Pay particular attention to unwanted reflections of the laser line outside the measuring object range (background, object holder or similar) which can be reflected back again into the view area of the receiver.

Matt black surface coatings are recommended for all objects outside the measuring range (object holders, transport apparatus, grippers or similar).

6.5.5 Mechanical Vibrations

If high resolutions in the µm range should be achieved with the sensor, particular attention must be paid to stable or vibration-damped sensor and measuring object mounting.

6.5.6 Surface Roughness

Surface roughness of 5 µm and more results in “surface noises“ due to interference of the laser light.

Direct reflections of the laser light to the receiver can also occur at the finest grooves (e.g. abrasion marks on the surface) particularly if these run in the line direction. This can result in inaccurate measured values. Prevention of this effect might be possible by adjusting several sensor settings e.g. exposure time, filter.

6.5.7 Shadowing Effects

- Receiver: The laser line can disappear completely or partially behind steep edges. The receiver then does not „see“ these areas.
- Laser line: The fan-shaped form of the laser line inevitably results in partial shadowing at vertical edges. In order to make these areas visible, only changing the sensor or object position helps.

As a general rule, measuring objects with steep edges cannot be one hundred percent measured using laser triangulation. The missing areas can only be supplemented or interpolated using suitable software.

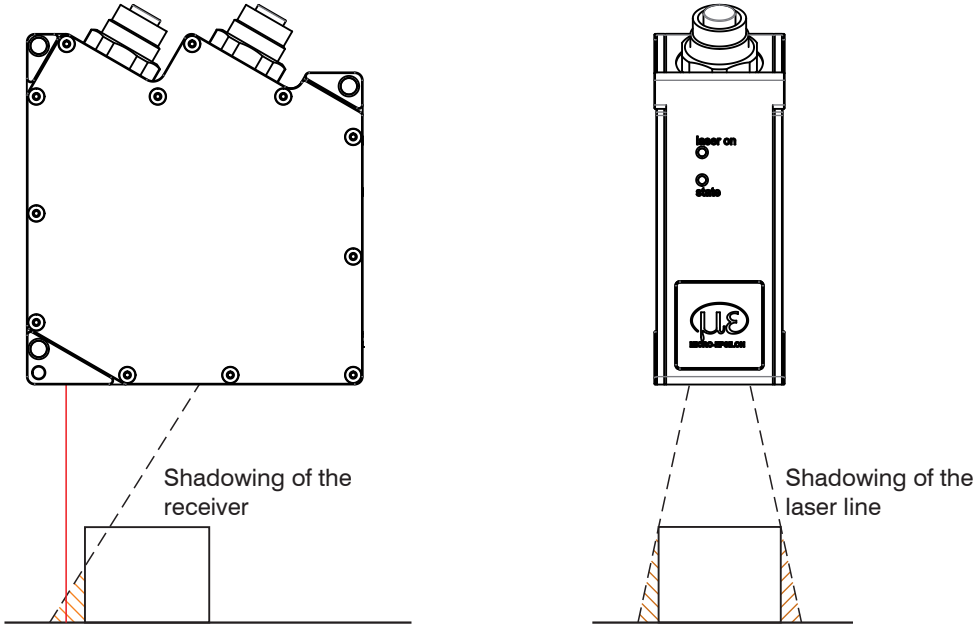


Fig. 17 Shadowings

6.6 Cleaning

A periodically cleaning of the protective housings is recommended.

Dry cleaning

This requires a suitable optical antistatic brush or blow off the panels with dehumidified, clean and oil free compressed air.

Wet cleaning

Use a clean, soft, lint-free cloth or lens cleaning paper and pure alcohol (isopropanol) for cleaning the protective housing.

Do not use commercial glass cleaner or other cleansing agents.

7. scanCONTROL Output Unit

The measurement system scanCONTROL 2910/2960 measures and evaluates 2D profile data of a surface and supplies analog and digital control signals. scanCONTROL Output Unit

- outputs digital and analog signals,
- is based on the WAGO®-I/O-System 750,
- uses Ethernet.

Setup and operation of scanCONTROL Output Unit are exemplarily described below.

7.1 scanCONTROL Output Unit - Components

- Output Unit Basic, consisting of:
  - Ethernet Fieldbus Coupler with system supply unit (OU-Fieldbus Coupler/Ethernet)
  - 24V DC power supply filter (OU-Filter module) and termination module (OU-Bus termination module)
- Digital output terminal
- Analog output terminal

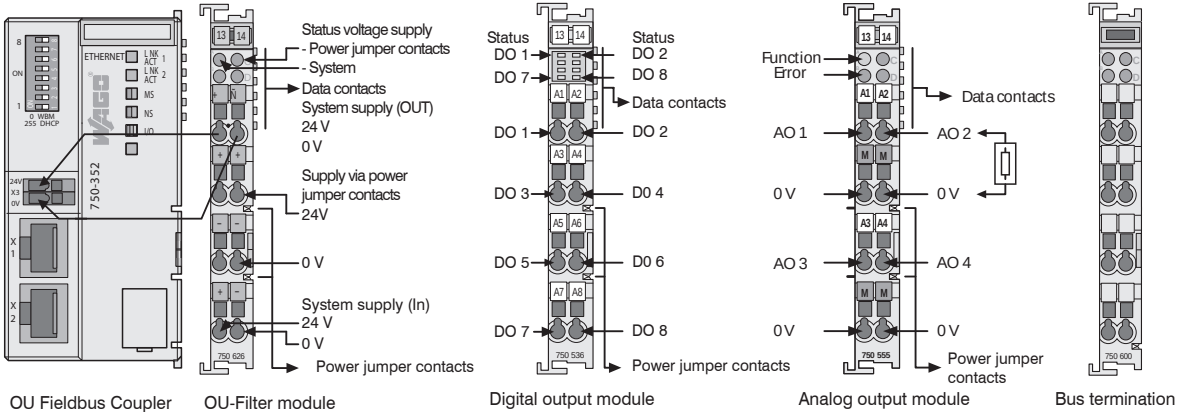


Fig. 18 Example configuration Ethernet with analog and digital output module

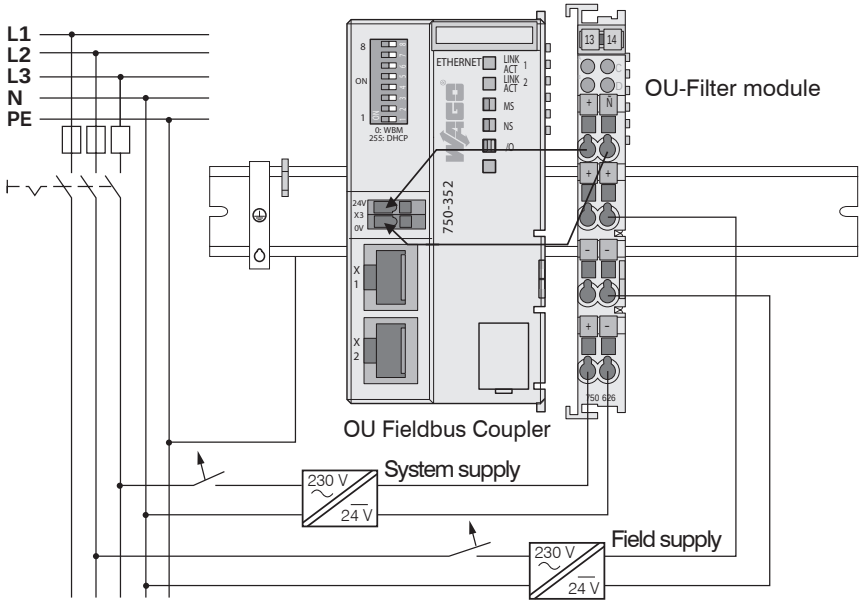
➡ Mount the components of a scanCONTROL Output Unit on a top hat rail (TS35) in the described order.

Without using a top hat rail a robust installation cannot be guaranteed. Ensure that each module is locked securely on the top hat rail.

➡ Terminate the bus with the bus termination, see Fig. 18.

Each module of scanCONTROL Output Unit is described, see Chap. 7.4. Further informations can be found in the data sheet and manual of the respective module in the supplied scanCONTROL Demo-CD.

7.2 Connect the Power Supply



Digital output modules need a field supply of 5 VDC or 24 VDC depending on the module type.

Fig. 19 Separated power units for system and field supply (Ethernet)

After mounting of the modules, the required wiring has to be installed.

- Connect the “System supply (out)“ terminals of the OU-Filter module to the “System supply (in)“ terminals of the OU-Fieldbus Coupler (0 V and 24 V, see Fig. 19).
- Connect the system supply (in) of the OU-Filter module to the power supply (0 V and 24 V, see Fig. 19).
- Connect the field supply (in) of the OU-Filter module to the power supply (0 V and 5 V/24 V, see Fig. 19).

i The system supply and field supply should be separated to ensure the bus operation and electrical isolation in case of a short-circuit of an actor.

7.3 Commissioning scanCONTROL Output Unit

After having installed the required wiring of the modules of scanCONTROL Output Unit, you have to parameterize the measurement system according to your measurement task to get the desired signals at the digital and analog output ports.

➡ Connect the sensor to the PC using the Ethernet cable.

Alternatively scanCONTROL Output Unit can be connected simultaneously to the PC and to the sensor.

➡ Parameterize the measurement system using scanCONTROL Configuration Tools and assign the desired signals to the digital and analog output ports.

When the parameterization is finished, save the settings to a user mode of the sensor.
scanCONTROL Configuration Tools > Menu `Parameters > Save parameters to scanCONTROL...`

Refer to scanCONTROL Configuration Tools, Chapter 3.14.4.

➡ Exit scanCONTROL Configuration Tools and disconnect scanCONTROL 2910/2960, PC and if necessary scanCONTROL Output Unit.

➡ Connect the scanCONTROL 2910/2960 sensor to the Output Unit by using the Ethernet cable.

scanCONTROL 2910/2960 and the output unit operate now as an independent measurement system and the digital and analog signals are output via the assigned ports.

7.4 Specification of the Components

7.4.1 Output Unit Basic

Micro-Epsilon order no. 6414073

Consists of

- OU-Fieldbus Coupler/Ethernet
- OU-Filter module
- OU-Bus termination module

- Interfaces: 2x Ethernet to connect scanCONTROL 2910/2960 sensors.
- Indicators (Status LED's, for detailed description refer to the manual of the OU-Fieldbus Coupler/Ethernet)
- The system supply is already mounted to the Fieldbus Coupler.

Fig. 20 OU-Fieldbus Coupler/Ethernet with system supply module

System data	
Max. number of bus sharing unit	Limited by Ethernet specification
Max. length of fieldbus segment	100 m
Baud rate	10/100 Mbit/s
Technical Data	
Number of bus terminals	64
With bus extension	250
Power supply	DC 24 V (-25 % ... +30 %)
Max. input current	280 mA at 24 V
Internal current consumption	450 mA at 5 V
Total current for I/O modules	700 mA at 5 V
Voltage drop at $I_{max.}$	< 1 V at 64 I/O modules

Fig. 21 Technical data Fieldbus Coupler/Ethernet

7.4.2 Supported Modules

- 8-Channel digital output module; DC 24 V; 0.5 A; high-side switching; 8 actors; short-circuit prooved; Micro-Epsilon order no. 0325115, see Chap. 7.4.3; power supply through power jumper contacts
- 8-Channel digital output module; DC 24 V; 0.5 A; low-side switching; 8 actors; short circuit prooved; Micro-Epsilon order no. 0325131; power supply through power jumper contacts
- 4-Channel analog output module; 0 - 10 V; Micro-Epsilon order no. 0325135, see Chap. 7.4.4
- 4-Channel analog output module; ±10 V; Micro-Epsilon order no. 0325116
- 4-Channel analog output module; 0 – 20 mA; Micro-Epsilon order no. 0325132
- 4-Channel analog output module; 4 – 20 mA; Micro-Epsilon order no. 0325133

7.4.3 OU-DigitalOut/8-Channel/DC24 V/0.5 A/High-side Switching/8 Actuators

- Micro-Epsilon order no. 0325115
- The 8-Channel digital output module DC 24V 0.5 A is short-circuit-proofed, high-side switching, for TS35, CAGE CLAMP® connections, 8 actuators.
- The field level is galvanically isolated to the system level.
- The indicators (Status LED's) additionally show the status of the digital outputs (IO/NIO),
  for detailed description refer to manual of the 8-Channel digital output modules DC 24 V 0.5A, 8 actuators, high-side switching
- Actuators can be operated at all digital outputs and be wired directly via DO 1/2/3/4/5/6/7/8.
- scanCONTROL 2910/2960 supports eight digital outputs.

Fig. 22 8-Channel DigitalOut-Module

Number of outputs	8
Current consumption (internal)	25 mA
Voltage via power jumper contacts	DC 24 V (-25 % / +30 %)
Type of load	resistive, inductive, lamps
Switching rate $_{max.}$	2 kHz
Output current	0.5 A short-circuit-prooved
Energy dissipation W $_{max.}$ (unique switching off)	0.9 J $L_{max.} = 2\ W_{max.}/I^2$
Current consumption typ. (field side)	15 mA (per module) + load

Fig. 23 Technical data of the digital output module

7.4.4 OU-AnalogOut/4-Channel/0-10 V

- Micro-Epsilon order no. 0325135
- 4-Channel analog output module DC 0-10 V
- Indicators (Status-LED's, for detailed description refer to manual of the 4-Channel analog output module DC 0-10 V)
- Voltage range is terminal-related 0 to +10 V and can not be extended by changing the appropriate setting in scanCONTROL Configuration Tools.
- The output signal is galvanically isolated output from the system level.
- The resolution is limited to 12 bits.
- scanCONTROL 2910/2960 supports four analog outputs.

Fig. 24 4-Channel-AnalogOut-Modul

Number of outputs	4
Power supply	via system voltage DC/DC
Signal voltage	0 V ... 10 V
Load	> 5 kΩ
Resolution	12 bit
Conversion time	typ. 10 ms
Setting time	typ. 100 µs
Measurement error at 25 °C	< ± 0.1 % of full scale (FS)
Temperature coefficient	< ± 0.01 % /K of full scale (FS)

Fig. 25 Technical data of analog output module

8. Warranty

All components of the device have been checked and tested for perfect function in the factory. In the unlikely event that errors should occur despite our thorough quality control, this should be reported immediately to MICRO-EPSILON. The warranty period lasts 12 months following the day of shipment. Defective parts, except wear parts, will be repaired or replaced free of charge within this period if you return the device free of cost to MICRO-EPSILON.

This warranty does not apply to damage resulting from abuse of the equipment and devices, from forceful handling or installation of the devices or from repair or modifications performed by third parties. No other claims, except as warranted, are accepted. The terms of the purchasing contract apply in full.

MICRO-EPSILON will specifically not be responsible for eventual consequential damages.

MICRO-EPSILON always strives to supply the customers with the finest and most advanced equipment. Development

and refinement is therefore performed continuously and the right to design changes without prior notice is accordingly reserved.

For translations in other languages, the data and statements in the German language operation manual are to be taken as authoritative.

9. Service, Repair

In a case of a defect on scanCONTROL 29xx:

- If possible, save the current sensor settings in a parameter set, see Configuration Tools, menu `Parameters > Save parameters to file...`, in order to load the settings back again into the sensor after the repair.
- Please send us the effected parts for repair or exchange.

In the case of faults the cause of which is not clearly identifiable, the whole measuring system must be sent back to:

MICRO-EPSILON Optronic GmbH
Lessingstraße 14
01465 Dresden - Langebrück /
Germany
Tel. +49 (0) 35201 / 729-0
Fax +49 (0) 35201 / 729-90
optronic@micro-epsilon.de
www.micro-epsilon.com

10. Decommissioning, Disposal

➥ Disconnect all cables between the scanCONTROL 29xx sensor and the following control or evaluation units.

scanCONTROL 29xx is produced according to the directive 2011/65/EU, “RoHS. The disposal is done according to the legal regulations (see directive 2002/96/EC).

11. Error Codes

(— LED “state“ lights for a long time lang, • LED “state“ lights briefly)

Flashing sequence	Cause	Remedy	Notes
Group: Loading / saving configuration			
.. 2x short	Mode not found.	Select different one.	Only previously stored modes can be called up.
..- 2x short, 1x long	White error flash	Contact manufacturer, return sensor.	Should not occur in normal operation.
… 3x short	Flash full	None, contact manufacturer.	Should not occur in normal operation.
…. 4x short	Loading suppressed due to active data transmission.	Stop active data transmission.	Prevents PC software crashes.

Group: Data processing and transmission			
-- 2x long	Data overflow in the sensor	Select smaller measuring field, reduce profile frequency, select less complex measuring program.	Data can be impaired; exposure time can be longer than expected.
--. 2x long, 1x short	Data overflow during receipt of the data from the sensor.	Select smaller measuring field, reduce profile frequency, select less complex measuring program.	Data can be impaired.
--.. 2x long, 2x short	Data overflow for serial port RS422	Reduce profile frequency, select less complex measuring program.	Data can be impaired.

Flashing sequence	Cause	Remedy	Notes
--.. 2x long, 3x short	Data overflow during transmission of the data via Ethernet	Reduce profile frequency, increase packet size.	Data can be impaired.
--….. 2x long, 5x short	Error during calculation	Reduce profile frequency, select faster calculation mode.	Data can be impaired.
--..... 2x long, 6x short	Error during Ethernet transmission	Reduce profile frequency.	Data can be impaired.
Group: Output Unit			
--- 3x long	scanCONTROL Output Unit not found.	Connect the sensor with the scanCONTROL Output Unit.	---
---. 3x long, 1x short	Connected modules of scanCONTROL Output Unit are not supported.	Use the supported modules only, see Chap. 7.4.2.	---
---.. 3x long, 2x short	Communication error (scanCONTROL Output Unit)	Reduce profile frequency.	---
---... 3x long, 3x short	Output overflow (scanCONTROL Output Unit)	Reduce profile frequency.	---

Group: Ethernet interface			
---- 4x long	IP Address conflict	Check the Ethernet configuration of device and the host PC. Choose another IP address for the device.	If the problem persists, please contact the manufacturer.

The “state“ LED flashes green; long during active data transmission and short for controller accesses. A controller access can cause various data overflows particularly if the measuring frequency is near its maximum.

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