![MICRO-EPSILON logo]

MICRO-EPSILON

Operating Instructions

scanCONTROL 30xx

LLT3000-25	LLT3010-25	LLT3002-25	LLT3012-25
LLT3000-25/BL	LLT3010-25/BL	LLT3002-25/BL	LLT3012-25/BL
LLT3000-50	LLT3010-50	LLT3002-50	LLT3012-50
LLT3000-50/BL	LLT3010-50/BL	LLT3002-50/BL	LLT3012-50/BL
LLT3000-100	LLT3010-100	LLT3002-100	LLT3012-100
LLT3000-100/BL	LLT3010-100/BL	LLT3002-100/BL	LLT3012-100/BL
LLT3000-200	LLT3010-200	LLT3002-200	LLT3012-200
LLT3000-430	LLT3010-430	LLT3002-430	LLT3012-430
LLT3000-600	LLT3010-600	LLT3002-600	LLT3012-600

Laser scanner

Contents

1. Safety

System operation assumes knowledge of the operating instructions.

1.1 Symbols Used

The following symbols are used in this operating instructions:

⚠ CAUTION	Indicates a hazardous situation which, if not avoided, may result in minor or moderate injury.
NOTICE	Indicates a situation that may result in property damage if not avoided.
➡	Indicates a user action.
i	Indicates a tip for users.
Measure	Indicates hardware or a software button/menu.

1.2 Warnings

Avoid unnecessary laser radiation to be exposed to the human body.

➡ Switch off the sensor for cleaning and maintenance.

➡ Switch off the sensor for system maintenance and repair if the sensor is integrated into a system.

Caution - use of controls or adjustments or performance of procedures other than those specified may cause harm.

⚠ CAUTION	Connect the power supply and the display/output device according to the safety regulations for electrical equipment > Risk of injury, damage to or destruction of the sensor
NOTICE	Avoid shocks and impacts to the sensor. > Damage to or destruction of the sensor

The supply voltage must not exceed the specified limits.
> Damage to or destruction of the sensor

Avoid constant exposure of the sensor to dust or splashes of water 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. Wipe off any fingerprints immediately with pure alcohol and a clean cotton cloth with no streaks.

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

Do not plug or unplug devices during the operation.

1.3   Notes on Product Marking

1.3.1   CE Marking

The following applies to the product:

- Directive 2014/30/EU ("EMC")

- Directive 2011/65/EU ("RoHS")

Products which carry the CE marking satisfy the requirements of the EU Directives cited and the relevant applicable harmonized European standards (EN). The product is designed for use in industrial and laboratory environments.

The EU Declaration of Conformity and the technical documentation are available to the responsible authorities according to the EU Directives.

1.3.2   UKCA Marking

The following applies to the product:

- SI 2016 No. 1091 ("EMC")

- SI 2012 No. 3032 ("RoHS")

Products which carry the UKCA marking satisfy the requirements of the directives cited and the relevant applicable harmonized standards. The product is designed for use in industrial and laboratory environments.

The UKCA Declaration of Conformity and the technical documentation are available to the responsible authorities according to the UKCA Directives.

1.4   Intended Use

- The scanCONTROL 30xx sensor is designed for use in industrial applications.

- It is used for

  - measuring profile
  - measuring length
  - monitoring quality and checking dimensions
- The sensor must only be operated within the limits specified in the technical data, see 3.2.

- The sensor must be used in such a way that no persons are endangered or machines and other material goods are damaged in the event of malfunction or total failure of the sensor.

- Take additional precautions for safety and damage prevention in case of safety-related applications.

1.5 Proper Environment

- Protection class
  - Sensor: IP67 (applies only when connected output connectors or protective caps)
- Pollution degree: 2
- Temperature range
  - Operation: 0 ... +45 °C (+32 ... +113 °F) (with free air circulation)
  - Storage: -20 ... +70 °C (-4 ... +158 °F)
- Area of application: Indoor and outdoor use
- Ambient pressure: Atmospheric pressure
- Humidity: 5 - 95 % RH (non condensing)
- Installation altitude: max. 2000 m above sea level

The sensor is dust-tight and suitable for temporary immersion in accordance with protection class IP67. 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 5.

The IP67 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

2.1   General

The scanCONTROL 30xx sensors operate with a semiconductor laser having a wavelength of 658 nm (visible/red), 660 nm (visible/red) resp. 405 nm (visible/blue).

i   If both warning labels are covered over when the unit is installed, the user must ensure that supplementary labels are applied.

Operation of the laser is indicated visually by the LED on the sensor, .

The housing of the optical sensors may only be opened by the manufacturer.

For repair and service purposes, the sensors must always be sent to the manufacturer.

Please observe national regulations, e. g., Laser Notice No. 56 for the USA.

When operating the sensors, the relevant regulations according to IEC 60825, Part 1 of 05/2014 and the applicable accident prevention regulations must be followed.
The laser warning labels for Germany have already been attached. For other non German speaking countries, an IEC standard label is included in delivery and the versions valid for the user's country must be attached before the device is put into operation for the first time.

2.2   Laser Class 2M

The sensors fall within laser class 2M. The laser is operated on a pulsed mode, the maximum optical power is $\leq$ 10 mW, $\leq$ 12 mW resp. 26 mW. The pulse frequency depends on the adjusted measuring rate (0 ... 25 kHz). The pulse duration of the peaks is regulated depending on the measuring rate and reflectivity of the target and can be 7 μs up to infinite (continuous operation).
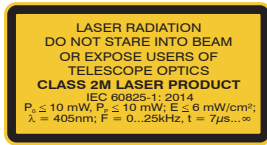
⚠ CAUTION   Laser radiation. Irritation or injury of the eyes possible. Close your eyes or immediately turn away if the laser beam hits the eye.
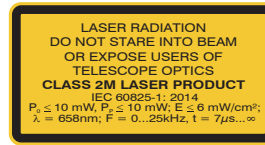
i   Observe the national laser protection regulations.

Accordingly, the following applies: 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. Directly looking into the beam can be dangerous, if the eye-closure reflex is consciously suppressed, e.g., during adjusting. Directly looking into the beam with optical devices, such as magnifying glasses, is dangerous. 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.
Lasers of Class 2M are not subject to notification and a laser protection officer is not required.

Attach the following warning labels to the cover of the housing:

LASER RADIATION
DO NOT STARE INTO BEAM
OR EXPOSE USERS OF
TELESCOPE OPTICS
CLASS 2M LASER PRODUCT
IEC 60825-1: 2014
$P_0 \leq 10$ mW; $P_z \leq 10$ mW; $E \leq 6$ mW/cm²;
$\lambda = 405$nm; F = 0...25kHz, t = 7µs...∞

LLT30xx-25/BL, 30xx-50/BL, 30xx-100/BL

LASER RADIATION
DO NOT STARE INTO BEAM
OR EXPOSE USERS OF
TELESCOPE OPTICS
CLASS 2M LASER PRODUCT
IEC 60825-1: 2014
$P_0 \leq 10$ mW; $P_z \leq 10$ mW; $E \leq 6$ mW/cm²;
$\lambda = 658$nm; F = 0...25kHz, t = 7µs...∞

LLT30xx-25, 30xx-50, 30xx-100
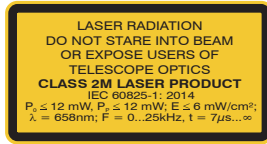
LASER RADIATION
DO NOT STARE INTO BEAM
OR EXPOSE USERS OF
TELESCOPE OPTICS
CLASS 2M LASER PRODUCT
IEC 60825-1: 2014
$P_0 \leq 12$ mW; $P_z \leq 12$ mW; $E \leq 6$ mW/cm²;
$\lambda = 658$nm; F = 0...25kHz, t = 7µs...∞

LLT30xx-200

LASER RADIATION
Do not stare into beam or expose
users of telescope optics
CLASS 2M LASER PRODUCT
IEC 60825-1: 2014
$P_0 \leq 26$ mW; $P_z \leq 26$ mW; $E \leq 6$ mW/cm²;
$\lambda = 660$nm; F = 0...25kHz; t = 7µs...∞

LLT30xx-430, LLT30xx-600

COMPLIES WITH 21 CFR 1040.10 AND 1040.11
EXCEPT FOR CONFORMANCE WITH
IEC 60825-1 ED. 3., AS DESCRIBED IN
LASER NOTICE NO. 56, DATED MAY 8, 2019

Only for USA

i Mark the laser area recognizable and everlasting.

Sensor with labels, LLT30xx-25, LLT30xx-50, LLT30xx-100, LLT30xx-200

Sensor with labels, LLT30xx-430, LLT30xx-600

2.3 Laser Class 3R

The sensors with the /3R option fall within laser class 3R. The laser is operated on a pulsed mode, the maximum optical power is ≤ 30 mW resp. ≤ 50 mW. The pulse frequency depends on the adjusted measuring rate (0 ... 25 kHz). The pulse duration of the peaks is regulated depending on the measuring rate and reflectivity of the target and can be 7 μs up to infinite (continuous operation).

i   Observe the national laser protection regulations.

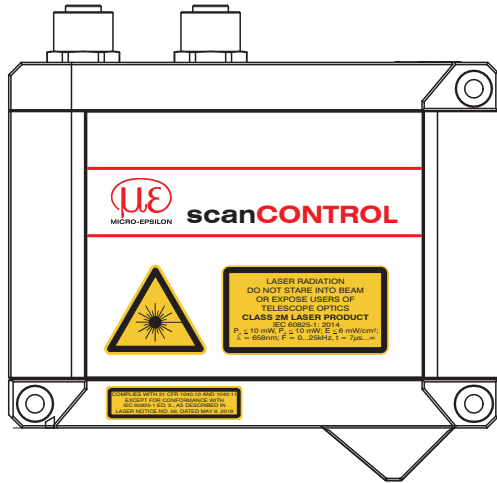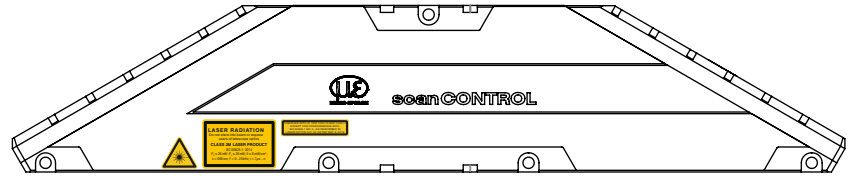**⚠ CAUTION**   Laser radiation. Irritation or injury of the eyes possible. Use suitable protective equipment and close your eyes or immediately turn away if the laser beam hits the eye.

Accordingly, the following applies: The accessible laser radiation is harmful to the eyes. Looking directly into the laser beam is harmful to the eyes with laser class 3R devices. Reflections of shiny or mirroring surfaces are also harmful to the eyes.

Attach the following warning labels to the cover of the sensor housing:

LASER RADIATION
AVOID DIRECT EYE EXPOSURE

CLASS 3R LASER PRODUCT

IEC 60825-1: 2014
P_o ≤ 30mW, P_p ≤ 30mW; E ≤ 18mW/cm²;
λ = 658nm; F = 0...25kHz, t = 7μs...∞

LLT30xx-25, LLT30xx-50

LASER RADIATION
AVOID DIRECT EYE EXPOSURE

CLASS 3R LASER PRODUCT

IEC 60825-1: 2014
P_o ≤ 50 mW, P_p ≤ 50 mW; E ≤ 30 mW/cm²;
λ = 658nm; F = 0...25kHz, t = 7μs...∞

LLT30xx-100, LLT30xx-200

COMPLIES WITH 21 CFR 1040.10 AND 1040.11
EXCEPT FOR CONFORMANCE WITH
IEC 60825-1 ED. 3., AS DESCRIBED IN
LASER NOTICE NO. 56, DATED MAY 8, 2019

Only for USA

i   Mark the laser area recognizable and everlasting.

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

**LASER
APERTURE**

i   Class 3R laser sensors require a laser protection officer.

Sensor with labels, LLT30xx-25, LLT30xx-50, LLT30xx-100, LLT30xx-200

2.4   Laser Class 3B

The sensors fall within laser class 3B. The laser is operated on a pulsed mode, the maximum optical power is ≤ 180 mW. The pulse frequency depends on the adjusted measuring rate (0 ... 25 kHz). The pulse duration of the peaks is regulated depending on the measuring rate and reflectivity of the target and can be 7 up to infinite μs.

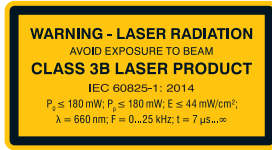| ⚠ CAUTION | Laser radiation. Injury of the eyes and the skin are possible. Wear suitable protective glasses and clothing. |

i   Observe the national laser protection regulations.

i   With laser class 3B sensors, the customer is required to provide an external key switch for laser switch-off, see 5.4.6.

Accordingly, the following applies:
- The accessible laser radiation is harmful to the eyes, and often also for the skin.
- Looking directly into the laser beam is harmful to the eyes. Reflections of shiny or mirroring surfaces are also harmful to the eyes.
- The accessible laser radiation is harmful to the skin with laser class 3B devices if the values of the maximum permissible exposure are exceeded.

Class 3B laser sensors are notifiable and a laser protection officer is required.

Mark the laser area recognizable and everlasting. During operation the laser area has to be restricted and marked.

WARNING - LASER RADIATION
AVOID EXPOSURE TO BEAM
CLASS 3B LASER PRODUCT
IEC 60825-1: 2014
$P_s \leq 180$ mW; $P_p \leq 180$ mW; $E \leq 44$ mW/cm²;
$\lambda = 660$ nm; $F = 0...25$ kHz; $t = 7$ µs...∞

LLT30xx-430, LLT30xx-600

COMPLIES WITH 21 CFR 1040.10 AND 1040.11
EXCEPT FOR CONFORMANCE WITH
IEC 60825-1 ED. 3., AS DESCRIBED IN
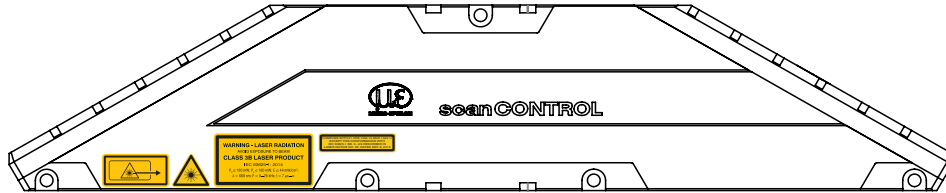LASER NOTICE NO. 56, DATED MAY 8, 2019

Only for USA

i   If both warning labels are covered over when the unit is installed, the user must ensure that supplementary labels are applied.

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

LLT30xx-430, LLT30xx-600 with laser labels

When the sensor is switched on, the laser power can be reduced using the software. It is not possible to reduce the laser power to 1 mW. The laser class does not change by reducing the laser power in the software.

Beam attenuator

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

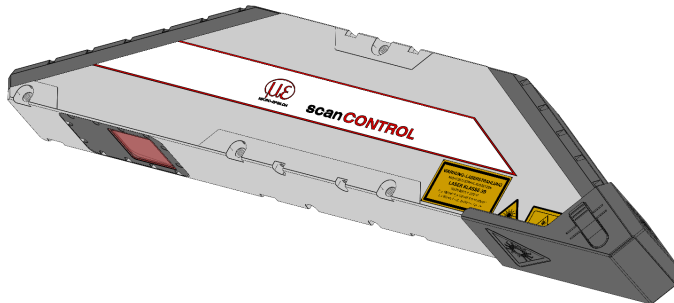*Fig. 1 Sensor with close beam attenuator*

Fig. 2 Sensor with open beam attenuator for measurements

The beam catcher is attached and can be removed for measuring operation.

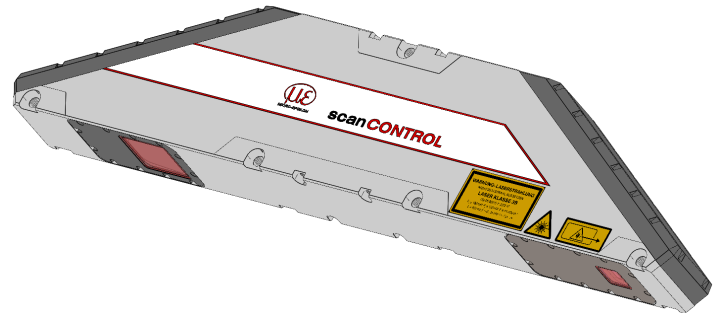The laser aperture must be open during measurement. Please observe the notes on external laser switching, see 5.4.6.

3.   Functional Principle, Technical Data

3.1   Short Description

3.1.1   Measuring Principle

The scanCONTROL 30xx 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 matrix 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.

Measuring range Z-axis (profile height)

Measuring range X-axis (profile width)
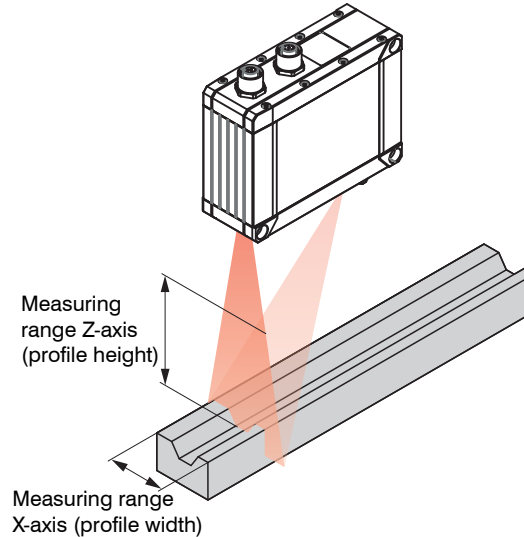
3.1.2   System Setup

The scanCONTROL 30xx 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 30xx 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 matrix 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 30xx 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 2D/3D Output Unit, which transforms the determined measurement signals in switching and analog signals for further processing in a PLC.
- 2D/3D Gateway allows for scanCONTROL SMART sensors to be integrated into various fieldbus systems (PROFINET, EtherNet/IP, EtherCAT).

3.1.4   Advantages of the Used Sensor Matrix (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 matrix 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.
- The High Dynamic Range mode (HDR) provides optimal measuring data on difficult target surfaces.

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 (selectable Pull-up or Pull down behavior)
- 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	LLT	30x0-25	30x0-50	30x0-100	30x0-200	30x0-430	30x0-600
Laser type		Red Laser | Blue Laser	Red Laser | Blue Laser	Red Laser | Blue Laser	Red Laser	Red Laser	Red Laser
z-axis Measuring range	Start of measuring range	77.5 mm	105 mm	200 mm	200 mm	330 mm	530 mm
	Mid of measuring range	85 mm	125 mm	270 mm	310 mm	515 mm	770 mm
	End of measuring range	92.5 mm	145 mm	340 mm	420 mm	700 mm	1010 mm
	Height of measuring range	15 mm	40 mm	140 mm	220 mm	370 mm	480 mm
Extended measuring range	Start of measuring range	-	-	190 mm	160 mm	330 mm	450 mm
	End of measuring range	-	-	360 mm	460 mm	720 mm	1060 mm
Max. deviation of a single point [1] (2sigma)	Red Laser	±0.07 %	±0.07 %	0.06 %	±0.10 %	±0.05 %	±0.06 %
	Blue Laser	±0.06 %	±0.06 %	0.05 %	-	-	-
Line linearity [1] [2]		1.5 μm	3 μm	9 μm	26 μm	12 μm	15 μm
		±0.01 %	±0.0075 %	±0.006 %	±0.012 %	±0.0032 %	±0.0031 %
x-axis Measuring range	Start of measuring range	23.0 mm	43.3 mm	75.6 mm	130 mm	324 mm	456 mm
	Mid of measuring range	25.0 mm	50.0 mm	100.0 mm	200 mm	430 mm	600 mm
	End of measuring range	26.8 mm	56.5 mm	124.4 mm	270 mm	544 mm	762 mm
Extended measuring range	Start of measuring range	-	-	72.1 mm	100 mm	324 mm	408 mm
	End of measuring range	-	-	131.1 mm	290 mm	560 mm	788 mm
Resolution		2,048 points/profile					
Profile frequency		up to 10,000 Hz					

Model	LLT	30x0-25	30x0-50	30x0-100	30x0-200	30x0-430	30x0-600
Interfaces	Ethernet GigE Vison	Output of measurement values / Sensor control / Profile data transmission					
	Digitale Eingänge	Mode switching / Encoder (counter) / Trigger					
	RS422 (halbduplex) [3]	Output of measurement values / Sensor control / Trigger / Synchronization					
Output of measurement values		Ethernet (UDP / Modbus TCP); RS422 (ASCII / Modbus RTU) analog [4]; switch signal [4]; PROFINET [5]; EtherCAT [5]; EtherNet/IP [5]					
Control and display elements		3x color LEDs for laser, data and error					
Light source	Red Laser	≤ 10 mW		≤ 12 mW		≤ 26 mW	
		Standard: laser class 2M, semiconductor laser 658 nm				Standard: laser class 2M, semiconductor laser 660 nm	
		≤ 30 mW		≤ 50 mW		≤ 100 mW	
		Option: laser class 3R, semiconductor laser 658 nm				Option: laser class 3B, semiconductor laser 660 nm	
	Blue Laser	≤ 10 mW		-	-	-	-
		Standard: laser class 2M, semiconductor laser 405 nm		-	-	-	-
	Laser switch-off	via software, hardware switch-off with /SI option					
Aperture angle of laser line		23°	28°	30°	45°	60°	
Permissible ambient light	(fluorescent light) [1]	10,000 lx				5.000 lx	
Protection class (DIN EN 60529)		IP67 (when connected)					
Vibration (DIN EN 60068-2-27)		2 g / 20 … 500 Hz					

Model	LLT	30x0-25	30x0-50	30x0-100	30x0-200	30x0-430	30x0-600
Shock (DIN EN 60068-2-6)		15 g / 6 ms					
Temperature range		Storage: -20 … +70 °C; Operation: 0 … +45 °C					
Weight		415 g (without cable)				2630 g (without cable)	
Supply voltage		11 … 30 VDC, nominal value 24 V, 500 mA, LPS and NEC Class 2 compliant IEEE 802.3af class 2, Power over Ethernet (PoE)					
Connections		sockets, cable outlets on top (/PT) or rear (/RT)				sockets, cable outlets on top (/PT)	

1) Based on measuring range; measuring object: Micro-Epsilon standard object

2) According to a one-time averaging over the measuring field (2,048 points)

3) RS422 interface, programmable either as serial interface or as input for triggering/synchronization

4) Only with 2D/3D Output Unit

5) Only with 2D/3D Gateway

Model			LLT 30x2-25	LLT 30x2-50	LLT 30x2-100	LLT 30x2-200	LLT 30x2-430	LLT 30x2-600
Laser type			Red Laser | Blue Laser	Red Laser | Blue Laser	Red Laser | Blue Laser	Red Laser	Red Laser	Red Laser
z-axis	Measuring range	Start of measuring range	77.5 mm	105 mm	200 mm	200 mm	330 mm	530 mm
		Mid of measuring range	85 mm	125 mm	270 mm	310 mm	515 mm	770 mm
		End of measuring range	92.5 mm	145 mm	340 mm	420 mm	700 mm	1010 mm
		Height of measuring range	15 mm	40 mm	140 mm	220 mm	370 mm	480 mm
	Extended measuring range	Start of measuring range	-	-	190 mm	160 mm	330 mm	450 mm
		End of measuring range	-	-	360 mm	460 mm	720 mm	1060 mm
	Max. deviation of a single point [1] (2sigma)"	Red Laser	0.09 %	0.09 %	0.08 %	0.12 %	±0.07 %	±0.08 %
		Blue Laser	0.08 %	0.08 %	0.07 %	-	-	-
	Line linearity [1][2]		2 μm	4 μm	10 μm	30 μm	15 μm	22 μm
			±0.013 %	±0.01 %	±0.007 %	±0.014 %	±0.0041 %	±0.0045 %
x-axis	Measuring range	Start of measuring range	23.0 mm	43.3 mm	75.6 mm	130 mm	324 mm	456 mm
		Mid of measuring range	25.0 mm	50.0 mm	100.0 mm	200 mm	430 mm	600 mm
		End of measuring range	26.8 mm	56.5 mm	124.4 mm	270 mm	544 mm	762 mm
	Extended measuring range	Start of measuring range	-	-	72.1 mm	100 mm	324 mm	408 mm
		End of measuring range	-	-	131.1 mm	290 mm	560 mm	788 mm

Model		LLT 30x2-25	LLT 30x2-50	LLT 30x2-100	LLT 30x2-200	LLT 30x2-430	LLT 30x2-600
Laser type		Red Laser | Blue Laser	Red Laser | Blue Laser	Red Laser | Blue Laser	Red Laser	Red Laser	Red Laser
Resolution		1,024 points/profile					
Profile frequency		up to 10,000 Hz					
Interfaces	Ethernet GigE Vison	Output of measurement values / Sensor control / Profile data transmission					
	Digital inputs	Mode switching / Encoder (counter) / Trigger					
	RS422 (half-duplex) [3]	Output of measurement values / Sensor control / Trigger / Synchronization					
Output of measurement values		Ethernet (UDP / Modbus TCP); RS422 (ASCII / Modbus RTU) analog [4]; switch signal [4]; PROFINET [5]; EtherCAT [5]; EtherNet/IP [5]					
Control and display elements		3x color LEDs for laser, data and error					
Light source	Red Laser	≤ 10 mW			≤ 12 mW	≤ 26 mW	
		Standard: laser class 2M, semiconductor laser 658 nm				Standard: laser class 2M, semiconductor laser 660 nm	
		≤ 30 mW	≤ 50 mW			≤ 100 mW	
		Option: laser class 3R, semiconductor laser 658 nm				Option: laser class 3B, semiconductor laser 660 nm	
	Blue Laser	≤ 10 mW			-	-	-
		Standard: laser class 2M, semiconductor laser 405 nm			-	-	-
	Laser switch-off	via software, hardware switch-off with /SI option					
Aperture angle of laser line		23°	28°	30°	45°	60°	
Permissible ambient light	(fluorescent light) [1]	10,000 lx				5000 lx	

Model	LLT 30x2-25	LLT 30x2-50	LLT 30x2-100	LLT 30x2-200	LLT 30x2-430	LLT 30x2-600
Protection class (DIN EN 60529)	IP67 (when connected)					
Vibration (DIN EN 60068-2-27)	2g / 20 … 500 Hz					
Shock (DIN EN 60068-2-6)	15 g / 6 ms					
Temperature range	Storage: -20 … +70 °C; Operation: 0 … +45 °C					
Weight	415 g (without cable)				2620 g (ohne Kabel)	
Supply voltage	11 … 30 VDC, nominal value 24 V, 500 mA, LPS and NEC Class 2 compliant IEEE 802.3af class 2, Power over Ethernet (PoE)					
Connections	sockets, cable outlets on top (/PT) or rear (/RT)				sockets, cable outlets on top (/PT)	

1) Based on measuring range; measuring object: Micro-Epsilon standard object

2) According to a one-time averaging over the measuring field (1,024 points)

3) RS422 interface, programmable either as serial interface or as input for triggering/synchronization

4) Only with 2D/3D Output Unit

5) Only with 2D/3D Gateway

3.3　LED Displays

LED **Laser**	Meaning
Yellow	Laser is on

LED **Data**	Meaning
Green	Measurement is active
Green, flashes slowly	Data transmission is active
Green, flashes short	Controller accesses

LED **Error**	Meaning
Red, flashes	Error code, see 12.

4.   Delivery

4.1   Unpacking, Included in Delivery

- 1 scanCONTROL 30xx sensor with integrated controller
- 1 PCR3000-5 multifunction cable, length 5 m; for power supply, trigger and RS422; screw connector and free cable ends
- Calibration final inspection / assembly instructions
- 2 Protective caps
- Centering elements (MR25-200: 2 pcs. / MR430/600: 4 pcs.)
- IEC warning labels

➡ Carefully remove the components of the measuring system from the packaging and ensure that the goods are forwarded in such a way that no damage can occur.

➡ Check the delivery for completeness and shipping damage immediately after unpacking.

➡ If there is damage or parts are missing, immediately contact the manufacturer or supplier.

4.2   Storage

Temperature range storage: -20 ... +70 °C (-4 ... +158 °F)
Humidity: 5 ... 95 % RH (non condensing)

5. Installation and Mounting

5.1 Attachment and Mounting for LLT30xx-25 / LLT30xx-50 / LLT30xx-100 / LLT30xx-200

- 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 define the sensor position using centering elements and fitting bores.

The cylindrical counterbore ø8H7 is intended for the position-defining centering elements. This allows for the sensor to be mounted in a reproducible and exchangeable way.

➡ The mounting dimensions refer to the dimensional drawings.

| NOTICE | Pay attention to careful handling during mounting and operation.
The bearing surfaces surrounding the fastening holes (through-holes) are slightly raised. Mount the sensor only to the existing holes on a flat surface. Clamps of any kind are not permitted. Do not exceed torques. If possible, mount the sensor with side A as bearing surface.
> Damage to or destruction of the sensor, inaccurate, erroneous measuring values. |

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

➡ Mount the sensor by means of screws type M5 or by means of through bores for M4.

Bolt connection			
Through length	Screw	Washer	Torque
40 mm	M4 x ISO 4762-A2	A 4,3 ISO 7089-A2	1.9 Nm

Direct fastening		
Screw depth	Screw	Torque
min 14 mm	M5 x ISO 4762-A2	2.5 Nm

Fig. 3 Mounting conditions
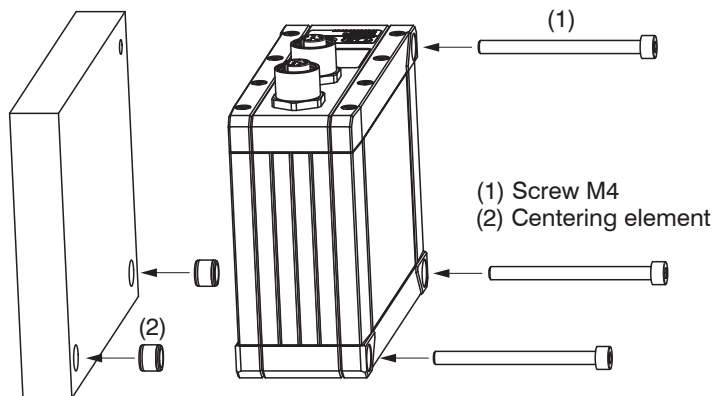
Fig. 4 Mounting example with bolt connection

Fig. 5 Mounting example with direct fastening

Bolt connection:
- 3 threaded holes (M4)

with centering element:
- additionally 2 cylindrical counter-bores 8H7 depth 1.8 - 2 mm

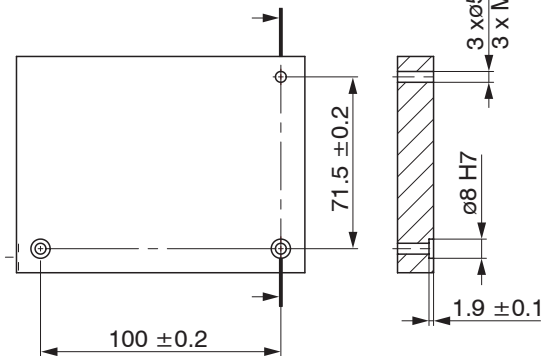**Direct fastening:**
- 3 bores ø 5.5

with centering element:
- additionally 2 cylindrical counterbores 8H7 depth 1.8 - 2 mm

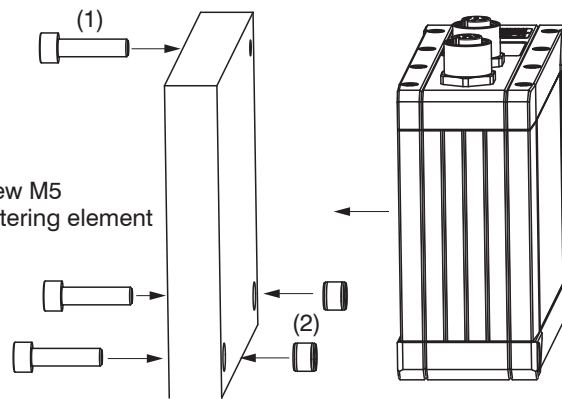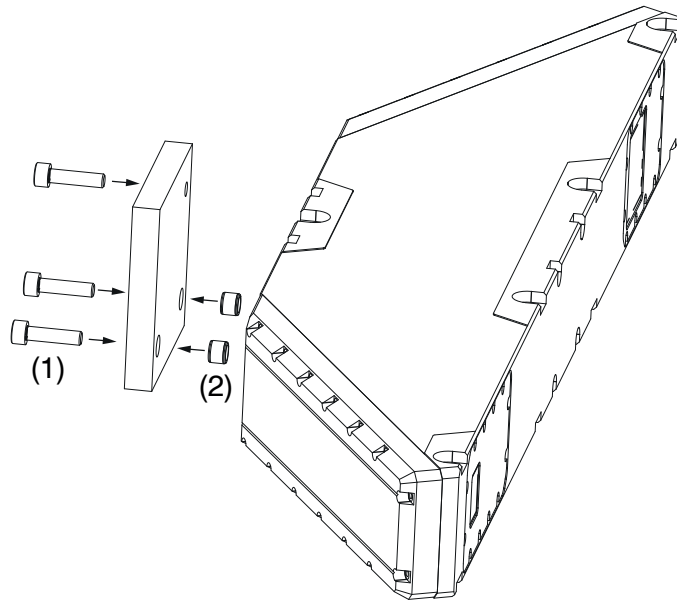Fig. 6 Dimensional drawing mounting bores, dimensions in mm, not to scale

5.2   Attachment and Mounting for LLT30xx-430 / LLT30xx-600

(1) Screw M5

(2) Centering element

Direct fastening:
- 3 bores ø 5,5 mm

with centering element:
- additionally 2 cylindrical counterbores 8H7 depth 2,9 - 3,1 mm

i The two centering elements must be located on one sensor side, i.e. they must not be arranged diagonally. The position of the third screw can be freely selected (4 threaded holes available).
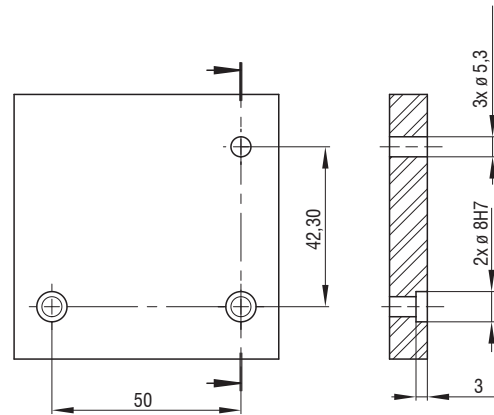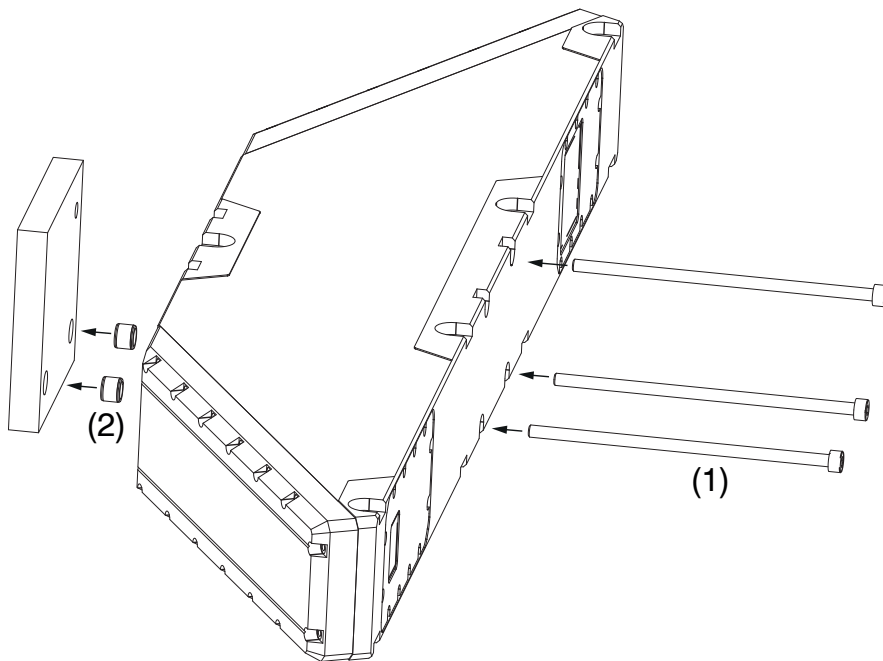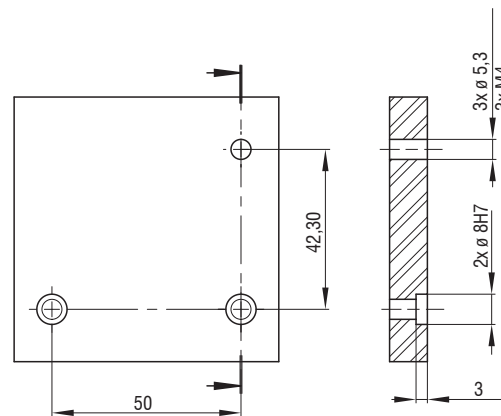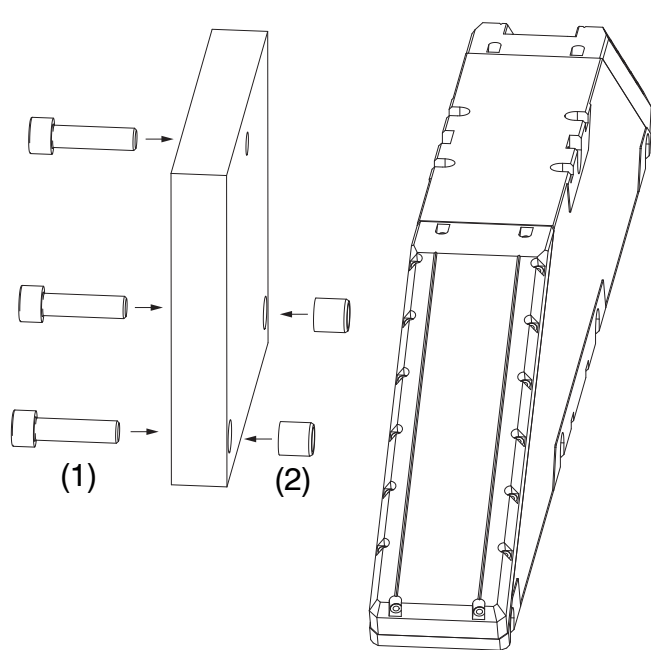

Fig. 7 Mounting example with direct fastening LLT30xx-430 / LLT30xx-600

Fig. 8 Dimensional drawing mounting bores, dimensions in mm, not to scale

Fig. 9 Mounting example with bolt connection LLT30xx-430 / LLT30xx-600

(1) Screw M4

(2) Centering element

Bolt connection:
- 3 through holes M4

with centering element:
- additionally 2 cylindrical counterbores 8H7 depth 2,9 - 3,1 mm

i The two centering elements must be located on one sensor side, i.e. they must not be arranged diagonally. The position of the third screw can be freely selected (4 through holes available).

Fig. 10 Dimensional drawing mounting bores, dimensions in mm, not to scale

(1) Screw M8

(2) Centering element

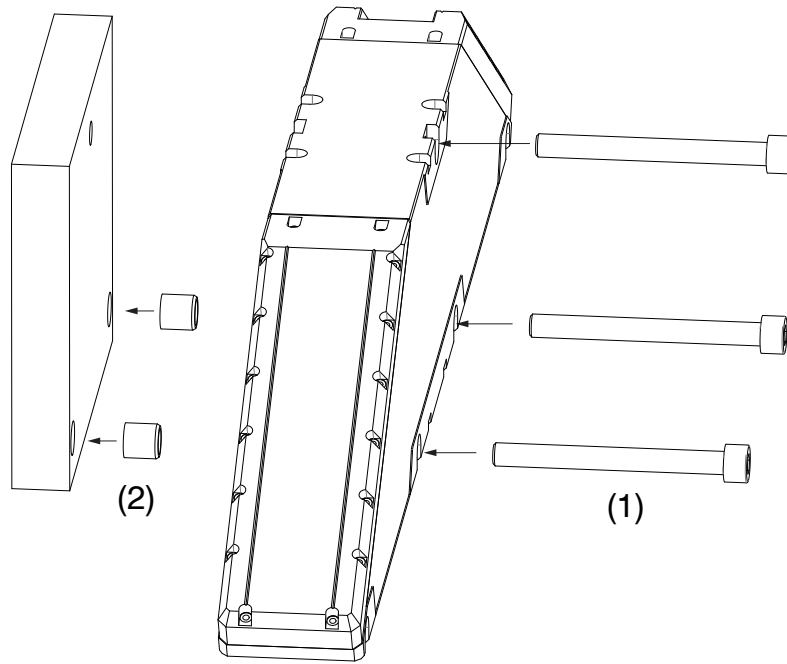**Direct fastening:**
- 3 bores ø 8,4 mm

with centering element:
- additionally 2 cylindrical counterbores 12H7 depth 8,2 - 8,8 mm

Fig. 11 Mounting example with direct fastening LLT30xx-430 / LLT30xx-600

(1) Screw M6

(2) Centering element

Bolt connection:
- 3 threaded holes M6

with centering element:
- additionally 2 cylindrical counterbores
  12H7 depth 8,2 - 8,8 mm

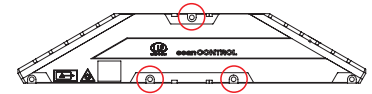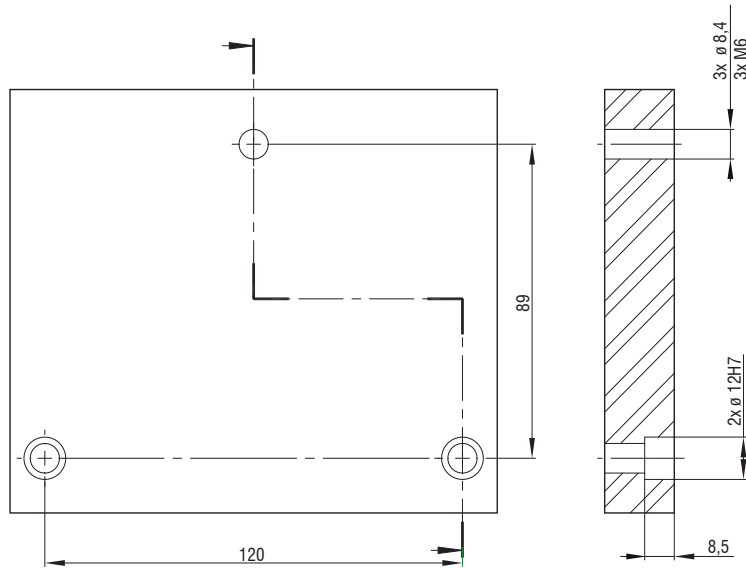*Fig. 12 Mounting example with bolt connection LLT30xx-430 / LLT30xx-600*

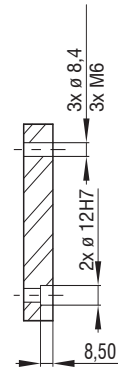Fig. 13 Dimensional drawing inner mounting holes,
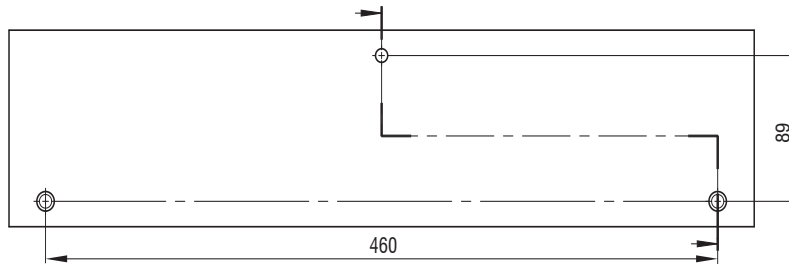dimensions in mm, not to scale

Fig. 14 Dimensional drawing outer mounting holes,
dimensions in mm, not to scale
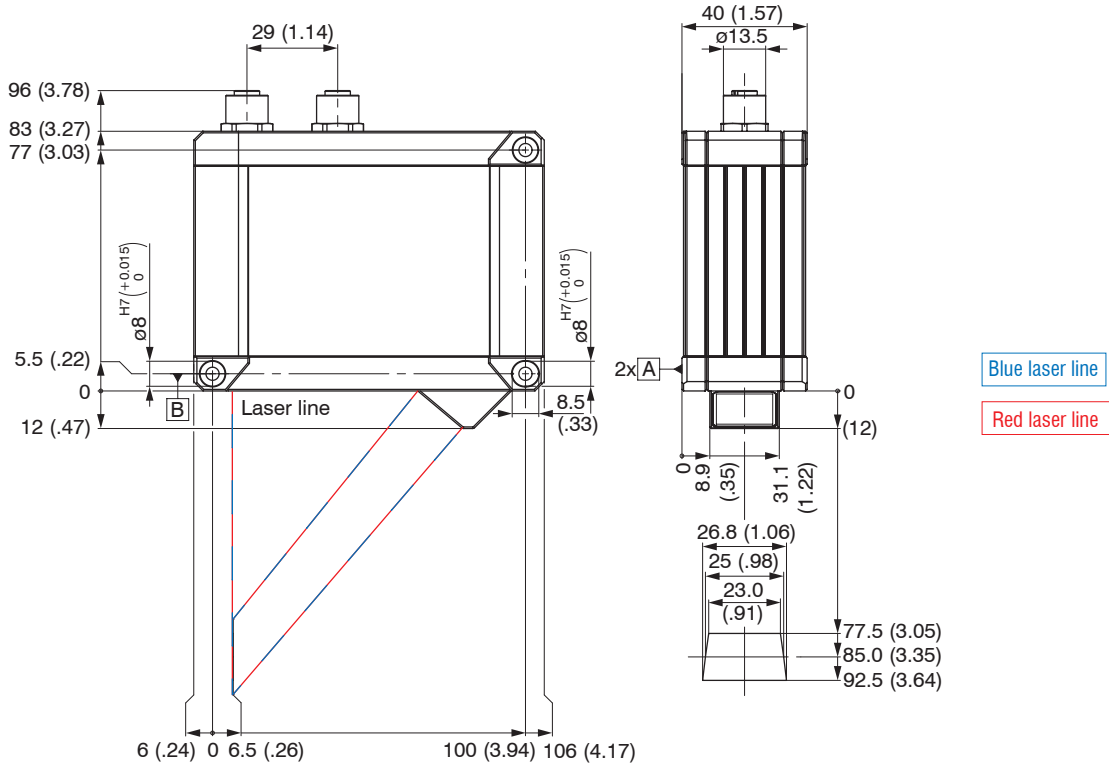
5.3 Dimensional drawings

Fig. 15 Dimensional drawing sensor scanCONTROL 30xx-25, dimensions in mm (inches)
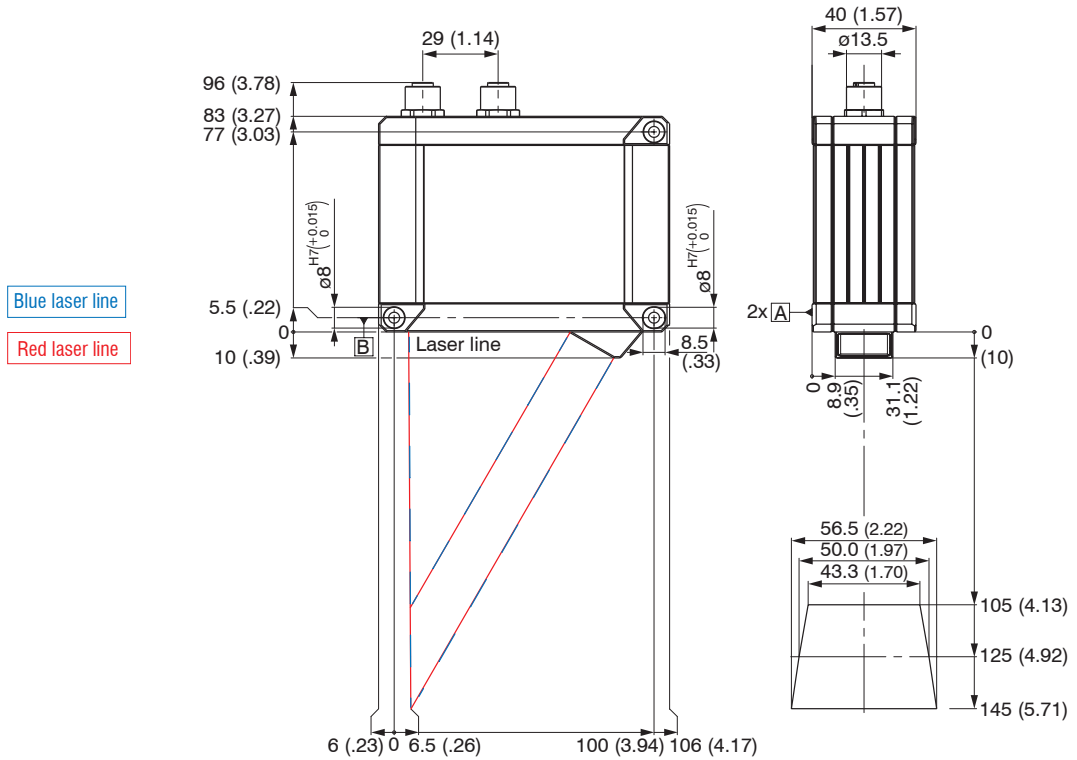
Blue laser line

Red laser line

Fig. 16 Dimensional drawing sensor scanCONTROL 30xx-50, dimensions in mm (inches)

96 (3.78)
83 (3.27)
77 (3.03)

29 (1.14)

ø8 H7 $\left(^{+0.015}_{0}\right)$

40 (1.57)
Ø13.5

5.50 (0.22)
0

Laser line

8.5
(.33)

ø8 H7 $\left(^{+0.015}_{0}\right)$

2x A

Z

0

131.3 extended
124.4 (4.90)
100 (3.94)
75.6 (2.98)
72.1 extended

190 (7.48) extended
200 (7.87) SMR

270 (10.6) MMR

340 (13.4) EMR

360 (14.2) extended

6 0 6.50   100 106 (4.17)

Blue laser line

Red laser line

Fig. 17 Dimensional drawing sensor scanCONTROL 30xx-100,
dimensions in mm (inches)

29 (1.14)

96 (3.78)
83 (3.27)
77 (3.03)

ø8 H7 (+0.015 / 0)

5.50 (0.22)

0

ø8 H7 (+0.015 / 0)

Laser
line

8.5
(.33)

40 (1.57)
Ø13.5

2x A

Z

0

290 (11.42) extended
270 (10.63)
200 (7.87)
130 (5.12)
100 (3.94)
extended

160 (6.30)
extended

200 (7.87)
SMR

310 (12.20)
MMR

420 (16.54)
EMR

460 (18.11)
extended

Red laser line

106(4.17)
6(.24) 0 6.50(.26) 100(3.94)

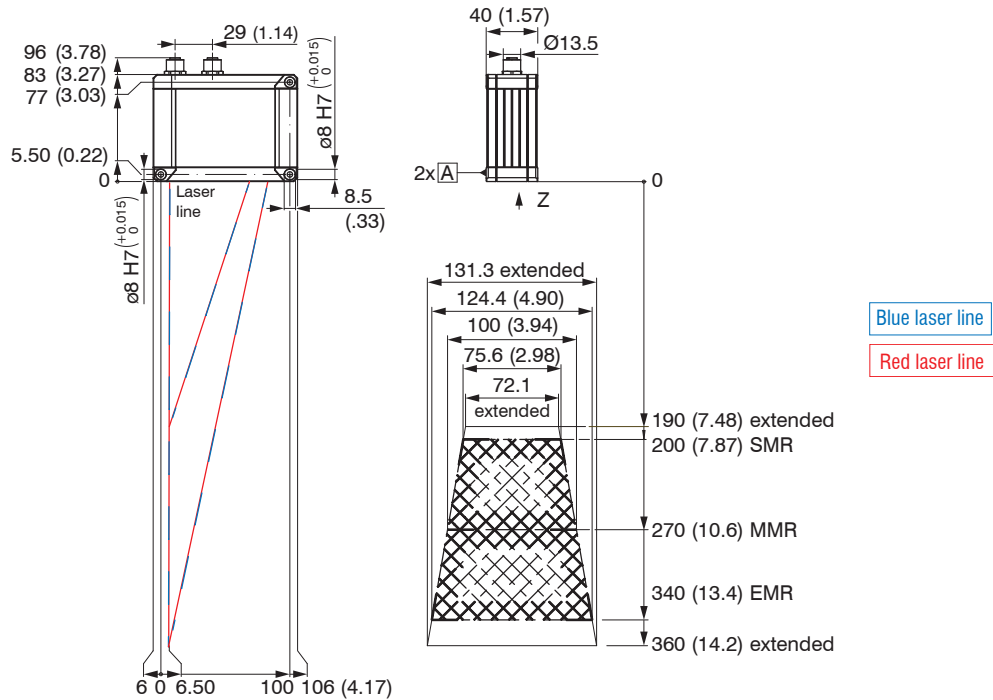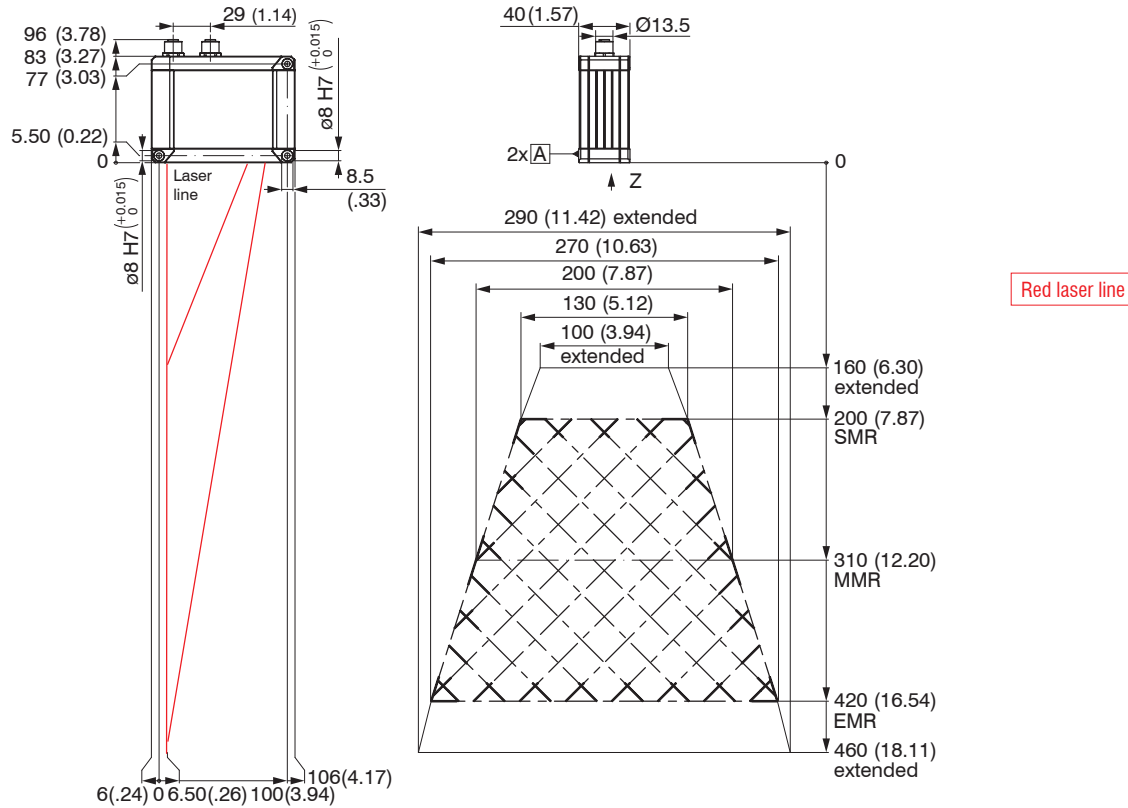*Fig. 18 Dimensional draw-
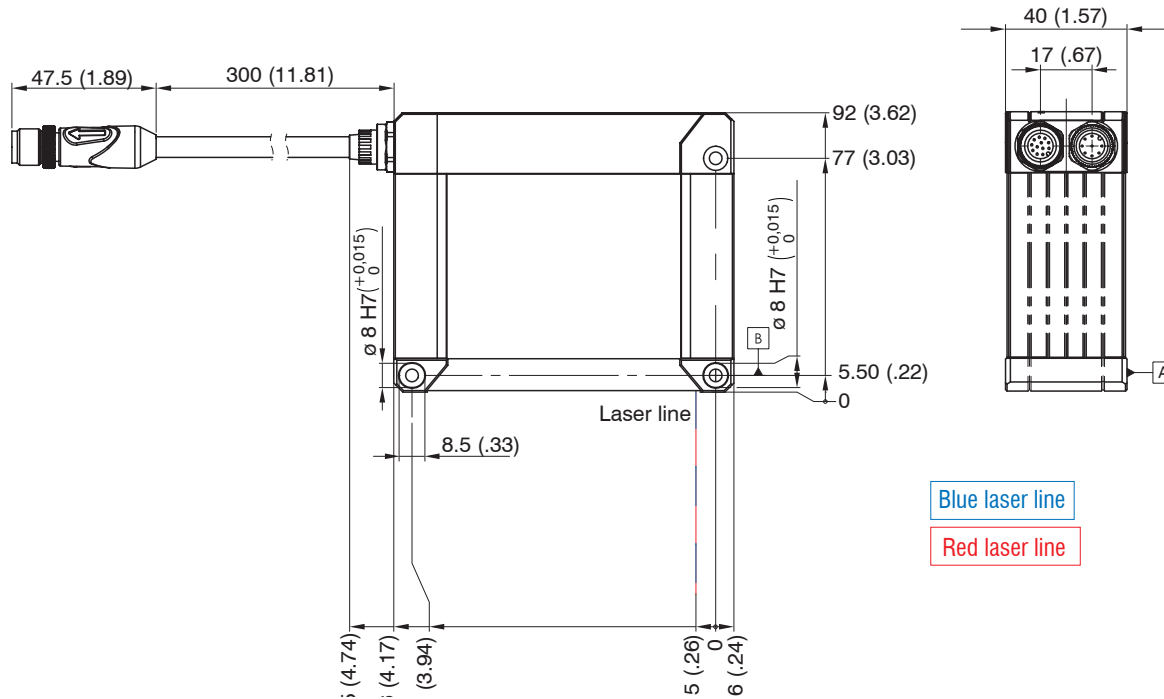ing sensor
scanCONTROL 30xx-200,
dimensions in mm (inches)*

Fig. 19 Dimensional drawing sensor scanCONTROL option RT for LLT30xx-25 / LLT30xx-50 / LLT30xx-100 / LLT30xx-200, dimensions in mm (inches)
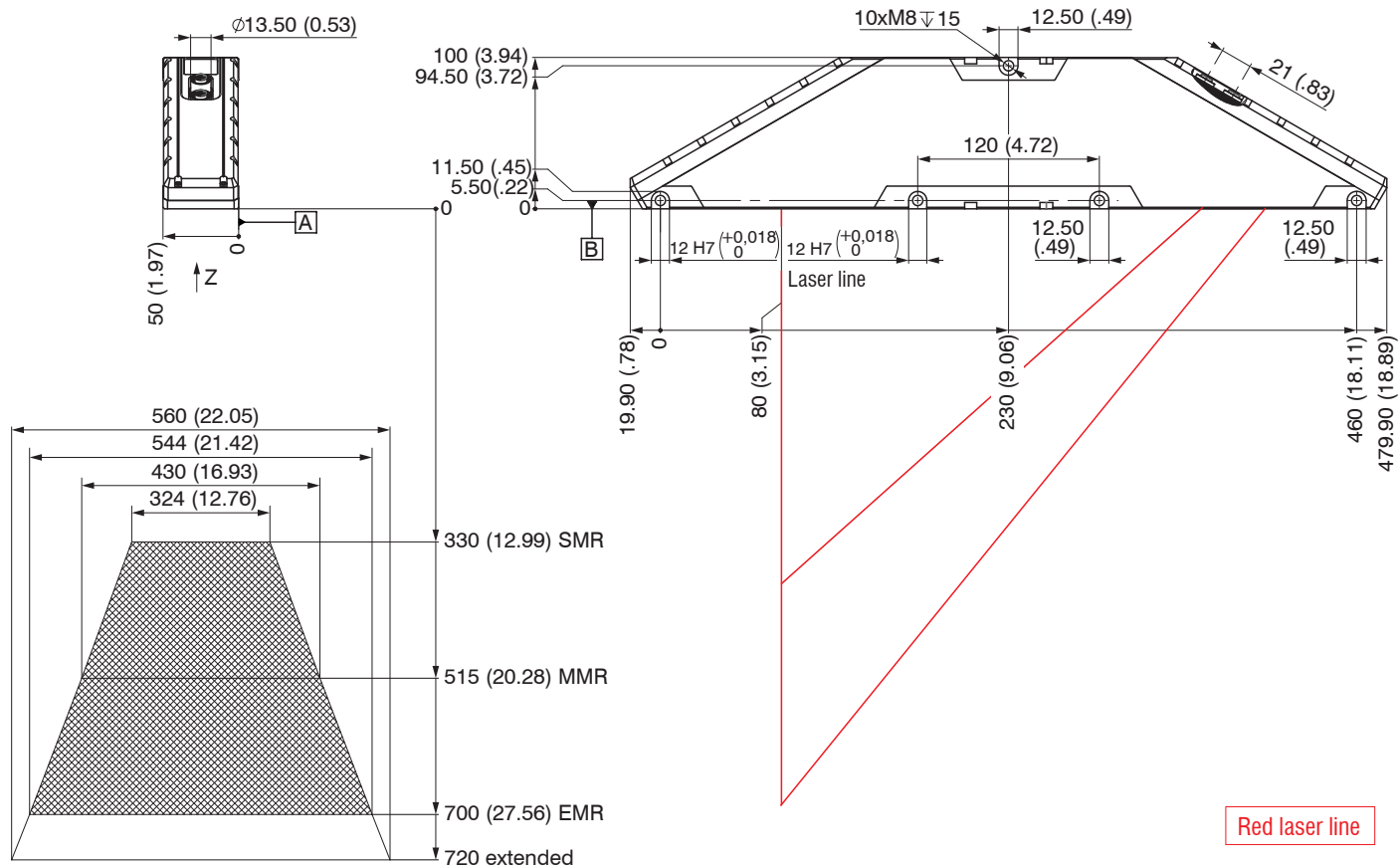
∅13.50 (0.53)

50 (1.97)

Z

A

10xM8 ∇15

12.50 (.49)

21 (.83)

100 (3.94)
94.50 (3.72)

120 (4.72)

11.50 (.45)
5.50 (.22)

0

B

12 H7 (+0,018 / 0)   12 H7 (+0,018 / 0)

Laser line

12.50 (.49)

12.50 (.49)

19.90 (.78)

80 (3.15)

230 (9.06)

460 (18.11)
479.90 (18.89)

560 (22.05)
544 (21.42)
430 (16.93)
324 (12.76)

330 (12.99) SMR

515 (20.28) MMR

700 (27.56) EMR
720 extended

Red laser line

Fig. 20 Dimensional drawing sensor scanCONTROL 30xx-430, dimensions in mm (inches)

⌀13,50 (.53)

50 (1.97)

A

Z

100 (3.94)
94.50 (3.72)

11.50 (.45)
5.50 (.22)
0
0

B

10xM8▽15

12.50 (.49)

21 (.83)

120 (4.72)

12 H7 $\left(^{+0,018}_{0}\right)$ 12 H7 $\left(^{+0,018}_{0}\right)$

12.50 (.49)

12.50 (.49)

Laser line

19.90 (.78)
0

30 (1.18)

230 (9.06)

460 (18.11)
479.90 (18.89)

788 (31.02)
762 (30)
600 (23.62)
456 (18.31)
408 (16.06)

450 (17.72) extended
530 (20.87) SMR

770 (30.31) MMR

1010 (39.8) EMR
1050 (41.34) extended

Red laser line
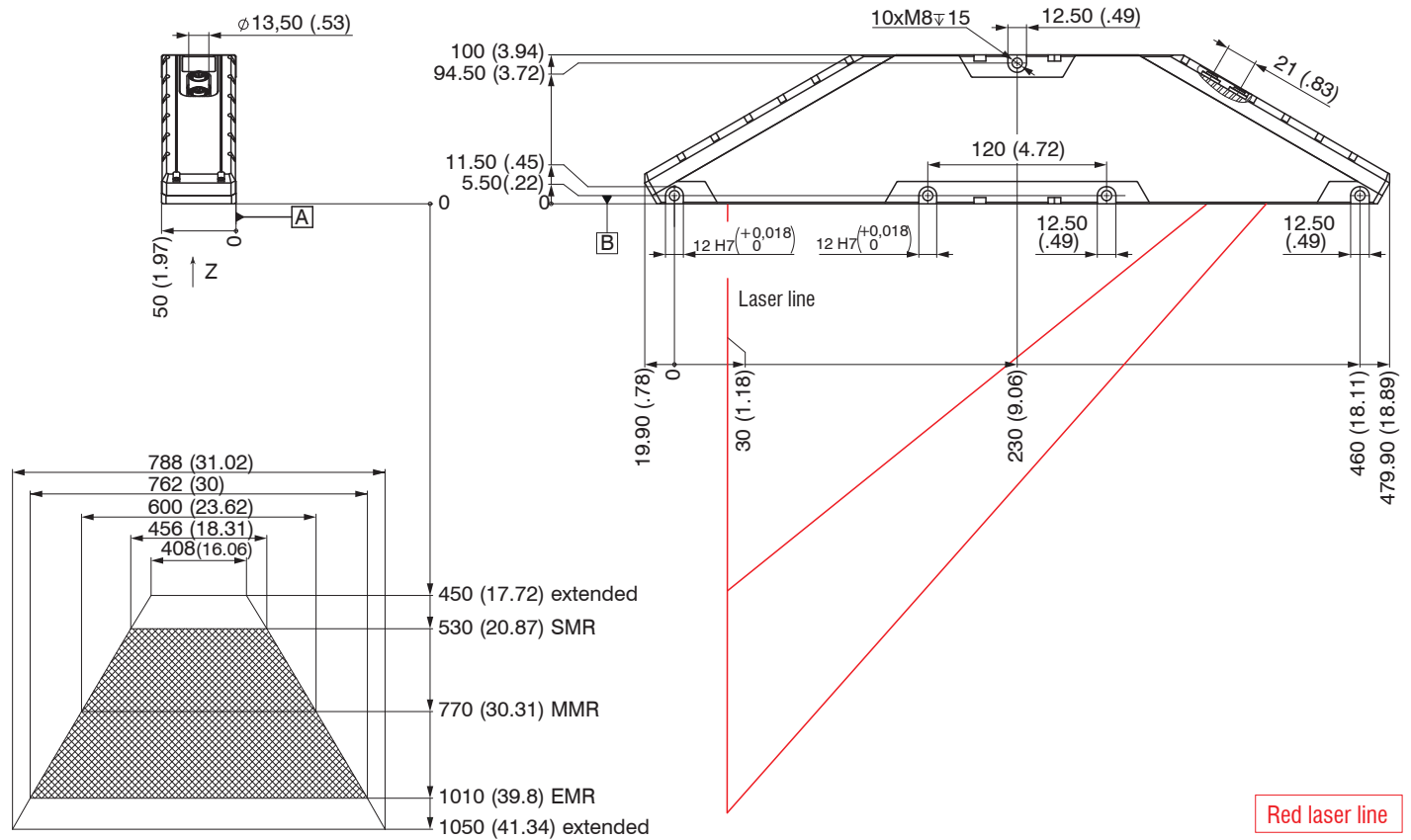
Fig. 21 Dimensional drawing sensor scanCONTROL 30xx-600

5.4   Connections

5.4.1   General

1	Multifunction socket (Power supply, IO)
2	Ethernet socket

Fig. 22 Output sockets arrangement

Designation	Sensor connector Pin	Cable color PCR3000-x	Notes	Connection view
V_+	9	Red	+ 11 V - 30 V DC (rated value 24 V); max. 5 W	
GND	2	Blue	0 V	
+Laser on/off	3	White	Available with SI option	
-Laser on/off	1	Brown		
RS422	12	Red-blue	RS422 input or output	
/RS422	11	Gray-pink		
GND RS422	10	Purple	Ground connection RS422	
In1	4	Green	Switching input In1	
In2	6	Yellow	Switching input In2	
In3	8	Gray	Switching input In3	
In4	5	Pink	Switching input In4	
GND-In	7	Black	Ground connection In	
Screen	Housing	Black	Not electrically connected to GND	

12-pin multifunction socket on the sensor, view on solder side (cable)

GND: Galvanically isolated from In1 ... 4, RS422, laser on/off laser on/off: input galvanically isolated from GND, In1 ... 4, RS422 In1 ... 4, RS422: inputs galvanically isolated from GND and laser on/off

Fig. 23 Assignment of the multifunction socket

5.4.2   Power Supply

Connector multifunction socket, see Fig. 22, pin assignment, see Fig. 23.

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

The operating voltage for the scanCONTROL 30xx 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 that conforms to LPS or NEC Class 2.

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 PCR3000-x is recommended.

NOTICE	Connect the multifunction socket only when the power supply is switched off. > Damage to or destruction of the sensor scanCONTROL 30xx supports Power over Ethernet acc. to IEEE 802.3af class 2. 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.

5.4.3   RS422, Synchronization

Connector multifunction socket, see Fig. 22, pin assignment, see Fig. 23. The scanCONTROL 30xx 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. 24) 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-In. When used GND-RS422 should connected to the GND of the remote station in order to avoid potential differences.
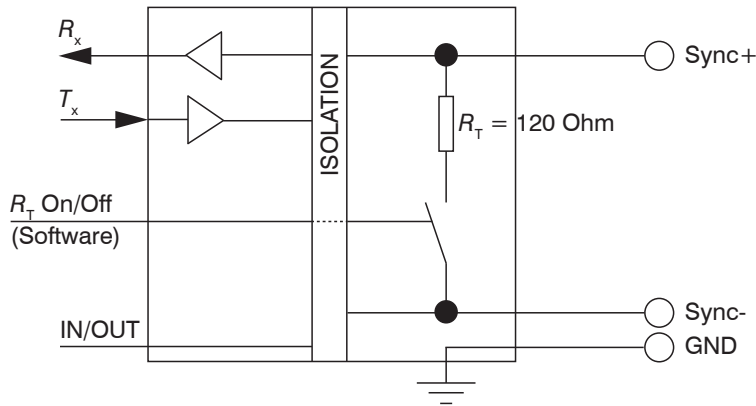

Fig. 24 RS422 synchronization internal circuity

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-RS422 (Pin 10) of the sensors to each other.

Software settings:

Setting	Sensor 1	Sensor 2 [1]	Other sensors
RS422 mode	External trigger output	External trigger input	External trigger input
RS422 termination	Off	On	Off

Fig. 25 External synchronization settings

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

1) The terminating resistor is activated (On) at the sensor that has the longest RS422 connection to sensor 1 (master).

5.4.4   Switching Inputs

Connector multifunction socket, see Fig. 22, pin assignment, see Fig. 23.
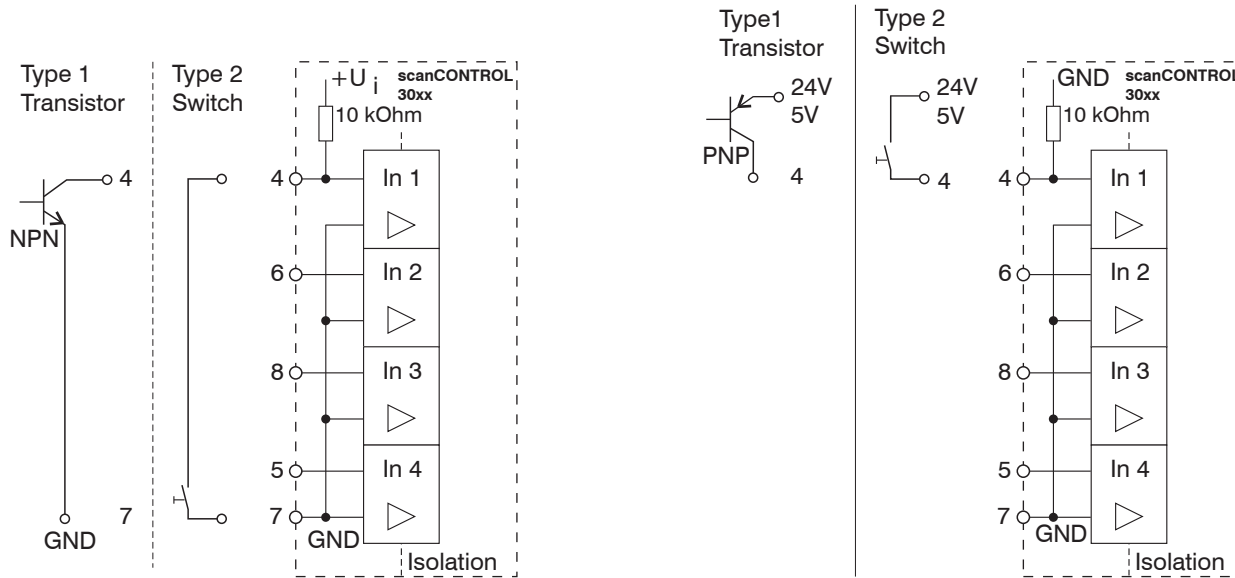

Fig. 26 Pull up

Fig. 27 Pull down

The switching inputs In1 up to In4 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 .

All switching inputs have one ground connection (GND-In), 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	In4
0	Encoder, positive edge of index track [1]		A	B	N
1	Encoder with external trigger input [1]	Trigger	A	B	N
2	External trigger input	Trigger	ppc 1 [2]	ppc 2	ppc 3
3	External trigger and load up to 8 user modes	Trigger	Bit 0	Bit 1	Bit 2
4	Load up to 15 user modes	Bit 0	Bit 1	Bit 2	Bit 3
5	Insert into timestamp	ppc 0	ppc 1	ppc 2	ppc 3
6	Frametrigger and encoder	Start container	A	B	Fill container
7	Frametrigger and encoderline A	Start container	A		Fill container
8	Encoder with gate	Gate	A	B	N
9	External trigger, load up to 4 user modes and 1 input for timestamp	Trigger	Bit 0	Bit 1	ppc 3
10	Load up to 8 user modes and 1 input for timestamp	Bit 0	Bit 1	Bit 2	ppc 3
11	Load up to 4 user modes and 2 inputs for timestamp	Bit 0	Bit 1	ppc 2	ppc 3

Signal level (switching level):

The signal levels are switchable for all switching inputs together via software between LLL (TTL logic) and HLL (HTL):
- LLL level: Low 0 V… 0.8 V,   High 2.4 V… 5 V, internal pull-up/down 10 kOhm to 5 V/GND
- HLL level: Low 0 V… 3 V, High 11 V… 24 V (permitted up to 30 V), internal pull-up/down 10 kOhm to 24 V/GND
- Pulse duration: $\geq 5\ \mu s$

$\mathbf{i}$ Use a shielded cable with twisted wires, especially the recommended connection cable PCR3000-x from the accessories.

➡ 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.
2) ppc = post processing control

5.4.5   Ethernet Connection

Connector "Ethernet", see Fig. 22.

The Ethernet connection is the standard connection to the PC.

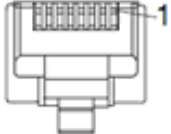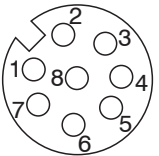The sensor supports the transmission with 100 Mbit and 1 Gbit.

RJ45 connector		8-pin. Ethernet socket (sensor side)		
Pin no.	Color of stranded hook-up wire SCR3000A-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 of male cable connector

View on solder side (cable) of screw connector (A-coded)

Fig. 28 Pin assignment Ethernet connection

We recommend the Gigabit-Ethernet connection cable SCR3000A-x for the Ethernet connection; cable length x in meters. Characteristics: 4 x 2 x 0.14 mm²; shielded.

Due to a high data rate, we recommend using a high-quality Ethernet PC plug-in card, for example IntelPro/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. The uncompressed sensor array view can only be used with activated jumbo frames.

NOTICE	scanCONTROL 30xx supports Power over Ethernet acc. to IEEE 802.3af class 2. 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.

Use the program `sensorTOOL` for network configuration.
This program is available online at https://www.micro-epsilon.com/download/software/sensorTOOL.exe.

5.4.6 External Laser Switching (optional)

Connector multifunction socket, see Fig. 22, pin assignment, see Fig. 23.

Function

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

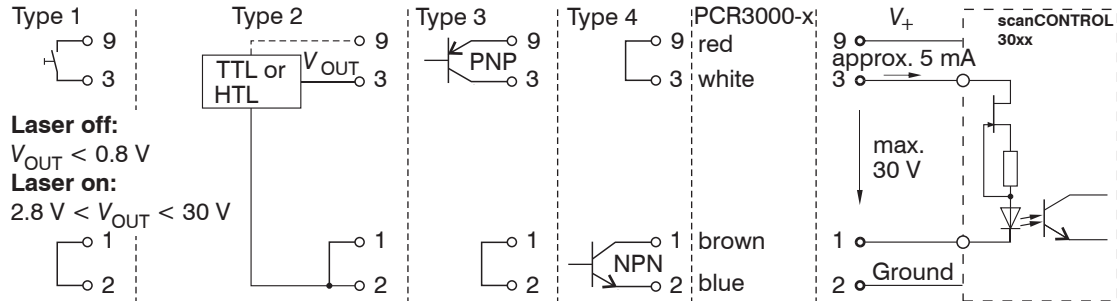- Laser off: Voltage between +laser on/off and -laser on/off < 0.8 V or open

Fig. 29 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.

5.5   Installation Instructions

- Only use shielded cables from the accessories for all connection cables.
- 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, see Appendix.

5.6   Getting Ready for Operation, Initial Operation

➡ Mount the sensor according to the installation instructions, see 5.1.

➡ Connect the sensor to the Ethernet cable.

➡ Connect the sensor to downstream display or monitoring units and to the power supply.

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.

➡ 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 `Error` LED indicates different error conditions by flashing, see . 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 30xx sensor needs a running-in time of typically 20 minutes for high precision measurements.

6.2 Operating and Demonstration Programs

For sensor operation, several programs are available. You will find them online on the sensor product website or in the Download area: https://www.micro-epsilon.com/2D_3D/laser-scanner/Software/downloads/

- The scanCONTROL Developer Tool program supports scanner parameterization and user-friendly visualization of profile data.
- scanCONTROL Configuration Tools is used to analyze typical 2D measurement tasks for scanCONTROL 30xx.
- scanCONTROL 3D-View visualizes three dimensional point data, which are recorded with scanCONTROL 30xx.
- 3DInspect supports you in typical 3D measurements with scanCONTROL 30xx.
- scanCONTROL Result Monitor is used to visualize the profile data and measured values of up to four Smart sensors.

The measuring fields are partially used in the demonstration programs, see 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:

scanCONTROL Configuration Tools
- Windows 8 oder 8.1, Windows 10, Windows 11 (each 64 bit)
- 1-GHz or faster (64 bit) processor / 1 GB RAM (recommended 4 - 8 GB)
- Screen resolution: 1024 x 768 (recommended 1920 x 1080)

scanCONTROL 3D-View
- Windows 8 or 8.1, Windows 10, Windows 11 (each 64 bit)
- 1-GHz or faster (64 bit) processor / 1 GB RAM (recommended 16 GB)
- Screen resolution: 1024 x 768 (recommended 1920 x 1080)
- Graphics card / GPU with OpenGL 3.1 or higher

NOTICE	Connect the sensor directly to the PC. Please do not use any hubs or switches.
	If your network card supports "VLAN" option, please deacivate it.
	To operate the sensor, the PC and the sensor must be in the same subnet.

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.

3. Connect the scanCONTROL 30xx measuring system to the PC via Ethernet.

6.3.2 Connecting scanCONTROL 30xx to the PC

Proceed as follows in order to connect scanCONTROL 30xx via Ethernet with the PC.

➡ Finish the installation of the software completely.

➡ Connect scanCONTROL 30xx via the Ethernet interface to the PC and switch on the power supply.

➡ Please wait until the scanCONTROL 30xx measuring system is recognized by the PC. This may take a few seconds.

The system is now ready to operate the scanCONTROL 30xx measurement system with scanCONTROL Configuration Tools.

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 sensor matrix.

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

The sensor matrix used in the scanCONTROL 30xx supports the reading of a restricted measuring field.

scanCONTROL 30x0 sensors can acquire up to 10,000 profiles per second. The actual measuring speed depends on two basic factors:

1st factor. Number of rows evaluated on the sensor matrix. Following computation is valid:

$$\text{Profile rate} = \frac{1 \text{ MHz}}{\text{Round up } (33.25 + (\text{rows} + 3) * 2.6875)}$$

Number of rows	1088 rows	816 rows	544 rows	272 rows	136 rows	68 rows	34 rows
Max. frequency	337 Hz	447 Hz	664 Hz	1293 Hz	2457 Hz	4444 Hz	7518 Hz
Region of interest in High Resolution or High Dynamic Range mode (HDR)							
Region of Interest in High Speed mode							

Fig. 30 Exemplary profile frequencies LLT30x0

The number of rows evaluated on the sensor matrix is the set union of the covered rows of region of interest 1 and region of interest 2.

If the sensor is used in high-speed mode, only every second row is used for evaluation and thus the number of covered rows by the ROIs (region of interest) is divided by two.
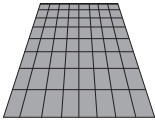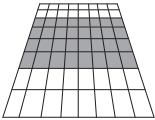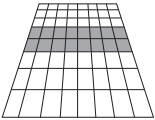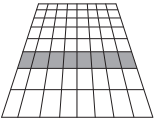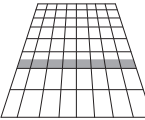
Number of rows	544 rows	272 rows	136 rows	68 rows	34 rows
Max. frequency	664 Hz	1293 Hz	2457 Hz	4444 Hz	7518 Hz
Region of Interest					

Fig. 31 Exemplary profile frequencies LLT30x2

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

2nd factor. Number of points per profile for processing. Following profile frequency limits are valid:

2048 points per profile: Max. profile frequency = 4800 Hz

1024 points per profile: Max. profile frequency = 7700 Hz

512 points per profile: Max. profile frequency = 10000 Hz

256 points per profile: Max. profile frequency = 10000 Hz

Measuring field and measuring range must be clearly differentiated in practical use. The measuring field is related to the sensor 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.

The scanCONTROL 30xx sensors have the following characteristics
- 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 2048 x 1088 pixels (LLT30x0) or 1024 x 544 pixels (LLT30x2) with the same measuring field size. The measuring field geometry is fixed.
- Reference for the distance (Z-axis) is the lowest body edge of the sensor, see 5.3.
- Use of the GigE-Vision standard. Standard GigE Vision implementation from different manufacturers can be used.

6.4.2   Calibration

The calibration of the sensor is performed using the complete sensor 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 calibration final inspection is enclosed for each sensor. Three diagrams for the linearity measurement which are briefly explained in the report are included in the calibration final inspection. The key diagram in the calibration final inspection is shown again below, see Fig. 32.

Points with deviation > 0.01 mm
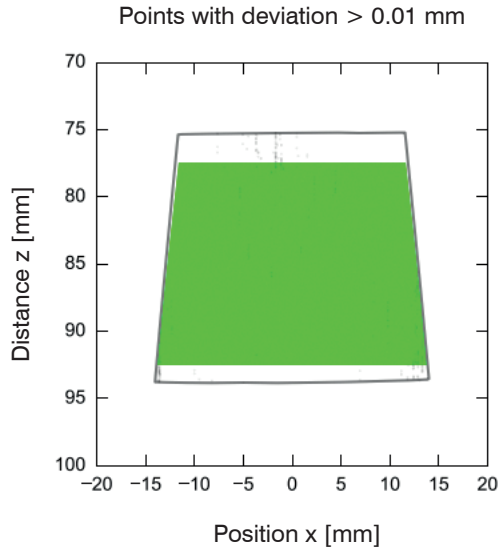
Fig. 32 Linearity deviation, example of an scanCONTROL 30xx-25

The black points show the places where the measurement error exceeds the linearity limit of 0.01 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   LLT30x0 Operating Modes

The scanCONTROL 30x0 series provides three different operating modes:

1. High Resolution | The High Resolution Mode provides the best measurement data with respect to linearity and resolution.

2. High Speed | The High Speed Mode provides high profile frequencies for profile acquisition.

3. High Dynamic Range (HDR) | The High Dynamic Range Mode provides the best measurement data for targets with heterogenous surface properties.
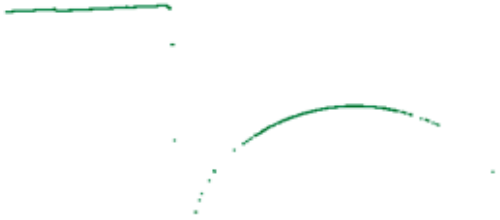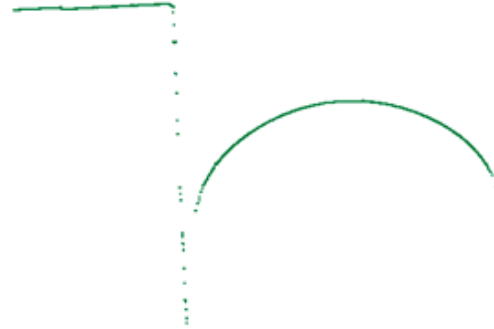

Fig. 33 Heterogenous target without HDR

Fig. 34 Heterogenous target with HDR

6.4.4   Automatic Exposure Time Regulation

The automatic exposure time (shutter time) regulation feature facilitates the profile recording of changing target surfaces. Therefore, a region of interest can be set on the sensor matrix so that the automatic exposure regulation only uses certain target areas for the determination of the optimal exposure time:
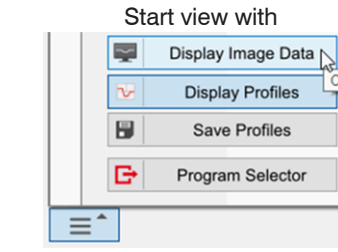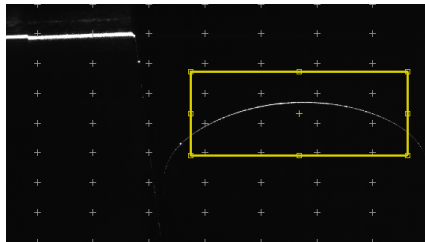

Fig. 35 Screenshot sensor matrix view: set region of interest (yellow) for automatic exposure regulation
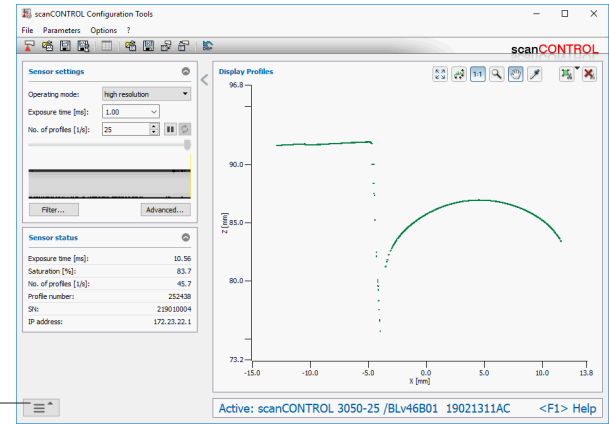

Fig. 36 Screenshot scanCONTROL Configuration Tools

The exposure time preset by the user is used as starting value for the automatic exposure regulation and it will be used as exposure time if no object is in the range. The preset exposure time has to be selected in such a way that at least some of the profile points can be acquired. These can be used as base for the regulation algorithm.

The used exposure time is limited by the profile frequency, e.g. at 100 Hz it may not exceed 10 ms, and by the set exposure time limits.

See software or SDK documentation for more information.

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 mini-mum 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 expo-sure 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 (back-ground, 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.
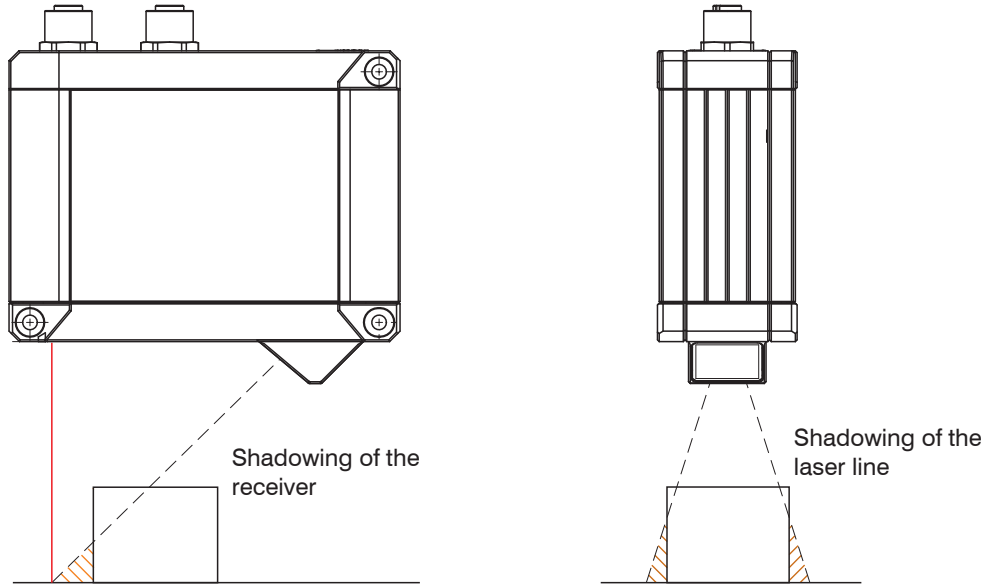
Shadowing of the receiver

Shadowing of the laser line

Fig. 37 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.

Use a dry, clean, soft, lint-free, antistatic lens cloth to clean the protective glass.

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, cleaning agents containing surfactants or other cleaning agents.

7. 2D/3D Output Unit

The measurement system scanCONTROL 30xx measures and evaluates 2D profile data of a surface and supplies analog and digital control signals. 2D/3D Output Unit

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

Setup and operation of 2D/3D Output Unit are exemplarily described below.

7.1 2D/3D 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)
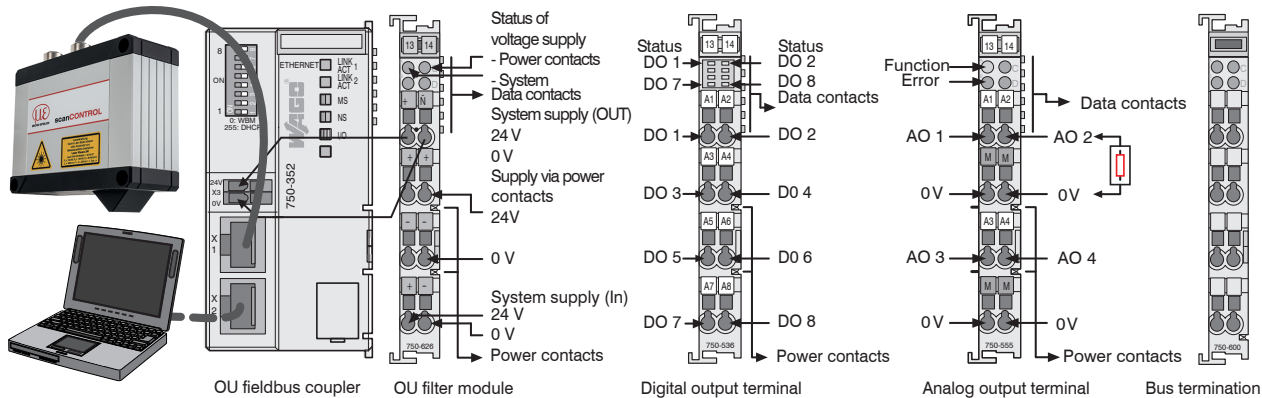- Digital output terminal
- Analog output terminal

Fig. 38 Example configuration Ethernet with analog and digital output module

➡️ Mount the components of a 2D/3D 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. 38.

For a description of the individual components of the 2D/3D Output Unit, please refer to Chap. 7.4, the respective datasheets and the manuals for scanCONTROL Configurations Tools.
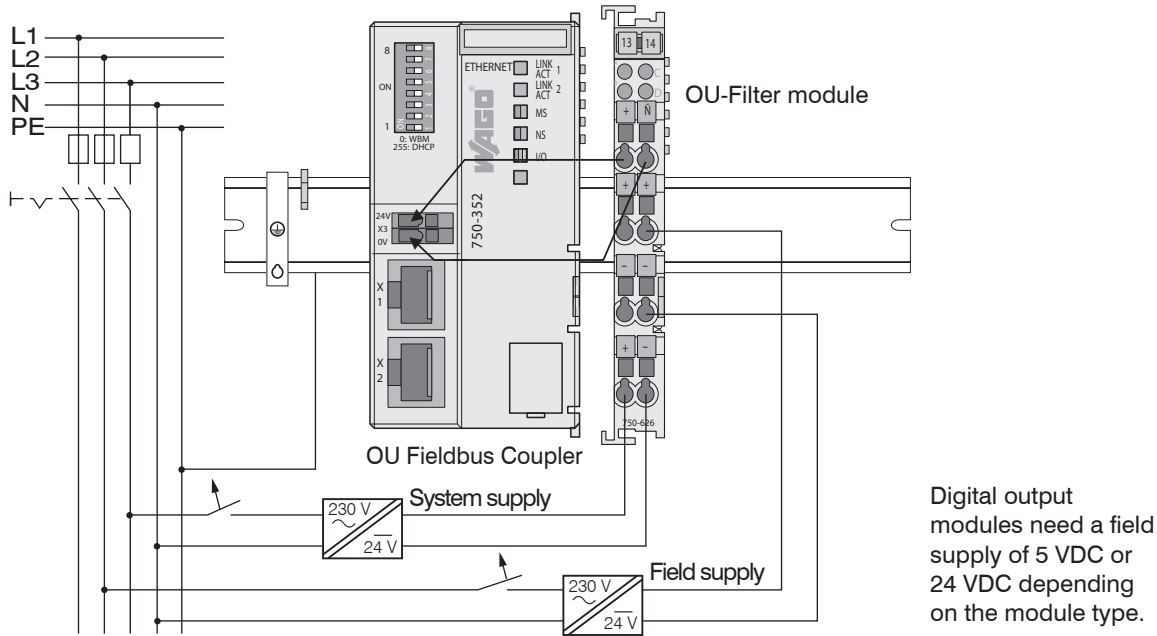
7.2   Connect the Power Supply

Fig. 39 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. 39).

▶ Connect the system supply (in) of the OU-Filter module to the power supply (0 V and 24 V, see Fig. 39).

▶ Connect the field supply (in) of the OU-Filter module to the power supply (0 V and 5 V/24 V, see Fig. 39).

ⓘ 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. Use LPS or NEC Class 2 compliant power supply units.

7.3   Commissioning 2D/3D Output Unit

After having installed the required wiring of the modules of 2D/3D 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 2D/3D 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 be output.

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.

▶ Exit scanCONTROL Configuration Tools and disconnect scanCONTROL 30xx, PC and if necessary
   2D/3D Output Unit.

▶ Connect the 2D/3D Output Unit by using the Ethernet cable.

scanCONTROL 30xx and the Output Unit operate now as an independent measurement system and the set 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 30xx 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. 40 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. 41 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 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 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 30xx supports eight digital outputs.

Fig. 42 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. 43 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 30xx supports four analog outputs.

Fig. 44 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. 45 Technical data of analog output module

8. 2D/3D Gateway

2D/3D Gateway allows for scanCONTROL SMART sensors to be integrated into various fieldbus systems:
- PROFINET
- EtherNet/IP
- EtherCAT

All measurement results obtained from the profile evaluation carried out of a scanCONTROL SMART sensor can be transmitted to a PLC via one of these fieldbus systems. Furthermore, all scanCONTROL sensor settings can be set via the 2D/3D Gateway (e. g. Laser on/off or load User Mode).
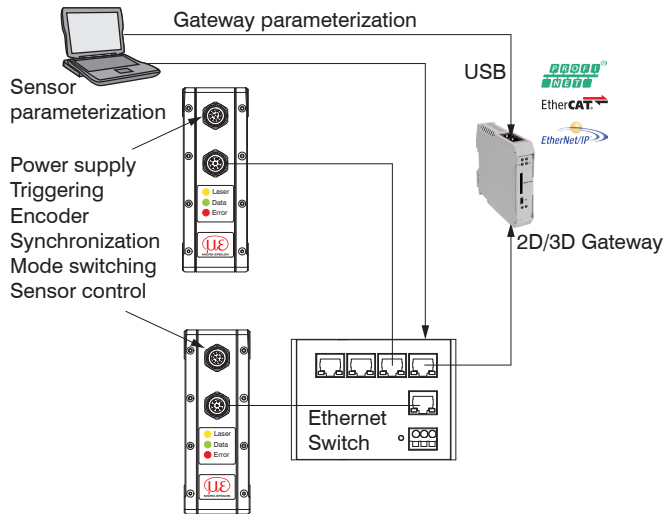

Fig. 46 Network layout for using 2D/3D Gateway

The 2D/3D Gateway can connect up to four scanCONTROL SMART sensors to the fieldbus. Measurement values are transmitted at up to 500 Hz. Please refer to the Connection Instructions for more details.

https://www.micro-epsilon.com/download/manuals/mav--2D3D-Gateway-II-scanCONTROL-PROFINET--en.pdf
https://www.micro-epsilon.com/download/manuals/mav--2D3D-Gateway-II-scanCONTROL-EtherNetIP--en.pdf
https://www.micro-epsilon.com/download/manuals/mav--2D3D-Gateway-II-scanCONTROL-EtherCAT--en.pdf

9. Disclaimer

All components of the device have been checked and tested for functionality in the factory. However, should any defects occur despite careful quality control, these shall be reported immediately to MICRO-EPSILON or to your distributor / retailer.

MICRO-EPSILON undertakes no liability whatsoever for damage, loss or costs caused by or related in any way to the product, in particular consequential damage,
e.g., due to
- non-observance of these instructions/this manual,
- improper use or improper handling (in particular due to improper installation, commissioning, operation and maintenance) of the product,
- repairs or modifications by third parties,
- the use of force or other handling by unqualified persons.

This limitation of liability also applies to defects resulting from normal wear and tear (e.g., to wearing parts) and in the event of non-compliance with the specified maintenance intervals (if applicable).

MICRO-EPSILON is exclusively responsible for repairs. It is not permitted to make unauthorized structural and / or technical modifications or alterations to the product. In the interest of further development, MICRO-EPSILON reserves the right to modify the design.

In addition, the General Terms of Business of MICRO-EPSILON shall apply, which can be accessed under Legal details | Micro-Epsilon https://www.micro-epsilon.com/legal-details/.

10. Service, Repair

If the sensor or sensor cable is defective:
- 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 affected parts for repair or exchange.

If the cause of a fault cannot be clearly identified, please send the entire measuring system to:

MICRO-EPSILON Optronic GmbH
Lessingstraße 14
01465 Dresden - Langebrück / Germany

Tel. +49 (0) 35201 / 729-0
Fax +49 (0) 35201 / 729-90
e-mail: info@micro-epsilon.com
www.micro-epsilon.com

11.   Decommissioning, Disposal

In order to avoid the release of environmentally harmful substances and to ensure the reuse of valuable raw materials, we draw your attention to the following regulations and obligations:
- Remove all cables from the sensor and/or controller.
- Dispose of the sensor and/or the controller, its components and accessories, as well as the packaging materials in compliance with the applicable country-specific waste treatment and disposal regulations of the region of use.
- You are obliged to comply with all relevant national laws and regulations.

For Germany / the EU, the following (disposal) instructions apply in particular:
- Waste equipment marked with a crossed garbage can must not be disposed of with normal industrial waste (e.g. residual waste can or the yellow recycling bin) and must be disposed of separately. This avoids hazards to the environment due to incorrect disposal and ensures proper recycling of the old appliances.
- A list of national laws and contacts in the EU member states can be found at https://ec.europa.eu/environment/topics/waste-and-recycling/waste-electrical-and-electronic-equipment-weee_en. Here you can inform yourself about the respective national collection and return points.
- Old devices can also be returned for disposal to MICRO-EPSILON at the address given in the imprint at https://www.micro-epsilon.com/legal-details/.
- We would like to point out that you are responsible for deleting the measurement-specific and personal data on the old devices to be disposed of.
- Under the registration number WEEE-Reg.-Nr. DE28605721, we are registered at the foundation Elektro-Altgeräte Register, Nordostpark 72, 90411 Nuremberg, as a manufacturer of electrical and/or electronic equipment.

12. Error Codes

(— LED `Error` lights for a long time, • LED `Error` 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.

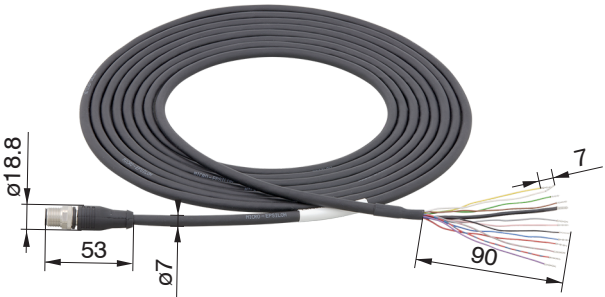| Flashing sequence	Cause	Remedy	Notes
Group: Data processing and transmission			
-- 2x long	Data overflow in the sensor	Select smaller measuring field, reduce profile frequency, select less complex measuring program.	Data can be impaired; exposure time can be longer than expected.
--. 2x long, 1x short	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 faulty.
--.. 2x long, 2x short	Data overflow for serial port RS422	Reduce profile frequency, select less complex measuring program.	Data can be faulty.

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 faulty.
--….. 2x long, 5x short	Error during calculation	Reduce profile frequency, select faster calculation mode.	Data can be faulty.
--...... 2x long, 6x short	Error during Ethernet transmission	Reduce profile frequency.	Data can be faulty.
Group: Output Unit			
--- 3x long	2D/3D Output Unit not found.	Connect the sensor with the 2D/3D Output Unit.	---
---. 3x long, 1x short	Connected modules of 2D/3D Output Unit are not supported.	Use the supported modules only, see 7.4.2.	---
---.. 3x long, 2x short	Communication error (2D/3D Output Unit)	Reduce profile frequency.	---
---... 3x long, 3x short	Output overflow (2D/3D 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 `Data` 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.

Appendix

A 1   Optional Accessories

PS2020		Power supply for DIN rail mounting, input 230 VAC, output 24 VDC/2.5 A LPS and NEC Class 2 compliant for maximum 2 sensors scanCONTROL 30xx at the same time.
PS25/26/29/30		Wall power supply, input 100-240 VAC, ~1.0 A, max 50-60 Hz, Output 24 VDC/1.0 A (24 W max) LPS and NEC Class 2 compliant

PCR3000-x		Multifunction cable, suitable for use with drag chains and robots, length x = 2, 5, 10, 15, 20, 25, 35 m, Power supply, digital inputs (TTL or HTL), RS422 (half-duplex). 12-pin M12 plug to open ends.Cable diameter: approx. 7 mm.
SCR3000A-x		Ethernet connection cable, suitable for use with drag chains and robots length x = 0.5, 2, 5, 10, 15, 20, 25, 35 m, cable 4x2x0,14; shielded, with integrally cast 8-pole M12x1 screw connector and 8-pole Ethernet cable connector RJ45
Connector/8-pin/Ethernet		Plug for the Ethernet socket, shielded, cutting-terminal connector, A-coded
Connector/12-pin/Multifunction		Plug for multifunction port, shielded, solder connection, A-coded

Protective housing (for LLT30xx-25, LLT30xx-50, LLT30xx-100, LLT30xx-200)		Protective housing for use of the scanner in dirty environments. With air purge of the optical path.
Protective cooling housing (for LLT30xx-25, LLT30xx-50, LLT30xx-100, LLT30xx-200)		Protective housing for use of the scanner in dirty environments or with increased ambient temperatures. With air purge of the optical path and water cooling circuit for sensor cooling.

2D/3D Output Unit		The 2D/3D Output Unit is addressed via Ethernet and outputs analog and digital signals. Different output terminals can be connected to the fieldbus coupler.
2D/3D Gateway		The 2D/3D Gateway communicates with the scanCONTROL SMART sensor via Ethernet Modbus. The resultant values are then converted to the PROFINET, EtherCAT or EtherNet/IP fieldbus systems. The gateway can also be parameterized in advance at the factory.

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