MICRO-EPSILON

Instruction Manual

scanCONTROL 2800/2810

LLT2800-10
LLT2810-10
LLT2800-25
LLT2810-25

LLT2800-100
LLT2810-100

MICRO-EPSILON
MESSTECHNIK
GmbH & Co. KG
Königbacher Strasse 15

94496 Ortenburg / Germany

Tel. +49 (0) 8542 / 168-0
Fax +49 (0) 8542 / 168-90
info@micro-epsilon.de
www.micro-epsilon.com

Certified acc.DIN EN ISO 9001: 2008

Contents

1. Safety

Knowledge of the operating instructions is a prerequisite for equipment operation.

1.1 Symbols Used

The following symbols are used in the 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.

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 herein may result in hazardous radiation exposure.

⚠CAUTION

The voltage supply and the display/output device must be connected according to safety regulations for electrical operating equipment.

> Injury hazard

> Damage or failure of the sensor and / or of the controller

NOTICE

Avoid impacts and shocks on the sensor and controller.

> Damage or failure of the sensor and / or of the controller

The voltage supply must not exceed specified limits.

> Damage or failure of the controller and / or of the sensor

Protect the cable from damage

> Failure of the measurement instrument

Avoid the continuous effect of splashing water on the sensor (and the controller).

> Damage or failure of the sensor and controller

Only operate sensors on controllers with the same serial number.

> Loss of the specified technical data

The controller housing may only be opened by authorized persons, see Chap. 9.

> Damage to or failure of the controller

1.3 Notes on CE Identification

The following applies to the scanCONTROL28x0 measurement system:

- 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

MICRO-EPSILON MESSTECHNIK
GmbH & Co. KG
Königbacher Straße 15
94496 Ortenburg

The measurement system is designed for use in the industrial field and fulfills the requirements according to the standards

- EN 61326-1 /2006-10 General requirements
- EN 55011 Class B /2007-11 Emitted interference
- EN 61 000-6-2 /2006-03 Immunity to interference

The measurement system fulfills the requirements when the guidelines described in the operating manual are followed during installation and operation.

1.4 Proper Use

- The scanCONTROL 28x0 measurement system has been designed for application in the industrial and laboratory fields.
- It is employed for
  - Profile measurement
  - Quality monitoring and inspection of dimensions

The measurement system may only be operated within the limits specified in the technical data, see Chap. 3.2.

It must be used such that with malfunctions or total failure of the sensor, no persons are put in danger nor machines damaged.

With safety-related applications additional precautions must be taken for safety and for the prevention of damage.

1.5 Proper Environment

- Protection class Sensor: IP 64 (applies only with sensor cable connected)
- Protection class controller: IP 50
- The level of protection does not apply to optical inputs, because when they become dirty, impairment or failure of the function results.
- Operating temperature: 0 ... 50 °C
- Storage temperature: -20 ... 70 °C
- Air humidity: 5 - 95 % (non-condensing)
- Ambient pressure: Atmospheric pressure
- EMC: According to
  - EN 61326-1 /2006-10 General requirements
  - EN 55011 Class B /2007-11 Emitted interference
  - EN 61 000-6-2 /2006-03 Immunity to interference

The protection class is limited to water (no penetrating liquids or similar).

2. Laser Safety

The scanCONTROL28x0 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 and on the controller.

When operating the scanCONTROL28x0 sensors, the relevant regulations according to EN 60825-1 (IEC 60825, Part 1 of 11/2001) and the applicable accident prevention regulations must be followed.

The housing of the scanCONTROL28x0 optical sensors must only be opened by authorized persons, see Chap. 9. For repair and service, the sensors should always be returned to the manufacturer.

2.1 Laser Class 2M

Sensors with a maximum laser power up to 15 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, that means exposure duration up to 0.25 s.

⚠ CAUTION

Do not intentionally look into the laser beam. 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, for example during adjustment. Direct viewing into the beam with optical aids, for example 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.

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

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

IEC label

Only for USA

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.

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.

2.2 Laser Class 3B

Sensors with a maximum laser power up to 50 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. 3.3.5, see Chap. 6.6.

Accordingly, the following applies:
The available laser radiation is hazardous for the eyes and usually for the skin also.

⚠ CAUTION

Do not intentionally look into the laser beam. Consciously close the eyes or turn away if the laser radiation hits the eye or the skin.

Looking directly into the laser beam is hazardous for the eyes. Also reflections on shining or mirroring surfaces can be hazardous for the eye.

Hazards to the skin through the available laser radiation is given by class 3B (IIIB) laser equipments if the values of the maximum permissible exposure are exceeded.

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.

If the sensor is on the laser output can be reduced to 15 mW with the software. Reducing the laser output to 1 mW is not possible.

Reducing the laser output from 50 mW to 15 mW with a software affects not the laser class!

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

IEC label

Only for USA

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.

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.

Beam attenuator

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

Fig. 1 scanCONTROL, beam attenuator masks aperture.

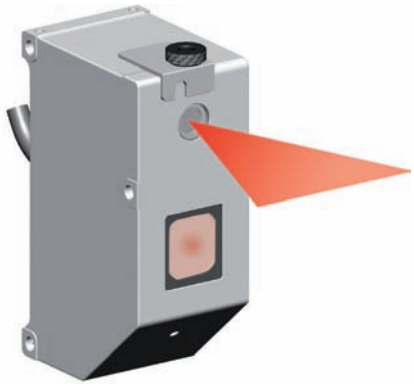


Fig. 2 scanCONTROL, beam attenuator in measuring position.

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.

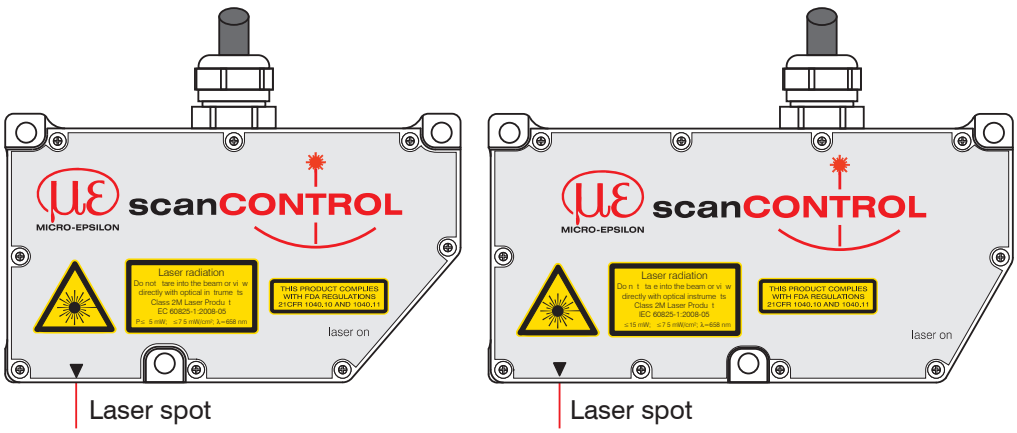


Fig. 3 True reproduction of the sensor with its actual location of the warning label

3. Functional Principle, Technical Data

3.1 Brief Description

3.1.1 Measurement Principle

The scanCONTROL28x0 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 CMOS 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.

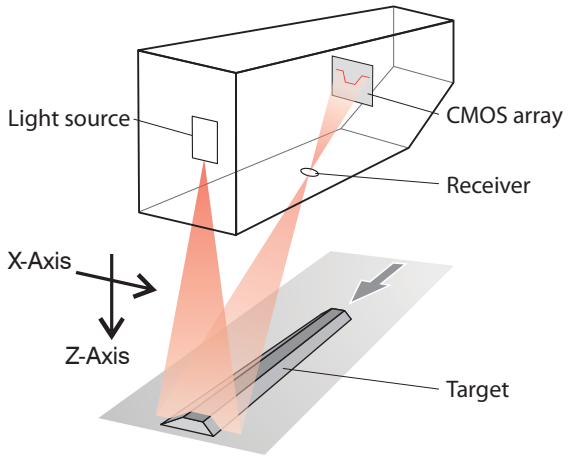


Fig. 4 Scanning a profile

Sensor and controller form one unit. For accurate measurements only use components assigned with the same serial number.

3.1.2 System Set-up

The scanCONTROL28x0 measurement system consists of a compact sensor and an intelligent controller which are connected together via an extendable connecting cable. The controller can output the measurements of the two axes or, optionally, coupled values. The user can also select from several evaluation functions (modes).

3.1.3 Special Performance Features

- scanCONTROL features speed with simultaneously high measurement accuracy. A special line-scanning optical system ensures uniform exposure of the measuring field.
- The CMOS array is arranged in the sensor head according to the Scheimpflug condition which facilitates uniform image focusing over the whole depth measurement range (z axis).
- In conjunction with saved configurations scanCONTROL 28x0 measurement system is also capable of functioning without a PC. The measurements are either output via two analog outputs (x-z profile or parameters) or can interact with a PLC via the digital inputs/outputs.

3.1.4 Advantages of the Used CMOS Array (Difference to Normal Video Matrices):

- The high resolution CMOS array has 1024 x 1024 pixels and freely selectable access to preselected areas. Consequently, the geometry of the measuring field (height Z and width X) can be varied and can be adapted to the measurement application.
- With fast moving objects a high profile accuracy is achieved for the complete profile using a global shutter (high speed shutter).
- The array enables the simultaneous exposure and reading out of the previous image. As a result, exposure can be for longer with the same profile frequency and hence also dark objects can be measured at high speed.

3.1.5 Further Features

- FireWire connection (IEEE 1394) as fast standard link to the PC
- External synchronization and triggering.
- Two serial interfaces (RS232 and RS422) for communication with PLCs or PCs
- Video output for adjustment purposes
- The automatic control of the exposure time enables consistent measurement results with changing surfaces. This function can be switched off on request.

3.2 Technical Data

Model		scanCONTROL 2800-10 / 2810-10
Standard measuring range z-axis		10 mm
	Start of measuring range	70 mm
	Midrange	75 mm
	End of measuring range	80 mm
Linearity z-axis [%] [1]		±0.3 % (3 σ)
Linearity z-axis [1]		±30 µm
Reference resolution z-axis [2] [3]		2 µm
Standard measuring range x-axis (width)	Start of measuring range	9.5 mm
	Midrange	10 mm
	End of measuring range	10.5 mm
Point distance	Midrange	appr. 10 µm
Resolution x-axis		1024 points/profile
Profile frequency		up to 4000 Hz
Measurement rate		256.000 points/sec
Light source		semiconductor laser 658 nm
Aperture angle laser line		10 °
Laser power	class 2M	7 mW
Laser off		remote input and key switch
Permissible ambient light (fluorescent light) [2]		10.000 lx
Interfaces	profile data	FireWire 1394a / RS232 / RS422
	trigger/counter	synchron IN
Signal output (scanCONTROL 2810)		RS232 / RS422
		analog
		switching signal
Display (LED)		1x power on, 1x laser on, 1x error, 1x control, 2x mode
Protection class	Sensor	IP 64
	Controller	IP 40
Vibration [4]		2 g / 20 ... 500 Hz / DIN EN 60068-2-6
Shock [4]		15 g / 6 ms / DIN EN 60068-2-29
Electromagnetic compatibility (EMC)	RFI emission	according to DIN EN 55011 / 11.2007 / Group 1, Class B and DIN EN 61326-1 / 10.2006 / Class B
	Immunity to interference	according to DIN EN 61 000-6-2 / 03.2006 and DIN EN 61326-1 / 10.2006 / Class B
Operating temperature		0 °C up to 50 °C
Storage temperature		-20 °C up to 70 °C
Cable length		up to 13 m
Weight sensor (without cable)		appr. 560 g
Weight controller		appr. 3.5 kg
Dimensions controller (LxWxH)		278 x 187 x 107 mm
Galvanic isolation		All interfaces are galvanically isolated
Supply		20-27 VDC, 500 mA

All specified data applies to metallic matt finished surfaces.

1) Standard measuring range

2) Measuring object: Micro-Epsilon standard object (metallic, diffusely reflecting material)

3) According to a one-time averaging across the measuring field (1024 points)

4) Data apply for sensor.

Model		**LLT28x0-25**	**LLT28x0-100**
Standard measurement ranges, typical values (±5 %) for extended measurement range in brackets			
Measurement range, z axis		25 (55) mm	100 (245) mm
Start of measurement range	(SMR)	62.5 (50) mm	145 (115) mm
Reference distance, midrange	(MR)	75 (82.5) mm	195 (235) mm
End of measurement range	(EMR)	87.5 (105) mm	245 (360) mm
Resolution z axis [1]	0.04 %	10 µm	40 µm
Linearity z axis (3 σ) [1]	0.2 %	50 µm	200 µm
Measurement range x axis	at SMR	13 (23) mm	30 (50) mm
	at EMR	18 (41) mm	50 (140) mm
Aperture angel of the laser line		30 °	
Resolution x axis		256 / 512 / 1024 [2], optional 64 / 128 points/profile	
Linearity x axis (3 σ) [1] 0.4 %	at SMR	60 µm	120 µm
	at EMR	80 µm	200 µm
Resolution profile parameters [3]		0.05 %	
Profile frequency (profiles/second)		up to 1000 profiles/s (optional up to 4000 profiles/s)	
Measurement rate (measuring points / s)		up to 256.000 measuring points / s	
Light source		Laser diode 658 nm, 15 mW (optional 50 mW)	
Laser class (EN 60825-1)		Class 2M (optional: 3B)	
Laser switch-off		Remote input and key switch	
Permissible extraneous light (fluorescent lamp)		10.000 lx	
Operating temperature		0 ... +50 °C	
Storage temperature		-20 ... +70 °C	
Electromagnetic compatibility (EMC)		EN 55011 Class B /2007-11 Spurious emission EN 61000-6-2 Resistance to disturbance	
Vibration (acc. to IEC 60068-2-6) [5]		2 g / 20 ... 500 Hz	
Shock (acc. to IEC 60068-2-29) [5]		15 g / 6 ms	
Sensor dimension (without cable)	LxWxH, mm	109 x 64 x 44	125 x 64 x 44
Sensor weight (without cable)		350 g	400 g
Sensor connecting cable, standard lenght		2 m	
Controller dimensions (without connectors)	LxWxH, mm	278 x 187 x 107	
Controller weight (without cable)		3.5 kg	
Output analog			
Preassigned: x and z axis, Alternatively: profile parameters [3]		± 10 V (16 Bit, to 150 kHz) R_l = 50 Ohm, I_{max} = 5 mA	
Interfaces			
Serial (measurements and control commands)		3x IEEE 1394 („FireWire“), 400 MBit/s, DCAM 1.30 Standard	
		RS232 / RS422; 115.200 Baud	
Switching signals			
Digital inputs [4]		Sync-In, Remote Laser ON/OFF, User mode, Encoder	
Digital outputs [4]		Sync-Out, error, user mode (2x)	
Power supply		24 VDC ± 15 %; 0.5 A	

All specified data applies to metallic matt finished surfaces.

1) For standard measurement range, slight displacement of the measuring field possible (depends on sensor)
2) 1024 points per profile with extended measurement range and 128,000 points/s (optional 256,000 points/s) only.
3) Only applies to values preprocessed in the controller, for example width, height, glue bead area, edge detection, groove width, angle et cetera
4) Preassigned, other functions possible, for example encoder.
5) The data apply to the sensor.

3.3 Connections

3.3.1 Analog Output

The two assigned profile signals for height (Z direction) and width (X direction) can be taken from the 4-pole connecting socket. If optional processing has been activated, profile parameters (e.g. height, width, area et cetera of a glue bead) are output on the analog output. In conjunction with saved configurations, the scanCONTROL 28x0 measurement system is also capable of functioning without a PC.

As delivered the sensor supplies 400 profiles / s for 1 ms exposure time in the standard measurement range. Other configurations can be saved.

i The analog connecting cable 3 m, “C2800-3”, is available as an optional accessory from Micro-Epsilon Messtechnik.

3.3.2 Communication

3.3.2.1 FireWire (IEEE 1394)

The FireWire port is the standard link to the PC. Three equal FireWire ports with up to 400 Mbit/s are present on the controller. The high data rate enables the cascading of a number of controllers or digital video cameras on one IEEE 1394 PC interface. In this case both line and star-shaped connection structures can be realized which must be connected free of loops. The controller does not supply any operating voltage to the 1394 connection sockets.

3.3.2.2 RS232/RS422

Programs can be loaded and measurements transferred via the RS232 or the RS422 interface. The RS232 connection on the controller can be connected to the COM interface of the PC via a commercially available 9-pole extension cable (plug - socket).

Only one of these interfaces can be active. The lower data rate permits only a lower measurement rate compared to FireWire.

3.3.3 Switching Signals

Three outputs and one input are available. All switching signals are opto-decoupled. In the standard setting they have the following functions:

- Input “Mode”: Function as for Mode button,
- Output “Error”: error is serial coded, see Chap. A 3
- Output “Mode 1” and “Mode 2”: Operating mode (in binary code).

3.3.4 Synchronous and Trigger Signals

Individual profiles (scans) can be triggered or a number of sensors synchronized together via the synchronous connection socket. Other functions are possible as options.

3.3.5 Laser Switch-off

Pins 3 and 13 on the synchronous socket are used for the external safety switch-off of the laser. A switching transistor with an open collector (for example in an optocoupler) or also a relay contact are suitable for switching.

- Laser Class 2M (IIM) sensors: The switch-off can be configured with open or connected pins (default setting).
- Laser Class 3B (IIIB) sensors: The laser is off if the pins are open. Therefore switch-off is configured with open pins 3 and 13 and cannot be changed.

3.3.6 Video Output

The video signal is only provided for adjustment and test purposes and can be activated by software (see FireWire documentation).

3.4 Operating and Display Elements

3.4.1 Key Switch

The key-operated switch interrupts the flow of current to the laser sensor for maintenance purposes. When the switch is in the “Off” position, the associated green LED goes out and the sensor plug can be withdrawn.

3.4.2 Reset Button

On pressing the Reset button a program restart is initiated in the controller, corresponding to a “power-on reset”.

3.4.3 Mode Button

The saved operating modes can be selected in a cyclic manner with the “mode” button. Also, the parameters configured by software can be permanently saved in the controller with the Mode button, see Chap. 11.

3.4.4 LED Indicators

Light emitting diodes on the controller signal:

- power on: The green “power on” LED lights when the operating voltage is applied.
- laser on: The green LED is off when the laser is off, see Chap. 3.3.5. The LED also may light, if no sensor is connected.
- error: The red error LED signalizes different error states by different blinking schemes, see Chap. A 3.
- control: Communication with PC. The green LED also blinks,
  - long during an active data transmission and
  - short for control access.
- mode 1 / 2: The yellow LEDs indicate the current operation mode

LED		Operation mode
mode 2	mode 1	
○	○	Default
○	☼	Mode 1
☼	○	Mode 2
☼	☼	Mode 3

A green light emitting diode on the sensor signals “laser on”.

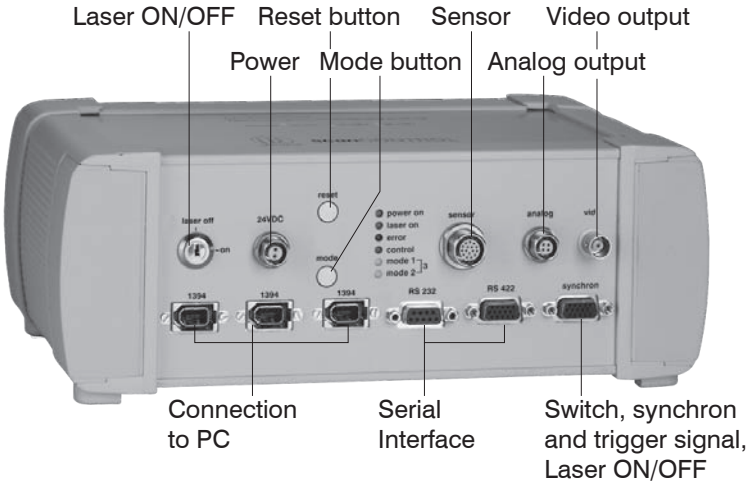


Fig. 5 Front view of the controller

4. Delivery

4.1 Unpacking:

1 sensor LLT 28x0

1 controller

1 instruction manual

1 power supply cable 3 m long “PC2800-3”

1 analog output plug, 4-pole, (ODU, Series MiniSnap L, Order no. S11L0C - T04MJGO - 7200).

1 scanCONTROL Software-CD

1 FireWire connecting cable 3 m

Fig. 6 Standard delivery of a scanCONTROL 28x0

Optional accessories:

See actual price list scanCONTROL.

Please check the shipment after unpacking for completeness and damage in transit. If items are damaged or incomplete, please contact the manufacturer or supplier.

4.2 Storage

Storage temperature: -20 to +70 °C

Air humidity: 5 - 95 % (non-condensing)

5. Mounting

5.1 Attachment and Mounting of the Sensor

The sensor can be mounted in three different ways:

1. With 3 through holes for M4 screws from the side.
2. With 3 M4 threaded holes on the front and
3. With 3 M4 threaded holes on the top (cable entry!).

The fixing dimensions can be taken from the subsequent dimensional drawings.

scanCONTROL28x0 is an optical sensor with which measurements in the µm range can be taken.

HINWEIS

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

When selecting mounting screws, pay attention to the depth of blind holes.
> Damage of the threads due to screws bottoming out.

The tightening torque should not be selected too high.

i Mount the sensor only to the existing holes on a flat surface. Clamps of any kind are not permitted.

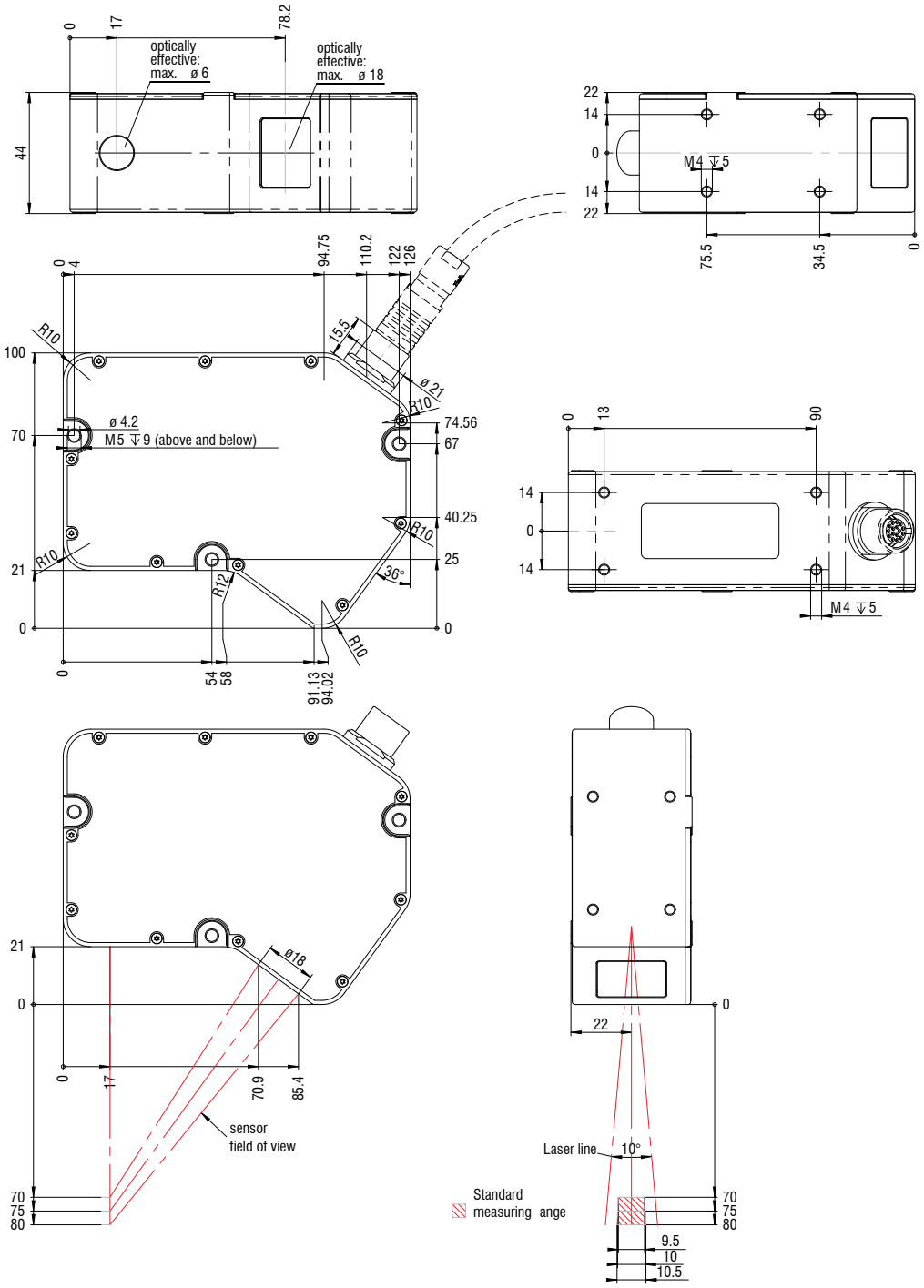


Fig. 7 Dimensional drawing LLT 28x0-10, dimensions in mm (inches)

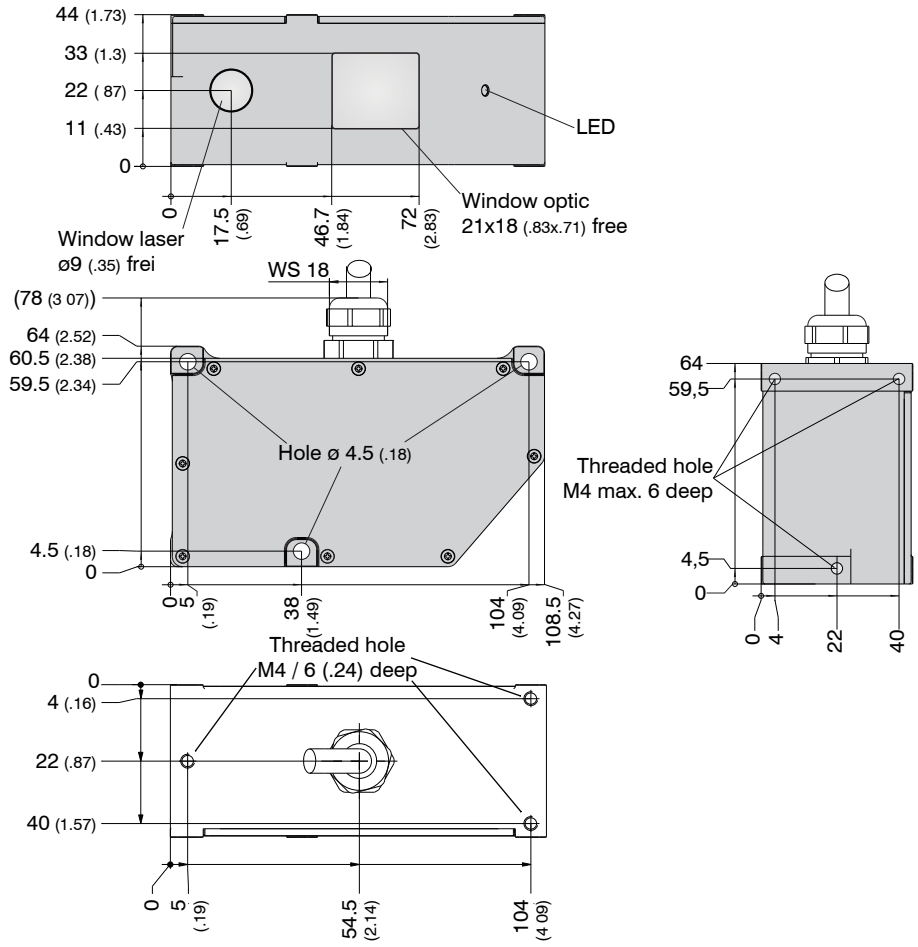


Fig. 8 Dimensional drawing LLT 28x0-25, dimensions in mm (inches), not to scale

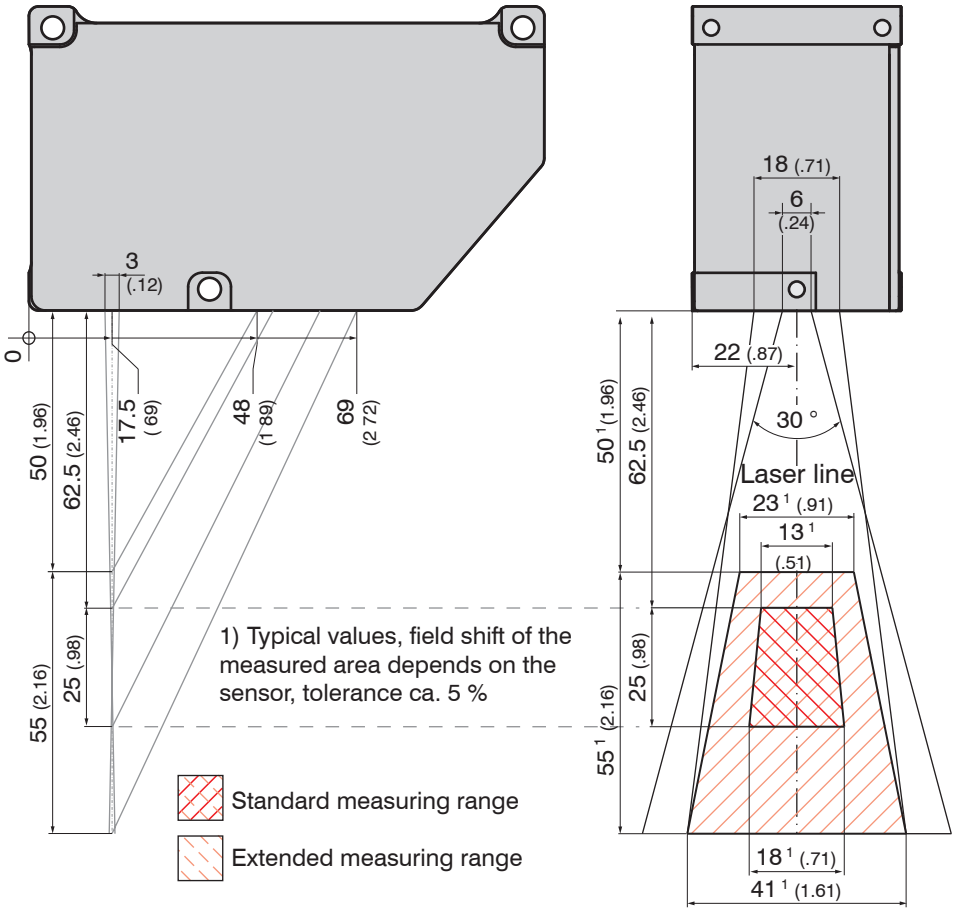


Fig. 9 Measuring field assignment LLT 28x0-25, dimensions in mm (inches), not to scale

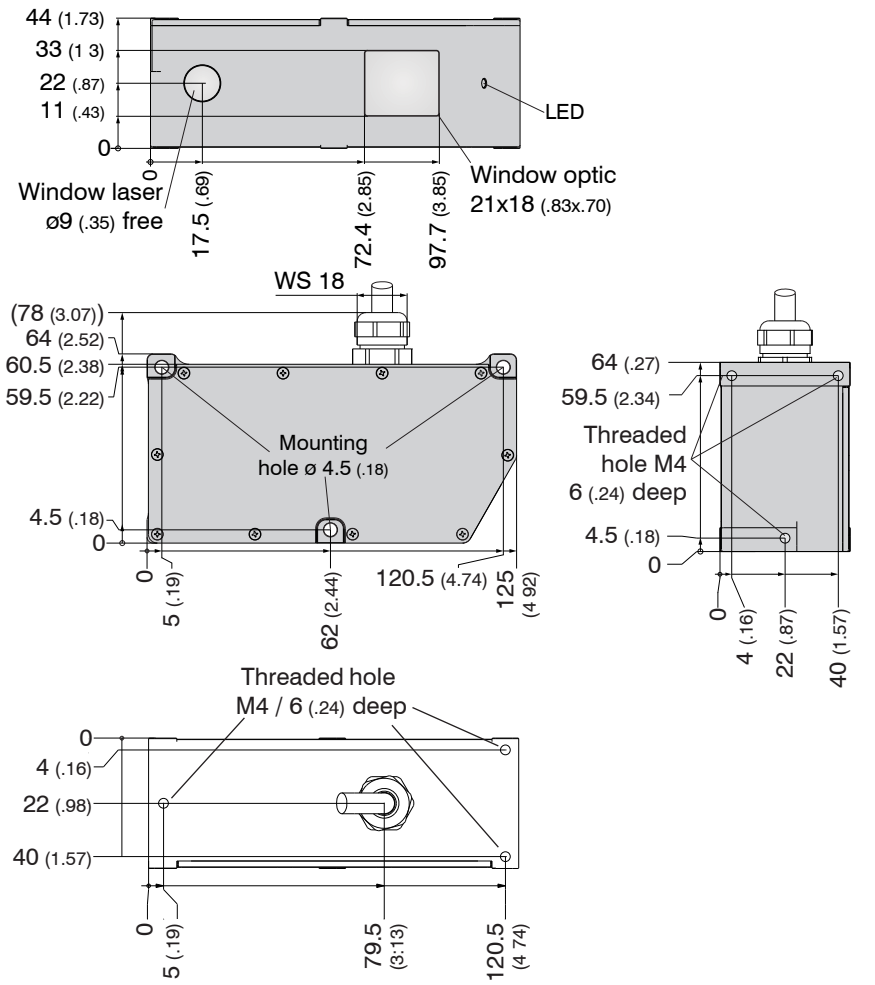


Fig. 10 Dimensional drawing LLT 28x0-100, dimensions in mm (inches), not to scale

Fig. 11 LLT 28x0-100 with mounting and threaded holes

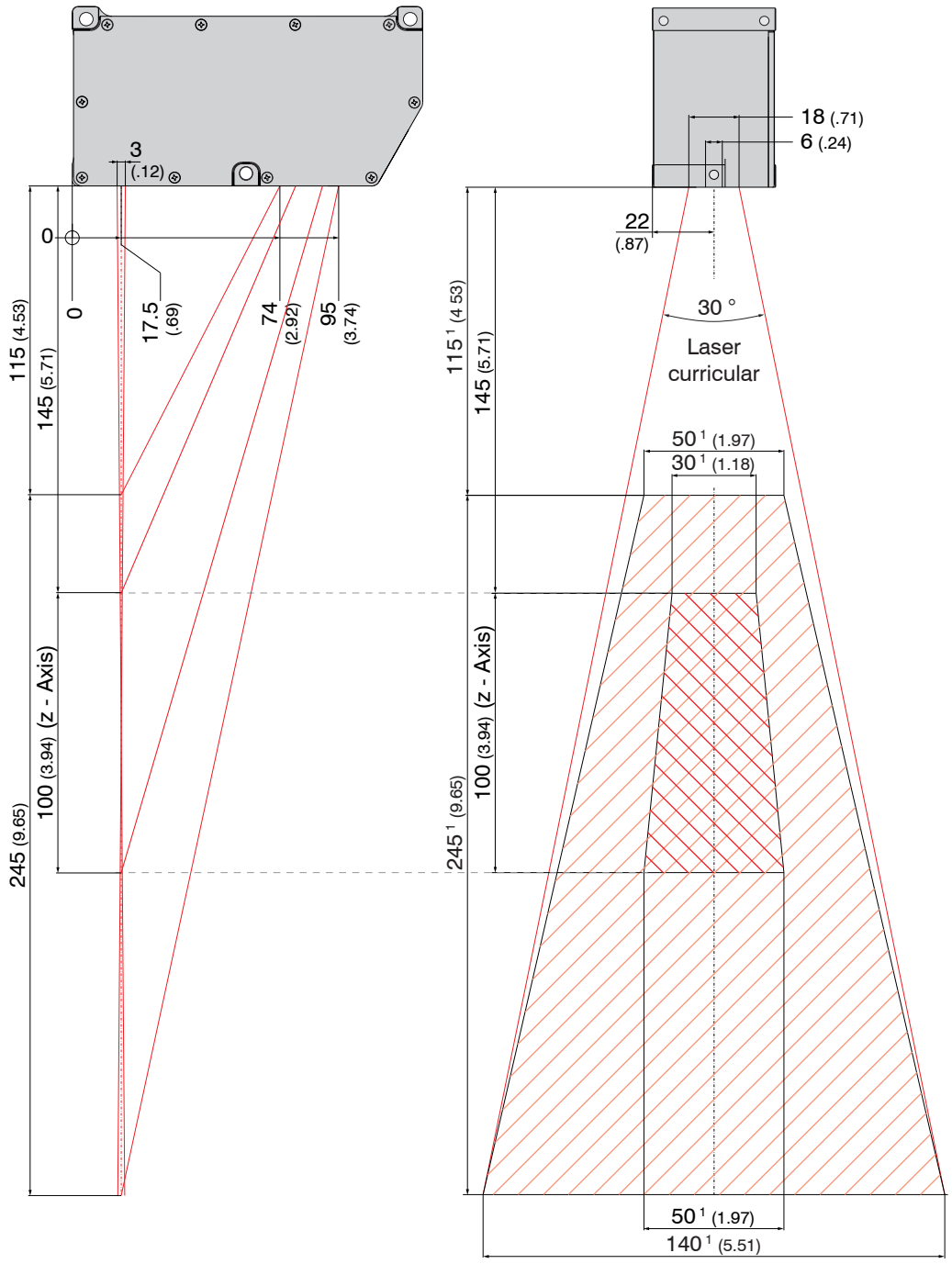


Fig. 12 Measuring field assignment LLT 28x0-100

Standard measuring range

Extended measuring range

1) Typical values, displacement of the measuring field depends on the sensor, tolerance approximately 5 %.

5.2 Attachment and Mounting of the Controller

The controller can be mounted using four M4 DIN 84 screws instead of the rubber feet, see the subsequent dimensional drawings.

- To do this, pull off the corner protection caps carefully to the side (for example with a screwdriver) and plug on again after mounting.
- Mount the controller such that the function-indicating LEDs are not hidden.

When mounting the controller particular care is needed in the routing of the cables and their strain relief.

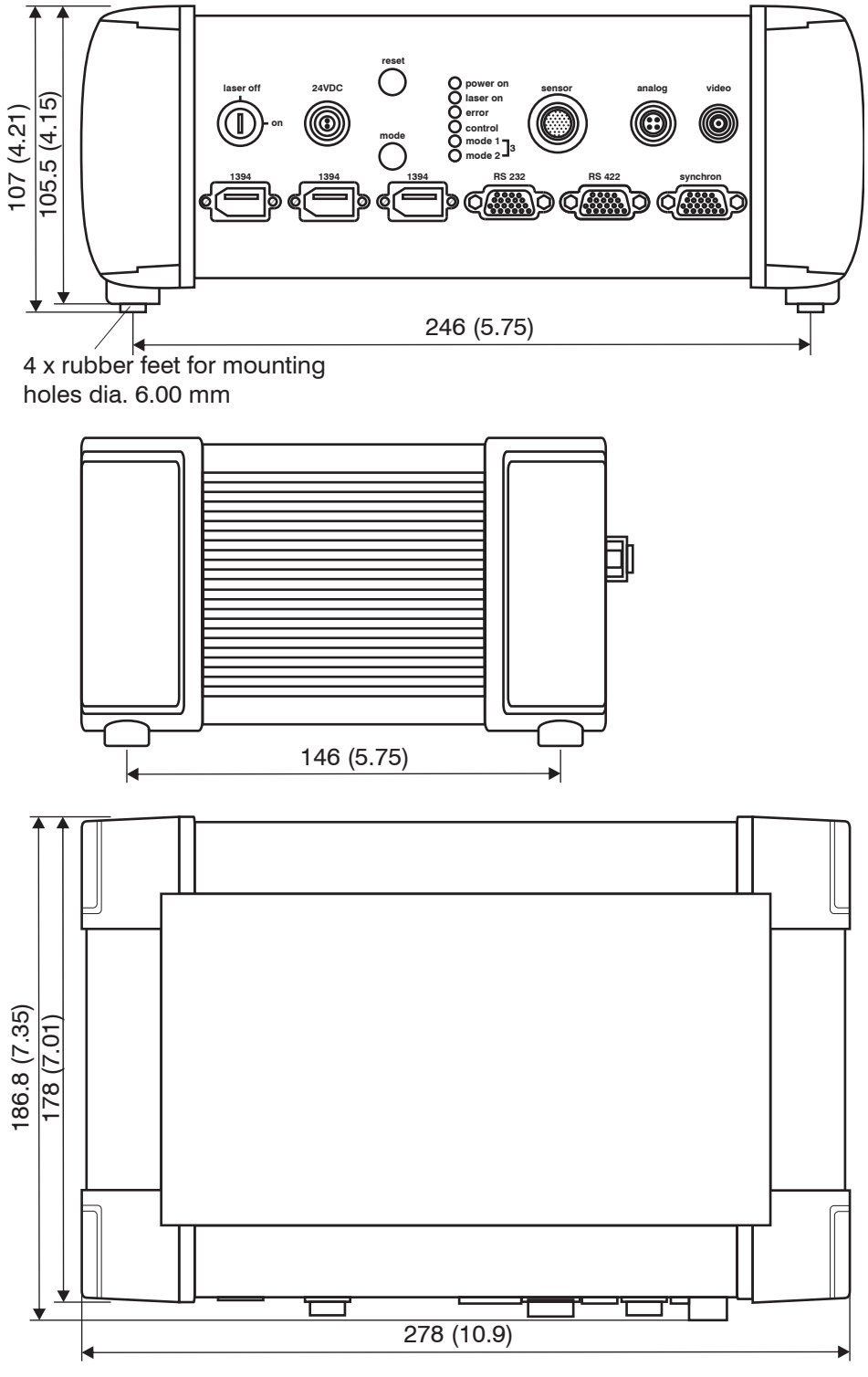


Fig. 13 Dimensional drawing controller scanCONTROL28x0

5.3 Requirements on the Cable and Cable Connection

Supply voltage:

- 24 VDC (±15 %, max. 500 mA)
- The cable shielding is connected to the connectors case.

➪ Connect the shielding of the power supply cable to the protective earth (PE).

i When employing power supply units, always use VDE-compliant and tested equipment.

Analog output:

- Recommendation: 2-way coaxial cable of type UNITRONIC LiYCY-CY 2 x 0.25. Maximum cable length 10 m.
- With longer cable lengths the effect of electromagnetic interference fields on the signal can lead to measurement uncertainties. To reduce the interference voltages a 1 nF capacitor can, if necessary, be wired in parallel to the input of the evaluation unit.
- Optionally, the analog connecting cable 3 m, „C2800-3“, can be used.
- Cable is double shielded and the outer shielding is connected to the plug enclosure.
- At the user‘s end the outer shielding should be connected to the earth conductor (PE).

Error output, synchronization:

➪ Twist the strands in the cable.

➪ Use a shielded cable. Connect the cable shielding to the connector case.

Fire-Wire Connections:

Use the recommended standard connecting cable (optional accessory).

➪ Connect the connecting cable to the PC only after concluding the driver installation, because otherwise problems can occur with the driver installation.

6. Measurement Setup and Putting into Operation

6.1 Preparing for Operation, Power Supply

➪ Mount the sensor and controller according to the mounting instructions, see Chap. 5.

➪ Connect the sensor and the controller to the sensor cable.

➪ Connect the controller to the following display or monitoring units and to the power supply.

The plugs for the operating voltage, sensor and analog outputs are fitted with a push-pull lock.

➪ Pull only on the grip section to release them.

i The sensor may only be plugged and unplugged with the power switched off, respectively with the operating voltage switched off or with the keyswitch in the „Off“ position (Laser off).

Connecting with the power supply

Pin	Assignment	Color PC2800-x (old version in ( ))	
1	Power + 24 VDC	white	(red)
2	Power-GND (0 VDC)	brown	(black or blue)
Housing	Screen	black	

Fig. 14 Pin assignment PC2800-x

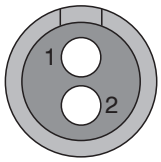


Fig. 15 View: Solder-pin side, male cable connector

i The minus pole of the supply voltage (Power GND) is electrically isolated from the system ground.

MICRO-EPSILON recommends the use of the optional available PS2010 power supply unit with snap rail mounting, input 230 VAC (115 VAC), output 24 VDC / 2.5 A.

➪ Connect the screen of the power supply cable with the safety earth conductor.

6.2 Operation of the scanCONTROL28x0 without a PC

6.2.1 Displays

➪ Once the preparations for operation are complete, switch on the external direct voltage supply (24 VDC).

The **“power on”** LED lights when the operating voltage is applied.

➪ Turn the keyswitch to “laser on”.

The “laser on” LED lights and the laser is operating.

The “error” LED indicates various error states by flashing. If a number of errors occurs simultaneously, two of them are indicated alternately. Therefore, after rectifying an error, the LED may continue to flash for some time. If no flashing occurs over a few seconds, then no error is present.

The “control” LED indicates communication with the PC and therefore does not light, see Chap. 3.4.4.

i Before putting the equipment into operation follow the information on the laser class, see Chap. 2.
Operate sensors on controllers with the same serial number only.
For accurate measurement, the sensor and controller need a warm-up period of typically 20 min.

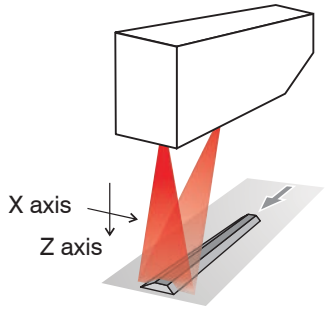
6.2.2 Analog Outputs

On both analog outputs you can now obtain the corresponding width (x) and height measurements (z) and, for example, display them as an x/y graph on an oscilloscope.

Without intervention, the sensor supplies 400 profiles / s for 1 ms exposure time in the standard measurement range (initial setting).

The analog values are only valid when the z values lie in the valid measurement range, see Fig. 16. Here, a profile may contain both valid and also invalid values. The latter occur at places where no measurement is possible, for example with partial shading, holes in the target, et cetera. In this case the error value for z is output.

The ranges 0 to 3 correspond to various spreads and offsets of the transmission curve for the analog values in mm.



Voltage range	Valid range (x, z)	Error value (z)
0	-10 ... +10 V	-10 V
1	-5 ... +5 V	-5 V
2	-10 ... 0 V	-10 V
3	0 ... +10 V	0 V

Assignment:
Analog signal 1: z
Analog signal 2: x

Standard: Range 0

Fig. 16 Valid analog value ranges and error values

Connecting the analog output

Pin	Assignment	Color C2800-x
1	GND analog signal 2	Screen 2
2	Analog signal 1 (z)	white
2	GND analog signal 1	Screen 1
4	Analog signal 2 (x)	brown

Fig. 17 Pin assignment "analog"

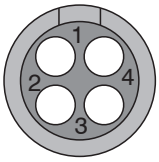


Fig. 18 View: Solder-pin side, male cable connector

MICRO-EPSILON recommends the use of the optional available C2800-x analog output cable with a length of 3 m.

Go to www.odu.de to get the assembly instructions of the MiniSnap/Series L male connector. Recommended cable: UNITRONIC LIYCY 2 x 0.25

6.2.3 Measurement Conversion for Analog Distance Values (z Values)

You obtain the z measurement (in mm from the sensor edge) according to the straight-line equation z (mm) = Ua (V) * Slope + Offset

The benchmark figures are selected such that the maximum possible measurement range fits into the voltage range. From this it follows that the standard measurement range only exploits part of the voltage range.

The reference value for z values (distance) is the sensor edge.

Type	LLT 28x0-10		LLT 28x0-25		LLT 28x0-100	
Analog range	Slope (mm/V)	Offset (Z value for 0 V)	Slope (mm/V)	Offset (Z value for 0 V)	Slope (mm/V)	Offset (Z value for 0 V)
0	1.6384	75 mm	3.2768	80 mm	16.384	250 mm
1	3.2768	75 mm	6.5536	80 mm	32.768	250 mm
2	3.2768	91 mm	6.5536	112 mm	32.768	410 mm
3	3.2768	58 mm	6.5536	46 mm	32.768	90 mm

Factory setting

Standard: Range 0

Distance z (mm)			Analog values (z values)			
MR 10	MR 25	MR 100	Range 0	Range 1	Range 2	Range 3
58.616	47.232	86.16	-10 V	-5 V	-10 V	0 V
75	80	250	0 V	-0 V	-5 V	5 V
91.384	112.768	413.84	+10 V	+5 V	0 V	10 V

Fig. 19 Benchmark values for analog measurements (z axis)

6.2.4 Measurement Conversion for Analog Transverse Coordinates (x Values)

You obtain the x measurement (in mm from the center) according to the straight-line equation

x (mm) = Ua (V) * Slope + Offset

The reference value for x values (position) is the central axis.

The slope for the x and z straight line equation is selected equal by the manufacturer to simplify the evaluation by the user. On account of the trapezoidal shape of the actual measuring field, see Fig. 9, see Fig. 12, the benchmark values of analog voltages quoted below cannot be achieved with all measuring field sizes. The values from the technical data, drawings and inspection log are the decisive values.

Type	LLT 28x0-10		LLT 28x0-25		LLT 28x0-100	
Analog range	Slope (mm/V)	Offset (x value for 0 V)	Slope (mm/V)	Offset (x value for 0 V)	Slope (mm/V)	Offset (x value for 0 V)
0	1.6384	0 mm	3.2768	0 mm	16.384	0 mm
1	3.2768	0 mm	6.5536	0 mm	32.768	0 mm
2	3.2768	16 mm	6.5536	32 mm	32.768	160 mm
3	3.2768	-16 mm	6.5536	-32 mm	32.768	-160 mm

Standard: Range 0

Position x (mm)			Analog values (x values)			
MR 10	MR 25	MR 100	Range 0	Range 1	Range 2	Range 3
-16.384	-32.768	-163.84	-10 V	-5 V	-10 V	0 V
0	0	0	0 V	-0 V	-5 V	5 V
16.384	32.768	163.84	+10 V	+5 V	0 V	10 V

Fig. 20 Benchmark values for analog measurements (x axis).

6.3 Coupling Sensors via the FireWire Interface

6.3.1 General Properties of the IEEE 1394 (FireWire) Bus System

FireWire (or the IEEE 1394 bus) is a serial bus system which can be branched as required with up to 63 devices operating together on one PC interface.

The data are transmitted in both directions (bi-directional) on symmetrical and shielded two wire lines via standard cable.

Restrictions:

- The branching must not include loops.
- A maximum of 17 devices can be cascaded in a line („daisy-chained“).
- The maximum cable length between two devices is 4.5 m.
- The maximum length of a „daisy chain“ section is 72 m.
- The data rate of 400 Mbit/s applies to the whole bus and must be shared between the connected devices. In the standard configuration up to four scanCONTROL 28x0 controllers can be operated on one bus.

i The controller does not supply any operating voltage to the 1394 connection sockets.

6.3.2 FireWire Configuration

The example illustrates the cascade wiring of two 28x0 (1 and 2) controllers and a controller (3) and a digital camera (2).

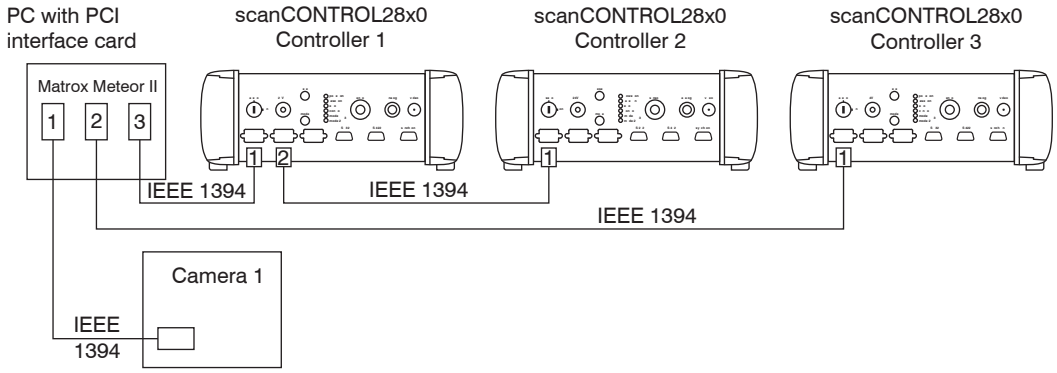


Fig. 21 Example of a FireWire configuration

To ensure “connection without loops”, the free connection of controller 3 must not be connected in addition to one of the connections of controller 1 or 2 or the PC interface card.

Devices added new are therefore most effectively added to the end of a line in order not to influence the parameterization and measurement transmission of existing sensors. We recommend the use of the FireWire standard connecting cable from the optional accessories. Further information and links can also be found in the Internet, for example under http://www.vxm.com/21R.49.html, or via a search engine under “FireWire” or “Fire Wire”. Micro-Epsilon cannot give any guarantee for the content and property rights of the sources quoted.

FireWire Connection Sockets

Three fully equivalent 6-pole connection sockets are provided with connection assignment according to the 1394-1995 specification. The controller does not supply any operating voltage to the 1394 connection sockets. The use of the standard connection cable from the accessories is recommended. The IEEE 1394 (FireWire) interfaces are electrically isolated from the rest of the circuit.

Pin	Signal
1	NC
2	NC
3	/TPB
4	TPB
5	/TPA
6	TPA

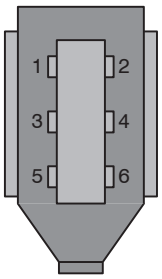


Fig. 22 FireWire connection socket

6.3.3 DCAM-Standard

- IEEE 1394 is the lowest protocol level during communication.
- DCAM 1.30 is the higher protocol level, particularly for digital cameras.
- Standard digital video camera drivers according to DCAM 1.30 from various manufacturers (for example Matrox) can be used.
- The scanCONTROL28x0 uses the DCAM standard, but with rededication of the parameters:
  - Camera parameters into triangulation parameters
  - Image into profile

An English description of the DCAM Standard 1.3 (IIDC_Spec_v1_30.pdf) can be obtained in the Internet at http://www.1394ta.org/.

Further details can be found in the internal specification “FireWire”.

6.4 Output Circuit of the Error and Mode Outputs

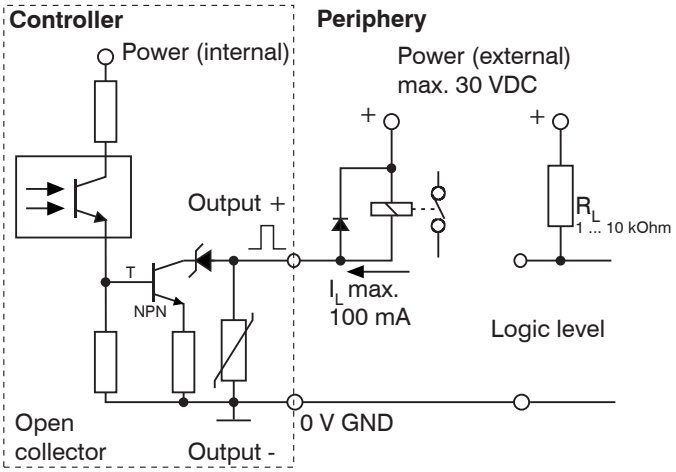


Fig. 23 Output circuit of the error and mode outputs

Type	Output		
	Mode 1	Mode 2	Error
	Port 1	Port 2	Port 3
	Output 1	Output 2	Output 3
Out+	15	10	14
Out-	5	4	9

Mode	Output Mode 1	Output Mode 2
Factory setting	open	open
1	closed	open
2	open	closed
3	closed	closed

States on the error output
No error: T open
Error: T closed

Fig. 24 Switching states on the mode output

Attributes:

- Open collector outputs, short circuit and reverse-polarity protected up to 30 VDC,
- The resistance in the conducting state is 15 Ohm or less at I_L = 100 mA.

External circuit:

Connect load (for example relay) between external auxiliary power (for example power supply +24 VDC) and the output+. Connect the negative pole of the auxiliary power with the negative pole of the power supply (does not apply with use of the power supply).

Remarks:

- The connections 2, 3, 4, 5 and 9 on the “Synchron” socket are electrically connected to the minuspole (Power-GND) of the 24 VDC supply voltage.
- The connections GND Sync-out, GND RS232, GND Video, GND Analog Signal 1 and GND Analog Signal 2 are electrically connected to the system ground.
- The minus pole of the supply voltage (Power-GND) is electrically isolated from the system ground.

Pin	Assignment	Remark	Function
1	Sync in +	Optocouppler	
7	Sync in -	Optocouppler	
11	Sync out		
6	GND Sync out	System ground	
13	Laser on/off +	Optocouppler	
3	Laser on/off -	Optocouppler	
8	Input +	Optocouppler	Mode
2	Input -	Optocouppler	Mode
15	Output +	Opto decoupled	Mode 1
5	Output -	Opto decoupled	Mode 1
10	Output +	Opto decoupled	Mode 2
4	Output -	Opto decoupled	Mode 2
14	Output +	Opto decoupled	Error
9	Output -	Opto decoupled	Error
12	n.c.		

Fig. 27 Pin assignment „Synchron“ socket

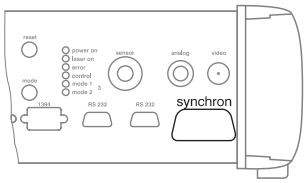


Fig. 25 Synchron connector on the controller

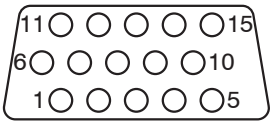


Fig. 26 15-pole HD subminiature connector, view on solder pin side male cable connector

6.5 Synchronization and Triggering

Using the “Sync in” input, the scanCONTROL measurement system can be triggered remotely from other devices as well as within the system. If the controller has been programmed to “external”, the measurement is started with a trigger edge. The controller then carries out a measurement with the preselected exposure time and waits for the next trigger pulse. The interval between trigger pulses must not fall below the reciprocal value of the profile frequency.

To synchronize a number of controllers to one another, connect the output Sync out of Controller 1 with the correct polarity to the input Sync in of Controller 2. The connecting cable should preferably be a shielded two-wire line, whereby the cable screen should be connected to the plug case. As Master, Controller 1 then synchronizes Controller 2. To do this, Controller 1 must be programmed to “internal” and all others to “external”.

i All synchronization inputs are electrically isolated by optocouplers. Shielded cables must be used for the synchronization.

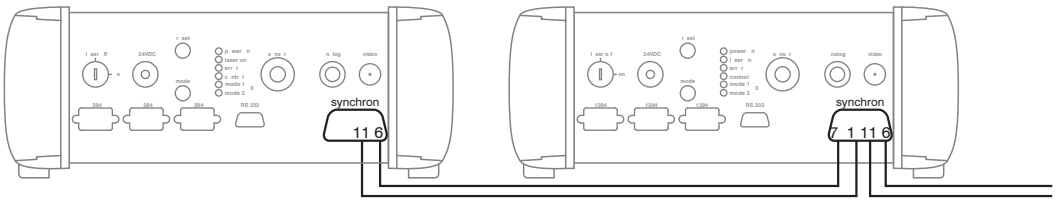


Fig. 28 Synchronizing the scanCONTROL28x0

Sync out + 11
GND 6
Sync in + 1
Sync in - 7

The output and input circuits are described in the following figures.

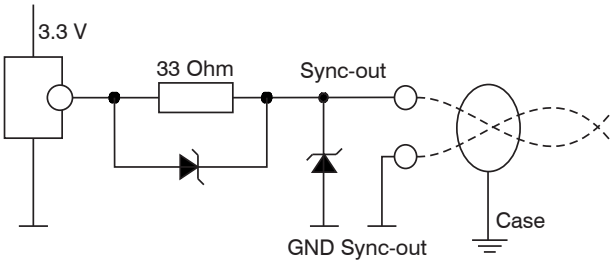
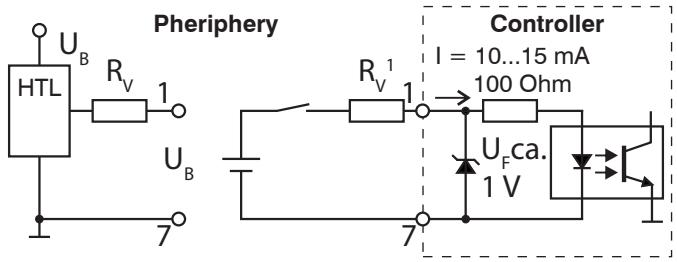


Fig. 29 Synchronization output circuit



1) Resistor RV, is used in combination with a trigger input only.

Fig. 30 Synchronization input circuit

Wiring with R_V

$$R_V = \frac{U_B - 1\ V}{I_E} - 100\ Ohm$$

HTL = High voltage transistor logic

The optocoupler at the sync input needs a current of 10 to 15 mA for operation.

Do not exceed this current value with external trigger sources.

6.6 Laser Switch-off, Mode and Encoder Inputs

The two available digital inputs with the same input circuit are configured in the standard version as “laser on/off” and “mode” inputs. They can be directly controlled by open collector transistor inputs or relay contacts. The power supply + 24 VDC is internally connected as an auxiliary power supply, see Fig. 31.

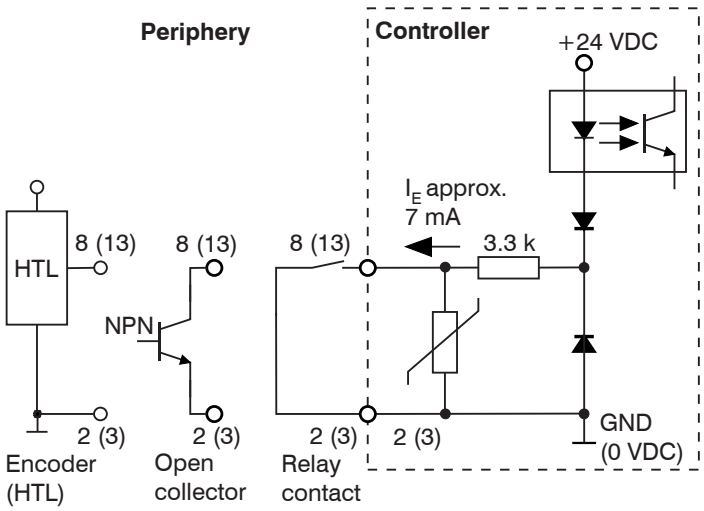
For all Class 2M (IIM) sensors the “laser on / off” input can be programmed from “normally open” (NO, not connected) to “normal closed” (NC, connected).

For Class 3B (IIIB) sensors the laser is off if the connections are open.

The laser is only switched on even if the key switch is set to “On“ position, see Chap. 3.4.1.

i Standard setting:
Laser Class 2M/IIM (15 mW): the laser operates (ON) with no connection between the pins 13 and 3.
Laser Class 3B/IIIB (50 mW); Laser operates (ON) with connection between the pins 13 and 3 only.

The mode input reacts like the identically named button and switches cyclically between the various user modes. In the optional operation mode with encoder input the function “mode” is not available.



- Use shielded two-wire cables for connection to a higher level controller, as for the synchronization.
- Connect the cable shield here to the plug case.

Fig. 31 Input circuit of the laser ON/OFF and mode inputs.

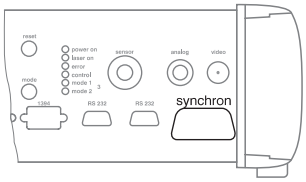


Fig. 32 Synchron connector on the controller

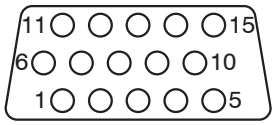


Fig. 33 15-pole HD subminiature connector. view on solder pin side male cable connector

6.7 Analog Outputs

Both analog outputs (x and z) have the same internal circuit.

Attributes:

Output impedance: 50 Ohm
Output current: max. 5 mA, no short circuit protection

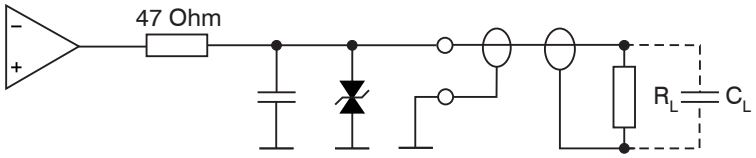


Fig. 34 Output circuit of the analog outputs

Recommendations:

➡ Select the load resistor R_L as high as possible for maximal accuracy.

A resistance of R_L = 50 kOhm results in a scaling error of 0.1 %.

- The load capacitor C_L can typically be 4.7 nF (ceramic capacitor) for noise reduction. Pay attention on the cable capacity regarding the high frequency limit (detail accuracy).
- Connect external devices with two shielded coaxial cables, whose shields provide signal ground and must therefore not be connected to the plug case or the power ground (0 VDC).

6.8 Video Output

Output impedance: 75 Ohm
Terminating resistor: 75 Ohm

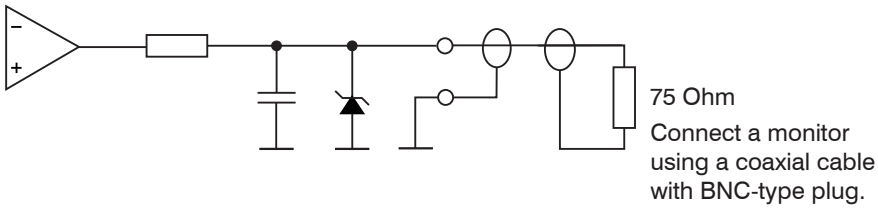


Fig. 35 Video output circuit

i Video output for test only. It must be activated by software for use.

7. Serial Interface

The scanCONTROL sensor is equipped with two digital interfaces (RS232 and RS422/485) via which communication can take place with the sensor from a normal PC. The interfaces cannot be used simultaneously. The data transfer takes place in plain text using ASCII characters. The exact documentation of the communication protocols can be found on CD.

7.1 RS232

The RS232 module uses the RS232 standard (EIA/TIA-232-E or EIA/TIA-694) for the serial communication.

Parameters	Bit rate:	115.2 kBaud
	Data format:	8 data bits, no parity, one start bit, 2 stop bits
	Max. cable length:	3 m

7.2 RS422/485

This interface is not capable of bus operation.

Parameters	Bit rate:	115.2 kBaud
	Data format:	8 data bits, no parity, 2 stop bits
	Max. cable length:	10 m

7.3 Pin Assignment

Pin	RS232
1	
2	TRS232
3	RRS232
4	
5	GND

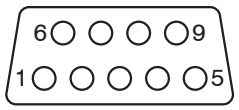


Fig. 36 9-pole HD subminiature connector, RS232, view on solder pin side male cable connector

Pin	RS422
1	/RRS422
2	RRS422
3	TRS422
4	/TRS422
5	

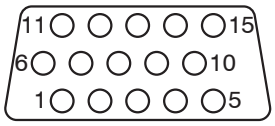


Fig. 37 15-pole HD subminiature, RS422, view on solder pin side male cable connector

7.4 Digital Measurement Output

Value range	1	...	65535	16 bit
	z =0		invalid	(error)

Computation of the measurement in mm from the digital value (numerical value):

scanCONTROL28x0-10:
z (mm) = (numerical value - 32768) * 0.0005 mm + 75 mm
x (mm) = (numerical value - 32768) * 0.0005 mm

scanCONTROL28x0-100:
z (mm) = (numerical value - 32768) * 0.005 mm + 250 mm
x (mm) = (numerical value - 32768) * 0.005 mm

scanCONTROL28x0-25:
z (mm) = (numerical value - 32768) * 0.001 mm + 80 mm
x (mm) = (numerical value - 32768) * 0.001 mm

For z values the reference point is the sensor edge and for x values the center line.

8. Information of Operation

8.1 Measuring Rate

The maximum point measuring frequency of the overall system is 250 kHz. A profile consists of a number of measuring points. Consequently, the number of measured profiles per second is simply the point measuring frequency divided by the number of measuring points per profile.

Measuring points per profile	Maximum Profile frequency in Hz
64	4000
128	2000
256	up to 1000
512	up to 500
1024	100 (optionally up to 250)

Fig. 38 Realized number of measuring points and profile frequency

As standard 256 measuring points are output per profile.

8.2 Automatic Control of the Exposure Time

The automatic control of the shutter time enables profile scanning with optimum exposure. It uses the information about the saturation of each point.

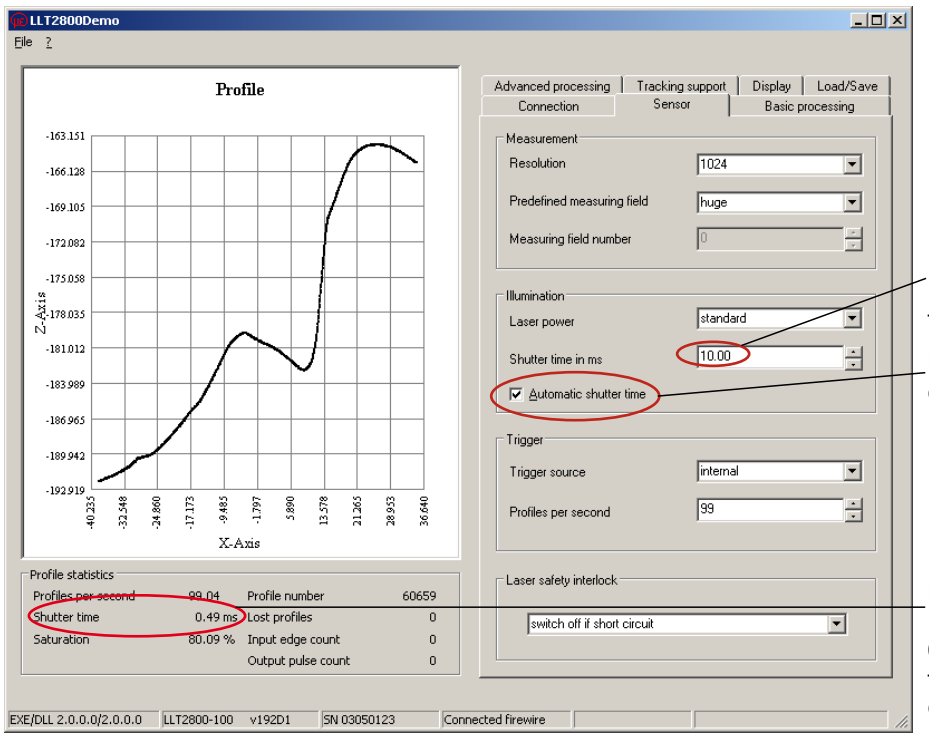


Fig. 39 Demonstration program with exposure control

The time preset of the user is used as initial value for the automatic regulation. It should be so largely selected that in the darkest place of the profile still valid measurements are available. Therefore one of the attached demo programs can be used.

If there is no target in the measuring range the “Shutter time” saved in the shutter register of the sensor is used for the exposure time. This value has to ensure a proof detection of a dark target too.

If the target is extreme dark or has a high contrast MICRO-EPSILON recommends a prior test. The various demonstration programs are suited for adjustment and test of the exposure time. Operate with different exposure times and watch on the effect in the charts.

The current exposure time can be calculated from the time stamp of the target profile values. The demonstration program, see Fig. 39, shows the current exposure time in the status line.

This function can be switched off on request.

8.3 Measuring Field Selection and Calibration

8.3.1 Measuring Field

The optical structure of the sensor is designed according to the so-called “Scheimpflug condition” which ensures optimum imaging over the complete measurement range.

Here, the measurement range is formed on a square matrix. The distortions which arise are illustrated in the following figures. The useful measurement range is always trapezoidal.

The maximum x values assigned to the z coordinates are entered as follows, see Fig. 43, see Fig. 44 et seq..

Take more precise values from the sensor inspection log for your sensor.

The upper edge corresponds to the start of the measurement range and the lower edge the end of the measurement range. The corners of the read-out image field are located on a grid with a pitch of 128 pixels. A change of image field is only possible on this pitch of 128 x 128 pixels.

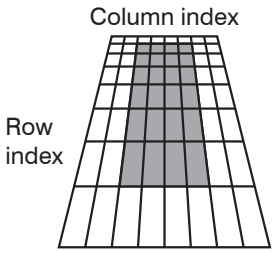


Fig. 40 Measuring field “50“

The high resolution CMOS imaging matrix has 1024 x 1024 pixels and freely selectable access to predefined areas. Consequently, the geometry of the measuring field (height Z and width X) can be varied and can be adapted to the measurement application. The measuring field size is determined in the controller by the measuring field register.

Example: The standard measurement range is located in the center:
Image field (Z x X) 768 x 512 pixels.
The measuring field value is determined by addition of the row and column index, see Fig. 40, see Chap. A 2.
Measuring field = 48 + 2 = 50.
The associated measuring fields are grey illustrated.

Other measuring fields and therefore measurement ranges are possible depending on the set measuring field parameter. The possible measuring field values with the associated measuring fields are illustrated, see Chap. A 2.

Examples:

With a measuring field value of zero the complete matrix is evaluated and with a measuring field value of “95” only an image field of 256 x 256 pixels in the center is evaluated.

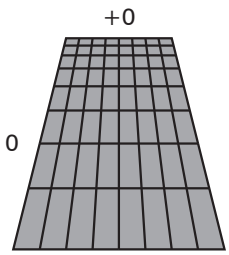


Fig. 41 Measuring field “0“

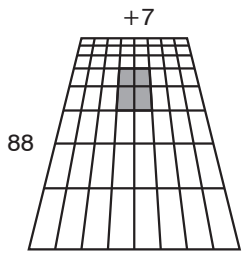
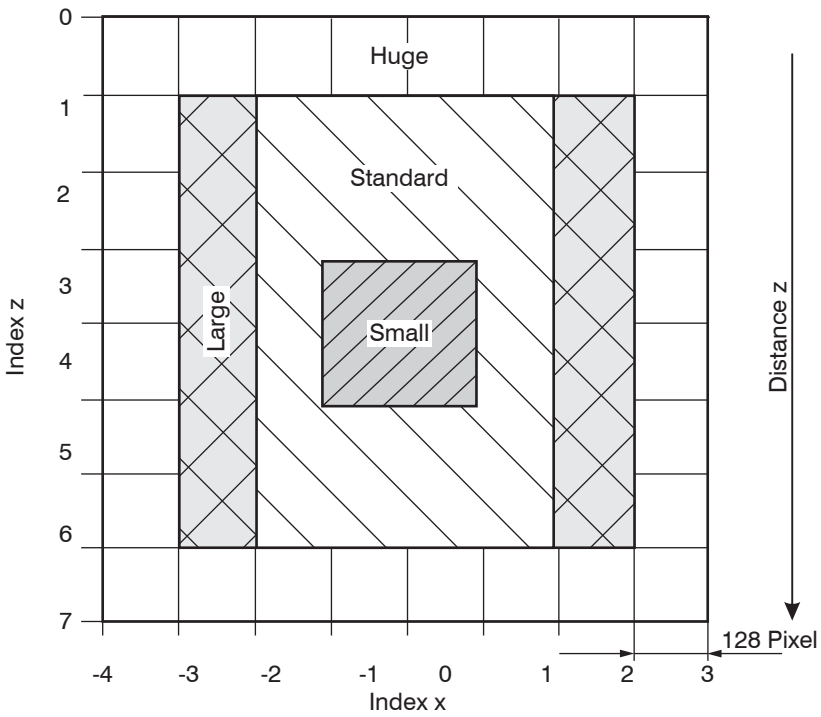


Fig. 42 Measuring field “95“



The terms “small”, “standard” and “huge” are taken from the programs.

Demo software	Measuring field	Number of pixels
“Small“	95 (88 +7)	256 x 256
“Standard“	50 (48 +2)	768 x 512
“Large“	18 (16 +2)	768 x 768
“Huge“	0	1024 x 1024

Fig. 43 Measuring field on the CMOS-Matrix

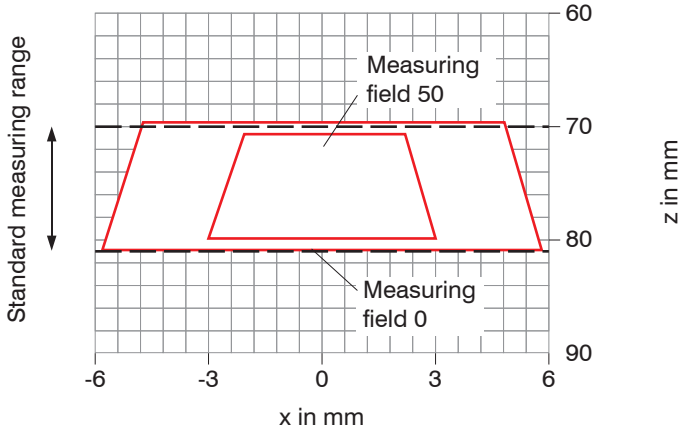


Fig. 44 Image of the CMOS matrix in the measuring space illustrated with LLT 2800-10

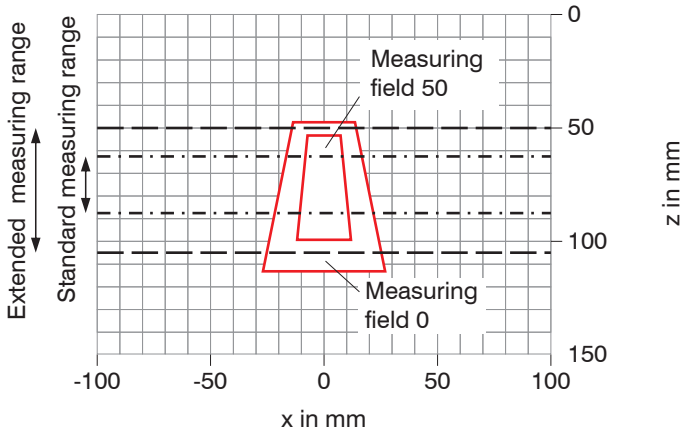


Fig. 45 Image of the CMOS matrix in the measuring space illustrated with LLT 2800-25

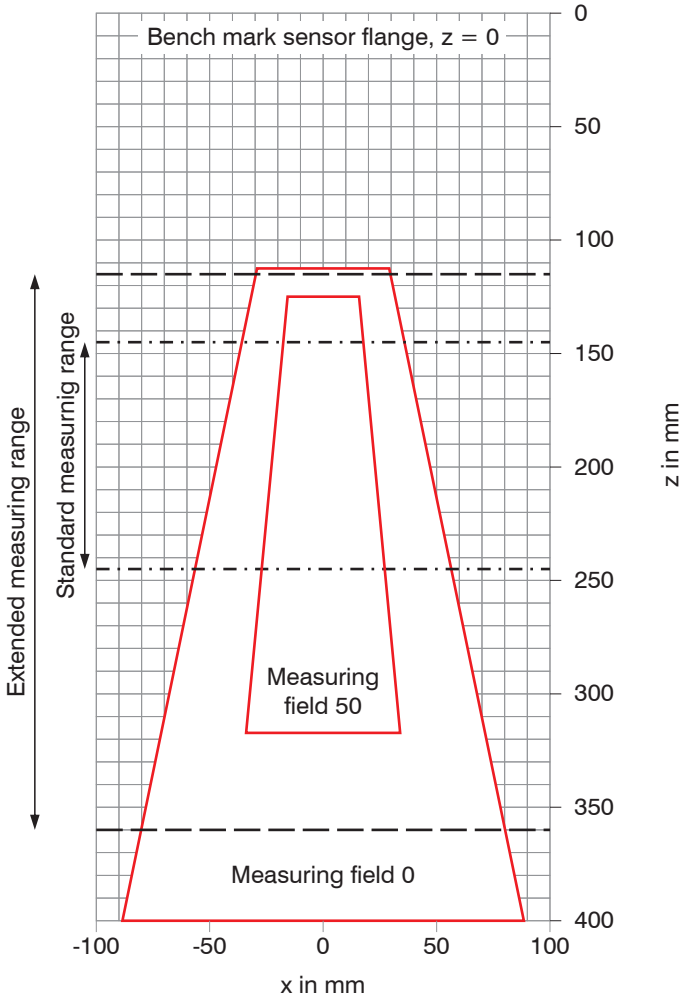


Fig. 46 Image of the CMOS matrix in the measuring space illustrated with LLT 2800-100

A slight displacement of the measuring field is possible and depends on the sensor. The actual measuring field size is noted in the sensor inspection log, see Chap. A 4.

8.3.2 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. 47.

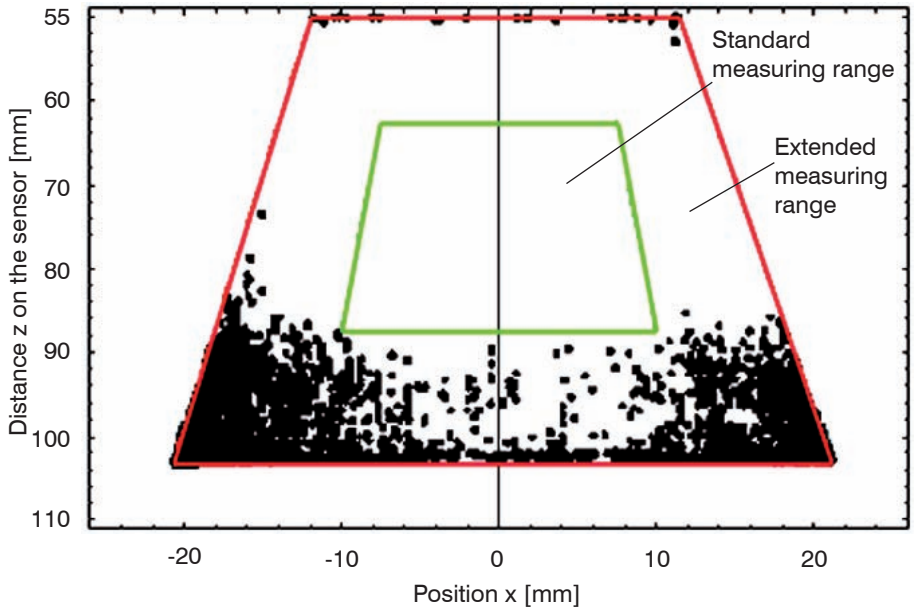


Fig. 47 Linearity deviation of an LLT2800-25

The black points show the places where the measurement error exceeds the linearity limit of 0.05 mm.

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.

i Do not select the measuring field too deep (z) in the extended measurement range!

8.4 Error Effects

8.4.1 Degree of Reflection on the Target Surface

Basically, the sensor evaluates the diffuse portion of the reflections of the point of laser light. Any statement about a minimum degree of reflection is only possible with restriction.

A preliminary examination is needed for application of the sensor on transparent or mirrored targets. The method of direct reflection on mirrored surfaces, as applied successfully during point triangulation, cannot be used with line triangulation due to the fan shape of the laser lines (central projection). Here, only a narrow region near the center would reach the receiver objective lens. In addition, since with profile measurement usually curved surfaces are to be measured, this region is narrowed even further.

8.4.2 Color Differences

Color differences on targets have an effect. Often however, these color differences are also associated with different penetration depths of the laser light into the material.

Different penetration depths lead in turn to apparent changes in the line intensity.

Consequently, changes of color, associated with changes in the penetration depth, can lead to measurement uncertainties.

Since the exposure parameters can only be changed overall for a profile, careful matching of the exposure to the target surface is recommended.

8.4.3 Temperature Effects

During initial operation, a warm-up time of at least 20 minutes is required in order to achieve a constant spread of temperature in the sensor.

If measurements are being taken in the µm accuracy range, the effect of temperature variations on the sensor mounting must be taken into account by the user. Fast temperature changes are only acquired with delay due to the damping effect of the sensor‘s thermal capacity.

8.4.4 Extraneous Light

An interference filter is provided in the sensor for the suppression of extraneous light, together with an adjustable detection threshold in the controller.

Generally, screening of extraneous light shining directly onto the target or reflecting into the sensor must be ensured by guard walls, et cetera. In addition, the application of the higher laser power of 15 mW (Laser Class 2M) is recommended, for which however no extra laser safety measures need to be taken.

Pay particular attention to undesired reflections of the laser line outside of the target area (background, target holder, etc.), which can be reflected back into the receiver‘s line of sight.

For all objects outside of the measurement range (target holder, transport equipment, grippers, et cetera), matt black surface coatings are recommended.

8.4.5 Mechanical Vibrations

If high resolution in the µm range is to be obtained with the sensor, special attention must be paid to the stable and vibration-damped mounting of the sensor and target.

8.4.6 Surface Roughness

Surface roughness in the order of magnitude of 5 µm and above leads to “surface noise” due to interference of the laser light. In addition, direct reflections of the laser light on very fine grooves (e.g. grinding marks on the surface) can also occur, particularly if they run in the direction of the lines. This can lead to erroneous measurements.

A remedy by matching the exposure, see Chap. 8.4.2 or the selection of a different evaluation method, see Chap. 11., is probably.

8.4.7 Shadows

Laser line:

The fan shape of the laser line inevitably leads to partial shading of vertical edges. To render these regions visible, only changing the position of the sensor or target provides a remedy.

Receiver:

The laser line may disappear completely or partially behind steep edges. The receiver then does not “see” these areas.

Generally, targets with steep edges cannot be acquired one hundred percent with laser triangulation. The missing areas can only be supplemented or interpolated with suitable software.

Impinge the laser beam on the target surface perpendicularly, otherwise measurement uncertainties cannot be eliminated.

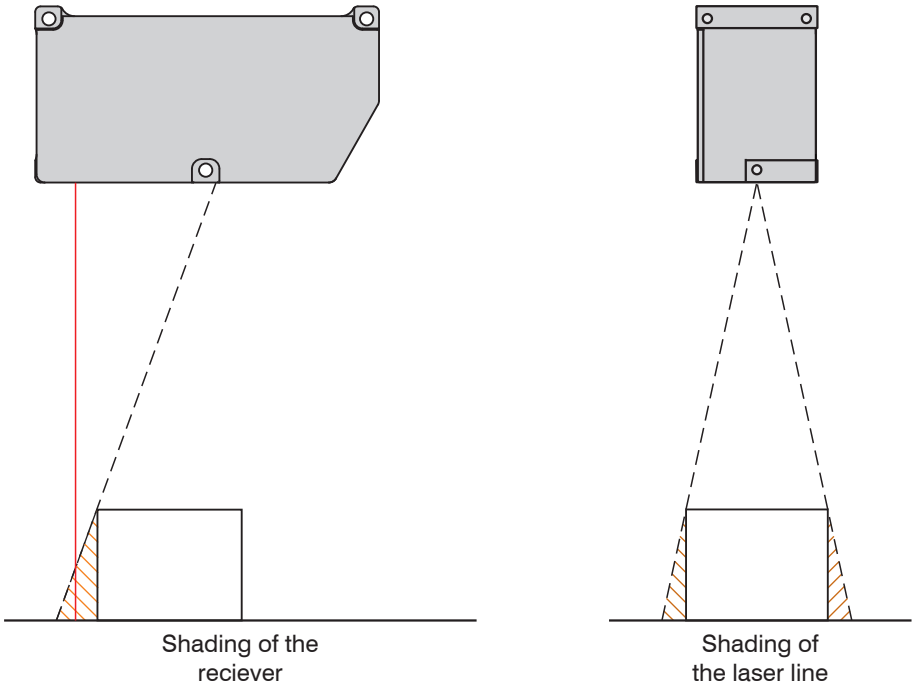


Fig. 48 Shadows

8.4.8 Multiple Reflections

Particularly on metal targets, mirror effects, which result in multiple reflections of the laser line in the receiver‘s line of sight, occur at corners and grooves, see the figure below.

For this effect, the extraneous light suppression (increasing the threshold) and the evaluation over the largest area („only highest integral intensity“) in the controller are useful.

Furthermore, these reflections can be suppressed by the sensor parameters, laser power and exposure time (shutter).

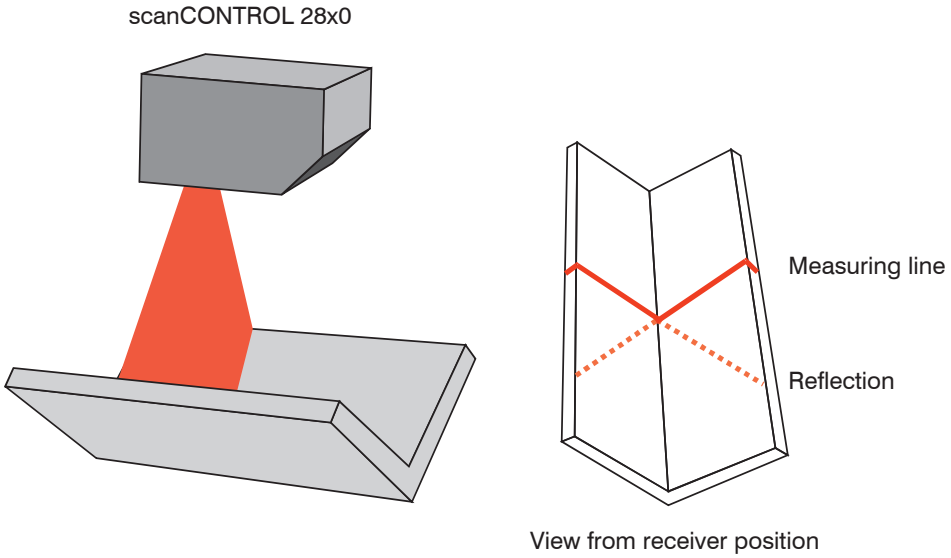


Fig. 49 Mirroring on reflecting surfaces

8.5 Laser Power

Use Configuration Tools to reduce the laser power of the sensor, see the manual “Configuration Tools”, Chap. 3.9). The software settings can be saved in the controller and can be used after a restart.

9. 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.

10. Service, Repair

In the case of a defect on the scanCONTROL 28x0:

- If possible, save the current sensor settings in a parameter set, see Chap. 3.4.3, see Chap. 11., 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

11. Software

You can find the description of the setup program, the software/measuring program on the delivered compact disk.

A DLL is available to integrate the scanCONTROL28x0 into extensive measuring programs. This function is included on the CD too.

12. Decommissioning, Disposal

- Disconnect the power supply on the controller.
- Disconnect the cables between sensor, controller and consecutively control and process units.
- Do the disposal according to the legal regulations (see directive 2002/96/EC).

Appendix

A 1 Accessory

CE2800-3-SB	Extension cable for sensor; 3.0 m long, qualified for drag chain use (female-male)
CE2800-3-SS	Connection cable for sensor; 2.75 m long, qualified for drag chain use (male-male)
CE2800-5-SB	Extension cable for sensor; 5 m long, qualified for drag chain use (male-female)
CE2800-5-SS	Connection cable for sensor; 4.75 m long, qualified for drag chain use (male-male)
CE2800-8-SB	Extension cable for sensor; 8 m long, qualified for drag chain use (male-female)
CE2800-8-SS	Connection cable for sensor; 7.75 m long, qualified for drag chain use (male-male)
CE2800-10-SB	Connection cable for sensor; 9.75 m long, qualified for drag chain use (male-female)
CE2800-10-SS	Connection cable for sensor; 9.75 m long, qualified for drag chain use (male-male)
CER2800-5-SS	Connection cable for sensor; 4.75 m long, qualified for robotic use (male-male)
CER2800-8-SB	Extension cable for sensor; 8 m long, qualified for robotic use (male-female)
CER2800-8-SS	Connection cable for sensor; 7.75 m long, qualified for robotic use (male-male)
CER2800-10-SS	Connection cable for sensor; 9.75 m long, qualified for robotic use (male-male)
PC2800-3	Power supply cable, 3 m long
SCD-IEEE-1394-3	FireWire-Cable, 3 m long
SC2800-0.5	Synchronization cable, 0.5 m long, for 2D - Laser displacement systems scanCONTROL, suitable for scanCONTROL28x0
PS2010	Power supply, input 210 - 240 VAC (or 110-120 VAC), output 24 VDC, for snap in mounting on DIN 50022 rail 35 x 7,5 mm

A 2 Possible Measuring Fields

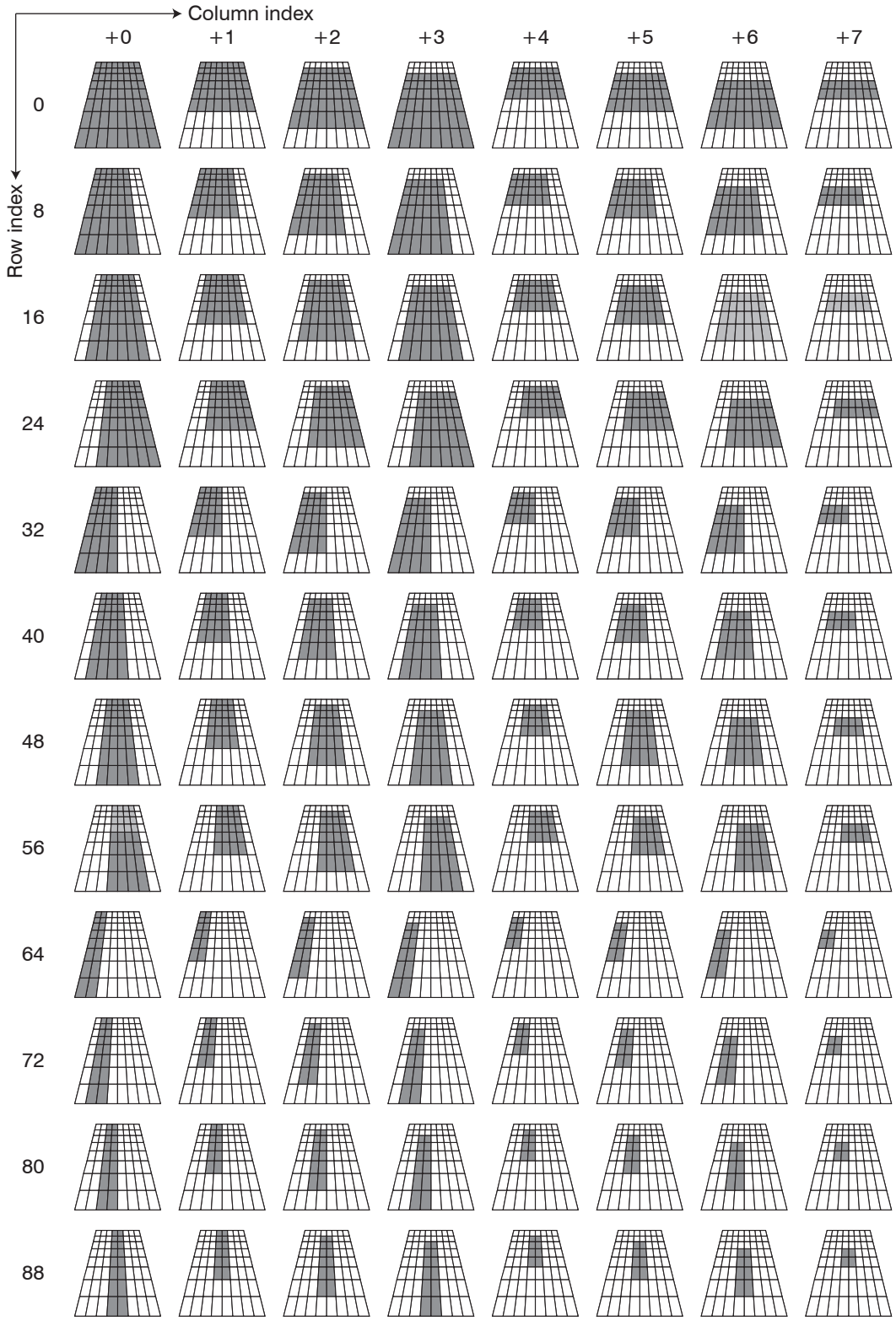


Fig. 50 Possible measuring fields of the scanCONTROL28x0

i Measuring fields with a measuring field value > 1 enable a fast readout of the data because 1024 x 1024 pixels not to be considered.

The measuring field value is determined by addition of the row and column index.

A 3 Error Coding

(— signifies a long flash, · short flash of the red LED “error”)

Flash sequence	Cause	Remedy	Remarks
Group: Load/save configuration			
. . 2x short	Mode not found	Select another user mode	Only previously saved modes can be called
. . _ 2x short, 1x long	Write error, flash	None, contact the manufacturer	Should not occur in normal operation
. . . 3x short	Flash overflow	None, contact the manufacturer	Should not occur in normal operation
. . . . 4x short	Mode key pressed with FireWire connection established	Disconnect FireWire connection	To avoid inconsistencies, the mode setting is prevented with existing FireWire connection and only the user mode number is switched; saving possible with long key depression
Group: Data processing and transfer			
_ _ . 2x long, 1x short	Data overflow on reception of data from the sensor	Select a smaller measuring field, reduce profile frequency, select less complex measurement program	Data may be corrupt
_ _ .. 2x long, 2x short	Data overflow on serial interface RS232/422	Reduce profile frequency, select less complex measurement program	Data may be corrupt
_ _ . . . 2x long, 3x short	Data overflow when sending data through FireWire	Reduce profile frequency, increase packet size	Data may be corrupt
_ _ . . . . 2x long, 4x short	Data overflow during analog output	Reduce profile frequency, increase the output frequency, deactivate the analog output if no required	Data may be corrupt
_ _ . . . . . 2x long, 5x short	Error during calculation	Reduce profile frequency, use faster calculation mode	Data may be corrupt
_ _ . . . . . . 2x long, 6x short	Error on FireWire transfer	Reduce profile frequency, increase packet size	Data may be corrupt

The green “control” LED also blinks, long during an active data transmission and short for control access.

Control accesses can cause various data overflows, especially if the measuring frequency is near the maximum.

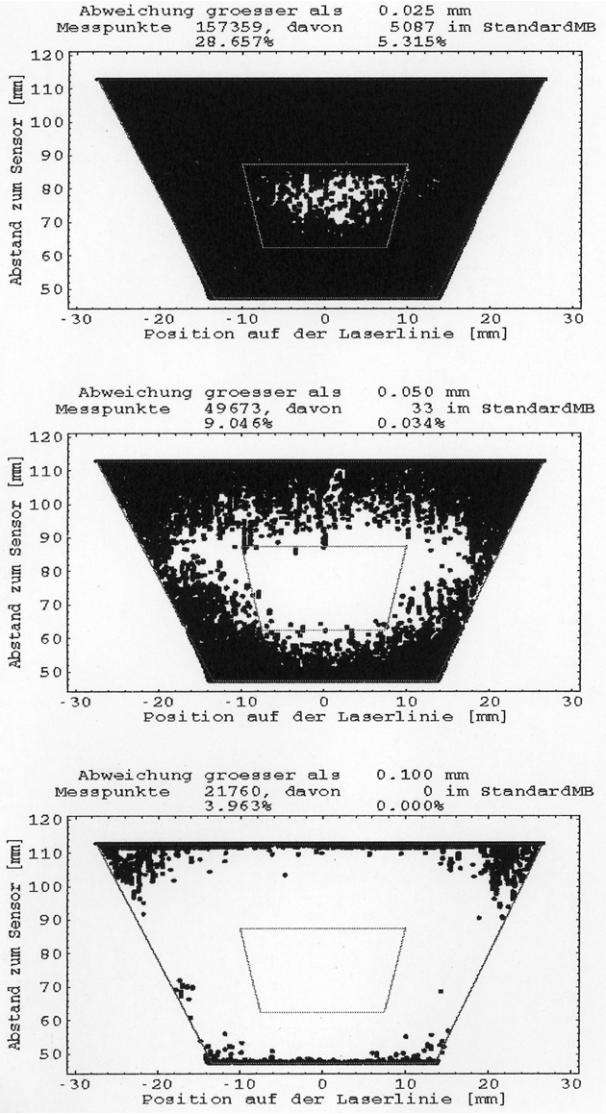
A 4 Sensor Inspection Log (Sample)

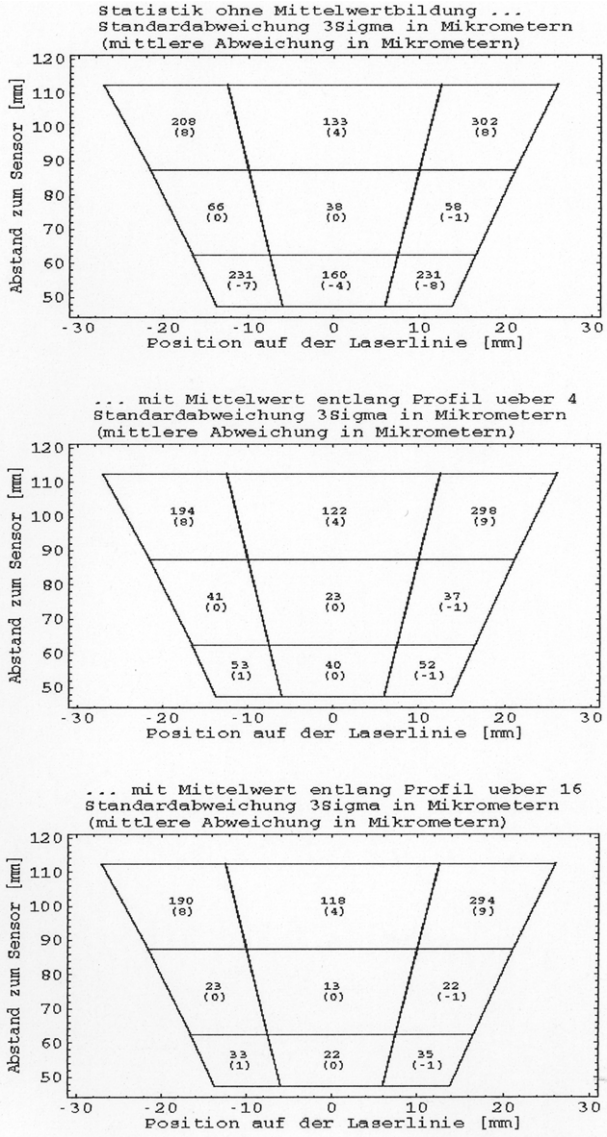
Sensor-Abnahmeprotokoll

scanCONTROL2800-25 v14-B1 S/N 12040105

Messung vom 13.12.2004 14:48:01
Protokoll vom 13.12.2004 5:04:26
Target Micro-Optronic-Standardtarget Matt-Metall
Version 1.30 (5.0)

ebenes Target, Neigung	5.182	Grad	
globale Verschiebung	4.605	mm	
Linearitätsfehler dz/dx	-0.064,	dz/dx	-0.127 Mikrometer/mm
Messpunkte insgesamt	549106,		davon 95705 im Standardmessbereich





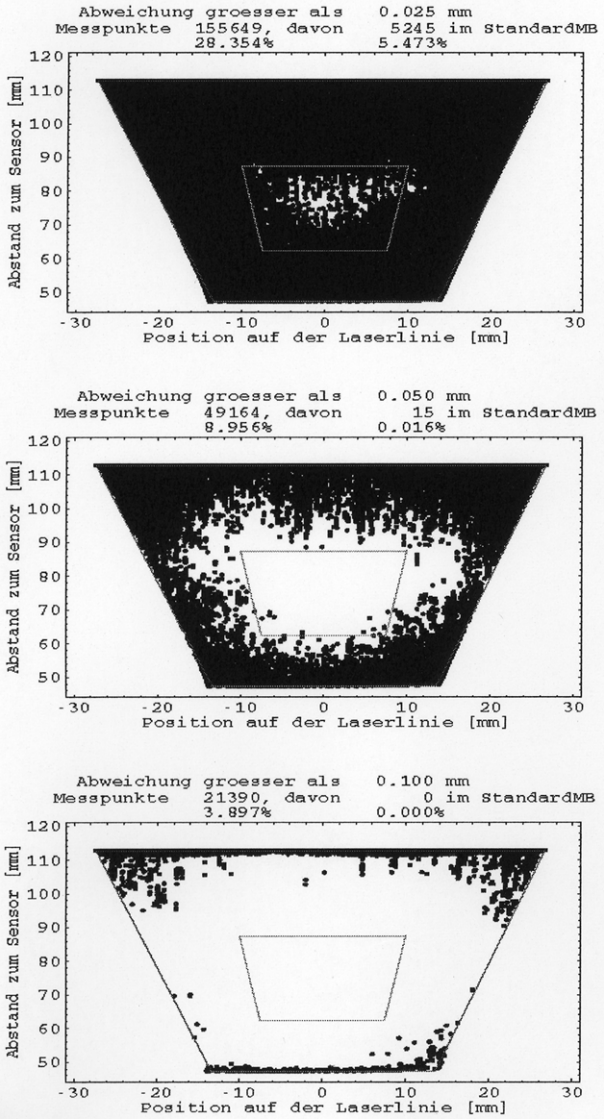
Sensor inspection log (sample)

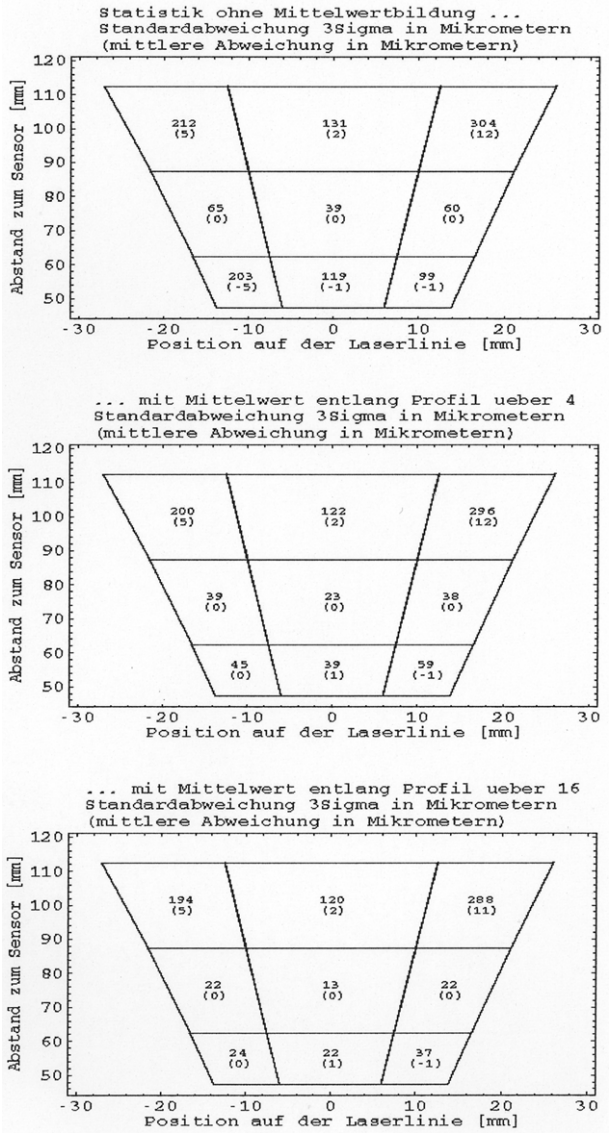
Sensor-Abnahmeprotokoll

scanCONTROL2800-25 v14-B1 S/N 12040105

Messung	vom 13.12.2004	14:52:30
Protokoll	vom 13.12.2004	15:07:52
Target	Micro-Optronic-Standardtarget Matt-Metall	
Version	1.30 (5.0)	

ebenes Target, Neigung	-5.175	Grad		
globale Verschiebung	-4.583	mm		
Linearitätsfehler dz/dx	-0.001,	dz/dx	-0.104	Mikrometer/mm
Messpunkte insgesamt	548950,		davon	95826 im Standardmessbereich





MICRO-EPSILON MESSTECHNIK GmbH & Co. KG
Königbacher Str. 15 · 94496 Ortenburg / Deutschland
Tel. +49 (0) 8542 / 168-0 · Fax +49 (0) 8542 / 168-90
info@micro-epsilon.de · www.micro-epsilon.de

X9751109-C041105HDR