MICRO-EPSILON

More Precision

scanCONTROL // 2D/3D laser scanner (laser profile sensors)
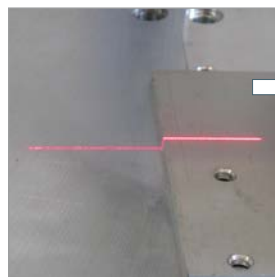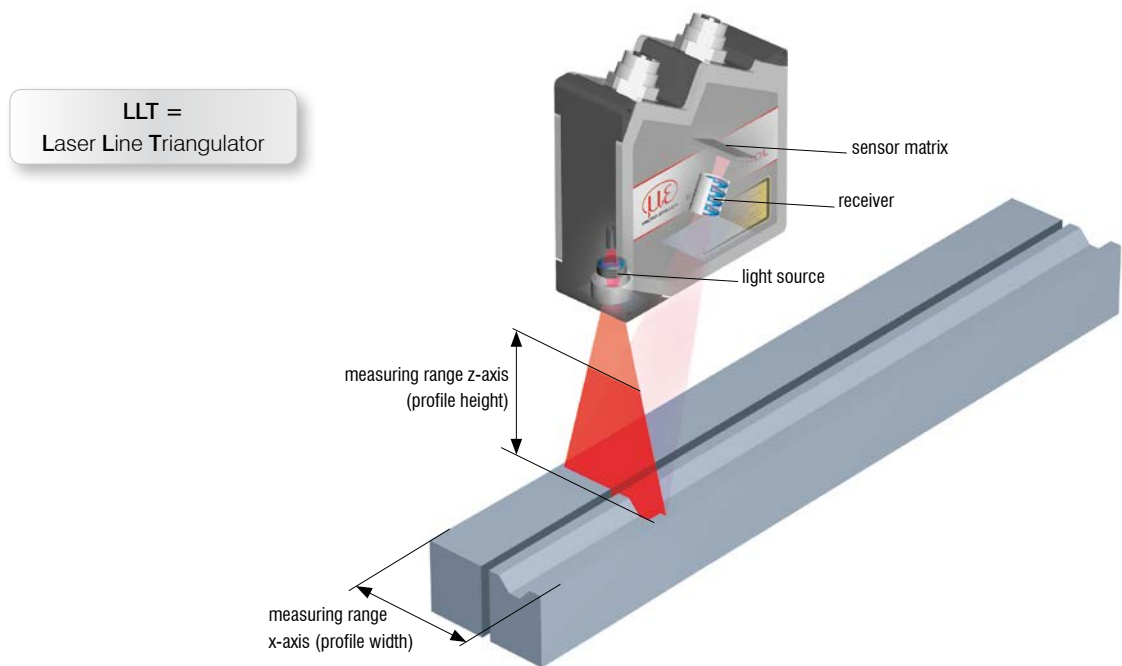
NEW

scanCONTROL Gateway (page 18)

- Outputs measured values via PROFINET, EtherCAT and EtherNet/IP
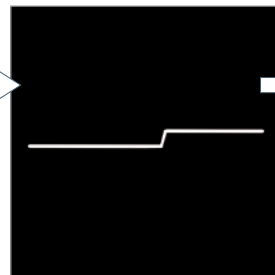- Up to 4 sensors

EtherNet/IP™

EtherCAT®

PROFINET®

NEW

SMART PLC Unit (page 30)

- Evaluates measured values of SMART and GAP sensors
- Fast data processing

LLT =
Laser **L**ine **T**riangulator

sensor matrix

receiver

light source

measuring range z-axis
(profile height)

measuring range
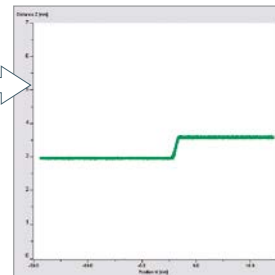x-axis (profile width)

Laser line
Projecting a laser line onto the
target surface

Sensor matrix (pixels)
The diffusely reflected light from
the laser line is shown on the high
quality sensor matrix

Calibrated x/z measuring points
Calculation of the distance coordinate z
and the actual position x along the laser
line for each measuring point

What are laser scanners?

Laser scanners from the LLT series record, measure and evaluate profiles on a variety of different target surfaces. With its scanCONTROL/gapCONTROL series, Micro-Epsilon offers from the pre-configured sensors to the complex measuring systems all from a single source.

The measuring principle

Laser scanners - often referred to as profile sensors - use the laser triangulation principle for two-dimensional profile detection on different target surfaces. By using special lenses, a laser beam is enlarged to form a static laser line and is projected onto the target surface. The optical system projects the diffusely reflected light of this laser line onto a highly sensitive sensor matrix. In addition to distance information (z-axis), the controller also uses this camera image to calculate the position along the laser line (x-axis). These measured values are then output in a two-dimensional coordinate system that is fixed with respect to the sensor. In the case of moving objects or a traversing sensor, it is therefore possible to obtain 3D measurement values.

Customer evaluation		Integrated evaluation	
These models provide calibrated profile data which can be further processed on a PC using a customer software evaluation.		These models provide selected measurement values. The parameter set up for the sensors and the measurement programs is stored in the integrated controller.	
COMPACT	HIGHSPEED	SMART	GAP
Laser scanners for common measurement tasks	Laser scanners with fast profile frequency	Laser scanners with comprehensive software	Laser scanners with software specifically developed for gap measurements

LLT26xx

640 points/profile
Profile frequency
Standard up to 300Hz
High speed up to 4000Hz

scanCONTROL **2600** ▸ Page 10	**scanCONTROL** **2650** ▸ Page 10	**scanCONTROL** **2610** ▸ Page 10	**gapCONTROL** **2611** ▸ Page 10

LLT29xx

1280 points/profile
Profile frequency
Standard up to 300Hz
High speed up to 2000Hz
Available with red or blue diode

scanCONTROL **2900** ▸ Page 12	**scanCONTROL** **2950** ▸ Page 12	**scanCONTROL** **2910** ▸ Page 12	**gapCONTROL** **2911** ▸ Page 12

Integration: SDK for C/ C++, LabVIEW-VI and examples for C# and Linux ▸ Page 28		Evaluation: **scanCONTROL** **Configuration Tools** ▸ Page 22	Evaluation: **gapCONTROL** **Setup Software** ▸ Page 24

Transmission of **calibrated profile data**

COMPACT

The COMPACT sensors are used for providing calibrated profile data for external profile analysis, for example, on a PC. They are suitable for static and dynamic measurements.

An Ethernet interface allows the user to configure the sensor via a PC application, as well as to transmit profile data. More details about the software interface can be found in the "Integrating scanCONTROL in application software" chapter.

HIGHSPEED

The HIGHSPEED models are also used to transmit the calibrated profile data. With a profile frequency of up to 4000Hz, these sensors offer everything for advanced high speed and 3D applications.

Individual further processing of calibrated profile data

Parameter set up via customer software application

Measurement data output

SMART

The scanCONTROL SMART series offers plug & play solutions for simple-to-complex measurement tasks, eliminating the need for any external controller or PC.

Set up and configuration of the sensor is carried out via the scanCONTROL Configuration Tools PC software, which enables the measurement of steps, angles, seams and grooves. The parameter sets are stored in the sensor which is why the sensor autonomously performs measurements without requiring any external control devices or PCs.

GAP

The GAP class offers a plug & play solution especially for gap measurements. The gapCONTROL Setup Software enables the necessary set up and configuration for different gap types and to store them in the sensor.

Profile analysis in the sensor head, transmission of measured values

Parameter set up via scanCONTROL Configuration Tools / gapCONTROL Setup Software

Advanced **technology**

- Up to 1280 points per profile
- Measurement frequency up to 4000 profiles/sec.
- Compact size
- Integrated evaluation without any external controller or IPC
- Factory calibration for metals
- Made / Developed in Germany
- Numerous references worldwide
- Proven high operational safety in the 24/7 operation over many years
- Real Time Surface Compensation

Different **laser types**

- 2M class (red)
- 3B class (red)
- Blue Laser

Universal application

- Inline measurement of gap, profile, step, angle, ...
- Provides 3D information and images for image processing
- Profile transmission or measurement data output
- Robust: for use in processing lines and laboratories
- Also suitable for use with robotic applications
- Multi scanner applications
- Versions for integrators and end users

Interfaces

- Gigabit Ethernet (GigE Vision)
- Trigger and encoder input
- Gateway for PROFINET, EtherNet/IP and EtherCAT
- Output Unit for analog outputs and switch signals
- Power over Ethernet (PoE) - only one cable
- Secure measurement data output via Modbus
- Fast measurement data output via UDP
- Direct communication using PLC

Comprehensive **software**

- SMART and GAP classes:
  Analysis and evaluation directly in the sensor head
- Configuration software provides ease of use
- Libraries for C, C++, C#
- LabVIEW driver
- Linux implementation
- Free software, libraries and firmware updates

Real Time Surface Compensation:
Dynamic adaption to rapidly changing surfaces

Laser profile scanners use the diffusely reflected laser light. The intensity of reflection is (highly) dependent on the surface properties like color, shininess and light absorption of the measurement target.

The Real Time Surface Compensation feature of the sensors permits reliable measurements of constantly changing surface conditions. Real time adaption of exposure time and the threshold of reflection detection enable you to get stable measurement results in fast-changing measurement situations without having to adapt the sensor settings manually.

scanCONTROL / gapCONTROL

Sensor, solution and system from a single source

Micro-Epsilon has many years' experience in integrating highly efficient laser line sensors to customer applications and in supplying complete systems from a single source.

LLT sensors are adapted to a variety of common applications in quality control, production processes and automation.
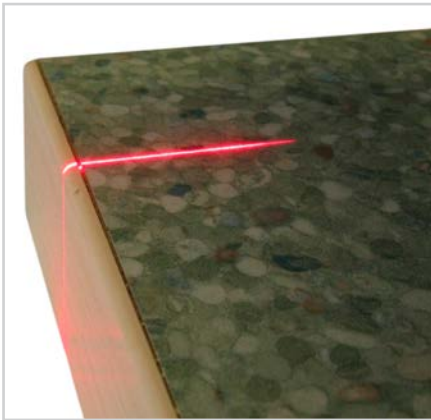
Defect recognition on worktops
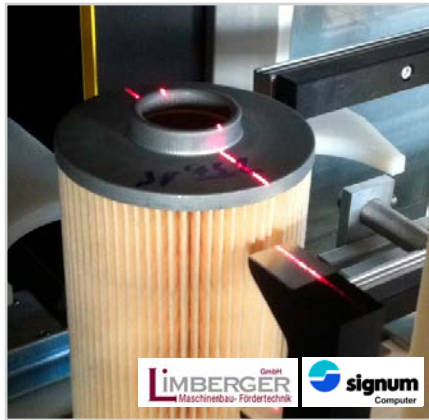
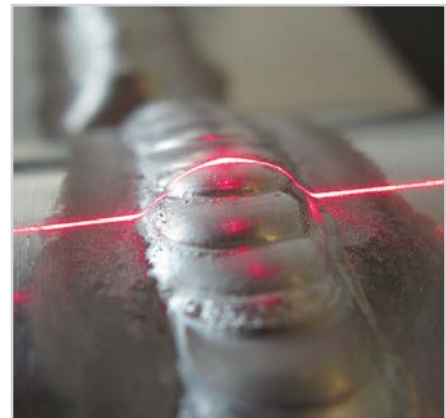Filter height in the automotive industry

V-gap measurement on pipes

Gap measurement on a car body
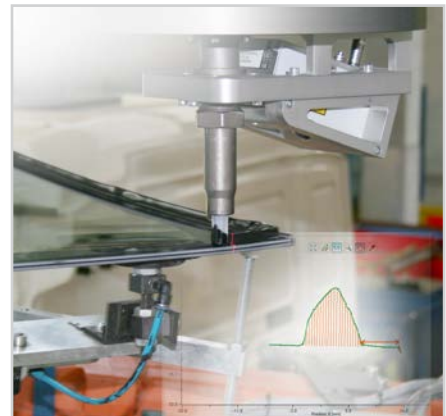

Profile measurements on brake disks

Measuring weld seam profiles

Tyre inspection

Distance measurement at the centre console

Inspection of the adhesive beading

scanCONTROL / gapCONTROL BL

The laser scanners with blue laser line are used for multi-dimensional measurement on red-hot glowing metals as well as on transparent and organic materials. While allowing higher stability, the blue laser light does not penetrate the measurement object due to the shorter wavelength of the blue-violet laser. Compared to red lasers, blue laser sensors enable more reliable measurements on red-hot glowing and organic objects. The high-focused, blue laser line enables furthermore to use laser scanners with 10mm line length in highest precision.
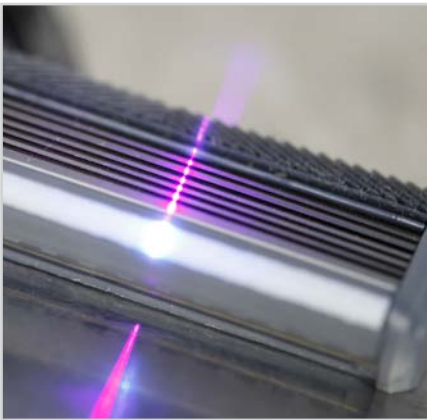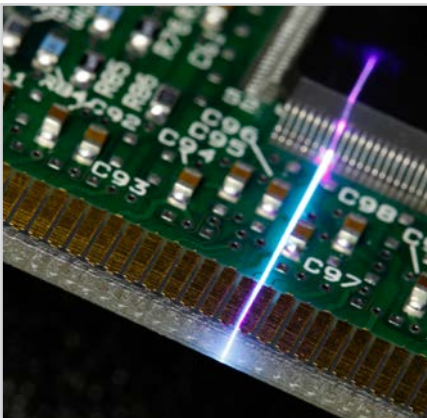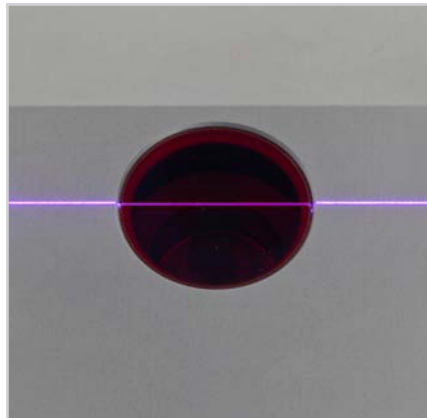

Blade angle of razors
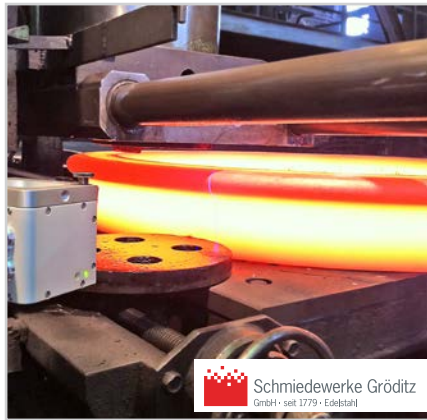
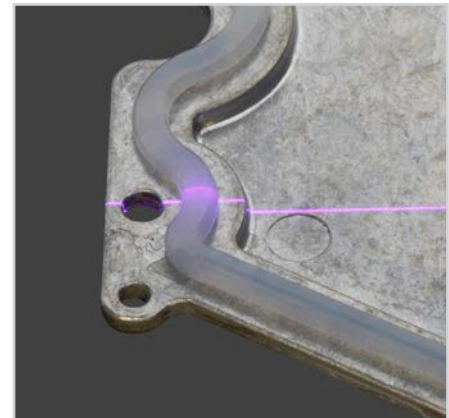Production of steel-forged rings
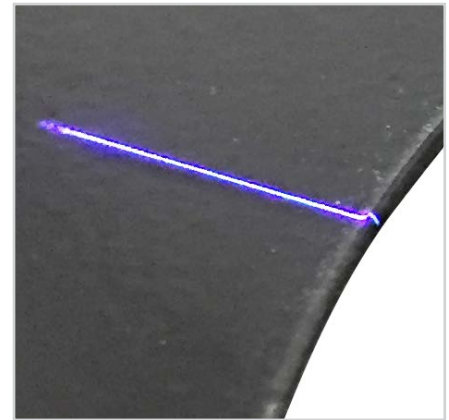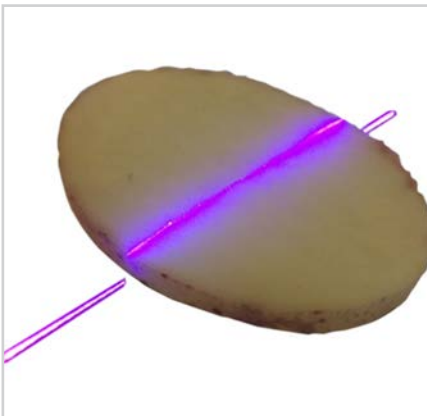

Burr measurement on punching sheets
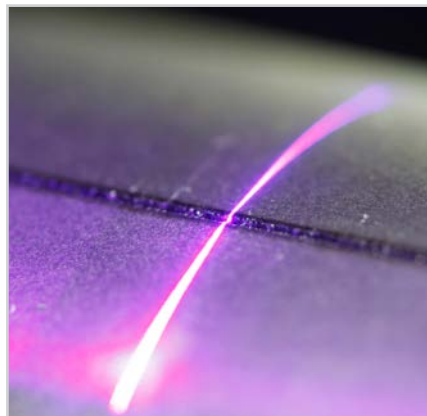

Position of electronic components

Gap measurement of inserted glass

Inspection of silicone adhesive beading

Thickness measurement of potato slices

Completeness of laser welding seams

Thermal tests

- *z-axis measuring range up to 265mm*

- *x-axis measuring range up to 143.5mm*

- *Profile frequency up to 4,000Hz*

- *Measuring rate up to 2,560,000 points/sec*

- *z-axis reference resolution from 2µm*

- *Resolution x-axis up to 640 points*

Compact design suitable for all measurement tasks

The design of the LLT 26xx series is focussed on compact size and low weight. The controller is integrated in the housing, simplifying cabling arrangements and mechanical integration. Due to its compact design and the profile frequency of up to 4000 profiles/sec., the 26xx series is especially suitable for dynamic and robotic applications.

Interfaces for universal integration

The multi-function port can be used for power supply, as data output, for switching parameters, as trigger input or for synchronizing several scanCONTROL sensors. During synchronous operation, an integrated mode can be used to operate the sensors alternately compensating for overlapping laser lines. One scanner is measuring whilst the other laser line is switched off.

The scanners can be supplied via Ethernet if necessary. If Industrial Ethernet is used as data output, only one cable will remain that connects the sensor to the periphery.

For all SMART and GAP class sensors, the measurement data output can be carried out in different ways, e.g. via Ethernet UDP, Modbus TCP or serial. Micro-Epsilon converters enable data transmission via analog signals, digital switching signals, PROFINET, Ethernet/IP or EtherCAT.

Article description structure

LLT	26	00	-25	/SI

Options
/SI = integrated laser switch-off
/PT = integrated pigtail cable 0.25 m
/3B = 3B laser class

Measuring range
25mm
50mm
100mm

Class
00=COMPACT
10=SMART
11=GAP
50=HIGHSPEED

Series
LLT26xx

Options*

/SI	Integrated laser switch-off	/PT	Pigtail cable
	Hardware switch-off of the laser line		0.25m long cable directly out of the sensor

/3B	3B laser class		
	Improved laser power (20mW) e.g. for dark surfaces		

*Options can be combined

Accessories from page 18

Model		LLT	26xx-25	26xx-50	26xx-100
z-axis (height)	Standard measuring range	Start of measuring range	53.5mm	70mm	190mm
		Midrange	66mm	95mm	240mm
		End of measuring range	78.5mm	120mm	290mm
		Height of measuring range	25mm	50mm	100mm
	Extended measuring range	Start of measuring range	53mm	65mm	125mm
		End of measuring range	79mm	125mm	390mm
	Linearity [1]	(2sigma)	±0.10% FSO	±0.10% FSO	±0.13% FSO
	Reference resolution [2] [3]		2µm	4µm	12µm
x-axis (width)	Standard measuring range	Start of measuring range	23.4mm	42mm	83.1mm
		Midrange	25mm	50mm	100mm
		End of measuring range	29.1mm	58mm	120.8mm
	Extended measuring range	Start of measuring range	23.2mm	40mm	58.5mm
		End of measuring range	29.3mm	60mm	143.5mm
	Resolution x-axis		640 points/profile		
Profile frequency		COMPACT / SMART / GAP	up to 300Hz		
		HIGHSPEED	up to 4,000Hz		

Interfaces	Multi function port	Ethernet GigE Vision	Output of measurement values Sensor control Profile data transmission
		Digital inputs	Mode switching Encoder Trigger
		RS422 (half-duplex) [4]	Output of measurement values Sensor control Trigger Synchronisation

Output of measurement values	Ethernet (UDP / Modbus TCP); RS422 (ASCII / Modbus RTU) Analog [5]; Switch signal [5] PROFINET [6]; EtherCAT [6]; EtherNet/IP [6]		
Display (LED)	1x laser ON/OFF, 1x power/error/status		
Light source	Semiconductor laser 658nm (red)		
Aperture angle laser line	20°	25°	25°
Laser power — standard	≤ 8mW (2M laser class)		
Laser power — optional	≤ 20mw (3B laser class)		
Integrated laser switch-off — optional	Safety interlock, hardware switch-off		
Permissible ambient light (fluorescent light) [2]	10,000lx		
Protection class (sensor)	IP 65		
EMC	acc. EN 61326-1: 2006-10 DIN EN 55011: 2007-11 (group 1, B class) EN 61000-6-2: 2006-03		
Vibration	2g / 20 ... 500Hz		
Shock	15g / 6ms		
Operating temperature	0°C to 45°C		
Storage temperature	-20°C to 70°C		
Dimensions	96 x 85 x 33mm		
Weight sensor (without cable)	380g		
Supply	11-30VDC, 24V, 500mA, IEEE 802.3af class 2, Power over Ethernet		

[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 (640 points)
[4] RS422 interface, programmable either as serial interface or input for triggering / synchronisation
[5] Only with Output Unit
[6] Only with scanCONTROL Gateway
FSO = Full scale output

- *z-axis measuring range up to 265mm*

- *x-axis measuring range up to 143.5mm*

- *Profile frequency up to 2,000Hz*

- *Measuring rate up to 2,560,000 points/sec*

- *z-axis reference resolution from 1µm*

- *Resolution x-axis up to 1,280 points*

- *Also available with blue laser*

Compact design for precise measurement tasks

The design of the LLT29xx series is focussed on minimal size and low weight. The controller is integrated in the housing, simplifying cabling arrangements and mechanical integration. Due to its compact design and the high profile resolution, the 29xx series is especially suitable for static, dynamic and robotic applications.

Interfaces for universal integration

The multi-function port can be used for power supply, as data output, for switching parameters, as trigger input or for synchronizing several scanCONTROL sensors. During synchronous operation, an integrated mode can be used to operate the sensors alternately compensating for overlapping laser lines.

One scanner is measuring whilst the other laser line is switched off. The scanners can be supplied via Ethernet if necessary. If Industrial Ethernet is used as data output, only one cable will remain that connects the sensor to the periphery.

For all SMART and GAP class sensors, the measurement data output can be carried out in different ways, e.g. via Ethernet UDP, Modbus TCP or serial. Micro-Epsilon converters enable data transmission via analog signals, digital switching signals, PROFINET, EtherNet/IP or EtherCAT.

Also available with blue laser

The Blue Laser technology uses a laser diode with a shorter wavelength of 405nm. The outstanding characteristics of this wavelength range enable reliable measurements to be made that to date have been difficult to achieve using red laser scanners. Its advantages can be seen particularly well on red-hot glowing metals, (semi-) transparent and organic materials.

Short measuring range

The laser line of only 10mm enables to reliably detect smallest details. The high profile resolution combined with the blue laser line allow for maximum precision destined for versatile applications, e.g. in the electronics production.

Article description structure

LLT	29	00	-25	/SI

Options
/SI = integrated laser switch-off
/PT = integrated pigtail cable 0.25 m
/3B = 3B laser class
/BL = Blue Laser (blue-violet laser line)

Measuring range
10mm (only Blue Laser) / 25mm / 50mm / 100mm

Class
00=COMPACT / 10=SMART
11=GAP / 50=HIGHSPEED

Series
LLT29xx

Options*

/SI	Integrated laser switch-off	/PT	Pigtail cable
	Hardware switch-off of the laser line		0.25m long cable directly out of the sensor
/3B	**3B laser class**	**/BL**	**Blue laser line**
	Improved laser power (20mW) e.g. for dark surfaces		Blue laser line (405nm) for (semi-) transparent, red-hot glowing and organic materials

*Options can be combined

Accessories from page 18

Model	LLT	29xx-10/BL	29xx-25	29xx-50	29xx-100
z-axis (height)					
Standard measuring range	Start of measuring range	52.5mm	53.5mm	70mm	190mm
	Midrange	56.5mm	66mm	95mm	240mm
	End of measuring range	60.5mm	78.5mm	120mm	290mm
	Height of measuring range	8mm	25mm	50mm	100mm
Extended measuring range	Start of measuring range	-	53mm	65mm	125mm
	End of measuring range	-	79mm	125mm	390mm
Linearity [1]	(2sigma)	±0.17% FSO	±0.10% FSO	±0.10% FSO	±0.10% FSO
Reference resolution [2] [3]		$1\mu m$	$2\mu m$	$4\mu m$	$12\mu m$
x-axis (width)					
Standard measuring range	Start of measuring range	9.4mm	23.4mm	42mm	83.1mm
	Midrange	10mm	25mm	50mm	100mm
	End of measuring range	10.7mm	29.1mm	58mm	120.8mm
Extended measuring range	Start of measuring range	-	23.2mm	40mm	58.5mm
	End of measuring range	-	29.3mm	60mm	143.5mm
Resolution x-axis		1,280 points/profile			

Profile frequency	COMPACT / SMART / GAP	up to 300Hz
	HIGHSPEED	up to 2,000Hz

Interfaces	Multi function port	Ethernet GigE-Vision	Output of measurement values Sensor control Profile data transmission
		Digital inputs	Mode switching Encoder Trigger
		RS422 (half-duplex) [4]	Output of measurement values Sensor control Trigger Synchronisation

Output of measurement values	Ethernet (UDP / Modbus TCP); RS422 (ASCII / Modbus RTU) Analog [5]; Switch signal [5] PROFINET [6]; EtherCAT [6]; EtherNet/IP [6]
Display (LED)	1x laser ON/OFF, 1x power/error/status

Light source	standard	Semiconductor laser 405nm (blue)	Semiconductor laser 658nm (red)		
	optional	-	Semiconductor laser 405nm (blue)		
Aperture angle laser line		10°	20°	25°	25°
Laser power	standard	≤ 8mW (2M laser class)			
	optional	-	≤ 20mw (3B laser class)		
Integrated laser switch-off	optional	Safety interlock, hardware switch-off			
Permissible ambient light (fluorescent light) [2]		10,000lx			
Protection class (sensor)		IP 65			
EMC		acc. EN 61326-1: 2006-10 DIN EN 55011: 2007-11 (group 1, B class) EN 61000-6-2: 2006-03			
Vibration		2g / 20 ... 500Hz			
Shock		15g / 6ms			
Operating temperature		0°C to 45°C			
Storage temperature		-20°C to 70°C			
Dimensions		96 x 118.5 x 33mm	96 x 85 x 33mm		
Weight sensor (without cable)		440g	380g		
Supply		11-30VDC, 24V, 500mA, IEEE 802.3af class 2, Power over Ethernet			

[1] Standard measuring range
[2] Measuring object: Micro-Epsilon standard object (metallic, diffusely reflecting material)
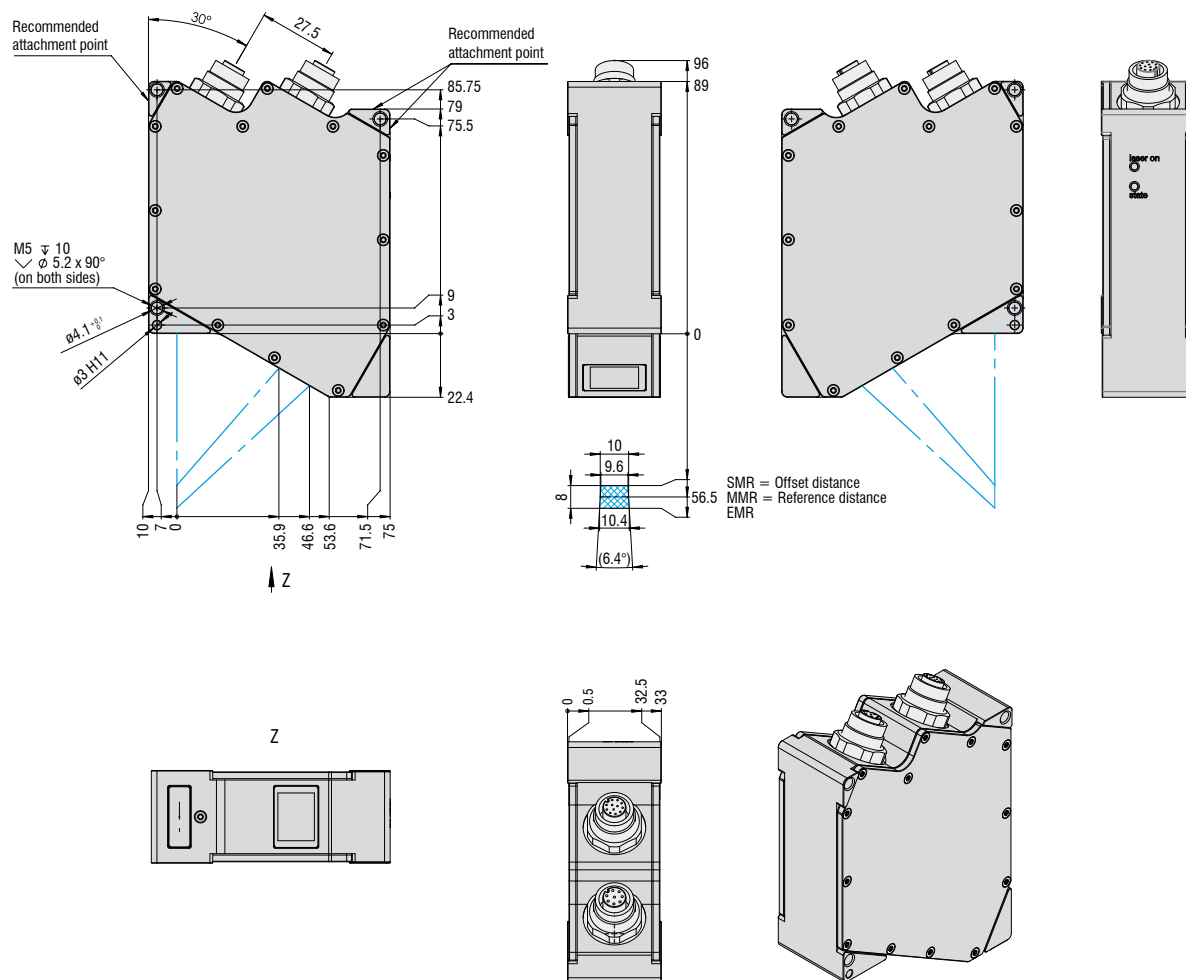[3] According to a one-time averaging across the measuring field (640 points)
[4] RS422 interface, programmable either as serial interface or input for triggering / synchronisation
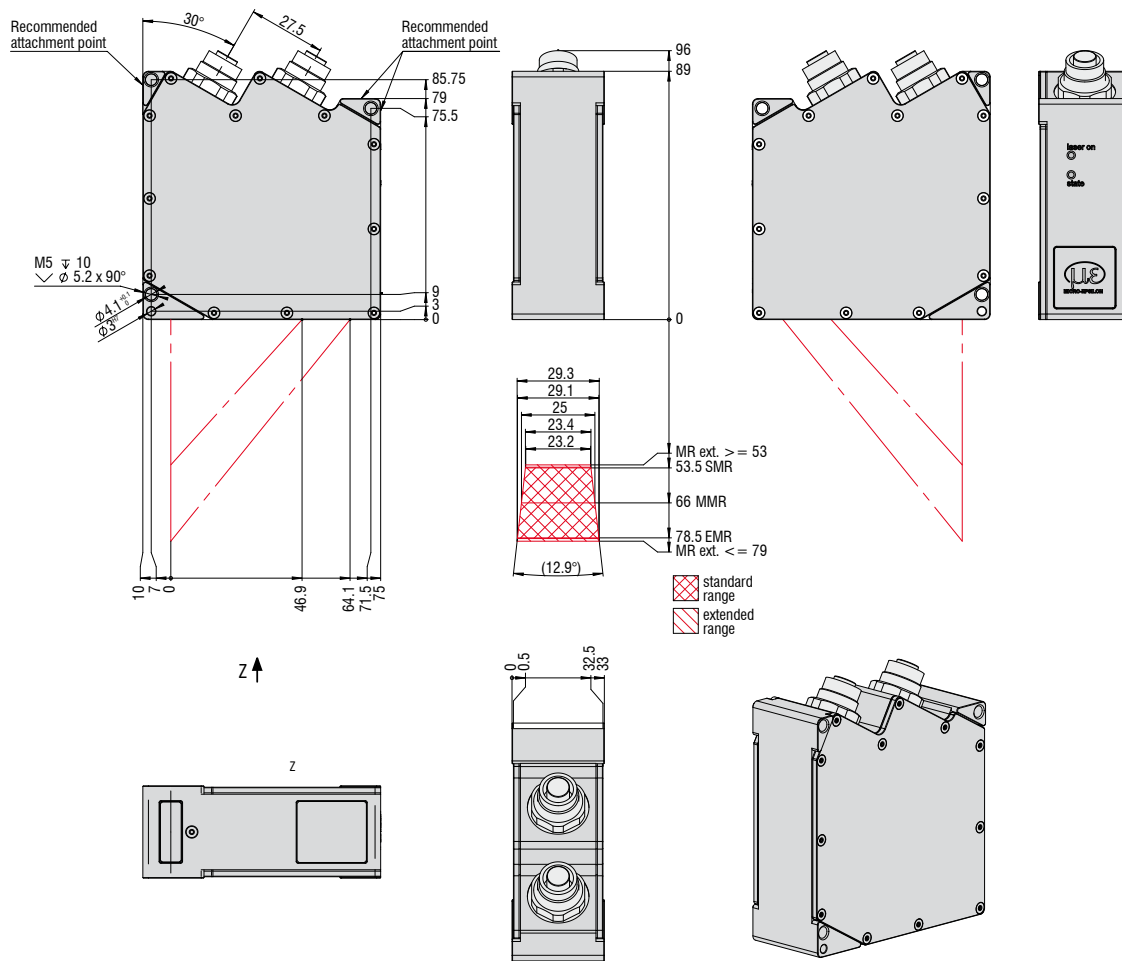[5] Only with Output Unit
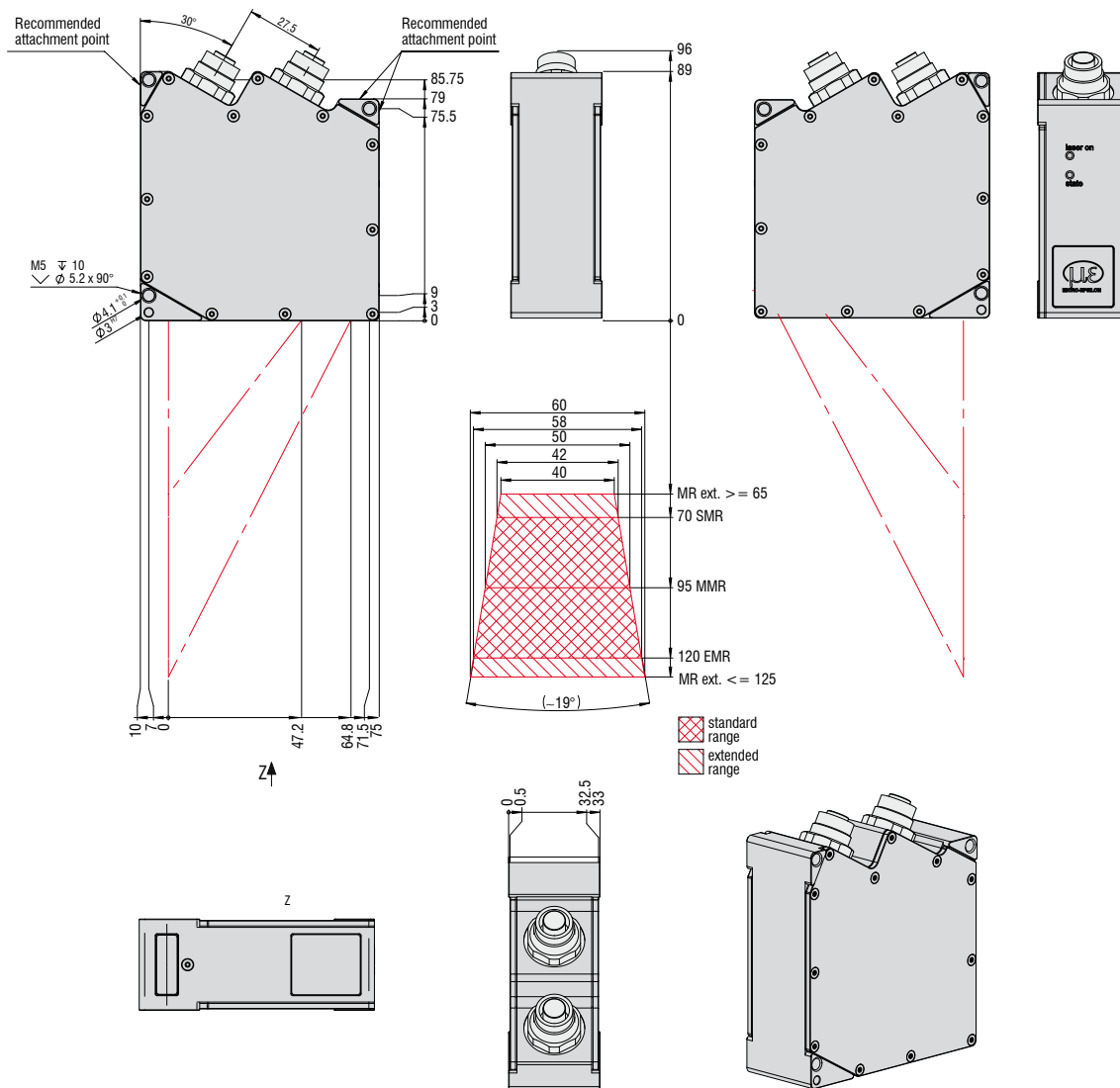[6] Only with scanCONTROL Gateway
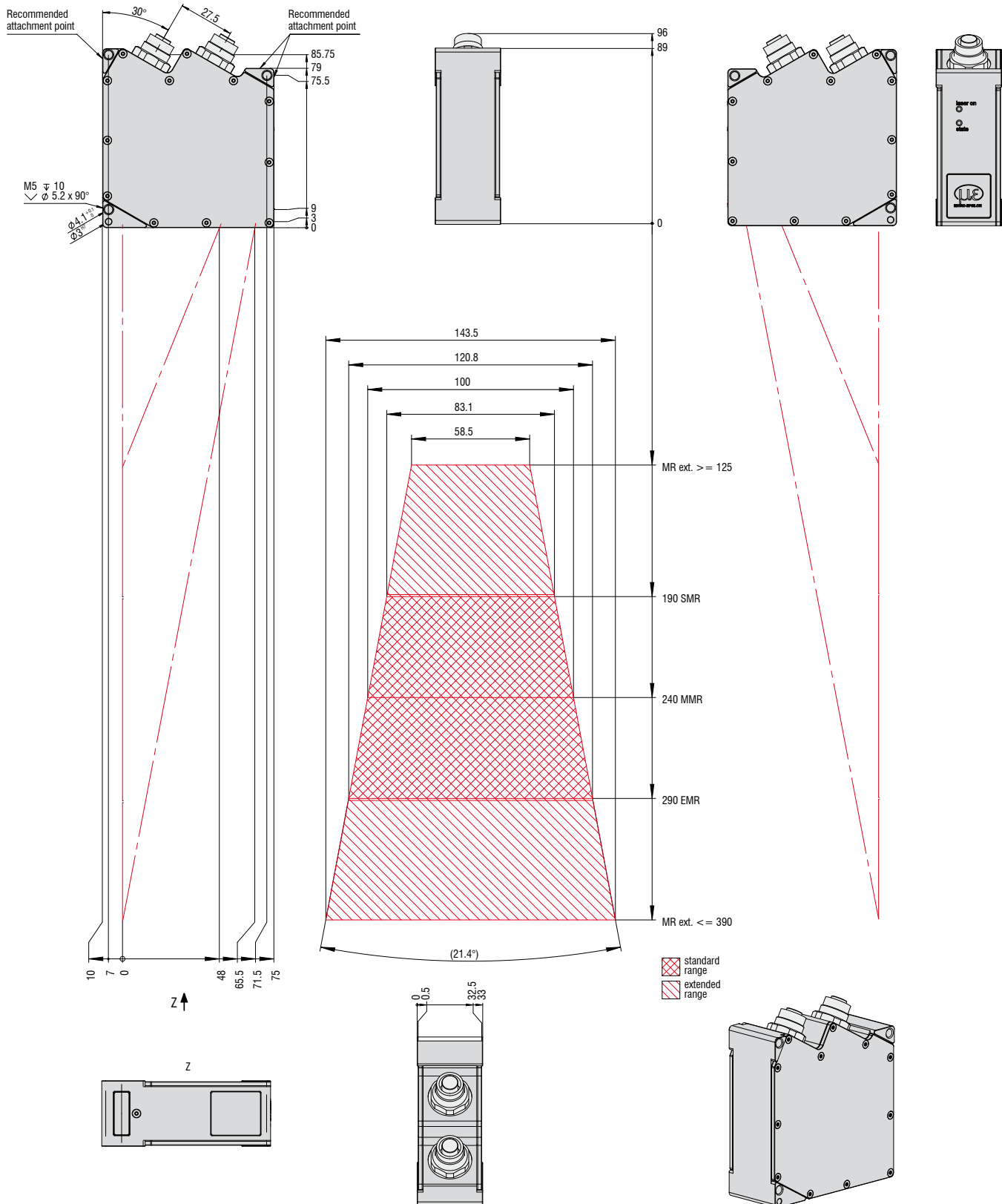FSO = Full scale output

LLT29xx-10/BL

Recommended attachment point

Recommended attachment point

30°   27.5

85.75
79
75.5

M5 ⩛ 10
∨ ⌀ 5.2 x 90°
(on both sides)

ø4.1 +0.1
ø3 H11

9
3

22.4

10 7 0   35.9 46.6 53.6   71.5 75

Z

96
89

0

10
9.6

8   56.5

10.4

(6.4°)

SMR = Offset distance
MMR = Reference distance
EMR

laser on
state

Z

0 0.5   32.5 33

LLT26xx/29xx-25

Recommended attachment point

Recommended attachment point

30° 27.5

85.75
79
75.5

M5 ⍙ 10
∅ 5.2 x 90°

∅4.1
∅3°

9
3
0

10
7
0

46.9

64.1
71.5
75

Z

96
89

0

29.3
29.1
25
23.4
23.2

MR ext. >= 53
53.5 SMR

66 MMR

78.5 EMR
MR ext. <= 79

(12.9°)

standard range

extended range

0
0.5

32.5
33

laser on

state

LLT26xx/29xx-50

Recommended attachment point

Recommended attachment point

30° 27.5

85.75
79
75.5

M5 10
Ø 5.2 x 90°

Ø 4.1
Ø 3

9
3
0

10
7
0

47.2

64.8
71.5
75

Z

96
89

0

60
58
50
42
40

MR ext. > = 65
70 SMR

95 MMR

120 EMR
MR ext. < = 125

(−19°)

standard range
extended range

laser on
state

0.5

32.5
33

Z

LLT26xx/29xx-100

30° 27.5

Recommended
attachment point

Recommended
attachment point

85.75
79
75.5

M5 ⩫ 10
⌵ ø 5.2 x 90°

ø4.1
ø3

9
3
0

96
89

0

143.5
120.8
100
83.1
58.5

MR ext. >= 125

190 SMR

240 MMR

290 EMR

MR ext. <= 390

(21.4°)

standard
range

extended
range

10 7 0   48 65.5 71.5 75

Z

0.5 32.5 33

PROFINET / EtherCAT / EtherNet/IP – for all scanners of the SMART and GAP classes

Each scanCONTROL Gateway can be connected with up to 4 sensors. It communicates with the scanCONTROL SMART sensor or the gapCONTROL sensor via Ethernet Modbus. The resultant values are then converted to PROFINET, EtherCAT or EtherNet/IP. The customer carries out the parameter set up with a detailed instruction manual.

*operating more than one sensor requires a switch.

scanCONTROL Gateway
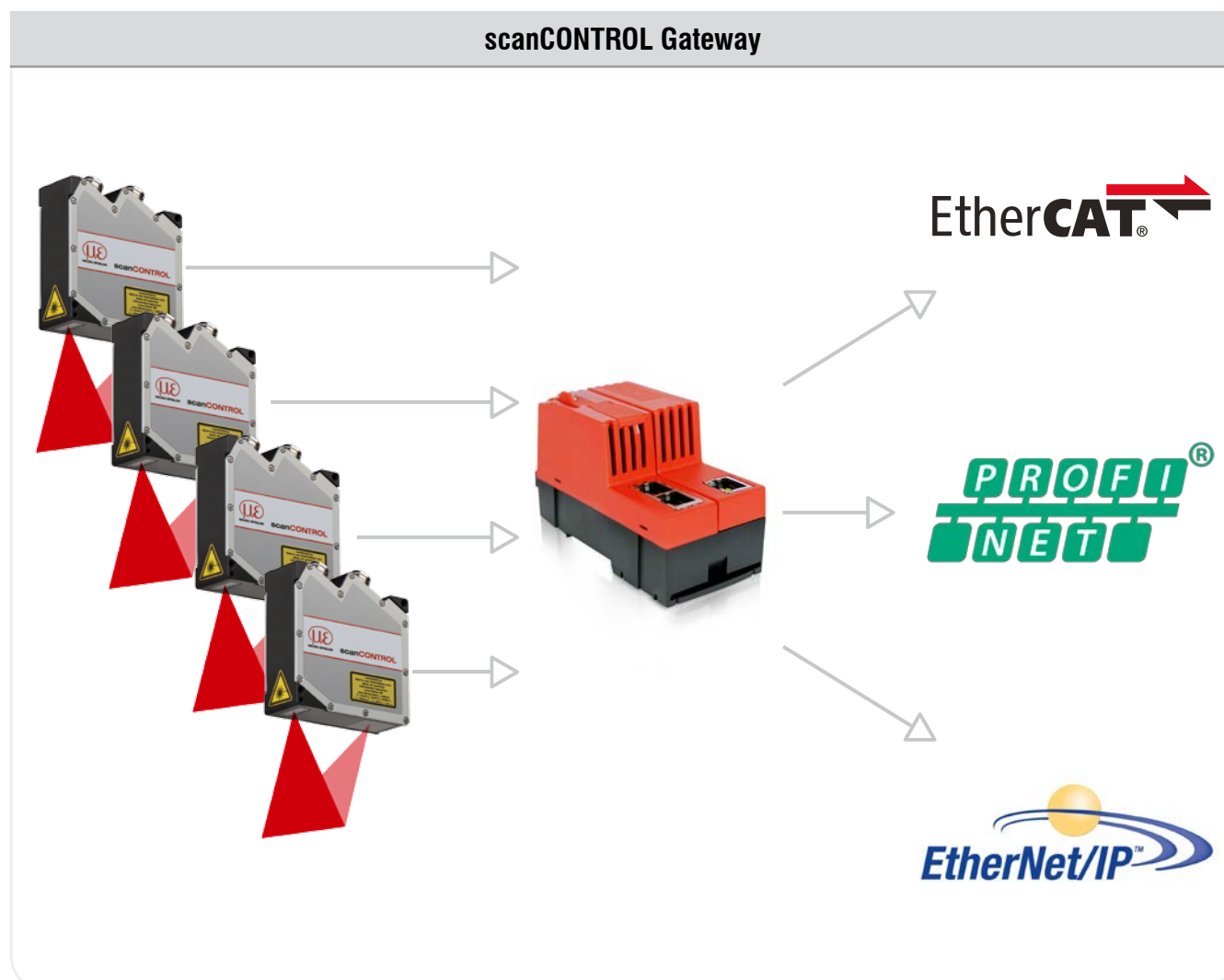
Gateway

6414129	scanCONTROL Gateway	Fieldbus coupler, configurable for PROFINET, EtherNet/IP and EtherCAT
6411168	scanCONTROL SPU Switch, 5 ports	Industrial Ethernet Switch (unmanaged) for mounting rail, 10/100/1000 Mbit/s, 5 ports
6411167	scanCONTROL SPU Switch, 8 ports	Industrial Ethernet Switch (unmanaged) for mounting rail, 10/100/1000 Mbit/s, 8 ports

Sensors on the gateway	Max. measurement frequency
1	450Hz
2	240Hz
3	160Hz
4	120Hz

Analog signals / digital switching signals – for all scanners of the SMART and GAP classes
The scanCONTROL Output Unit is addressed via Ethernet and outputs analog and digital signals.
Different output terminals can be connected to the fieldbus coupler.

scanCONTROL Output Unit

Analog signals

Digital signals
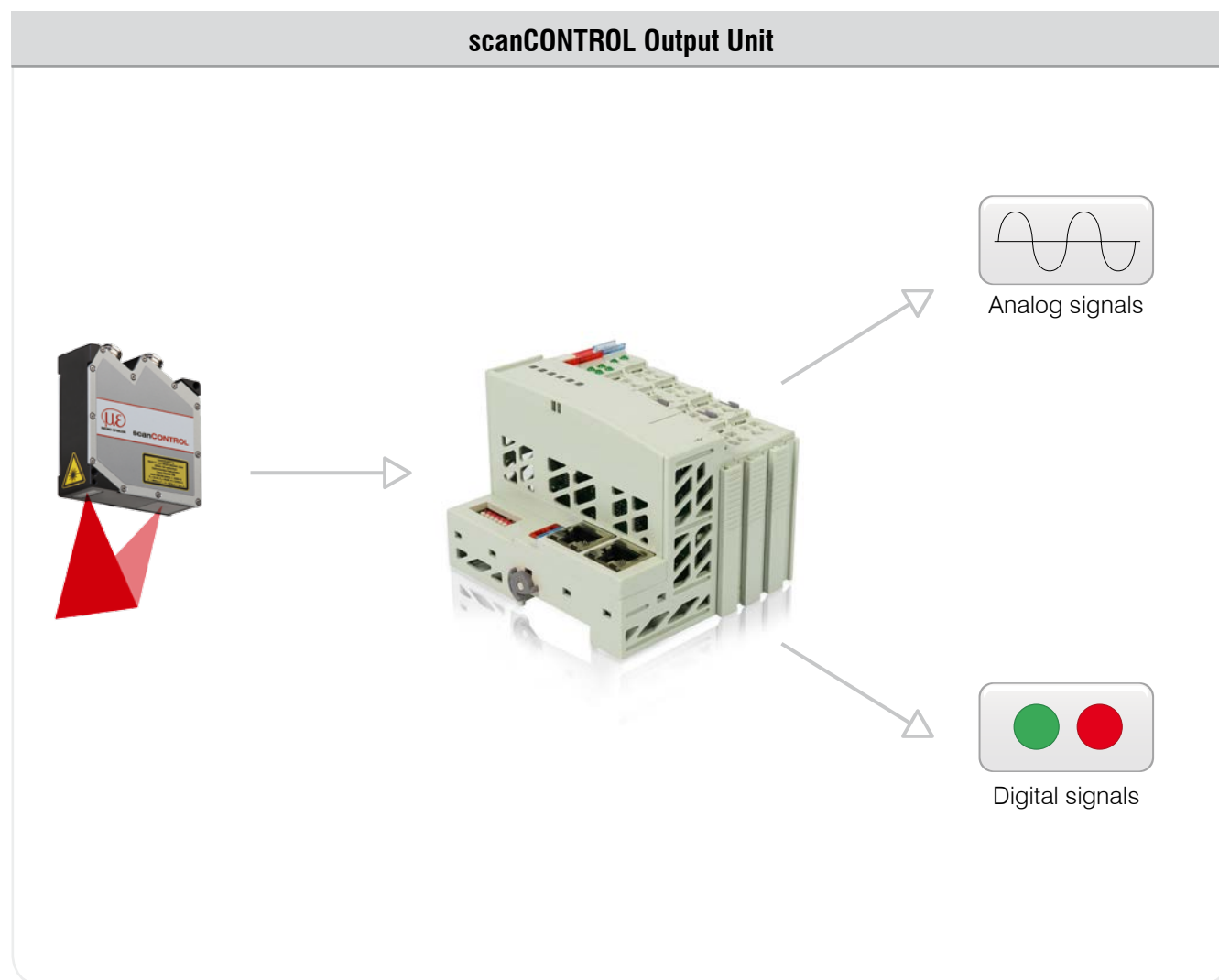
Output Unit

6414073	Output Unit Basic/ET	Fieldbus coupler with filter module and bus end terminal
0325131	OU-DigitalOut/8-channel/DC24V/0.5A/negative	8-channel digital output terminal; DC 24V; 0.5A; negative switching;
0325115	OU-DigitalOut/8-channel/DC24V/0.5A/positive	8-channel digital output terminal; DC 24V; 0.5A; positive switching
0325116	OU-AnalogOut/4-channel/±10V	4-channel analog output terminal; ±10V
0325135	OU-AnalogOut/4-channel/0-10V	4-channel analog output terminal; 0-10V
0325132	OU-AnalogOut/4-channel/0-20mA	4-channel analog output terminal; 0-20mA
0325133	OU-AnalogOut/4-channel/4-20mA	4-channel analog output terminal; 4-20mA

Further terminals are available on request.

Connection cable

Multi-function cable
For power supply, digital inputs (TTL or HTL),
RS422 (half-duplex)

PC	2600/2900	-5	
		Cable length in metres	
	Sensor type		

PC = Multi-function cable qualified for drag chain use
PCR = Multi-function cable suitable for use with robots

Ethernet connection cable
For parameter set up, value
and profile transmission

SC	2600/2900	-5	
		Cable length in metres	
	Sensor type		

SC = Ethernet connection cable qualified for drag chain use
SCR = Ethernet connection cable suitable for use with robots

Accessories

Art. No.	Model	Description
0323478	Connector/12-pol/LLT2600-2900/PS/RS422/DigIN	Connector multi-function port for scanCONTROL series LLT26xx and 29xx
0323479	Connector/8-pol/LLT2600-2900/Ethernet	Connector for Ethernet socket for scanCONTROL series LLT26xx and 29xx
2420067	PS2600/2900	Power supply unit for scanCONTROL 2600/2900
0254072	Suitcase scanCONTROL 26/27/29 MR 10-100	Transport suitcase for scanCONTROL sensors, incl. measuring stand

Ethernet connection cable

Multi-function cable
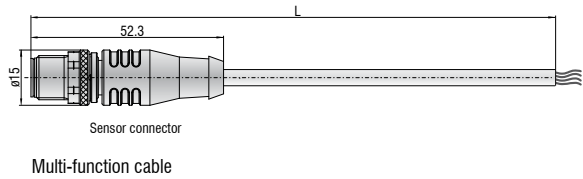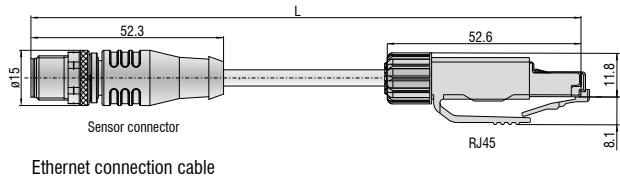
Protection and cooling housing for LLT26xx and 29xx

Protection housing including blow-out system

Air purge connection

Exchangeable protective glass

Adjustable splash guard

3x mounting holes M4

Ø6
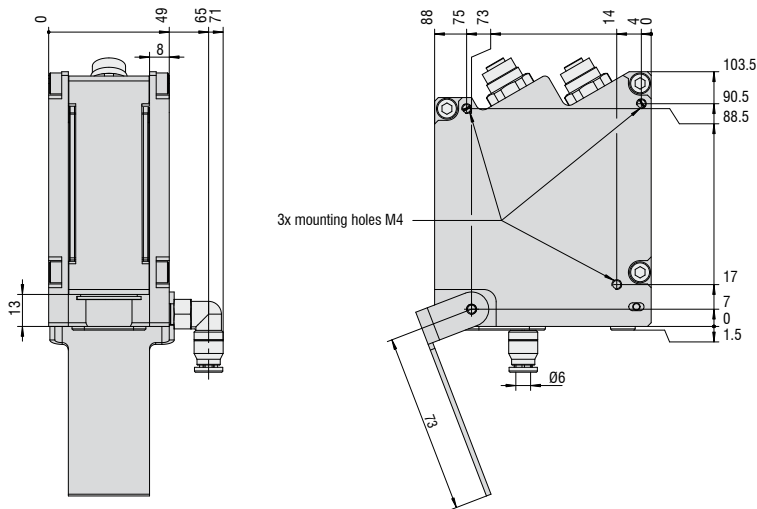
Protection housing including blow-out system and water cooling

Connections for liquid cooling

Connections for liquid cooling

Air purge connection

Exchangeable protective glass

Adjustable splash guard

3x mounting hole M4

5x Ø6
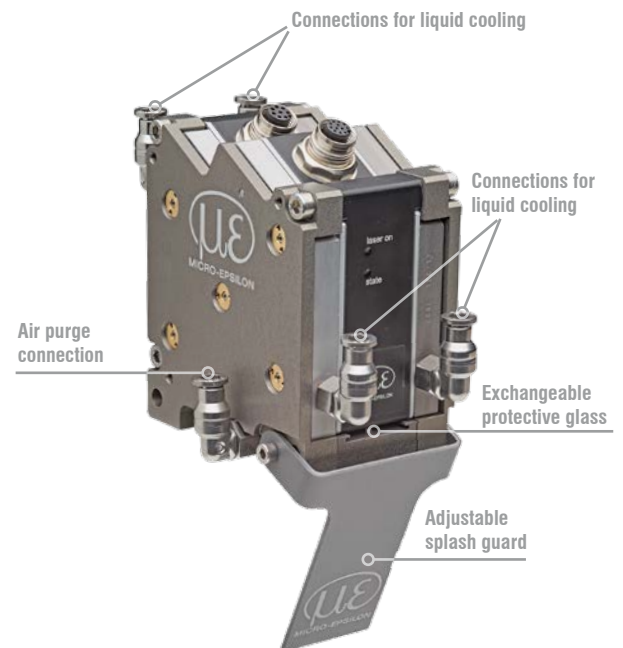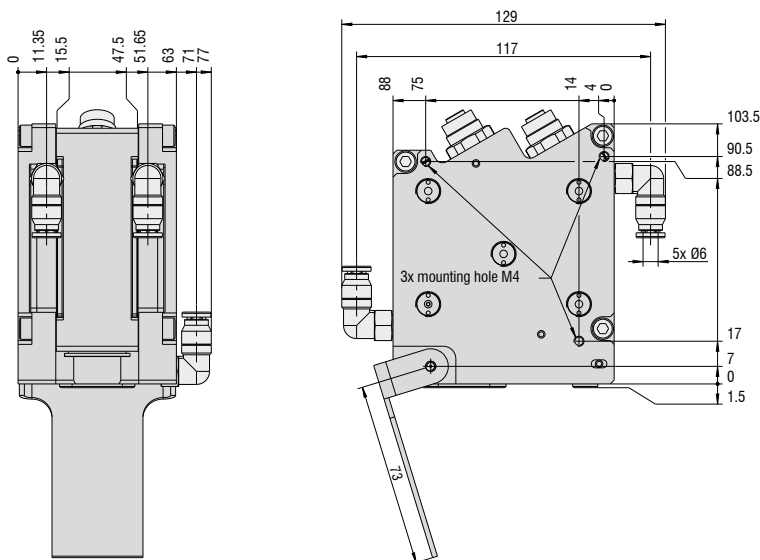
Art. No.	Model	Description
2105058	scanCONTROL LLT26/29 protection housing	Adaptive protection housing for scanCONTROL 26xx/29xx
2105059	Protective scanCONTROL LLT26/29 cooling housing	Adaptive protection and cooling housing for scanCONTROL 26xx/29xx
0755075	Exchangeable glass for protection housing	Exchangeable glass for protection/cooling concept LLT 26/29, pack. with 50 pcs
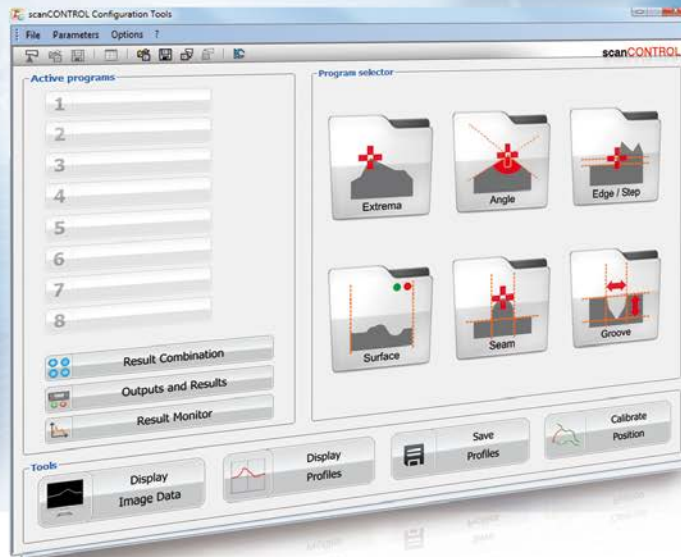
- *Plug & Play solution for complex measurement tasks*

- *Evaluation in the sensor head - without external controller*

- *Parallel execution of different measurement tasks and multiple evaluation*

- *Easy online and offline analysis*

The sensors of the SMART series have an intelligent controller which allows simple profile analysis without an additional PC.

The scanCONTROL Configuration Tools software is used for parameter set up of the profile analysis. As well as configuration of the sensor, this also enables the parameters of the measurement task to be set up and of the outputs, resulting in a compact, industrial, inline measurement solution.

For offline testing of high speed processes, the functions of the software also operate using pre-recorded profiles, without requiring a sensor to be connected.

A complete profile analysis task can be programmed in four simple steps. The pre-configured measuring system operates in standalone mode and transmits the measured values to a PLC.
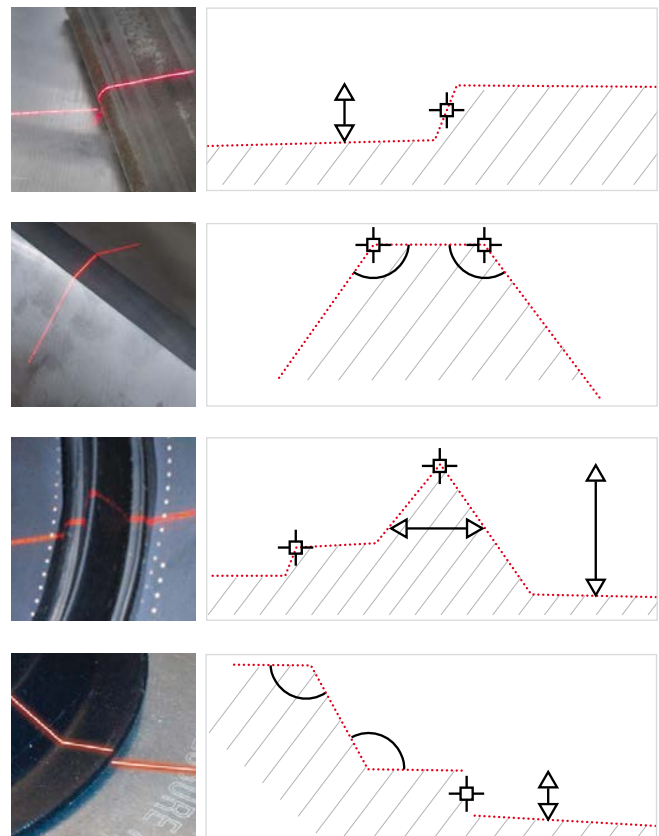
The system is freely configurable and can be quickly and easily adjusted for a variety of tasks

Step 1

Alignment of the sensor

The ‚Display Image Data' module will help you to mount the sensor. This shows a live image of the sensor matrix and the optimum measuring range, as well as the reflection characteristics of the target.

Step 2

Sensor setting

Selecting exposure time, profile frequency and other parameters adjust the laser scanner to the desired application. Dynamic algorithms such as the automatic exposure time or the dynamic threshold enable to detect difficult surfaces as well. The software delivers a direct feedback about the achieved saturation and the current scanner profile frequency.

Step 3

Selection of measurement programs

Depending on the measurement task, one or more measurement programs can be selected with a simple mouse click. More than 25 modules are available. There are different module groups for the respective, common profile measurement tasks. The measurement programs to the right are suitable for the exemplary profiles above.

Step 4

Configuration of measurement programs

Each of these measurement programs can be individually configured. On a simple interface, different methods of interacting with the live measurement signal are available. Therefore, the relevant areas of the signal, for example, can be cut out and reference points set. The results of the individual measurement packages are displayed directly in the profile.

Step 5

Defining the outputs and displaying measured values

In the final step, all measurement values are displayed as a profile, filtered temporally if required, and assigned to the different outputs. Limit values and interfaces can therefore be easily configured.

Download:
http://www.micro-epsilon.com/configuration-tools
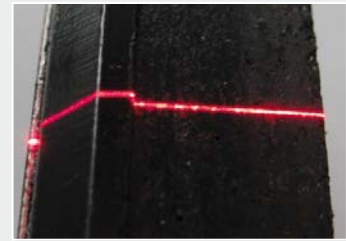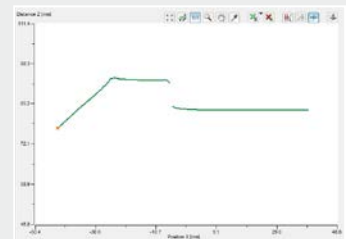
Step 1

Alignment of the sensor

Step 2

Sensor setting

Step 3

Selection of measurement programs

Step 4

Configuration of measurement programs
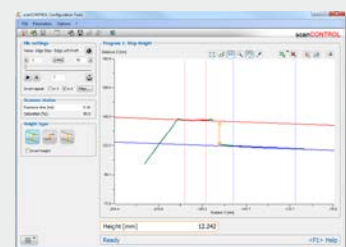
Step 5

Output and display of measured values
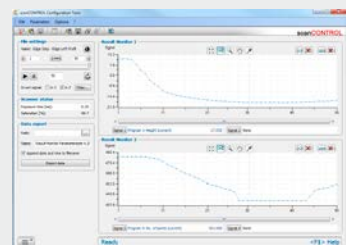
- Plug & Play solution for gap measurements

- Different gap definitions

- Various measurement values (gap width, height offsets, position,...)

- Evaluation in the sensor head - without external controller

The following gap main groups are available:

Basic gaps
The edgeless gaps are the so-called „Basic Gaps" and are characterised by clearly defined reference points for gap measurement. These could be, for example, the end points or the lowest points of each side. Furthermore, the offset of both sides is easily measurable. This gap type allows for an easy entry and the desired measurement result is output by modifying just a few settings.

Projected gaps
With these types of gaps, the end points of both sides are projected. There are different ways of projection, for example, the projection onto a common parallel or the projection of an end point onto the opposite side. The distance between the projected points is described as gap width. The pre-defined gap variants allow for easy and fast setting.

Groove gaps
If there is a visible ground in the gap, further inspections can be carried out in order to e.g. measure the gap depth. The evaluations also apply for grooves and other cavities. With soldering applications e.g. the so-called V-gap of pipelines, special algorithms of the „Advanced Groove Gap" output the oscillation width depending on the current soldering depth.

Advanced gaps
These types offer the user advanced settings. The algorithms for flushness measurement or projection can be adapted independently of each other as well as the search criteria for the respective gap points. Furthermore, these gap types provide numerous additional measured values such as angle or unevenness of the edges.

Basic Gaps

Projected Gaps

Groove Gaps

Advanced Gaps
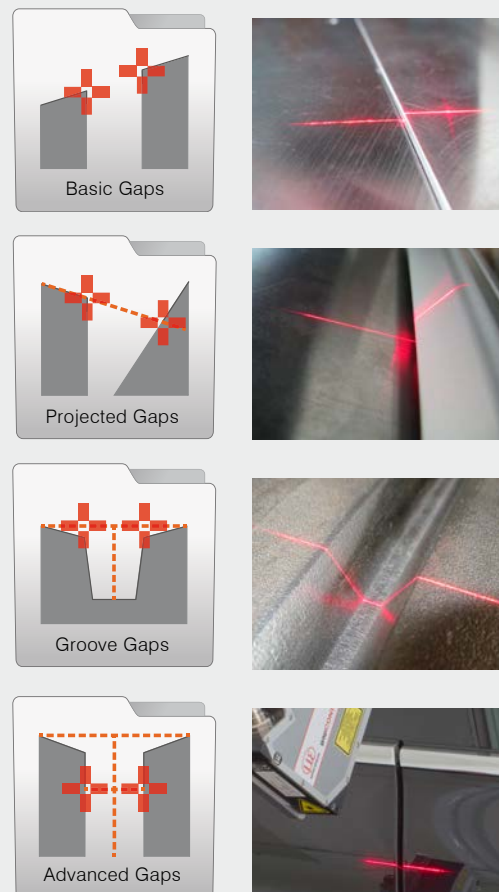
Main groups of different gap types

gapCONTROL Setup Software

Not all gaps are alike. There are different definitions of how the optical gap is defined for different industries and measuring targets. The gapCONTROL Setup Software enables quick and easy configuration of gapCONTROL sensors. Both components together represent a complete solution for automated gap measurement. After parameterisation, the sensor operates in standalone mode. However, the software can be used for the visualisation of the measured values.

gapCONTROL modes

The user-friendly, intuitive software guides the user through the program. In the first step, a gap mode is chosen from a wide selection of conventional gap types. This pre-selection specifies a start configuration for the chosen gap type. With simple types of gap, e.g. "Edge Points Gap", no additional configuration is needed. Other gap types offer application-specific configuration options.

Set up and configuration of gap measurements

After selecting the gap mode, the search algorithms for the right and left-hand gap edges as well as for the gap offset are specified with the gapCONTROL Software. For dynamic processes, gapCONTROL also offers tracking functionality, e.g. following the centre position.

Measurement output: plug & play solution in the integrated controller

For output of measured values, these can be configured with freely assigned values. The configuration of gapCONTROL can be saved in the memory of the sensor. Consequently, the sensor is ready for running in its standalone mode without an external PC. Besides measurement value output via Ethernet (Modbus TCP, UDP) and RS422 (Modbus RTU or ASCII format), additional digital switch signals and analog measuring values can also be output.

Measurement and evaluation of the measurement value sequence

Using the „Result Monitor" analysis program, selected measurement value sequences of recorded profiles and live profiles can be displayed and analysed, enabling the evaluation of measurements. Additionally, an integrated cgm analysis (capability gauge measurement), and further statistical parameters (e.g. limit value exceeded, average values) are available. The software allows these values to be exported for archive purposes or for further analysis in calculation tables.

Load and save

The gapCONTROL Setup Software allows both profiles and measuring results (e.g. gap width) to be saved. Stored profiles, even without a gapCONTROL sensor connected, can be re-loaded, and all parameters of the evaluation can be tested on these offline data. Several example profiles are already included with the standard installation of the gapCONTROL Setup Software, and they can largely be used to test the functioning of the software.
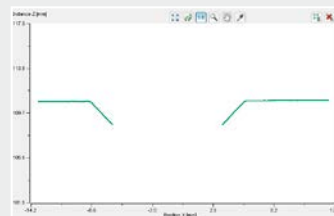
Download:
http://www.micro-epsilon.com/gapcontrol-setup-software

Step 1

Alignment of the sensor
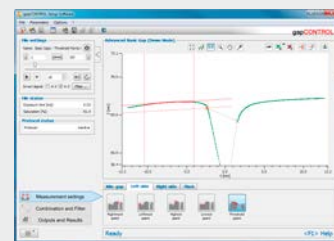
Step 2

Sensor setting

Step 3

Selection of measurement programs
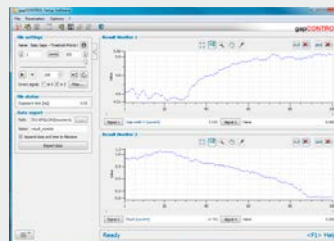
Step 4

Configuration of measurement programs

Step 5

Output and display of measured values

- *Display of profile sequences*

- *Offline or real-time display of 3D profiles*

- *Synchronisation of the direction of travel (e.g. by encoder)*

- *2D Export of the profile sequences (PNG)*

- *3D Export (ASC, STL, CSV) for CAD programmes*

- *Intensity per point can be displayed and exported*

3D visualisation for all scanCONTROL/gapCONTROL models
By means of the relative movement between sensor and target, the third dimension for the measurement data is obtained. The y-coordinates are assigned via a trigger or CMM counter.

The scanCONTROL 3D-View software is designed for viewing and exporting this 3D data. In addition, 3D-View also supports the configuration of the sensor.

The software enables the interactive viewing of 3D data and the export of this measurement data to common data formats (ASCI, STL or PNG). Various display modes, views and color palettes help in setting up the sensors and analysing the profiles.

The software supports the online visualisation of the profiles as well as offline analysis of stored profile sequences.
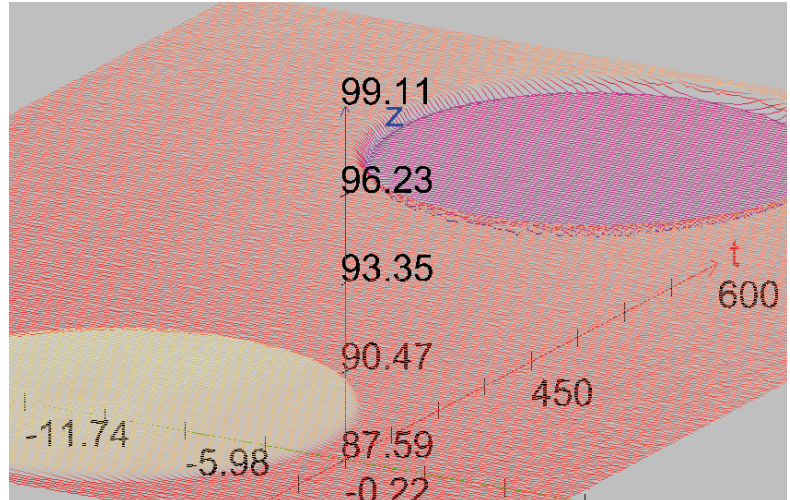
Download:
http://www.micro-epsilon.com/3d-view
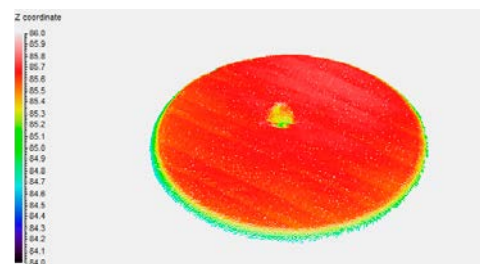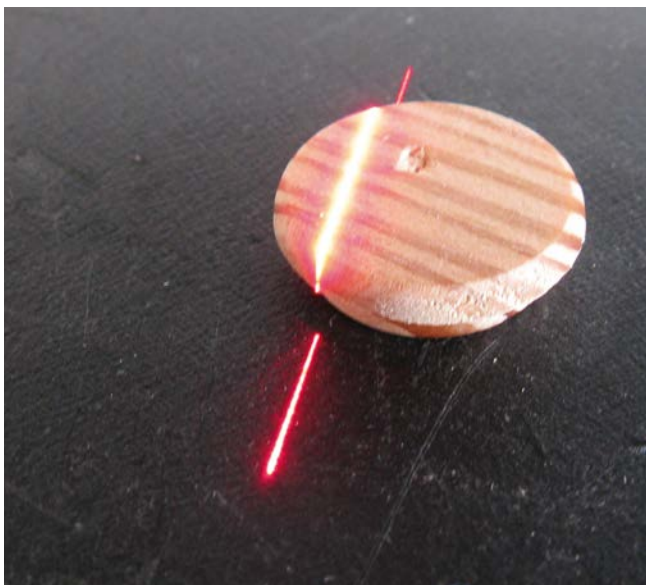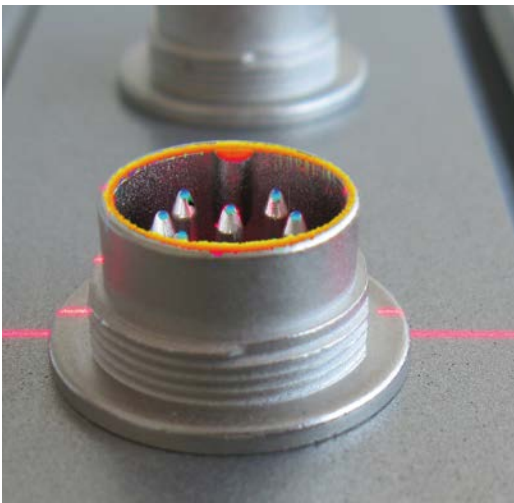

Distance profile
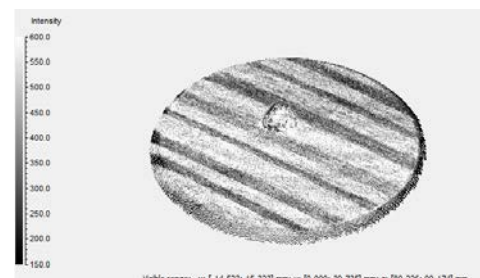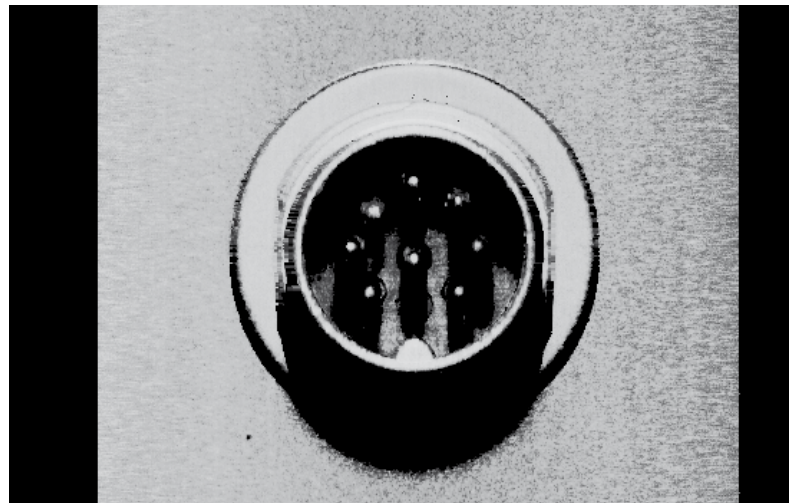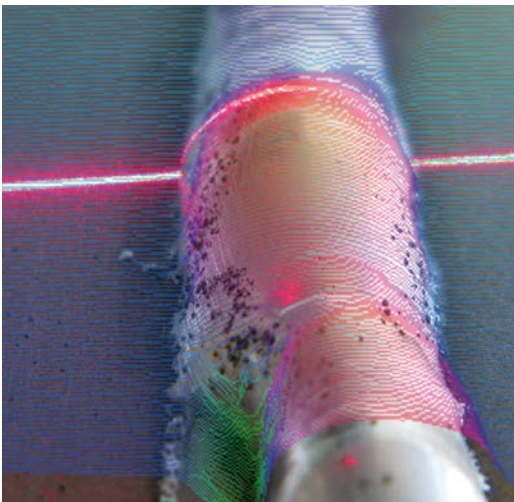

Intensity
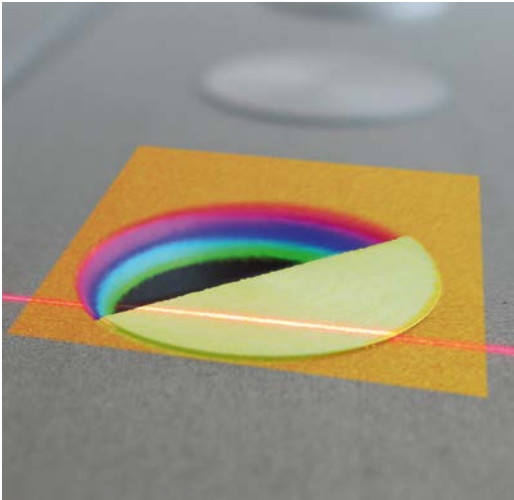
Rivet

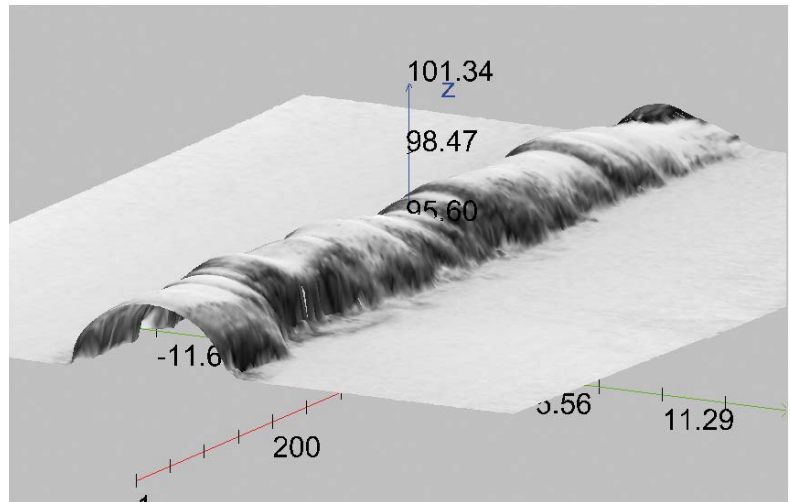Display mode: „3D view lines"; Color palette „z-coordinates"

Pin

Display mode: „2D view"; Color palette „intensity"

Weld seam

Display mode: „3D view triangles"; Color palette coding "intensity"

The scanCONTROL COMPACT and HIGHSPEED sensors record a profile from individual calibrated points for each measurement. These profiles can be used individually or combined in a container set, and transferred to customer applications as an array or matrix. In addition to the data transfer of individual measuring points and their additional information (e.g. intensity, counter reading) the entire configuration of the sensor can also be controlled from its own application software.

Micro-Epsilon provides a number of interfaces to access the parameter and data transfer functions. The transmission interface primarily used by LLT sensors for communications and profile transfer is Ethernet.

Ethernet and GigE Vision
Each scanCONTROL sensor complies with the GigE Vision Standard (Gigabit Ethernet for Machine Vision) of the AIA (Automated Imaging Association).

The standard is widely used in the image processing industry and is therefore supported by all conventional computer vision tools, ensuring fast and smooth integration into different image processing software packages - also for 3D evaluation.

GigE Vision ensures optimum data security, perfect performance and short design-in times during implementation. GigE Vision is based on gigabit Ethernet and offers a maximum transfer rate. Ethernet technology offers advantages such as long cable lengths without using repeaters/hubs, and it permits the use of inexpensive network components. The GigE Vision standard provides an open framework for data transmission (e.g. profiles, data sets) and control signals between scanCONTROL and a PC. The infrastructure topology provides numerous opportunities for single and multiple scanner applications.
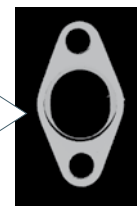
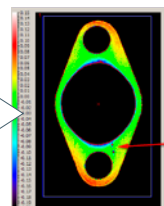Profile recording   Grey-scale image   Image processing software

Integration with the C/C++ library

The C/C++ library for scanCONTROL supports both static and dynamic loading. Both stdcall and cdecl are supported as calling conventions. The individual functions of the library are clearly documented in the interface description and explained using examples.

The scanCONTROL SDK integration package includes:
- the LLT.DLL library file
- Interfaces and scanCONTROL documentation
- numerous programming examples for C++ and C#, e.g. for trigger and container mode
- Tool DeveloperDemo.exe for quick testing of the sensor configuration.
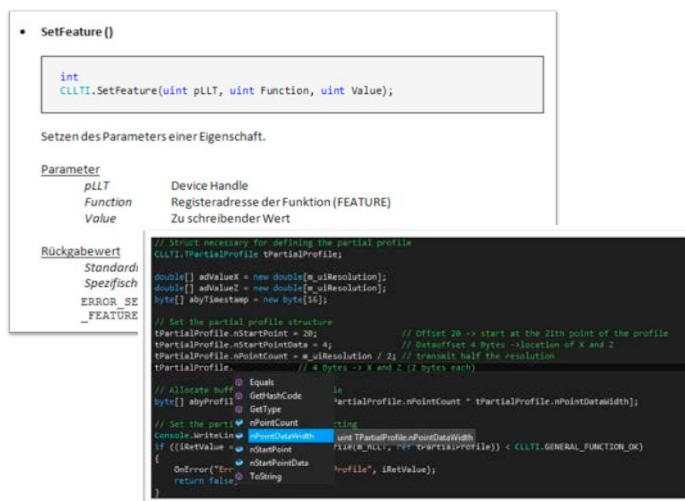
Integration with LabVIEW

The LabVIEW scanCONTROL instrument driver supports fast integration of scanCONTROL sensors into the LabVIEW application environment. For accessing a scanCONTROL sensor and its basic settings, users can drag-and-drop modules directly from the function palette into their VI. Example VIs that illustrate scanCONTROL integration are also included in this package.

The integration of scanCONTROL sensors into the LabVIEW environment is based on the C/C++ library (LLT.DLL) of Micro-Epsilon. Detailed documentation also shows how to set up additional special sensor parameters.
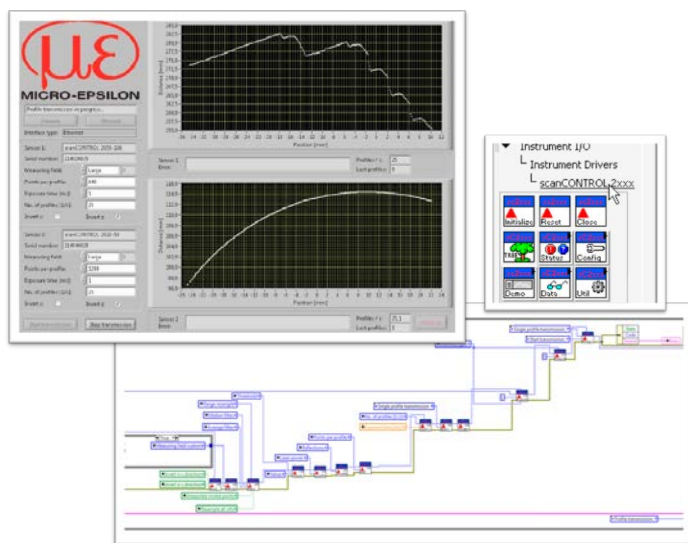

Integration with Linux

The integration into Linux is performed using an Open Source C library which has been extended by some important control features for scanCONTROL. An additional C++ library enables fast sensor integration of the entire functionality into a user-friendly API.

This library is based on the GeniCam standard which is why the sensor can be controlled either via GeniCam commands or directly via the control parameters listed in the documentation. For integration support (e.g. trigger, container mode), also some example programs are available.

Use on ARM embedded PCs (e.g. Raspberry Pi) is possible with restrictions.
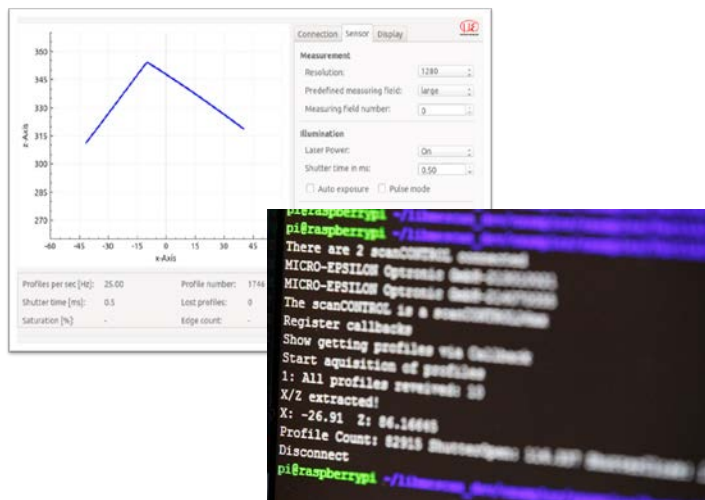
- *Measurement value evaluation of up to 8 laser scanners*

- *Transmission of measured values to higher-level PLC (PROFINET, UDP, Modbus)*

- *Digital / analog in- / outputs*

- *Integrated web server for display of results*

- *Numerous possibilities for recording measurement values*

Many applications require several scanners e.g. for contour measurement or when detecting large components. The scanCONTROL Smart PLC Unit is an industrial control unit incl. customised application software for measurement value calculation intended for laser scanners of the scanCONTROL Smart and gapCONTROL product classes.
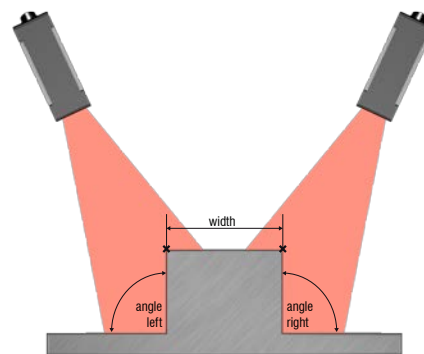
The scanned measurement values are evaluated, displayed, recorded and transmitted to higher-level PLCs using analog and digital interfaces. The modular design of the Smart PLC Unit enables the user to connect up to 8 laser scanners.
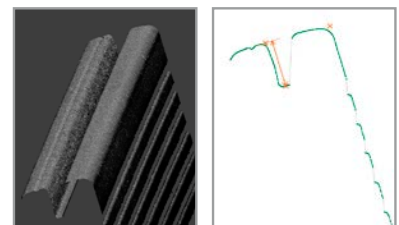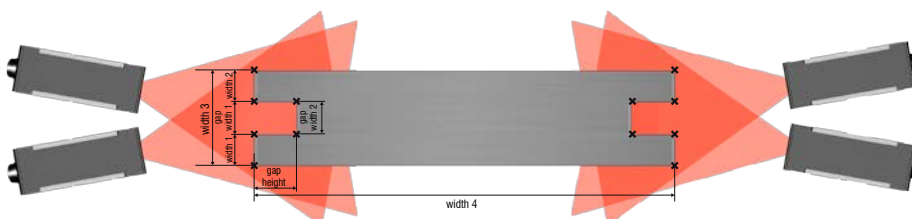
Application examples:

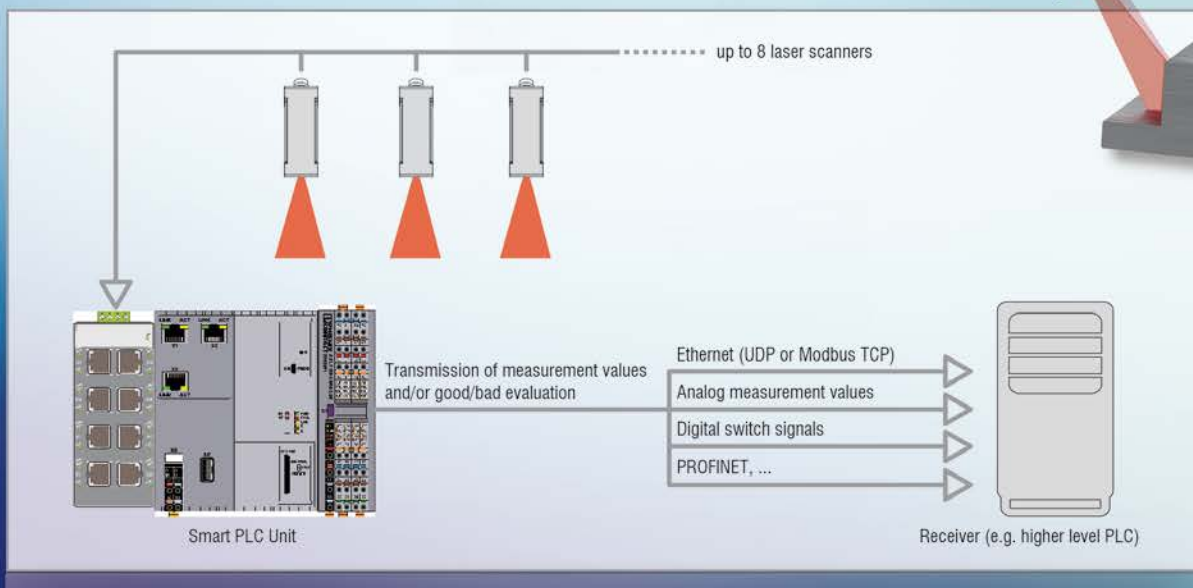**Determination of cross-section in the extrusion process**
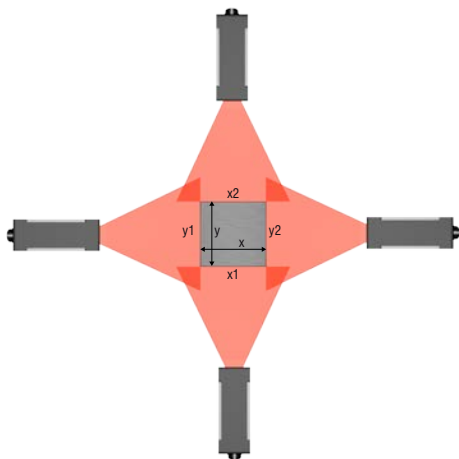
Contour measurement of a rail

Profile evaluation (profile width, bar width, groove width, groove depth)

up to 8 laser scanners

Transmission of measurement values
and/or good/bad evaluation

Ethernet (UDP or Modbus TCP)

Analog measurement values

Digital switch signals

PROFINET, ...

Smart PLC Unit

Receiver (e.g. higher level PLC)

High performance sensors made by Micro-Epsilon

Sensors and systems for displacement and position

Sensors and measurement devices for non-contact temperature measurement
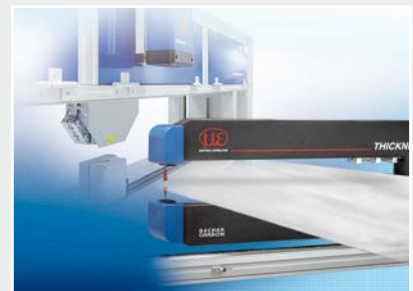

2D/3D profile sensors (laser scanner)

Optical micrometers, fiber optic sensors and fiberoptics

Color recognition sensors, LED analyzers and color inline spectrometer

Measurement and inspection systems

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