More Precision

scanCONTROL // 2D/3D laser scanner (laser profile sensors)
Laser scanner for precise profile measurement and evaluation

**NEW**

**scanCONTROL Gateway** (page 18)
- Outputs measured values via PROFINET, EtherCAT and EtherNet/IP
- Up to 4 sensors

**NEW**

**SMART PLC Unit** (page 30)
- Evaluates measured values of SMART and GAP sensors
- Fast data processing
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.
Laser scanner for precise profile measurement and evaluation

### Customer evaluation
These models provide calibrated profile data which can be further processed on a PC using a customer software evaluation.

<table>
<thead>
<tr>
<th>Compact</th>
<th>Highspeed</th>
<th>Smart</th>
<th>Gap</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laser scanners for common measurement tasks</td>
<td>Laser scanners with fast profile frequency</td>
<td>Laser scanners with comprehensive software</td>
<td>Laser scanners with software specifically developed for gap measurements</td>
</tr>
</tbody>
</table>

#### LLT26xx
- 640 points/profile
- Profile frequency: Standard up to 300Hz, High speed up to 4000Hz

- **scanCONTROL 2600**
  - Page 10
- **scanCONTROL 2650**
  - Page 10
- **gapCONTROL 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**
- **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.

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.
**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.
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.
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.

Technical details and versions
scanCONTROL 26x0
- 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

gapCONTROL 26x1

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
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<td>/Si = integrated laser switch-off</td>
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<td>/PT = integrated pigtail cable 0.25 m</td>
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<tr>
<td>/3B = 3B laser class</td>
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</table>

Measuring range
25mm
50mm
100mm

Class
00 = COMPACT
10 = SMART
11 = GAP
50 = HI-SPEED

Series
LLT26xx

Options*

<table>
<thead>
<tr>
<th>/Si</th>
<th>Integrated laser switch-off</th>
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<tr>
<td>/PT</td>
<td>Pigtail cable</td>
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<td>Hardware switch-off of the laser line</td>
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<td>0.25m long cable directly out of the sensor</td>
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<table>
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<tr>
<th>/3B</th>
<th>3B laser class</th>
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<tr>
<td>Improved laser power (20mW) e.g. for dark surfaces</td>
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*Options can be combined

Accessories from page 18
## Technical details

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<tr>
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<td>Midrange</td>
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<td>±0.10% FSO</td>
<td>±0.13% FSO</td>
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<td><strong>x-axis (width)</strong></td>
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<td>83.1mm</td>
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<td>58mm</td>
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<td>23.2mm</td>
<td>40mm</td>
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<td>up to 300Hz</td>
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<td></td>
<td>up to 4,000Hz</td>
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<td>Profile data transmission</td>
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<td>Trigger</td>
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<td></td>
<td>RS422 (half-duplex) 4)</td>
<td>Output of measurement values</td>
<td>Sensor control</td>
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<td></td>
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<td>Trigger</td>
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<td>PROFINET 6); EtherCAT 6); EtherNet/IP 6)</td>
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<tr>
<td><strong>Display (LED)</strong></td>
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<td>1x laser ON/OFF, 1x power/error/status</td>
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<td><strong>Light source</strong></td>
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<td>25°</td>
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<tr>
<td></td>
<td>optional</td>
<td>≤ 20mw (3B laser class)</td>
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<td>Safety interlock, hardware switch-off</td>
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<td><strong>EMC</strong></td>
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<td>acc. EN 61326-1: 2006-10</td>
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<td></td>
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<td>EN 61000-6-2: 2006-03</td>
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<td><strong>Vibration</strong></td>
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<td><strong>Shock</strong></td>
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<td>15g / 6ms</td>
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<td><strong>Weight sensor (without cable)</strong></td>
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<td>380g</td>
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<td><strong>Supply</strong></td>
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<td>11-30VDC, 24V, 500mA, IEEE 802.3af class 2, Power over Ethernet</td>
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</table>

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) Only with Output Unit
5) Only with scanCONTROL Gateway
6) FSO = Full scale output
Compact design for precise measurement tasks

The design of the LLT29xx series is focused 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.

Article description structure

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<thead>
<tr>
<th>LLT</th>
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<td>/3B = 3B laser class</td>
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<tr>
<td>Class</td>
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<td>00 = COMPACT / 10 = SMART</td>
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<td>11 = GAP / 50 = HIGHSPEED</td>
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</table>

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 excellent 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.

Options*

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

*Options can be combined

Accessories from page 18
### Technical Details

#### Model LLT 29xx-10/BL 29xx-25 29xx-50 29xx-100

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<thead>
<tr>
<th>Feature</th>
<th>29xx-10/BL</th>
<th>29xx-25</th>
<th>29xx-50</th>
<th>29xx-100</th>
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<td><strong>Start of measuring range</strong></td>
<td>52.5mm</td>
<td>53.5mm</td>
<td>70mm</td>
<td>190mm</td>
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<tr>
<td><strong>End of measuring range</strong></td>
<td>60.5mm</td>
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<td><strong>End of measuring range</strong></td>
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<tr>
<td><strong>Height of measuring range</strong></td>
<td>8mm</td>
<td>25mm</td>
<td>50mm</td>
<td>100mm</td>
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<tr>
<td><strong>Extended measuring range Start of measuring range</strong></td>
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<td>1300mm</td>
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#### Linearity

(2sigma) ±0.17% FSO ±0.10% FSO ±0.10% FSO ±0.10% FSO

#### Reference resolution

1µm 2µm 4µm 12µm

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### Interfaces

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Ethernet GigE-Vision</td>
<td>Output of measurement values, Sensor control, Profile data transmission</td>
</tr>
<tr>
<td>Digital inputs</td>
<td>Mode switching, Encoder, Trigger</td>
</tr>
<tr>
<td>RS422 (half-duplex)</td>
<td>Output of measurement values, Sensor control, Trigger, Synchronisation</td>
</tr>
<tr>
<td>Multi function port</td>
<td>Ethernet (UDP / Modbus TCP), RS422 (ASCII / Modbus RTU), Analog, Switch signal, PROFINET, EtherCAT, EtherNet/IP</td>
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<tr>
<td>Output of measurement values</td>
<td>Ethernet (UDP / Modbus TCP), RS422 (ASCII / Modbus RTU), Analog, Switch signal, PROFINET, EtherCAT, EtherNet/IP</td>
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</tbody>
</table>

### Display (LED)

1x laser ON/OFF, 1x power/error/status

### Light source

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>standard</td>
<td>Semiconductor laser 405nm (blue)</td>
</tr>
<tr>
<td>optional</td>
<td>Semiconductor laser 658nm (red)</td>
</tr>
</tbody>
</table>

### Laser power

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>standard</td>
<td>≤ 8mW (2M laser class)</td>
</tr>
<tr>
<td>optional</td>
<td>≤ 20mw (3B laser class)</td>
</tr>
</tbody>
</table>

### Integrated laser switch-off

Safety interlock, hardware switch-off

### Permissible ambient light (fluorescent light)

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 / 8ms

### Operating temperature

0°C to 45°C

### Storage temperature

-20°C to 70°C

### Dimensions

96 x 118.5 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
7 FSO = Full scale output
Dimensions and measuring range

LLT29xx-10/BL

Recommended attachment point

M5 × 2
5.2 x 90° (on both sides)

SMR = Offset distance
EMR = Reference distance

Z
Dimensions and measuring range

scanCONTROL 26x0 / 29x0

gapCONTROL 26x1 / 29x1

LLT26xx/29xx-50

Recommended attachment point

Recommended attachment point

MR ext. >= 65
70 SMR
95 MMR
120 EMR
MR ext. <= 125

standard range
extended range

Recommended attachment point

Recommended attachment point

MR ext. >= 65
70 SMR
95 MMR
120 EMR
MR ext. <= 125

standard range
extended range

 Recommended attachment point

Recommended attachment point

MR ext. >= 65
70 SMR
95 MMR
120 EMR
MR ext. <= 125

standard range
extended range

 Recommended attachment point

Recommended attachment point

MR ext. >= 65
70 SMR
95 MMR
120 EMR
MR ext. <= 125

standard range
extended range
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

<table>
<thead>
<tr>
<th>Gateway</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>6414129</td>
<td>scanCONTROL Gateway Fieldbus coupler, configurable for PROFINET, EtherNet/IP and EtherCAT</td>
</tr>
<tr>
<td>6411168</td>
<td>scanCONTROL SPU Switch, 5 ports Industrial Ethernet Switch (unmanaged)</td>
</tr>
<tr>
<td>6411167</td>
<td>scanCONTROL SPU Switch, 8 ports Industrial Ethernet Switch (unmanaged)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sensors on the gateway</th>
<th>Max. measurement frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>450Hz</td>
</tr>
<tr>
<td>2</td>
<td>240Hz</td>
</tr>
<tr>
<td>3</td>
<td>160Hz</td>
</tr>
<tr>
<td>4</td>
<td>120Hz</td>
</tr>
</tbody>
</table>
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**

<table>
<thead>
<tr>
<th>Output Unit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>6414073</td>
<td>Output Unit Basic/ET</td>
</tr>
<tr>
<td>0325131</td>
<td>OU-DigitalOut/8-channel/DC24V/0.5A/negative</td>
</tr>
<tr>
<td>0325115</td>
<td>OU-DigitalOut/8-channel/DC24V/0.5A/positive</td>
</tr>
<tr>
<td>0325116</td>
<td>OU-AnalogOut/4-channel/±10V</td>
</tr>
<tr>
<td>0325135</td>
<td>OU-AnalogOut/4-channel/0-10V</td>
</tr>
<tr>
<td>0325132</td>
<td>OU-AnalogOut/4-channel/0-20mA</td>
</tr>
<tr>
<td>0325133</td>
<td>OU-AnalogOut/4-channel/4-20mA</td>
</tr>
</tbody>
</table>

Fieldbus coupler with filter module and bus end terminal
8-channel digital output terminal; DC 24V; 0.5A; negative switching;
8-channel digital output terminal; DC 24V; 0.5A; positive switching
4-channel analog output terminal; ±10V
4-channel analog output terminal; 0-10V
4-channel analog output terminal; 0-20mA
4-channel analog output terminal; 4-20mA

Further terminals are available on request.
## Connection cable

<table>
<thead>
<tr>
<th>Connection</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multi-function cable</td>
<td>For power supply, digital inputs (TTL or HTL), RS422 (half-duplex)</td>
</tr>
<tr>
<td>Ethernet connection cable</td>
<td>For parameter set up, value and profile transmission</td>
</tr>
</tbody>
</table>

### Multi-function cable
- **PC** 2600/2900 -5
  - Cable length in metres
  - Sensor type

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

## Accessories

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

---

**Diagram:**
- Ethernet connection cable
- Multi-function cable
Protection and cooling housing for LLT26xx and 29xx

Protection housing including blow-out system

Protection housing including blow-out system and water cooling

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
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.

- 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 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
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.
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:
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 (ASCII, 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
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.
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.
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.

**Application examples:**

**Determination of cross-section in the extrusion process**

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.

**Contour measurement of a rail**

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