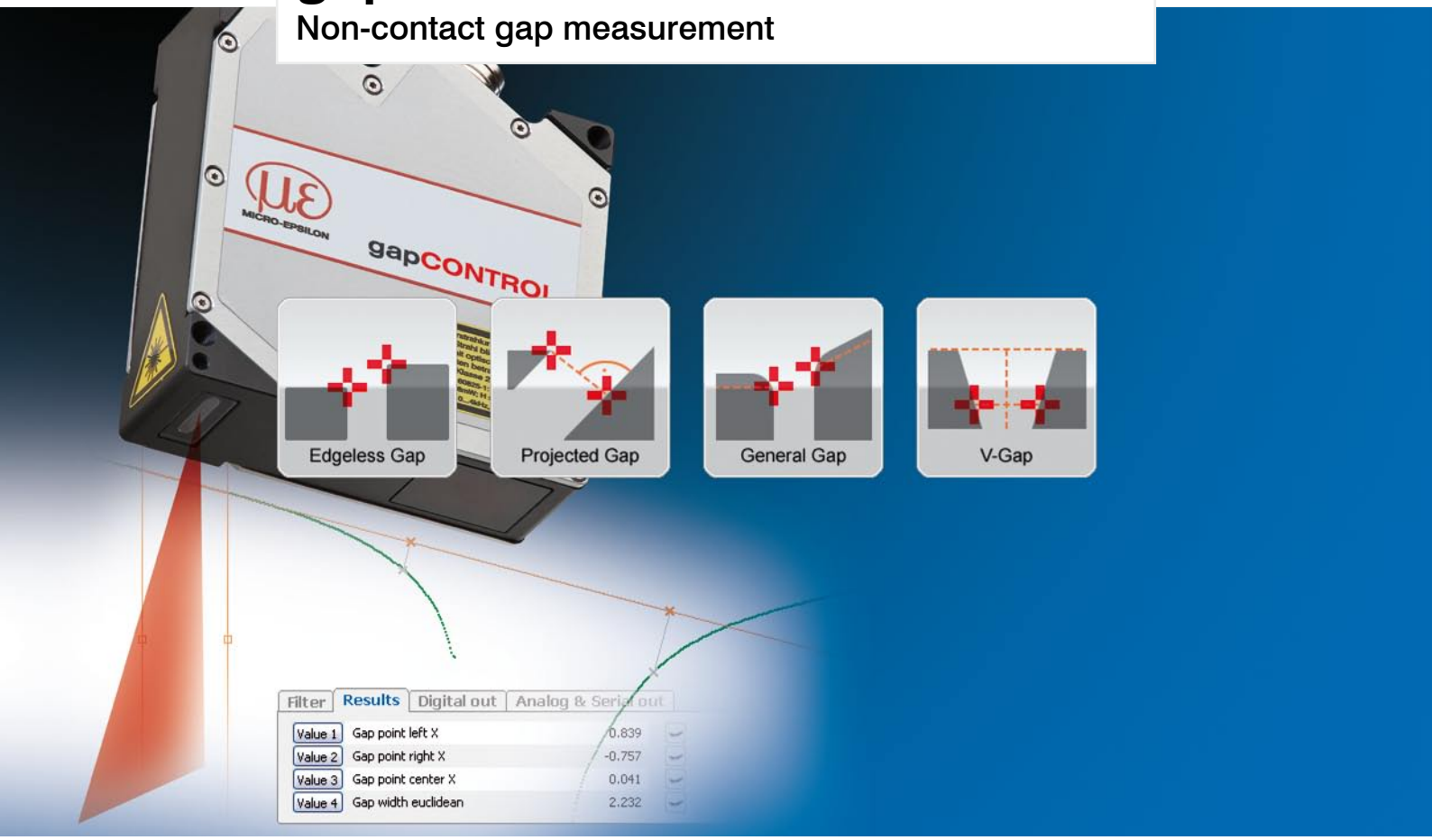
MICRO-EPSILON

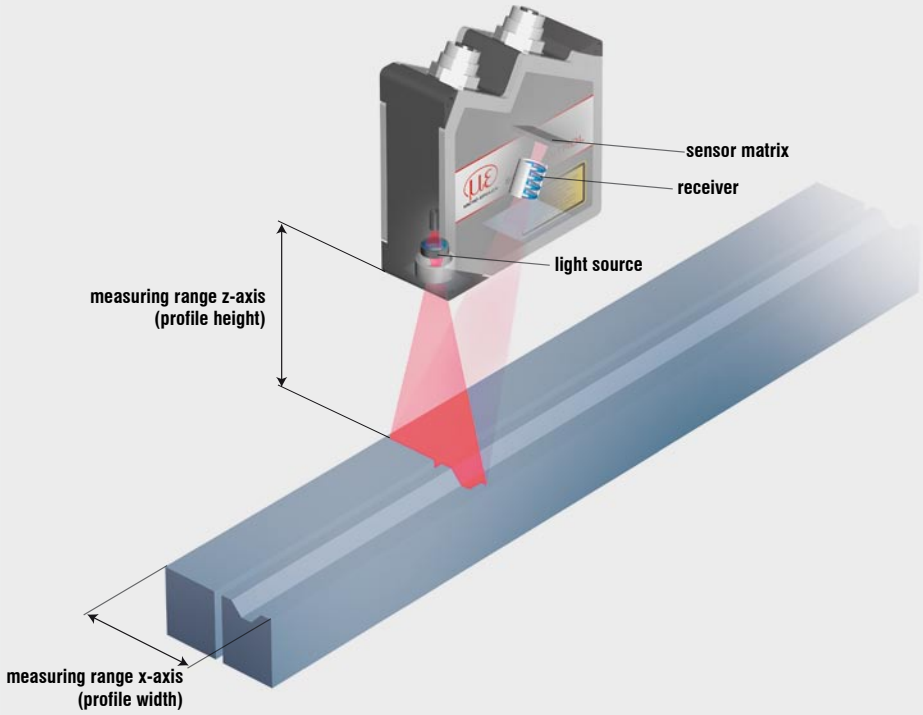
More Precision.

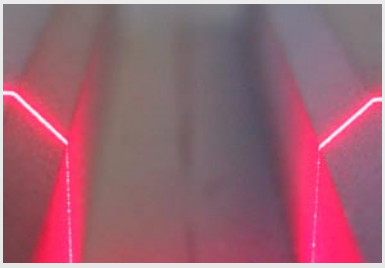
gapCONTROL

Non-contact gap measurement

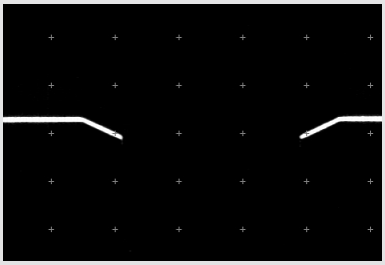


Measuring principle: laser line triangulation

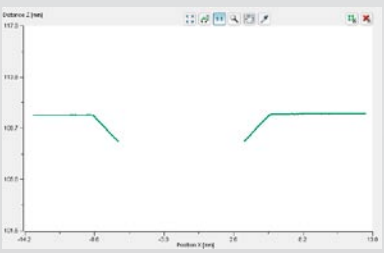




❶ Laser line
Projecting a laser line onto the target surfcae



❷ Sensor matrix (pixels)
The diffusely reflected light of the laser line is displayed on the high-value sensor matrix



❸ 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 is gapCONTROL?

The laser scanners of the gapCONTROL series record, measure and evaluate gaps on very different target surfaces. With gapCONTROL, Micro-Epsilon offers a measurement system specially matched to the demands of gap measurement.

The measuring principle

Laser scanners - often referred to as profile sensors - use the laser triangulation principle for two-dimensional profile detection on very different target surfaces.
Using special lenses, a laser beam is enlarged to form a static laser line and projected onto the target surface. A high-quality optical system projects the diffusely reflected light of this laser line onto a highly sensitive CMOS matrix. In addition to the 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 designated as a profile in a two-dimensional coordinate system that is fixed in respect to the sensor. The gapCONTROL sensor evaluates this profile according to specified criteria and outputs the result (e.g. gap width) as a measured values via the interfaces.

gapCONTROL Setup Software

Gap measurement and evalutation means to be a complex task. In detail, there are different definitions of how the optical gap is defined for different industries and measuring targets. The gapCONTROL Setup Software has been precisely adjusted to the requirements of the different gap measurements and it makes configuration of gapCONTROL sensors quick and easy.

The gapCONTROL Setup Software, together with the gapCONTROL sensors, represents 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 gap modes

The user-friendly software guides the user through the program intuitively. After selecting the basic type of gap, the evaluation is parameterized in detail and the desired result values are output. In a first step, a gap mode is chosen from a selection of common types of gaps. This pre-selection specifies a start configuration for the chosen gap type. With simple types of gap, e.g. “Edgeless Gap”, no additional configuration is needed. Other gap types offer application-specific configuration options.

Parameterisation of the gap measurements

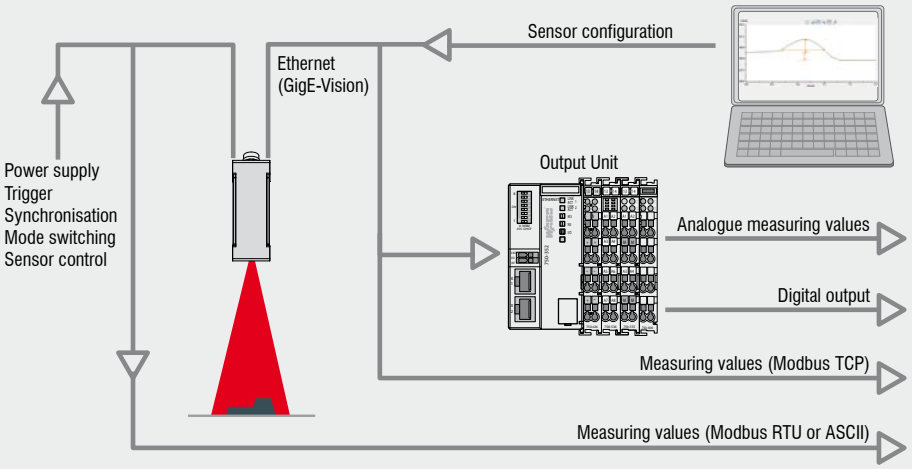
After selecting the gap mode, the search algorithms for the right and left-hand gap edges are specified with the gapCONTROL Software. The criteria can be separately configured for both gap edges.

Besides the settings for the respective gap edge, global sensor settings can also be made quickly. For dynamic processes, gapCONTROL also offers tracking functionality, e.g. following the center position.

Measurement output: Plug&Play solution in the integrated controller

For output of the measured values, the outputs can be configured with freely assigned values. The configuration of gapCONTROL can be saved in the memory of the sensor. Now the sensor is ready for running in its standalone mode without an external PC.

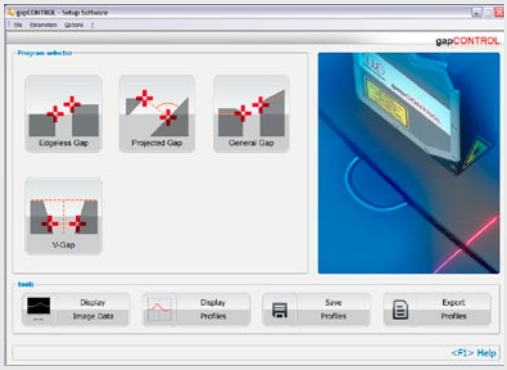
Besides measurement value output via Ethernet (Modbus TCP protocol) and RS422 (Modbus RTU protocol or ASCII format), additional digital switch signals and analogue measuring values can also be output. This is done by an Output Unit which transforms the measurement signals into digital and analogue signals. The RS422 can be programmed as a serial interface (measurement value output) or as a trigger input.



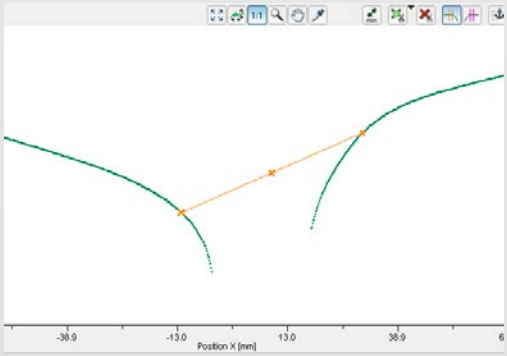
Load and save

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 this 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 how the software works.

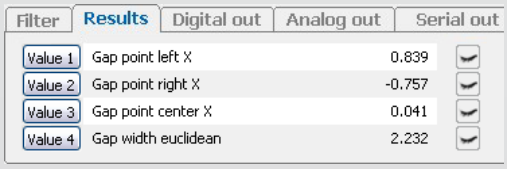
Download at: www.micro-epsilon.com/gapCONTROL



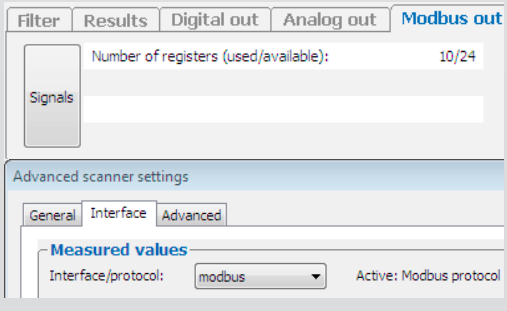
❹ Selection of the gap type and measuring program



❺ Parameterising the gap on the left and right-hand edge

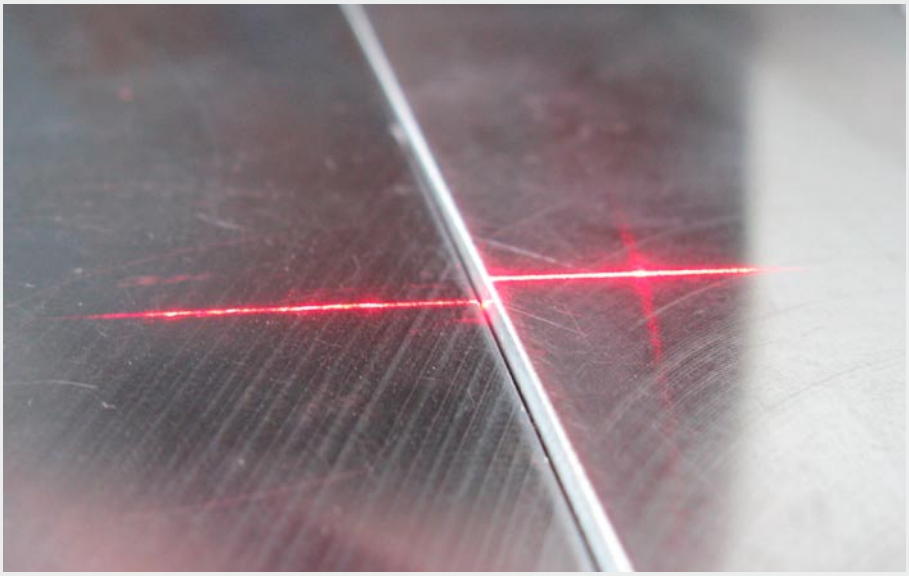


❻ Parameterising and specifying the output values



❼ Measurement value output via Modbus

“Edgeless Gap” measuring program



Edgeless Gap

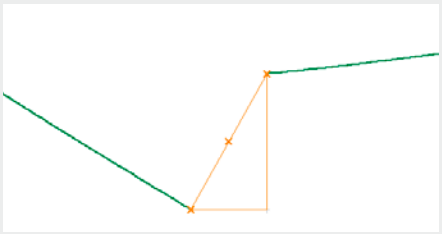
With an edgeless gap, the two objects possess a clearly defined end point. These two points are used as references when calculating the gap. The two objects must not be arranged on the same plane. They can freely vary in their spatial position. The distance between the two end points is always given as output.

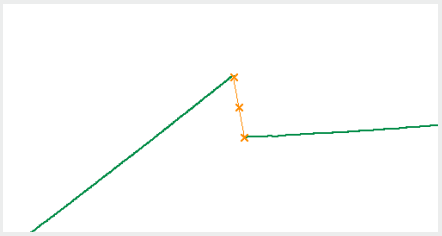
Typical applications:

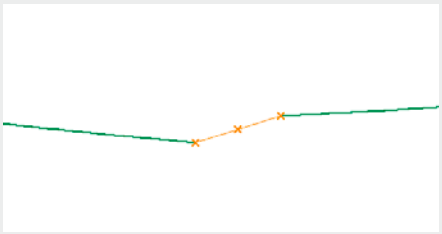
- Welding processes
- Joining processes
- Measuring flushness
- Proximity monitoring

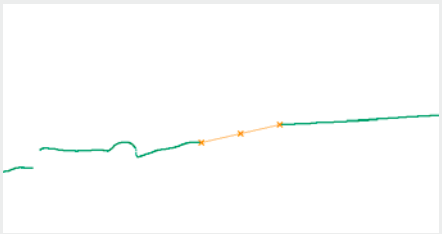
Typical values measured:

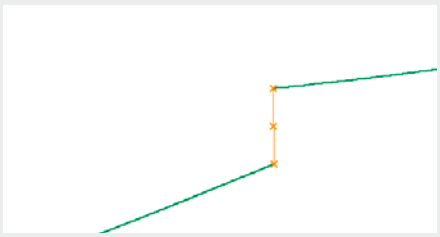
- Gap width
- Height differences
- Center position

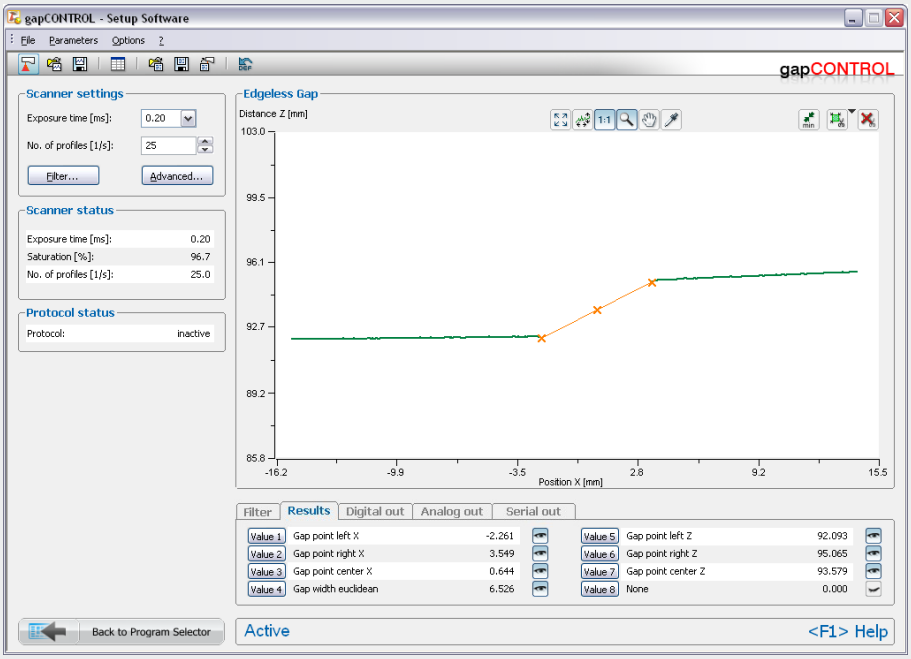




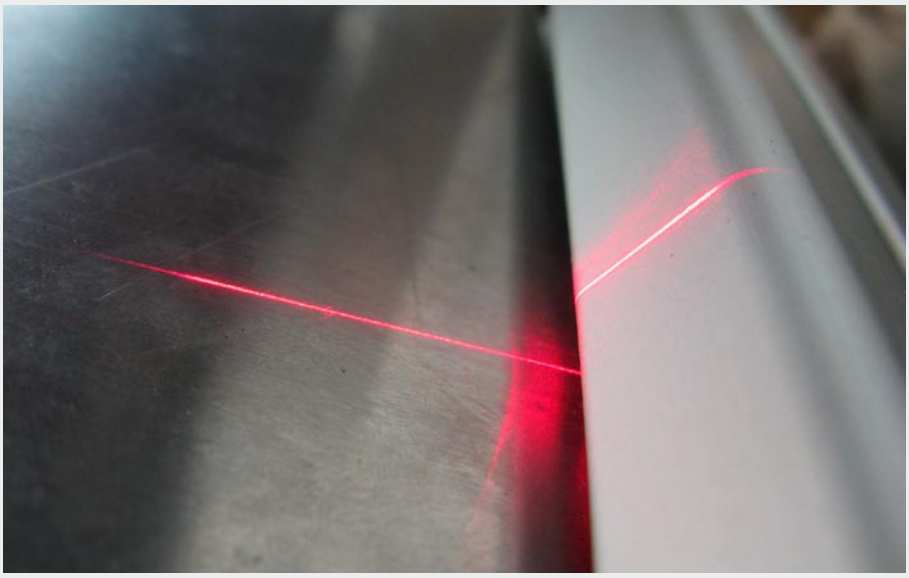








“Projected Gap” measuring program



Projected Gap

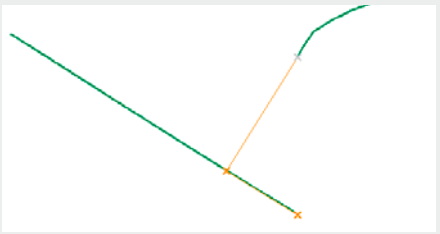
The projected gap consists of two objects that are arranged at an angle to each other. Typically, the gap dimension is defined from an edge. The gap dimension and its position from the edge is defined within the software. Often the term “projected gap” is used, as one edge is projected onto the second in order to obtain a defined gap measurement.

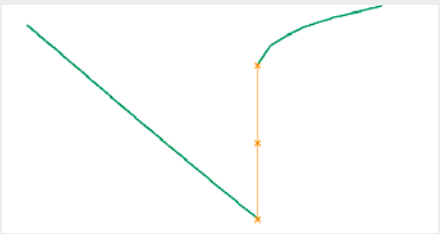
Typical applications:

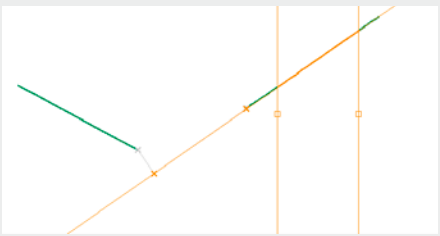
- Welding processes
- Joining processes
- Measuring flushness
- Proximity monitoring
- Avoiding collisions

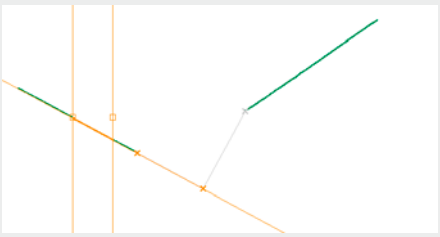
Typical values measured:

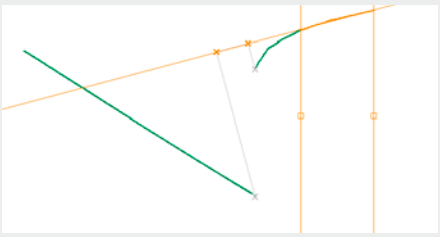
- Gap width
- Minimum distance
- Angle

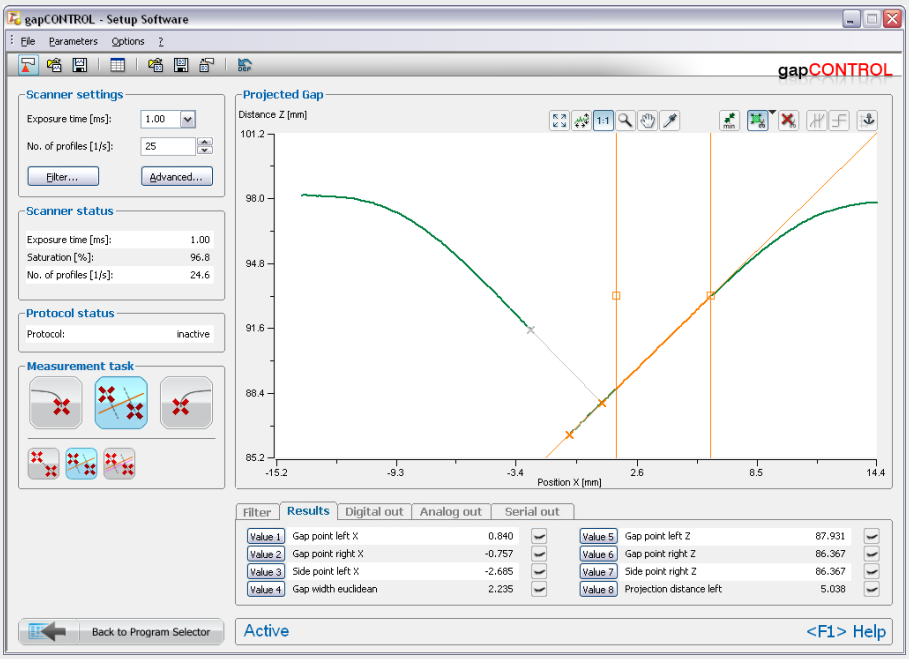




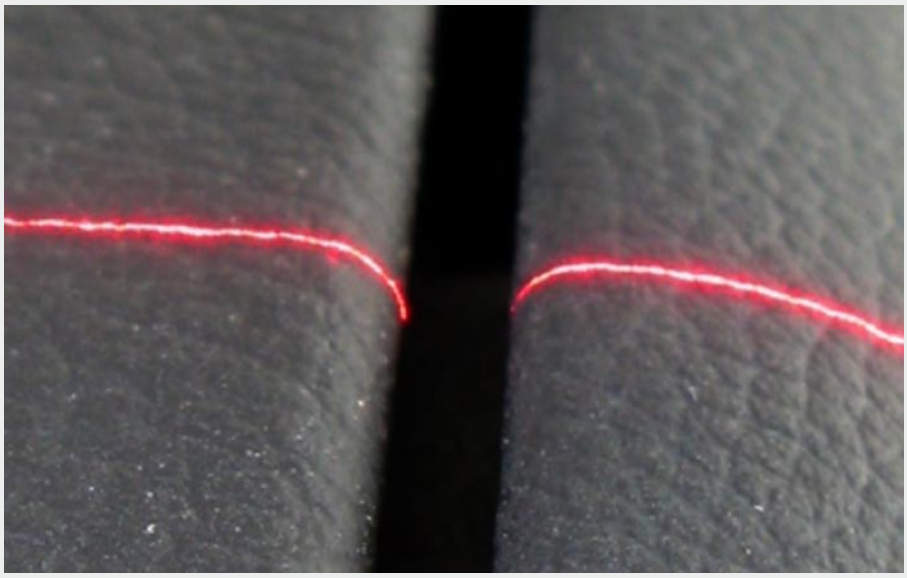








“General Gap” measuring program



General Gap

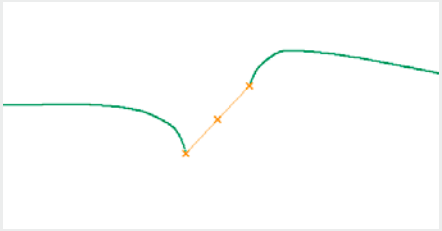
For this gap variant the ends of the measuring object are not predefined. The program is used to specify the point from which the gap measurement starts. To do so, either points are defined on the profile or projected points are defined with a straight line reference.

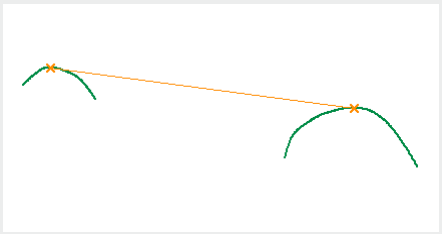
Typical applications:

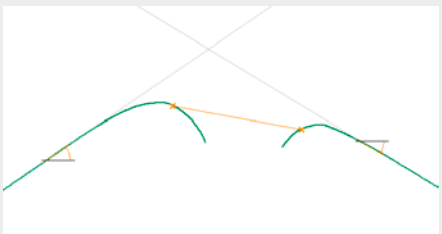
- Automobile
- Joining processes
- Measuring flushness
- Proximity monitoring

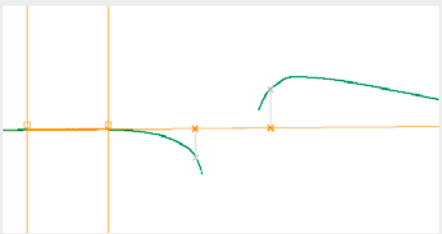
Typical values measured:

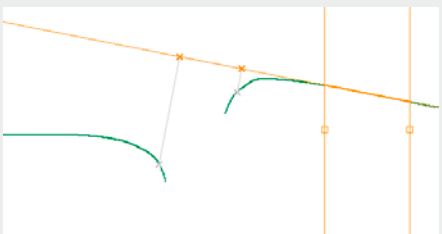
- Definition of straight line references
- Projecting measuring points from profile

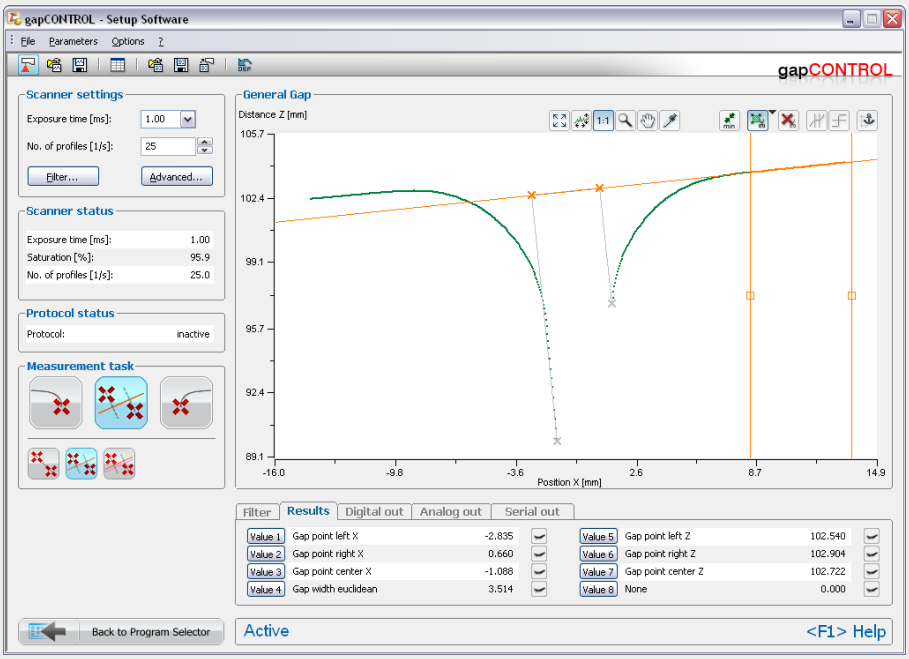




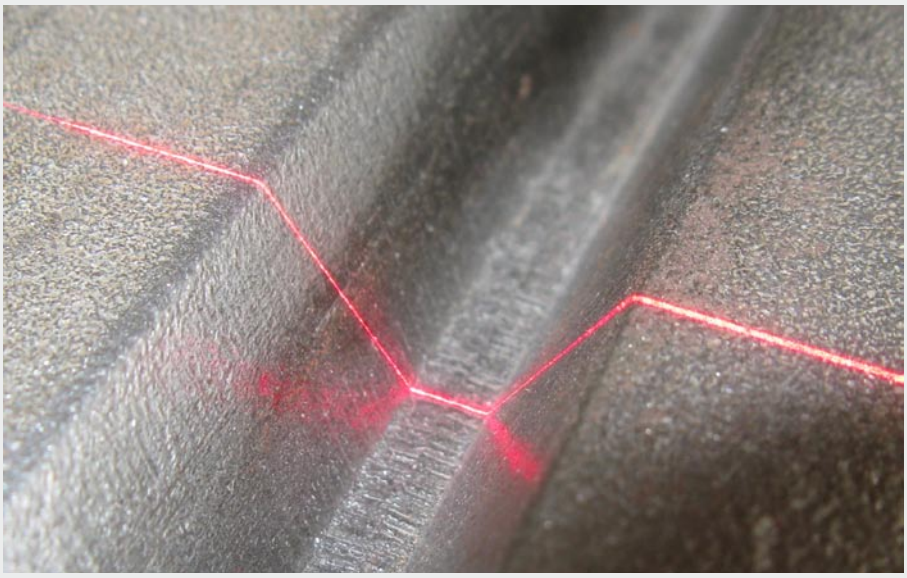


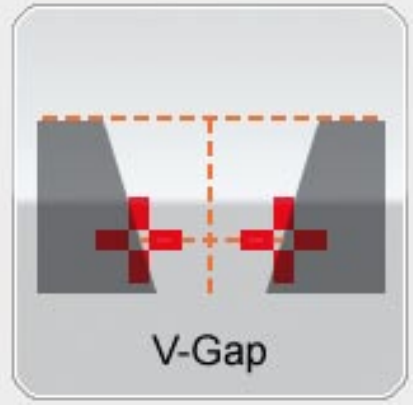






“V-Gap” measuring program





V-Gap

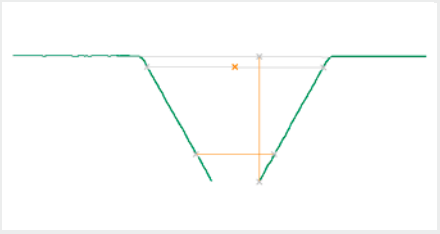
The V-gap is frequently used during welding processes on pipelines. When assembling the two ends of a pipeline, the ends must be as accurately aligned to each other as possible. To produce a stable weld seam, the flanks are prepared to form a “V” and then welded together step-by-step. For automatic welding, it is important to know the current filling height, as well as the width and center of the gap. The exact guidance of the welding head is determined from this data. The most important characteristics can be selected, calculated in one measurement and then output.

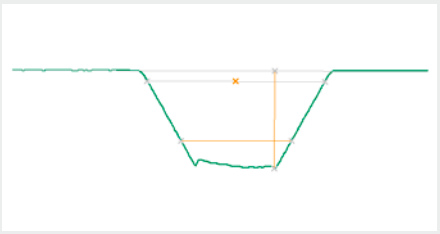
Typical applications:

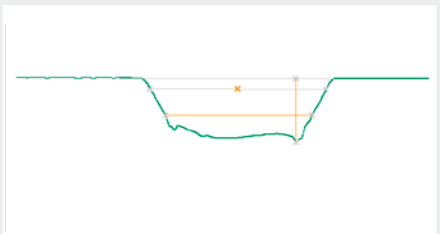
- Pipeline welding

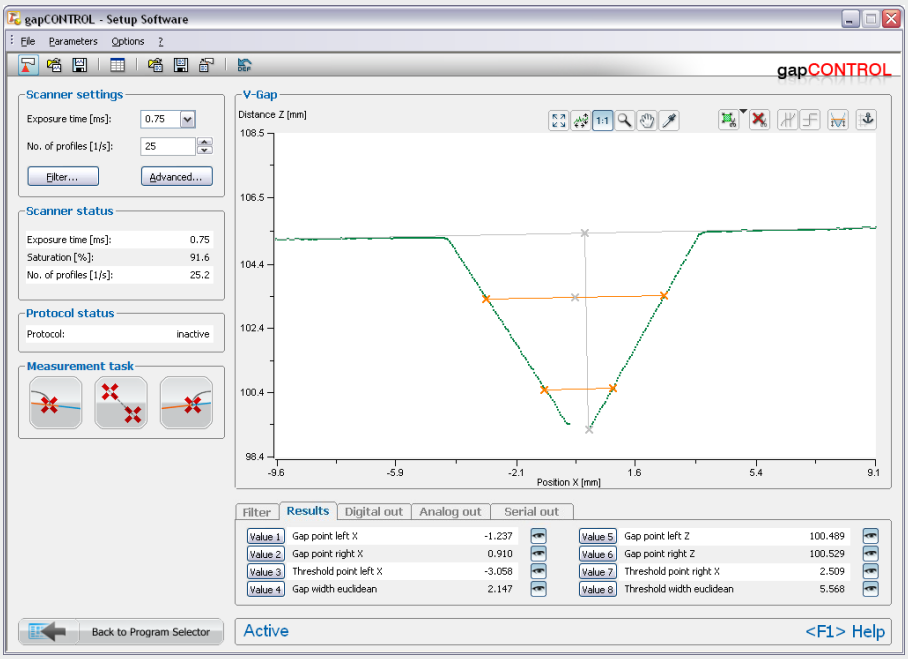
Typical values measured:

- Gap depth
- Oscillation width
- Middle of the gap





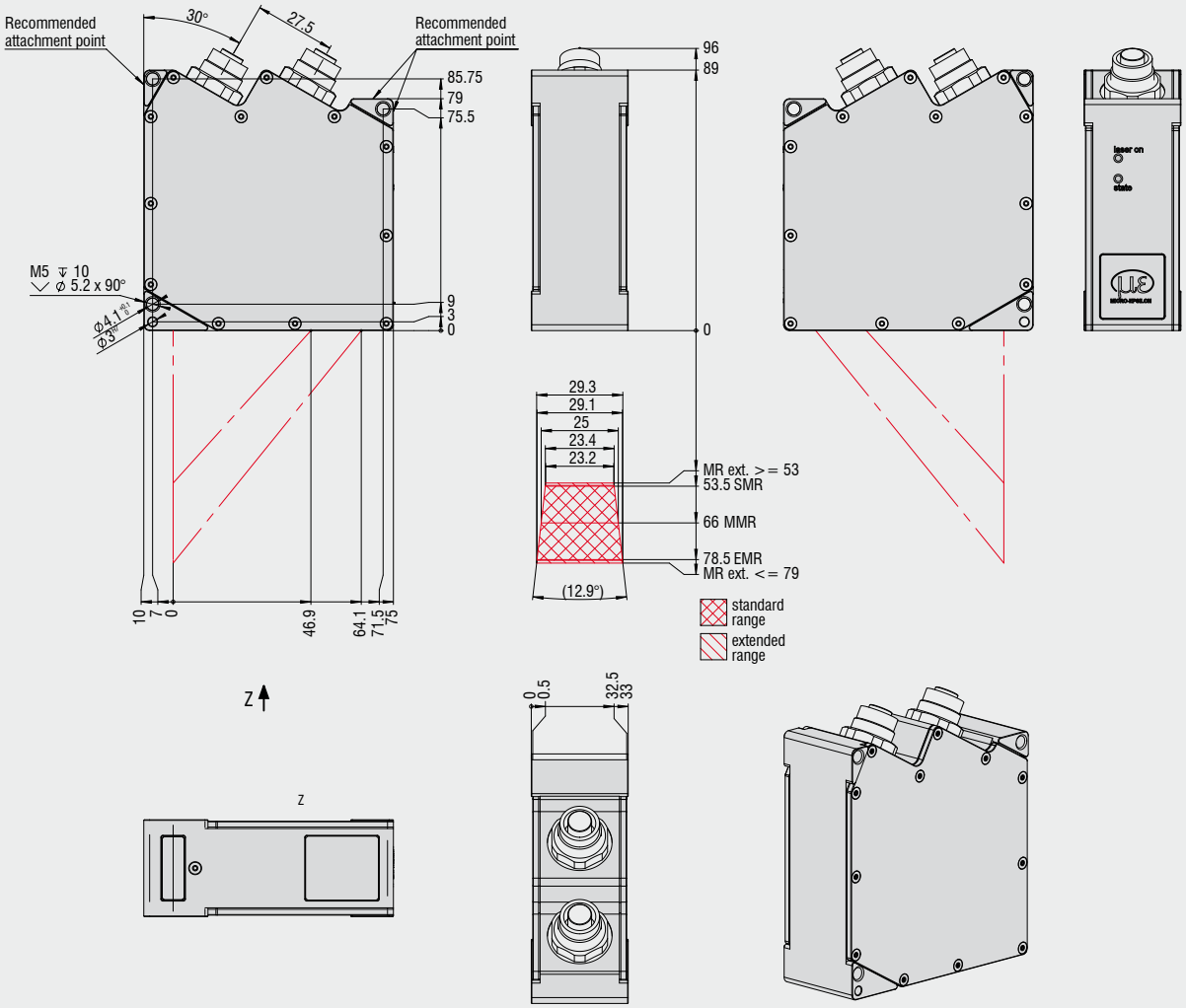


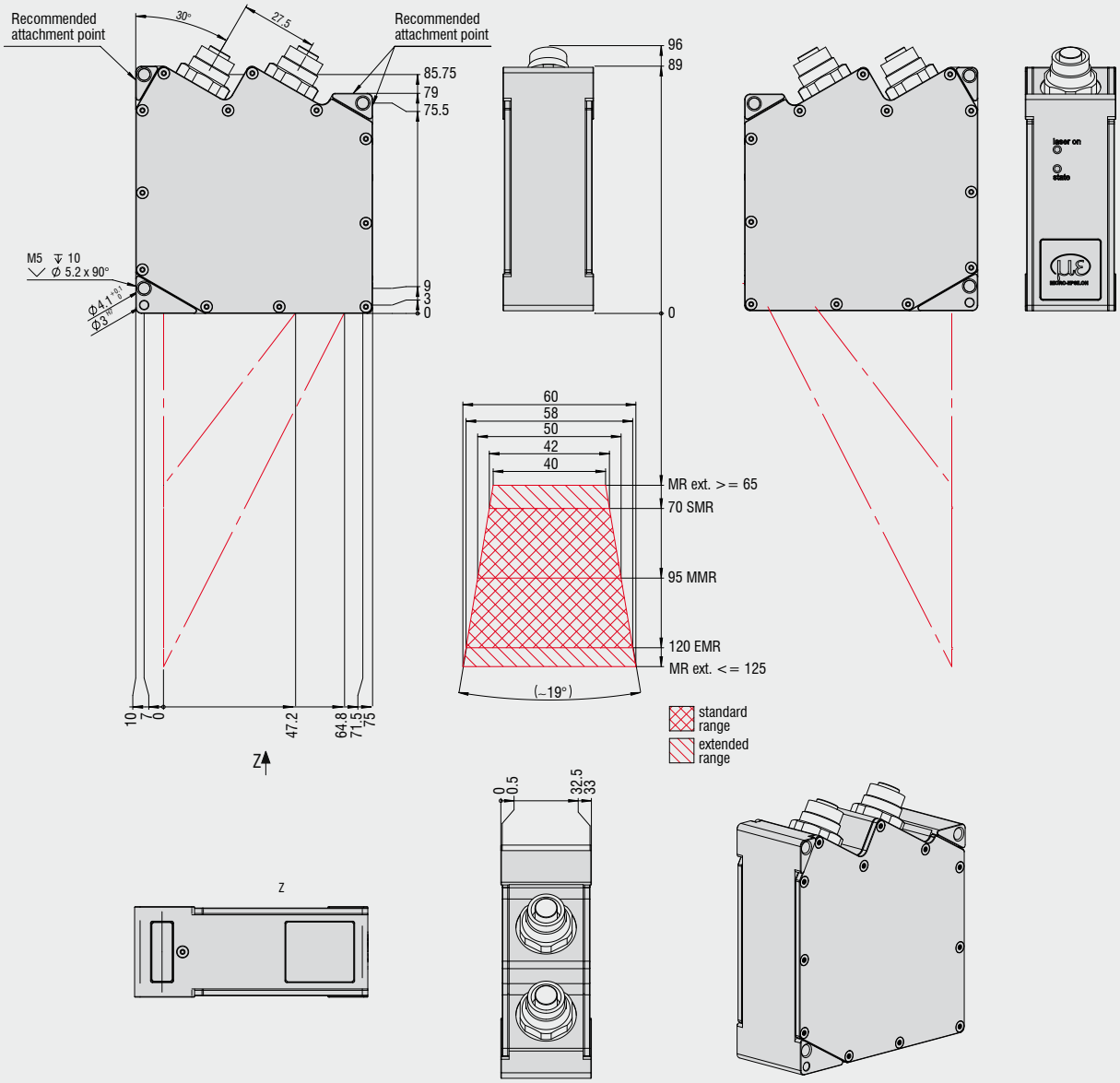


Technical Data gapCONTROL 2611

	Model	gapCONTROL	2611-25	2611-50	2611-100
z-axis (height)	Standard measuring range	Start of measuring range	53.5 mm	70 mm	190 mm
		Midrange	66 mm	95 mm	240 mm
		End of measuring range	78.5 mm	120 mm	290 mm
	Extended measuring range	Start of measuring range	53 mm	65 mm	125 mm
		End of measuring range	79 mm	125 mm	390 mm
	Linearity [1]	(3sigma)	±0.16 % FSO	±0.16 % FSO	±0.2 % FSO
	Reference resolution [2] [3]		2 µm	4 µm	12 µm
x-axis (width)	Standard measuring range	Start of measuring range	23.4 mm	42 mm	83.1 mm
		Midrange	25 mm	50 mm	100 mm
		End of measuring range	29.1 mm	58 mm	120.8 mm
	Extended measuring range	Start of measuring range	23.2 mm	40 mm	58.5 mm
		End of measuring range	29.3 mm	60 mm	143.5 mm
	Resolution x-axis		640 points/profile		
	Profile frequency		200 Hz	200 Hz	200 Hz
	Sensor configuration and profile data transmission	Ethernet	■	■	■
		RS422 [4]	■	■	■
	Sensor control	Trigger [4] [6]	■	■	■
		Synchronisation [4]	■	■	■
	Measurement value output	Ethernet (Modbus TCP)	■	■	■
		RS422 (ASCII / Modbus RTU) [4]	■	■	■
		Analogue [5]	■	■	■
		Switching signal [5]	■	■	■
	Interfaces	Ethernet GigE-Vision	Profile data, sensor configuration and measurement values		
		multi-function: digital inputs	Mode switching Encoder Trigger		
		multi-function: RS422 (half duplex)	Output of measurement values Sensor control Trigger Synchronisation		
	Display (LED)		1x laser ON/OFF, 1x power/error/status		
	Light source		Semiconductor laser 658nm		
	Aperture angle laser line		20°	25°	25°
	Laser power		8mW (class 2M)		
	Laser off		via external contact (optional)		
	Permissible ambient light (fluorescent light) [2]		10,000lx		
	Protection class		IP 65		
	EMC		acc. EN 61326-1: 2006-10 DIN EN 55011: 2007-11 (group 1, class B) EN 61000-6-2: 2006-03		
	Operating temperature		0°C to 45°C		
	Storage temperature		-20°C to 70°C		
	Dimensions		96 x 85 x 33mm		
	Weight		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 can be programmed as serial interface or as input for trigger / Synchronisation
[5] Only with Output Unit
[6] Trigger via RS422 or Digital Inputs (HTL/TTL)
FSO = Full scale output


Recommended attachment point
30°
27.5
Recommended attachment point
85.75
79
75.5
M5 ↧ 10
⌵ ⌀ 5.2 x 90°
9
3
0
10
7
0
46.9
64.1
71.5
75
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
Z
Z
0
0.5
32.5
33


Recommended attachment point
Recommended attachment point
30°
27.5
85.75
79
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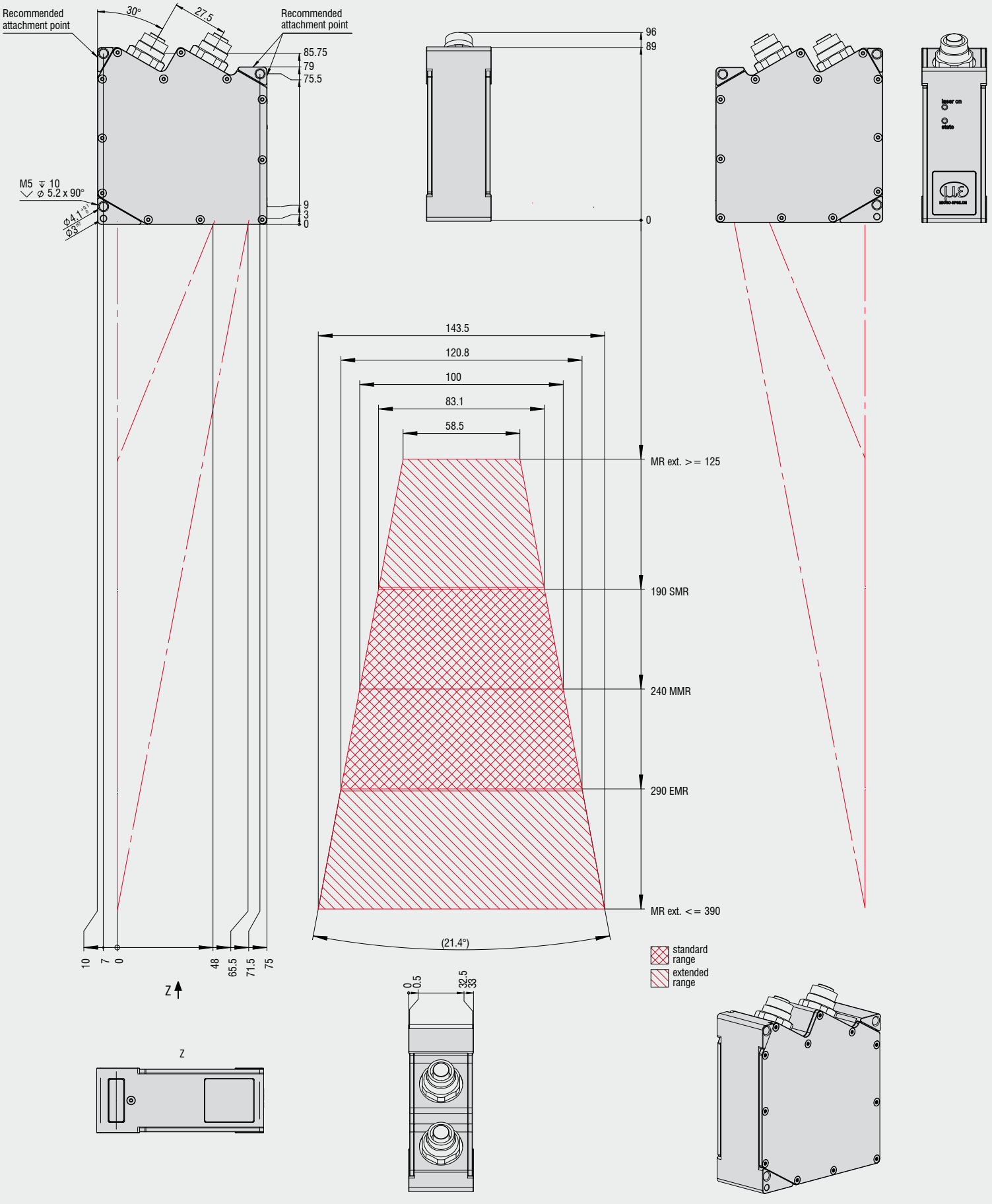
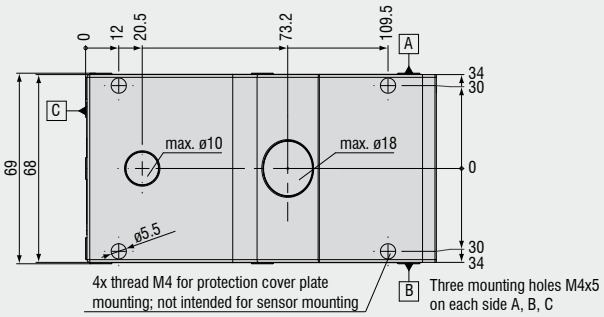
9
3
0
M5 ↧ 10
⌵ Ø 5.2 x 90°
Ø4.1 +0.1
Ø3 +0.2
10
7
0
47.2
64.8
71.5
75
Z
96
89
0
60
58
50
42
40
MR ext. >= 65
70 SMR
95 MMR
120 EMR
MR ext. <= 125
(~19°)
standard range
extended range
laser on
state
0
0.5
32.5
33
Z

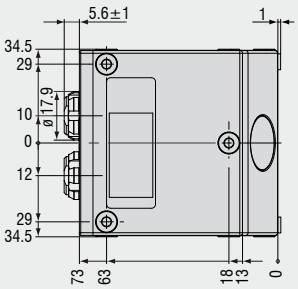

Recommended attachment point
30°
27.5
Recommended attachment point
85.75
79
75.5
M5 ↧ 10
⌵ ⌀ 5.2 x 90°
9
3
0
96
89
0
laser on
state
143.5
120.8
100
83.1
58.5
MR ext. >= 125
190 SMR
240 MMR
290 EMR
MR ext. <= 390
(21.4°)
standard range
extended range
10
7
0
48
65.5
71.5
75
Z
Z
0
0.5
32.5
33

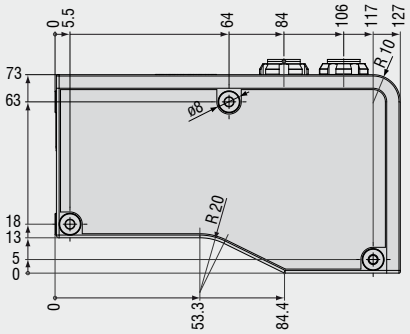
Technical Data gapCONTROL 2711

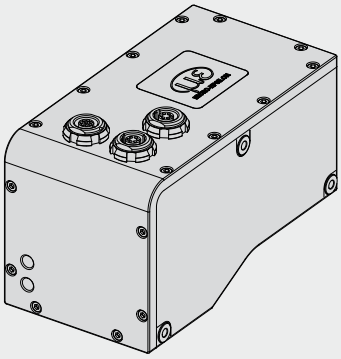
	Model	gapCONTROL	2711-25	2711-50	2711-100
z-axis (height)	Standard measuring range	Start of measuring range	90 mm	175 mm	350 mm
		Midrange	102.5 mm	200 mm	400 mm
		End of measuring range	115 mm	225 mm	450 mm
	Extended measuring range	Start of measuring range	85 mm	160 mm	300 mm
		End of measuring range	125 mm	260 mm	600 mm
	Linearity [1]	(3sigma)	±0.2% FSO	±0.2% FSO	±0.2% FSO
	Reference resolution [2] [3]		4 µm	10 µm	15 µm
x-axis (width)	Standard measuring range	Start of measuring range	23 mm	44 mm	88 mm
		Midrange	25 mm	50 mm	100 mm
		End of measuring range	27 mm	56 mm	112 mm
	Extended measuring range	Start of measuring range	22 mm	41 mm	76 mm
		End of measuring range	29 mm	64 mm	148 mm
	Resolution x-axis		640 points/profile		
	Profile frequency		100 Hz		
	Sensor configuration and profile data transmission	Ethernet	■	■	■
		RS422 [4]	■	■	■
	Sensor control	Trigger [4]	■	■	■
		Synchronisation [4]	■	■	■
	Measurement value output	Ethernet (Modbus TCP)	■	■	■
		RS422 (ASCII / Modbus RTU) [4]	■	■	■
		Analogue [5]	■	■	■
		Switching signal [5]	■	■	■
	Display (LED)		1x laser, 1x power/error/status		
	Light source		semiconductor laser 658nm		
	Aperture angle laser line		20°		
	Laser power	standard	10mW (class 2M)		
		optional	20mW (class 3B)		
	Laser off		via software (standard) / via external contact (optional)		
	Permissible ambient light (fluorescent light) [2]		10,000lx		
	Protection class		IP 64		
	Vibration		2g / 20 ... 500 Hz		
	Shock		15g / 6ms		
	EMC		acc. EN 61326-1: 2006-10 DIN EN 55011: 2007-11 (group 1, class B) EN 61000-6-2: 2006-03		
	Operating temperature		0°C up to 50°C		
	Storage temperature		-20°C up to 70°C		
	Dimensions		127 x 69 x 73mm	142 x 69 x 73mm	170 x 69 x 73mm
	Weight		~700g	~800g	~850g
	Supply		8-30 VDC, 500 mA		

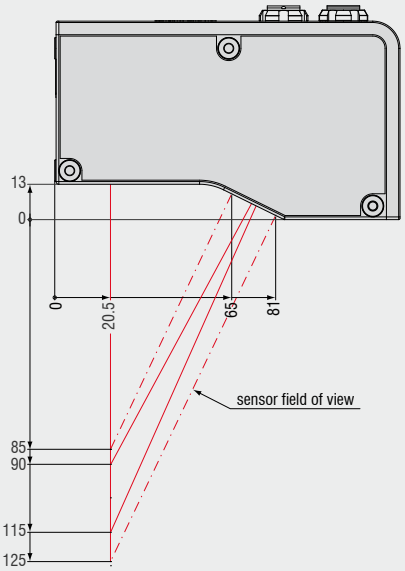
[1] Standard measuring range
[2] Measuring object: Micro-Epsilon standard object (metallic, diffusely reflecting material)
[3] According to a one-time averaging across the measuring field (640 points)
[4] RS422 interface can be programmed as serial interface or as input for trigger / Synchronisation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

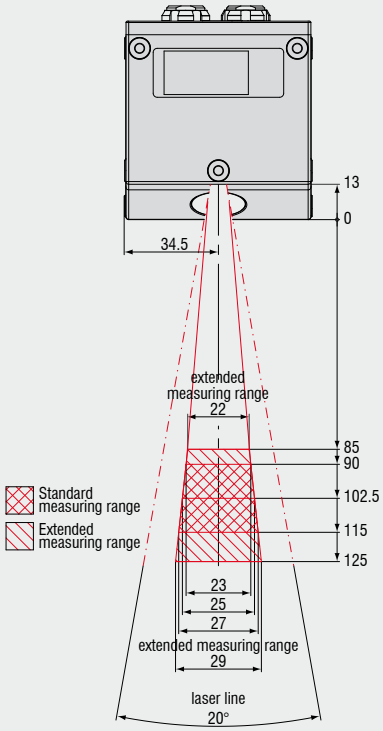

0
12
20.5
73.2
109.5
A
C
34
30
0
30
34
69
68
max. ø10
max. ø18
ø5.5
4x thread M4 for protection cover plate mounting; not intended for sensor mounting
B
Three mounting holes M4x5 on each side A, B, C

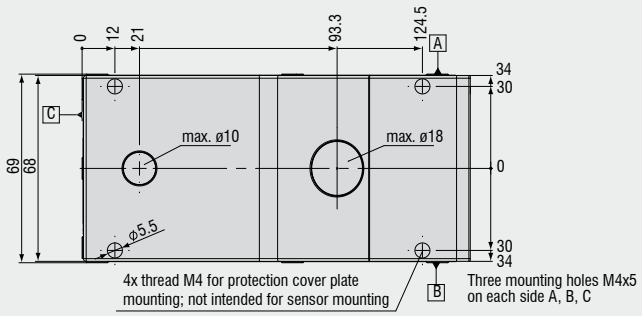

5.6±1
1
34.5
29
10
0
12
29
34.5
ø17.9
73
63
18
13
0

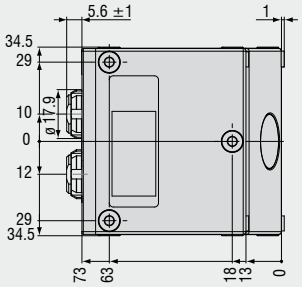

0
5.5
64
84
106
117
127
73
63
ø8
R 10
R 20
18
13
5
0
0
53.3
84.4

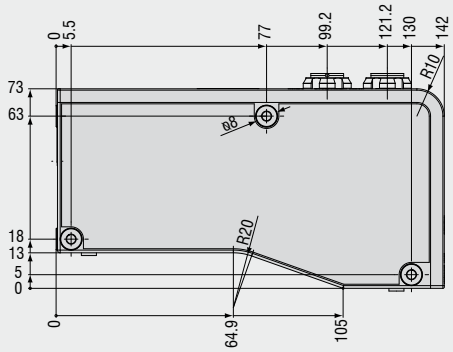


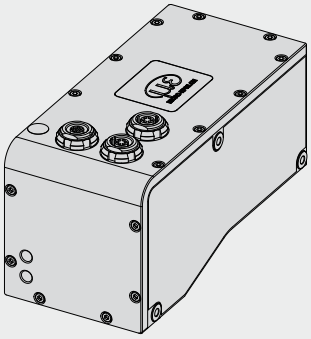

13
0
0
20.5
65
81
sensor field of view
85
90
115
125

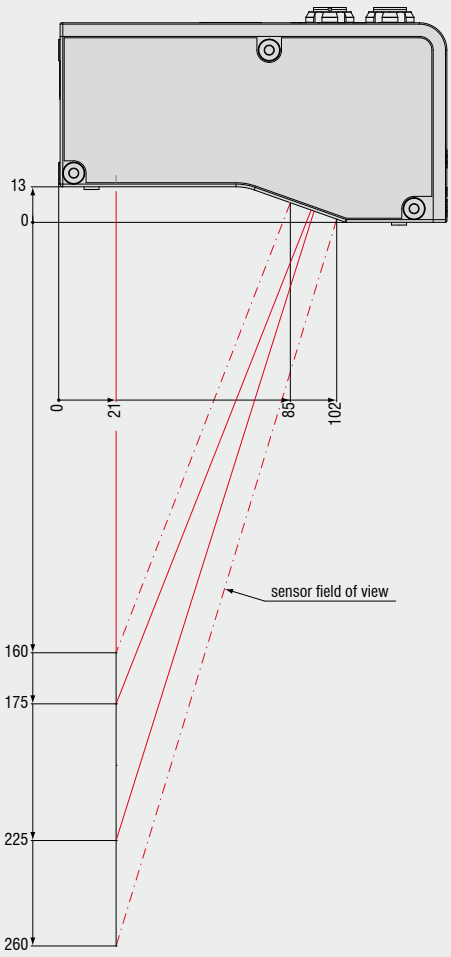

13
0
34.5
extended measuring range
22
85
90
102.5
115
125
Standard measuring range
Extended measuring range
23
25
27
extended measuring range
29
laser line
20°

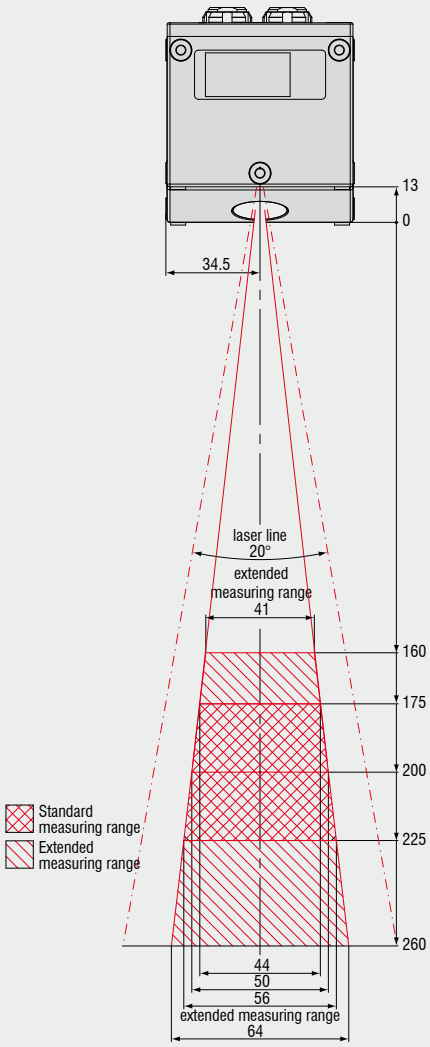

0
12
21
93.3
124.5
A
34
30
0
30
34
C
max. ø10
max. ø18
69
68
ø5.5
4x thread M4 for protection cover plate mounting; not intended for sensor mounting
B
Three mounting holes M4x5 on each side A, B, C

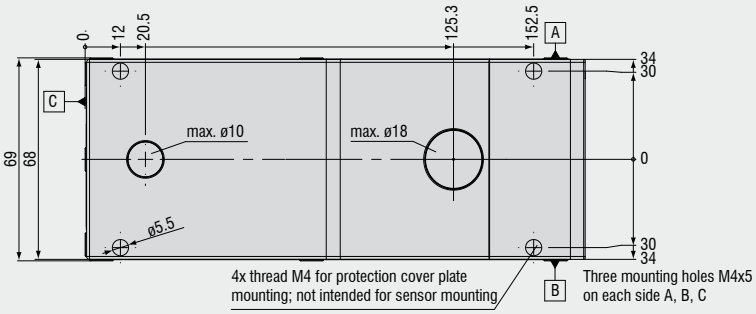

5.6 ±1
1
34.5
29
10
0
12
29
34.5
ø 17.9
73
63
18
13
0

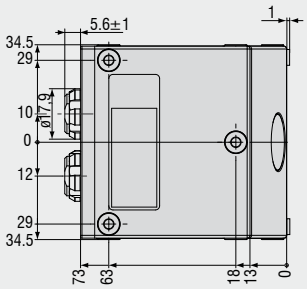

0
5.5
77
99.2
121.2
130
142
R10
73
63
ø8
18
13
5
0
R20
0
64.9
105

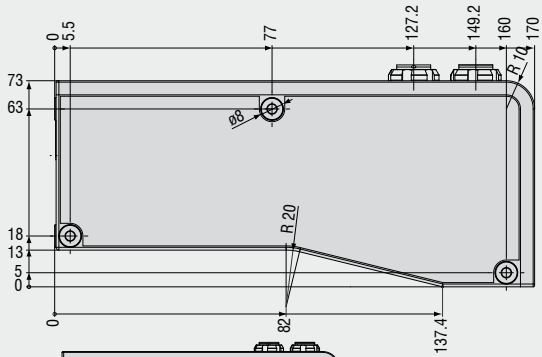


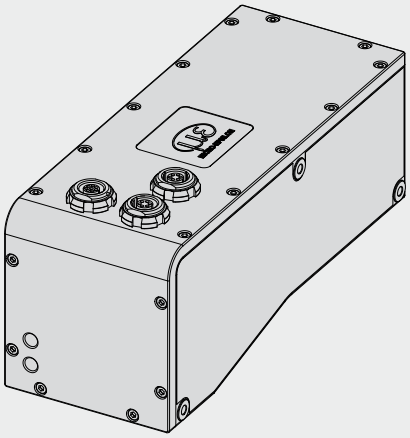

13
0
0
21
85
102
sensor field of view
160
175
225
260

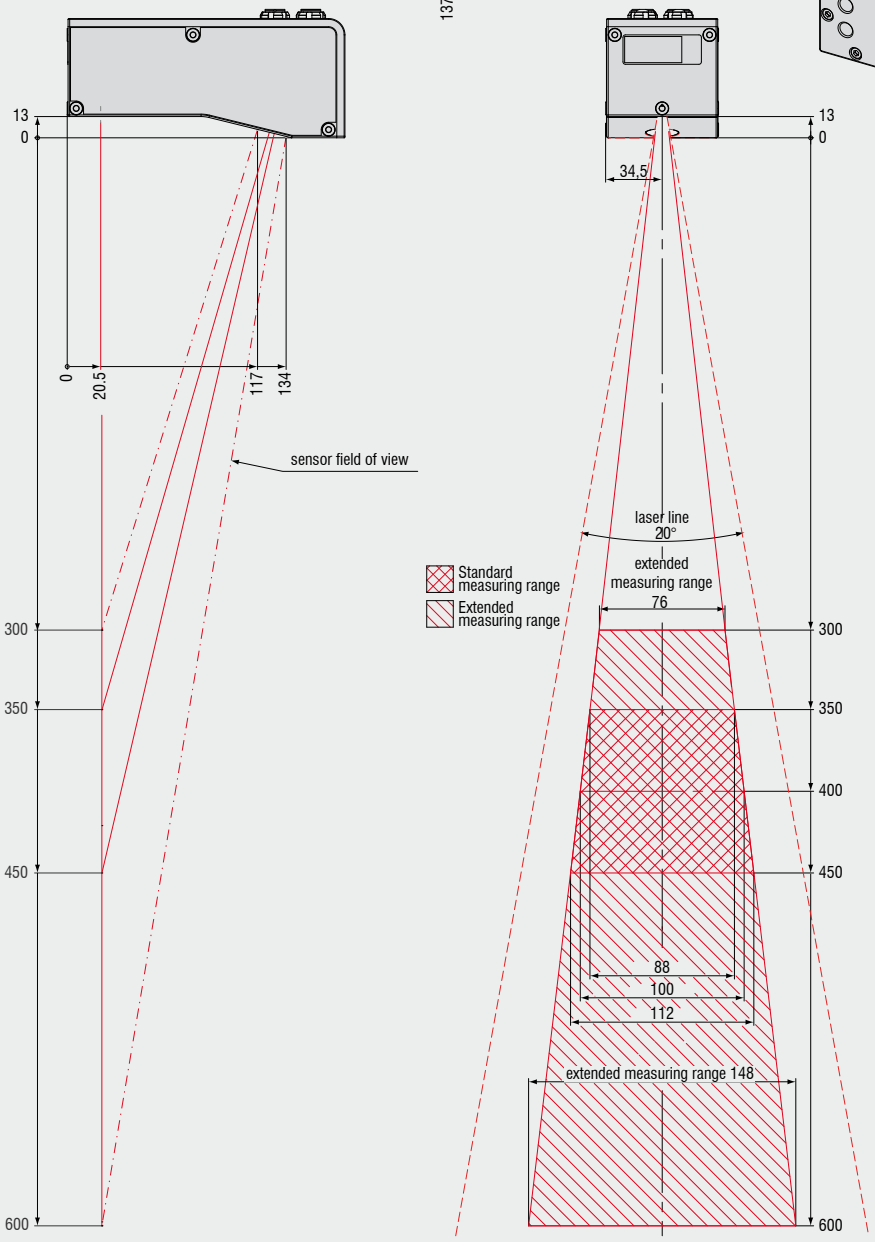

13
0
34.5
laser line
20°
extended measuring range
41
160
175
200
225
260
Standard measuring range
Extended measuring range
44
50
56
extended measuring range
64


max. ø10
max. ø18
ø5.5
4x thread M4 for protection cover plate mounting; not intended for sensor mounting
Three mounting holes M4x5 on each side A, B, C




ø8
R 20
R 10

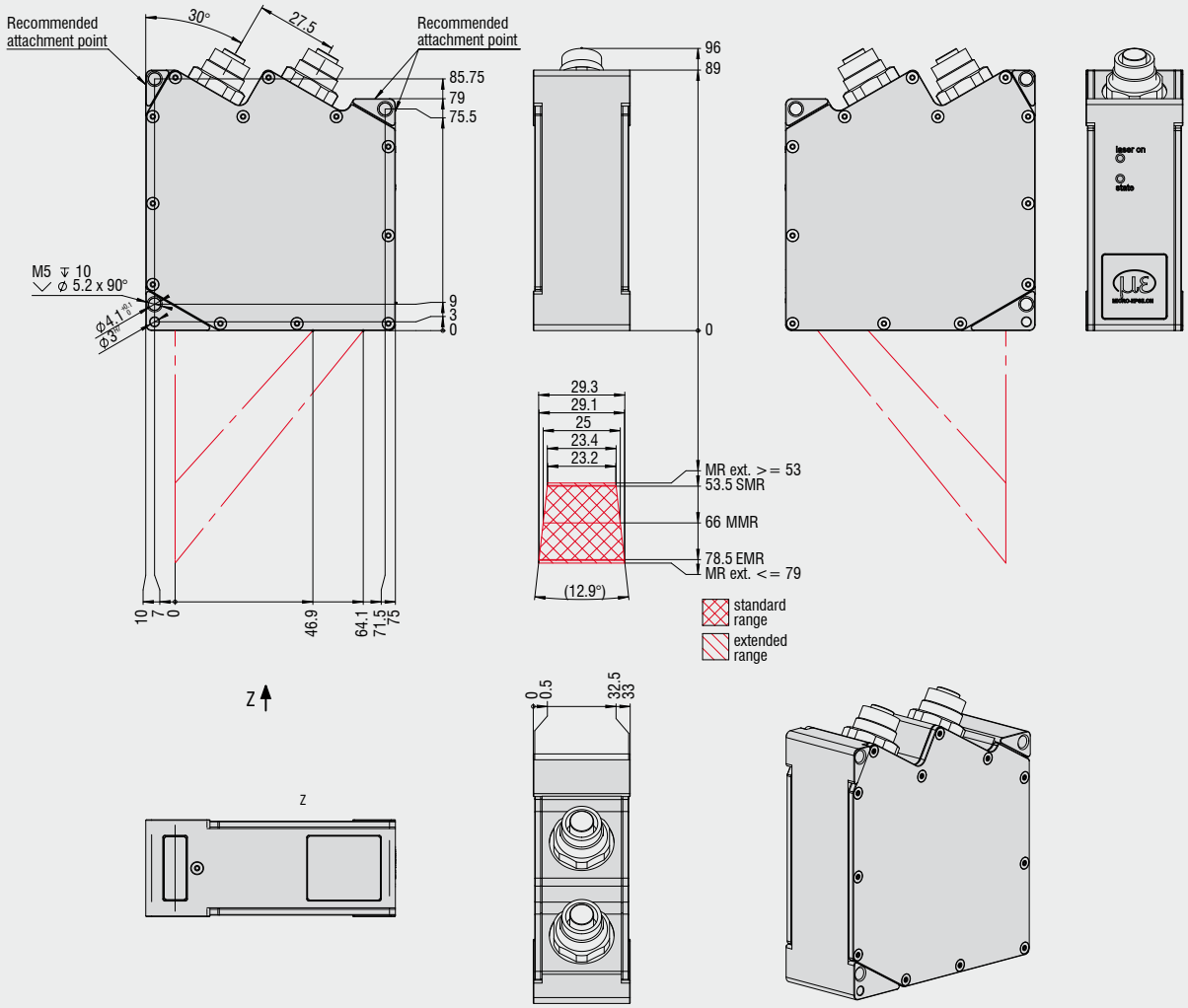


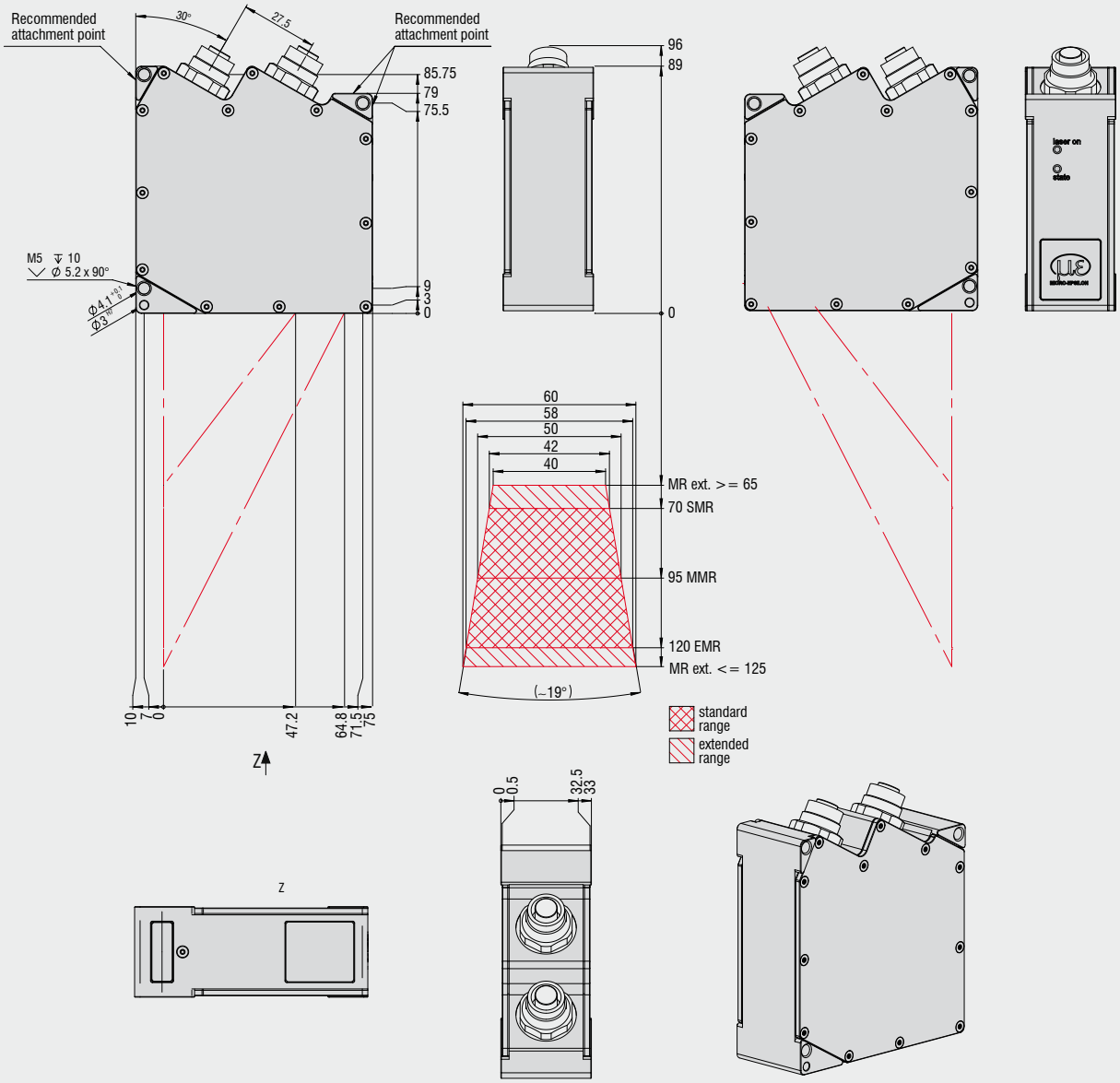

sensor field of view
laser line
20°
extended measuring range
76
Standard measuring range
Extended measuring range
88
100
112
extended measuring range 148

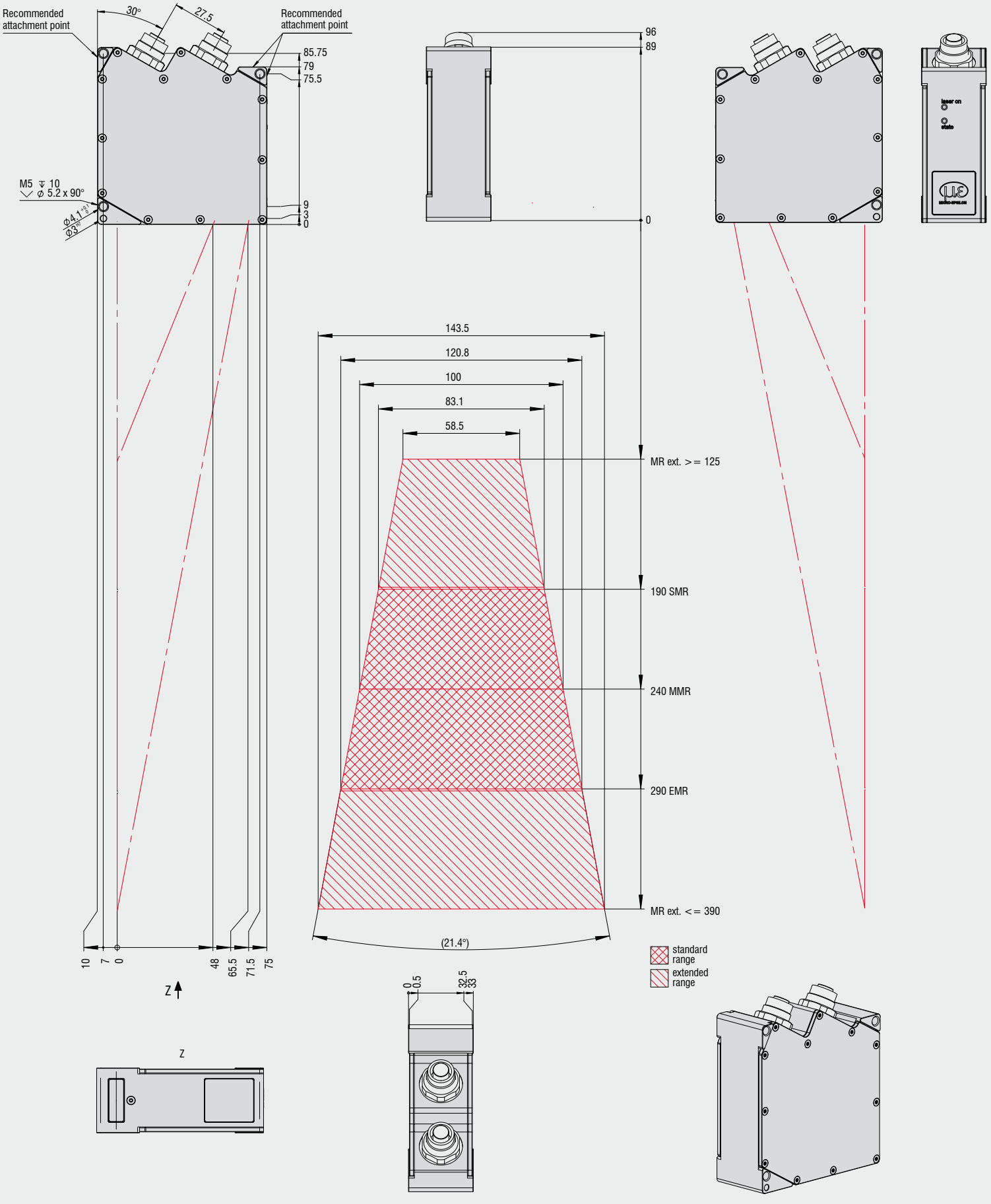
Technical Data gapCONTROL 2911

	Model	gapCONTROL	2911-25	2911-50	2911-100
z-axis (height)	Standard measuring range	Start of measuring range	53.5 mm	70 mm	190 mm
		Midrange	66 mm	95 mm	240 mm
		End of measuring range	78.5 mm	120 mm	290 mm
	Extended measuring range	Start of measuring range	53 mm	65 mm	125 mm
		End of measuring range	79 mm	125 mm	390 mm
	Linearity [1]	(3sigma)	±0.16 % FSO	±0.16 % FSO	±0.16 % FSO
	Reference resolution [2] [3]		2 µm	4 µm	12 µm
x-axis (width)	Standard measuring range	Start of measuring range	23.4 mm	42 mm	83.1 mm
		Midrange	25 mm	50 mm	100 mm
		End of measuring range	29.1 mm	58 mm	120.8 mm
	Extended measuring range	Start of measuring range	23.2 mm	40 mm	58.5 mm
		End of measuring range	29.3 mm	60 mm	143.5 mm
	Resolution x-axis		1280 points/profile		
	Profile frequency		200 Hz	200 Hz	200 Hz
	Sensor configuration and profile data transmission	Ethernet	■	■	■
		RS422 [4]	■	■	■
	Sensor control	Trigger [4] [6]	■	■	■
		Synchronisation [4]	■	■	■
	Measurement value output	Ethernet (Modbus TCP)	■	■	■
		RS422 (ASCII / Modbus RTU) [4]	■	■	■
		Analogue [5]	■	■	■
		Switching signal [5]	■	■	■
	Interfaces	Ethernet GigE-Vision	Profile data, sensor configuration and measurement values		
		multi-function: digital inputs	Mode switching Encoder Trigger		
		multi-function: RS422 (half duplex)	Output of measurement values Sensor control Trigger Synchronisation		
	Display (LED)		1x laser ON/OFF, 1x power/error/status		
	Light source		Semiconductor laser 658nm		
	Aperture angle laser line		20°	25°	25°
	Laser power		8mW (class 2M)		
	Laser off		via external contact (optional)		
	Permissible ambient light (fluorescent light) [2]		10,000lx		
	Protection class		IP 65		
	EMC		acc. EN 61326-1: 2006-10 DIN EN 55011: 2007-11 (group 1, class B) EN 61000-6-2: 2006-03		
	Operating temperature		0°C to 45°C		
	Storage temperature		-20°C to 70°C		
	Dimensions		96 x 85 x 33mm		
	Weight		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 can be programmed as serial interface or as input for trigger / Synchronisation
[5] Only with Output Unit
[6] Trigger via RS422 or Digital Inputs (HTL/TTL)
FSO = Full scale output


Recommended attachment point
30°
27.5
Recommended attachment point
85.75
79
75.5
M5 ↧ 10
⌵ ⌀ 5.2 x 90°
9
3
0
10
7
0
46.9
64.1
71.5
75
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
Z
Z
0
0.5
32.5
33


Recommended attachment point
30°
27.5
Recommended attachment point
85.75
79
75.5
M5 ↧ 10
⌵ Ø 5.2 x 90°
9
3
0
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
10
7
0
47.2
64.8
71.5
75
Z
laser on
state
Z
0
0.5
32.5
33


Recommended attachment point
30°
27.5
Recommended attachment point
85.75
79
75.5
M5 ↧ 10
⌵ ⌀ 5.2 x 90°
9
3
0
96
89
0
laser on
state
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
Z
0
0.5
32.5
33

Connection cables for power supply and interfaces

Ethernet connection cable, cable track compatible

Art. No.	*Model*	*Description*
2901512	SC2700-2/ET	Ethernet connection cable for 2711, 2m
2901513	SC2700-5/ET	Ethernet connection cable for 2711, 5m
2901514	SC2700-10/ET	Ethernet connection cable for 2711, 10m
2901515	SC2700-15/ET	Ethernet connection cable for 2711, 15m
2901516	SC2700-20/ET	Ethernet connection cable for 2711, 20m
2901856	SC2600/2900-0,5	Ethernet connection cable for 2611/2911, 0.5 m
2901857	SC2600/2900-2	Ethernet connection cable for 2611/2911, 2 m
2901858	SC2600/2900-5	Ethernet connection cable for 2611/2911, 5 m
2901769	SC2600/2900-10	Ethernet connection cable for 2611/2911, 10 m
2901859	SC2600/2900-15	Ethernet connection cable for 2611/2911, 15 m
2901783	SC2600/2900-20	Ethernet connection cable for 2611/2911, 20 m
2901860	SC2600/2900-35	Ethernet connection cable for 2611/2911, 35 m

Ethernet connection cable, suitable for use with robots

Art. No.	*Model*	*Description*
2901542	SCR2700-2/ET	Ethernet connection cable for 2711, 2m
2901543	SCR2700-5/ET	Ethernet connection cable for 2711, 5m
2901544	SCR2700-10/ET	Ethernet connection cable for 2711, 10m
2901545	SCR2700-15/ET	Ethernet connection cable for 2711, 15m
2901546	SCR2700-20/ET	Ethernet connection cable for 2711, 20m
2901861	SCR2600/2900-0,5	Ethernet connection cable for 2611/2911, 0.5 m
2901862	SCR2600/2900-2	Ethernet connection cable for 2611/2911, 2 m
2901863	SCR2600/2900-5	Ethernet connection cable for 2611/2911, 5 m
2901864	SCR2600/2900-10	Ethernet connection cable for 2611/2911, 10 m
2901865	SCR2600/2900-15	Ethernet connection cable for 2611/2911, 15 m
2901866	SCR2600/2900-20	Ethernet connection cable for 2611/2911, 20 m
2901867	SCR2600/2900-35	Ethernet connection cable for 2611/2911, 35 m

Other cables

Art. No.	*Model*	*Description*
2901407	PC2700-4.5	PC2700-4.5 power supply cable, 4.5m
2901406	SC2700-4.5/RS422	RS422 connection cable, 4.5m
2901581	SC2700-0.5/SYNC	Synchronisation cable for two sensors of the gapCONTROL 2711 series, 0.5m
2901868	PC2600/2900-5	Multi-function cable (qualified for drag chain use): Power supply, digital inputs (TTL or HTL), RS422 (half-duplex), 5m
2901767	PC2600/2900-10	Multi-function cable (qualified for drag chain use): Power supply, digital inputs (TTL or HTL), RS422 (half-duplex), 10m
2901869	PC2600/2900-20	Multi-function cable (qualified for drag chain use): Power supply, digital inputs (TTL or HTL), RS422 (half-duplex), 20m

Accessories

Art. No.	*Model*	*Description*
0254026	scanCONTROL case	Transport case for two sensors of the gapCONTROL 2711 series, inc. mains adapter
2420062	PS2020	PS2020 power supply, 24V/2.5A

Output Unit

Art. No.	*Model*	*Description*
6414073	Output Unit Basic/ET	Fieldbus coupler with filter module and bus end terminal
0325131	OU-DigitalOut/8-channel/DC24V/0.5A/neg.	8-channel digital output terminal; DC 24V; 0.5A; negative switching
0325115	OU-DigitalOut/8-channel/DC24V/0.5A/pos.	8-channel digital output terminal; DC 24V; 0.5A; positive switching
0325116	OU-AnalogueOut/4-channel/±10V	4-channel analogue output terminal; ±10V
0325135	OU-AnalogueOut/4-channel/0-10V	4-channel analogue output terminal; 0-10V
0325132	OU-AnalogueOut/4-channel/0-20mA	4-channel analogue output terminal; 0-20mA
0325133	OU-AnalogueOut/4-channel/4-20mA	4-channel analogue output terminal; 4-20mA

Further terminals are available on request.

MICRO-EPSILON

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info@micro-epsilon.com · **www.micro-epsilon.com**