SENSORS & SYSTEMS

High speed profile measurement

MICRO-EPSILON

LASER LIGHT SECTION PRINCIPLE

The high speed profile sensor

- High speed measurement up to 4 kHz
- Dynamic detection of the profile
- Easy setup software
- Highly flexible for a variety of measurement applications

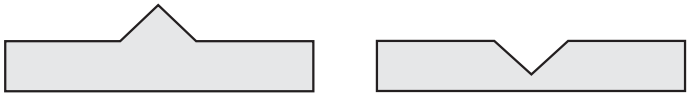
2D/3D profile sensor

scanCONTROL 2810

Principle and system advantages

Application

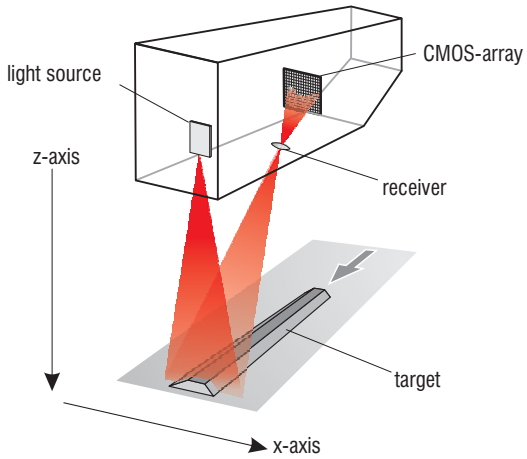
The system scanCONTROL 2810 detects beads (e.g. a seam) or grooves (e.g. a channel or gap) and computes their characteristic dimensions inside the controller. The system evaluates the measurements taken and provides control signals via analog and digital outputs. The system can be easily configured via the parameterization software included with the sensor package.



Bead **Groove**

The highest point of a bead has the smallest z-distance value due to scaling from the sensor's viewpoint. The z-distance value is maximum for a groove.

Measuring principle



Measurement principle

The laser line scanner scanCONTROL 2810 makes use of the triangulation principle for the two-dimensional acquisition of a profile on various target surfaces. Unlike familiar point laser sensors, a static laser line is projected onto the surface of the measurement object. A high quality optical camera system focusses the diffuse reflected light from this laser line onto a CMOS array. The controller computes the profile data from the camera picture and outputs it as calibrated x/z measurement coordinates. In addition the dimensional properties of the adhesive bead or groove are computed by the controller and transferred to the output.

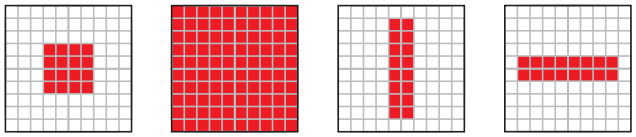
High speed real time measurement

Due to the high measuring rate of up to 256,000 measurement points/s, a significant increase in cycle time is achieved in real time quality inspection or online process guidance. Depending on the resolution and size of the measurement range, a profile frequency of up to 4,000 profiles/s can be attained.

Synchronous measurement through synchronous shutter

Instead of the conventional "rolling shutters" (reading out line by line), scanCONTROL has an innovative CMOS array with an instant high speed electronic shutter, which grabs the entire profile and reads out immediately.

Flexible measuring field (examples)



The CMOS array active field (where measurements will be taken) can be programmed according to 96 predefined possibilities, eg. using only a portion of the array increases data aquisition speed, selecting the central area increases accuracy.

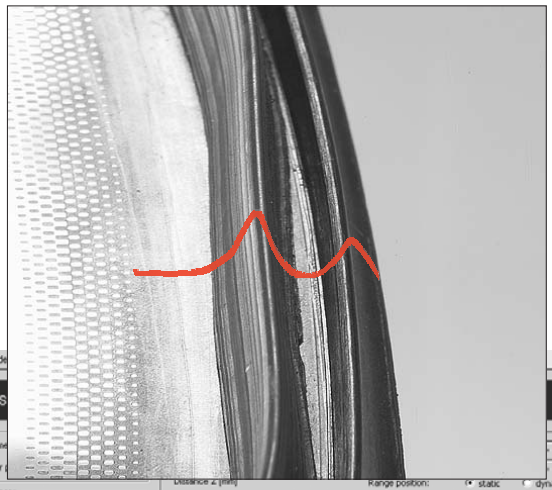
Flexible measurement field

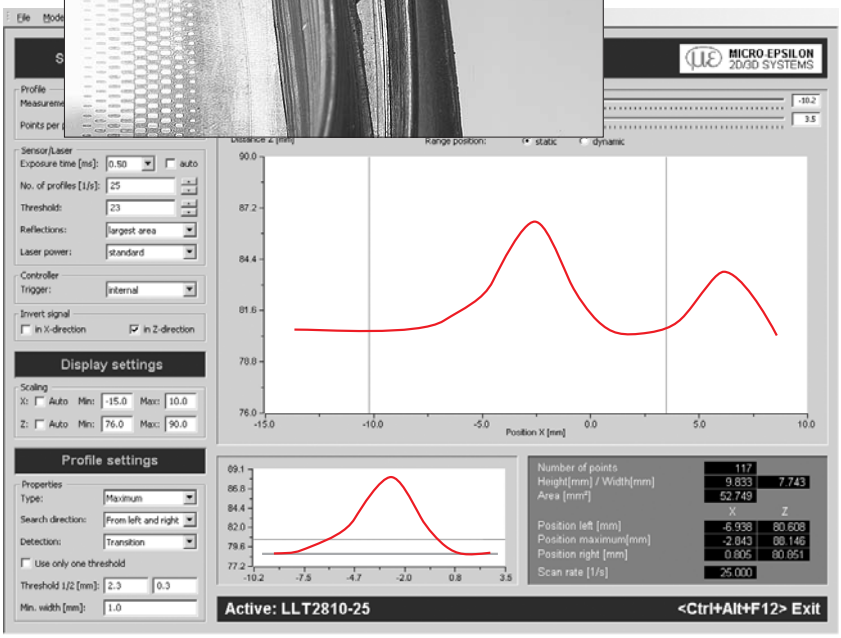
Depending on the application, with scanCONTROL either the data processing rate or the pixel resolution (x or z axis) can be further increased through the variable measurement field. Each second a maximum of 256,000 points are processed:

64 points/profile: Profile frequency of **4,000 profiles/s**
128 points/profile: Profile frequency of **2,000 profiles/s**
256 points/profile: Profile frequency of **1,000 profiles/s**
512 points/profile: Profile frequency of **500 profiles/s**
1,024 points/profile: Profile frequency of **250 profiles/s**

Apart from the processing rate and the number of measurement points to be read out, the height and width of the measurement field can be adjusted: e.g. 512 points over a narrow measurement strip (e.g. edge detection) or 256 points over a wide strip for high speed applications (e.g. inspection of glue beading).

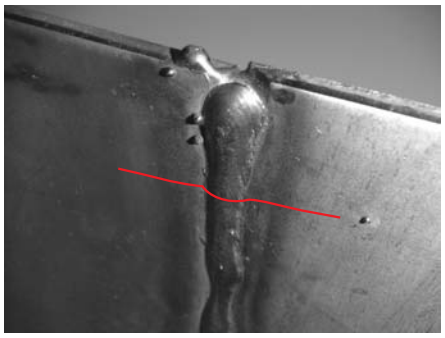
scanCONTROL 2810 was specially developed for measurements on beads (buldges, bumps) or grooves (indentations, gaps). It operates in a stationary mode - e.g. a fixed installed sensor unit looking at moving parts - and in the scanning mode - e.g. in conjunction with a motion control device or a robot. The application examples given here are just some of numerous possible applications.





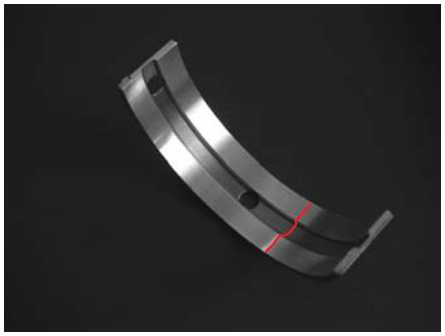
Glue bead profile visualisation

Typical applications

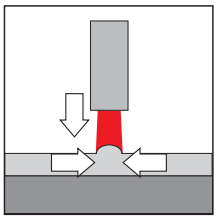


Welding bead / welding seam

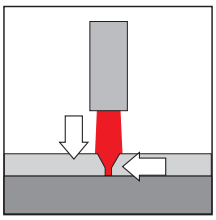
Gap / joining contact



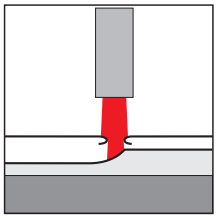
Groove width / groove depth



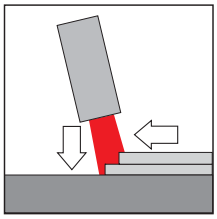
Welding seam inspection
Glue bead inspection
Profile monitoring



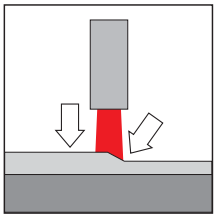
Groove width / depth
Robot guidance
Positioning



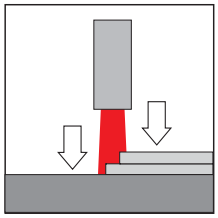
Door edges
Gap and flush



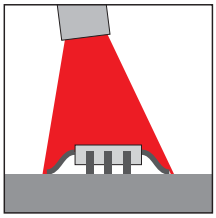
Edge detection
Height profile
Web width



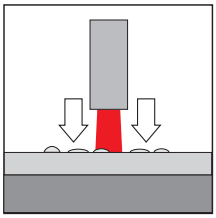
Angle measurement



Step & height measurement



Surface control
Planarity
Lead-Position



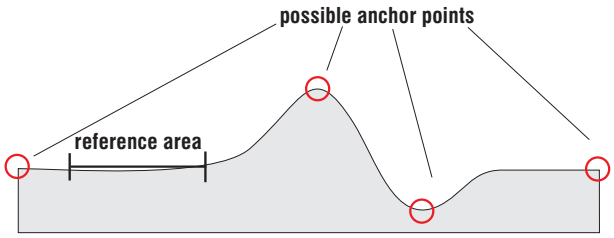
Welding bead control

Sequence of profile computation

In the following application example, the measurement on an adhesive bead and the possible calculated dimensions are shown.

Automatic tracking by an anchor point

In order to detect the area of interest within the changes of its position in the X and Z direction an anchor point is specified for the profile. This anchor point serves also as an absolute reference feature to provide the orientation on the target. Therefore the scanning line does not need to be accurately guided in order to follow the bead or groove. This feature allows an easy inspection especially for parts with various radii or very uneven base material.



The selection of the anchor point can therefore be adapted to the task in hand. With the scanCONTROL 2810 the following points can be defined as anchor points:

First/last point of the profile

The first/last point can be the leading or trailing edge of the surface. This means, for example, that the relative distance of the adhesive bead to the edge of the disk is obtained as the measurement.

Highest point

This is recommended when the adhesive bead itself always represents the highest point. This is usually the case on flat areas.

Lowest point

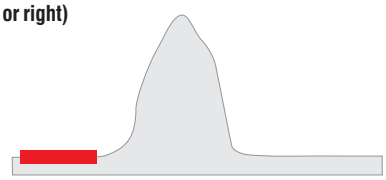
When the glue bead is at the edge of a groove and/or its position is of interest.

Reference lines for profile computation

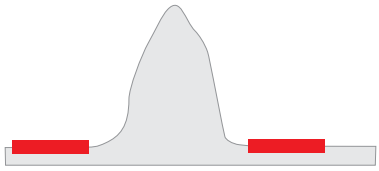
After defining the anchor point, one or two lines are now specified within the profile section which serve as a reference basis for the measurement. These sections can be dynamically defined on various levels. This offers advantages particularly when the quality of the surface on one or both sides of the adhesive bead changes along the adhesive beading.

Possible types of reference lines

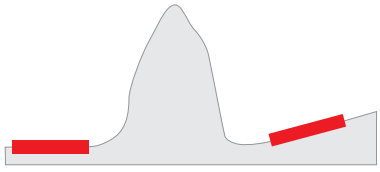
- One line (left or right)



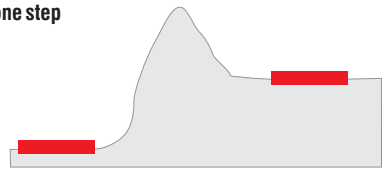
- Two lines



- Two lines at an angle to one another

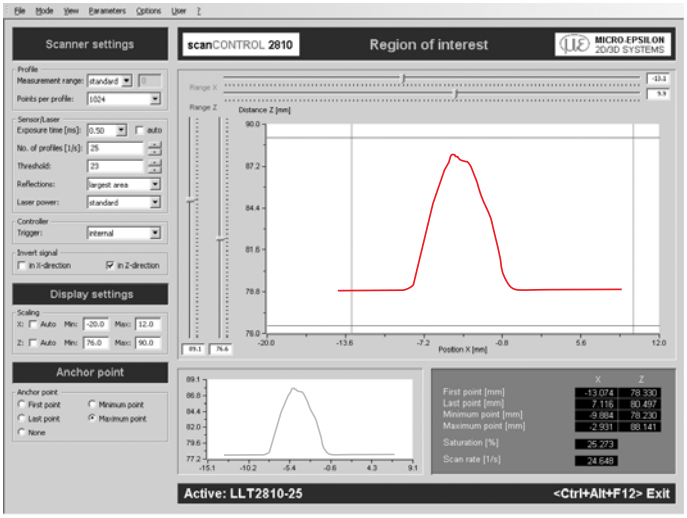


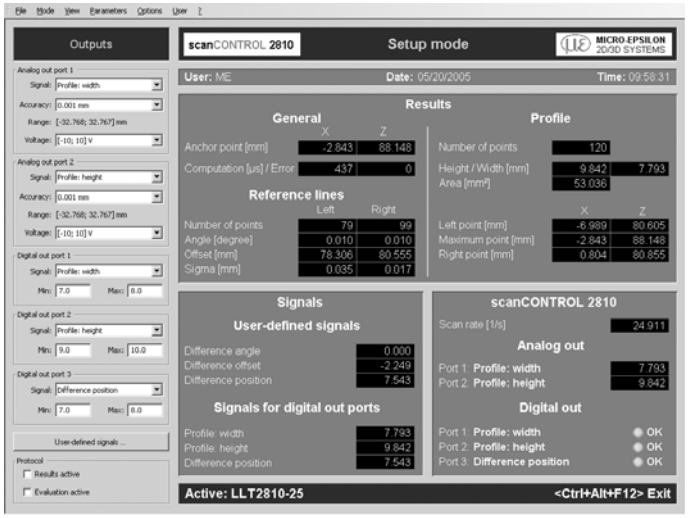
- Two lines of one step



Graphical user interface

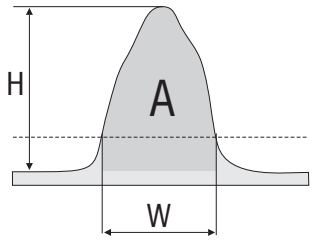
The parameterization software facilitates flexible adjustment to various test criteria and target conditions, which are then saved in the controller. These settings are made via the FireWire interface using a notebook or PC. The easy to use parameterization allows a quick adjustment of new test criteria.



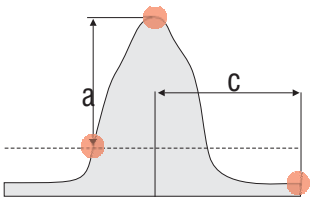


Evaluation and signal output

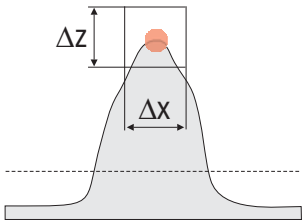
Along with other information, the following measurement results can be output over the three digital and two analog outputs.



Height, width and area



X and Z values of various prominent points or computed values

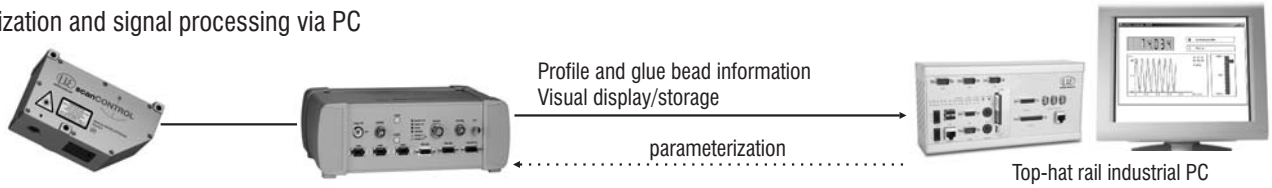


Control signal for exceeding of high or low limits

Possible configurations

Parameterization via Notebook/PC

Parameterization and signal processing via PC



Categories, scope of supply and accessories

Overview of measurement categories

Designation	Description	Remarks
General		
Anchor Point X/Z [mm]	Anchor point coordinates	x, z separately
Computation Time	Computation time	In µs
Error Code	Error code	
Reference Lines		
Number of Points	Number of valid measurement points in the basic range	Left/right separately
Angle	Angle of the reference lines	Left/right, A: 0.01°
Offset [mm]	Offset of the reference lines	Left/right separately
Sigma [mm]	Standard deviation of the measurement points for reference line	Left/right separately
Profile		
Number of Points	No. of profile points on the bead / groove	
Height [mm]	Height of the bead / groove	
Width [mm]	Width of the bead / groove	
Area [mm²]	Area of the bead / groove	
Left Point X/Z [mm]	Left end of the bead / groove	x, z separately
Maximum Point X/Z [mm]	Highest/lowest point of the bead / groove	x, z separately
Right Point X/Z [mm]	Right end of the bead / groove	x, z separately

Items included:

- Sensor, controller and sensor cable
- C++ library for linking into user applications
- Operating software under Windows 2000 / Windows XP for the configuration and control of measurement tasks
- Connecting cable for IEEE 1394
- Sensor log

Accessories:

- Sensor extension cable 3 m or 8 m
- Connection cable for analog output
- Top-hat rail industrial PC (see description on the right)

Options:

- High speed version with 4 kHz
- 50 mW laser power
- Various cable lengths and cable types
- Trigger and synchronization options

Top-hat rail industrial PC for the parameterization, visualization and storage of measurement data:

- Saving and loading parameter settings
- Logging (selected) measurements and the status of the digital outputs
- Control of the system via serial interface (RS232) or Ethernet (UDP, TCP/IP) including evaluation of the measurement process, logging of the evaluated measurement process
- Starting and stopping a continuous measurement
- Single measurement
- Selection / switchover of parameter settings

Top-hat rail industrial PC with preinstalled operating and display software

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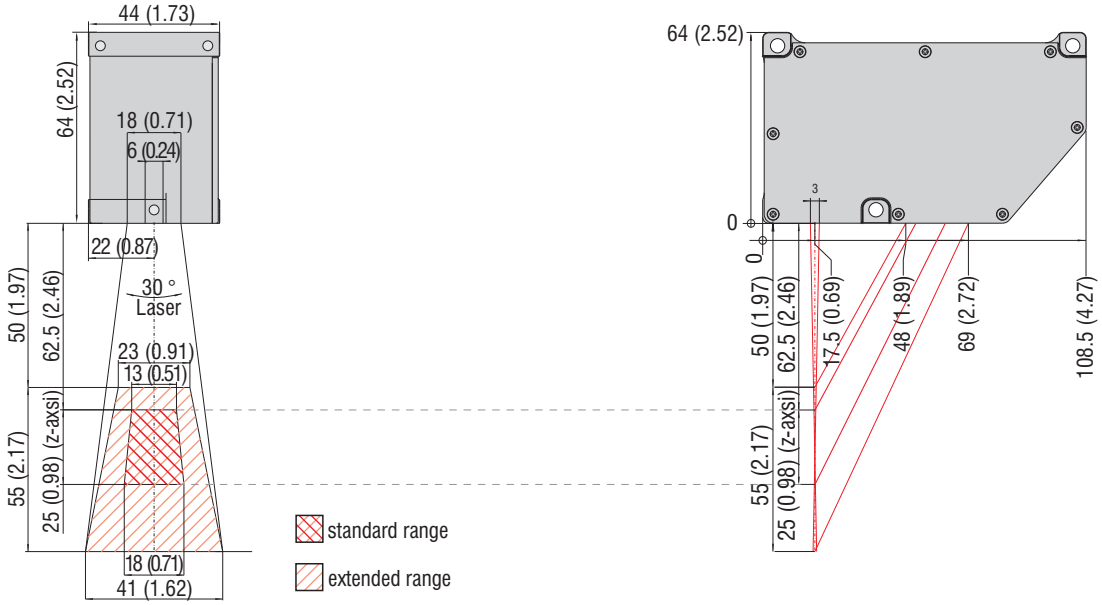
Model		scanCONTROL 2810-25		scanCONTROL 2810-100	
Standard ranges, extended range data (±5%) in brackets					
Measuring range z-axis		25 (55) mm	0.98 (2.17) "	100 (245) mm	3.94 (9.65) "
Resolution z-axis [1]	0.04%	10 µm		40 µm	
Measuring range x-axis	SMR	13 (23) mm	0.51 (0.91) "	30 (50) mm	1.18 (1.97) "
	EMR	18 (41) mm	0.70 (1.61) "	50 (140) mm	1.97 (5.51) "
Resolution x-axis		**256 / 512 / 1,024 [2], option: 64 / 128 points/profile**			
Profile frequency		**up to 1,000 profiles/s (option: up to 4,000 profiles/s)**			
Measuring rate		**up to 256,000 measurement points/s**			
Light source		laser diode 655 nm,15 mW (option: 50 mW)			
Laser class (EN 60825-1)		class 2M (option: 3B)			
Laser off		remote input and key switch			
Permissible ambient light (fluorescent light)		10.000 lx			
Protection class		sensor IP 64 controller IP 40			
Operating temperature		0...50 °C (32 ... 122 °F)			
Storage temperature		-20...70 °C (-4 ... 158 °F)			
Electromagnetic compatibility (EMC)		EN 61000-6-3 (emitted interference)			
		EN 61000-6-2 (immunity to interference)			
Vibration (IEC 68-2-6)		2 g / 20 ... 500 Hz			
Shock (IEC 68-2-29)		15 g / 6 ms			
Weight (without cable)	sensor	350 g		400 g	
	controller	3.5 kg			
Sensor connecting cable		standard 2 m			
Dimensions controller	LxWxH	278 x 187 x 107 mm			
Output analog					
Profile parameter on page 6 [3]		± 10 V (16 Bit, up to 150 kHz)			
Output/Input digital					
Interface (measurement data and control commands)		3x IEEE 1394 („FireWire"), 400 MBit/s, DCAM 1.30 standard			
		1x RS232 (115,200 Baud)			
		1x RS422 (115,200 Baud)			
Synchron-connector, input [4]		Sync-In, Remote Laser ON/OFF, Mode			
Synchron-connector, output [4]		Sync-Out, Error, User Mode (2x)			
Video signal (test and set up mode)		1 V_{SS} (BAS-signal, 8-bit-grey)			
Supply		24 VDC ±15 %; 0.5 A			

All specifications apply for a diffusely reflecting matt metallic target SMR = Start of measuring range EMR = End of measuring range
Marginal position tolerance of the measuring-field is possible (sensor depending)
[1] for standard measuring ranges
[2] 1024 points/profile only in extended range possible (up to 128,000 points/s, option up to 256,000 points/s)
[3] only for preprogrammed data (e.g. width, heigth, area)
[4] preprogrammed, other function possible

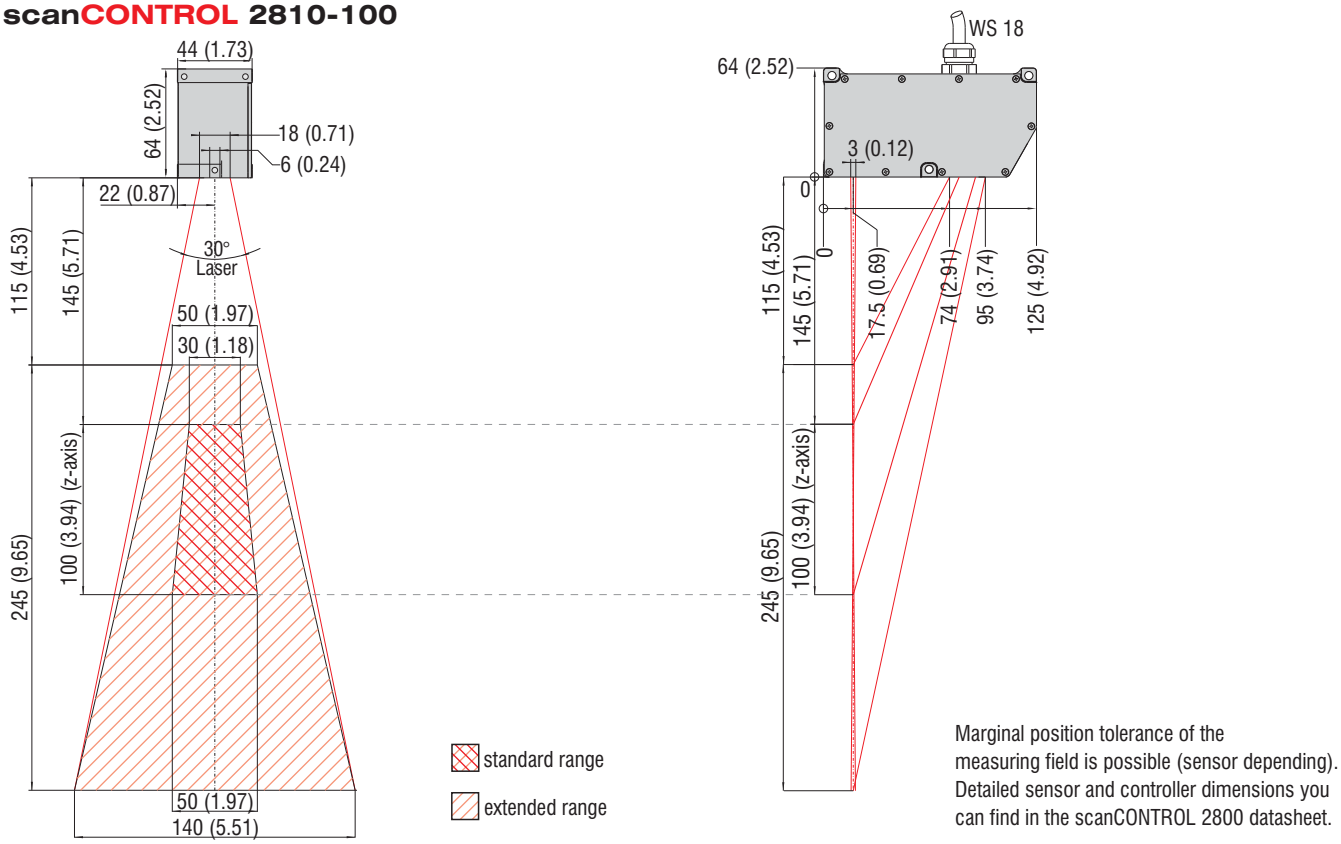
The laser unit of scanCONTROL 2810 uses a semiconductor laser with a wavelengh of 655 nm (visible/red) and 15 mW optical output (class 2M). The sensor is classified as laser class 2M. A warning sign is attached to the sensor housing.

Dimensions in mm (rounded inch), not to scale

scanCONTROL 2810-25



scanCONTROL 2810-100



Marginal position tolerance of the measuring field is possible (sensor depending). Detailed sensor and controller dimensions you can find in the scanCONTROL 2800 datasheet.

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