# RLS Series

► RLS-GD-20/20°

- 20° gloss measurement (for high-gloss surfaces)
- Insensitive to outside light due to clocked white light
- 2 receivers (20°, 60°) and reference
- Storing of up to 31 gloss degrees
- Tolerance adjustable for each gloss degree
- Working distance typ. 15 mm ± 10%
- Parameterisable under Windows®
- RS232 interface (USB or Ethernet converter is available)
- 5 switching outputs (npn-/pnp-able, 100 mA, short circuit proof)
- Switching state indication by means of 5 yellow LEDs
- Transmitter power adjustable or controllable (STAT or DYN)
- Averaging can be activated (over up to approx. 32000 values)
- Calibration function (Wood's glass)
- Various evaluation algorithms (standardized or calibrated onto Wood's glass = 100%)
- 2 analog outputs (0...+10V and 4...20mA, proportional to the gloss degree 0%...100% or zoomed via zoom function)
- 1 digital input for teaching
- Scratch-resistance optics cover made of glass, sturdy aluminum housing
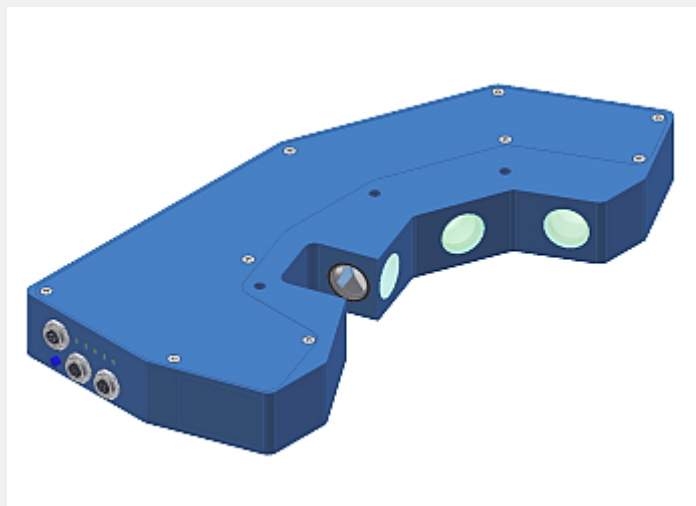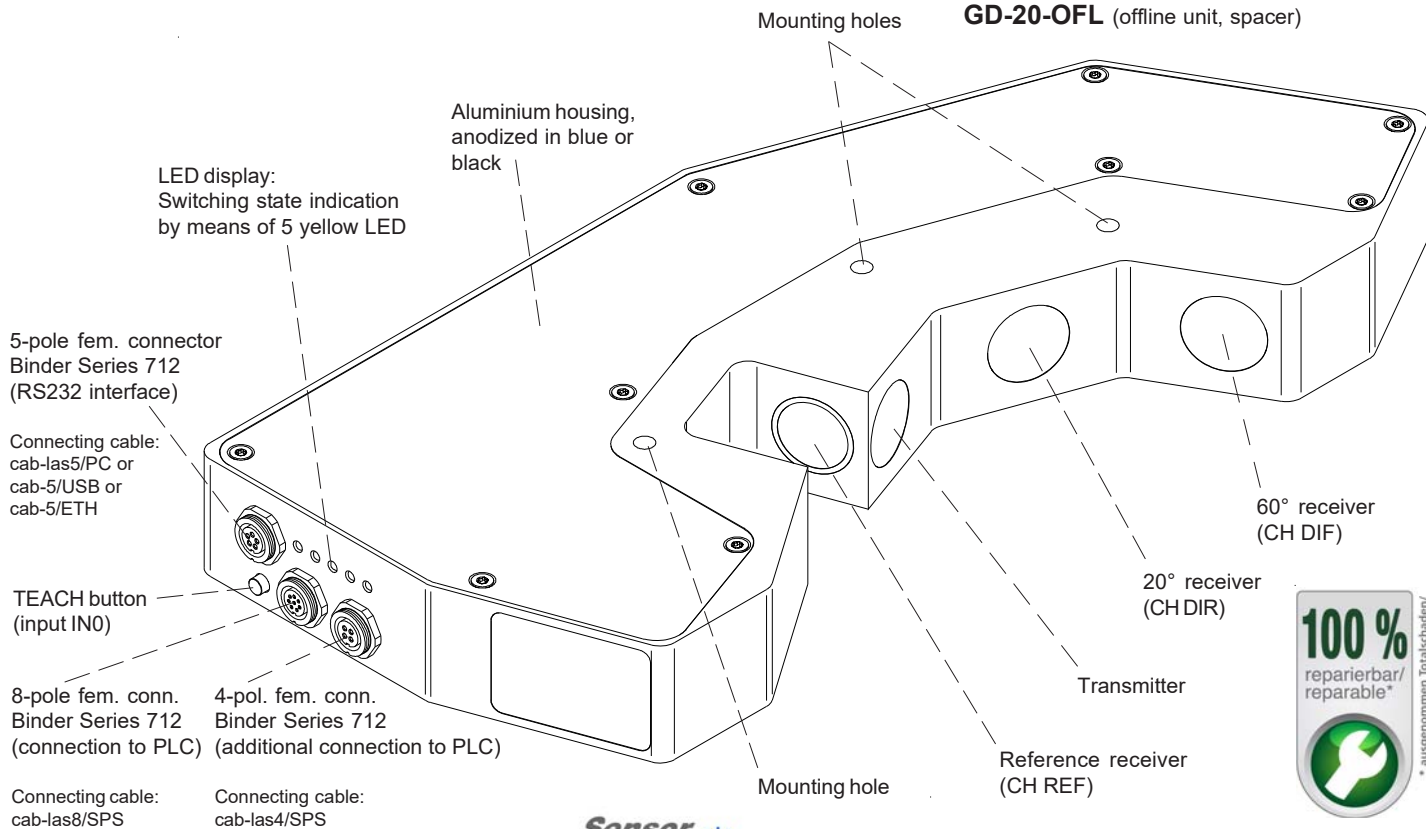

Design

Product name:

RLS-GD-20/20°
(incl. Windows® PC software RLS-GD-Scope)

Accessories: (cf. page 9-11)

ABL-RLS-GD-20 (blast-air top-part)
GD-20-CAL (calibration add-on unit)
GD-20-CAL-UV-MIRR (calibration add-on unit)
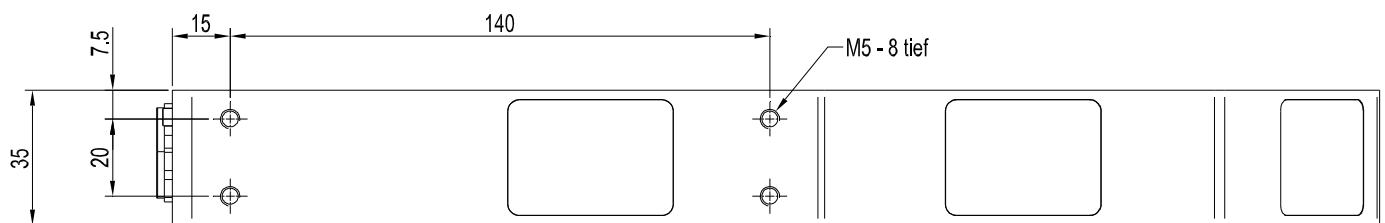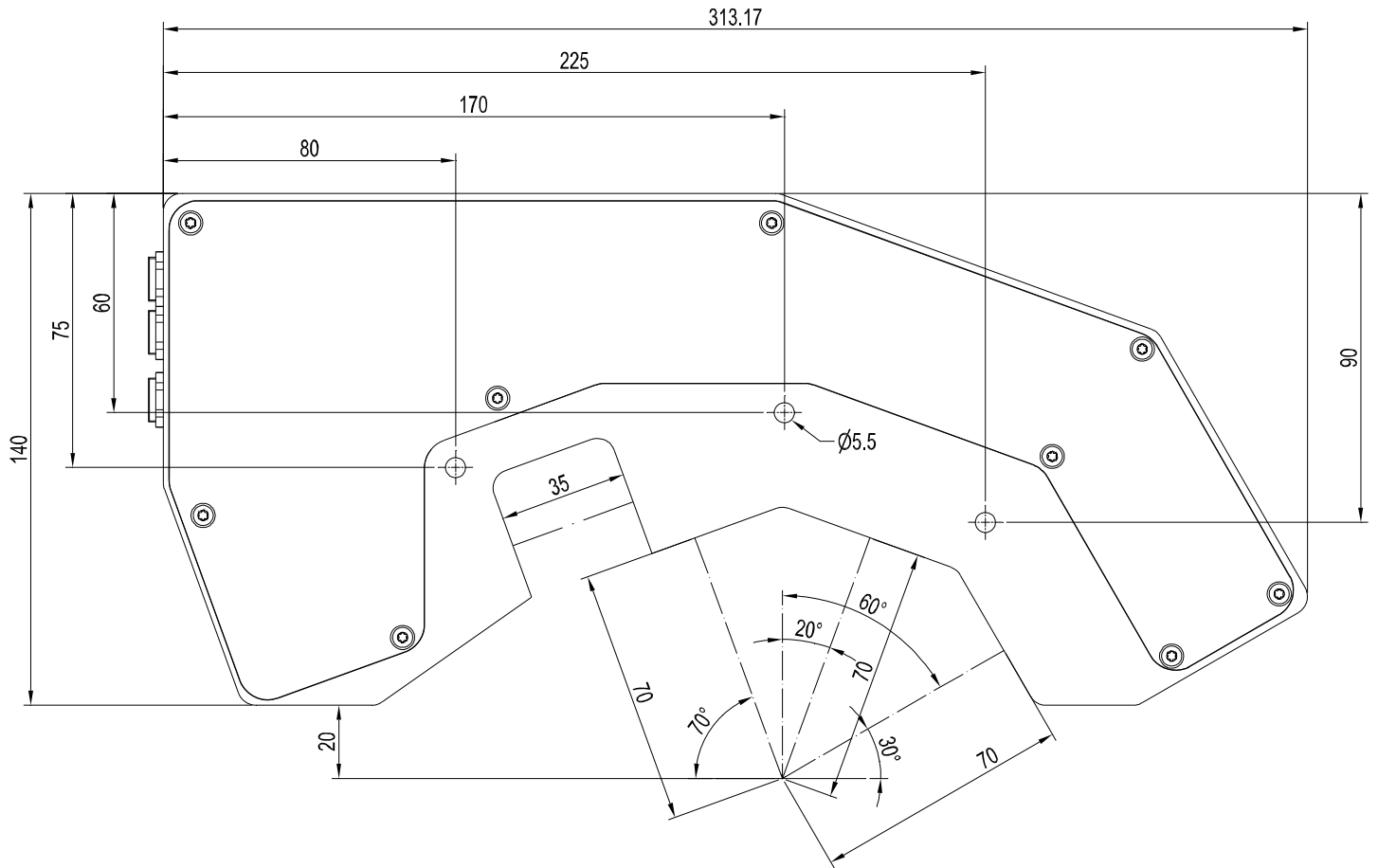**GD-20-OFL** (offline unit, spacer)

Mounting holes

Aluminium housing, anodized in blue or black

LED display: Switching state indication by means of 5 yellow LED

5-pole fem. connector Binder Series 712 (RS232 interface)

Connecting cable: cab-las5/PC or cab-5/USB or cab-5/ETH

TEACH button (input IN0)

8-pole fem. conn. Binder Series 712 (connection to PLC)

Connecting cable: cab-las8/SPS

4-pol. fem. conn. Binder Series 712 (additional connection to PLC)

Connecting cable: cab-las4/SPS

Mounting hole

60° receiver (CH DIF)

20° receiver (CH DIR)

Transmitter

Reference receiver (CH REF)

100 % reparierbar/reparable* * ausgenommen Totalschaden/ excluding total loss

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(2024-09-30) *RLS-GD-20/20° / Page 1 of 14*
(0326.04, 0556.01, 0343.02, 1521.00)
Subject to alteration

Technical Data

| Model	RLS-GD-20/20°
Light source	1x white light LED, AC-operation (100 kHz)
Working distance	typ. 20 mm ± 10%
Light spot size	in a distance of 20 mm: typ. 16 mm x 18 mm (elliptical)
Optical filters	day light filter (KG2), UV block filter
Resolution	0.1 GU (Gloss Unit)
Reproducibility	± 0.1 GU (Gloss Unit), in case of an averaging of 512
Voltage supply	+24VDC (± 10%), protected against polarity reversal, overload protected
Pulsating light operation	100 kHz
Ambient light	up to 5000 Lux
Enclosure rating	IP54
Current consumption	typ. 110 mA
Interface	RS232, parameterisable under Windows®
EMC test acc. to	DIN EN 60947-5-2 CE
Type of connector	connection to PLC: 8-pole female connector Binder Series 712 connection to PLC: 4-pole female connector Binder Series 712 connection to PC: 5-pole female connector Binder Series 712
Connecting cables	to PLC: cab-las8/SPS or cab-las8/SPS-w and cab-las4/SPS to PC/RS232 interface: cab-las5/PC or cab-las5/PC-w to PC/USB interface: cab-5/USB or cab-5/USB-w to PC/Ethernet interface: cab-5/ETH-500
Operating temperature range	-20°C ... +55°C
Storage temperature range	-20°C ... +85°C
Housing material	aluminum, anodized in blue or black
Housing dimensions	LxWxH approx. 313 mm x 140 mm x 35 mm
Max. switching current	100 mA, short-circuit proof
Switching frequency	max. 5 kHz (depends on averaging)
Output DIGITAL (5x)	OUT0 ... OUT4: Qinv or Q, adjustable via PC: Qinv: npn bright-switching (npn n.c.) / pnp dark-switching (pnp n.o.) Q: pnp bright-switching (pnp n.c.) / npn dark-switching (npn n.o.)
Output ANALOG (2x)	1x voltage output (0 ... +10V) 1x current output (4 ... 20mA)
Input DIGITAL (1x)	IN0 (Pin 3), digital (0V/+24V) or teach push button at the housing
Sensitivity (switching threshold)	parameterisable under Windows® (selection: threshold or tolerance window)
Pulse lengthening	0 ms ... 100 ms
Transmitted light power	adjustable under Windows®
Averaging	over 32000 values (adjustable under Windows®)
Switching state indication	by means of 5 yellow LED

Dimensions

All dimensions in mm

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Subject to alteration

Connector Assignment

Connection to PLC:
8-pole fem. connector Binder Series 712

Pin:	Color:	Assignment:
1	white	GND (0V)
2	brown	+24VDC (±10%)
3	green	IN0
4	yellow	OUT0 (Digital 0: typ. 0 … 1V, Digital 1: typ. +Ub - 10%)
5	grey	OUT1 (Digital 0: typ. 0 … 1V, Digital 1: typ. +Ub - 10%)
6	pink or black	OUT2 (Digital 0: typ. 0 … 1V, Digital 1: typ. +Ub - 10%)
7	blue	OUT3 (Digital 0: typ. 0 … 1V, Digital 1: typ. +Ub - 10%)
8	red	OUT4 (Digital 0: typ. 0 … 1V, Digital 1: typ. +Ub - 10%)

Connecting cable:
cab-las8/SPS-(length)
cab-las8/SPS-w-(length) (angle type, 90°)
(standard length 2m)
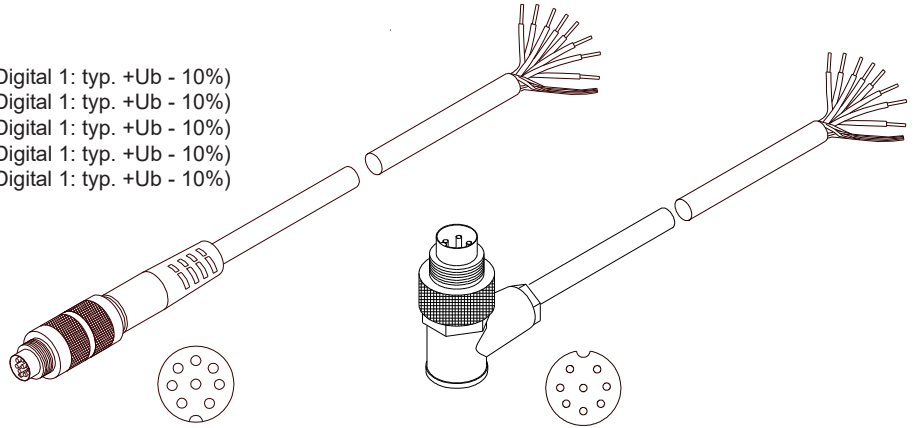
cab-las8/SPS-...
(max. length 25m, outer jacket: PUR)

cab-las8/SPS-w-...
(max. length 25m, outer jacket: PUR)

Additional connection to PLC:
4-pole fem. connector Binder Series 712

Pin:	Color:	Assignment:
1	white	GND (0V)
2	brown	not connected
3	black	Analog output voltage (0...+10V)
4	blue	Analog output current (4...20mA)
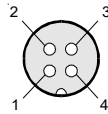
Connecting cable:
cab-las4/SPS-(length)
(Standard length 2m)
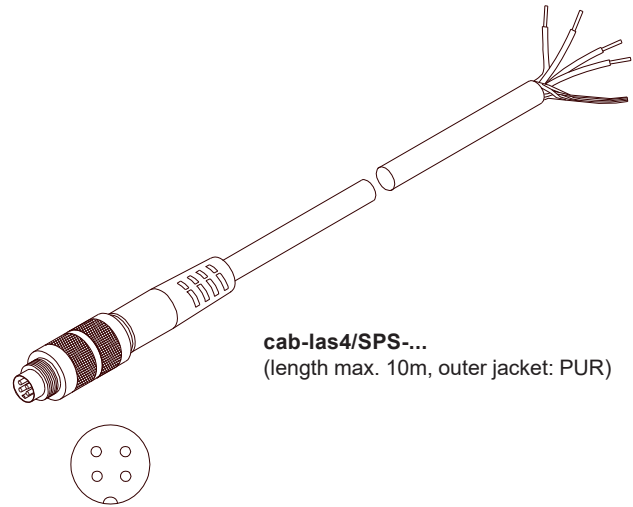
cab-las4/SPS-...
(length max. 10m, outer jacket: PUR)

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Connector Assignment

Connection to PC:
5-pole fem. connector Binder Series 712

Pin: Assignment:
1   GND (0V)
2   TxD
3   RxD
4   +24VDC (+Ub, OUT)
5   not connected

Connection via RS232 interface at the PC:
Connecting cable:
cab-las5/PC-(length)
cab-las5/PC-w-(length) (angle type 90°)
(standard length 2m)

alternative:
Connection via USB interface at the PC:
USB converter (incl. driver software):
cab-5/USB-(length)
cab-5/USB-w-(length) (angle type 90°)
(standard length 2m)

Connection to local network via Ethernet bus:
Ethernet converter (incl. software „SensorFinder"):
cab-5/ETH-500
(standard length 0.5m)

Optional: External CAT5 cable, e.g.
cab-eth/M12D-RJ45-flx-(length)
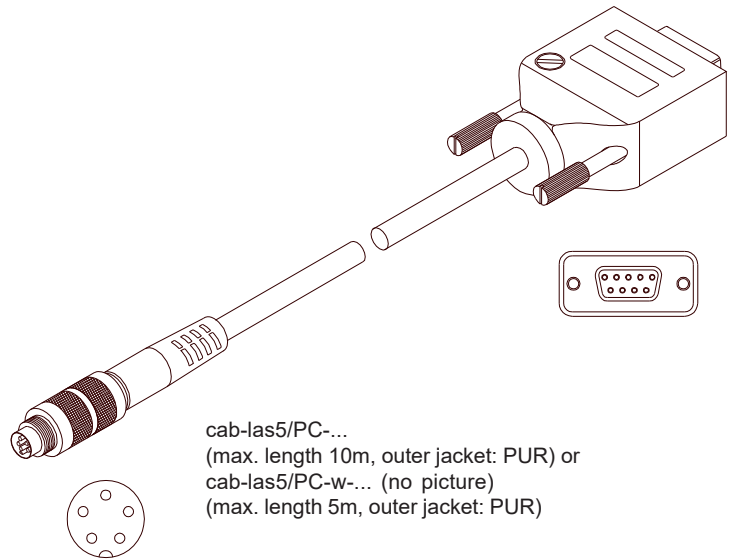
cab-las5/PC-...
(max. length 10m, outer jacket: PUR) or
cab-las5/PC-w-... (no picture)
(max. length 5m, outer jacket: PUR)

cab-5/USB-... or
cab-5/USB-w-... (no picture)
(each max. length 5m, outer jacket: PUR)

cab-5/ETH-500
(length 0.5m, outer jacket: PUR)
4-pole M12 fem. conn. (D-coded)
for connection of an external
CAT5 cable, e.g.
cab-eth/M12D-RJ45-flx-(length)

Visualization

Visualization of the gloss degrees:

Under Windows® representation of the gloss degree on a PC in numeric form and in a gloss chart, and representation of the 20°/60° values in a time chart. In addition the current 20°/60° values are displayed as a bar chart.

The following evaluation algorithms can also be selected:

- Target lies within the tolerance window of a taught gloss grade.
- EXTERN TEACH: With this function field the gloss sensor can be taught by means of a LOW-signal at pin 3 (for instance via push button, or PLC). During this procedure the object to be taught has to be in the visibility range of the gloss sensor. The yellow LEDs indicate a successful teaching procedure.
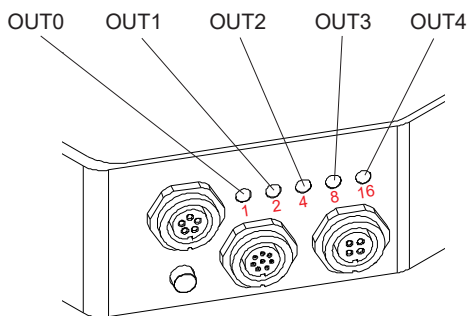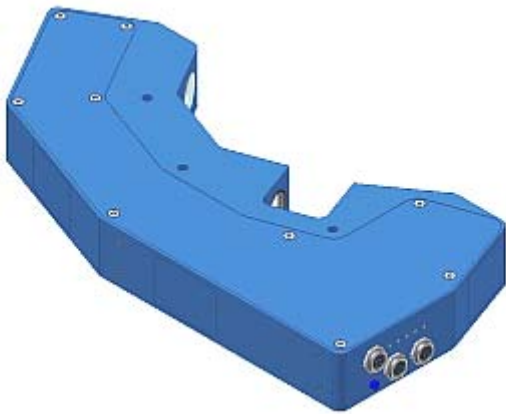
LED Display

LED display:

The gloss grade is visualized by means of 5 yellow LEDs at the housing of the gloss sensor.

In the BINARY mode the gloss grade indicated at the LED display is output as 5-bit binary information at the digital outputs OUT0 ... OUT4 of the 8-pole PLC connector.

The RLS-GD sensor is able to process a maximum of 31 line vectors (0 ... 30) in accordance with the corresponding lines in the TEACH TABLE.
An "error" or a "not detected" is displayed by the lighting of all LED (OUT0 ... OUT4) digital outputs are set to HIGH-level).

In the DIRECT mode the maximum number of gloss grades to be taught is 5. These 5 gloss grades can be directly output at the 5 digital outputs.

○○○○○ **0**	●○○○○ **1**	○●○○○ **2**
●●○○○ **3**	○○●○○ **4**	●○●○○ **5**
○●●○○ **6**	●●●○○ **7**	○○○●○ **8**
●○○●○ **9**	○○●●○ **10**	●●○●○ **11**
○○●●○ **12**	●○●●○ **13**	○○●●○ **14**
●●●●○ **15**	○○○○● **16**	●○○○● **17**
○●○○● **18**	●●○○● **19**	○○●○● **20**
●○●○● **21**	○●●○● **22**	●●●○● **23**
○○○●● **24**	●○○●● **25**	○●○●● **26**
●●○●● **27**	○○●●● **28**	●○●●● **29**
○●●●● **30**	●●●●● „error" respectively „not detected"	

OUT0 OUT1 OUT2 OUT3 OUT4
1   2   4   8   16

	Measuring Angles

For the gloss detection sensors of RLS-GD Series different standard measuring angles are available:

20°:   For high-gloss surfaces.
A 20° gloss sensor is used if gloss grades >70GU are to be determined.
That is, if the gloss grade measured with a 60° gloss meter is >70GU, a 20° gloss sensor is used.

60°:   For semi-gloss surfaces.
A 60° gloss sensor is used if gloss grades >10GU to <70GU are to be determined.
This variant is an "all-rounder". The 60° gloss sensor is therefore standard for most applications.

75°:   TAPPI standard (paper industry) for matt surfaces.

85°:   For matt surfaces.
An 85° gloss sensor is used when gloss grades <10GU are to be determined.
That is, if the gloss grade measured with a 60° gloss meter is <10GU, an 85° gloss sensor is used.

[GU = Gloss Unit]

	Measuring Principle

Measuring principle of the gloss detection sensor RLS-GD-20/20°:

The RLS-GD-20/20° sensor can be "taught" up to 31 gloss degrees or normalized vector. Evaluation always is performed with 12 bits.
With the help of a modulated white-light LED a white light spot (Ø approx. 15 mm) is projected onto the surface to be inspected by way of an optical transmitter unit at an angle of 20° to the vertical plane.

Part of the light directly reflected by the object to be measured is directed onto a photodiode by means of an optical receiver unit (optical receiver unit also arranged at an angle of 20° to the vertical plane). Furthermore, diffuse reflection is determined by way of one additional optical unit. The gloss degree is then determined from the 2 receiver signals (20°, 60°).

As an alternative calibration can be performed on black glass (under 20°, corresponds to 100). For this purpose a reference line is applied during calibration to store a reference value which then serves as a comparison value during measurement.

Gloss detection either operates continuously or is started by an external PLC trigger signal. The gloss degree respectively the detected normalized vector is output at the 5 digital outputs OUT0 to OUT4, or it can be sent analog either to the voltage output 0 … +10V or to the current output 4 … 20mA. At the same time the detected gloss degree is visualised by means of 5 LEDs at the housing of the RLS-GD-20/20°.

TEACH button:
With the TEACH button at the sensor housing the sensor can be taught the currently detected gloss degree or the normalized vector. For this purpose the corresponding evaluation mode must be set with the software. The TEACH button is connected in parallel to the input IN0 (green wire of cable cab-las8/SPS).

Evaluation algorithm EXTERN TEACH:
With this function field the gloss sensor can be taught by means of a LOW-signal at pin 3 (for instance via push button, or PLC). During this procedure the object to be taught has to be in the visibility range of the gloss sensor. The yellow LEDs indicatea successful teaching procedure.

RS232 interface:
Through the RS232 interface parameters and measured values can be exchanged between the PC and the RLS-GD-20/20° sensor. All the parameters for gloss degree detection respectively normalized vector detection can be stored in the non-volatile EEPROM of the RLS-GD-20/20° sensor. When parameterization is finished the gloss sensor continues to operate with the current parameters in "stand alone" mode without a PC.

Calibration:
In order to perform gloss degree detection the sensor must be calibrated. For this purpose a black glass inlay is required which by definition has a gloss degree of 100%. Calibration is then performed with the help of the PC software.

Temperature compensation:
The sensor is factory-temperature-compensated. It is stable over a temperature range from 10 degres to 60 degrees centigrade. The current temperature inside the housing is visualised by the PC user interface.

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Parameterization

Windows® user interface:

The RLS-GD gloss sensor is parameterized under Windows® with the RLS-GD-Scope software. The Windows® user interface facilitates the teach-in process at the sensor and supports the operator in the task of adjustment and commissioning of the sensor.
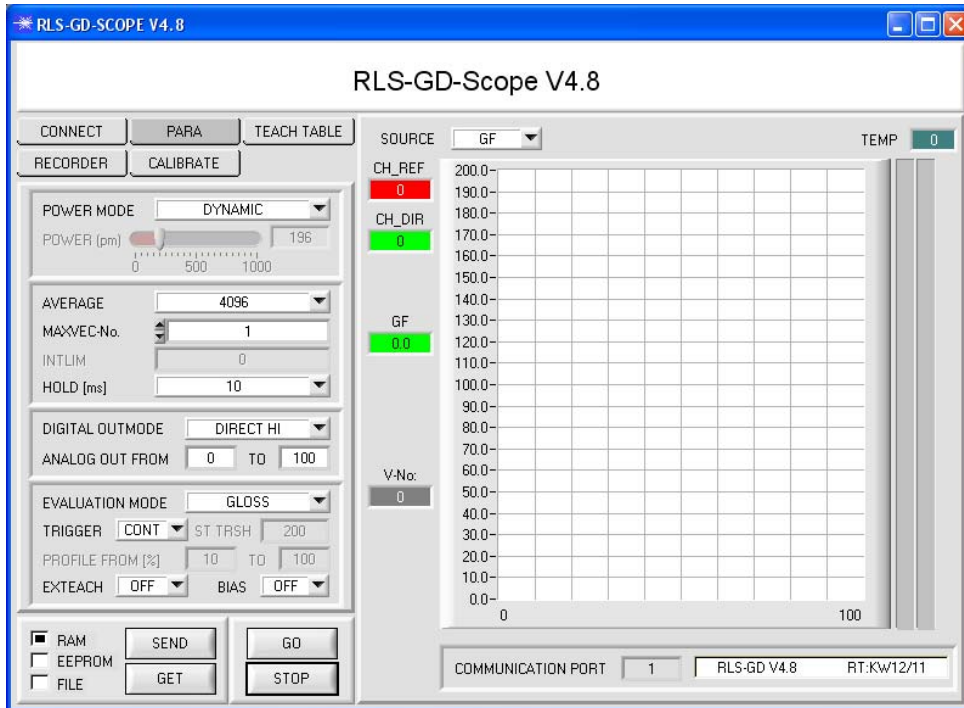

The RS232 interface (PARA) is used for setting parameters such as:
- MAXVEC-No.:
  Number of gloss degrees (normalized vectors) to be checked
- POWER MODE:
  In this function field the operating mode of automatic power correction at the transmitter unit can be set
- EVALUATION MODE:
  The RLS-GD sensor can be operated with two different evaluation modes (NORM_INT or GLOSS)
- AVERAGE:
  Averaging over a maximum of 32768 values
- TRIGGER:
  Continuous or external or self trigger
- DIGITAL OUTMODE:
  Triggering of the digital outputs
- INTLIM:
  Minimum intensity required for gloss evaluation
- HOLD:
  Pulse lengthening up to 100ms max.

Under Windows® representation of the gloss value on a PC in numeric form and in a color chart, and representation of RGB values in a time chart. In addition the current RGB values are displayed as a bar chart.

Firmware Update by means of the software Program Loader:
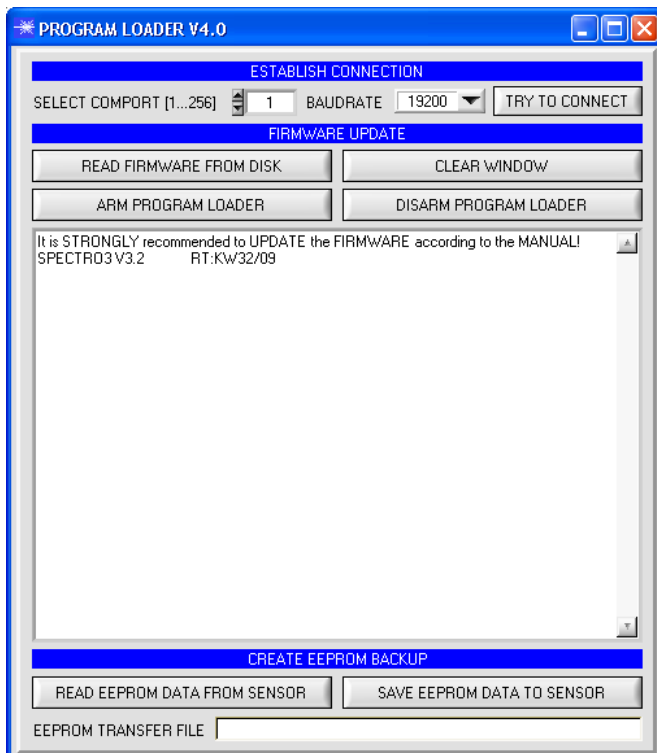
The software „Program Loader" allows the user to perform an automatic firmware update. The update will be carried out through the RS232 interface.

An initialisation file (xxx.ini) and a firmware file (xxx.elf.S) are required for performing a firmware update. These files can be obtained from your supplier. In some cases an additional firmware file for the program memory (xxx.elf.p.S) is also needed, and this file will be automatically provided together with the other two files.

A plausibility check is performed after the initialisation file has been loaded with the Program Loader. If the initialisation file was changed or damaged, it will not be possible to perform a firmware update.

When the plausibility check is successfully completed, the instructions contained in the initialisation file will be carried out step by step.

The complete memory contents of the micro-controller in the sensor will be deleted in a firmware update. This means that both the program in the program memory and the data in the data memory will be lost.

The new firmware automatically writes the correct data to the program memory again.

However, the parameter settings, temperature curves, linearization curves, etc. that are stored in the data memory (EEPROM) will be deleted.
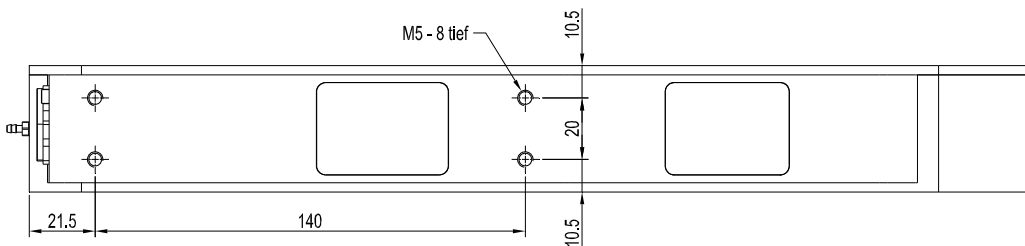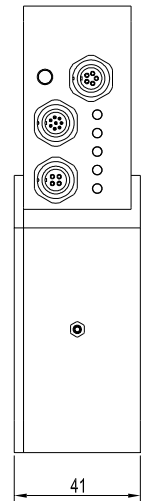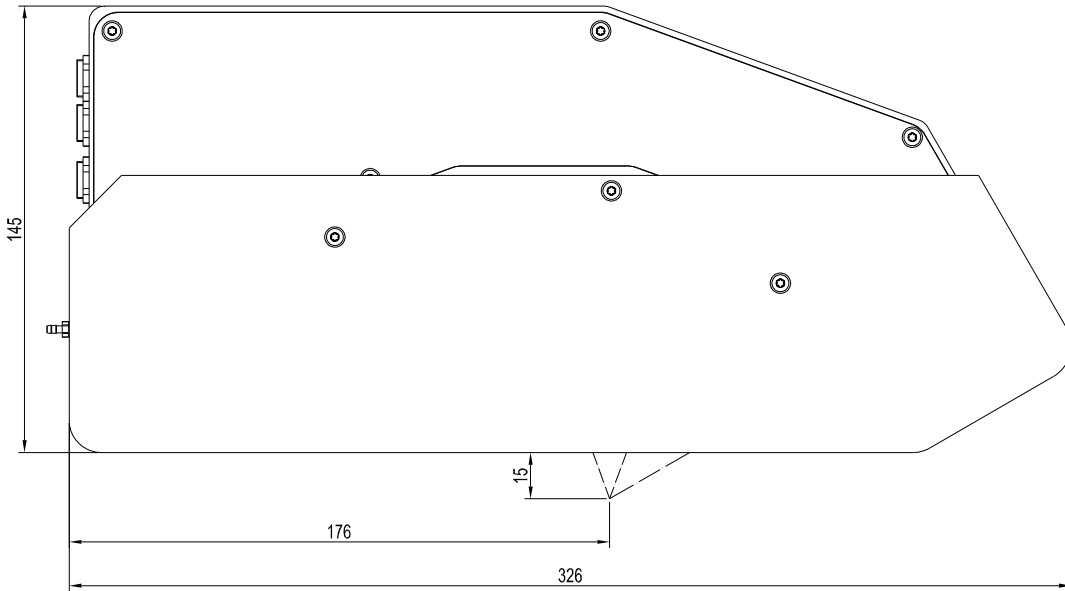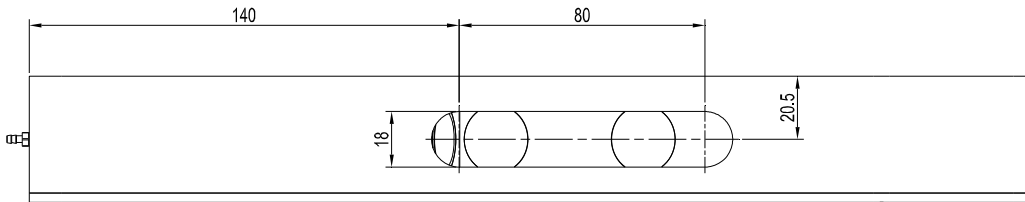
With the Program Loader V4.0 software the data will be saved in the EEPROM, and can be written back again after successful firmware update.
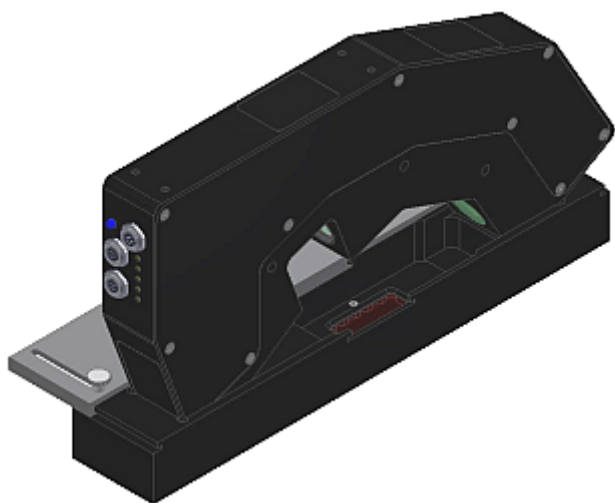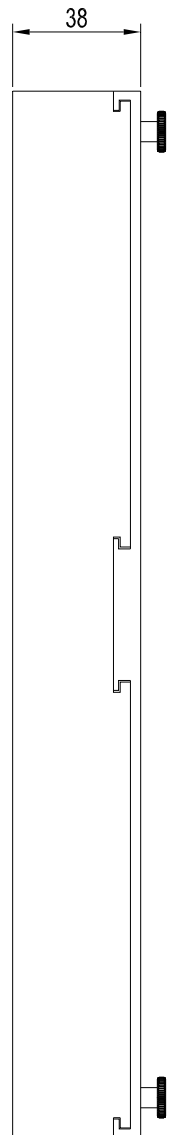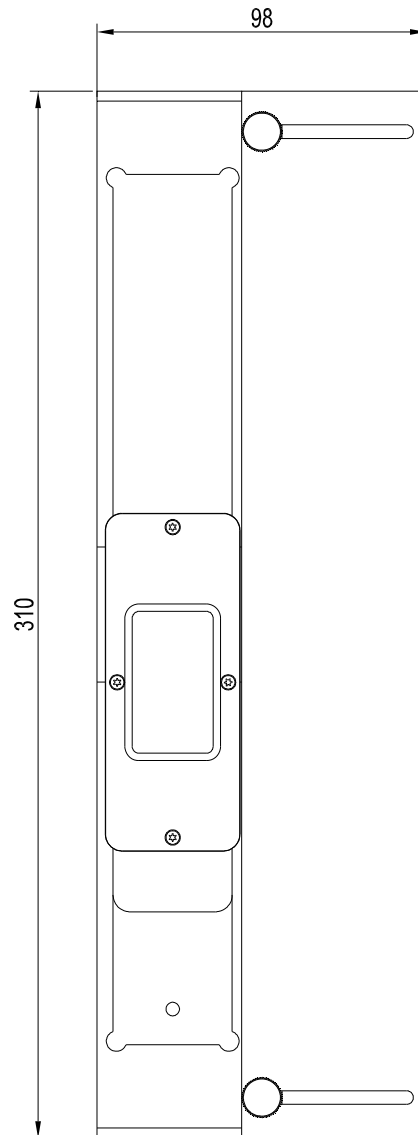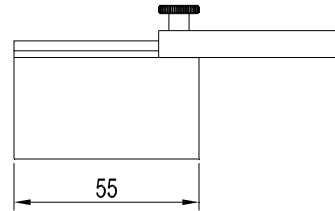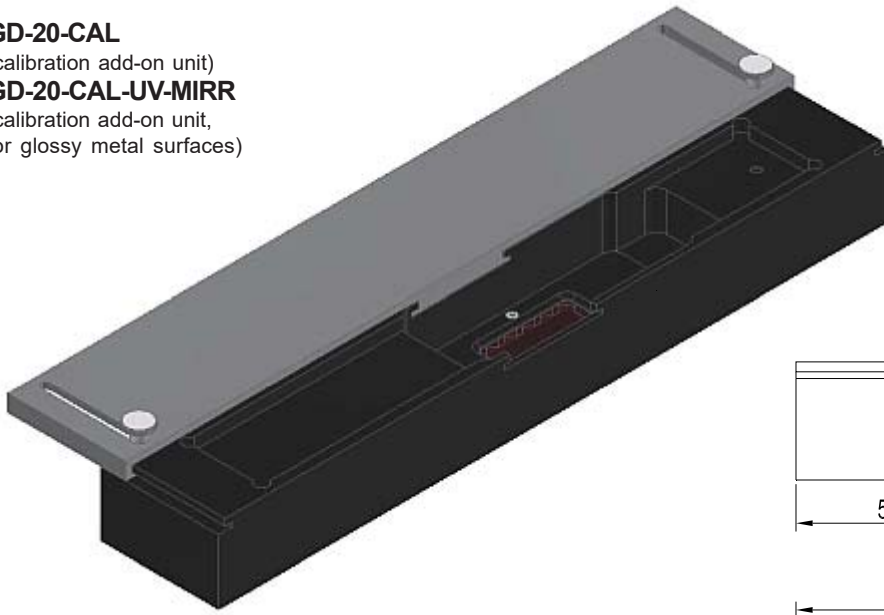For this purpose the software creates an EEPROM backup file.

Accessories

ABL-RLS-GD-20
(blast-air top-part)

All dimensions in mm

Accessories

GD-20-CAL
(calibration add-on unit)
GD-20-CAL-UV-MIRR
(calibration add-on unit,
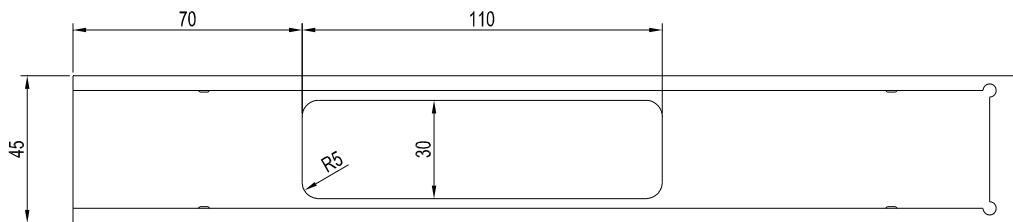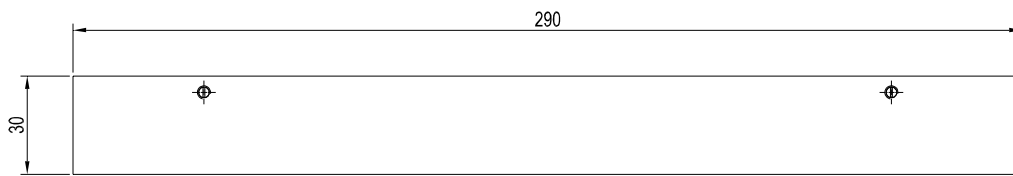for glossy metal surfaces)

55

98

38

310

All dimensions in mm

Accessories

**GD-20-OFL**
(offline unit, spacer)


All dimensions in mm

Application Examples

Online measurement of the gloss degree

In the production of plastic sheets (design sheets, wall coverings, floor coverings, table coatings, foam sheets, and coated carrier materials for the furniture industry, automobile industry, fashion industry, or construction industry) and ceramic parts (ceramic tiles and plates for wall and floor) 100% quality inspection of the optically visible surface has become an ever more frequent requirement.

For this purpose the RLS-GD sensor features non-contacting detection of the gloss degree. The simultaneous measurement of the object from two different directions (direct reflection and diffuse reflection) allows intensity-independent evaluation. The sensor can be taught to a certain surface, and up to 31 tolerance windows can be applied around the taught value. Measurement output is performed digitally by way of five outputs.
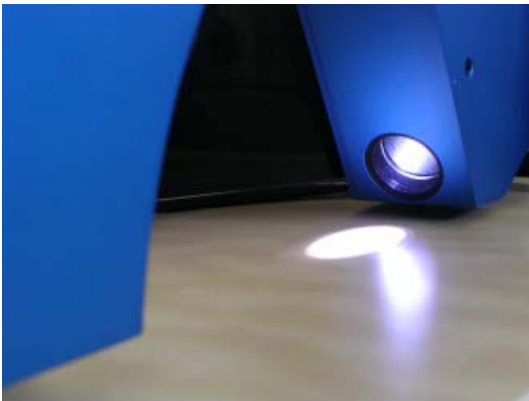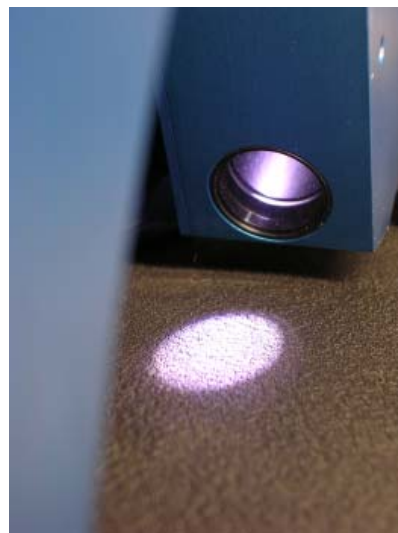

Gloss degree determination of sheets for the furniture industry
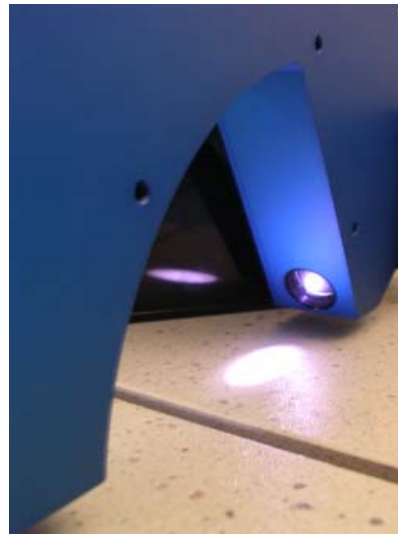
Online gloss measurement at ceramic parts

Monitoring of the gloss value of imitation leather

Examination of leather surfaces with respect to their gloss behavior

Gloss degree monitoring at plates of stone

Application Examples

### Checking the presence of sub-decor during laminate flooring production

It may happen in the production of laminate flooring that the sub-decor is not applied. Such missing sub-decor should be detected as early as possible in the production process, which is why surface checking should be performed directly after the laminating unit. Because of the great variety of different products and surface decors, image processing systems and color sensors turned out to be unsuitable for this application.
The RLS-GD-15/60° gloss sensor, however, can perfectly distinguish between sub-decor present / not present.
The application uses the analog output (4mA ... 20mA), which behaves proportionally to the gloss grade of the surface. A missing sub-decor leads to a sudden change of the analog signal, i.e. of the gloss grade. It is furthermore possible to perform teaching to the respective sub-decor, the gloss grade is then indicated in 31 stages (from good to bad) by way of switching outputs, and can thus easily be inter-rogated by a PLC. When a certain stage is exceeded, an alarm signal can be triggered or, in case of small deviations (trend), the operator can be informed in time.

Online gloss measurement at laminate flooring (monitoring of counteracting paper)

These sensors are used to check whether the resistant hard-paper layer is applied correctly. For this inspection use is made of the different gloss degrees of the hard-paper layer and the uncoated back side of the laminate flooring. This wood processing company presently is considering the use of the RLS-GD-15/60° for quality inspection of the decor, where a distinction should be made between decor and sub-decor.
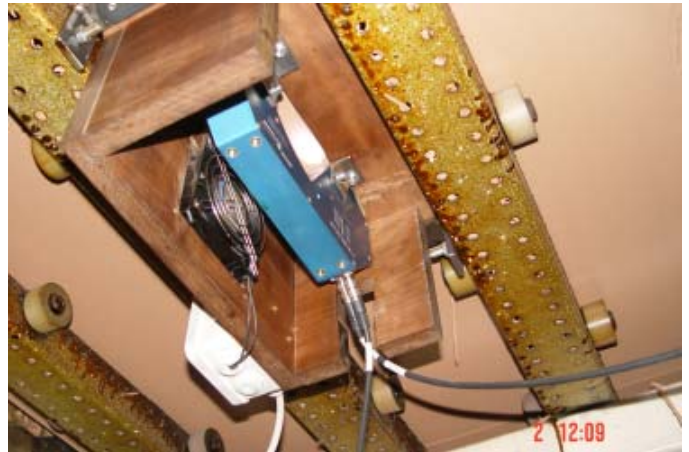
Online gloss measurement during PVC-flooring production in transverse motion operation

In the production of plastic floor coverings the gloss degree decisively depends on the material temperature in the extruder. Environmental influences such as air humidity and ambient temperature also are of importance with respect to the gloss degree."Until now, measurements were only performed at the start and end of production. With the RLS-GD-15/60° online measuring system the gloss degree can now be determined during the whole production process."It is furthermore planned to use the analog signal (4...20mA, proportional to the gloss degree) for automatically controlling the temperature of the extruder and thus the gloss degree.

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Application Examples

Gloss measurement of aluminium strip material

In the production of aluminium strip material the gloss rate provides information about the quality of the product. This parameter furthermore informs the machine operator how to set his machine in case of a deviation from the ideal value. Until now the gloss rate was determined by way of random sampling with laboratory equipment, the RLS-GD-20/20° inline gloss measuring system and the RLS-GD-MONITORING monitoring software provides information about both the current gloss rate and the current trend of the gloss value. 'Order number', 'date', 'time', 'operator name', and 'customer' data also are stored.

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