SPECTRO-INLINE SYSTEMS

SPECTRO-T-4-INLINE-VISNIR
SPECTRO-T-4-INLINE-VISNIR-RS485

- **Inline measurement system for identifying various plastic granules and flakes as well as textiles made from natural and synthetic fibers in the visible range (VIS) and near-infrared range (NIR)**
- 4 light sources:
  In the VIS range, a white light source and an integrated triple receiver for the red, green, and blue components (true-color detector)
  In the NIR range, three NIR light sources with different wavelengths (1300 nm, 1550 nm, 1650 nm) and a broadband NIR detector
- **Two versions of the sensor (measurement system) are available:**
  I/O version with digital input IN0 and digital output OUT0
  RS485 version with RS485 interface
- Sequential pulse mode; scan frequency max. 5 kHz
- Working distance (object distance): typ. 10 mm ± 1 mm
- Half-value width for INTnir: typ. 12 mm (of the detection range)
- Half-value width for INTvis: typ. 8 mm (of the detection range)
- Insensitive to outside light due to pulse mode
- Windows® PC software SPECTRO-T-4-DOCAL-Scope
- Factory calibration and on-site calibration possible
- Temperature compensation for ambient temperatures from 10°C to 45°C
- RS232 interface (USB converter included in the delivery scope, Ethernet converter available as an option)
- Available as an option: SI-PPC-500-15“ (V2.0) monitoring and parameterization unit (computer evaluation system)

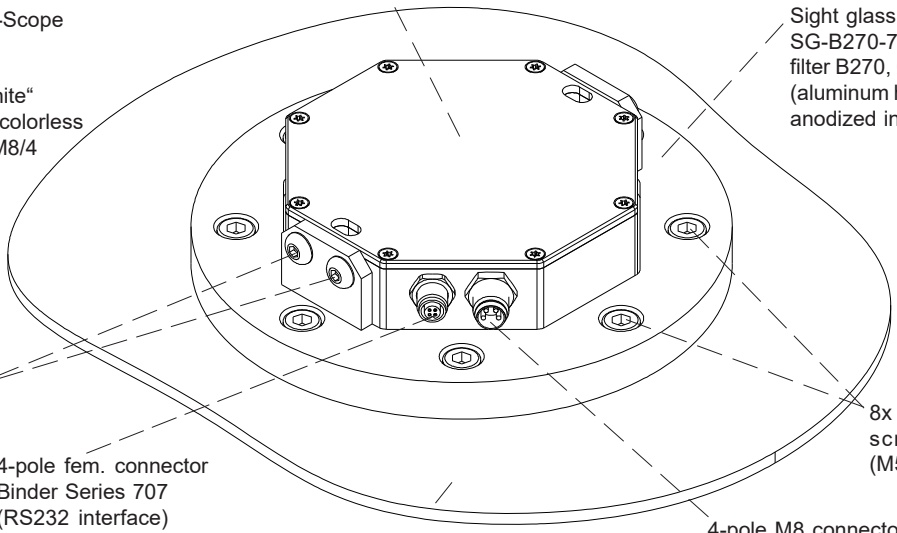
Design

Product name:

SPECTRO-T-4-INLINE-VISNIR or
SPECTRO-T-4-INLINE-VISNIR-RS485
(Inline measurement system)
incl. Color/NIR sensor (hybrid sensor) SPECTRO-T-4-10-DIF-VISNIR
or SPECTRO-T-4-10-DIF-VISNIR-RS485
incl. Windows® software SPECTRO-T-4-DOCAL-Scope
incl. Sight glass SG-B270-75
incl. Offline unit FW-B270-75-OFL
incl. RAL plastic color card „RAL 9010-P pure white“
incl. Aluminum card in RAL format (148x105mm) colorless
incl. External power supply PS-24V-1,25A/30W-M8/4
incl. USB converter cab-4/USB-2m
(optional: Ethernet converter cab-4/ETH-500)

Accessories: (p. 15)

SI-PPC-500-15“ (V2.0)
(Monitoring and parameterization unit)



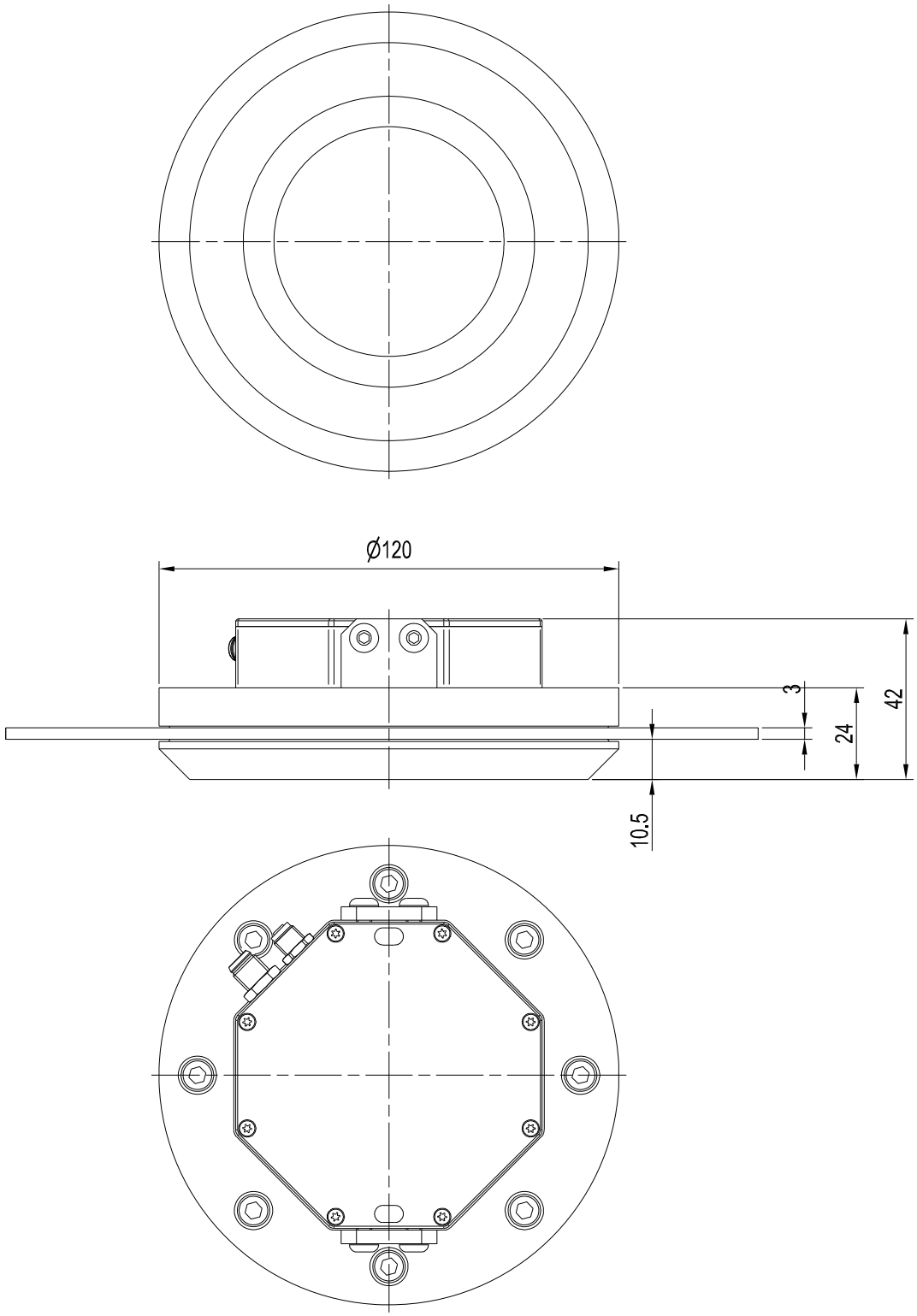
100 % reparierbar/reparable* * ausgenommen Totalschaden/excluding total loss

Technical Data

Type	SPECTRO-T-4-INLINE-VISNIR	SPECTRO-T-4-INLINE-VISNIR-RS485
Voltage supply	+24VDC (±10%), reverse polarity protected, overcurrent protected	
Current consumption	< 300 mA	
Max. switching current	100 mA, short circuit proof	
Interface	RS232 USB converter included in the scope of delivery (ETHERNET converter available as an option)	
Digital input	digital input IN0 (Pin 2): input voltage +Ub/0V, with protective circuit	---
Digital output	digital output OUT0 (Pin 4): 100 mA, short-circuit proof	---
Additional interface	---	RS485 interface (A, B), max. baud rate: 460800 Bit/s, RS485 address: (Initial 200)
Pulse lengthening	0 ... 100 ms, adjustable via PC software	
Averaging	max. 32768 values, adjustable via PC software	
Scan frequency	max. 5 kHz	
Measuring spot diameter	see diagrams	
Transmitter (light source)	VIS range: 6 sunlight LEDs, with volumetric diffuser NIR range: 3x 6 NIR emitters with three different wave lengths (1300 nm, 1550 nm, and 1650 nm), with volumetric diffuser	
Receiver	VIS range: true-color detector NIR range: broadband NIR detector (900 nm ... 1700 nm)	
Receiver gain setting	8 steps (AMP1 ... AMP8), adjustable via PC software	
Ambient light	max. 5000 Lux	
Working distance (object distance)	typ. 10 mm ± 1 mm	
Housing dimensions	LxH approx. Ø 120 mm x 42 mm	
Housing material	Hybrid sensor SPECTRO-T-4-10-DIF-VISNIR (-RS485): Aluminum, anodized in black Sight glass SG-B270-75: Aluminum, anodized in black Offline unit FW-B270-75-OFL: Aluminum, anodized in black	
Enclosure rating	IP64	
Connecting cables	USB converter: cab-4/USB-2m (optional Ethernet converter: cab-4/ETH-500) Power Supply (+24V): PS-24V-1,25A/30W-M8/4 (cable length approx. 1.5m)	
Type of connector	connection to PLC: 4-pole M8 connector (Binder 768/718) connection to PC: 4-pole fem. connector (Binder 707)	
Operating temp. range	-20°C ... +55°C	
Storage temperature range	-20°C ... +85°C	
EMC test acc. to	DIN EN 60947-5-2 CE	

Dimensions

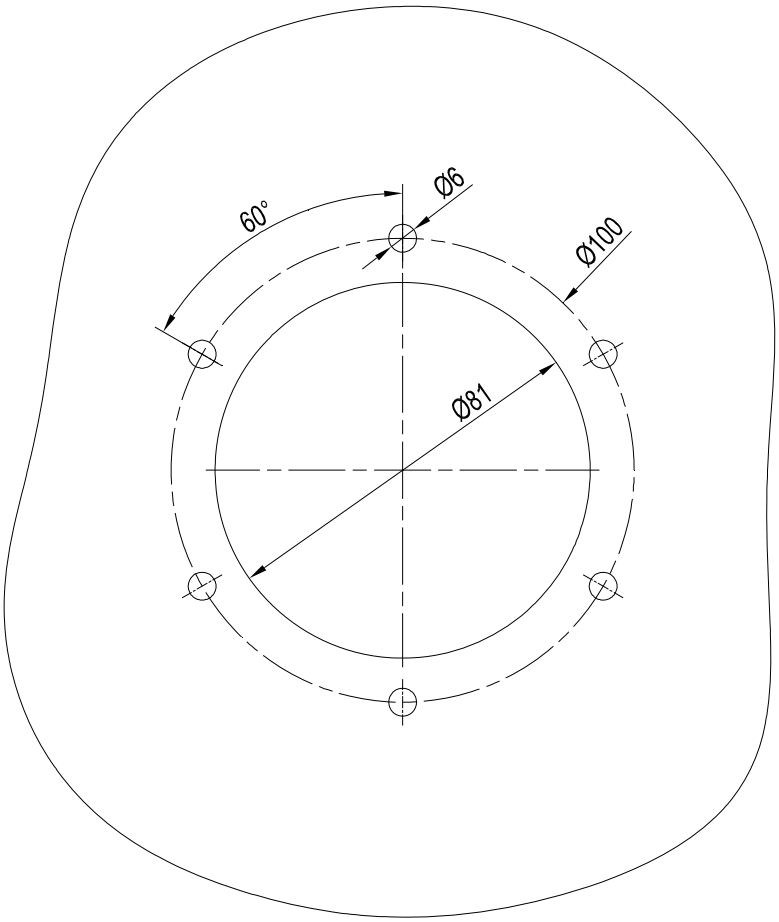
SPECTRO-T-4-INLINE-VISNIR (or SPECTRO-T-4-INLINE-VISNIR-RS485) inline measurement system



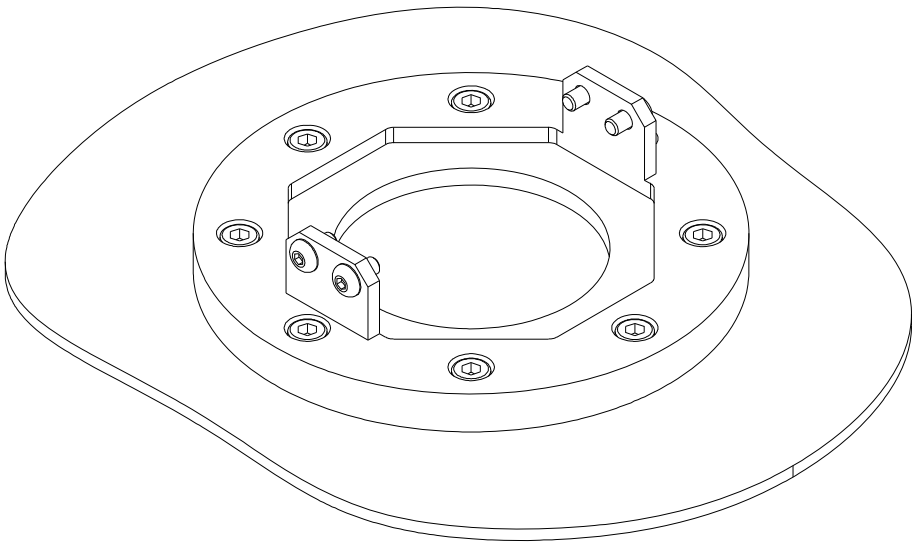
All dimensions in mm

Drilling Pattern

Drilling pattern for mounting of SG-B270-75 sight glass

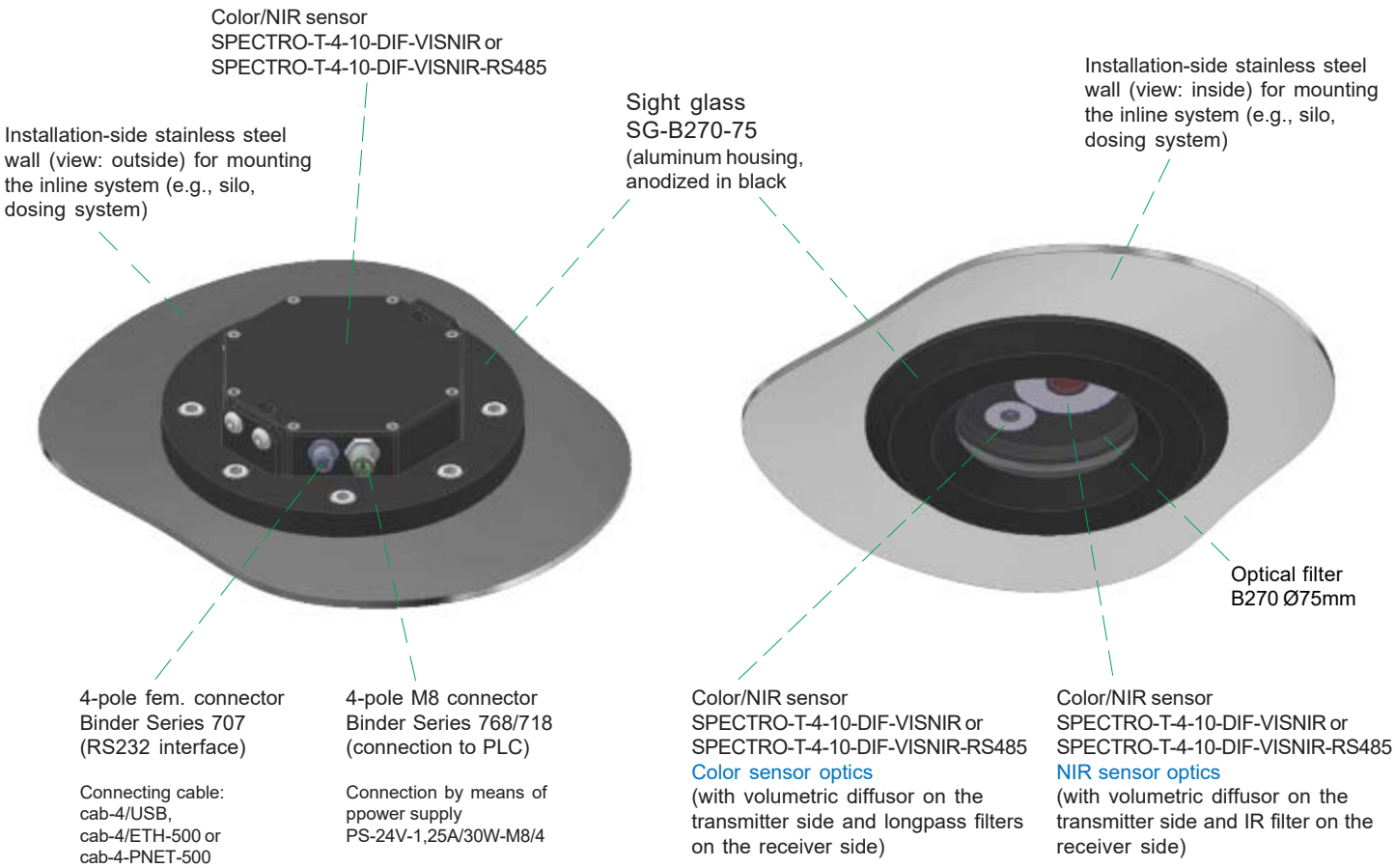


All dimensions in mm



System Setup

SPECTRO-T-4-INLINE-VISNIR (or SPECTRO-T-4-INLINE-VISNIR-RS485) inline measurement system



SPECTRO-T-4-INLINE-VISNIR (Inline measurement system):
Color/NIR sensor SPECTRO-T-4-10-DIF-VISNIR (or -RS485)
with sight glass SG-B270-75
(view: outside of stainless steel wall: connectors)

SPECTRO-T-4-INLINE-VISNIR (Inline measurement system):
Color/NIR sensor SPECTRO-T-4-10-DIF-VISNIR (or -RS485)
with sight glass SG-B270-75
(view: inside of stainless steel wall: optics)

Measuring Principle

Measuring principle of the SPECTRO-T-4-INLINE-VISNIR (or SPECTRO-T-4-INLINE-VISNIR-RS485) inline measurement system

With the help of the color/NIR sensor SPECTRO-T-4-10-DIF-VISNIR (or SPECTRO-T-4-10-DIF-VISNIR-RS485), the L*a*b* value (color value) and the N*i*r* value (NIR value) of the same recyclate sample are determined almost simultaneously. This is achieved by arranging a three-range color detector in conjunction with a white light LED (D65-similar) ring illumination as well as a NIR broadband detector and a NIR LED illumination ring consisting of three groups of LEDs with different wavelengths (1300 nm, 1500 nm, 1650 nm). This (NIR) is also a three-range method; the N*i*r* value is determined using the same algorithms as those used to calculate the L*a*b* value. So-called volume diffusion discs (frosted glass discs) are placed in front of both illumination rings to ensure diffuse and homogeneous light distribution in the measuring area.

The SPECTRO-T-4-10-DIF-VISNIR (or SPECTRO-T-4-10-DIF-VISNIR-RS485) sensor is mounted using a sight glass on the corresponding cutout, for example in the stainless steel wall of a material storage unit or a dosing system. A transparent crown glass plate separates the interior of the device from the exterior. During the measurement, the individual pellets are arranged as densely as possible immediately behind the glass wall of the sight glass facing the interior.

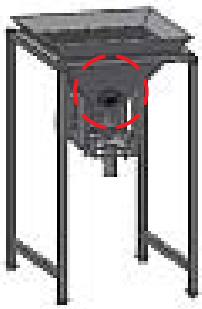
Measurement Process

Measurement process of the SPECTRO-T-4-INLINE-VISNIR (or SPECTRO-T-4-INLINE-VISNIR-RS485) inline measurement system

The measurement is started using the SPECTRO-T-4-DOCAL software when the sight glass is completely covered by the granulate to be measured. The measurement data is recorded continuously.

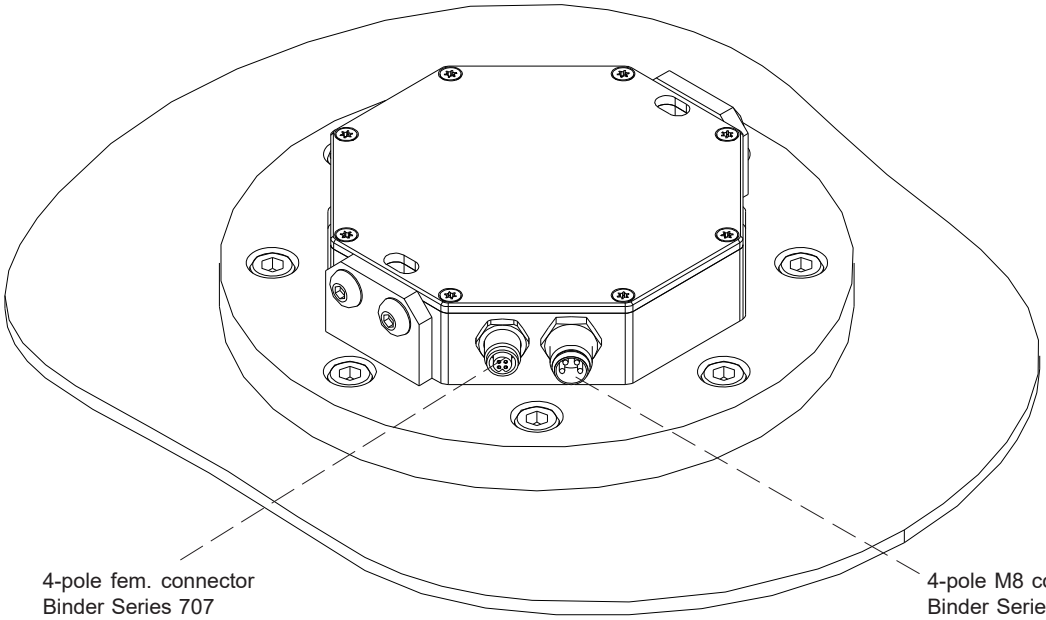
On site, the trend of the L*a*b* and N*i*r* values is displayed graphically on the monitor, for example on the SI-PPC-500-15" (V2.0) computer evaluation unit. Furthermore, a message is displayed if the respective tolerance range is exceeded.

Installation in silos or dosing systems, for example:



Connectors

SPECTRO-T-4-INLINE-VISNIR (or SPECTRO-T-4-INLINE-VISNIR-RS485) inline measurement system



4-pole fem. connector
Binder Series 707
(RS232 interface)

Connecting cable:
cab-4/USB or
cab-4/ETH-500

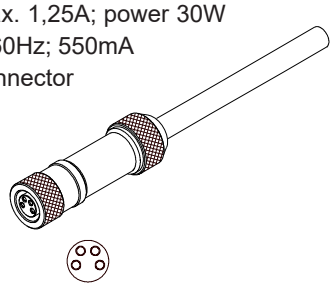
4-pole M8 connector
Binder Series 768/718
(connection to power supply)

Power supply:
PS-24V-1,25A/30W-M8/4

Power supply PS-24V-1,25A/30W-M8/4
(included in the scope of delivery)

This power supply unit enables the system to be connected to the mains power supply.

- Secondary side 24VDC; current max. 1,25A; power 30W
- Mains voltage: 100...240Veff.; 50...60Hz; 550mA
- Secondary side 4-pole M8 fem. connector
- Cable length 1.5m



Connection of SPECTRO-T-4-10-DIF-VISNIR = version with digital input and digital output:

PS-24V-1,25A/30W-M8/4 (power supply):
4-pole M8 fem. connector Binder Series 768/718

Pin:	Assignment:
1	+24VDC
2	IN0 (Digital 0: 0 … 1V, Digital 1: +Ub - 10%)
3	GND (0V)
4	OUT0 (Digital 0: 0 … 1V, Digital 1: +Ub - 10%)

Connection of SPECTRO-T-4-10-DIF-VISNIR-RS485 = version with RS485 interface:

PS-24V-1,25A/30W-M8/4 (power supply):
4-pole M8 connector Binder Series 768/718

Pin:	Assignment:
1	+24VDC
2	RS485-A
3	GND (0V)
4	RS485-B

Connecting Cables

SPECTRO-T-4-INLINE-VISNIR (or SPECTRO-T-4-INLINE-VISNIR-RS485) inline measurement system

USB connecting cable (converter) cab-4/USB-2m

(included in the scope of delivery, incl. driver software „Self Installing Executable“)

This USB converter cable enables the system to be connected to a PC with a serial interface..

- Galvanically isolated power supply:
  +24VDC via sensor
  +5V via USB hub
- 4-pole circular connector Binder Series 707
- Optionally available in 5m length

cab-4/USB-2m

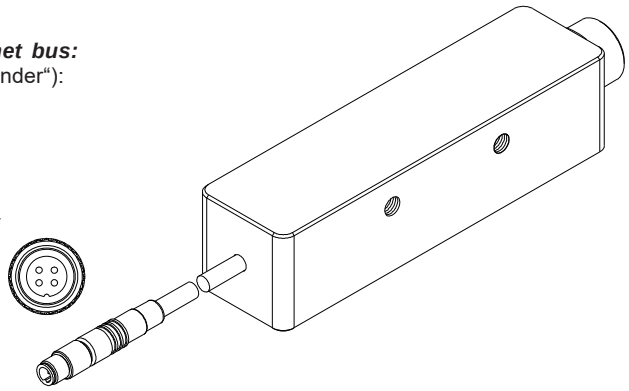
cab-4/USB-2m (USB converter):
4-pole connector Binder Series 707

Pin:	Assignment:
1	+24VDC (+Ub, OUT)
2	GND (0V)
3	RxD
4	TxD

Alternatively:

Connection to local network via “Ethernet bus:
Ethernet-Converter (incl. software „SensorFinder“):
cab-4/ETH-500
(standard length 0.5m)

Optional: External CAT5 cable, e.g.
cab-eth/M12D-RJ45-flx-(length)
(available lengths: 2m, 5m, 10m, 20m)



cab-4/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)

Calibration

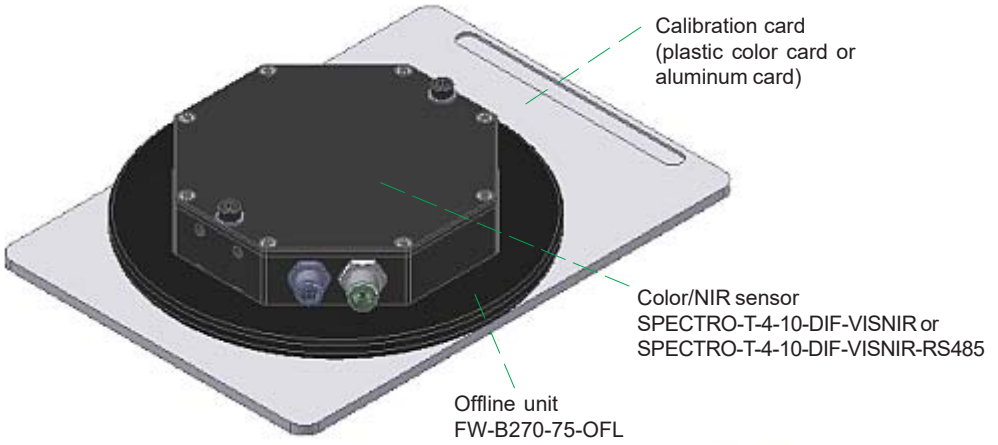
Calibration of the SPECTRO-T-4-INLINE-VISNIR (or SPECTRO-T-4-INLINE-VISNIR-RS485) inline measurement system

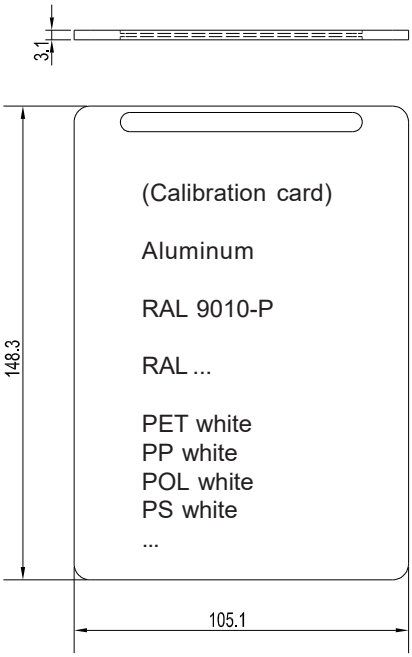
The following cards are required for white light calibration (included in the scope of delivery):
Color: RAL plastic color card „RAL 9010-P pure white“
NIR: Aluminum card in RAL format (148x105mm) colorless
In addition, plastic color cards can be used that are similar in color or material to the recyclates to be inspected.

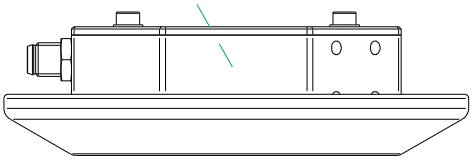
Calibration is not performed directly on the material storage unit or the dosing system. Instead, the SPECTRO-T-4-10-DIF-VISNIR (or SPECTRO-T-4-10-DIF-VISNIR-RS485) color/NIR sensor is removed from the stainless steel wall (by loosening the screws) and mounted on an FW-B270-75-OFL offline unit.

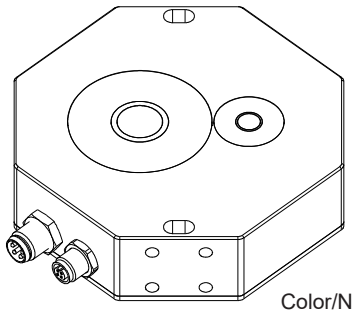
Calibration is performed using the SPECTRO-T-4-DOCAL-Scope Windows® software. In interactive mode, the CAL menu item requests the cards to be calibrated. The color and NIR values are entered into the calibration table together with the measured data. The SPECTRO-T-4-DOCAL-Scope software then determines the correction factors and transmits them to the sensor system. The sensor calibrated in this way is then removed from the FW-B270-75-OFL and reattached to the stainless steel wall.

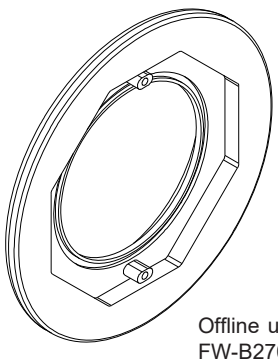
Calibration arrangement:

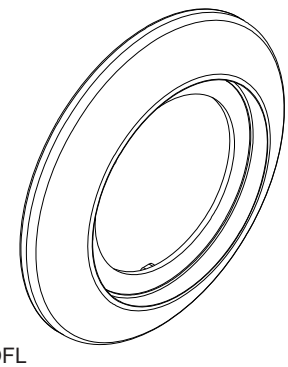




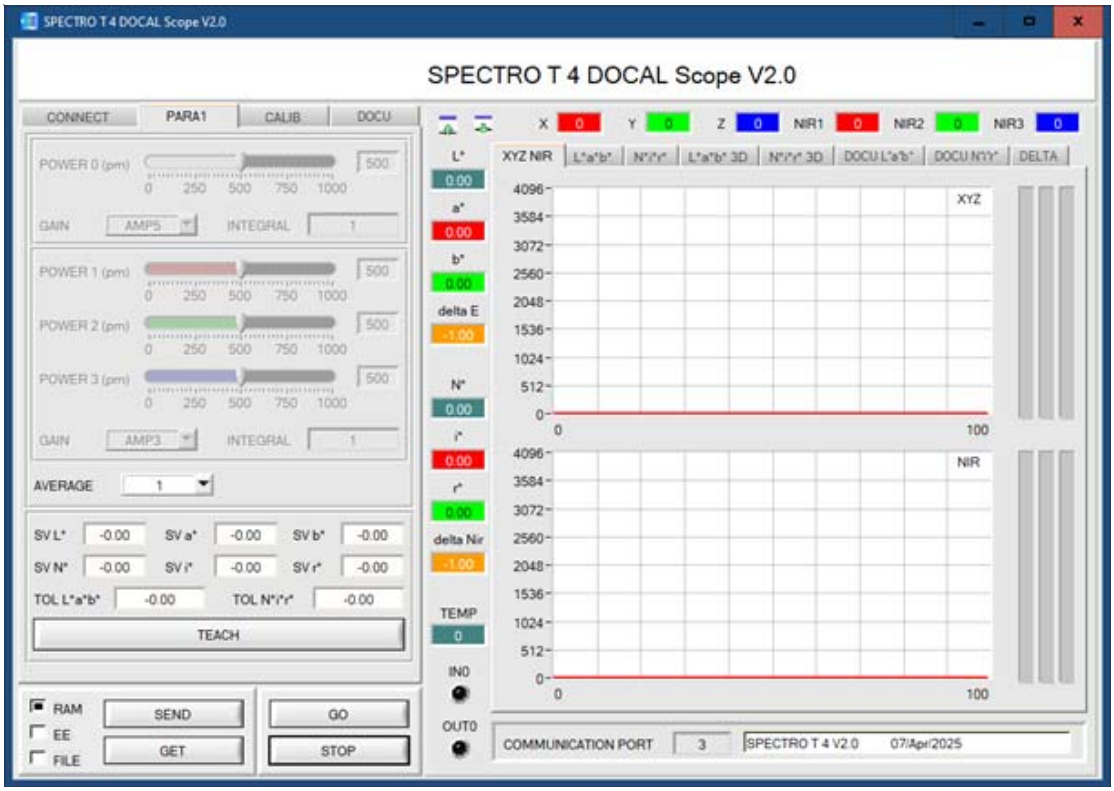








DOCAL Software

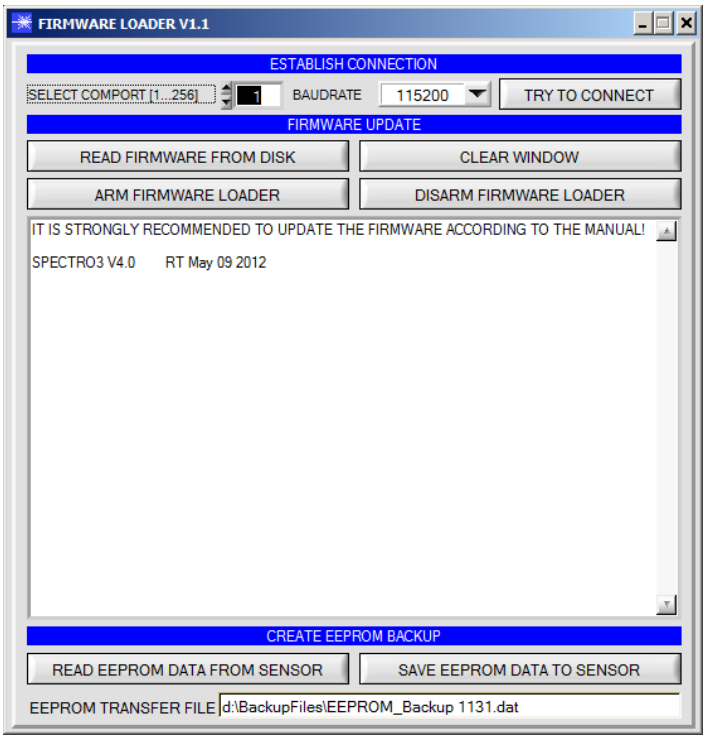


The SPECTRO-T-4-DOCAL-Scope software enables data to be recorded and also allows the measurement data to be viewed during recording.

Furthermore, trends in deviations from the respective reference value are displayed, and any exceedance of the respective tolerance values is indicated by a colored frame around the affected measurement values.

Firmware Update

Firmware update by means of the software „Firmware Loader“:



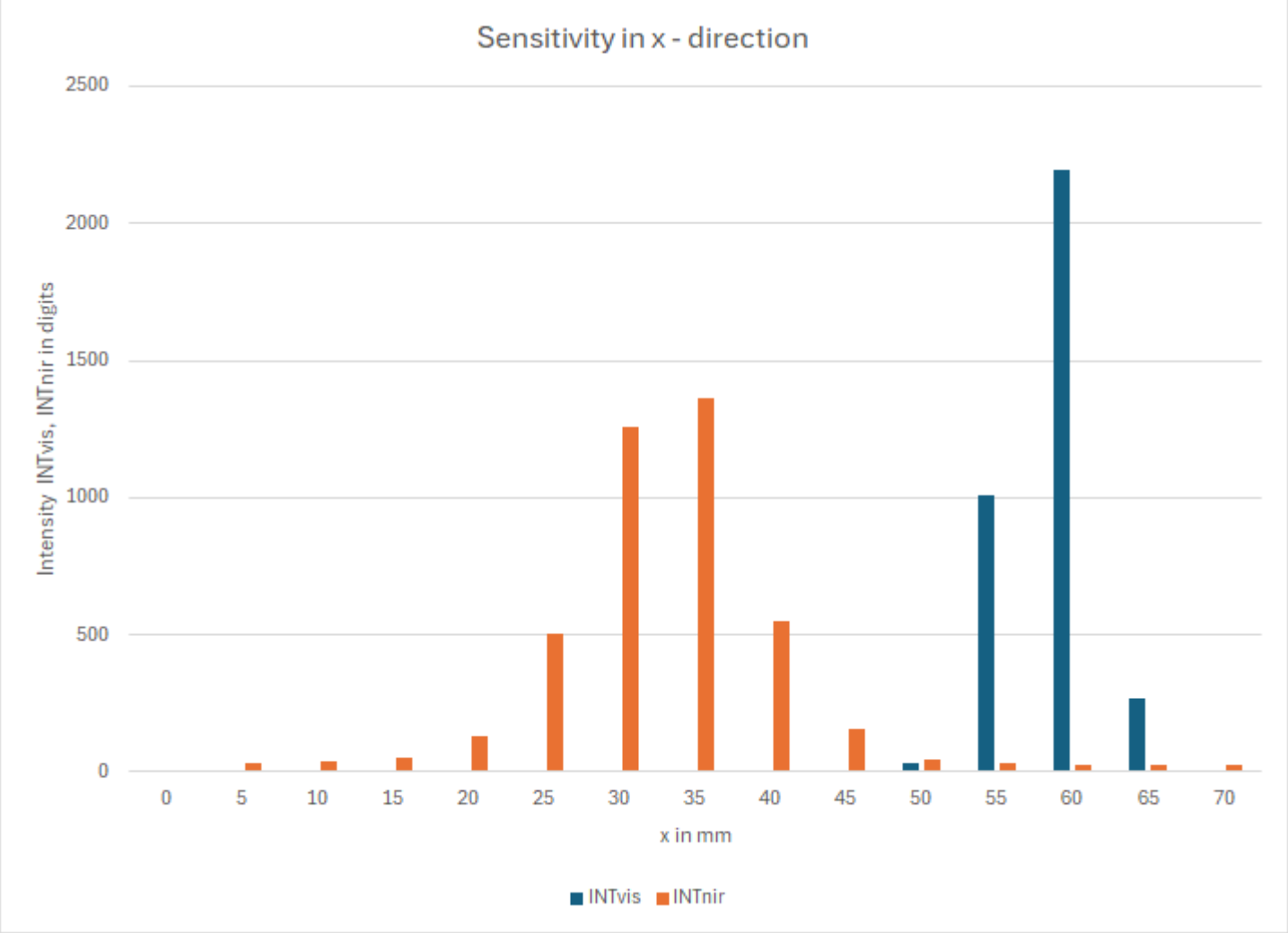
The software „Firmware Loader“ allows the user to perform an automatic firmware update. The update will be carried out through the RS232 interface.

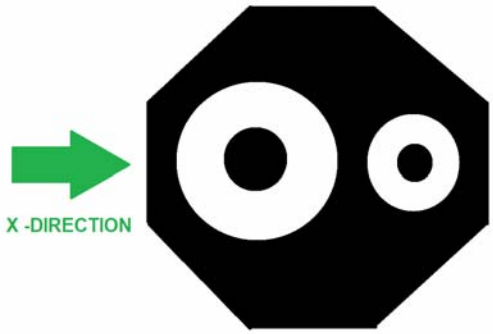
An initialisation file (xxx.ini) and a firmware file (xxx.elf.S) are required for performing a firmware update. These files can be obtained from your supplier. In some cases an additional firmware file for the program memory (xxx.elf.p.S) is also needed, and this file will be automatically provided together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

Diagrams

Diagrams: **Sensitivity in x-direction**
SPECTRO-T-4-10-DIF-VISNIR (or SPECTRO-T-4-10-DIF-VISNIR-RS485) color/NIR sensor

AMP4 INT2 (color)
AMP2 INT2 (NIR)



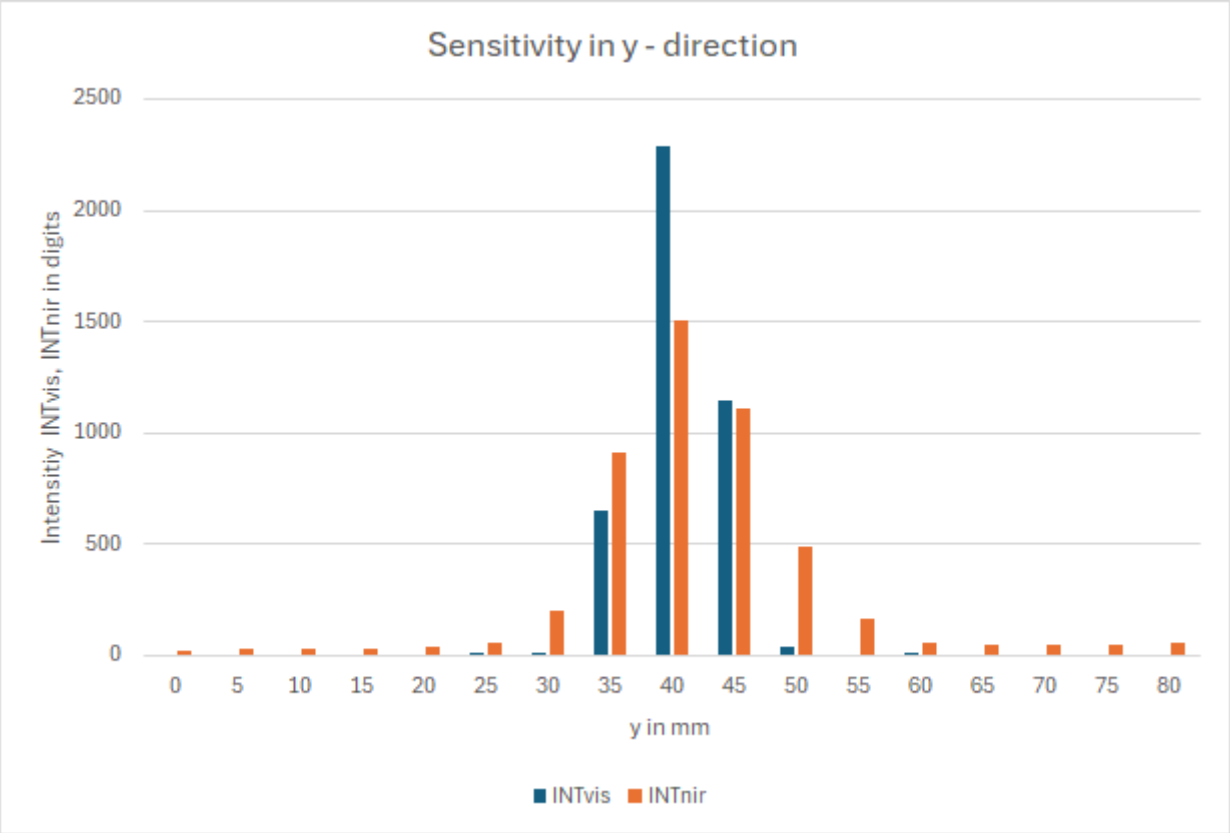


Half value width for INTnir: typ. 12 mm (of the detection range)
Half value width for INTvis: typ. 8 mm (of the detection range)

Diagrams

Diagrams: **Sensitivity in y-direction**
SPECTRO-T-4-10-DIF-VISNIR (or SPECTRO-T-4-10-DIF-VISNIR-RS485) color/NIR sensor

AMP4 INT2 (color)
AMP2 INT2 (NIR)



Half value width for INTnir: typ. 12 mm (of the detection range)
Half value width for INTvis: typ. 8 mm (of the detection range)

Calibration Cards

Calibration cards

(included in the sope of delivery)

A **RAL plastic color card „RAL 9010-P pure white“** as well as an **aluminum card in RAL format (148x105mm) colorless** are included in the scope of delivery of the SPECTRO-T-4-INLINE-VISNIR (or SPECTRO-T-4-INLINE-VISNIR-RS485) Inline measurement system.

RAL plastic color card „RAL 9010-P pure white“

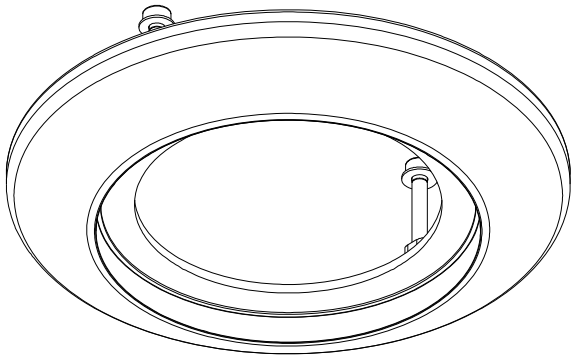
Aluminum card in RAL format (148x105mm) colorless

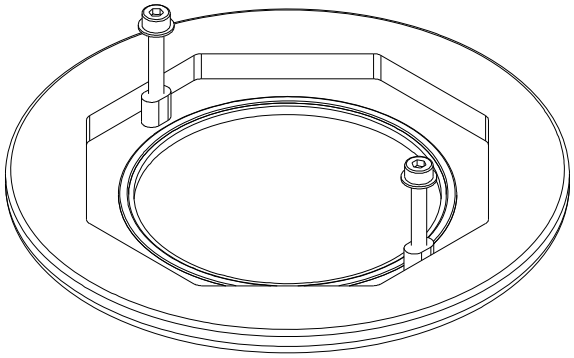
Offline Unit

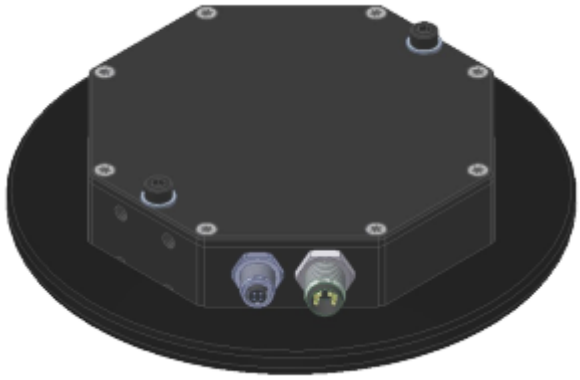
FW-B270-75-OFL (offline unit)
(included in the sope of delivery)

FW-B270-75-OFL (offline unit)

FW-B270-75-OFL (offline unit)
with SPECTRO-T-4-10-DIF-VISNIR or
SPECTRO-T-4-10-DIF-VISNIR-RS485
(view: optics side)







FW-B270-75-OFL (offline unit)
with SPECTRO-T-4-10-DIF-VISNIR or
SPECTRO-T-4-10-DIF-VISNIR-RS485
(view: connnector side)

Accessories

SI-PPC-500-15“ V2.0 (monitoring and parameterization unit)
(please order separately)

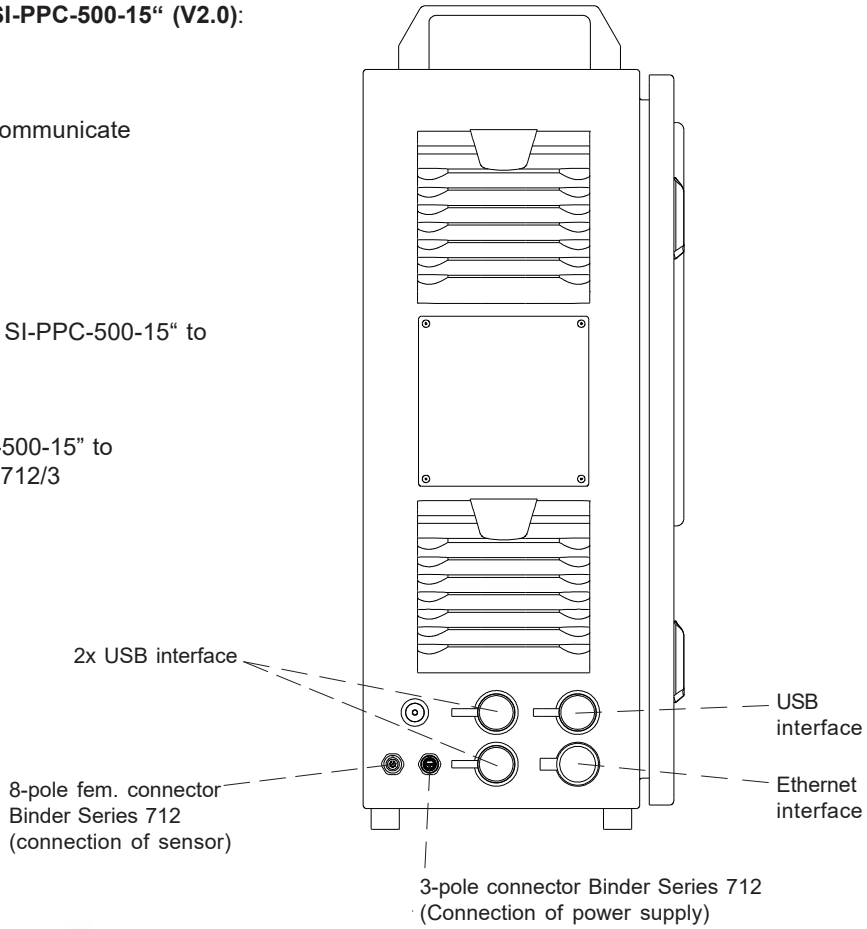
Consisting of:
– Industrial panel PC with touchscreen 15,6“ TFT monitor
– External keyboard and external computer mouse
– External +24V power supply
– 3x USB interfaces, 1x Ethernet interface
– 1x 8-pole fem. connector Binder Series 712 (connection of sensor)
– Sturdy stainless steel housing
– Windows® 11 operation system preinstalled
– On request: Windows® SI sensor software preinstalled
– On request: Printer driver software for labe printer „cab eos2 mobile/300“ preinstalled

The video signal from the line sensor can be viewed using PC software. Furthermore, the threshold at which a deviation from the ideal video profile is to be perceived as an error can be set. In the event of an error (falling below the threshold), a digital signal is generated at the output of the sensor system.

The following connections are available at the **SI-PPC-500-15“ (V2.0)**:

– 1x Ethernet:
Via the RJ45 connection, the computer can communicate with a 10/100/1000 Base-T Ethernet network.

– 3x USB:
USB devices are connected with type A plugs.

– 1x 8-pole fem. connector Binder Series 712:
This female connector is used to connect the SI-PPC-500-15“ to the sensor.

– 1x 3-pole connector Binder Series 712:
This connector is used to connect the SI-PPC-500-15” to the power supply using the PS-24V-3.3A/80W-712/3 power supply unit.