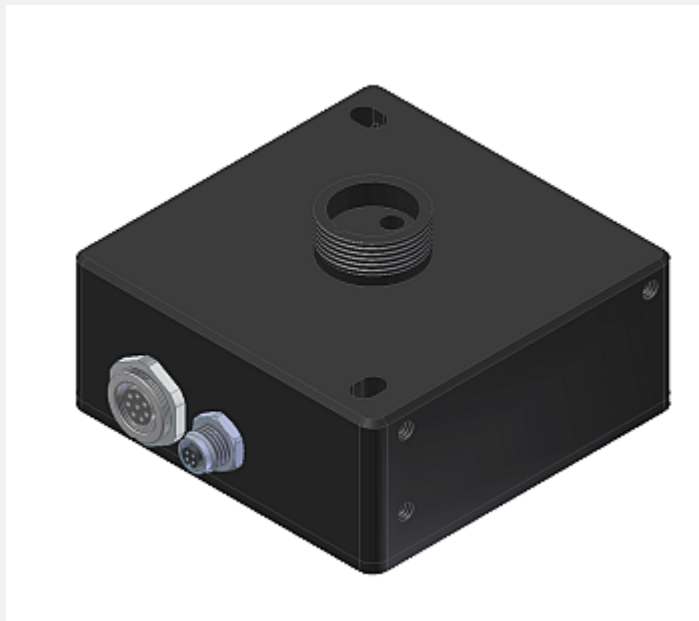


SPECTRO Series

► SPECTRO-3-FIO-JR

- Big working range: typ. 1 mm ... 500 mm (depends on fiber optics and attachment optics)
- Big assortment of fiber optics (reflected or transmitted light)
- Up to 31 colors can be stored
- RS232 interface (USB or Ethernet adapter is available)
- Super-bright white-light LED (AC-/DC-/PULSE-operation or OFF for luminous objects can be switched)
- Color detection, contrast detection, and gray scale detection
- Insensitive to outside light (in AC- or PULSE-operation)
- Brightness correction can be activated (STAT/DYN)
- Scan frequency max. 35 kHz (in DC- or OFF-operation)
- Switching frequency typ. 40 kHz
- TEACH via PC or PLC (external input)
- Various evaluation algorithms can be activated
- "BEST HIT" mode ("human color assessment")
- Parameterizable via Windows® software, scope function
- Temperature compensated
- Averaging can be activated (from 1 up to over 32000 values)
- Color control of luminous objects (LEDs, halogen lamps, displays, ...)
- 3-color filter detector (true color detector: "human color perception")



Design

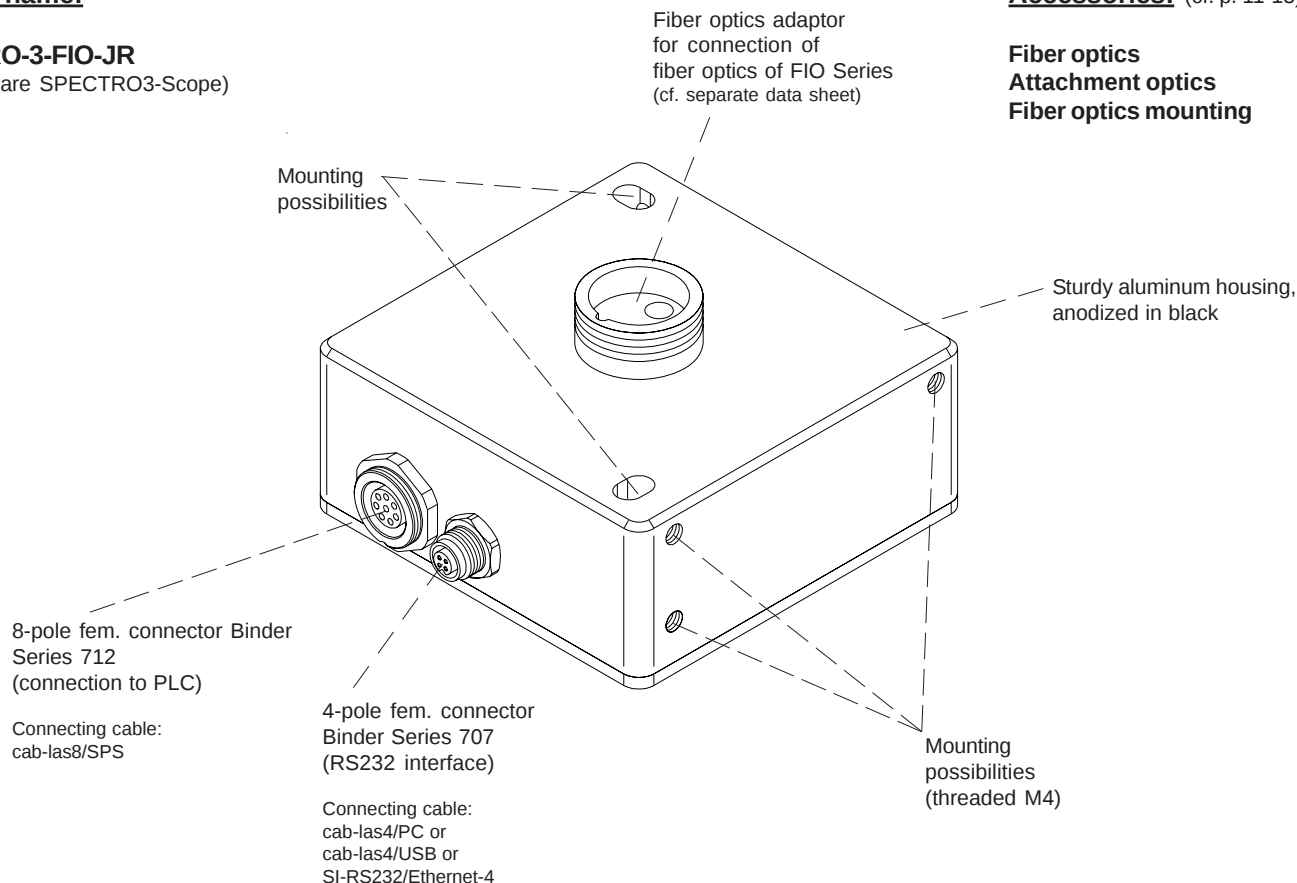
Product name:

SPECTRO-3-FIO-JR
(incl. software SPECTRO3-Scope)

Accessories:

 (cf. p. 11-15)

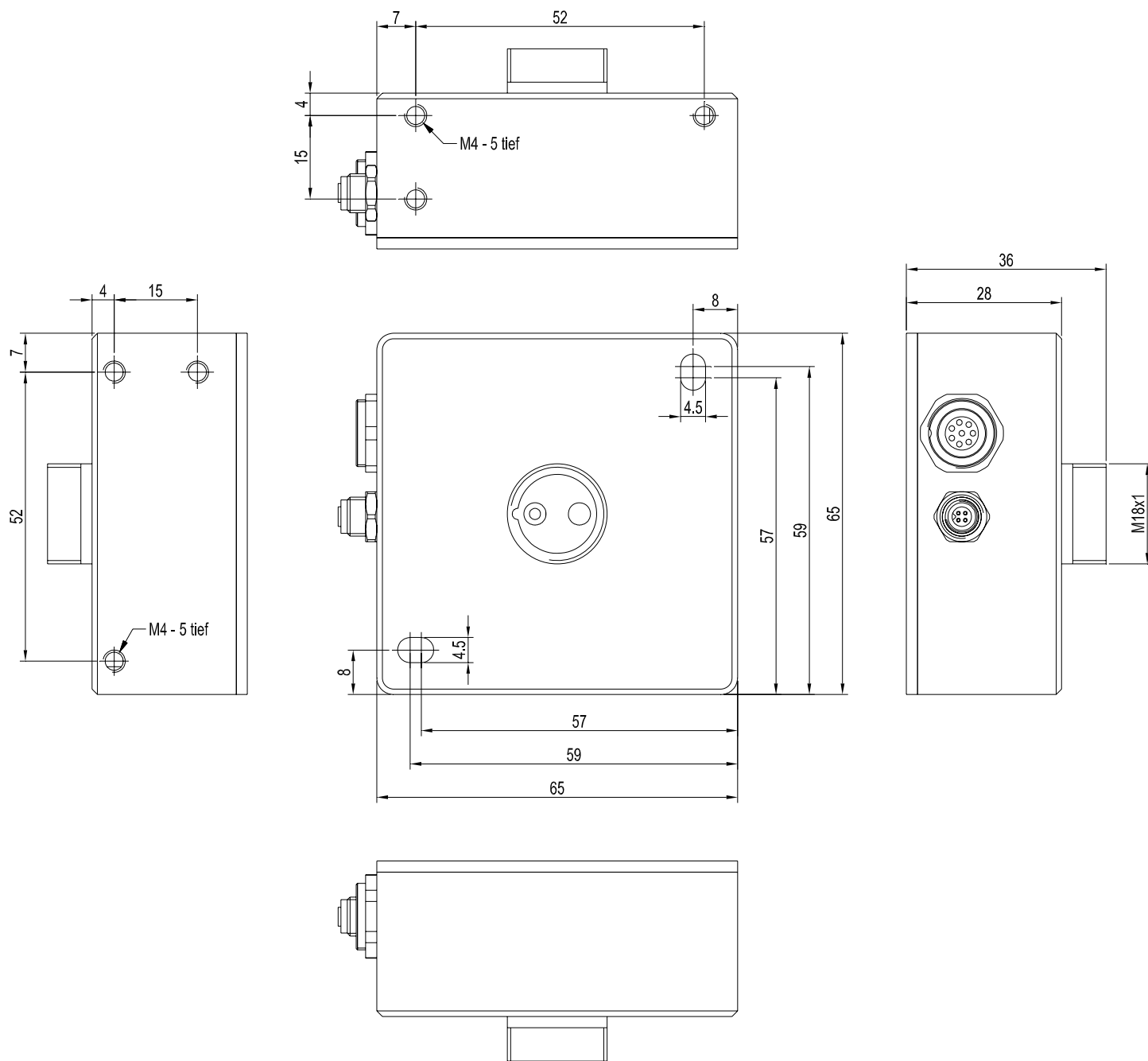
Fiber optics
Attachment optics
Fiber optics mounting





Technical Data

Model	SPECTRO-3-FIO-JR
Voltage supply	+24VDC ($\pm 10\%$), reverse polarity protected, overcurrent protected
Current consumption	< 160 mA
Max. switching current	100 mA, short circuit proof
Input digital (1x)	IN0 (Pin 3), digital (0V/+24V)
Outputs digital (5x)	OUT0 ... OUT4 (Pin 4 ... 8): digital (0V/+24V), npn-/pnp-able (bright-/dark-switching, can be switched)
Interface	RS232
Pulse lengthening	0 ... 100 ms, adjustable via PC software
Averaging	max. 32768 values, adjustable via PC software
Scan frequency	LED operation, can be switched via PC software: AC operation: max. 20 kHz (depends on parameterization) DC and OFF operation: max. 35 kHz (depends on parameterization) PULSE operation: max. 5 kHz (depends on parameterization)
Switching frequency	typ. 40 kHz
Transmitter (light source)	Super-bright white-light LED
Transmitter control	can be switched via PC software: AC operation (LED MODE-AC), DC operation (LED MODE-DC), OFF operation (LED MODE-OFF)
Object distance (measuring range)	with reflected light fiber optics: typ. 1 mm ... 500 mm (depends on fiber optics and attachment optics) with transmitted light fiber optics: typ. 10 mm ... 500 mm (depends on fiber optics and attachment optics)
Receiver	3-color filter detector (TRUE COLOR detector, "human color perception"), color filter curves acc. to CIE 1931
Receiver gain setting	8 steps (AMP1 ... AMP8), adjustable via PC software
Ambient light	max. 5000 Lux
Size of light spot	circular: typ. $\varnothing 0.2$ mm ... $\varnothing 20$ mm or rectangular: typ. 3 mm x 0.5 mm ... 6 mm x 1 mm depends on fiber optics and attachment optics (cf. catalog FIO series)
Reproducibility	in the X, Y color range each 1 digit at 12-bit A/D conversion
Temperature drift X,Y	$\Delta X/\Delta T$; $\Delta Y/\Delta T$ typ. 0,2 digits/ $^{\circ}\text{C}$ (< 0,01% / $^{\circ}\text{C}$)
Color difference	$\Delta E \geq 0,5$
Color space	X Y INT siM (Lab)
Color memory capacity	non-volatile EEPROM with parameter sets for max. 31 colors
Housing dimensions	LxWxH approx. 65 mm x 65 mm x 36 mm (incl. fiber optics adapter M18x1, without flange connectors)
Housing material	aluminum, anodized in black
Enclosure rating	IP64
Connecting cables	to PLC: cab-las8/SPS or cab-las8/SPS-w to PC/RS232 interface: cab-las4/PC or cab-las4/PC-w to PC/USB interface: cab-las4/USB or cab-las4/USB-w to PC/Ethernet interface: SI-RS232/Ethernet-4
Type of connector	connection to PLC: 8-pole fem. connector (Binder 712), connection to PC: 4-pole fem. connector (Binder 707)
Operating temp. range	-20 $^{\circ}\text{C}$... +55 $^{\circ}\text{C}$
Storage temperature range	-20 $^{\circ}\text{C}$... +85 $^{\circ}\text{C}$
EMC test acc. to	DIN EN 60947-5-2

Dimensions


All dimensions in mm



Connector Assignment

Connection to PLC:

8-pole fem. connector Binder Series 712

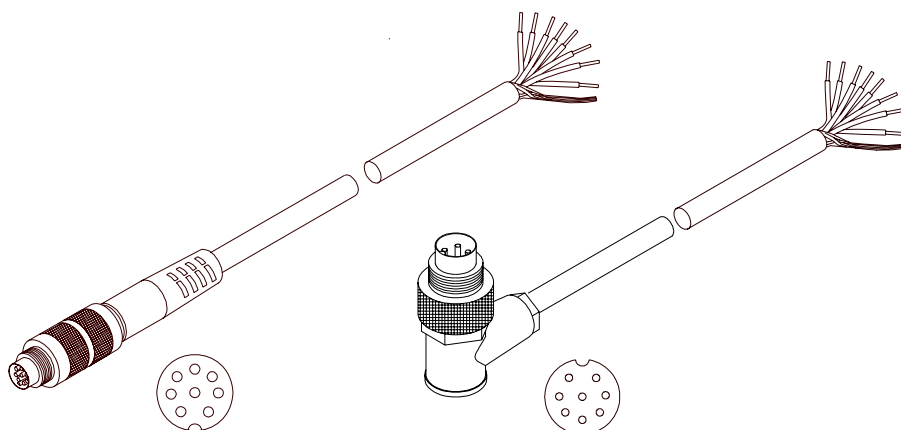
Pin:	Color:	Assignment:
1	white	GND (0V)
2	brown	+24VDC ($\pm 10\%$)
3	green	INO
4	yellow	OUT0
5	grey	OUT1
6	pink	OUT2
7	blue	OUT3
8	red	OUT4

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)

Connection to PC:

4-pole fem. connector Binder Series 707

Pin: Assignment:

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

Connection via RS232 interface at the PC:

Connecting cable:

cab-las4/PC-(length)

cab-las4/PC-w-(length) (angle type 90°)

(standard length 2m)

alternative:

Connection via USB interface at the PC:

Connecting cable (incl. driver software):

cab-las4/USB-(length)

cab-las4/USB-w-(length) (angle type 90°)

(standard length 2m)

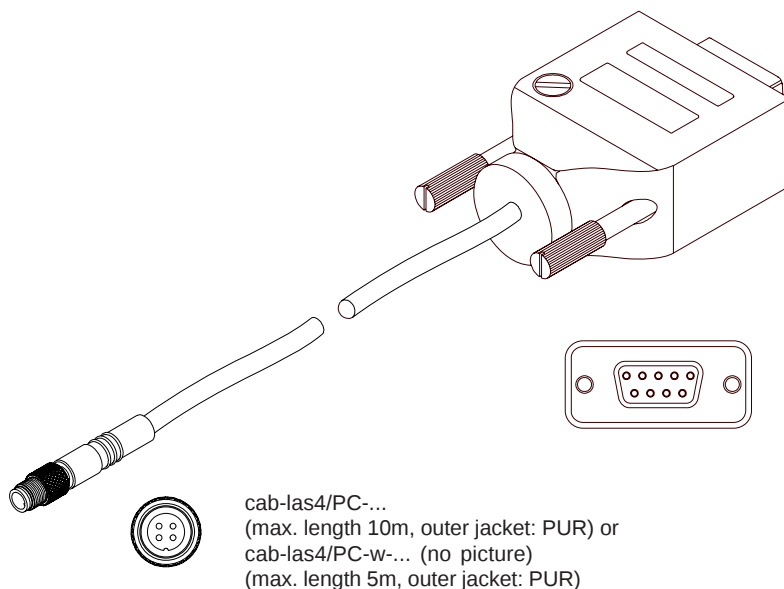
alternative:

Connection to local network via Ethernet bus:

Adapter (based on Lantronix XPortModul):

SI-RS232/Ethernet-4-(length)

(standard length 2m)

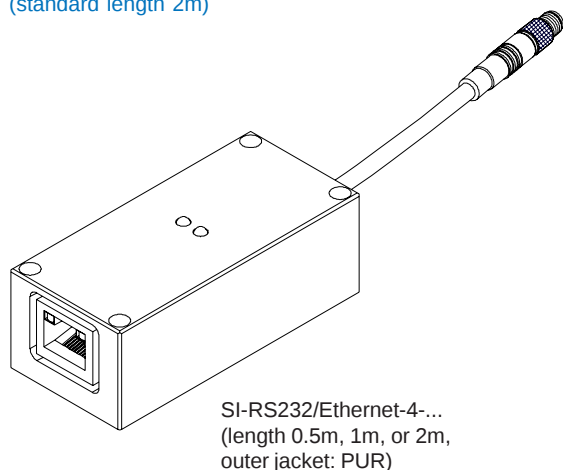


cab-las4/PC-...

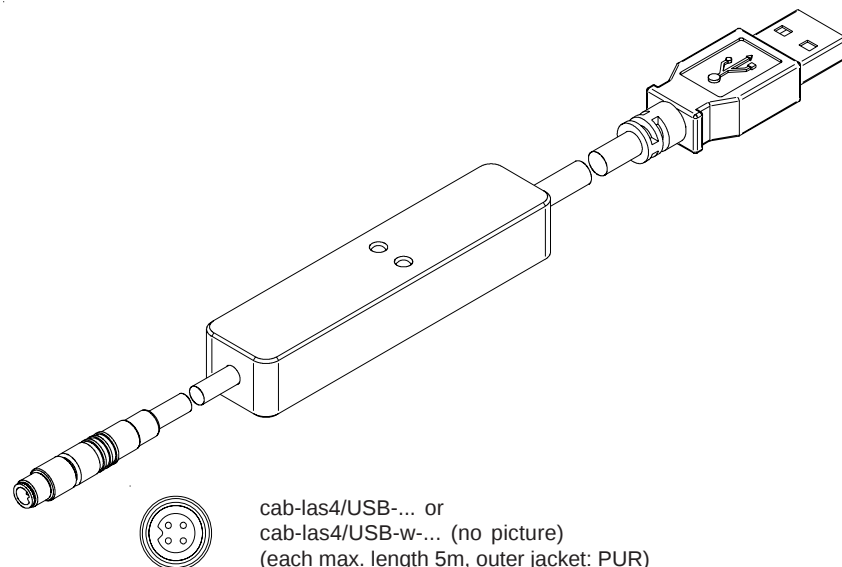
(max. length 10m, outer jacket: PUR) or

cab-las4/PC-w-... (no picture)

(max. length 5m, outer jacket: PUR)



SI-RS232/Ethernet-4-...
(length 0.5m, 1m, or 2m,
outer jacket: PUR)



cab-las4/USB-... or

cab-las4/USB-w-... (no picture)

(each max. length 5m, outer jacket: PUR)



Measuring Principle

Measuring principle of the color sensors of SPECTRO-3 series:

The SPECTRO-3 provides highly flexible signal acquisition. For example, the sensor can be operated in alternating-light mode (AC mode), which makes the sensor insensitive to extraneous light. It also can be set to constant-light mode (DC mode), which makes the sensor extremely fast and allows a scan-frequency of up to 35 kHz. An OFF function turns off the integrated light source at the sensor and changes to DC operation. The sensor then can detect so-called „self-luminous objects“. In PULSE operation extremely dark surfaces can be reliably detected. With the stepless adjustment of the integrated light source as well as the selectable gain of the receiver signal and an INTEGRAL function the sensor can be set to almost any surface or any „self-luminous object“.

When the integrated light source of the SPECTRO-3 color sensor is activated, the sensor detects the radiation that is diffusely reflected from the object. As a light source the SPECTRO-3 color sensor uses a white-light LED with adjustable transmitter power. An integrated 3-fold receiver for the red, green, and blue content of the light that is reflected from the object, or the light that is emitted by a „self-luminous object“, is used as a receiver.

The SPECTRO-3 color sensor can be „taught“ up to 31 colors. For each of these taught colors it is possible to set tolerances. In „X Y INT - 2D“ or „s i M - 2D“ mode these tolerances form a color cylinder in space. In „X Y INT - 3D“ or „s i M - 3D“ mode the tolerances form a color sphere in space. Color evaluation according to „s i M - 2D“ is based on the lab calculation method. All modes can be used in combination with several operating modes such as „FIRST HIT“ and „BEST HIT“. Raw data are represented with 12 bit resolution.

As a special feature the sensor can be taught two completely independent parameter sets. Input IN0 can then be used to tell the sensor which parameter set it should work with.

Color detection either operates continuously or is started through an external PLC trigger signal. The respective detected color either is provided as a binary code at the 5 digital outputs or can be sent directly to the outputs, if only up to 5 colors are to be detected. At the same time the detected color code is visualised by means of 5 LEDs at the housing of the SPECTRO-3.

[\[Please note: Visualisation by means of LEDs not available with SPECTRO-3-...-JR types.\]](#)

With a TEACH button at the sensor housing the color sensor can be taught up to 31 colors. 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 at cable cab-las8/SPS). [\[Please note: TEACH button not available with SPECTRO-3-...-JR types.\]](#)

Parameters and measurement values can be exchanged between a PC and the SPECTRO-3 color sensor through the serial RS232 interface. All the parameters for color detection also can be saved to the non-volatile EEPROM of the SPECTRO-3 color sensor through this serial RS232 interface. When parameterisation is finished, the color sensor continues to operate with the current parameters in STAND-ALONE mode without a PC.

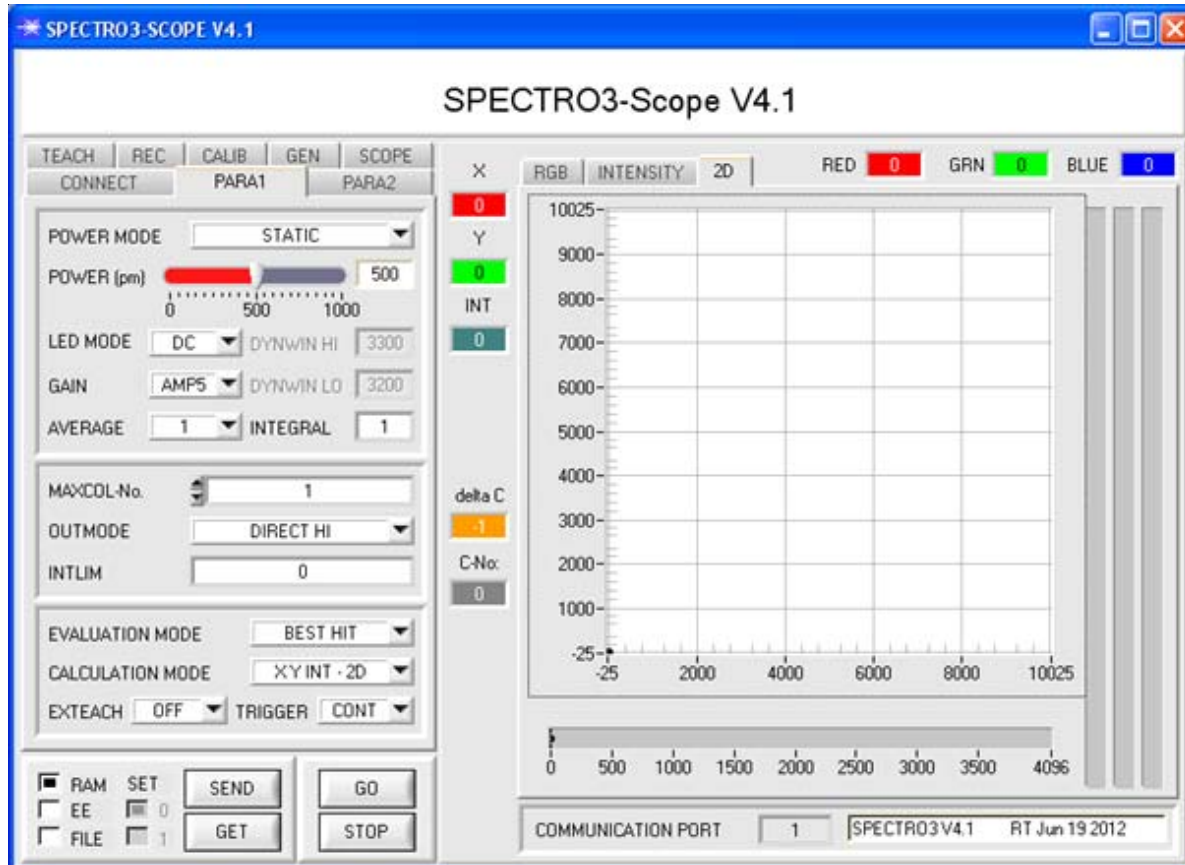
The sensors of the SPECTRO-3 series can be calibrated (white-light balancing). Balancing can be performed to any white surface. A ColorChecker™ table with 24 color fields is available as an alternative. White-light balancing or calibration can be performed to one of the white fields.



Parameterization

Windows® user interface:

The color sensor is parameterized under Windows® with the SPECTRO3-Scope software. The Windows® user interface facilitates the teach-in process at the color sensor and supports the operator in the task of adjustment and commissioning of the color sensor.



Under Windows® representation of the color 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.

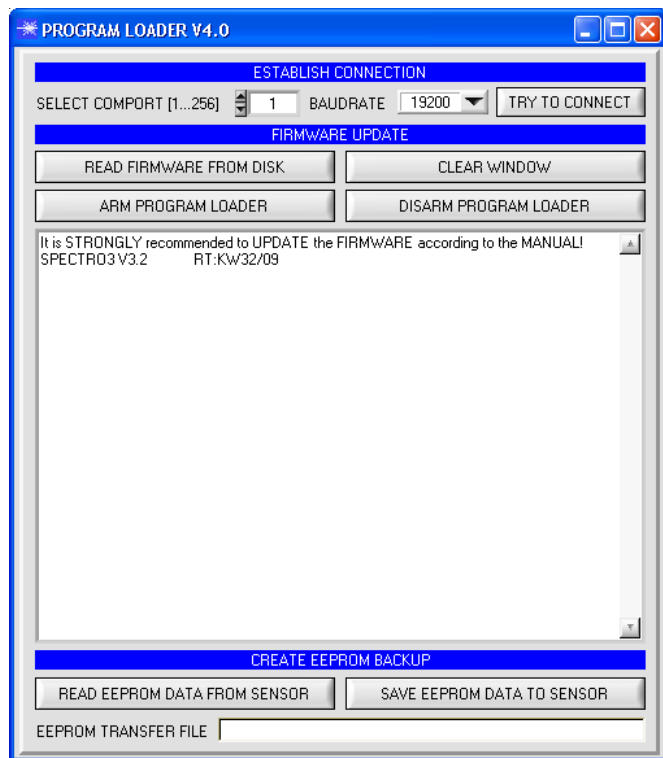
The RS232 interface (tab PARA1 or PARA2) is used for setting parameters such as:

- POWER MODE: Light power of the LED
- LED MODE: Triggering of the internal light source
- GAIN: Used for setting the gain of the receiver
- AVERAGE: Averaging over a maximum of 32768 values
- INTEGRAL: This function field is used to set the number of scan values (measurement values) over which the raw signal measured at the receiver is summed up. This integral function allows the reliable detection even of extremely weak signals
- MAXCOL-No.: Number of colors to be checked
- OUTMODE: Triggering of the digital outputs
- INTLIM: Minimum intensity required for color evaluation
- EVALUATION MODE: Various evaluation modes to choose from (FIRST HIT, BEST HIT, MIN DIST, COL5)
- CALCULATION MODE: There are 2 methods of teaching a color. The CALCULATION MODE X/Y/INT (or s/i/M) uses a color sphere in space with radius TOL. Contrary to this, the CALCULATION MODE X/Y INT (or s/i M) uses a color cylinder in space with radius CTO or siTO and with height ITO or M.
- EXTEACH: In all the evaluation modes teaching of a color can be performed externally through IN0 or by means of the button at the sensor housing [Please note: TEACH button not available with SPECTRO-3-...-JR types.]
- TRIGGER: Continuous or external or self trigger



Firmware Update

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



The software „Program Loader“ or „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.

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.

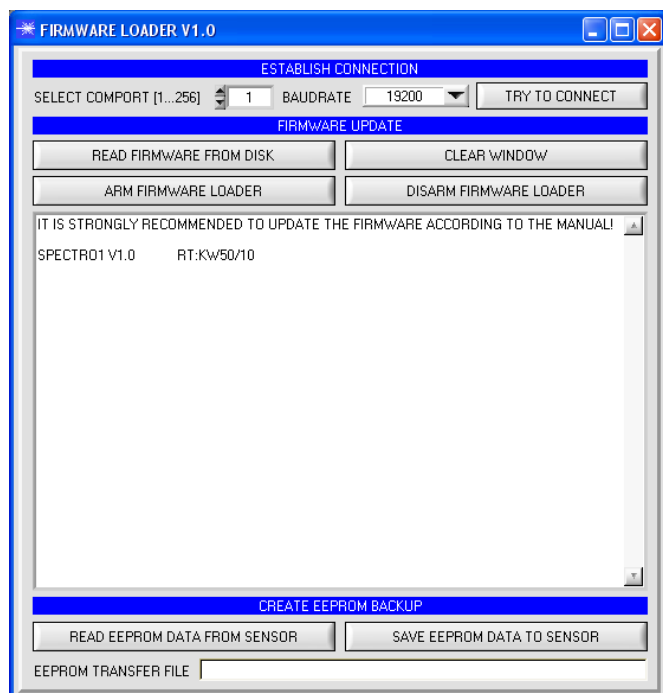
When the plausibility check is successfully completed, the instructions contained in the initialisation file will be carried out step by step.

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.



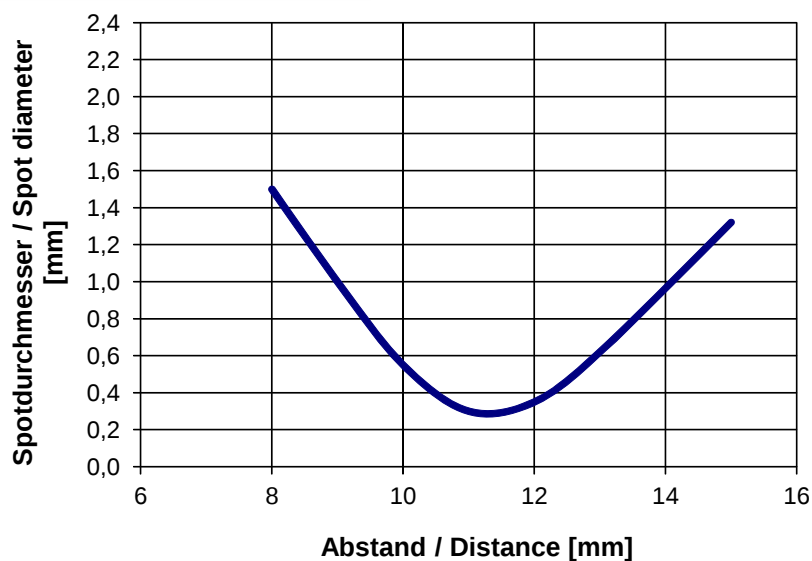


Diagrams

Diagrams: SPOT DIAMETER
depending on distance

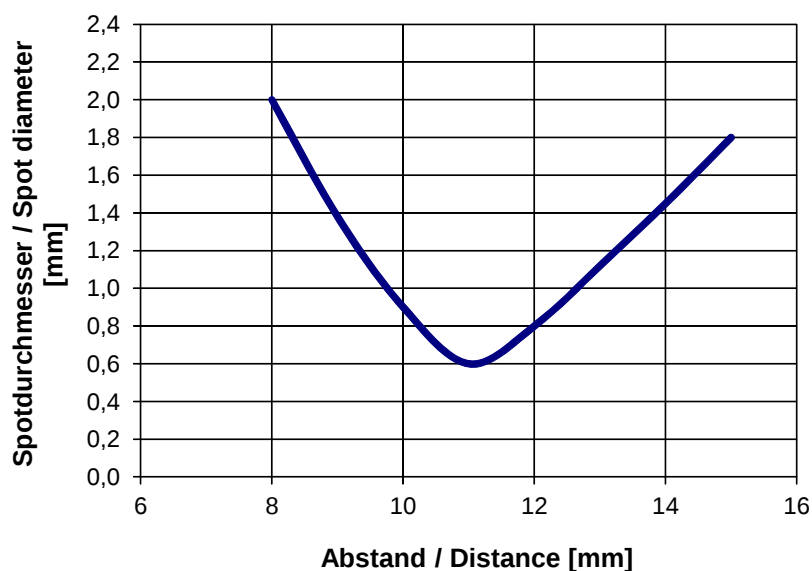
SPOT DIAMETER [distance], typ.

SPECTRO-3-FIO-JR
with fiber optics R-S-A1.1-(0.6)-1200-67°
and attachment optics KL-4
(fiber optics fixed at limit stop into attachment optics)



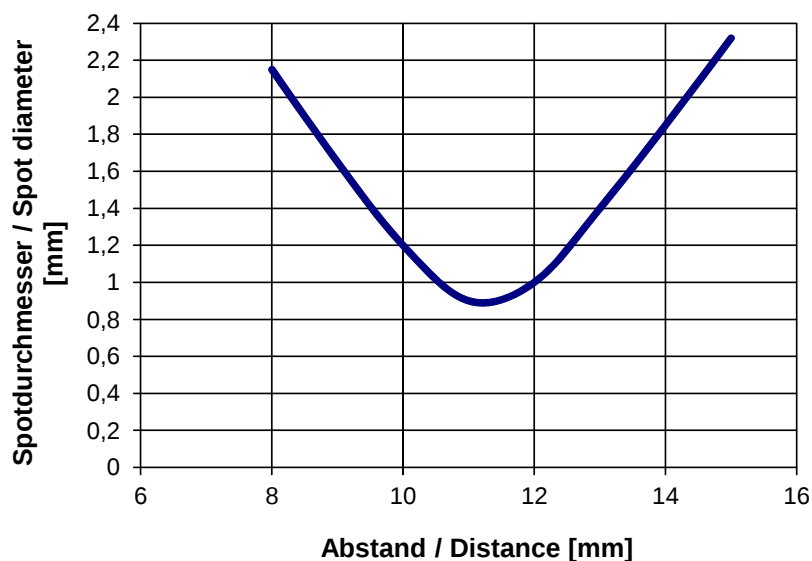
SPOT DIAMETER [distance], typ.

SPECTRO-3-FIO-JR
with fiber optics R-S-A1.1-(1.1)-1200-67°
and attachment optics KL-4
(fiber optics fixed at limit stop into attachment optics)



SPOT DIAMETER [distance], typ.

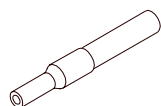
SPECTRO-3-FIO-JR
with fiber optics R-S-A1.1-(1.5)-1200-67°
and attachment optics KL-4
(fiber optics fixed at limit stop into attachment optics)





Diagrams

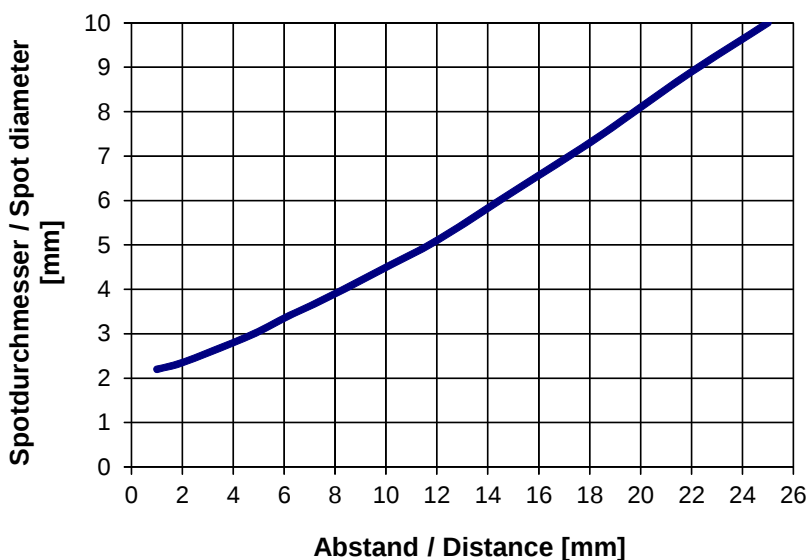
Diagrams: SPOT DIAMETER
depending on object distance



Fiber bundle Ø 2.5 mm

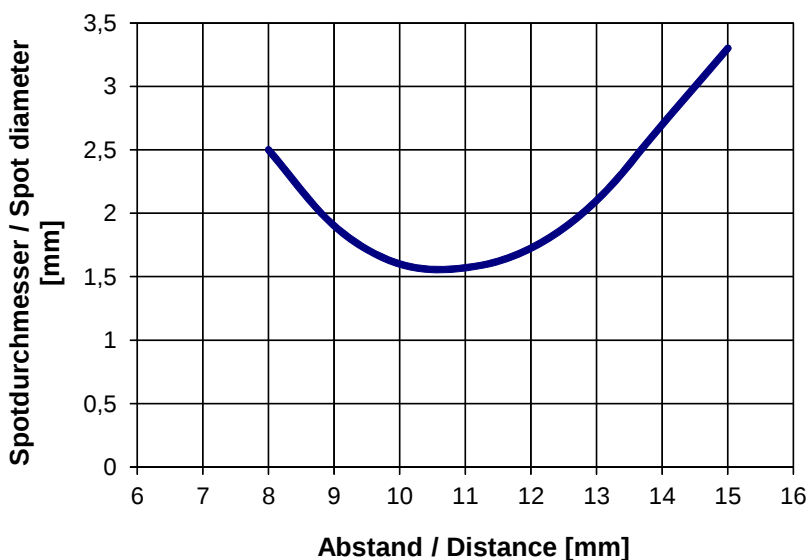
SPOT DIAMETER [distance], typ.

SPECTRO-3-FIO-JR
with fiber optics R-P-A2.0-(2.5)-600-67°



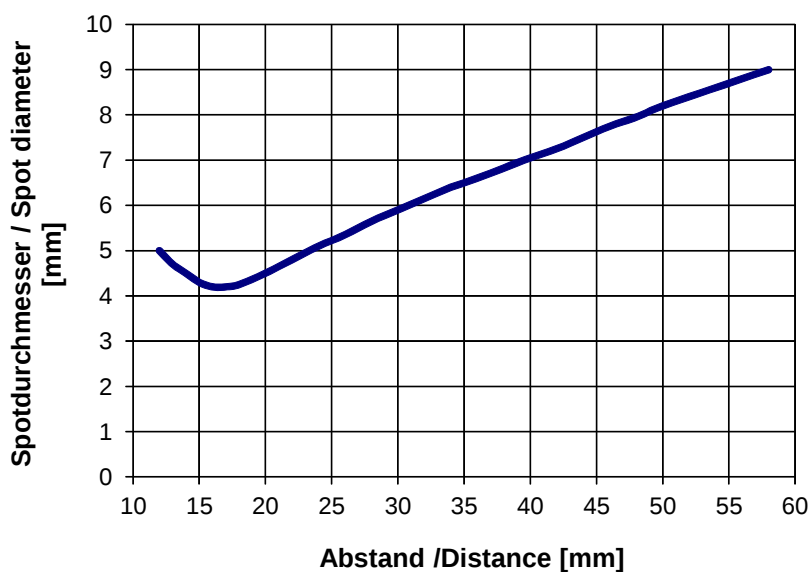
SPOT DIAMETER [distance], typ.

SPECTRO-3-FIO-JR
with fiber optics R-S-A2.0-(2.5)-1200-67°
and attachment optics KL-3
(fiber optics is inner stop fixed to attachment optics)



SPOT DIAMETER [distance], typ.

SPECTRO-3-FIO-JR
with fiber optics R-S-A2.0-(2.5)-1200-67°
and attachment optics KL-M18-A2.0
(fiber optics is inner stop fixed to attachment optics)



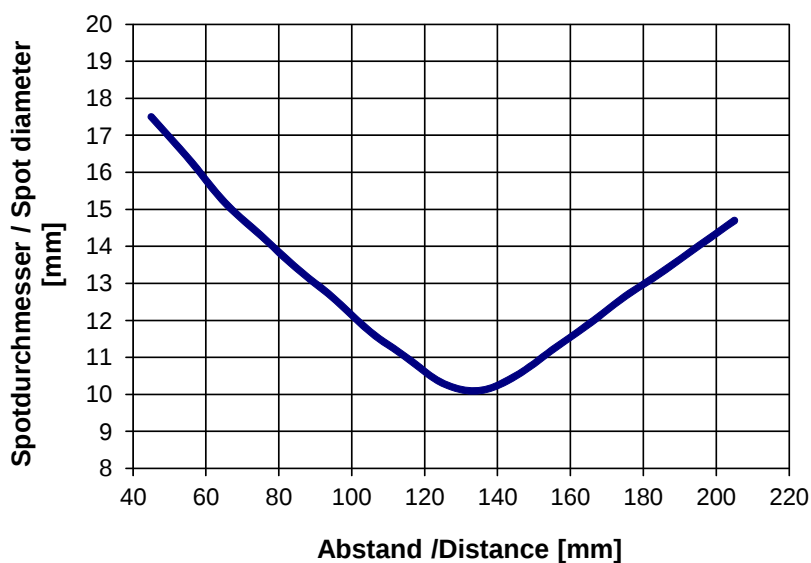


Diagrams

Diagrams: SPOT DIAMETER depending on object distance

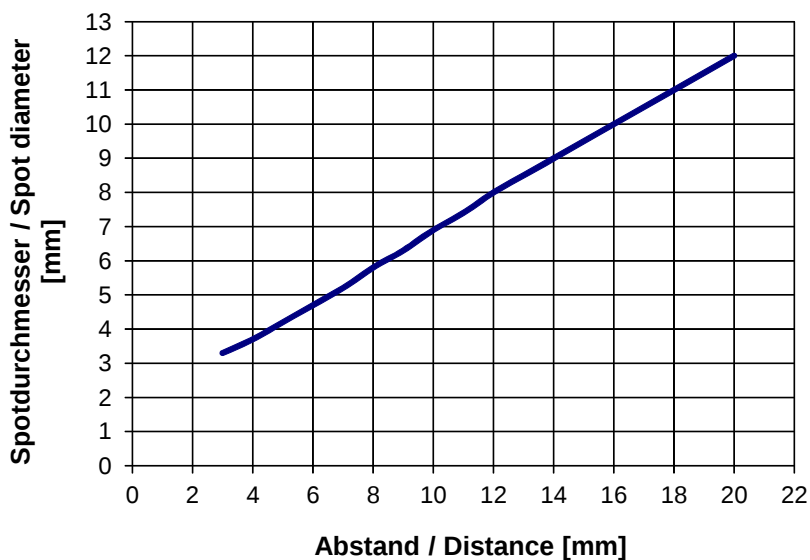
SPOT DIAMETER [distance], typ.

SPECTRO-3-FIO-JR
with fiber optics R-S-A2.0-(2.5)-1200-67°
and attachment optics KL-M34-A2.0
(fiber optics is inner stop fixed to attachment optics)

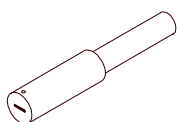


SPOT DIAMETER [distance], typ.

SPECTRO-3-FIO-JR
with fiber optics R-S-A3.0-(3.0)-1200-67°



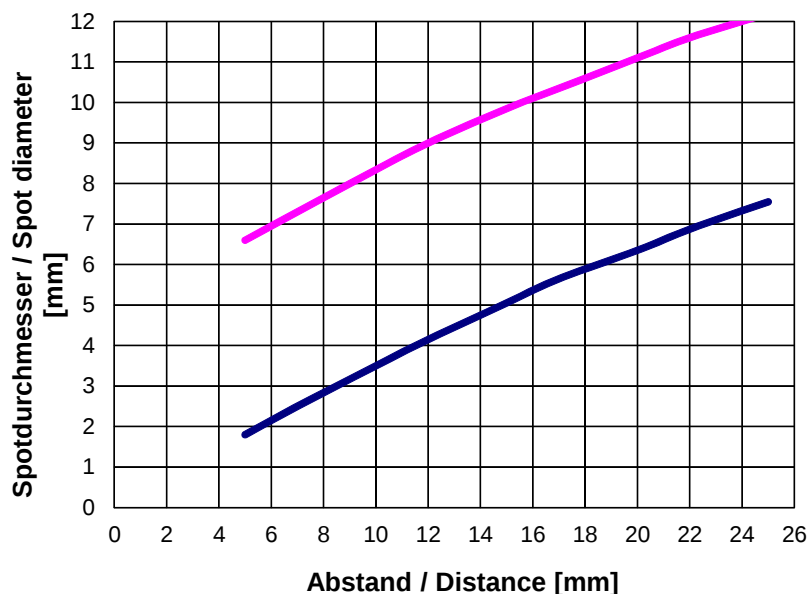
◆ short semiaxis
● long semiaxis



Fiber gap 6 mm x 1 mm

SPOT DIAMETER [distance], typ.

SPECTRO-3-FIO-JR
with fiber optics R-S-R2.1-(6x1)-1200-67°





Fiber Optics

Field of use:

Optical fibers offer solutions for difficult tasks in optoelectronics. They can be used universally and allow flexible applications.

Advantages:

- Highest quality
- Selection from different fiber types
- Thermal stability
- Great variety of available standard sensor heads
- Special designs
- Various attachment optics available



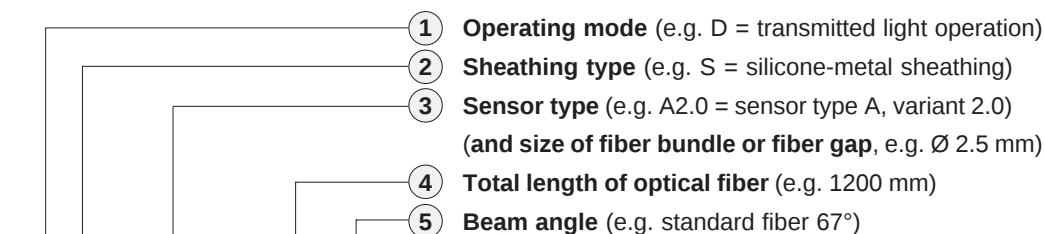
Characteristics:

Light-conducting glass fibers are optical components that allow the transmission of light through any curved path based on the principle of total reflection.

The individual fiber is composed of high-break core glass and low-break cladding glass. The light beams entering the core glass within the critical angle are guided through the fiber by way of reflection at the core/cladding contact surfaces (step index fiber).

The highly flexible optical fibers are made of bundled individual glass fibers. The ends are each glued into a sensor head and a connector. The faces are optically polished. For protection against mechanical, chemical, or thermal destruction the optical fibers are provided with a corresponding protective sheath.

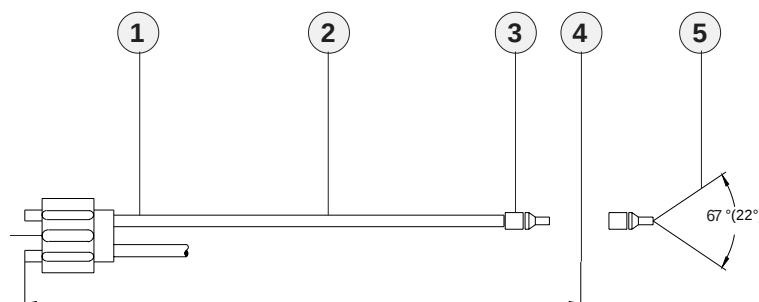
Order Code:



D-S-A2.0-(2.5)-1200-67°

Order code for optical fiber

(For detailed description of the various types of fiber optics, please cf. catalog „FIO Series“)



Dimensions of adapter

Attachment optics (e.g. focus lens, reflex optics, prism optics)

Fiber optics for reflex light operation

Fiber optics for transmitted light operation

Mounting hints

cf. catalog FIO Series

cf. catalog FIO Series

cf. catalog FIO Series

cf. catalog FIO Series

cf. catalog FIO Series



Attachment Optics

Overview: Attachment optics for reflective light fiber optics (cf. catalog FIO Series):

Part No.	Working distance	Suitable for fiber optics type ... (R = reflective light operation)	Working range or characteristics
KL-3	typ. 11 mm	R-S-A2.0-(2.5)-...-67°	Working range typ. 10 mm ... 20 mm
KL-3/30	typ. 11 mm	R/D-S-A2.0-(2.5)-...-67°	Working range typ. 30 mm
KL-4	typ. 11 mm	R-S-A1.1-(1.5)-...-67°	Working range typ. 10 mm ... 15 mm
KL-5	typ. 11 mm	R-S-R1.1-(3x0.5)-...-67°	Working range typ. 8 mm ... 20 mm
KL-8	typ. 11 mm	R-S-R2.1-(6x1)-...-67°	Working range typ. 8 mm ... 25 mm
KL-8-N	typ. 11 mm	R-S-R2.1-(6x1)-...-67°	Working range typ. 8 mm ... 25 mm - <i>with neutral glass filter</i>
KL-9	typ. 11 mm	R-S-A3.0-(3.0)-...-67°	Working range typ. 8 mm ... 25 mm
KL-M8-A1.1	typ. 11 mm	R-S-A1.1-(1.5)-...-67°	Working range typ. 8 mm ... 20 mm
KL-M12-A1.1	typ. 11 mm	R-S-A1.1-(1.5)-...-67°	Working range typ. 8 mm ... 20 mm
KL-M12-A2.0	typ. 11 mm	R-S-A2.0-(2.5)-...-67°	Working range typ. 8 mm ... 20 mm
KL-M12-A3.0	typ. 11 mm	R-S-A3.0-(3.0)-...-67°	Working range typ. 8 mm ... 20 mm
KL-M12-R1.1	typ. 11 mm	R-S-R1.1-(3x0.5)-...-67°	Working range typ. 8 mm ... 20 mm
KL-M12-XL-A1.1	typ. 50 mm	R-S-A1.1-(1.5)-...-67°	Working range typ. 30 mm ... 200 mm
KL-M12-XL-A2.0	typ. 50 mm	R-S-A2.0-(2.5)-...-67°	Working range typ. 30 mm ... 200 mm
KL-M12-XL-R1.1	typ. 50 mm	R-S-R1.1-(3x0.5)-...-67°	Working range typ. 30 mm ... 200 mm
KL-M18-A1.1	typ. 20 mm	R-S-A1.1-(1.5)-...-67°	Working range typ. 10 mm ... 60 mm
KL-M18-A2.0	typ. 20 mm	R-S-A2.0-(2.5)-...-67°	Working range typ. 10 mm ... 80 mm
KL-M18-A3.0	typ. 20 mm	R-S-A3.0-(3.0)-...-67°	Working range typ. 10 mm ... 80 mm
KL-M18-R1.1	typ. 20 mm	R-S-R1.1-(3x0.5)-...-67°	Working range typ. 10 mm ... 60 mm
KL-M18-R2.1	typ. 20 mm	R-S-R2.1-(6x1)-...-67°	Working range typ. 10 mm ... 80 mm
KL-M18-XL-A1.1	typ. 100 mm	R-S-A1.1-(1.5)-...-67°	Working range typ. 50 mm ... 300 mm
KL-M18-XL-A2.0	typ. 100 mm	R-S-A2.0-(2.5)-...-67°	Working range typ. 50 mm ... 300 mm
KL-M18-XL-A3.0	typ. 100 mm	R-S-A3.0-(3.0)-...-67°	Working range typ. 50 mm ... 300 mm
KL-M18-XL-R1.1	typ. 100 mm	R-S-R1.1-(3x0.5)-...-67°	Working range typ. 50 mm ... 300 mm
KL-M18-XL-R2.1	typ. 100 mm	R-S-R2.1-(6x1)-...-67°	Working range typ. 50 mm ... 300 mm
KL-M34-A1.1	typ. 130 mm	R-S-A1.1-(1.5)-...-67°	Working range typ. 50 mm ... 200 mm
KL-M34-A2.0	typ. 130 mm	R-S-A2.0-(2.5)-...-67°	Working range typ. 50 mm ... 250 mm
KL-M34-A3.0	typ. 130 mm	R-S-A3.0-(3.0)-...-67°	Working range typ. 50 mm ... 300 mm
KL-M34-R1.1	typ. 130 mm	R-S-R1.1-(3x0.5)-...-67°	Working range typ. 50 mm ... 200 mm
KL-M34-R2.1	typ. 130 mm	R-S-R2.1-(6x1)-...-67°	Working range typ. 50 mm ... 300 mm
KL-M34-M5.0	typ. 130 mm	T-S-M5.0-(5.0)-1200-67°	Working range typ. 50 mm ... 300 mm
KL-M34-M6.0	typ. 130 mm	T-S-M6.0-(6.0)-1200-67°	Working range typ. 50 mm ... 300 mm
KL-M34/62-A1.1	typ. 120 mm	R-S-A1.1-(1.5)-...-67°	Working range typ. 80 mm ... 200 mm
KL-M34/62-A2.0	typ. 120 mm	R-S-A2.0-(2.5)-...-67°	Working range typ. 80 mm ... 200 mm
KL-M34/62-A3.0	typ. 120 mm	R-S-A3.0-(3.0)-...-67°	Working range typ. 80 mm ... 200 mm
KL-M34/62-R1.1	typ. 120 mm	R-S-R1.1-(3x0.5)-...-67°	Working range typ. 80 mm ... 200 mm
KL-M34/62-R2.1	typ. 120 mm	R-S-R2.1-(6x1)-...-67°	Working range typ. 80 mm ... 200 mm



Attachment Optics

Overview: Attachment optics for transmitted light fiber optics (cf. catalog FIO Series):

Part No.	Working distance	Suitable for fiber optics type ... (R = transmitted light operation)	Working range or characteristics
KL-0/90°-A2.0		D-S-A2.0-(2.5)-...-67°	Transmitter/receiver distance typ. 50 mm ... 500 mm
KL-0/90°-A3.0		D-S-A3.0-(3.0)-...-67°	Transmitter/receiver distance typ. 50 mm ... 500 mm
KL-1 (2 pcs.)		D-S-A2.0-(2.5)-...-67° oder 22°	Transmitter/receiver distance typ. 50 mm ... 200 mm
KL-2 (2 pcs.)		D-S-A2.0-(2.5)-...-67° oder 22°	Transmitter/receiver distanced max. 300 mm, beam divergency $\pm 7,5^\circ$
KL-3/30	typ. 11 mm	R/D-S-A2.0-(2.5)-...-67°	Working range typ. 30 mm
KL-5/85°-A2.0	typ. 5 mm	D-S-A2.0-(2.5)-...-67°	Angle of incidence 85° to the vertical in a distance of 5 mm to the object, gloss control of extremely rough surfaces
KL-5/85°-A3.0	typ. 5 mm	D-S-A3.0-(3.0)-...-67°	Angle of incidence 85° to the vertical in a distance of 5 mm to the object, gloss control of extremely rough surfaces
KL-10/75°-A2.0	typ. 10 mm	D-S-A2.0-(2.5)-...-67°	Angle of incidence 75° to the vertical in a distance of 10 mm to the object, gloss control of rough surfaces
KL-10/75°-A3.0	typ. 10 mm	D-S-A3.0-(3.0)-...-67°	Angle of incidence 75° to the vertical in a distance of 10 mm to the object, gloss control of rough surfaces
KL-12/60°-A2.0	typ. 12 mm	D-S-A2.0-(2.5)-...-67°	Angle of incidence 60° to the vertical in a distance of 12 mm to the object, gloss control of matt to light glossy rough surfaces
KL-12/60°-A3.0	typ. 12 mm	D-S-A3.0-(3.0)-...-67°	Angle of incidence 60° to the vertical in a distance of 12 mm to the object, gloss control of matt to light glossy surfaces
KL-12/60°-R2.1	typ. 12 mm	D-S-R2.1-(6x1)-...-67°	Angle of incidence 60° to the vertical in a distance of 12 mm to the object, gloss control of matt to light glossy surfaces
KL-15/45°-A2.0	typ. 15 mm	D-S-A2.0-(2.5)-...-67°	Angle of incidence 45° to the vertical in a distance of 15 mm to the object, gloss control of matt to glossy surfaces
KL-15/45°-A3.0	typ. 15 mm	D-S-A3.0-(3.0)-...-67°	Angle of incidence 45° to the vertical in a distance of 15 mm to the object, gloss control of matt to glossy surfaces
KL-20/20°-A2.0	typ. 20 mm	D-S-A2.0-(2.5)-...-67°	Angle of incidence 20° to the vertical in a distance of 20 mm to the object, gloss control of strongly glossy surfaces
KL-20/20°-A3.0	typ. 20 mm	D-S-A3.0-(3.0)-...-67°	Angle of incidence 20° to the vertical in a distance of 20 mm to the object, gloss control of stongly glossy surfaces
KL-90 (2 pcs.)	typ. 100 mm	D-S-A2.0-(2.5)-...-67°	Can be focused, high light efficiency - <i>prism optics</i>
KL-D-2.5	typ. 300 mm	D-S-A2.0-(2.5)-...-67°	Working range typ. 100 mm ... 500 mm
KL-D-6	typ. 200 mm	D-S-A2.0-(2.5)-...-67°	Working range typ. 100 mm ... 250 mm
KL-D-14	typ. 80 mm	D-S-A2.0-(2.5)-...-67°	Working range typ. 60 mm ... 120 mm
KL-D-14-T400	typ. 80 mm	D-S-A2.0-(2.5)-1200-67°-T400	Working range typ. 60 mm ... 120 mm - <i>high temperature resistant</i>
KL-D-17	typ. 50 mm	D-S-A2.0-(2.5)-...-67°	Working range typ. 30 mm ... 80 mm
KL-D-20	typ. 30 mm	D-S-A2.0-(2.5)-...-67°	Working range typ. 20 mm ... 40 mm
KL-D-28	typ. 25 mm	D-S-A2.0-(2.5)-...-67°	Working range typ. 20 mm ... 30 mm
KL-D-30	typ. 25 mm	D-S-A2.0-(2.5)-...-67°	Working range typ. 20 mm ... 30 mm
KL-D-40	typ. 20 mm	D-S-A2.0-(2.5)-...-67°	Working range typ. 15 mm ... 25 mm



Attachment Optics

Overview: Attachment optics for standard fiber optics (cf. catalog FIO Series):



KL-1



KL-2



KL-3
KL-4
KL-5
KL-8
KL-9



KL-3/30



KL-0/90°-A2.0
KL-0/90°-A3.0



KL-5/85°-A2.0
KL-5/85°-A3.0



KL-10/75°-A2.0
KL-10/75°-A3.0



KL-12/60°-A2.0
KL-12/60°-A3.0
KL-12/60°-R2.1



KL-15/45°-A2.0
KL-15/45°-A3.0



KL-20/20°-A2.0
KL-20/20°-A3.0



KL-90



KL-D-2.5



KL-D-6



KL-D-14



KL-D-17



KL-D-20



KL-D-28



KL-D-40



KL-M8-A1.1



KL-M12-A1.1
KL-M12-A2.0
KL-M12-A3.0
KL-M12-R1.1



KL-M12-XL-A1.1
KL-M12-XL-A2.0
KL-M12-XL-R1.1



KL-M18-A1.1
KL-M18-A2.0
KL-M18-A3.0
KL-M18-R1.1
KL-M18-R2.1



KL-M18-XL-A1.1
KL-M18-XL-A2.0
KL-M18-XL-A3.0
KL-M18-XL-R1.1
KL-M18-XL-R2.1



KL-M34-A1.1
KL-M34-A2.0
KL-M34-A3.0
KL-M34-R1.1
KL-M34-R2.1



KL-M34/62-A1.1
KL-M34/62-A2.0
KL-M34/62-A3.0
KL-M34/62-R1.1
KL-M34/62-R2.1



KL-M34-M5.0
KL-M34-M6.0



Fiber Optics Mounting

Overview: Mounting plates for transmitted light fiber optics of sensor type „Q...“ (cross-section converter)
(cf. catalog FIO Series):

Part No.	Working distance	Suitablefor fiber optics type ... (D = transmitted light operation, Q = cross-section converter)	Working range
KL-50/50-5	50 mm	D-S-Q1-(5x0.5)-...-67°	5 mm
KL-50/50-10	50 mm	D-S-Q2-(10x0.3)-...-67°	10 mm
KL-50/50-18	50 mm	D-S-Q3-(18x0.3)-...-67°	18 mm
KL-50/50-28	50 mm	D-S-Q4-(28x0.2)-...-67°	28 mm
KL-50/50-38	50 mm	D-S-Q5-(38x0.15)-...-67°	38 mm
KL-50/50-48	50 mm	D-S-Q6-(48x0.15)-...-67°	48 mm



KL-50/50-5
+ D-S-Q1-(5x0.5)-...-67°



KL-50/50-10
+ D-S-Q2-(10x0.3)-...-67°



KL-50/50-18
+ D-S-Q3-(18x0.3)-...-67°



KL-50/50-28
+ D-S-Q4-(28x0.2)-...-67°



KL-50/50-38
+ D-S-Q5-(38x0.15)-...-67°



KL-50/50-48
+ D-S-Q6-(48x0.15)-...-67°