

# SPECTRO Series

## ► SPECTRO-3-COF-...-MSM-SLE

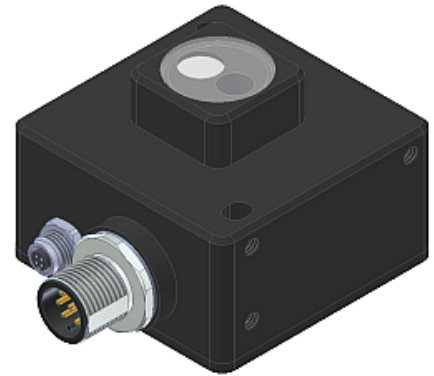
- **Color control** (color, contrast, and gray scale detection)
- Measurement range typ. 10 mm ... 200 mm
- Integrated transmitter and receiver optics (confocal)
- $L^*a^*b^*$ ,  $L^*C^*h^*$ ,  $L^*u^*v^*$ ,  $L^*u^*v'$  and  $xyY$  evaluation (CIE standard)
- Up to 31 colors (max. 48 in group mode) can be stored
- Super-bright white-light LED (AC-/DC-operation can be switched)
- Insensitive to outside light (in AC-operation)
- Scan frequency max. 35 kHz (in DC-operation)
- Switching frequency typ. 60 kHz
- 5 digital outputs to output taught colors (either as binary code or directly with max. 5 colors)
- TEACH via PC or PLC (external input)
- Various evaluation algorithms can be activated
- "BEST HIT" mode ("human color assessment")
- Averaging can be activated (from 1 up to over 32000 values)
- Parameterizable via Windows® software, scope function
- RS232 interface (USB or Ethernet converter available)
- Temperature compensated
- Color control of luminous objects (LEDs, halogen lamps, displays, ...)
- 3-color filter detector (true color detector: "human color perception")

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## Design

### Product name:

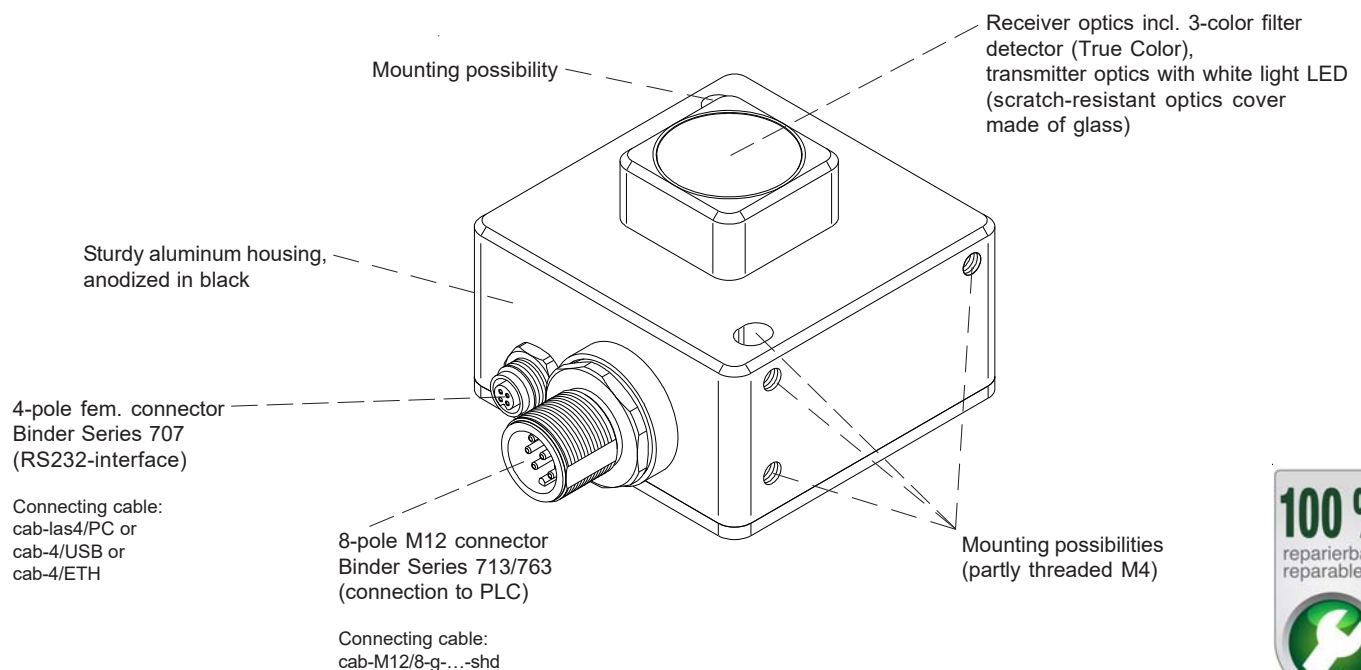
**SPECTRO-3-COF-d3.0-MSM-SLE** (size of light spot typ.  $\varnothing$  3.0 mm at a distance of 75 mm)

**SPECTRO-3-COF-d5.0-MSM-SLE** (size of light spot typ.  $\varnothing$  5.0 mm at a distance of 80 mm)

**SPECTRO-3-COF-d8.0-MSM-SLE** (size of light spot typ.  $\varnothing$  8.0 mm at a distance of 85 mm)

**SPECTRO-3-COF-5x1.5-MSM-SLE** (size of light spot typ. 5 mm x 1.5 mm at a distance of 45 mm)

(incl. Windows® software SPECTRO3-MSM-SLE-Scope)





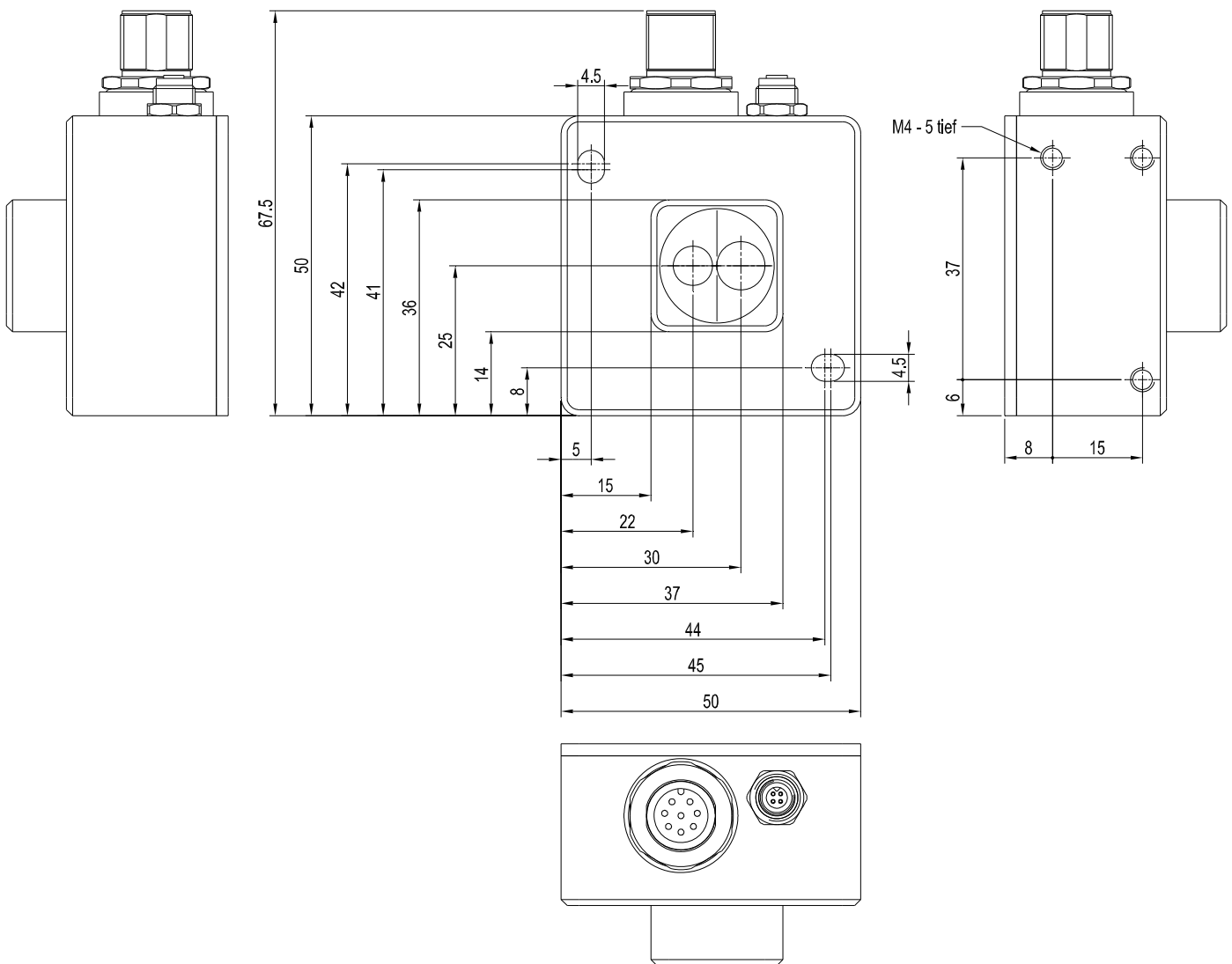
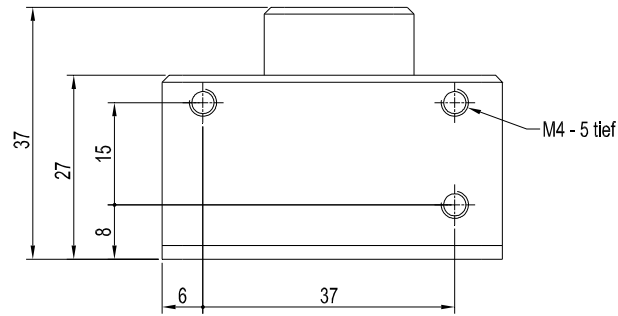
**Technical Data**

Type	SPECTRO-3-COF-...-MSM-SLE
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 ... OUT1 (Pin 4 ... Pin 8): digital (0V/+24V), npn-/pnp-able (bright-/dark-switching, can be switched)
Interface	RS232 (an external USB and ETHERNET converter is available)
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 operation: max. 35 kHz (depends on parameterization)
Switching frequency	typ. 60 kHz
Transmitter (light source)	super-bright white-light LED, diffuse
Transmitter control	can be switched via PC software: AC operation (LED MODE-AC), DC operation (LED MODE-DC)
Measuring range	typ. 10 mm ... 200 mm
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	SPECTRO-3-COF- <b>d3.0</b> -MSM-SLE: typ. $\varnothing$ 3.0 mm at a distance of 75 mm SPECTRO-3-COF- <b>d5.0</b> -MSM-SLE: typ. $\varnothing$ 5.0 mm at a distance of 80 mm SPECTRO-3-COF- <b>d8.0</b> -MSM-SLE: typ. $\varnothing$ 8.0 mm at a distance of 85 mm SPECTRO-3-COF- <b>5x1.5</b> -MSM-SLE: typ. 5 mm x 1.5 mm at a distance of 45 mm
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/ $^{\circ}$ C (< 0,01% / $^{\circ}$ C)
Color difference	$\Delta E \geq 0,3$
Color space	CIE L*a*b*, CIE L*C*h*, CIE L*u*v*, CIE L*u'v' and CIE xyY
Color memory capacity	non-volatile EEPROM with parameter sets for max. 31 colors (max. 48 colors in GROUP mode)
Housing dimensions	SPECTRO-3-COF- <b>d...-MSM-SLE</b> : LxWxH approx. 50 mm x 50 mm x 37 mm (without flange connectors) SPECTRO-3-COF- <b>5x1.5-MSM-SLE</b> : LxWxH approx. 50 mm x 50 mm x 45 mm (without flange connectors)
Housing material	aluminum, anodized in black
Enclosure rating	IP64
Connecting cables	to PLC: cab-M12/8-g-...-shd to PC/RS232 interface: cab-las4/PC or cab-las4/PC-w to PC/USB interface: cab-4/USB or cab-4/USB-w to PC/Ethernet interface: cab-4/ETH
Type of connector	connection to PLC: 8-pole M12-connector (Binder 713/763), connection to PC: 4-pole fem. connector (Binder 707)
Operating temp. range	-20 $^{\circ}$ C ... +55 $^{\circ}$ C
Storage temperature range	-20 $^{\circ}$ C ... +85 $^{\circ}$ C
EMC test acc. to	DIN EN 60947-5-2



Dimensions

SPECTRO-3-COF-d3.0-MSM-SLE  
 SPECTRO-3-COF-d5.0-MSM-SLE  
 SPECTRO-3-COF-d8.0-MSM-SLE

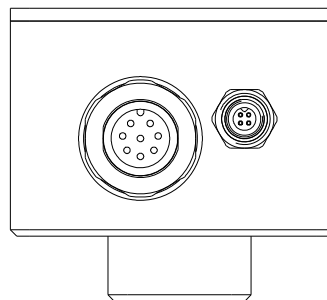
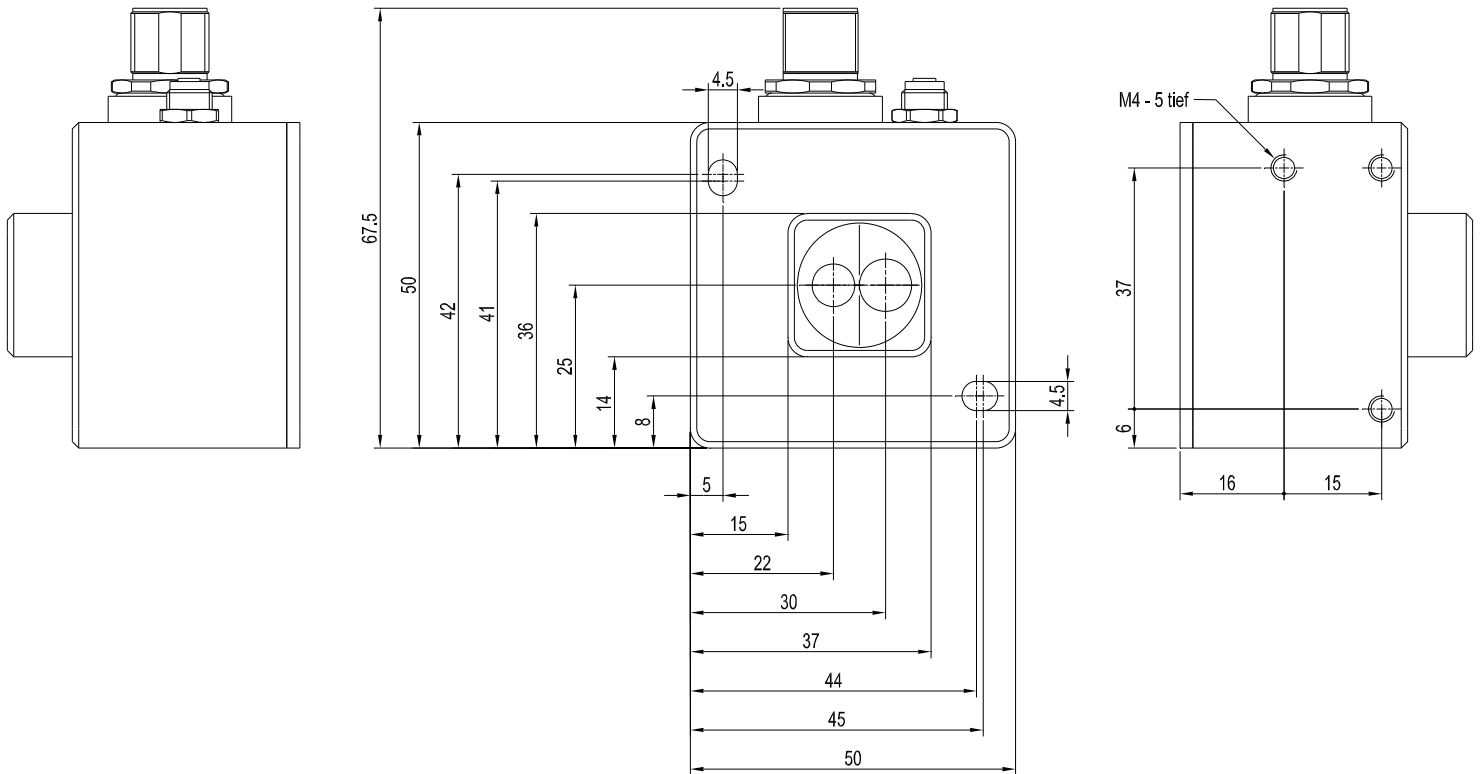
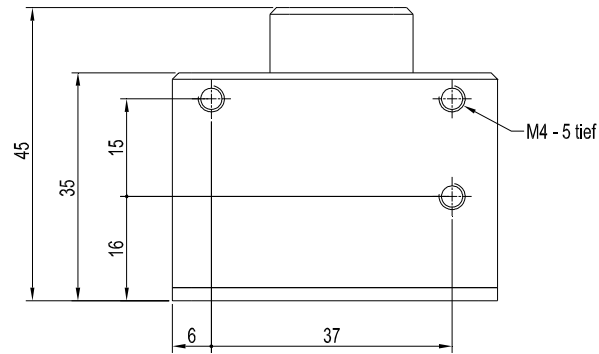


All dimensions in mm



Dimensions

SPECTRO-3-COF-5x1.5-MSM-SLE



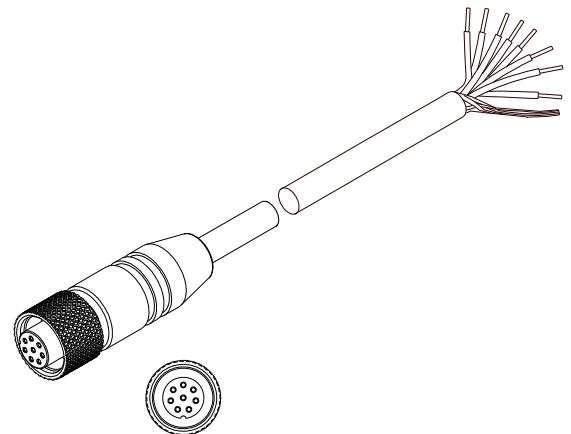
All dimensions in mm



**Connector Assignment**
**Connection to PLC:****8-pole M12 connector Binder Series 713/763**

Pin:	Color:	Assignment:
1	white	GND (0V)
2	brown	+24VDC ( $\pm 10\%$ )
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-M12/8-g-(length)-shd (shielded)  
 (standard length 2m)



cab-M12/8-g-...-shd  
 (max. length 5m, 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)

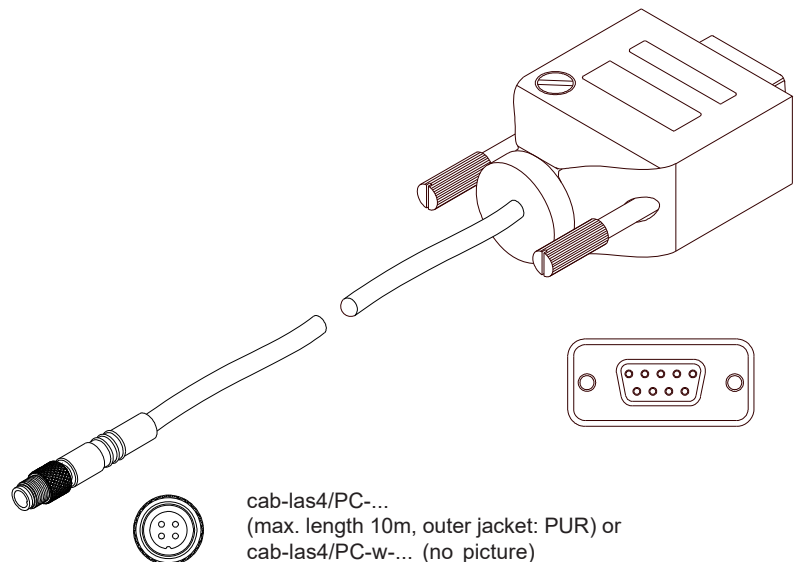
**alternative:****Connection via USB interface at the PC:**

Connecting cable (incl. driver software):  
 cab-4/USB-(length)  
 cab-4/USB-w-(length) (angle type 90°)  
 (standard length 2m)

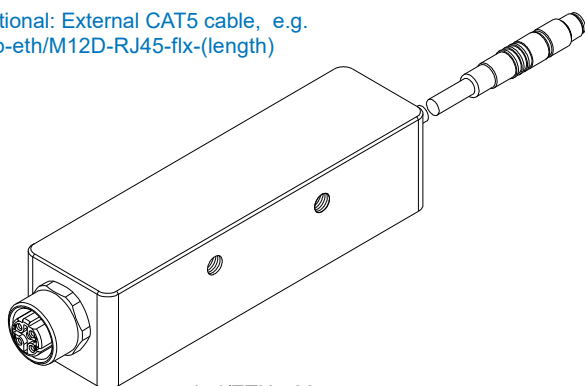
**alternative:****Connection to local network via Ethernet bus:**

Adapter (incl. software „SensorFinder“):  
 cab-4/ETH-500  
 (standard length 0.5m)

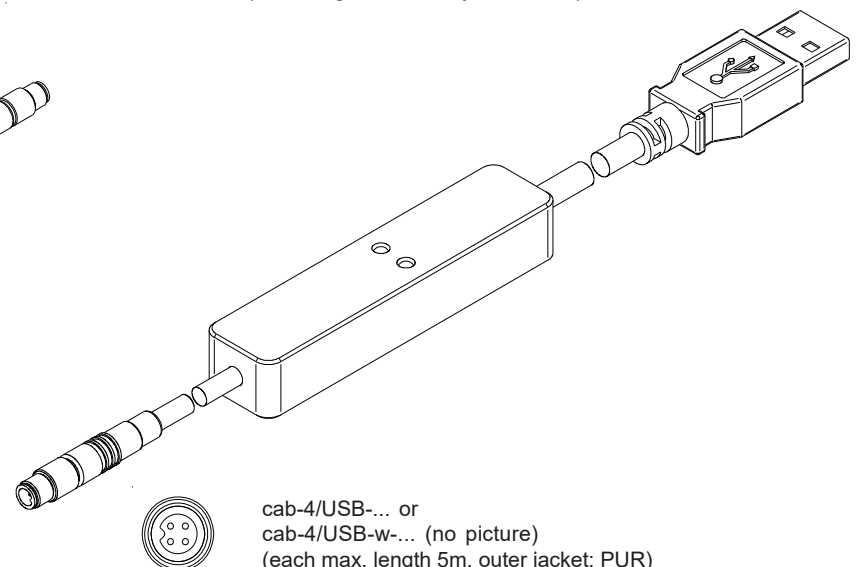
Optional: External CAT5 cable, e.g.  
 cab-eth/M12D-RJ45-flx-(length)



cab-las4/PC-...  
 (max. length 10m, outer jacket: PUR) or  
 cab-las4/PC-w-... (no picture)  
 (max. length 5m, outer jacket: PUR)



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)



cab-4/USB-... or  
 cab-4/USB-w-... (no picture)  
 (each max. length 5m, outer jacket: PUR)

**Measuring Principle****Measuring Principle of the color sensors of SPECTRO-3-MSM-SLE series:**

The SPECTRO-3-MSM-SLE 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. 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-MSM-SLE color sensor is activated, the sensor detects the radiation that is diffusely reflected from the object. As a light source the SPECTRO-3-MSM-SLE color sensor uses LEDs 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 color sensors of the SPECTRO-3-MSM-SLE series can be taught up to 31 colors that are provided directly at the outputs, and up to 48 colors that are output by means of grouping. For each of these taught colors it is possible to set tolerances. Evaluation of the taught colors is performed either with the „FIRST HIT“ or with the „BEST HIT“ mode. With „FIRST HIT“ the first hit in the teach table is output, and with „BEST HIT“ the best hit in the teach table is output. Raw data are represented with 12 bit resolution.

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.

Through input IN0 the color sensor can be taught up to 31 colors (max. 48 colors in group mode). For this purpose the corresponding evaluation mode must be set with the software.

Parameters and measurement values can be exchanged between a PC and the SPECTRO-3-MSM-SLE 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-MSM-SLE 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.

Possible firmware updates can be easily performed through the RS232 interface, even with the sensor system in installed condition. (à cf. Annex „Firmware update via software Firmware Loader“).

The sensors of SPECTRO-3-MSM-SLE series are factory calibrated. When establishing the connection, the date of the next calibration is displayed in the status window in the **CONNECT** tab. For continuously accurate measurement results, we recommend having the calibration renewed every 12 months and sending in the sensors for calibration.

The sensors of the SPECTRO-3-MSM-SLE series can be individually calibrated. Calibration can be performed to any surface with known color coordinates. A ColorChecker™ table is available as an alternative. This table has 24 color fields according to the CIE STANDARD that can be used for calibration.

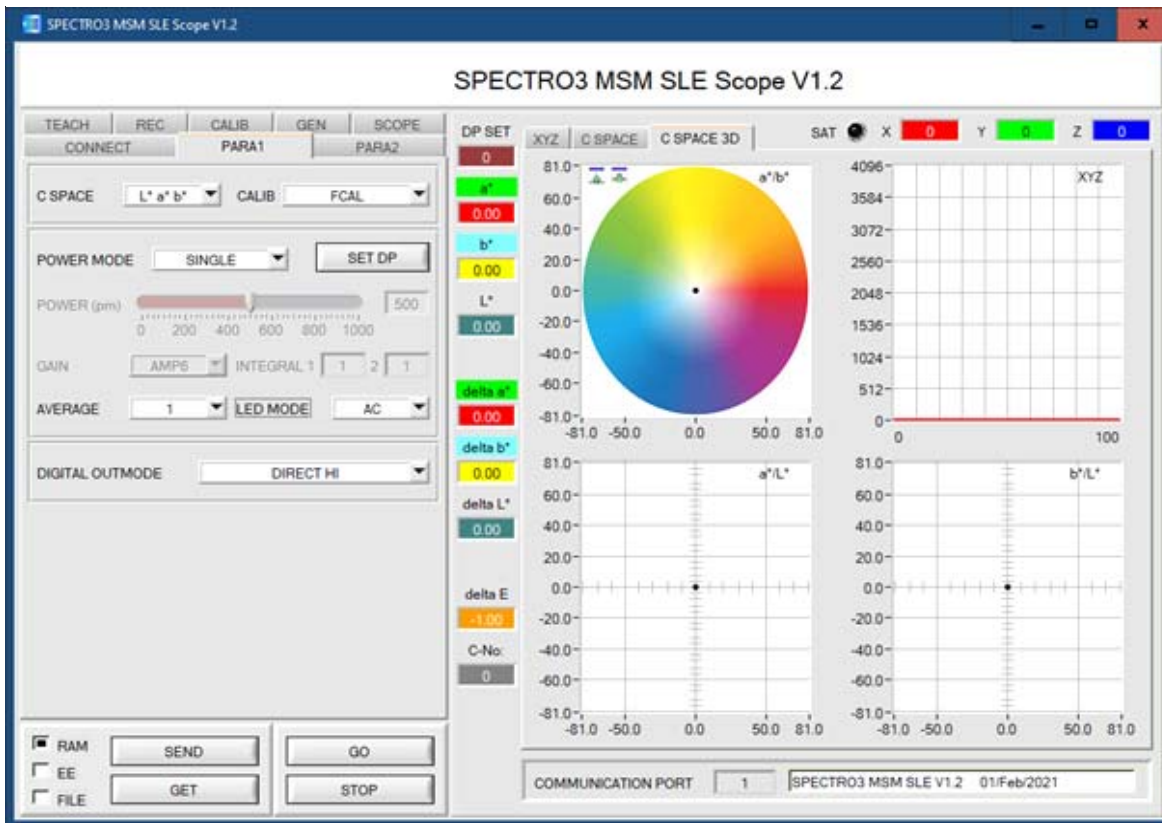


Parameterization

**Windows® user interface:**

(The current software version is available for download on our website.)

The color sensor is parameterized under Windows® with the SPECTRO3-MSM-SLE-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.



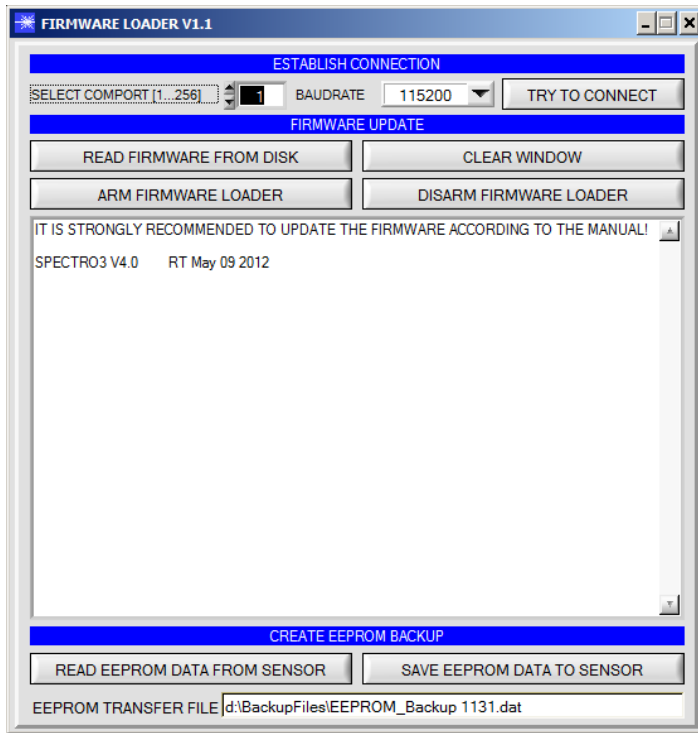
The RS232 interface (tab PARA1) is used for setting parameters such as:

- POWER MODE: Light power of the LED
- LED MODE: Triggering of the internal light source (AC, DC)
- GAIN: Used for setting the gain of the receiver (AMP1 ... AMP8)
- AVERAGE: Number of scanning values (measurement values, 1 ... 32768) over which the raw signal measured at the receiver is averaged. A higher AVERAGE default value reduces noise of the raw signals at the receiver unit and there will be a decrease of the maximal available switching frequency of the sensor.
- INTEGRAL: 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
- SET DP: Set Double Parameter
- C SPACE: Selection of a color space ( $L^*a^*b^*$ ,  $L^*C^*h^*$ ,  $L^*u^*v^*$ ,  $L^*u^*v'$ , or  $xyY$ ) for the calculation of the color stimulus specification
- SHAPE MODE: This function field is used to specify whether the color space coordinates (e.g.  $L^* a^* b^*$ ) should be viewed as a block, cylinder, or sphere in space
- EVALUATION MODE: Evaluation mode (FIRST HIT or BEST HIT)
- TRIGGER: Continuous or external or self trigger (CONT, EXT1, EXT2, TRANS)
- EXTEACH: In all the evaluation modes teaching of a color can be performed externally through INO
- INTLIM: Minimum intensity required for color evaluation
- MAXCOL-No.: Number of colors to be checked
- DIGITAL OUTMODE: Triggering of the five digital outputs (OUT0 ... OUT4)
- Tab TEACH: Opens a window where you can teach colors to the TEACH TABLE
- Tab GEN: Displays the current temperature value TEMP in the sensor housing
- Tab REC: Data recorder
- Tab CALIB: Selection of calibration mode (FCAL = factory calibration or UCAL = user calibration)
- Tab SCOPE: Visualises an oscilloscope



## Firmware Update

### Firmware update by means of the software „FirmwareLoader“:



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.



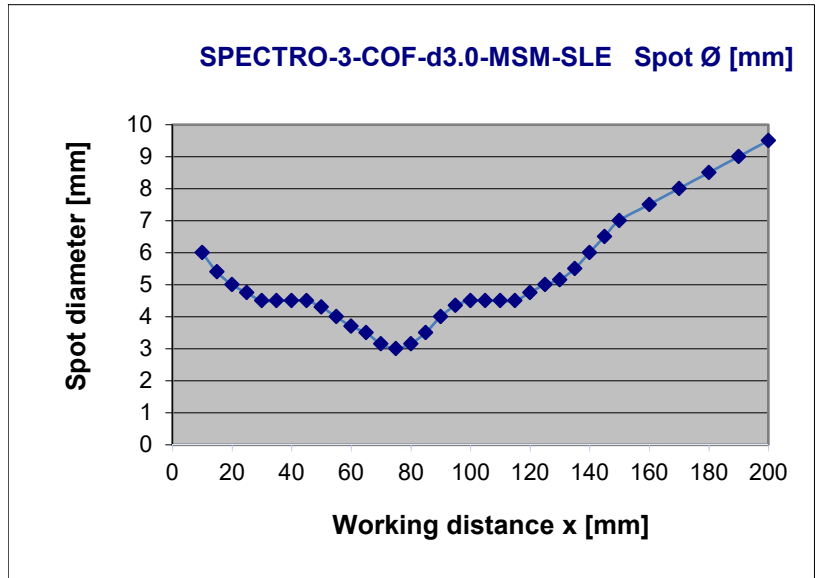


Diagrams

**Diagrams:** SPOT DIAMETER and RELATIVE INTENSITY  
SPECTRO-3-COF-d3.0-MSM-SLE

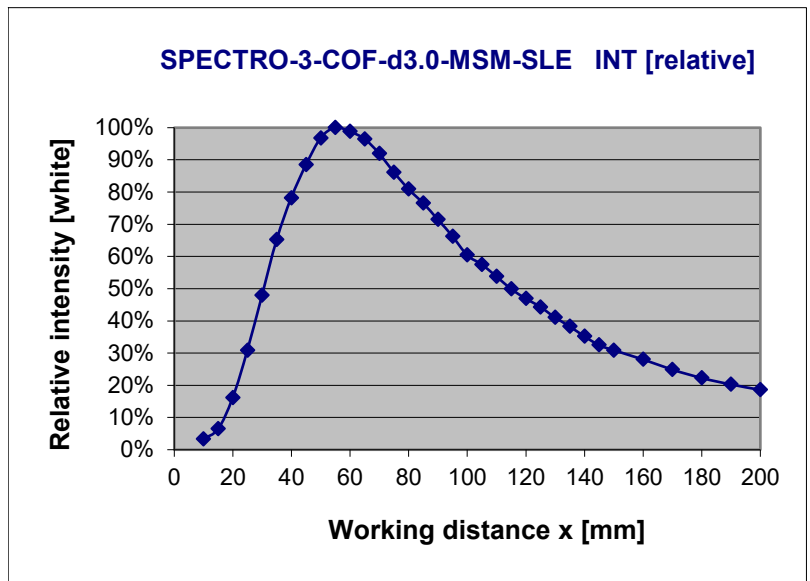
**Spot diameter**

SPECTRO-3-COF-d3.0-MSM-SLE:  
3.0mm (typ.) at a working distance of 75 mm



**Relative intensity**

SPECTRO-3-COF-d3.0-MSM-SLE:  
100% at a working distance of 55 mm  
(INTENSITY 3242)



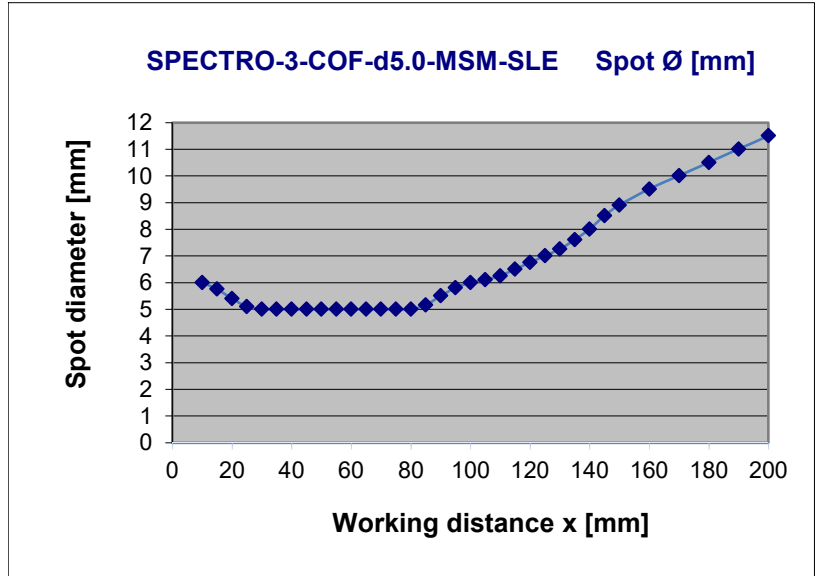


Diagrams

**Diagrams:** SPOT DIAMETER and RELATIVE INTENSITY  
SPECTRO-3-COF-d5.0-MSM-SLE

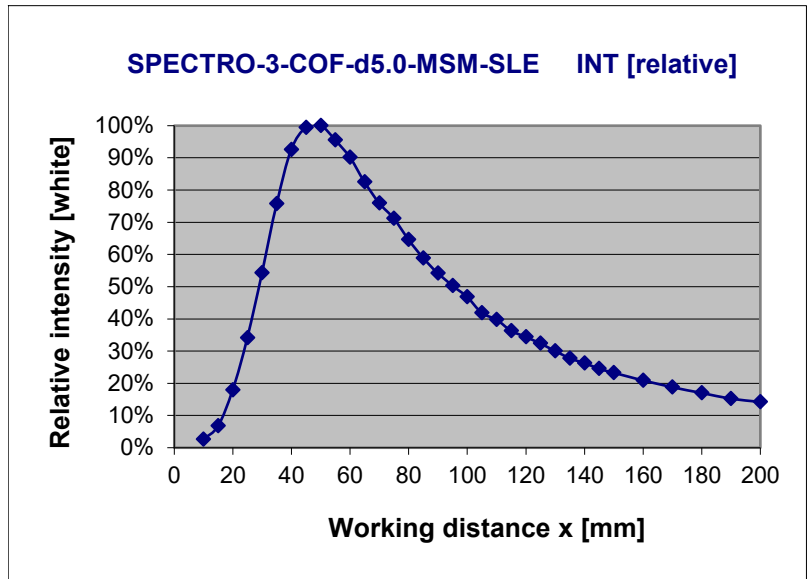
**Spot diameter**

SPECTRO-3-COF-d5.0-MSM-SLE:  
5.0mm (typ.) at a working distance of 80 mm



**Relative intensity**

SPECTRO-3-COF-d5.0-MSM-SLE:  
100% at a working distance of 50 mm  
(INTENSITY 3462)



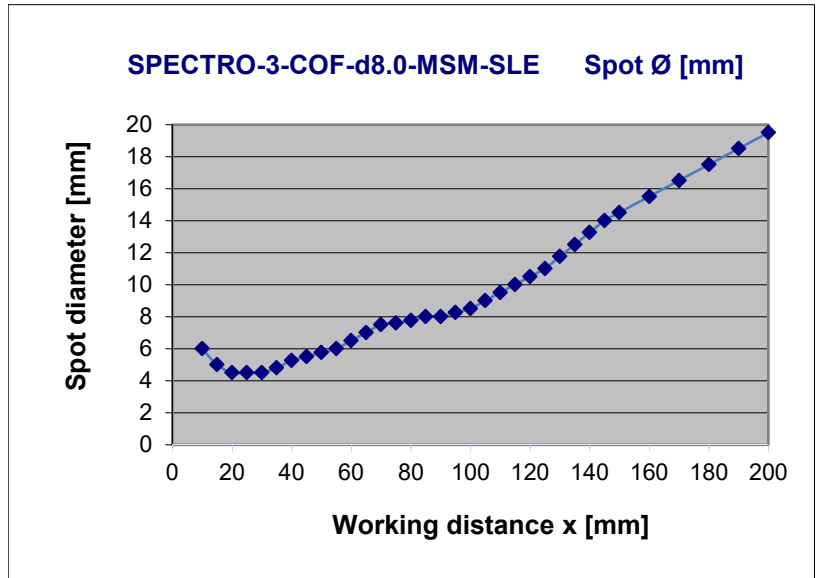


Diagrams

**Diagrams:** SPOT DIAMETER and RELATIVE INTENSITY  
SPECTRO-3-COF-d8.0-MSM-SLE

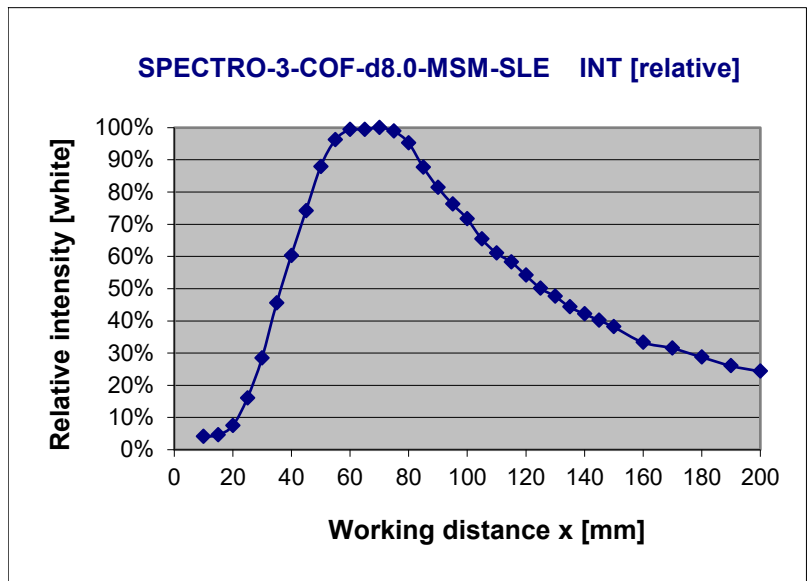
**Spot diameter**

SPECTRO-3-COF-d8.0-SLE:  
8.0 mm (typ.) at a working distance of 85 mm



**Relative intensity**

SPECTRO-3-COF-d8.0-MSM-SLE:  
100% at a working distance of 70 mm  
(INTENSITY 3051)



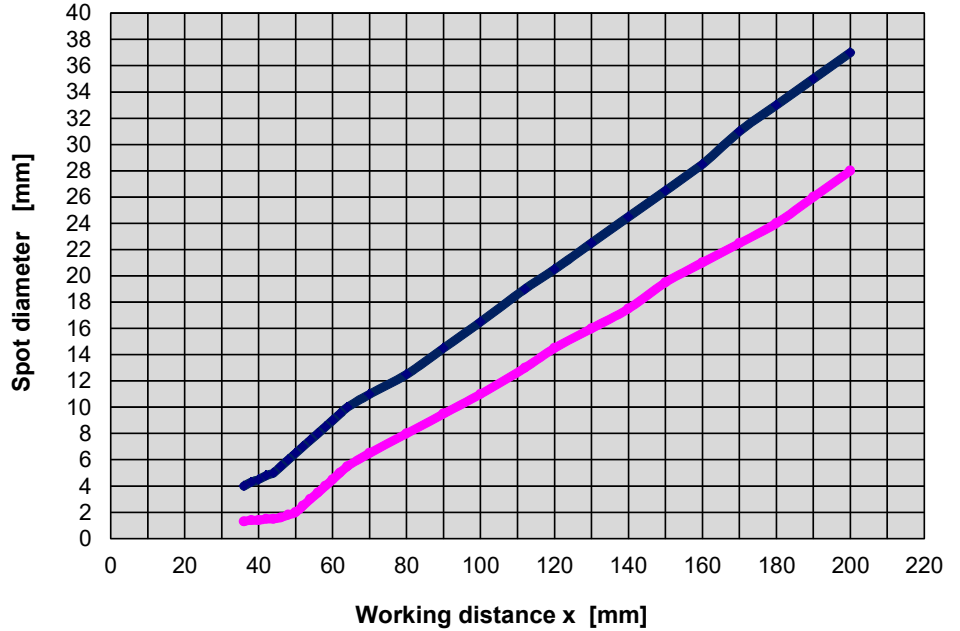
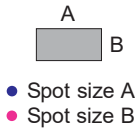


Diagramme

**Diagrams:** SPOT DIAMETER and RELATIVE INTENSITY  
SPECTRO-3-COF-5x1.5-MSM-SLE

**Spot diameter**

SPECTRO-3-COF-5x1.5-MSM-SLE:  
typ. 5 mm (A) x 1.5 mm (B)  
at a working distance of 45 mm



**Relative intensity**

SPECTRO-3-COF-5x1.5-MSM-SLE:  
100% at a working distance of 45 mm  
(INTENSITY 3550)

