

In Proud Partnership with Sensor Instruments

**PAQUIN**  
SENSORS

 For technical support, sales, & distribution  
within the USA & Canada

www.paquin.com | (800) 831-8217 | paquinsensors@paquin.com

# SI-JET Series

## SI-JET3-FIO-RL

The SI-JET3-FIO-RL spray jet control system uses three red light beams to monitor the density as well as the symmetry around the opening angle of the spray jet. The comprehensive software SI-JET-Scope allows a parameterization under Windows®.

- Telecentric setup; thus large transmitter/receiver distance possible (measuring range 50 mm to 500 mm)
- Averaging adjustable (up to 32000 values)
- RS232 interface (USB or Ethernet converter available)
- Windows® user interface, Scope function
- Various teach options (via PC or PLC)
- 5 digital outputs for output of the detected state
- High resolution (12-bit A/D converter)
- Brightness control can be activated (STATIC, DYNAMIC)
- Different evaluation algorithms can be activated
- Temperature compensated
- Up to 32 states can be stored (max. 64 in group mode)
- Scan frequency max. 45 kHz (in DC mode), switching frequency typ. 60 kHz
- High dynamic range due to adjustable transmitter power and receiver gain
- Insensitive to ambient light in AC mode
- Can be used in areas subject to explosion hazards (EX-RL, Zone 0) due to use of fiber optic frontends



## Design

### Product name:

#### SI-JET3-FIO-RL

(incl. Windows® software SI-JET-Scope as of V4.0)

#### Suitable fiber optics:

##### Transmitter fiber optics:

R3-M-A1.1-(1.5)-1200-67°-3X

R3-M-A1.1-(1.5)-2000-67°-3X

R3-M-A1.1-(1.5)-3000-67°-3x

R3-M-A1.1-(1.5)-5000-67°-3x

##### Receiver fiber optics:

R3-M-A2.0-(2.5)-1200-67°-3X

R3-M-A2.0-(2.5)-2000-67°-3X

R3-M-A2.0-(2.5)-3000-67°-3X

R3-M-A2.0-(2.5)-5000-67°-3X

R3-M-A1.1-(1.5)-5000-67°-3X

Available on request:

Fiber optics type D-BOA-...  
suitable for drag chains



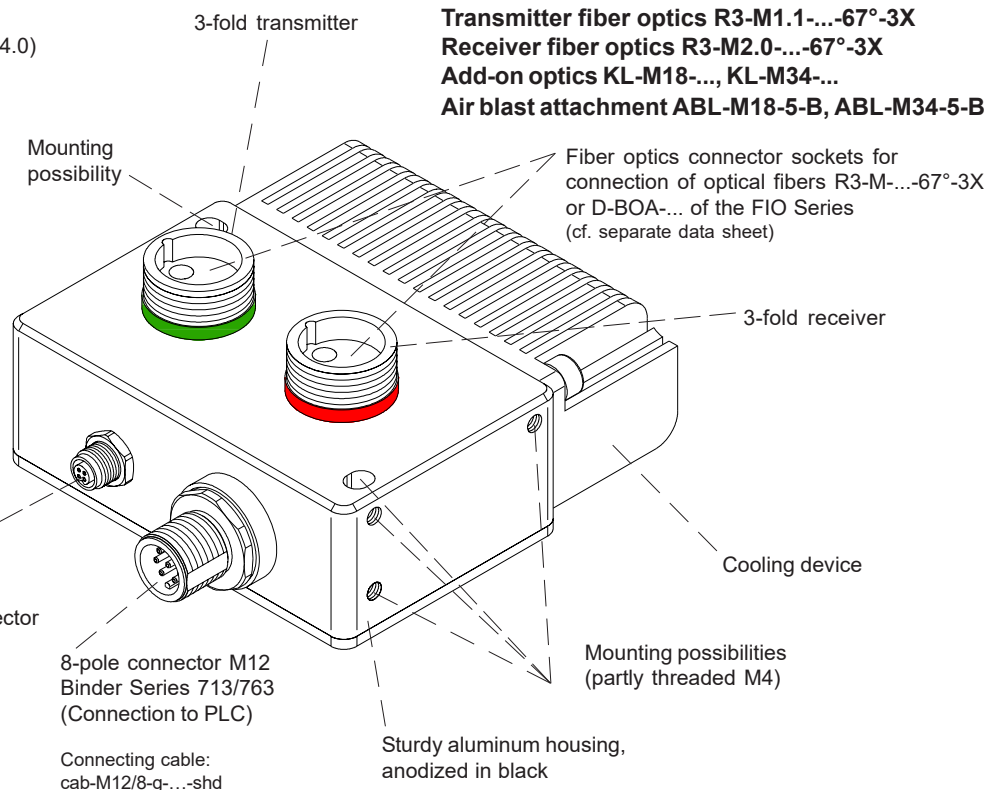
### Accessories: (p. 8-10)

Transmitter fiber optics R3-M1.1-...-67°-3X

Receiver fiber optics R3-M2.0-...-67°-3X

Add-on optics KL-M18-..., KL-M34-...

Air blast attachment ABL-M18-5-B, ABL-M34-5-B



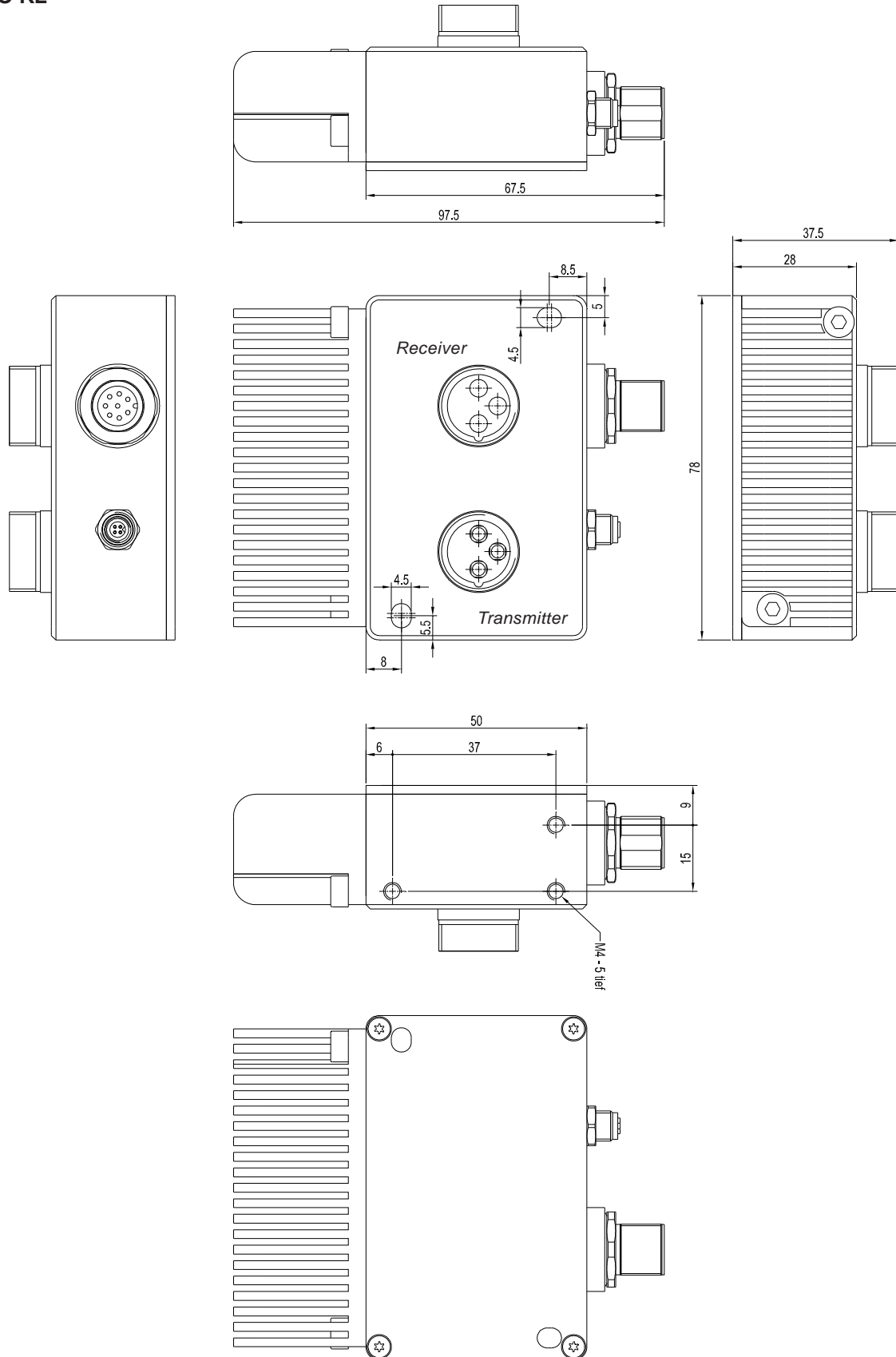


**Technical Data**

Type	SI-JET3-FIO-RL
Voltage supply	+24VDC (± 10%), reverse polarity protected, overcurrent protected
Current consumption	< 150 mA
Max. switching current	100 mA, short circuit proof
Outputs digital (5x)	OUT0 ... OUT4 (Pin 4 ... 8): digital (0V/+24V), npn-/pnp-able (bright-/dark-switching, can be switched)
Inputs digital (1x)	IN0 (Pin 3), digital (0V/+24V)
Interface	RS232
Pulse lengthening	0 ... 100 ms, adjustable via PC software
Averaging	max. 32768 Werte, adjustable via PC software
Scan frequency (alternating light operation/ direct light operation)	LED operation, can be switched via PC software: AC operation: max. 24 kHz (depends on parameterization) DC operation: max. 45 kHz (depends on parameterization)
Switching frequency	typ. 60 kHz
Object distance (measurement range)	typ. 50 mm ... 500 mm
Receiver	3-fold receiver for the left, center and right part of the light transmitted by the measured object
Optical filter	Red light filter
Receiver gain setting	8 steps (AMP1 ... AMP8), adjustable via PC software
Ambient light	max. 5000 Lux
Temperature drift X,Y	$\Delta X/\Delta T$ ; $\Delta Y/\Delta T$ typ. 0,2 digits/°C (< 0,01% / °C)
Color memory capacity	non-volatile EEPROM with parameter sets for max. 31 states (max. 64 states in group mode)
Housing dimensions	LxWxH approx. 97.5 mm x 78 mm x 37.5 mm
Housing material	Aluminum, anodized in black
Enclosure rating	IP67
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 series 713/763) Connection to PC: 4-pole fem. connector (Binder series 707) 2 fiber optics connectors (adaptors)
Operating temperature range	-20°C ... 55°C
Storage temperature range	-20°C ... 85°C
EMC test acc. to	DIN EN 60947-5-2

Dimensions

SI-JET3-FIO-RL



All dimensions in mm

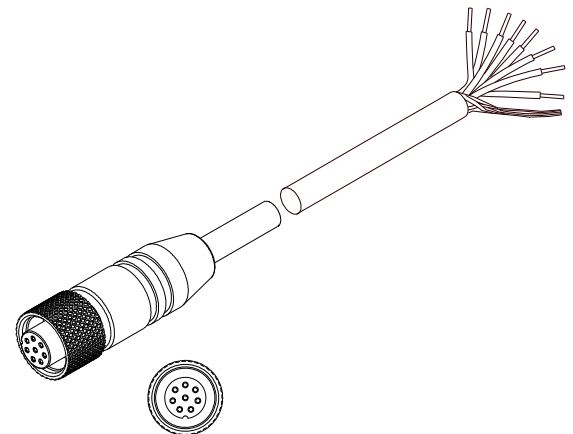
## Connector Assignment

**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	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)  
 cab-M12/8-w-(Länge)-shd (shielded)  
 (standard length 2m, also available: 5m)



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)

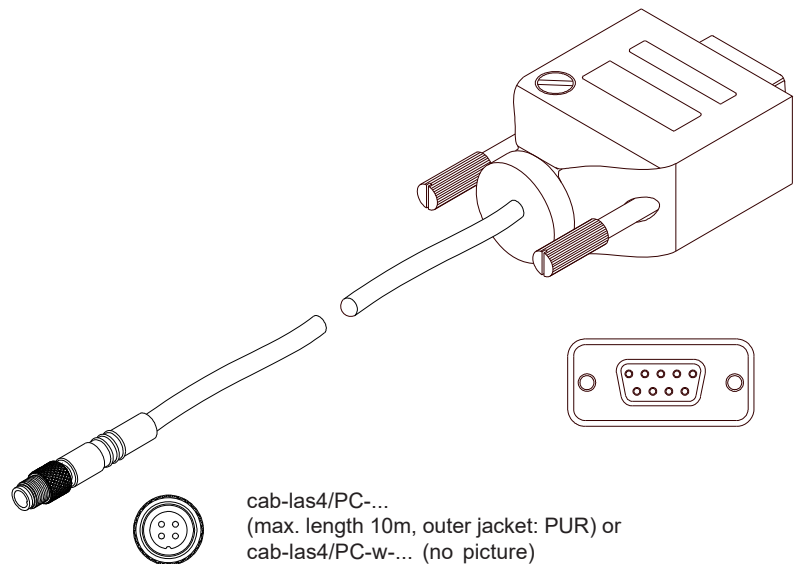
**alternative:****Connection via USB interface at the PC:**

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

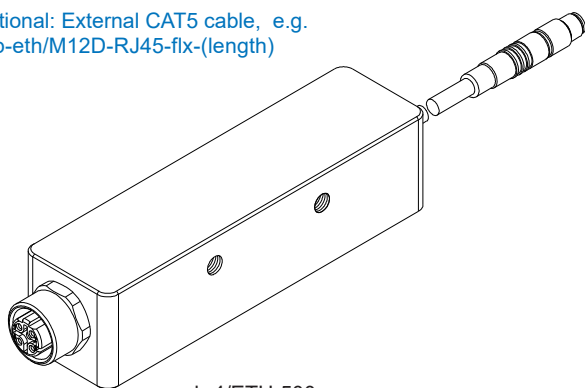
**alternative:****Connection to local network via Ethernet bus:**

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

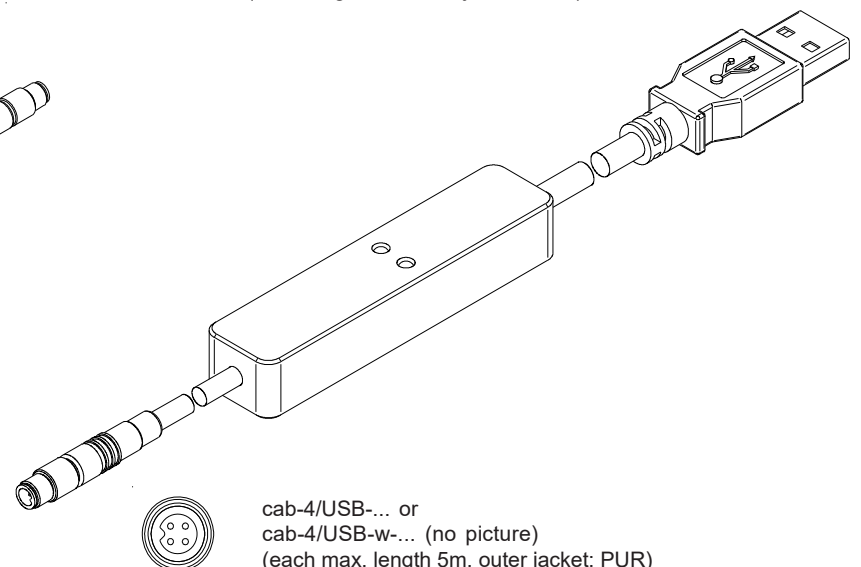
**Optional: External CAT5 cable, e.g.**  
 cab-eth/M12D-RJ45-flx-(length)



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 SI-JET3-FIO-RL three-channel spray jet sensor**

The **SI-JET3-FIO-RL** spray jet sensor allows highly flexible signal acquisition. The sensor, for example, can be operated in alternating-light mode (AC mode), which means the sensor is not influenced by external light, or in constant-light mode (DC mode), which provides outstanding high-speed sensor operation. With stepless adjustment of the integrated light source, selectable gain of the receiver signal, and an INTEGRAL function the sensor can be adjusted to almost any surface.

The **SI-JET3-FIO-RL** spray jet sensor detects the radiation that is transmitted from the measurement object. Depending on the system a red-light LED or a laser diode with adjustable transmission power is used as a light source for the **SI-JET3-FIO-RL** sensor. An integrated 3-fold receiver is used for the left, center, and right component of the light transmitted from the measurement object.

Raw data are detected and displayed with 12 bit resolution.

A density and two symmetry values are formed from the detected values for the left, center, and right channel. These values and their individually adjustable tolerances represent a status, and this status is referred to as a vector.

The sensors of the SI-JET series can be „taught“ up to 31 vectors that can be directly provided at the outputs, and up to 64 vectors that can be output by way of grouping.

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. Vector detection either operates continuously or is started through an external PLC trigger signal. The respective detected vector 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 vectors are to be detected.

Through input IN0 the sensor can be taught up to 31 vectors (max. 64 vectors in group mode). For this purpose the corresponding evaluation mode must be set with the software.

In another evaluation mode a switching threshold can be set for each of the 3 channels left, center, and right. The respective output switches when the value falls below this threshold.

Parameters and measurement values can be exchanged between PC and sensor through the RS232 interface. Through this RS232 interface all the parameters for vector detection can be stored in the non-volatile EEPROM of the sensor. When parameterisation is finished, the sensor continues to operate with the current parameters in STAND-ALONE mode without a PC.

Necessary firmware updates can be easily performed through RS232, also with the sensor installed.

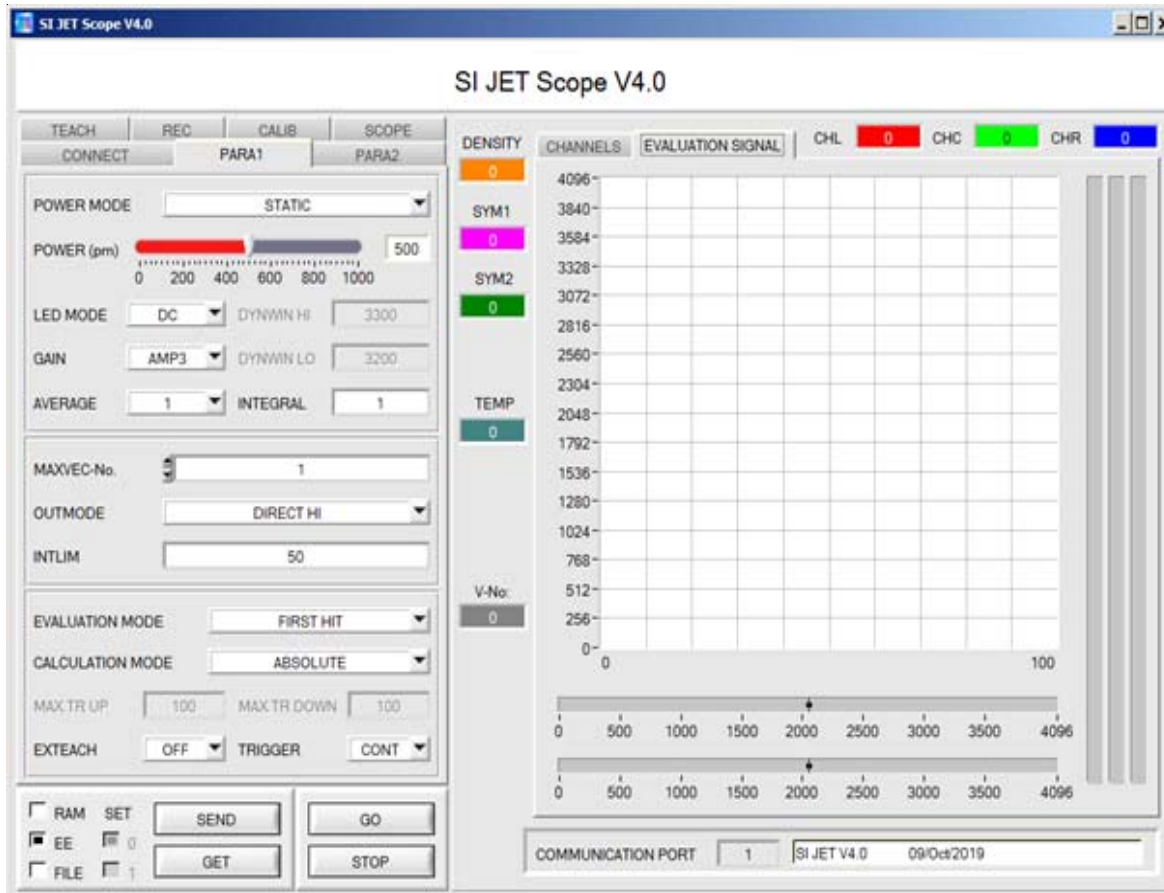
The sensors of the SI-JET series can be calibrated (channel calibration). Such calibration is performed in transmitted-light mode, when there is no object between transmitter and receiver.



**Parameterization**
**Windows® user interface:**

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

The SI-JET sensor is parameterized under Windows® with the SI-JET-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 (tab PARA1 or PARA2) is used for setting parameters such as:

- POWER MODE: Setting the operating mode of the power control on the transmitter unit
- 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
- MAXVEC-No.: Number of vectors to be checked
- OUTMODE: Triggering of the digital outputs
- INTLIM: Setting of an intensity limit (minimum intensity required for evaluation)
- EVALUATION MODE: Setting of the evaluation mode (FIRST HIT, VEC5, THD CHA)
- CALCULATION MODE: There are 2 methods of teaching a vector, which are selectable via CALCULATION MODE. In CALCULATION MODE = ABSOLUTE you define how the values for DENSITY, SYM1 and SYM2 are calculated from the raw signals CHL, CHC and CHR. In CALCULATION MODE = RELATIVE all three channels CH\_L, CH\_C and CH\_R (red, green and blue line) are normalized to their respective current maximum values (red, green and blue dashed line).
- EXTEACH: In all the evaluation modes teaching of a vector can be performed externally through IN0
- TRIGGER: Setting the trigger mode on the sensor



## Data Recorder

### Function of the data recorder:

The SI-JET-Scope software features a data recorder that makes it possible to save the data that are acquired and calculated by the sensor. The recorded file is saved to the hard disk of the PC and can then be evaluated with a spreadsheet program.

Recording depends on the EVALUATION MODE that is chosen. Several EVALUATION MODES do not need certain data, therefore these data will be set to 0, i.e. for these data the value 0 will be recorded.

RECORD MODE	AUTO LIMITED ▼		
RECORD-TIME INTERVAL [sec]	1.00		
RECORD VALUES (MAX 32767)	1000		
TOTAL RECORD TIME (days hours min sec)			
0	0	16	40.00
RECORDED		REMAINING	
0		1000	
START RECORD		STOP RECORD	
ID			
SELECT RECORD FILE		SHOW GRAPH	
d:\Mist\RecordFile.dat			



Fiber Optic Frontends

**Receiver fiber optics (3-fold):**

R3-M-A2.0-(2.5)-1200-67°-3X

R3-M-A2.0-(2.5)-2000-67°-3X

R3-M-A2.0-(2.5)-3000-67°-3X

R3-M-A2.0-(2.5)-5000-67°-3X

(please order separately)

- R3 = Reflected light operation, three-sectioned
- M = Metal sheath
- A2.0-(2.5) = Sensor head type A2.0 with fiber bundle Ø 2.5 mm
- 1200, 2000, 3000, 5000 = Total length in mm
- 67° = Beam opening angle
- 3X = fiber optic frontend 3-fold

**Transmitter fiber optics (3-fold):**

R3-M-A1.1-(1.5)-1200-67°-3X

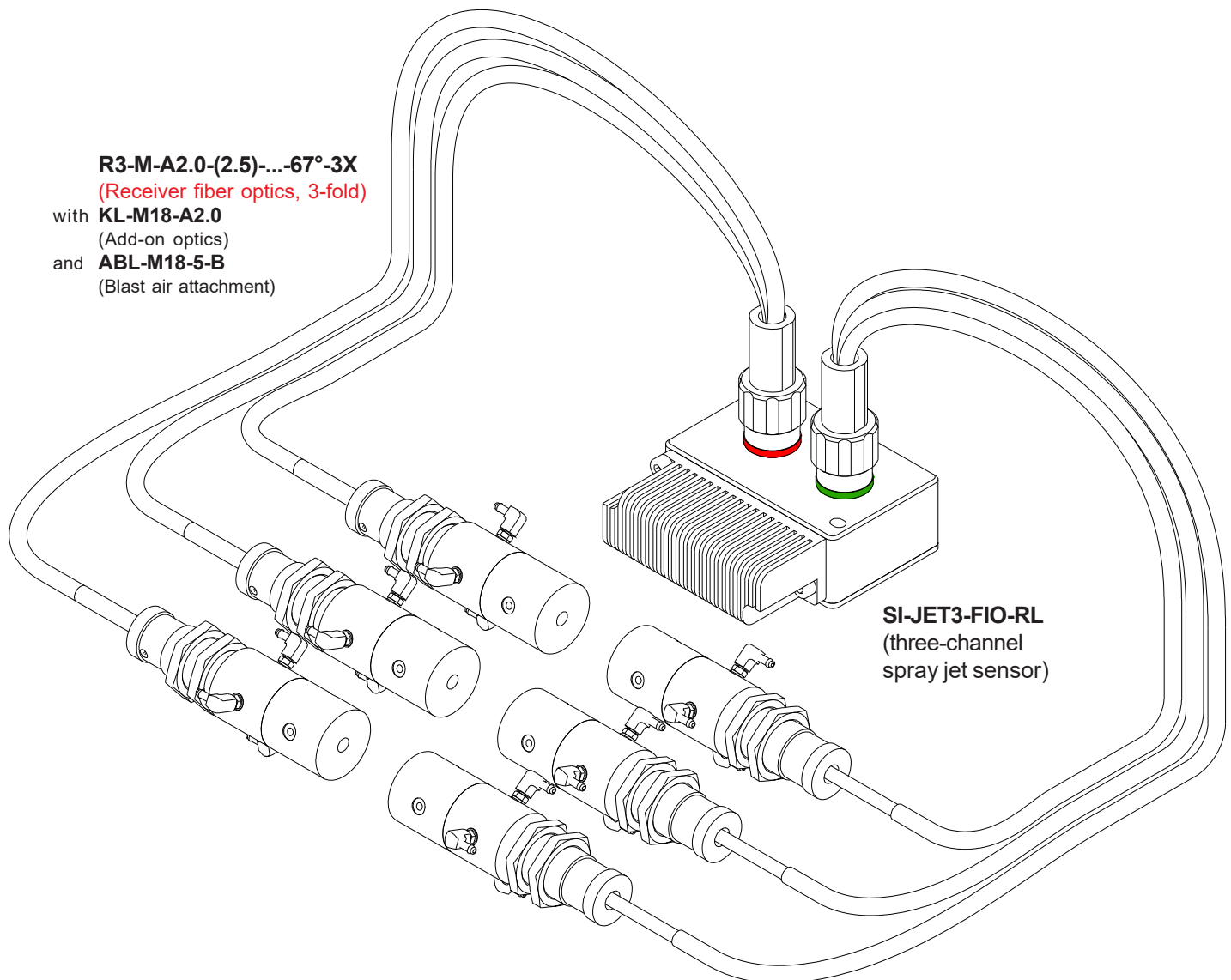
R3-M-A1.1-(1.5)-2000-67°-3X

R3-M-A1.1-(1.5)-3000-67°-3X

R3-M-A1.1-(1.5)-5000-67°-3X

(please order separately)

- R3 = Reflected light operation, three-sectioned
- M = Metal sheath
- A1.1-(1.5) = Sensor head type A1.1 with fiber bundle Ø 1.5 mm
- 1200, 2000, 3000, 5000 = Total length in mm
- 67° = Beam opening angle
- 3X = fiber optic frontend 3-fold

**R3-M-A2.0-(2.5)-...-67°-3X****(Receiver fiber optics, 3-fold)**with **KL-M18-A2.0**

(Add-on optics)

and **ABL-M18-5-B**

(Blast air attachment)

**SI-JET3-FIO-RL**  
 (three-channel  
 spray jet sensor)
**R3-M-A1.1-(1.5)-...-67°-3X****(Transmitter fiber optics, 3-fold)**with **KL-M18-A1.1**

(Add-on optics)

and **ABL-M18-5-B**

(Blast air attachment)

*Further fiber optic frontends are available on request:*

**Fiber optics suitable for drag chains**  
 type D-BOA-... (without illustration)





Add-on Optics

**Add-on optics KL-M18-A1.1 or KL-M34-A1.1**

(suitable for transmitter fiber optics R3-M-A1.1-(1.5)-...-67°-3X)

**Add-on optics KL-M18-A2.0 or KL-M18-XL-A2.0 or KL-M34-A2.0**

(suitable for receiver fiber optics R3-M-A2.0-(2.5)-...-67°-3X)

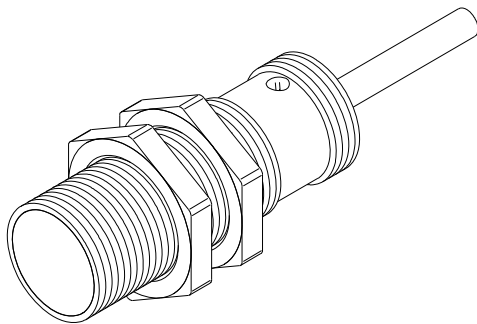
(please order separately, also cf. catalog FIO Series)

- Large working distance (typ. 60 mm)
- Working range typ. 20 mm ... 65 mm
- Minimal color change with distance change
- Focusable
- Scratch resistant optics made of glass
- Sturdy brass housing (nickel-plated)

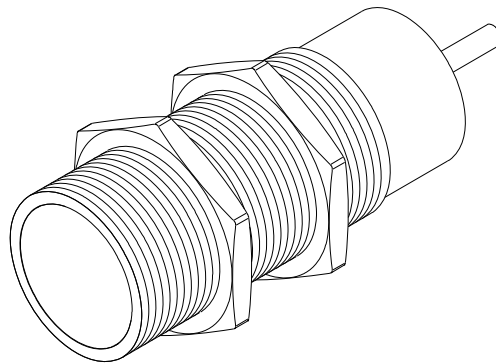
For one SI-JET3-FIO-RL system are required:

3 pcs. KL-...-A1.1 for transmitter fiber optics

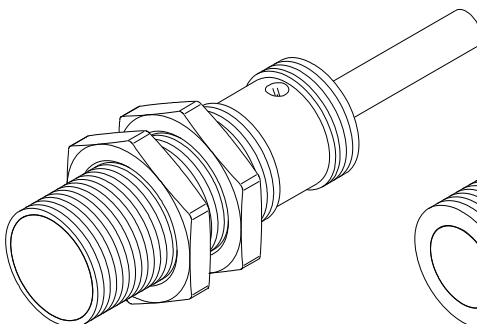
3 pcs. KL-...-A2.0 for receiver fiber optics



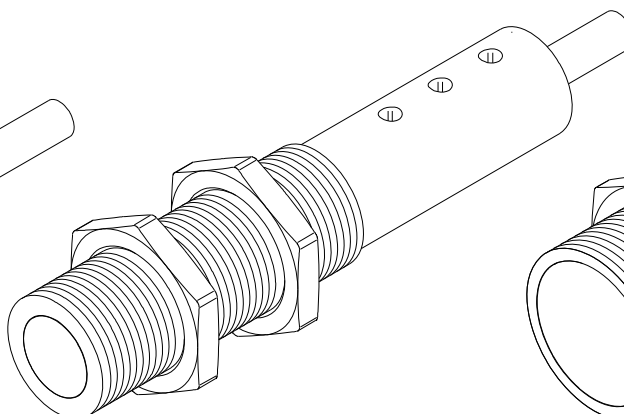
KL-M18-A1.1



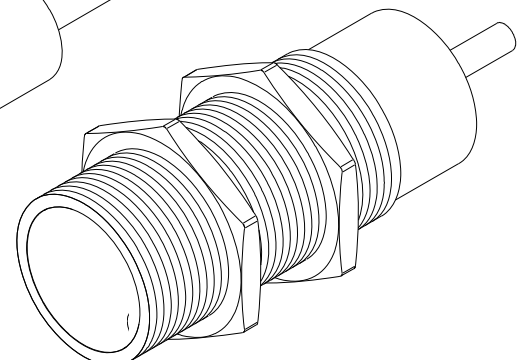
KL-M34-A1.1



KL-M18-A2.0



KL-M18-XL-A2.0



KL-M34-A2.0

*Weitere Aufsatzoptiken auf Anfrage erhältlich.*



## Air Blast Attachments

### Air blast attachment ABL-M18-5-B

(suitable for add-on optics KL-M18-A1.1, KL-M18-A2.0, or KL-M18-XL-A2.0)

(please order separately)

- Air outlet opening  $\varnothing$  5.0 mm

(Figure still to be completed)

For one SI-JET3-FIO-RL system 6 pcs. ABL-M18-5-B are required.

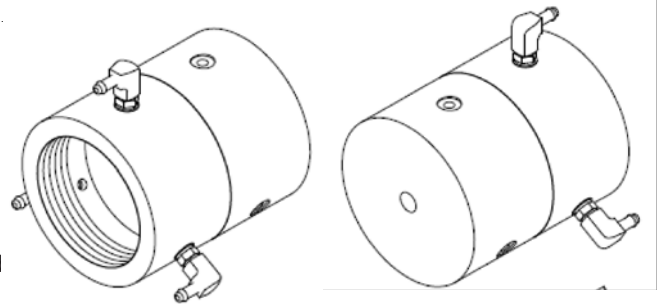
### Air blast attachment ABL-M34-5-B

(suitable for add-on optics KL-M34-A1.1 or KL-M34-A2.0)

(please order separately)

- Air outlet opening  $\varnothing$  5.0 mm

For one SI-JET3-FIO-RL system 6 pcs. 6 pcs. ABL-M34-5-B are required



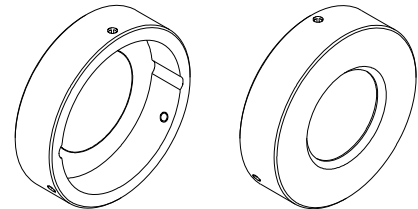
### Air blast attachment ABL-KL-M34-CAL-NG5

(suitable for add-on optics KL-M34-A1.1 or KL-M34-A2.0,  
verwendbar in Verbindung mit der Software mit MSA-Funktion)

(please order separately)

- Air outlet opening  $\varnothing$  5.0 mm

For one SI-JET3-FIO-RL system 6 pcs. ABL-KL-M34-NG5-B are required.



*Other air blast attachments available on request.*