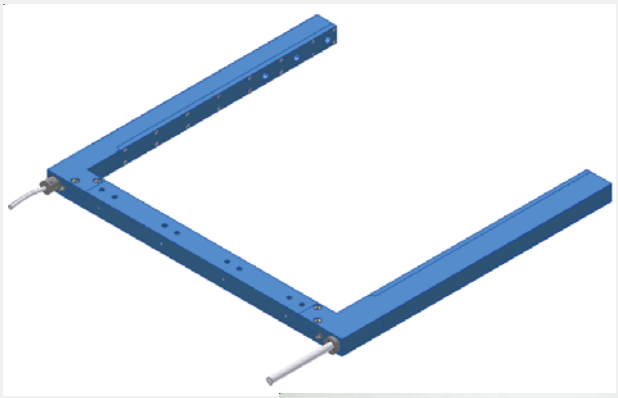
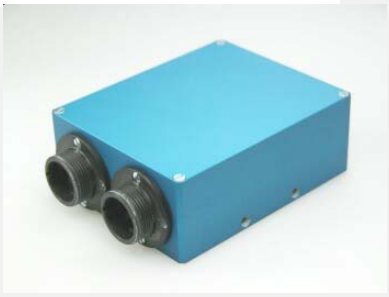
SI-JET Series



SI-JET2-FK-400/400
SI-JET2-CON5

By way of the three optical fibers that are integrated in the transmitter and receiver branch, the SI-JET2 Spray Jet Monitoring System monitors the density and the symmetry around the opening angle of the spray jet. With the comprehensive SI-JET2-Scope software the system can be parameterised under Windows®.

- Telecentric design enables a big fork width
- Insensitive to dirt accumulation due to pressed air facility (at transmitter and receiver side of the fork)
- Averaging (over 32000 values)
- RS232 interface and Windows® user interface
- Teachable by means of integrated button, PLC, or PC)
- Insensitive to outside light due to clocked red light LED (100 kHz)
- High dynamic range (due to light power adjustment of LED via RS232)
- High resolution (12-bit-A/D-converter)
- Fiber optic fork can be used in areas subject to explosion hazards (EX-RL, Zone 0)

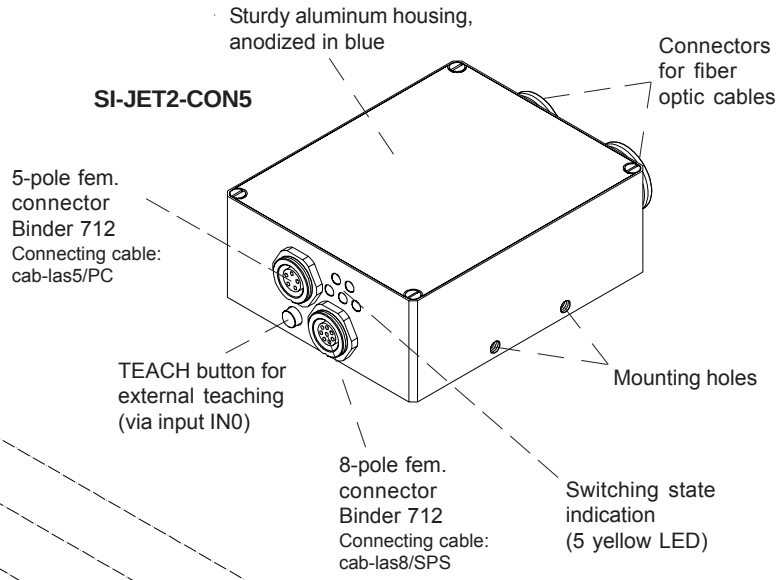


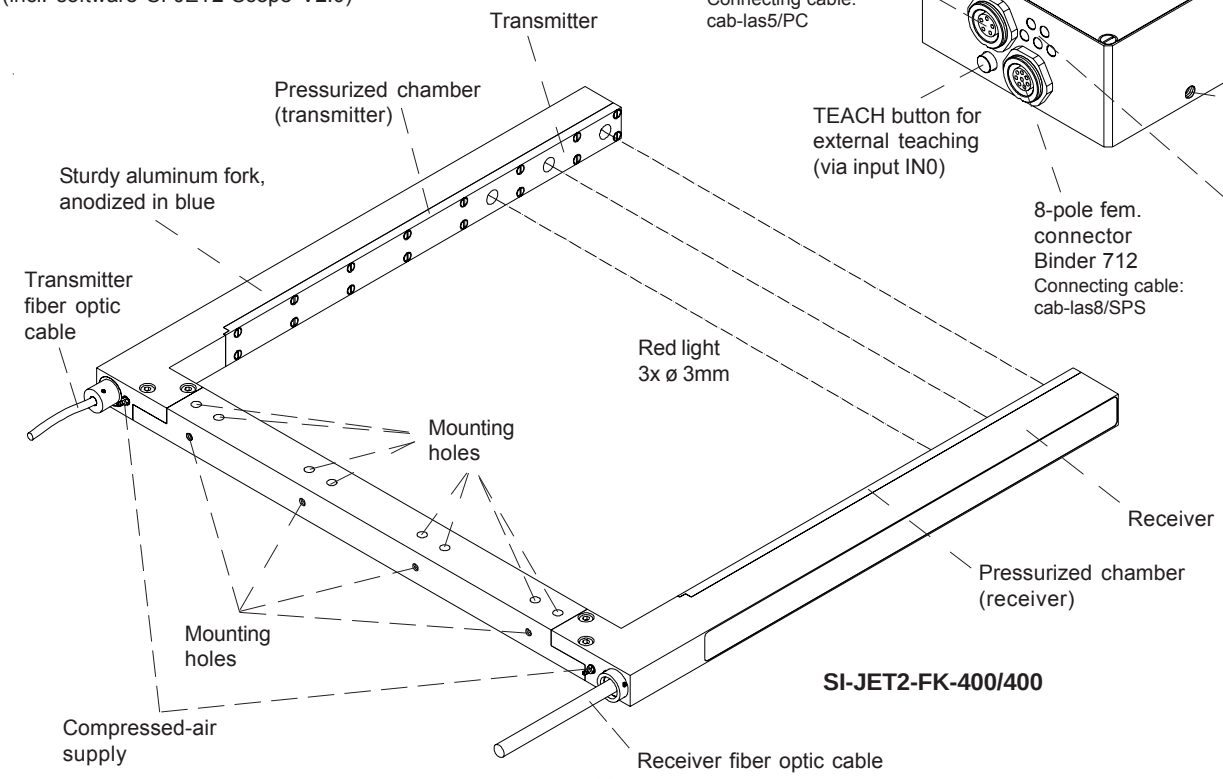
Design

Product name:

Sensor frontend
SI-JET2-FK-400/400

Electronic control unit
SI-JET2-CON5
(incl. software SI-JET2-Scope V2.0)





SI-JET2-FK-400/400

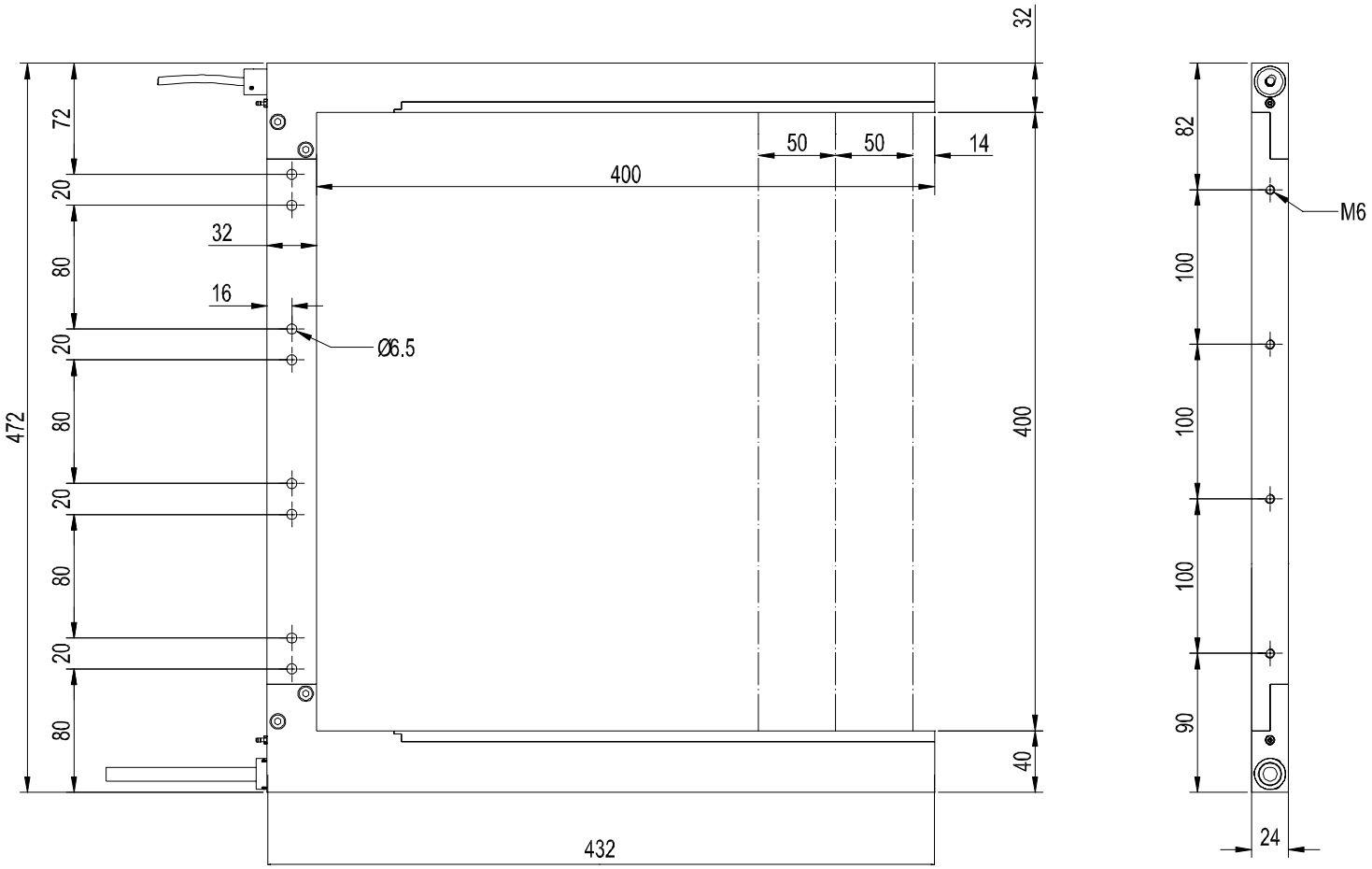
Technical Data

Model	SI-JET2-FK-400/400 (sensor frontend)
Fork width	400 mm
Red light beam alignment	telecentric, 3 x Ø 3 mm, distance between the beam bundles: 50 mm
Optical filter	Red light filter RG630
Beam divergency	typ. 10 mrad
Enclosure rating	IP 67
Operating temperature range	-10°C ... +50°C
Storage temperature range	-20°C ... +85°C
Housing material	Aluminum, anodized in blue
Housing dimensions	approx. 472 mm x 432 mm x 24 mm
Fiber optics transmitter	2 fiber optic connectors, silicone metal sheath, length approx. 5000 mm
Fiber optics receiver	3 fiber optic connectors, silicone metal sheath, length approx. 5000 mm
Pressed air connector	at transmitter side and at receiver side

Model	SI-JET2-CON5 (electronic control unit)
Voltage supply	+12VDC ... +30VDC, reversed-polarity protected, overload protected
Current consumption	typ. 200 mA
Operating temperature	-10°C ... 50°C
Enclosure rating	IP64
Housing material	Aluminum, anodized in blue Fiber optics connector: Aluminum, anodized in black
Housing dimensions	approx. 80 mm x 65 mm x 30 mm (without connectors)
Type of connector	Connection to PC: 5-pole female connector type Binder 712 Connection to PLC: 8-pole female connector type Binder 712
Transmitter	Super bright LED (red, 650 nm), modulated 100 kHz
Fiber optics connector	Transmitter: 1 x 2-pin, receiver: 1 x 3-pin
External teaching	by means of an integrated push-button
Switching state indication	by means of 5 yellow LEDs
Interface	RS232, parameterizable under Windows®
Averaging	adjustable under Windows: max. 32768 values
Outputs	OUT0 ... OUT4, digital (0V/+U_B), short-circuit-proof, 100 mA max. switching current; npn- or pnp-capable (bright- and dark-switching can be adjusted)
External teach input IN0	+U_B-Signal (min. pulse length 250 ms, max. pulse length 1000 ms)
Pulse lengthening	adjustable under Windows®: 0 ms .. 100 ms

Sensor Frontend

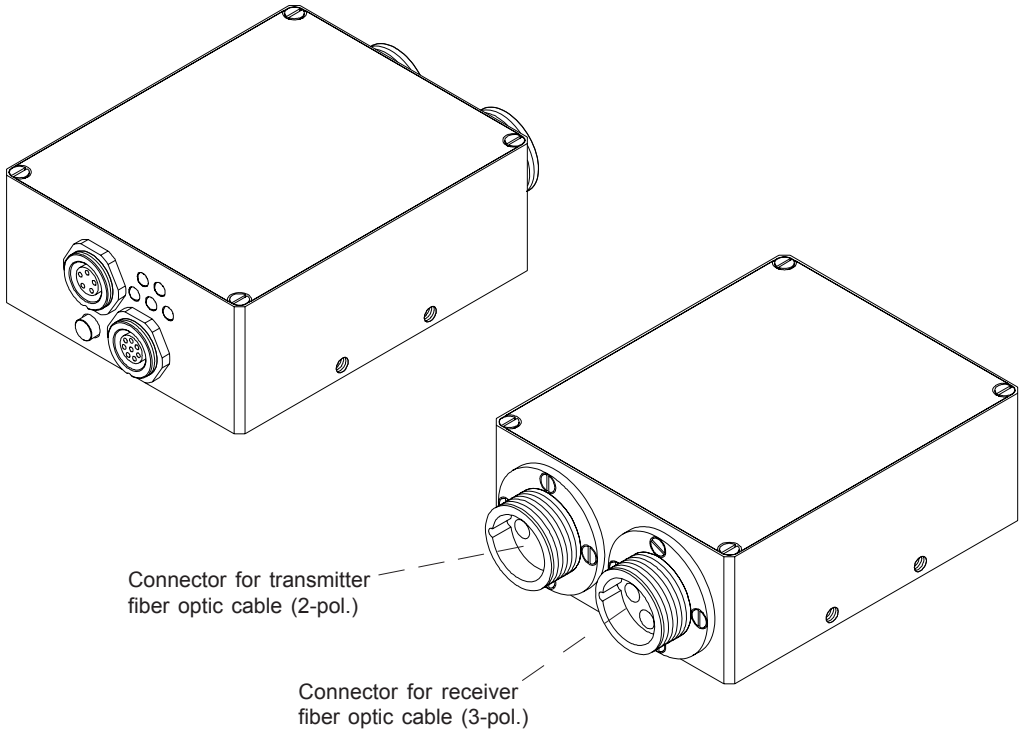
SI-JET2-FK-400/400

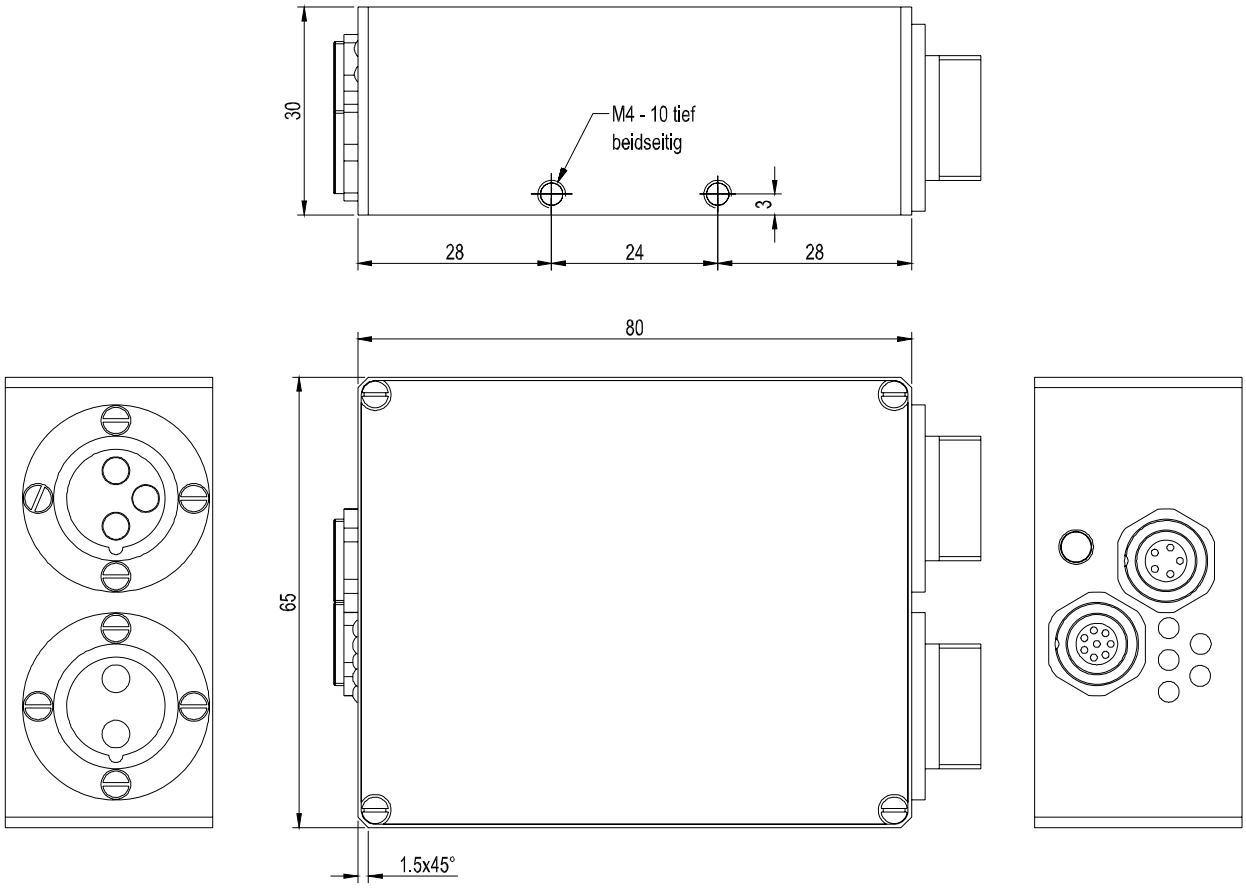


All dimensiosn in mm

Electronic Control Unit

SI-JET2-CON5





All dimensions in mm

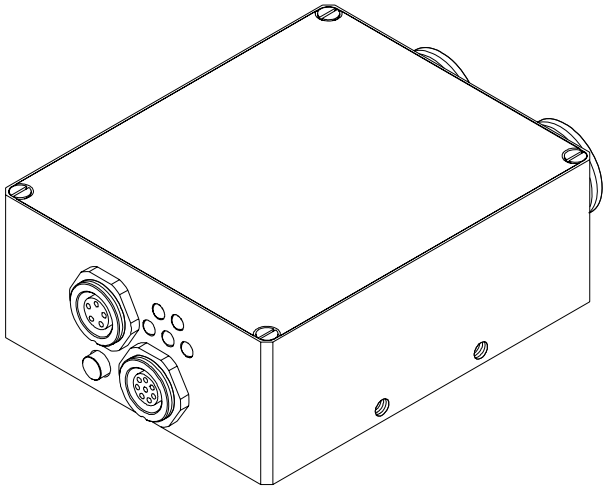
Connector Assignment

Connection SI-JET2-CON5 to PLC

8-pole female circular connector type Binder Series 712

Pin No.:	Assignment:
1	0V (GND)
2	+12 ... +30 VDC
3	IN0
4	OUT0
5	OUT1
6	OUT2
7	OUT3
8	OUT4

Connecting cable: cab-las8/SPS



Connection SI-JET2-CON5 to PC (RS232)

5-pole circular female connector typ Binder Series 712

Pin No:	Assignment:
1	0V (GND)
2	TxD
3	RxD
4	not connected
5	not connected

Connecting cable: cab-las5/PC

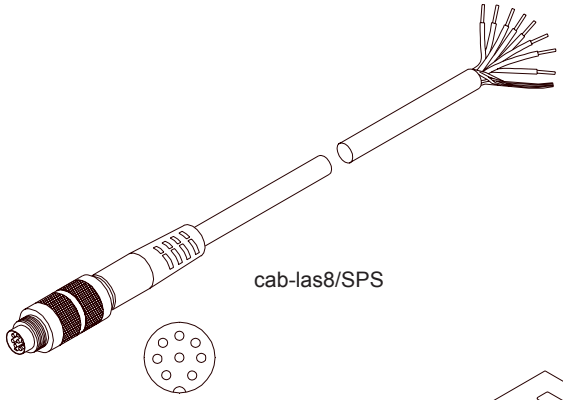
Connecting Cables

Connecting cable "cab-las8/SPS": SI-JET2-CON5 to PLC

8-pole circular connector typ Binder Series 702

Pin No.:	Color:	Assignment:
1	wht	0V (GND)
2	brn	+12 ... +30 VDC
3	grn	IN0
4	yel	OUT0
5	gry	OUT1
6	pnk	OUT2
7	blu	OUT3
8	red	OUT4

(Available cable lengths: 2m or 5m)

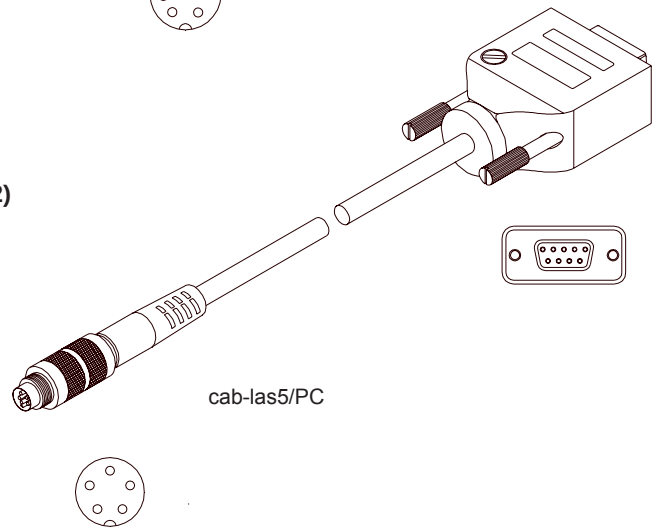


Connecting cable "cab-las5/PC": SI-JET2-CON5 to PC (RS232)

5-pole circular connector type Binder Series 702

Pin No.:	Assignment:
1	0V (GND)
2	TxD
3	RxD
4	not connected
5	not connected

(Available cable lengths: 2m or 5m)



Measuring Principle

With the help of a super-bright red-light LED modulated light is coupled in a transmitting optical-fiber and is aligned in parallel by means of a collimator optic unit that is integrated in the optical-fiber fork. A suitable aperture technology ensures that three beams of red light (Ø 3 mm each, 50 mm distance to each other) leave the transmitting branch of the transmitter, and at the receiving side are again directed onto three receiving optical-fibers by mean of 3 apertures with suitable receiving optics.

By means of the optoelectronic detectors that are integrated in the receiving optical-fiber holder, the three light signals are converted into three electronic signals and are digitised by way of 12-bit-A/D-converters. When a spray jet now crosses the path of the three red light beams, the respective light beams are attenuated due to light absorption and/or light deflection at the droplets contained in the spray jet. The degree of attenuation of the respective signal is a measure for the droplet contraction at the place of the light beam.

Parameterization

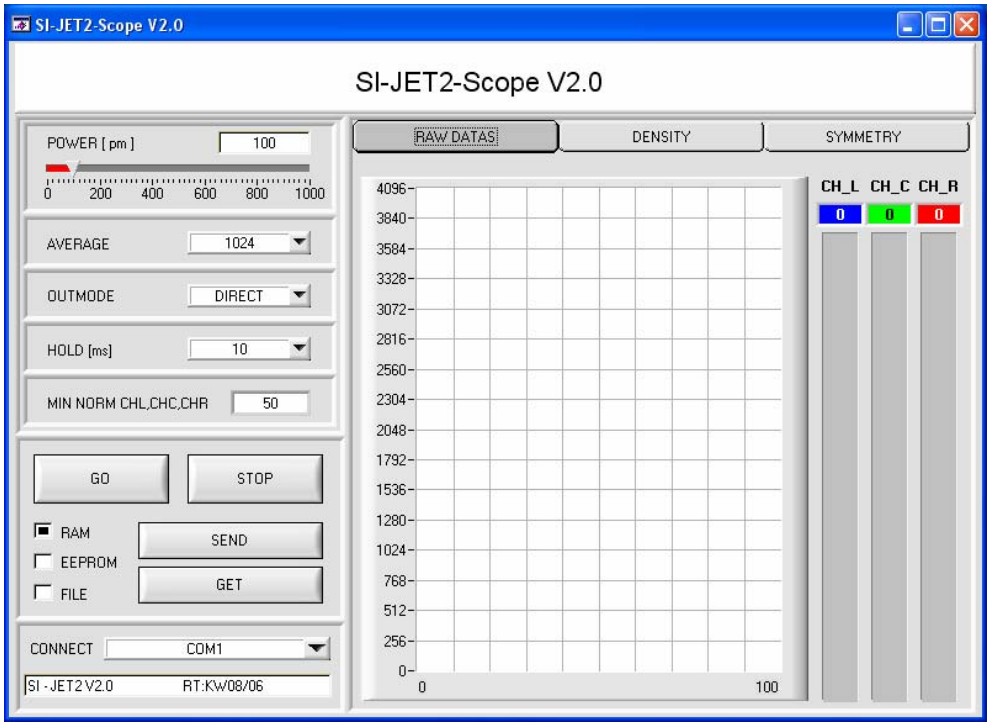
Parameterization under Windows® with software SI-JET2-Scope:

Parameterisation of the spray jet sensor is performed under Windows® with the SI-JET2-Scope V2.

The following three measurands are picked up and monitored in the production process by the SI-JET2 spray jet monitoring system:

- Spray jet density (hereinafter referred to as density)
- Symmetry 1 (the two outer channels are put into proportion to each other)
- Symmetry 2 (Symmetry 1 is put into proportion to the middle channel)

However, a teach process must be performed first. Teaching must be carried out every time the sensor was without power or the spray process is changed (different nozzle, etc).



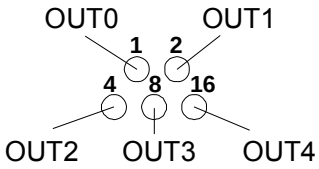
TEACH process:

The teach process is started by way of the teach input (IN0 PIN3 green at the cab-las8/SPC cable) or by means of the button at the housing.
Please note that the timing must be observed when performing a teach process. There are three different methods for performing a teach process. Each of these methods leads to the same result, and the selection of a method is based on experience values of the respective operator.

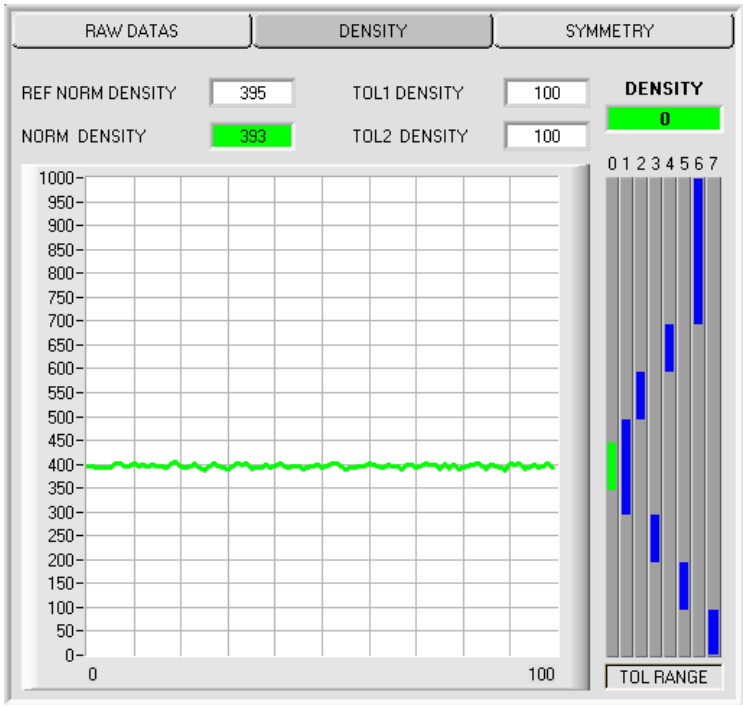
While the teach signal is applied (+24V!) the control unit determines the respective absolute maximum (spraying off) and absolute minimum (spraying on) values for the individual channels.

LED Display

LED display:

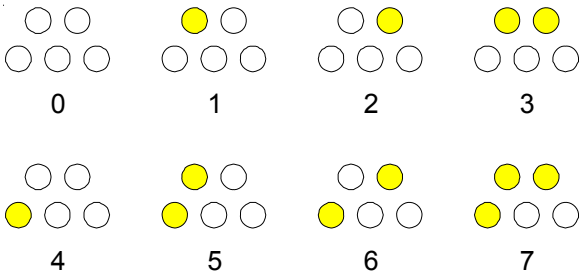


The **DENSITY** of the spray jet is determined with the middle red light channel. At the output the density value is provided in 8 tolerance steps through 3 digital outputs (OUT0, OUT1, OUT2). Furthermore, the respective tolerance range is visualised by 3 yellow LEDs. The tolerances can be set under Windows®.



Density (OUT0, OUT1, OUT2):

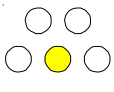
0 = innermost tolerance window
(REF NORM DENSITY ± (TOL1 DENSITY / 2)
1 = like 0, but twice as large
(REF NORM DENSITY ± TOL1 DENSITY
2 = upper limit of tolerance range 1 + TOL2 DENSITY
3 = lower limit of tolerance range 1 - TOL2 DENSITY
4 = upper limit of tolerance range 2 + TOL2 DENSITY
5 = lower limit of tolerance range 3 - TOL2 DENSITY
6 = upper limit of tolerance range 4 to 1000
7 = lower limit of tolerance range 1 to 0

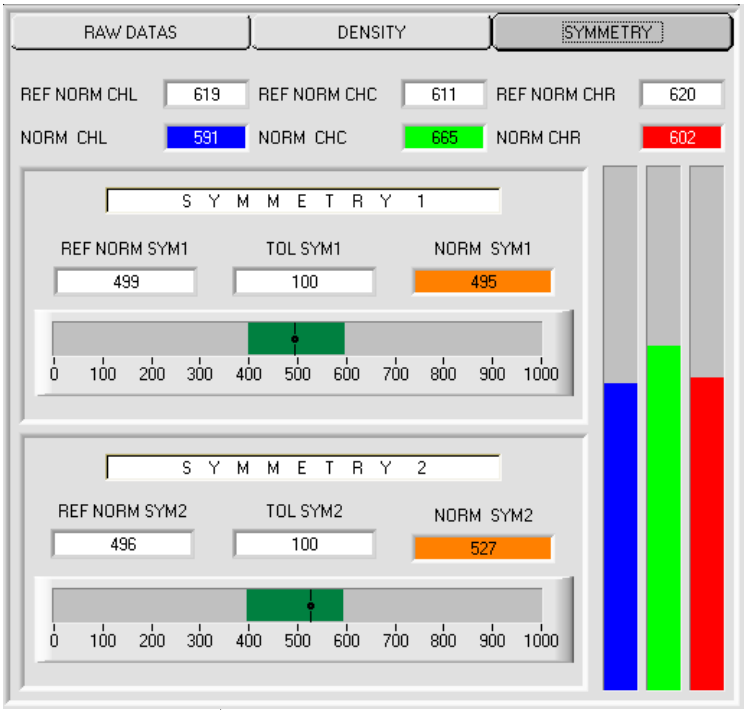


There are two methods for determining the **SYMMETRY**:

Symmetry 1 (OUT3):
The two outer channels are compared to determine whether this value is within or without a defined tolerance. The tolerance can be set under Windows®.

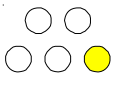
Switching output OUT3 informs whether this symmetry value is without or within the defined tolerance. A yellow LED (OUT3) is used for visualisation.





Symmetry 2 (OUT4):
The sum of the two outer channels is compared with the middle red light channel to determine whether this value is within or without the defined tolerance window.

The value is output through OUT4, and the switching state is indicated by a yellow LED (OUT4).

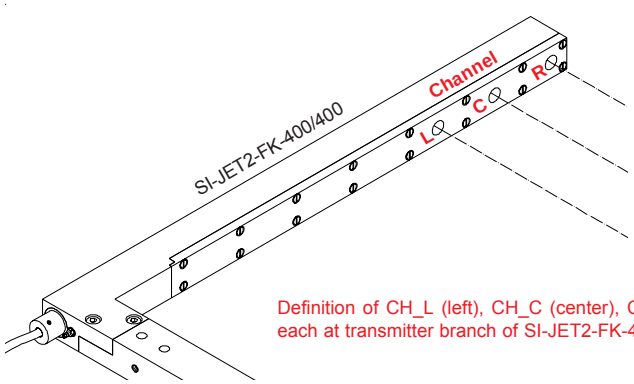


Parameterization

Only the middle one (channel center) of the three red light beams is used for measuring the spray jet density. The reference value (teach value) for the density was calculated in the teaching process.

The two outer red light beams (channel left and right) are used for measuring Symmetry 1. In the teaching process the standardised reference values for the individual channels were calculated first. The difference, i.e. the delta of "spraying off" and "spraying on" is used for this purpose. Delta is determined by calculating 1000 minus the standardised value.

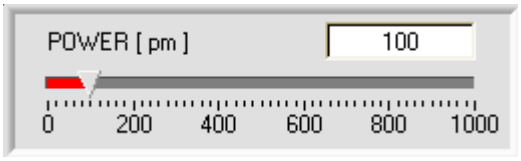
For measuring Symmetry 2, the two outer red light beams (channel left and right) are put into proportion to the middle red light beam (channel center).
In the teaching process the standardised reference values for the individual channels were calculated first. The teach value for symmetry 2 can then be determined from the calculated standardised values for the individual channels.



Definition of CH_L (left), CH_C (center), CH_R (right), each at transmitter branch of SI-JET2-FK-400/400

Parameter setting:

Among others the following parameters can be set:



POWER:
In this function field the intensity of the transmitter unit can be adjusted by using the slider or by entering a value in the edit box.
A value of 1000 means full intensity at the transmitter unit, a value of 0 stands for the lowest transmitter intensity adjustment.

AVERAGE:
This function field serves for setting the number of measured values over which the raw signal that is measured at the receiver is averaged. A higher AVERAGE setting reduces the noise of the raw signals of the receiver unit, and at the same time reduces the maximum achievable switching frequency of the SI-JET2 spray jet sensor.

OUTMODE:
Direct: The output control mode is High Active.
Inverse: The output control mode is Low Active.

HOLD:
The SI-JET2 spray jet sensor operates with minimum scan times in the range of less than 150µs. For this reason most of the SPCs that are connected at the digital outputs OUT0 to OUT4 have difficulties with the reliable detection of the resulting short changes of switching states.
By selecting the respective HOLD button, a pulse lengthening of up to 100 ms can be set at the digital outputs of the SI-JET2 sensor system.

MIN NORM CHL,CHC,CHR:
In this function field a minimum value for NORM CHL, NORM CHC and NORM CHR can be set. If the current values for NORM CHL, CHC and CHR all are smaller than this value, NORM CHL = 1, NORM CHC = 1 and NORM CHR = 0 will be set.
This parameter was introduced to provide a stable output signal when the spray process is switched off.