SEIKOM ELECTRONIC

Operating instructions **NLSW®45-3 SIL2 Analog**

24 V AC/DC, 230 V AC

Version 1

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1. SAFETY INSTRUCTIONS

Please read the product description carefully before using the device. Make sure that the product is fully suitable for your application.

Improper use can lead to malfunctions of the device or to undesirable effects on your application. For this reason, installation, electrical connection, commissioning, operation and maintenance of the device may only be carried out by trained personnel.

2. GENERAL INFORMATION

The NLSW®45-3 SIL2 Analog air flow monitor is a flow monitor consisting of two air flow sensors and an evaluation unit. The device works according to the calorimetric measuring principle. The device meets the SIL2 standards according to IEC 61508-5:2010. Both the circuitry in the evaluation unit and the sensor have a redundant design.

The NLSW®45-3 SIL2 Analog is a redundant air flow monitor that monitors gaseous flows in the range of approx. 0.1 ... 30 m/s. A 4 ... 20 mA, a 0 ... 10 V DC output and a relay with changeover contact are available per channel as output signals for the flow. The NLSW®45-3 SIL2 Analog has two channels, so that each output is available twice.

To increase operational safety, the sensor and the evaluation electronics are monitored for function and faults (e.g. sensor breakage) during operation.

2.1 Field of application and practical use

The electronic airflow monitors of the NLSW®45-3 SIL2 Analog series are used in safety-critical environments such as the chemical industry, power plants, clean room technology, pharmaceutical production and in environments containing hydrogen, where reliable measurement of the airflow is essential for the safe operation of processes.

Functionality

Flow monitors of the NLSW®45-3 SIL2 Analog series operate according to the calorimetric principle. The calorimetric measuring principle is based on a heated, temperature-sensitive resistor. Heat is extracted from the precision resistor by the flow in the medium. The temperature of the resistor changes and with it its resistance value. This change is evaluated by the device. However, since not only the flow velocity of the medium has an influence on the amount of heat dissipated, but also its temperature, a correlation between flow and temperature must be established. This is achieved by a second, temperature-dependent precision resistor in addition to the first. The second precision resistor (temperature compensation) is not heated and is only used to measure the temperature.

2.2 Outputs

The NLSW®45-3 SIL2 analog devices have one relay, one 4 ... 20 mA and one 0 ... 10 V output per air flow sensor. The relay with changeover contact switches off as soon as the air flow falls below the set flow velocity / threshold value (0.1 ... 30 m/s).

Depending on the set flow, the current output (I_{out}) supplies a value between 4 ... 20 mA. Both the relay outputs and the current outputs are available for further evaluation by a (safety) PLC.

The switching point is independent of the current output. For example, the 4 ... 20 mA output can be set to a measuring range of 0 ... 20 m/s and the relay switching point can be set at 25 m/s. Depending on the application, this independent functionality offers further application possibilities.

3. TECHNICAL DATA

Type	NLSW®45-3 SIL2 Analog 24 V AC/DC	NLSW®45-3 SIL2 Analog 230 V AC
Item number	1145SIL2	1147SIL2
Operating voltage	24 V AC/DC	230 V AC 50/60 Hz
Voltage tolerance	± 10%	± 10%
Overvoltage category	II	
Signal lamp Voltage	Green LEDs	
Power consumption	5 VA	11 VA
Ambient temperature Device	-20°C ... 60°C	
Signal output flow	2 x relay contacts (changeover contact) 2 x analog output 4 ... 20 mA 2 x analog output 0 ... 10 V	
Switching function with flow	Relay picks up	
Max. Switching voltage	250 V AC, 30 V DC	
Current and contact load capacity	250 V AC, 4A, 1 kVA / 150W	
Minimum switching load	100 mA / 5 V DC	
Mechanical service life	1 mio. switching operations (180 / minute)	
Electrical service life (at 5 A / 230 V AC)	50,000 switching operations	
Electrical service life (at 5 A / 30 V DC)	100,000 switching operations	
Flow signal lamp	Yellow LEDs	
Start-up bypass	5 s ... 60 s	
Start-up bypass signal lamp	Yellow LEDs	
Media temperature range	0°C ... 85°C	
Temperature gradient	30 K/min	
Switching point adjustment	Adjustable via potentiometer between 0.2 ... 30 m/s	
Measuring range	0.1 ... 30.0 m/s	
Associated sensor	F3.x SIL2	
Immersion depth sensor	50 mm (F3 SIL2), 130 mm (F3.1 SIL2), 165 mm (F3.2 SIL2), 300 mm (F3.3 SIL2), 400 mm (F3.4 SIL2), 500 mm (F3.5 SIL2)	
Process connection	PG7 thread	
Sensor material	MS58, nickel-plated, optionally available in stainless steel	
Compressive strength	10 bar	
Electrical connection	14 Terminal connector, ≤ 2.5 mm^2	
Enclosure protection class	IP65	
Protection class Sensor	IP67	
Pollution class	2	
Housing dimensions (L x W x H)	165.5 mm x 85.5 mm x 55 mm	
SIL certification	SIL2 classification IEC 61508 SIL 2: 03.2023, type A	
Further certifications	CE, UKCA	

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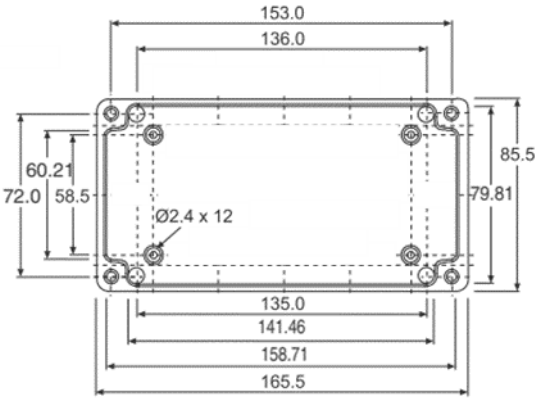
3.1 Device dimensions



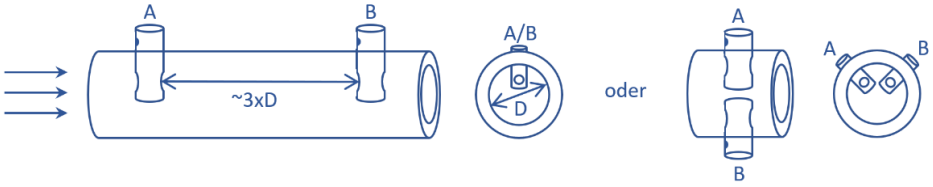
4. INSTALLATION AND COMMISSIONING

Installation and commissioning must be carried out by authorized and qualified personnel.

4.1 Installation conditions of the airflow sensors

The following installation conditions must be observed for the F3.x SIL2 sensor:

- The sensor tip should be located in the center of the pipe if possible and must be fully surrounded by the medium (air/gas).
- Align the mark on the sensors in the direction of the flow.
- The sensors must be mounted in the same pipe in such a way that they do not influence each other (approx. 3 x D (pipe inside diameter) distance in a row or at the same height in the duct) - see the following drawing:

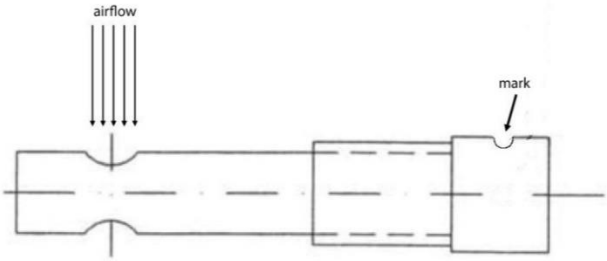


- For vertical ducts, the flow direction should ideally be from bottom to top.
- Maintain a free inlet section 5 x D upstream of the sensor and an outlet section 3 x D downstream of the sensor.
- Only screw in the sensors via the hexagon of the sensor.
- The sensors are independent of the installation position.
- The sensors must be connected to the airflow monitor in accordance with the connection diagram. Mixing up the connections will lead to malfunctions and possible damage.

- Each sensor is calibrated for its channel and should be connected to this channel.
- If the sensor cable is laid in a duct together with other live cables (e.g. motors or solenoid valves), we recommend shielding the sensor cable (connect a shield). Sensors with shielded cables are available as accessories from SEIKOM.
- To avoid malfunctions, the sensor cable must be extended with a cross-section of at least 1.5 mm^2. The maximum cable length should not exceed 50 m.
- Maintenance instructions: Regular cleaning is necessary depending on the application. Maintenance intervals must be determined and specified as required.

4.2 Installation

It is mounted using the PG7 thread on the sensor housing. Mounting is also possible using the enclosed PG7 nuts. The marking serves as an alignment aid to align the cross hole with the sensors in the air flow. When commissioning with media temperatures below 0°C and strong air currents, the start-up time of the device may be extended to 60 s until it is ready for operation.



4.3 Electrical connection

The mains connection (L1, N) must be established via a fused isolating switch with the usual fuses. The general VDE regulations must always be observed during electrical installation (VDE0100, VDE0113, VDE0160).

If a safety extra-low voltage is applied to the potential-free contact, ensure that the connecting cables are sufficiently insulated up to the terminal point, as otherwise the double insulation to the mains voltage side will be impaired. The current carrying capacity of the potential-free contact is limited to 4 A.

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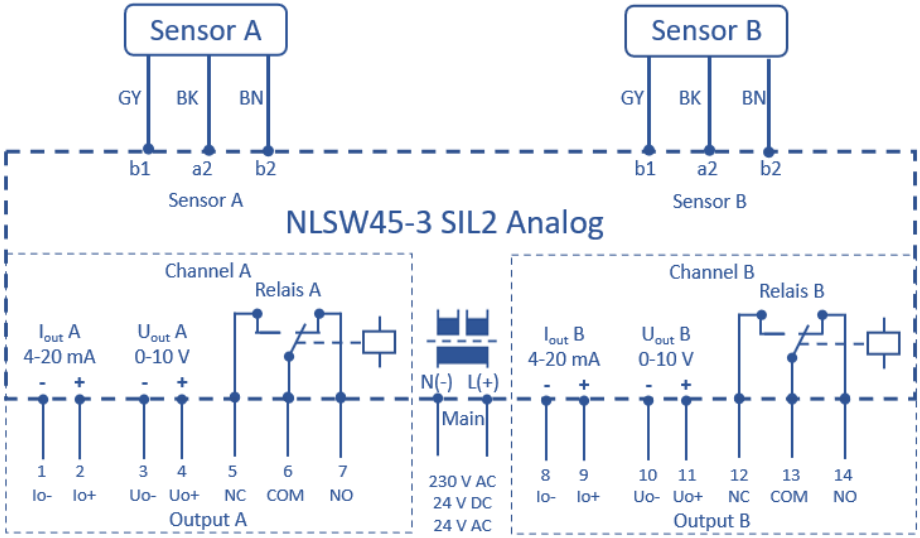
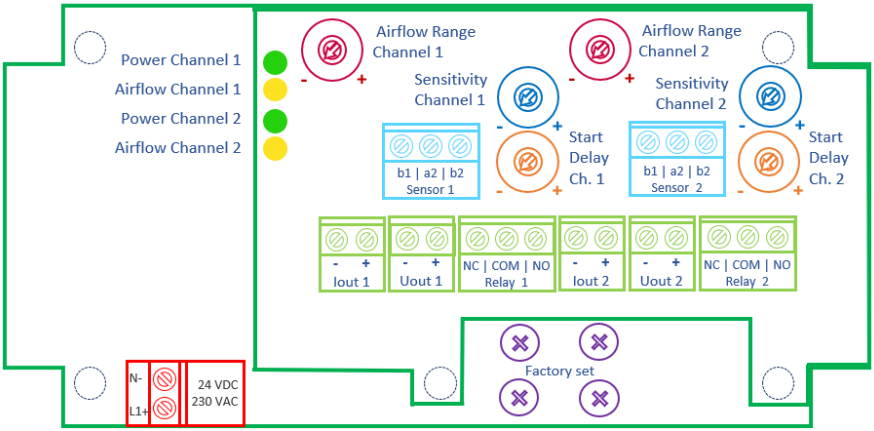


Color code: GY=grey | BK=black | BN=brown

4.4 Commissioning the device

The following sequence must be observed when commissioning and adjusting the devices:

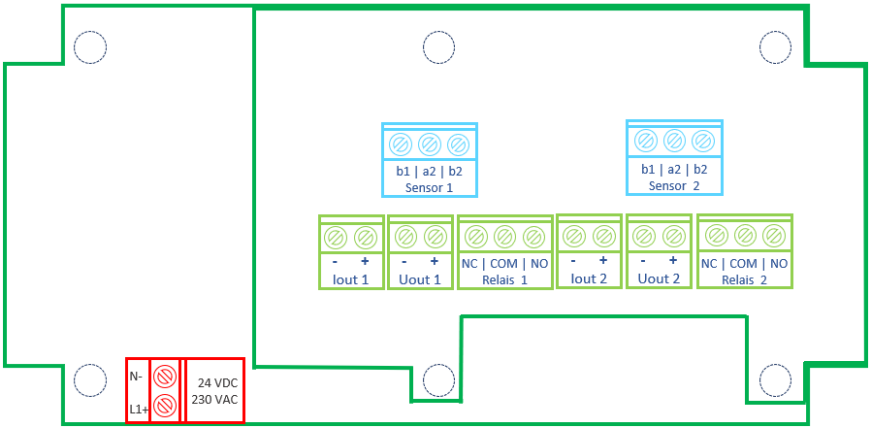
1. Mounting the sensors in the air duct
2. Connecting the sensors to the NLSW®45-3 SIL2 Analog *(see section 4.4.1)*
3. Connecting the electrical connections to the outputs of the NLSW®45-3 SIL2 Analog
4. Checking the electrical connections
5. Connecting the mains voltage
6. Checking the device function in idle state
7. Switching on the air flow
8. Adjusting the settings on the NLSW®45-3 SIL2 Analog *(see section 4.4.2) and* checking the measured values



The four potentiometers (purple) fixed with protective lacquer are set at the factory and must not be adjusted.

The steps for commissioning and setting the device are described below.

4.4.1. Connecting the sensors to the NLSW®45-3 SIL2 Analog



a) Connect two suitable sensors (F3.x SIL2) to the device using the supplied terminals; sensor A to channel 1 [sensor1], sensor B to channel 2 [sensor2] (light blue).

b) Connect the PLC/controller to relay outputs 1 and 2 via the supplied terminals and, if required, to the analog outputs [Iout] 4 ... 20 mA or [Uout] with 0 ... 10 V (green).
Please note the contact assignment NC ('normally closed') and NO ('normally open') in the circuit with the PLC.

Iout must not be connected to negative supply voltage or earth.

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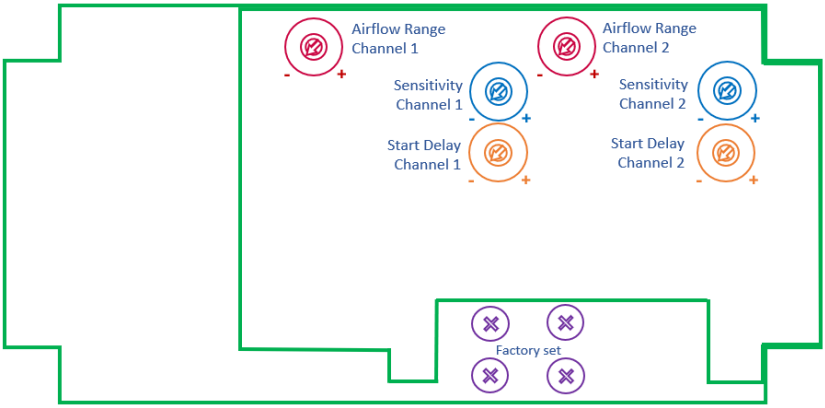
4.4.2. Adjusting the settings on the NLSW®45-3 SIL2 Analog



a) Set the "Sensitivity" potentiometer [Sense] (dark blue) for both channels to the left stop (insensitive).
b) Set the "Start-up delay" potentiometer [Delay] (orange) for both channels to the desired start-up delay time of approx. 5 ... 60 seconds (left stop approx. 5 seconds/right stop approx. 60 seconds) for both sensors.
c) Apply mains voltage (red). The green LEDs light up. The device is ready for operation within 2 seconds ready for operation.
d) The yellow LEDs light up (briefly) and go out again as soon as the set start-up bridging time has elapsed. The relays are energized during this time.
e) Switch on the airflow generator.
f) Before setting the switching points, the appliance should run for at least 2 minutes under operating conditions (with flow).

Switching point adjustment

a) The switching point setting requires a sensitive adjustment on the potentiometer and is independent of the current/voltage output.
b) Slowly turn the "Sensitivity" potentiometer [Sense] channel 1 (dark blue) to the right until the yellow LED lights up and the output relay is energized. To achieve stable switching conditions, you should turn slightly beyond the switching point. Set the same switching ratio for channel 2.
Note: Depending on the installation position and air flow situation in the duct, small switching differences between duct 1 and duct 2 are normal.

Setting the current or voltage output

a) Connect current meter or PLC to Iout (or voltage meter to Uout) and measure current value or voltage value.
b) Ex works, the analog signal covers the measuring range 0.1 ... 20 m/s - corresponds to 0 ... 10 V or 4 ... 20 mA. The measuring range or measured value for Iout / Uout can be set for each channel using the "Air flow" [Flow] potentiometer.

Please check the installation position beforehand and only change it if the current values of the two channels differ and need to be adjusted or if the measuring range needs to be increased or reduced.

c) Check the flow setting with the PLC by changing or switching off the air flow.
Please note that the analog outputs Iout and Uout are not linear.
If you adjust the measuring range of the device, please remember to adjust the current and voltage values stored in the PLC.
d) If the start-up bypass is preset, do not adjust the sensitivity until the start-up bypass has expired and the yellow LED has gone out.
e) To check the flow monitoring, reduce or switch off the flow generation. The yellow LEDs go out and the output relays de-energize.
f) For continuous operation, readjust the settings after 0.5 hours of operation if necessary.

The device is now set to the monitoring function.

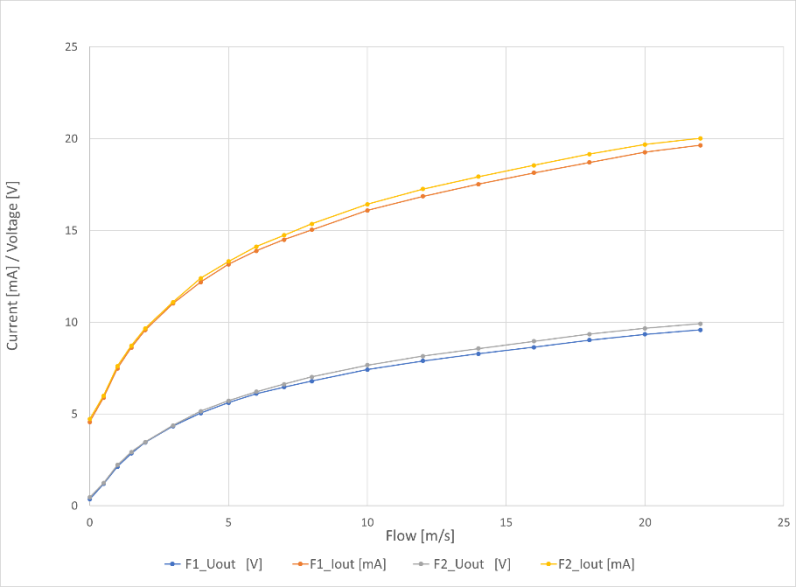
Preset values of the NLSW®45-3 SIL2 Analog:

- The switching hysteresis is fixed.
- The switching delay is 0.2 s as standard.
- The start-up delay is adjustable from 5 s to 60 s as standard.

4.5 Typical output values

The NLSW®45-3 SIL2 Analog is factory set so that 0 ... 20 m/s corresponds to approximately 4 ... 20 mA and 0 ... 10 V. The following curves show typical output values of the NLSW®45-3 SIL2 Analog airflow monitor, possibly with small differences between the channels.

If the NLSW®45-3 SIL2 Analog is set to a different measuring range, the curve scales accordingly. For example, Iout at a maximum set air flow of 5 m/s or 25 m/s is approx. 20 mA in each case.



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The media temperature only has a small influence on the current or voltage output and switching point. Please take this influence into account when commissioning and setting the measuring device by setting the devices in normal operating mode.

4.6 Switching point adjustment

When setting the switching point, it should be noted which change is to be monitored, as different settings have their own advantages and disadvantages. The relationship between air velocity and resistance change is not linear. In the lower range (small flows), the change in resistance is very large. In the upper range, the change in resistance becomes smaller and smaller for the same flow changes. The following requirements/guidelines should therefore be observed:

Small flow change in the high flow velocity range: The switching point must be selected very close to the measured value of the normal flow, as the measured value change is very small when the flow changes. As the temperature compensation has a certain delay compared to the actual temperature change, such a switching point setting is only possible for applications with slow temperature changes.

Small flow change in the low flow velocity range: The switching point can be selected with a greater distance to the measured value of the normal flow, as the measured value change is large when the flow changes. A change in temperature has no effect on the switching behavior.

Large flow change: A 'yes/no statement' is usually required here (e.g. fan running or fan stopped). Therefore, such a large safety distance can be selected that neither temperature changes nor turbulence have an influence on the switching behavior.

The switching points are set on the evaluation unit of the airflow monitor.

5. SERVICING AND MAINTENANCE

5.1 Maintenance specification Manufacturer

Definition of terms according to IEC 60079-17

Maintenance and repair: A combination of all activities carried out to maintain or restore an item to a condition that meets the requirements of the relevant specification and ensures the performance of the required functions.

Inspection: An activity involving the careful examination of an object with the aim of making a reliable statement about the condition of this object, whereby it is carried out without disassembly or, if necessary, with partial disassembly, supplemented by measures such as measurements.

Type of examination	Definition of	Recommended interval
Visual inspection	A visual inspection is an inspection in which visible faults are detected without the use of access equipment or tools, for example damage to the sensor or dust deposits.	Monthly
Close-up inspection	A test in which, in addition to the aspects of the visual inspection, faults are detected that can only be detected by using access equipment, e.g. steps (if necessary) and tools. For close-up tests, an enclosure does not usually need to be opened or the equipment de-energized.	Every 6 months
Detailed check	A test in which, in addition to the aspects of the close-up test, defects such as loose connections, which can only be detected by opening housings and/or, if necessary, using tools and test equipment, are detected.	Every 12 months
Testing the overall system	In the area of responsibility of the operator	

The air flow sensor should be serviced at regular intervals, i.e. when used in heavily polluted areas. contaminated media, the air flow sensor is cleaned. The following procedure is expedient:

- Dismantling the air flow sensor
- Carefully soak the sensor in lukewarm soapy water for approx. 10 minutes (depending on the degree of soiling) and then rinse carefully with lukewarm water
- Refit the sensor as originally (note the installation position)
- Commission the airflow monitor and carry out a new adjustment with the evaluation electronics if necessary

Never use hard or sharp objects (e.g. screwdrivers, wire brushes, etc.) for cleaning.

After cleaning, please check the current setting and switch setting and readjust if necessary.

6. TROUBLESHOOTING

The following instructions are intended to help you if your airflow monitor is not working properly. If you have any further questions, the SEIKOM Electronic team will be happy to help you at any time by phone or e-mail.

Problem	Possible cause	Troubleshooting
Device does not work at all	No or incorrect mains voltage connected	Check mains voltage and connection
Device does not detect any flow (on one or both channels)	Sensor(s) is/are not installed correctly or the sensitivity on the evaluation unit is not set correctly	Check installation conditions and sensitivity settings
	Flow rate is outside the measuring range	Reduce the sensitivity on the affected channel using the [Sense] potentiometer. Adjust the diameter of the pipe to increase or decrease the flow rate.
The yellow LED and the relay switch on and off at short intervals	Sensitivity set too close to the switching point or Air flow fluctuates near switching point.	Increase the sensitivity on the affected channel using the [Sense] potentiometer to make the switching point slightly more sensitive.
	Mains voltage is too low (< 21 V)	Ensure stable and sufficient mains voltage. Do not connect sources of interference (e.g. large loads) to the same supply voltage.
NLSW®45-3 SIL2 Analog works, but both channels switch (very) differently.	Sensor of a channel not set correctly or defective. The sensors may be mixed up and therefore not connected to the corresponding calibrated channel.	Check the installation and connection of the sensors and, if necessary, replace and readjust the sensors. Check the flow setting [Flow] and adjust slightly if necessary.

NLSW®45-3 SIL2 Analog has modified response behavior	Sensor is heavily soiled by the medium (deposits on the sensor)	Carefully clean the sensor with water. Never use hard objects for cleaning.
NLSW®45-3 SIL2 Analog switches in the event of a rapid increase or decrease in media temperature	Temperature gradient is outside the specification	Check the temperature gradient of the system (max. 30 K/min). In the event of a fault, set the switching point with hot flowing medium.
Current output drops to 0 mA (the relay has also dropped out and the yellow LED has gone out).	Sensor or cable breakage of the heated sensor, or the appliance is switched off.	Check the sensor connections and wiring. Check the sensor for breakage or damage.
Significant voltage and current drop during operation (with air flow present).	Sensor or cable breakage of the unheated sensor	Check the sensor connections and wiring. Check the sensor for breakage or damage.
Current setting does not exactly match the set value.	System has only been in operation for a short time.	If necessary, readjust the appliance after 30 minutes of continuous operation.
	One of the sensors is dirty or blocked.	Check sensor and air system/duct.
Current output does not output exactly 4 mA when the air flow is switched off.	Not a mistake.	Depending on the flow setting, the current output supplies slightly more than 4 mA.
Voltage output does not output exactly 0 V when the air flow is switched off.	Not a mistake.	Depending on the flow setting, the voltage output supplies slightly more than 0 V.
Current output outputs more than 20 mA.	Maximum occurring flow is above the set end value	Set the current output according to the instructions.

7. DISPOSAL

The packaging and used parts must be disposed of in accordance with the regulations of the country in which the product is installed.

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8. EU DECLARATION OF CONFORMITY

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EU-Konformitätserklärung

Die EU-Konformitätserklärung gilt für folgendes Gerät:

NLSW45-3 SIL2 Analog

Die alleinige Verantwortung für die Ausstellung dieser Konformitätserklärung trägt der Hersteller. Wir bestätigen die Übereinstimmung mit den grundlegenden Anforderungen der europäischen Richtlinien:

2014/30/EU (EMV-Richtlinie)
2014/35/EU (Niederspannungsrichtlinie)
2011/65/EU (Beschränkung gefährlicher Stoffe)
2015/863/EU (Ergänzung RoHS 3)

Die folgenden Standards wurden angewendet:

DIN EN IEC 63000: 2019-05
DIN EN IEC 61000-6-2: 2019-11
DIN EN 61000-6-3: 2021-03

Wülfrath, den 22. Dezember 2023

Philipp Hein
Geschäftsführer

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