

## Analogue Converter for Broadband-Lambda Probe LSU4.9

### General:

The great advantage of the Bosch broadband Lambda probe LSU4.9 as compared to a conventional skip probe (e.g. LSM11) is that it can provide a clear, continuous signal not only at the stoichiometric point at  $\lambda=1$ , but also in a wide lambda range ( $0.7 < \lambda < \text{air}$ ) in connection with control electronics. The trigger behaviour is also up to 10 x faster than in previous skip probes.

### Function:

The analogue converter LSU49-AC comprises both internal control electronics for the oxygen pump and Nernst concentration cell for generation of the lambda sensor signal, and the control electronics for highly precise temperature control of the probe. A subsequent amplifier stage prepares the sensor signal, linearises it and outputs it as an industrial standard signal (e.g. 4-20mA).

A digital input signal can be used to actively switch the probe heating and thus start clearance for lambda measurement. After clearance, the heating voltage is started up slowly at first (soft-start function). During soft-starting, "interference lambda probe" is signalled, because the lambda signal cannot be assessed during this time.

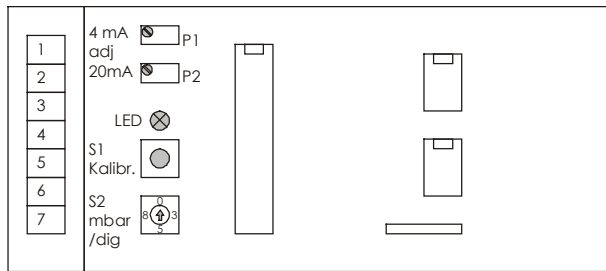
In practice, the start clearance should be activated with a delay after the motor start, since this ensures that the probe and thus the heating ceramics are free of condensate.

A lambda probe interference (e.g. wire breakage) is signalled through the digital output signal "lambda probe interference" and the analogue output signal ( $I_{\text{out}} > 21 \text{ mA}$ ), and can be confirmed via the digital input "Heating ON" by application of a 0-signal (low-level).

### Technical Data:

Type:	LSU49-AC-21 Analogue-Converter for Bosch Broadband Lambda Probe LSU4.9
Power supply:	18-36 VDC DC-isolated
Power-consumption:	max. 30VA
Input: (Sensor)	1 x LSU4.9 Lambda Probe via special 6-pole connector Type: LSU4.9 / Bosch-No.: 0258017025 Measuring range: $\lambda = 1,00 - 3,00$ Option: $\text{O}_2 = 0,5 - 21\%$ (Other probes and measuring ranges upon request)
Input: (digital)	1 x Heating ON DC-connected to power supply $U_{\text{on}}$ : 12-36 VDC / max. 17 mA $U_{\text{off}}$ : 0-5 VDC $R_e$ : 2 K $\Omega$
Output: (analogue)	4-20mA impressed current DC-isolated from power supply Option: 2-10 V max. Burden: 400 $\Omega$ error limit: $\pm 0,5 \%$
Output: (digital)	1 x Lambda probe interference DC-connected to power supply $U_a$ : $U_H - 3V$ short-circuit proof / 80 mA closed-circuit principle
Ambient temperature:	0 - 60°C
El. connection:	Spring clamp termination max. 1,5 mm <sup>2</sup> cable duct via PG 11
Protection type:	IP 67
Housing:	Aluminium case (H x W x D) 150 x 65 x 40 mm <sup>3</sup> Fixing via 4 x M4
Inst. position:	any position admissible

# Settings:

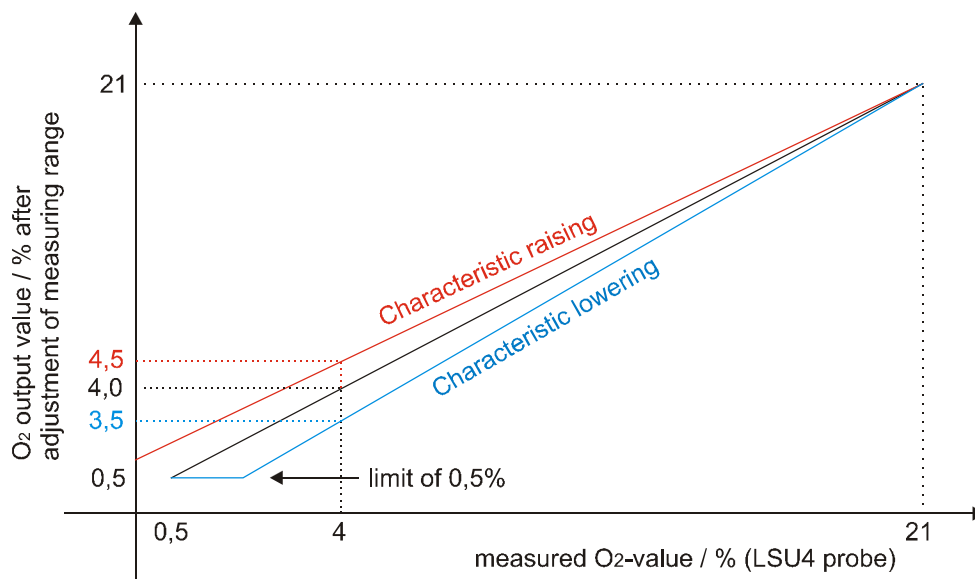


## 1) Adjustment of measuring range

The potentiometer P1 (4mA adj.) is factory pre-set to the range specified in the order and may not be changed.

The potentiometer P2 (20mA adj.) is used for precise adjustment of the measured value in the measuring range. The following must be carried out as follows:

- 1) Start up plant-specific working point and connect to a flue gas analyzer to the measuring site of the lambda probe for balance.
- 2) The analogue-converter must be connected to the display panel "AP-LSU49-AC" and the plain text output can be activated by pressing the "Start/Reset" button. (acc. to manual AP-LSU49-AC). The analogue-converter has to be in active measuring mode, this means digital input "heating on" must have a high level.
- 3) Press button S1 (calibration). The red LED glows and analogue-converter is in adjustment mode.
- 4) By means of potentiometer P2 (20mA adj.) measuring value (display on AP-LSU49-AC) can be adjusted to the displayed value of the flue gas analyzer. The shown value rises by turning right, and falls by turning left. The maximum adjustment stroke for balancing is depending on working point, it is the highest in case of measuring point lower than 5% O<sub>2</sub>.
- 5) Adjustment can be stored in the EPROM by pressing button S1 (calibration). The red LED goes out. Only by starting "Calibration at probe exchange" this value can be resetted.
- 6) Now analogue-converter processes adjustment data with characteristic line of connected LSU4.9 Lambda probe. Adjustment of measuring range can be repeated any number of times.



## 2) Exhaust pressure

For the broad-band probe LSU4.9, the output signal depends on the relative exhaust pressure. An exhaust pressure of, e.g., 100 mbar, will lead to a measuring error of approx. 2.5%.

Switch S2 can reduce this error drift to a minimum by setting the practically measured exhaust pressure at commissioning.

e.g.:        -measured exhaust pressure: 120 mbar  
              -Switch S2 to position 6 (6 x 20 mbar / dig = 120 mbar)

## 3) Initial calibration

At initial commissioning of the analogue converter, it must be calibrated first with the connected LSU probe. Probe-specific data for the connected LSU probe are stored in the micro controller of the analogue converter.

Procedure:

- 1) Wire analogue converter according to clamp connection diagram.
- 2) Connect LSU probe via plug connection and operate with fresh-air supply during calibration. (do not screw into the exhaust tube!!!)
- 3) Apply supply voltage 24 VDC.
- 4) Press button S1 (calibration). The digital input "Heating on" must have a low level.
- 5) In the defect-free condition, the red LED is permanently lit, and the LSU probe heating is brought to operating temperature via the soft-start function. In case of an error (wiring error, probe defect...), the soft-start function is interrupted at once and the red LED goes out. Repeat the process after removal of the defect.
- 6) The red LED goes out after approx. 4,5 minutes and the calibration process is completed.
- 7) Switch off supply voltage, disconnect probe, screw into exhaust tube and then connect again to the analogue converter via the plug connection.
- 8) After the supply voltage is activated again, the analogue converter is now ready for exhaust measurement.

## 4) Calibration

Probe aging of approx. 3000 operating hours leads to a measuring error of approx. 8%. To keep this measurement error to below 1%, the analogue converter must be calibrated with the connected probe at least every 2000 operating hours.

Procedure:

- 1) Switch off supply voltage 24 VDC.
- 2) Disconnect probe and screw out of the exhaust tube.  
(probe must be exposed to fresh air during calibration!!!)
- 3) Connect LSU probe via plug coupling and switch on supply voltage.
- 4) Press button S1 (calibration). The digital input "Heating on" must have a low level.
- 5) In the defect-free condition, the red LED is permanently lit, and the LSU probe heating is brought to operating temperature via the soft-start function. In case of error (probe defect, aging too advanced), the soft-start function is interrupted at once and the red LED starts to flash. The probe must be replaced and then calibrated as described in item 5.
- 6) After approx. 4,5 minutes, the red LED goes out and calibration is completed.
- 7) Switch off supply voltage, disconnect probe, screw probe into exhaust tube and then connect again to the analogue converter via the plug coupling.
- 8) After the supply voltage is activated again, the analogue converter works with a minimum measuring error and is ready for exhaust measurement.

## 5) Calibration at probe exchange

If calibration shows a probe error, e.g. from probe defect or too-advanced aging, it must be replaced with a new one. For this, the probe-specific data of the defective probe in the micro controller memory of the analogue converter have to be deleted first. Then initial calibration is performed as described in item 3.

Procedure:

- 1) Switch off 24 VDC supply voltage.
- 2) Disconnect defective probe and screw out of the exhaust tube.
- 3) Switch on supply voltage (without probe connection!!!).
- 4) Press button S1 (calibration). The digital input "Heating on" must have a low level.  
This deletes the probe-specific data from the micro controller memory.
- 5) Switch off supply voltage.
- 6) Connect new probe via plug coupling and operate in fresh air during calibration.  
(Do not screw into the exhaust tube!!!)
- 7) Switch on supply voltage.
- 8) Press button S1 (calibration).
- 9) In the defect-free condition, the red LED is permanently lit, and the LSU probe heating is brought to operating temperature via the soft-start function. In case of an error, the soft-start function is interrupted and the red LED goes out. Repeat the process after removal of the defect.
- 10) The red LED goes out after approx. 4,5 minutes and the calibration process is completed.
- 11) Switch off supply voltage, disconnect probe, screw into exhaust tube and then connect again to the analogue converter via the plug connection.
- 12) After the supply voltage is activated again, the analogue converter is now ready for exhaust measurement.

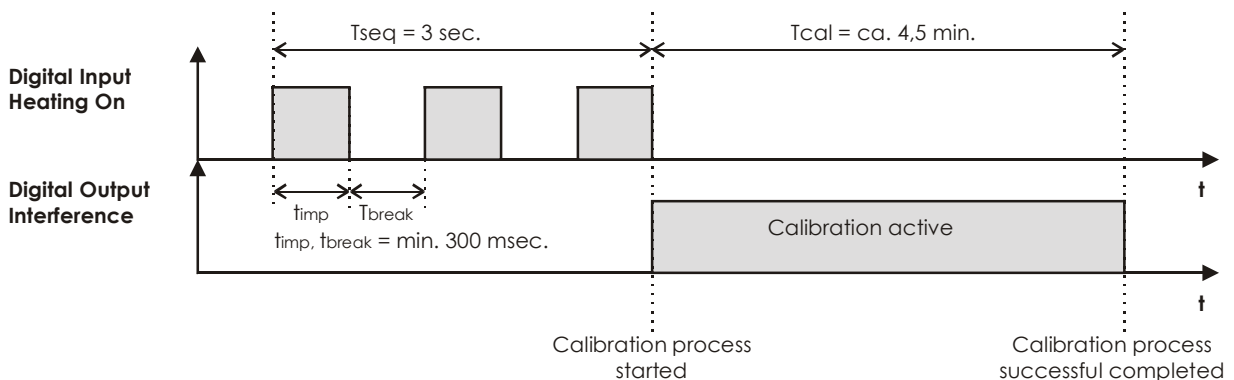
## 6) Calibration via the digital input "Heating On"

Initial calibration and any further calibrations can be performed via the digital input "Heating on" using a special external control sequence.

Observe that the conditions at the measuring site of the broadband probe must be close to fresh air during calibration. Otherwise, calibration will be performed incorrectly, leading to measuring errors.

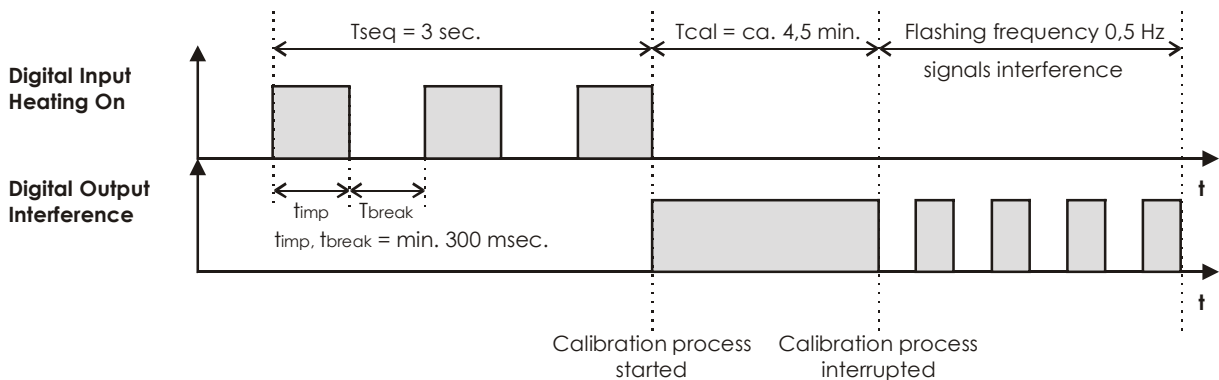
### Process chart for correct calibration:

If the digital input "Heating on" counts at least 3 impulses within a control sequence time "Tseq", the calibration process is started. The digital output "Interference" signals the calibration process status.

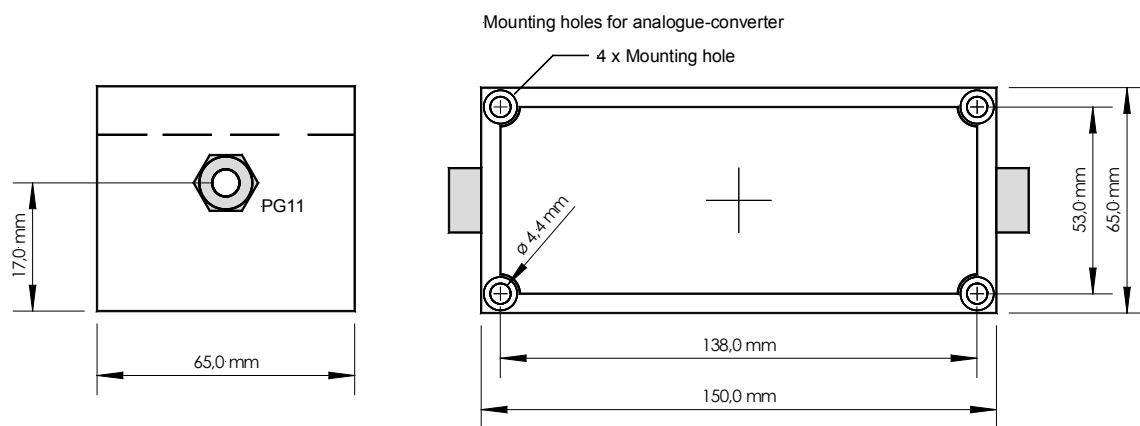
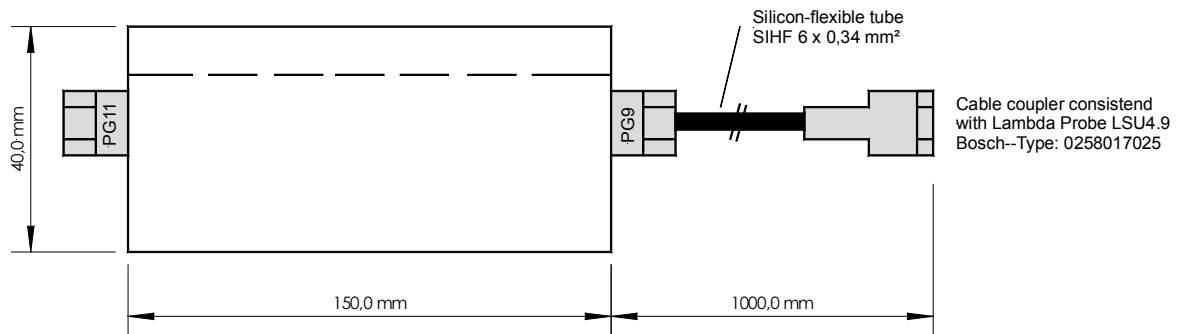


### Process chart for defective calibration:

In case of an error (probe defect, aging process too advanced or no fresh-air flushing), the calibration process is interrupted and the digital output signals "interference" with a flashing frequency of 0.5 Hz. The probe must be replaced and then recalibrated as described in item 5. If there are any doubts regarding ideal fresh-air composition during calibration, the calibration process can be repeated under ideal fresh-air conditions.



## Dimensional drawing



Information about the housing assembly:  
When mounted on a heat carrying mounting plates a housing distance of approximately 10 mm must be maintained, since the internal power loss is dissipated through the bottom edge of the analogue-converter.

## Technical connection diagram

