Single Channel Strain Gauge Amplifier
SG-KP-12E/24E-xxx

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Content

1 General Information

To ensure reliable and safe operation, the measuring amplifier must be operated in compliance with the specifications according to this technical description only. These regulations must also be observed if using accessories, that have been ordered from Althen Mess- & Sensortechnik GmbH together with the measuring amplifier.

Notice: Every person who is in charge for the start-up or service of this measuring amplifier must have read this technical manual and must have understood the safety instructions in particular.

1.1 Safety Instructions

When using the amplifier, the legal- and safety regulations for each case of application must be observed. To avoid risks for the system or the operator the following points are to be considered.

- If any visual damage or malfunctions are noticed, the measuring system must be switched off and marked appropriately.
- Disconnect the supply voltage before opening the device.
- The complete measuring unit must be protected against contact and influence of unauthorized persons.
- In the case of a safety-relevant application, where a potential malfunction could cause damage to property or persons, it is imperative that an additional, independent monitor is provided.
- In combination with sensors, the maximum loads / pressures etc. must never be exceeded.

If you have reasons to assume that safe operation is no longer possible, immediately take the device out of operation and secure it against unintentional operation.

1.2 Qualified Personnel

This measuring system must be operated by qualified personnel and in compliance with the relevant technical specifications only. Qualified personnel include such persons who are conversant with the setting up, mounting and starting up of the measuring system and who have qualifications that are appropriate for the tasks they're about to perform.

1.3 Intended Use

Amplifiers from Althen Mess- & Sensortechnik GmbH serve to measure the intended measurand and the evaluation thereof in combination with one or more sensors. Any other use over and above that is regarded as non-intended use.

2 Instructions for use of the measuring amplifier

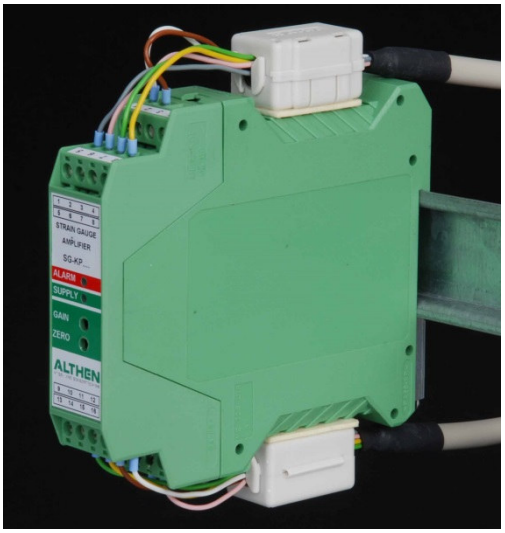
Notice: The parameterizations, further information concerning the scaling as well as the customized analogue output can be found on the additional sheet "Device-Configuration".

Since this amplifier is a highly sensitive measurement technology product, it must be used for its intended use as well as the described operating conditions only. Initial start-up and changes in setup and settings must be done by qualified personnel only. To prevent interventions / modifications made by unauthorized personnel, suitable measures must be taken. Both function and calibration must be checked regularly.

Notice: To avoid possible interferences, it is recommended to install the amplifier with at least 20 mm distance to other electronic devices.

The amplifier is contained in a plastic housing (IP20) designed for DIN top hat rail montage. The electrical connections are made via screw-clamps and the sensor may be connected in 4 or 6-wire technology.

The amplifier must be connected to clean earth-potential. To avoid possible potential equalization currents over the shield of the cable to the following evaluation unit, this shield should be connected over a suitable capacitor (10nF/200V).



Overall the shield connections must be done properly to EMC-standards (as short as possible with large wire cross-section) and connected to a central point (star grounding). In order to not increase the interference sensitivity of the amplifier, all cables should be kept as short as possible and should not be extended. Possible cable-bound interferences must be blocked very near the cable ends (evaluation unit) by suitable measures.

To increase immunity to interferences (i.e. noise) the wiring must be put through the delivered ferrites. Shielded cables, preferably twisted in pairs should be used only. The EMC-installation instructions must be complied with. All connection cables and the amplifier must not be installed in proximity to disturbance emitting devices or cables. The amplifier must be operated with a separate power source used for measurement devices only.

Notice: Changes of the amplifier of any kind demand for the explicit approval of Althen Mess- & Sensortechnik GmbH. Changes of any kind done without that approval exclude all possible warranty and/or liability of Althen Mess- & Sensortechnik GmbH.

2.1 Instructions for use of strain gauge sensors

Notice: Strain gauge sensors with a small range are extremely sensitive to improper handling. Force transducers can be destroyed simply by touching. Same applies to the diaphragms of pressure transducers. So, bear in mind: handle with care!

Loading the transducer in excess of the nominal range may result in an increased and lasting zero balance offset as well as damage to the sensor. The same applies to short-term force or pressure impulses that exceed the nominal range.

To most force transducers the force must be applied centrically in order to avoid shear forces, which may be harmful to the sensor, or may cause measurement inaccuracy. Rounded surfaces, joint heads or other suitable guides can ensure centric force transmission.

Tightening torques while mounting any sensors may result in an increased zero balance offset.

If the sensor has been replaced, the calibration of the amplifier must be checked. A new adjustment might be necessary.

3 Technical description

The described single channel measuring amplifier serves to supply a strain gauge sensor with a full bridge resistance of 300 Ohms or more and the amplification of the sensor signal. The supply voltage of the amplifier is galvanically isolated from analogue output, sensor supply and sensor signal.

Standard analogue outputs are available for further evaluation.

The coarse amplification is determined by an internal resistor and can be fine adjusted by a potentiometer on front of the amplifier. A second potentiometer on front allows the correction of the zero point.

The presence of the supply / internal operating voltage is indicated by the 2 green LEDs on the front.

4 Terminal Assignment

The electrical connections are made via screw-clamps. The numbering can be found on the front side of the clamps. The maximum wire cross section is 2,5 mm². The EMC-installation instruction is to be complied with. Maximum interference immunity is achieved by direct connection of the cable screen with "clean" and low resistance protective ground (PG). A lengthening of the cable screen makes the interference immunity considerably worse. The connection of the screen should be done directly with a cable clamp.

If, however, a connection to a PG is not possible, the cable screen may be connected to clamp 15 of the amplifier (analogue ground/screen). Anyhow, enough interference immunity is to be ensured.

Clamp	*Description*
1	Supply voltage
2	Supply Ground
3	Supply Ground
4	Analogue Ground
5	Analogue Ground
6	Analogue output 2 (Version 4 ... 20 mA)
7	Analogue Ground
8	Analogue output 1 (0 ... +10 V / ± 10 V)

Clamp	*Description*
9	-SG-Signal Transducer
10	+SG-Signal Transducer
11	+SG-Sense Transducer
12	+SG-Excitation Transducer
13	-SG-Sense Transducer
14	-SG-Excitation Transducer
15	Analogue Ground/Screen
16	Analogue Ground

Terminals "supply ground" and "analogue ground" are isolated galvanically. To unset this isolation clamp 3 and 4 are to be bridged.

4/6 wire technology:

Factory pre-set

	Jumper J1	Jumper J2
* 4-wire technology	ON	ON
6-wire technology	OFF	OFF

4.1 Supply voltage

The supply voltage of version -24E is in the range of 18 to 30 VDC and version –E12 within 10 to 18 VDC. The presence of the supply / internal operating voltage is indicated by the 2 green LEDs on the front.

To protect the electronics (to the supply voltage version corresponding) an internal self-healing "polyswitch-resettable®" fuse is built in. Whether an external additional fuse is necessary has to be considered. However, an additional external delay fuse of 0,315 A is recommended.

If the indicator LEDs go off, the supply voltage and possibly existing external protection has to be checked.

Notice: During switch-on phase the amplifier is capacitive. Thus, the switch-on current is greater than the operating current. This must be taken into consideration when dimensioning and selecting the power pack, especially if several amplifiers are being wired to the same power source.

4.1.1 Galvanic isolation

The supply voltage of the amplifier is galvanically isolated from analogue output, sensor supply and sensor signal. To unset this isolation, clamp 3 and 4 have to be bridged.

4.2 Strain gauge excitation voltage

The described measuring amplifier is able to supply one strain gauge transducer. Any strain gauge full bridge with a bridge resistance of 300 Ohms or more may be connected. The transducer can be supplied with a bipolar voltage of either ± 5 V (= 10 V) or ± 2,5 V (= 5 V). This value can be selected by internal solder points and with 2 potentiometers for fine adjustment.

LP81-1	LP81-2	SG-Excitation
SET	SET	±5 VDC (=10VDC)
NOT SET	NOT SET	±2,5 VDC (=5 VDC)

4.2.1 Connecting in 4 or 6 wire technology

The described measuring amplifier allows to connect the transducer in either 4 or 6 wire technology.

The excitation voltage received by the sensor has great influence on the sensors signal. So, if with a very long cable, or lengthening of it, the excitation voltage drops even by a slight value the signal drops accordingly. If the amplifier together with the sensor has been factory calibrated a longer cable is not a problem. But it must not be lengthened. This way the factory calibration is still valid.

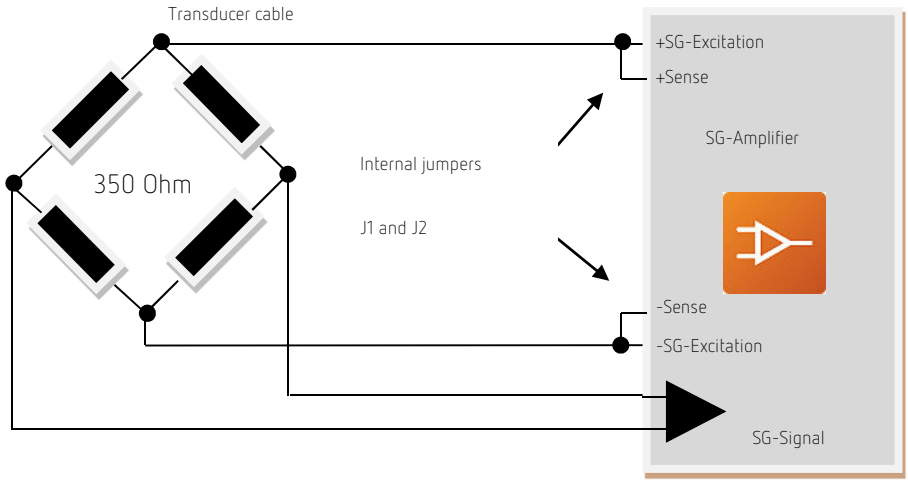
It is preferred to connect the sensor in 6 wire technology, if the cable has to be lengthened, because the 2 additional wires measure the excitation voltage directly at the sensor and the amplifier adjusts the excitation voltage accordingly.

4.2.2 Connecting in 4 wire technology

Notice: When connecting in 4 wire technology the jumpers J1 and J2 must be set. Otherwise the transducer might get damaged resp. destroyed.

The values in the calibration certificate of the sensor have been recorded with the attached cable. So, this cable must not be shortened, because it would increase the sensor signal and therefore change the accuracy.

With a sensor without a cable the values of the certificate have been recorded right at the connector. In this case a connection in 6 wire technology is recommended.

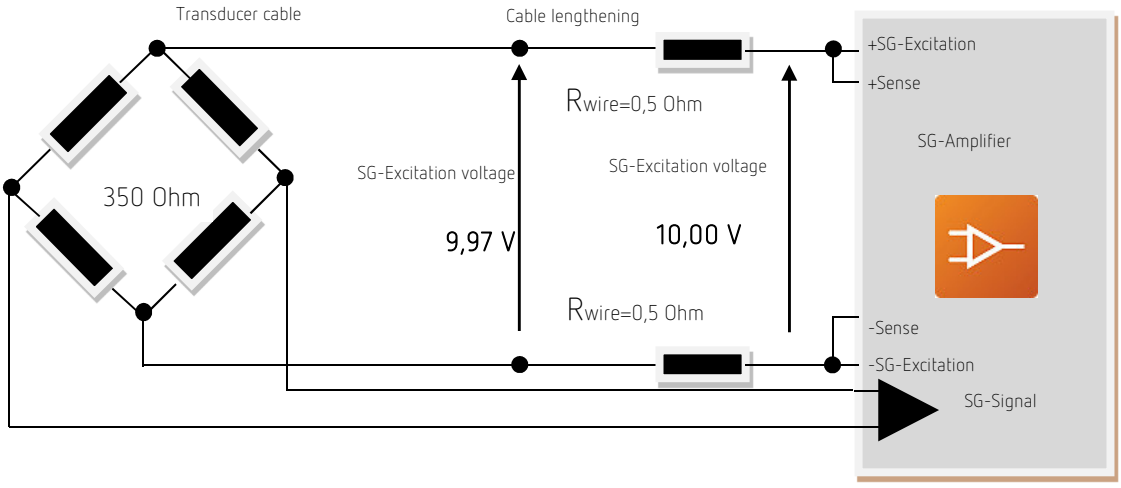


Pic. 1: Connection in 4-wire technology

4.2.3 Lenghening a cable in 4 wire technology

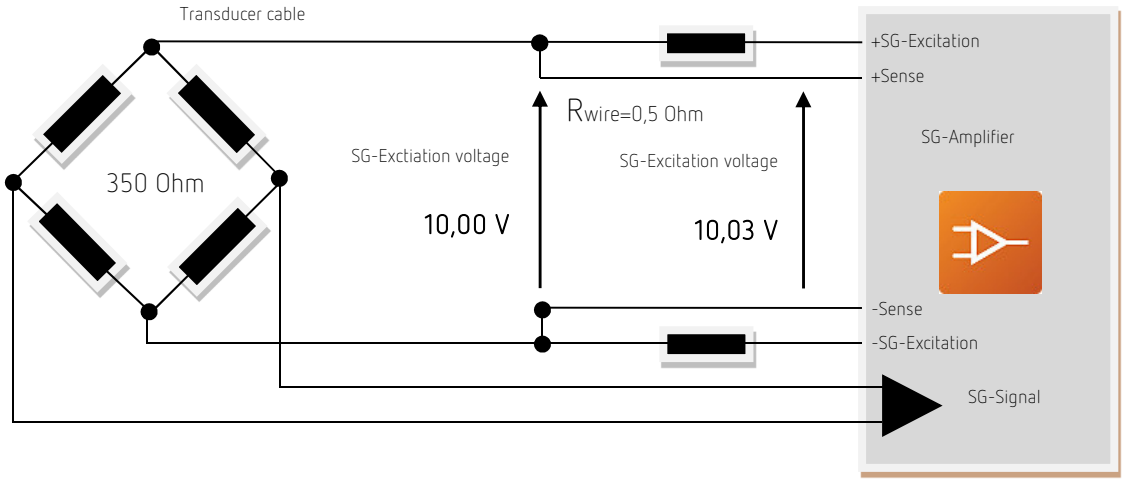
As mentioned above the connection should be in 6 wire technology if the sensor comes with no hard-mounted cable or the existing cable is to be lengthened.

Example: The sensor has been calibrated with an excitation of 10,000 V.



Pic. 2: Connection in 4-wire technology; drop of SG-Excitation voltage caused by cable lengthening (0,5 Ohm)

In the picture above the original cable has been lengthened and this additional cable results in a resistance increasing of 0,5 ohms. Thus, the excitation voltage drops by 0,03 V (resp. 30 mV) which results a measurement inaccuracy of 0,3 %.

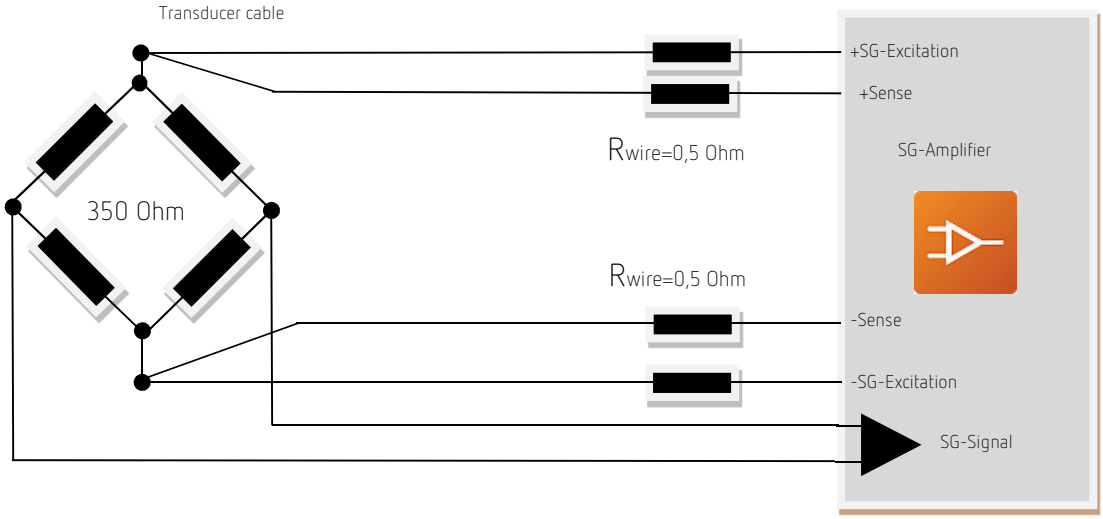


Pic. 3: Sensor with 4 wire cable. Lengthened with 6 wire cable

In the picture above the cable has been lengthened with a 6-wire cable, so the voltage drop of 30 mV is corrected by the amplifier by measuring the actual voltage at the end of the original cable.

4.2.4 Connecting in 6 wire technology

Notice: When connecting in 6 wire technology the jumpers J1 and J2 must be removed. Otherwise the 6-wire technology does not have the desired effect.



Pic. 4: Connection in 6-wire technology

4.3 Analogue output

The following standardized analogue outputs, depending on the ordered option, are available:

Version ...010:
The output is: 0 ... +10 Volts (max 1 mA)

Version ...B10:
The output is: ± 10 Volts (max 1 mA)

Version ...420:
The output is: 4 ... 20 mA (max 500 ohms)

Other analogue outputs available on request. For parameter settings, further information concerning scaling, or customized analogue outputs, please refer to the additional sheet "Allocation / Device Configuration).

4.3.1 Analogue output voltage

The analogue voltage output can be picked up on the corresponding clamps. See chapter 4 "Terminal Assignment".

In combination with a transducer which is capable to handle tension and compression forces an analogue output of ± 10 volts is available. If an unipolar voltage is needed with such a sensor it is possible to set the zero point of the transducer to 5 volts of the output. This zero-point elevation is also necessary for the analogue current output. See chapter5.1

4.3.2 Analogue output current

The analogue current output can be picked up on the corresponding clamps. See chapter 4 "Terminal Assignment":

The analogue current output is not capable of going below 4 mA, therefore when adjusting the designated zero-point, the output signal has to be set slightly higher than that, just in order to check if said signal does not virtually hang below 4 mA. If the output reacts immediately it can be set back to 4 mA, otherwise the signal of the transducer has to be checked. If the current of 4 mA does not increase while loading a force to the transducer the polarity of the signal has to be checked. If this is of negative polarity the signal wires need to be interchanged.

If the circuit of the analogue current output is open somehow, this is indicated by a red LED on the front.

4.3.3 Low-pass filter

In order to suppress unwanted high frequency disturbances a low pass filter can be switched on. The DIP-switches have to be set accordingly:

Frequency Limit	DIP60/4	DIP60/3
10 Hz (Lowpass Filter)	OFF	ON
1 kHz	ON	OFF

Notice: Low-pass filter is not factory preset.

If an optional higher limit frequency has been ordered, the low-pass filter will be set from 10Hz to 1kHz.

Before removing the pcb from its casing, the grounded hat-rail is to be touched.

5 Starting up

If an adjustment (A-K-1K / A-D-1K) has been ordered in combination with the amplifier(-s) and/or transducers(-s) it may be necessary for a slight fine adjustment nonetheless. This is due to possible various environmental influences as well as to mounting etc.

If any visual damage or malfunctions are noticed, the measuring system must be switched off and marked appropriately.

- Mounting transducer and amplifier
- Connect transducer to the amplifier
- Connect multimeter to analogue output
- Connect supply voltage – consider pin assignment
- Allow the system about 30 min. to warm up
- Check function and calibration of the system

Notice: The allocation of transducer / amplifier is to be complied with. After replacing a transducer, the calibration has to be checked. It is to be noted that there is a slight dependence between zero-point adjustment and amplification (gain).

5.1 Zero point adjustment range

It is to be noted that there is a slight dependence between zero-point adjustment and amplification (gain).
The zero-point adjustment range is approx. ± 10 %.
This range can be changed by setting the dip-switch according to the table below:

DIP50-1	DIP50-2	DIP50-3	DIP50-4	corresponding to the analogue voltage output		
ON	ON	ON	ON	-1,0 V	...	+1,0 V
ON	OFF	OFF	ON	-3,3 V	...	+3,3 V
ON	OFF	ON	OFF	-0,4 V	...	-4,0 V
OFF	ON	OFF	ON	+4,0 V	...	+0,4 V

Setting the zero point:

Increase	DIP60/2	DIP60/1
+5 V	OFF	ON
-5 V	ON	OFF

Notice: A base load reduces the remaining load capacity by just that value. Overloading may cause damage!

Base load / tare + maximum load to measure = capacity of transducer

5.2 Adjustment / calibration of the amplifier

In order to adjust or calibrate the amplifier a multimeter has to be connected to the analogue output.

Inspection:

- Unload the measuring device.
- Connect the multimeter (refer to chapter 4 "Terminal Assignment").
- Set the analogue output to 0 Volts resp. 4 mA.
- Load the measuring device (i.e. the transducer) at least 3 times with its maximum load.
- Load the device with 80 % of its maximum load.
- Check if the analogue outputs comply with the load and is in the designated specs.
- If not, the measurement system might need to be recalibrated. Above that, the installation position and the overall setup might need an inspection.

Adjustment / Calibration:

The coarse amplification, and thus the voltage output, is determined by an internal resistor (RG) and can be fine adjusted by a potentiometer (P-02). To adjust the current output, which follows the voltage output, the potentiometer P-03 is to be used. (See next chapter.)

Before the calibration a warm-up time of approx. 30 mins should be kept. The measuring device has to be unloaded.

Unloaded means with:

- Force transducers: no applied force at all
- Pressure transducers no pressure, except atmospheric influence

- In this unloaded state adjust the zero-point with the potentiometer P-01.
- Apply a defined load. (by calibrated weights, pressure generator etc.)
- Adjust the analogue output corresponding to the applied load.

In order to reach the required accuracy, it may be necessary to repeat these steps.

5.2.1 Correction of the analogue current output

The minimum of analogue current output is 4 mA. A lower current is not possible. When calibrating, the zero-point current has to be set to 4,1 mA with the potentiometer "NULLPUNKT". Now the range of the current output can be set to 16 mA by using the potentiometer P-03. With an adjusted range of 16 mA the output has to read 20,1 mA at maximum load. After adjusting the range, the zero shall be set back to 4,0 mA.

5.2.2 Calculation of amplification determining resistor

The amplification is:

$G_{total} = G_{differential\ amplifier} \times G_{output\ stage}$

The amplification of the output stage is adjustable with the potentiometer P-02 (GAIN). The adjustable range is:

$$G_{output\ stage} = 9{,}5 \ldots 10{,}5 \text{ Volts}$$

Calculation of the coarse amplification resistor R_G (applies for 10 Volts output):

$$G_{differential\ amplifier} = \frac{1000 \text{ mV}}{\text{Exc. (V)} \times \text{Signal } (\frac{\text{mV}}{\text{V}})}$$

$$R_G = \frac{50 \text{ kOhm}}{(G \text{ differential amplifier} - 1)}$$

Example:

Transducer: 2,5000 mV/V (0,0025V/V)

Excitation: 10,000 V

$$R_G = \frac{50 \text{ kOhm}}{(\frac{1V}{10 \text{ V} \times 0{,}0025 \text{ V}} - 1)} = 1282 \text{ Ohm}$$

6 Maintenence

The flawless function and calibration of the whole measuring system is to be checked regularly. This inspection is also necessary after every repair or change of any component of the measurement system.

7 Old appliances disposal

According to European and German law, it is prohibited to dispose old electronic devices into household waste, but must be collected and disposed of separately.

Amplifiers and measurement units manufactured and sold by Althen Mess- & Sensortechnik GmbH serve B2B purposes only. Therefore, those old appliances must not be given to the communal disposer, but must be given back to the seller or disposed of properly. If you need any further information, please contact your local authorities.

These measures serve to protect the environment and allow recycling and recovery of valuable materials. Furthermore, do electronic devices contain substances that may cause damage to the environment if burned or dumped with normal household waste.

Appendix

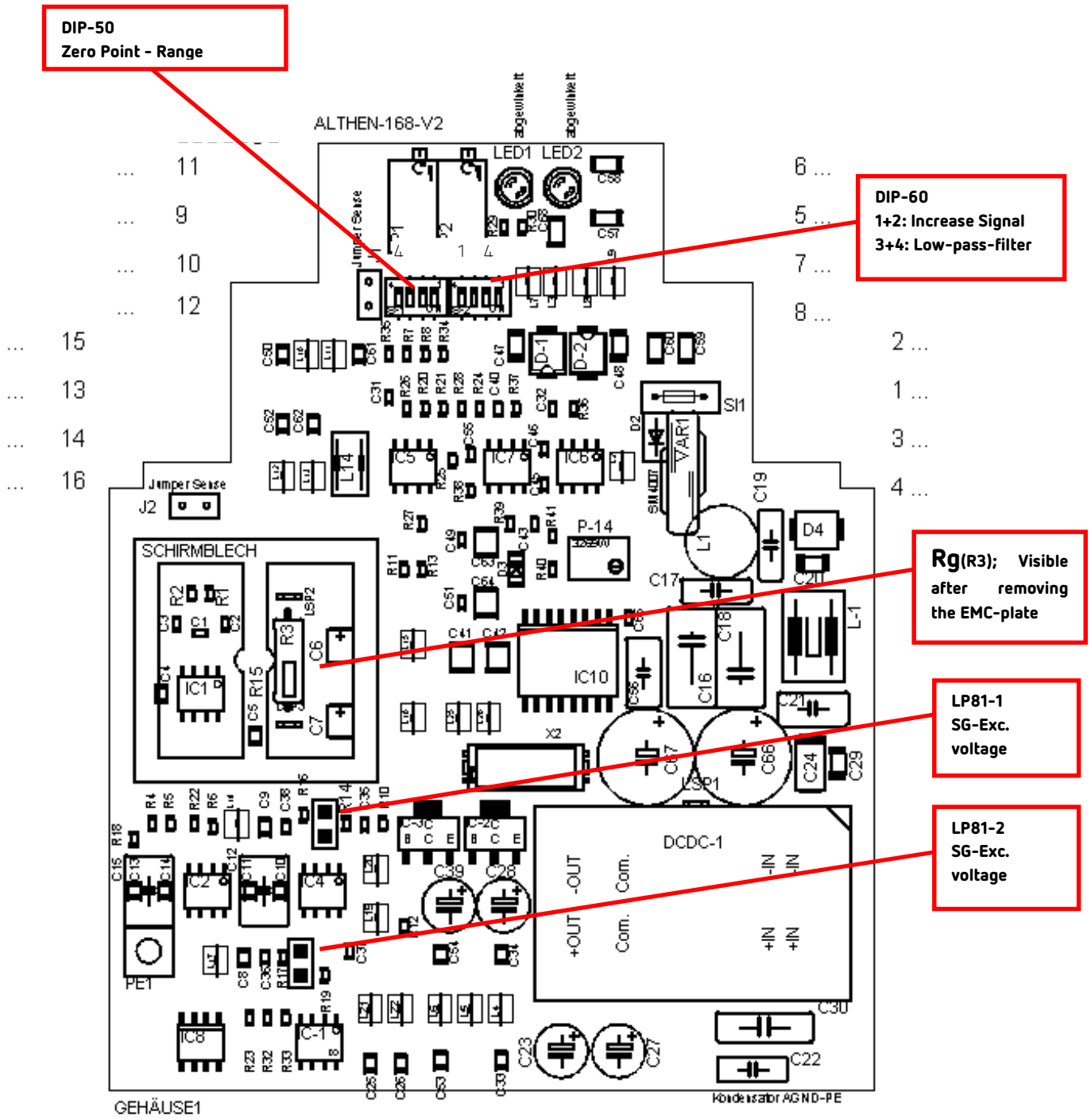
Datasheet

Number of measuring channels:	1 (Strain gauge full bridge > 300 Ω)	
Supply voltage:	12E - 10 ... 18 VDC 24E - 18 ... 30 VDC	Electronics protected against voltage reversal
Isolating proof voltage input to output:	200 V	Higher isolated proof voltage on request
Power consumption:	max. 3 W	
Strain gauge excitation supply:	±2,5 VDC ± 1% / ±5 VDC ± 1%	
Analogue output	0 ... 10 V / ±10 V 4 ... 20 mA	max. 1 mA (short-period short-circuit proof) max. 500 Ω
Limit frequency (-3 dB):	1 kHz (10 Hz with low pass filter)	optional up to 30 kHz
Input resistance:	>3 MΩ	
Max. input sensitivity:	100 mV/V at ±5 VDC excitation supply	
Non-linearity:	±0.05 % FSO	
Electrical connection:	Pluggable Screw clamps	
Housing:	Plastic enclosure for top hat rail mounting (IP20)	
Dimension (W x H x D):	23 x 99 x 115 mm	
Weight:	approx. 150 g	
Temperature, storage:	-20 °C ... +60 °C	
Temperature, operating:	0 °C ... +50 °C	

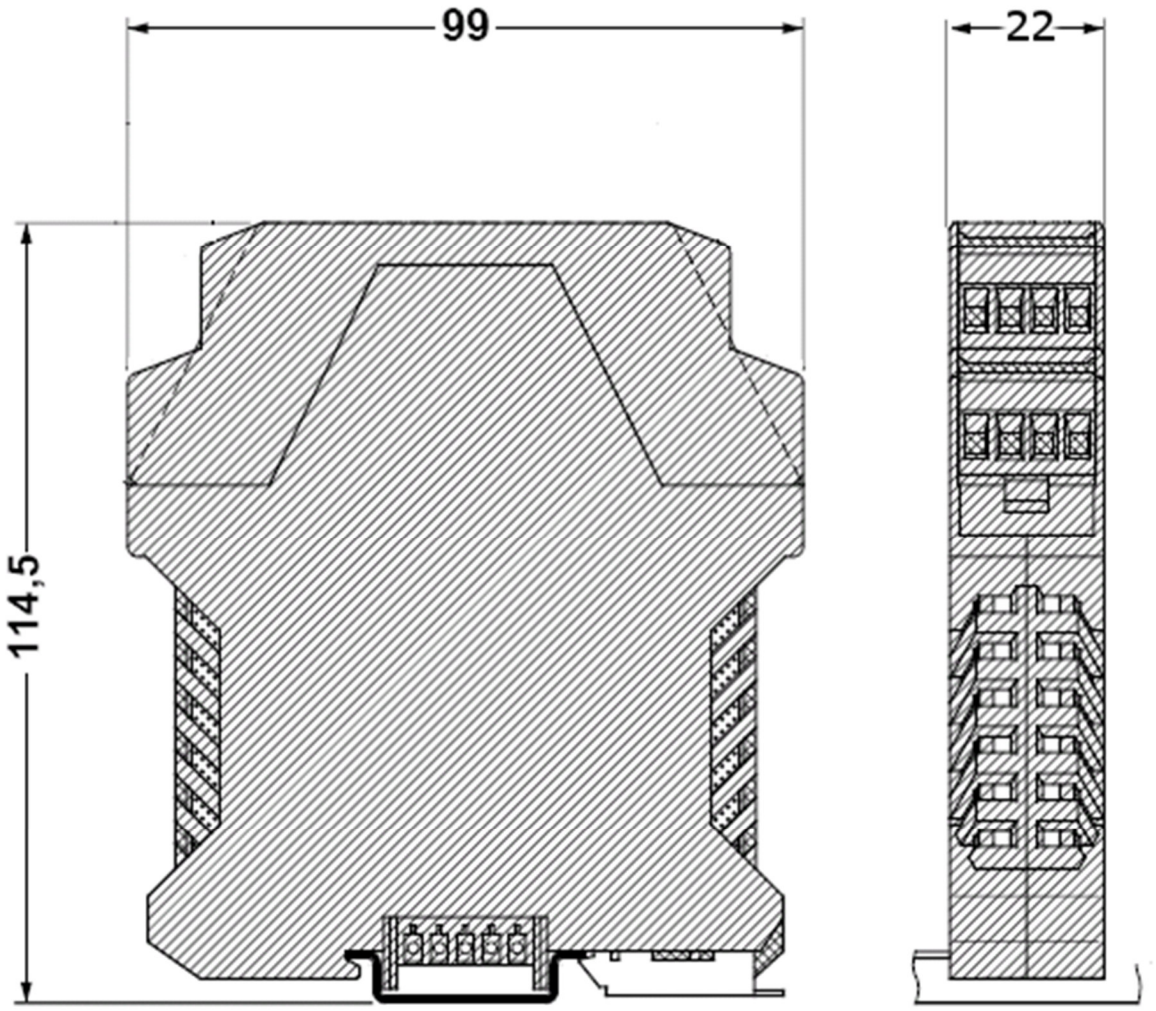
Order designation

SG-KP...	Single channel strain gauge-amplifier in plastic housing for DIN-top hat rail mounting (IP20)		
	...-12E-...	Supply voltage: 10 ... 18 VDC	
	...-24E-...	Supply voltage: 18 ... 30 VDC	
		...-010-...	Analogue output: 0 ... 10 V
		...-B10-...	Analogue output: ± 10 V
		...-420-...	Analogue output: 0 ... 10 V and 4 ... 20 mA
			... -GFxxx: frequency limit up to 30 kHz
			...no declaration: standard version 1 kHz

Component diagram



Housing dimensions



Subject to modifications.
All information describes our products in general form.