Single Channel Strain Gauge Amplifier for up to 4 parallel normalized sensors

SG-IP-12E/24E-xxx-4P

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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 accessories, that have been ordered from Althen Mess- & Sensortechnik GmbH together with the measuring amplifier being used.

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.

The amplifier must be operated with a separate power source used for measurement devices only. Shielded cables, preferably twisted in pairs should be used only. The EMC-installation instructions must be complied with.

The amplifier is contained in an aluminum housing which is equipped with an EMC- cover gasket as well as EMC-cable glands. After initial start-up the lid is to be closed properly. Unused cable glands must be closed with filler plugs.

The amplifier must be connected to clean earth-potential. Please refer to the EMC-Mounting-Instructions in order to connect the sensor-shields correctly. 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 (10 nF / 200 V).

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 disturbance sensitivity of the amplifier, all cables should be kept as short as possible and should not be extended. Possible cable-bound disturbances (i.e. noise) must be blocked very near the cable ends (evaluation unit) by suitable measures.

If it is to be expected that the amplifier is, as example, cleaned with a high-pressure cleaner/ steam jet an additional protection shall be provided.

Notice: Changes of the amplifier of any kind demands 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 for 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, that may be harmful to the sensor, or may cause measurement inaccuracy. Centric force transmission can be ensured by rounded surfaces, joint heads or other suitable guides.

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 one to 4 parallel connected strain gauge sensors with each a resistance of 300 Ohms or more and the amplification of the sensor signals.

The supply voltage of the amplifier is galvanically isolated from analogue output, sensor supply and sensor signal.

The circuitry is in 4-wire technology. Standard analogue outputs are available for further evaluation. The amplifier is built in a robust aluminum die cast housing, which is suited for rough and industrial environment.

The coarse amplification is determined by an internal resistor and can be fine adjusted by a potentiometer. After opening the lid, the potentiometer mentioned before as well as the potentiometer for zero-adjustment allow a correction of the calibration. In addition, a dip-switch allows to change the width of the zero-adjustment range. If even this expansion of the range should not be sufficient, an internal resistor can be soldered in to add a tare.

In addition the amplifier allows, in combination with option "2G", the monitoring of the signal with 2 freely adjustable and potential-free relays.

4 Terminal assignment

The electrical connections are made via cable glands to terminal blocks inside. The terminal numbering can be found on the pcb. The maximum cable cross-section is 2,5 mm². The EMC-installation instruction must be complied with.

Notice: The amplifier must be operated with closed lid only.

Clamp	Description
1	Supply Voltage
2	Supply Ground
3	Supply Ground
Galvanic isolation	
4	Analogue Ground
5	Analogue output 1 (0 ... +10 V, ±10 V)
6	Analogue output 2 (Version 4 ... 20 mA)
7	Analogue Ground
8	+SG-Signal Transducer 1
9	-SG-Signal Transducer 1
10	+SG-Excitation Transducer 1
11	-SG-Excitation Transducer 1
12	Screen/Enclosure
13	+SG-Signal Transducer 2

Clamp	Description
14	-SG-Signal Transducer 2
15	+SG-Excitation Transducer 2
16	-SG-Excitation Transducer 2
17	Screen/Enclosure
18	+SG-Signal Transducer 3
19	-SG-Signal Transducer 3
20	+SG-Excitation Transducer 3
21	-SG-Excitation Transducer 3
22	Screen/Enclosure
23	+SG-Signal Transducer 4
24	-SG-Signal Transducer 4
25	+SG-Excitation Transducer 4
26	-SG-Excitation Transducer 4
27	Screen/Enclosure

Option -2G-:

28	SP 1 (Relay 1) (30 VDC / 0.5 A) MIN N/C
29	SP 1 (Relay 1) (30 VDC / 0.5 A) MIN root
30	SP 1 (Relay 1) (30 VDC / 0.5 A) MIN N/O

31	SP 2 (Relay 2) (30 VDC / 0.5 A) MAX N/C
32	SP 2 (Relay 2) (30 VDC / 0.5 A) MAX root
33	SP 2 (Relay 2) (30 VDC / 0.5 A) MAX N/O

Terminals "supply ground" and "analogue ground" are isolated galvanically. To unset this isolation clamp 2 (3) and 4 are to be bridged.

4.1 Supply voltage

The supply voltage is with version -24E in the range of 18 to 30 VDC and with version –E12 within 10 to 18 VDC. The presence of the supply/ internal operating voltage is indicated by the 2 green LEDs on the pcb, in case of option -GW (Grenzwerte=Setpoints) on the case-lid.

To protect the electronics an (to the supply voltage version corresponding) internal self-healing "polyswitch-resettable®" fuse is built in. Whether an external additional fuse is necessary is to be checked. However, an additional external fuse of 0,5 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 2(3) and 4 have to be bridged.

4.2 Strain gauge excitation voltage

The transducer can be supplied with either 10 VDC or 5 VDC unipolar voltage. This value can be selected with solder points (LP-04 and LP-05) for coarse, and with potentiometers (P-03 and P-04) for fine adjustment.

If an optional pre-adjustment of the amplifier has been ordered, the excitation voltage is pre-selected and fine adjusted. Changing the excitation voltage should not be necessary.

LP-05A	LP-05B	LP-04A	LP-04B	Excitation voltage
ON	OFF	ON	OFF	± 5V (10 VDC)
OFF	ON	OFF	ON	±2,5VDC (5 VDC)

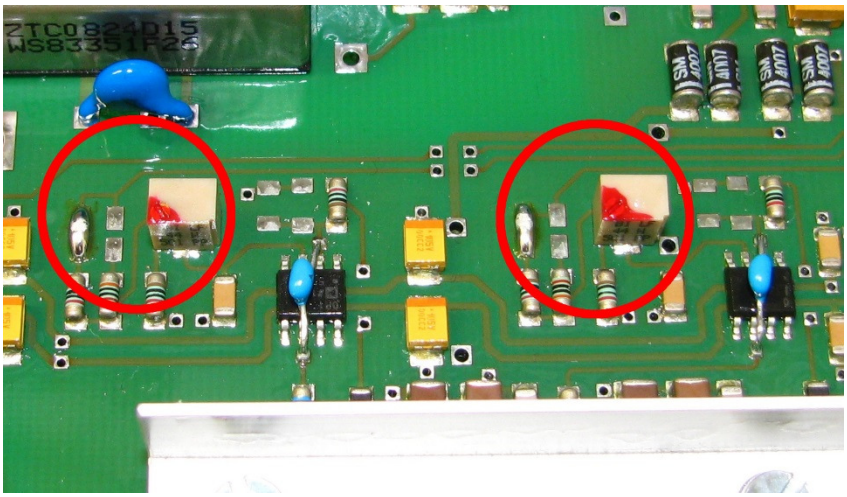


Fig. 1: Soldering points for excitation voltage adjustment

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. But if a unipolar voltage is needed 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. (5 V ± 5 V equals 12 mA ± 8 mA) To lift the zero point to 5V, please refer to chapter 5.1.1 "tare".

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 pcb.

In combination with a, transducer which is capable to handle tension and compression forces, an analogue output of ± 10 volts is available. However, if a unipolar voltage is needed anyway, 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. (5 V ± 5 V equals 12 mA ± 8 mA) To lift the zero point to 5V the solder point LP03 needs to be set.

4.4 Setpoints (option GW)

The setpoint characteristics are as follows:

GW2 = MAX; GW1= MIN (GW GrenzWert = SetPoint)

Notice: Other setpoint characteristics on request.

The 2 red LEDs in the lid signal the state of the relays, thus the setpoints.

	Relays	LED
Permitted state	on	off
None permitted state	off	on

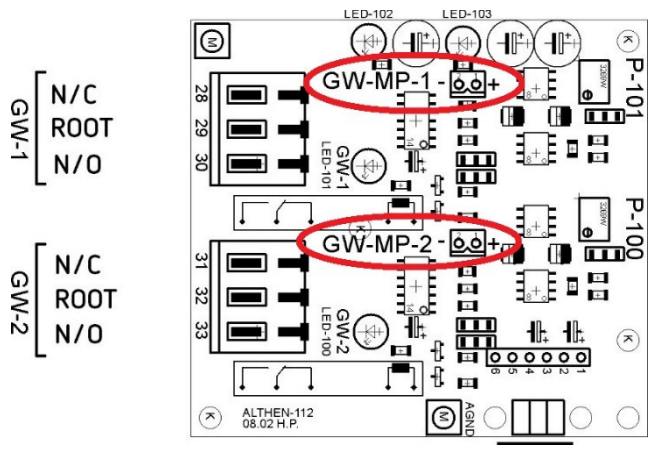
Within the permitted range (SP1/MIN < current measuring value < SP2/MAX) all set-point relays are activated. The relays drop out if a setpoint is under-run SP-1 or exceeded SP-2 or if the supply voltage fails.

Notice: The setpoints are not pre-adjusted by the manufacturer. These settings have to be made by the customer.

The maximum switching capacity is 30V/0,5A

4.4.1 Setpoint settings

The setpoints can be set freely over the complete range of the measurement by using the potentiometers P-100 and P-101 on the additional pcb (Althen 112). The adjustment may be executed either with loaded sensor(-s), or by measuring the desired voltage on the pcb (Althen 112) on the measuring points (GW-MP.1/2). The scaling of the GW-Test-signal equals to the analogue output voltage.



The relays should be used for control signals only, instead of switching heavy electrical loads.

The external wiring must be executed in a manner that noises are suppressed.

Fig. 2 measuring points

The test-signals are scaled as follows:

$$\text{GW-test signal (Volt)} = \frac{\text{threshold (phys. unit)x 10 V}}{\text{measuring range (phys. unit)}}$$

Notice: After adjusting the setpoints the potentiometers are to be sealed with anti-temper seal/ protective coating.

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:

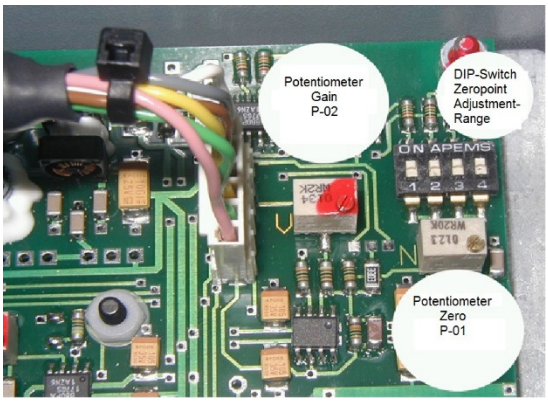


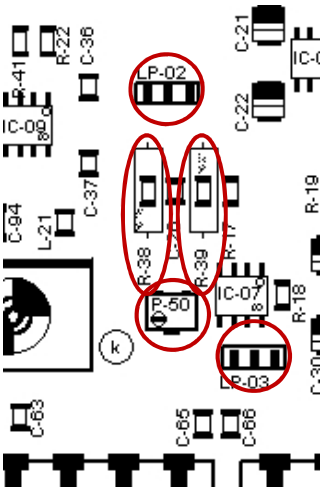
Fig. 3 Dip-switch and potis

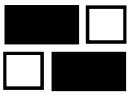
S01-1	S01-2	S01-3	S01-4	corresponding to the analogue voltage output		
ON	ON	ON	ON	-1,4 V	...	+1,4 V
ON	OFF	OFF	ON	-5 V	...	+5 V
ON	OFF	ON	OFF	+0,6 V	...	+6,5 V
OFF	ON	OFF	ON	-6,5 V	...	-0,6 V

5.1.1 Tare

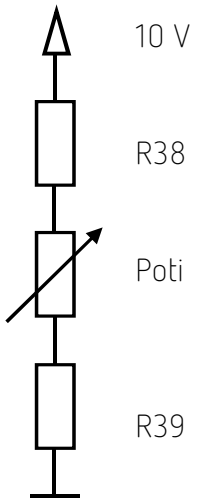
A potential base load can be electrically suppressed by an additional resistor (-network) on the pcb, if an expansion of the zero-point adjustment range is neither sufficient, nor desirable.

In order to do so, a combination of resistors, respectively bridges and one potentiometer has to be soldered in. The solder-point LP-03 determines, if the tare is activated. LP-02 has to be set for positive, or negative adding. With the potentiometer P-50 a tare of up to 10 times the actual measuring range can be adjusted. However, the adjustment just by potentiometer is rather coarse, thus inaccurate. In order to improve the accuracy, it is possible to narrow the voltage range of the potentiometer down, with a voltage divider.



LP-02: + Tara 
– Tara

LP-03: Tara aktiviert 
Tara inaktiv



Example 1:

Measuring Range:	+ 200 kN (equals 1 V)
Tare:	+ 100 kN (equals 0,5 V)
Tare range:	± 50 kN (equals ± 0,25 V)
Tara lower value:	+ 50 kN (equals 0,25 V)
Tara upper value:	+ 150 kN (equals 0,75 V)

So, the poti should have an adjustment range from 0,25 to 0,75 Volts. That means, with an overall voltage of 10 Volts and a potentiometer of 10 kOhm by default, the first series resistor (R-39) has to be 5 kOhm and the second one (R-38) 185 kOhm.

Example 2:

Measuring Range:	+ 1000 kN (equals 1 V)
Tare:	+ 1000 kN (equals 1 V)
Tare range:	± 200 kN (equals ± 0,2 V)
Tara lower value:	+ 800 kN (equals 0,8 V)
Tara upper value:	+ 1200 kN (equals 1,2 V)

So, the poti should have an adjustment range from 0,8 to 1,2 Volts. That means, with an overall voltage of 10 Volts and a potentiometer of 10 kOhm by default, the first series resistor (R-39) has to be 20 kOhm and the second one (R-38) 220 kOhm.

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

5.2 Adjustment / calibration of the amplifier

In order to adjust or calibrate the amplifier at least one multimeter has to be connected to one of the analogue outputs.

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 fully.
- 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 (R_G) 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 is 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 P-06. Now the range of the current output can be set to 16 mA by using the potentiometer P-05. 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.

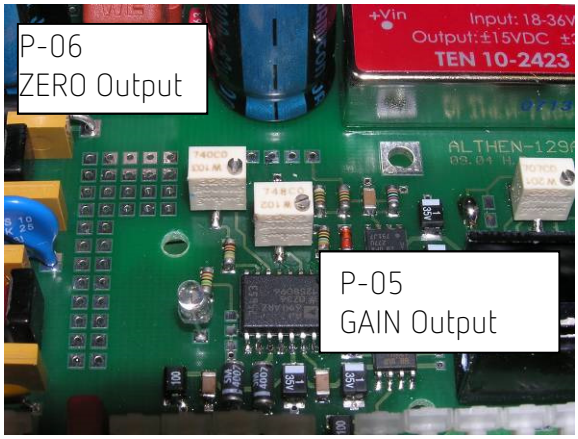


Fig. 4 Analogue output current adjustment

5.2.2 Calculation of amplification determing resistor

The amplification is:

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

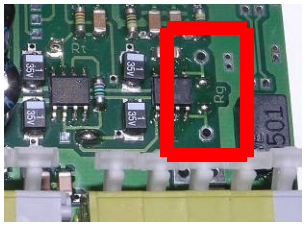
The amplification of the output stage is adjustable with the potentiometer P-02 (GAIN). The adjustable range is:

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

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

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

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



Example:

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

Excitation: 10,000 V

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

6 Maintenance

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 of old electronic devices by 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

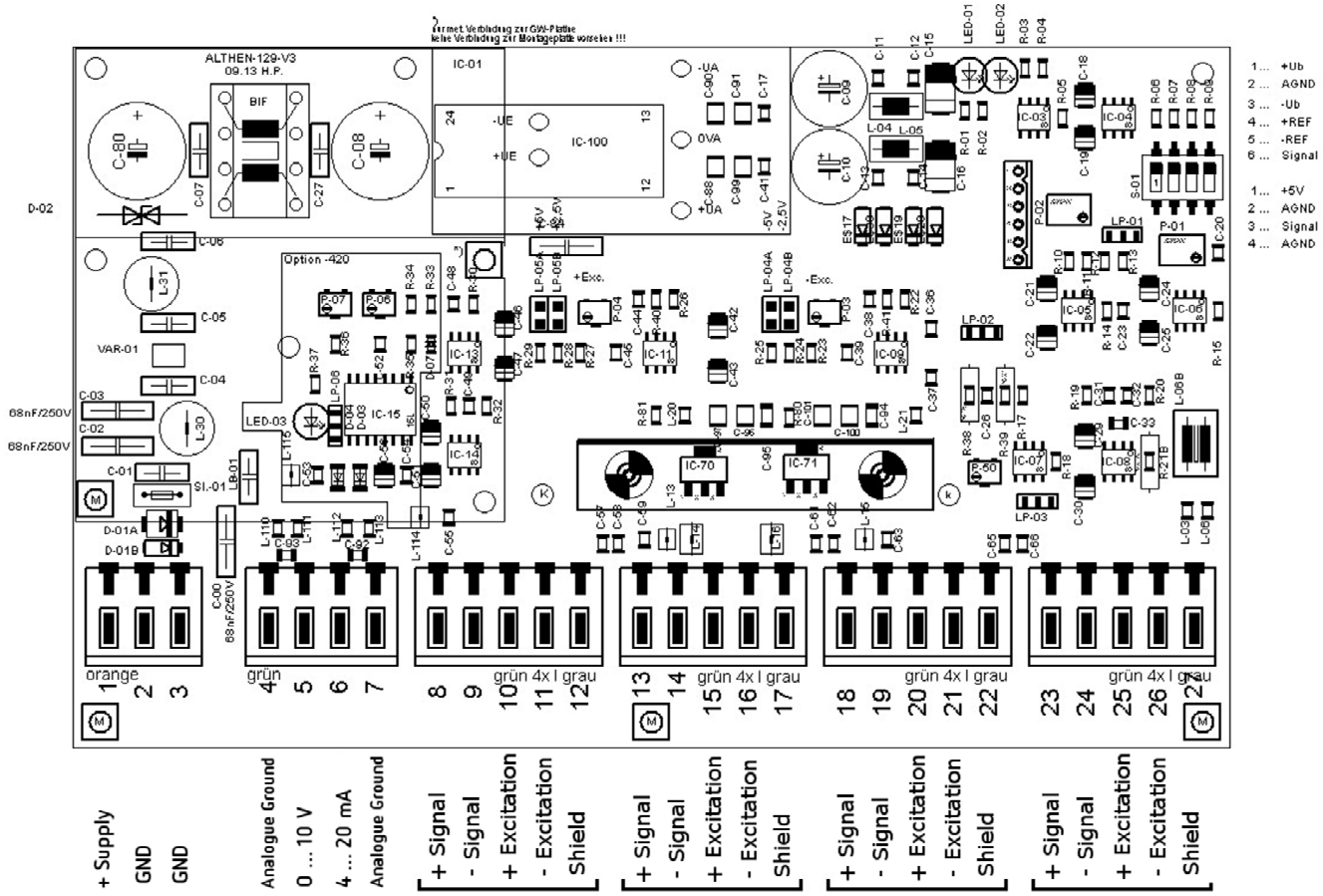
Datasheet

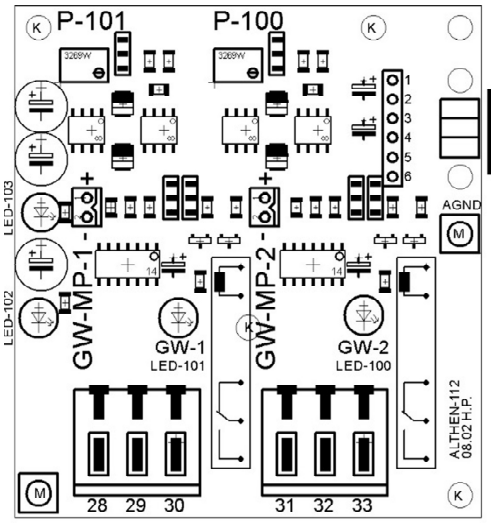
Number of measuring channels:	1	(full bridge resistance > 300 Ω), **parallel operating of up to 4 transducers with normalized signal**
Supply voltage:	10...18 VDC 18...30 VDC	Electronic protected against voltage reversal
Isolating proof voltage input to output:	200 V	Higher isolated proof voltage on request
Power consumption:	max. 8 W	
Strain gauge excitation supply:	±2.5 VDC / ±5 VDC	
Analogue output:	0 ... 10 V / ±10 V 4 ... 20 mA, only version -420-	max. 1 mA (short-period short-circuit proof) max. 500 Ω
Limit frequency (-3 dB):	1 kHz	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:	EMC-cable gland on internal terminal block	
Enclosure:	EMC-aluminum diecast enclosure (IP66)	
Dimension (B x H x D):	220 x 80 x 120 mm	
Weight:	1650 g	
Temperature, storage:	-20 °C ... +60 °C	
Temperature, operating:	-20 °C ... +50 °C	

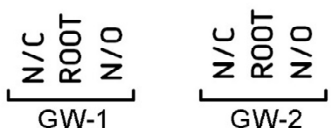
Order designation

SG-IP-...	Single channel strain gauge amplifier in an EMC-aluminum diecast enclosure (IP66)				
	...-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 **(Option)**		
			...-4P-...	For up to four strain gauge transducers with normalized sensitivity	
				...-GFxx	Limit frequency optionally up to 30 kHz **No declaration (GFxx) for standard version 1kHz**
				...-2G	2 adjustable threshold value setpoints as well as potential-free switching contacts (max. 30 VDC/ 0.5 A) **(Option)**

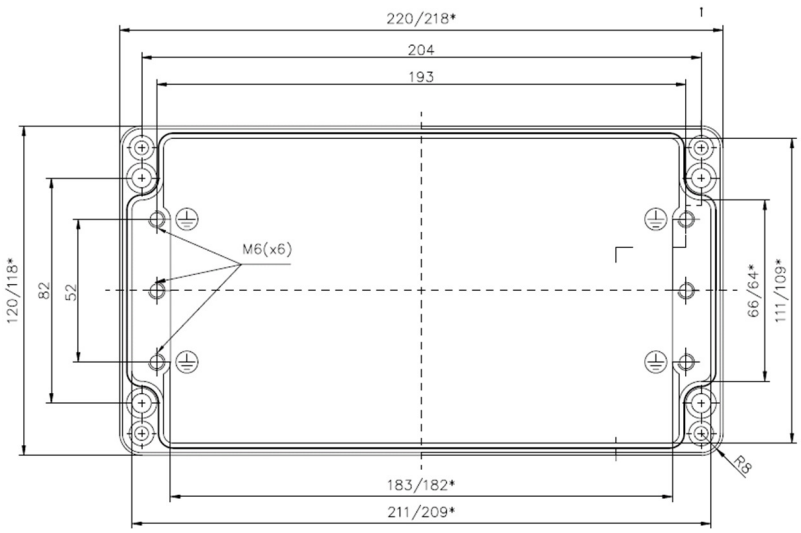
Component diagram

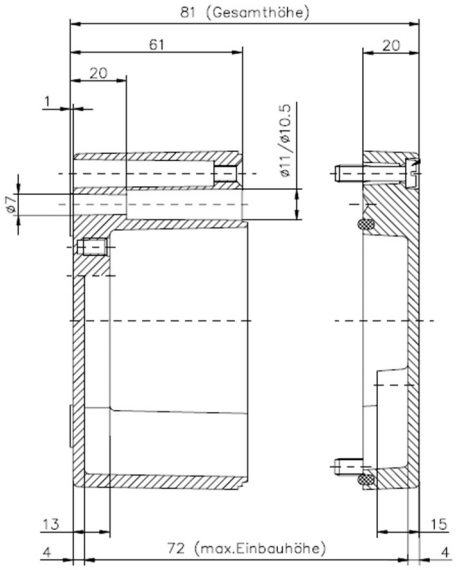






Housing dimensions





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