1-/2-Channel Strain Gauge Amplifier

for 19'' Racks

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Contents

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.

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2 Instructions for use of the measuring amplifier

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.

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 m minimize 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.

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 (10 nF / 200 V).

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.

Notice: Changes / modification 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 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

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

The described 1 or 2-channel strain gauge amplifier for 19'' rack mounting serves to supply up to 2 Strain gauge sensors with a full bridge resistance of 300 Ohms or more and the amplification of the sensors signal. The wiring can be done in 4 wire or 6 wire technology, depending on the cable lengths and variability thereof. In 6 wire, two additional wires measure the excitation directly at the sensor and the possible voltage drop is being compensated by the amplifier. The excitation of the sensors takes place with a highly stable, bipolar DC voltage of either ± 5 V (=10V) or ± 2,5 V (=5V). The input stage is a high precision differential amplifier with an input resistance of greater than 3 Megaohms.

The sensors signal, usually around 0,1 to 10 mV per Volt excitation, is amplified by the amplifier, so that an analogue output of 0 ... 10 V or ± 10 V, resp. 0 ... 20 mA or 4 ... 20 mA is available for further evaluation of the measurement. By standard the frequency band is 0 to 1 kHz. An extended band up to 30 kHz is available on request.

The coarse amplification is determined by an internal resistor and can be fine adjusted by a potentiometer (V) on front of the amplifier.

The potentiometers N_x (zero point) and V_x (amplification / final value) on the amplifiers front allow to correct the adjustment of the individual channels. An internal dip-switch allows to change the zero-point adjustment range. If, however, the different ranges should not be sufficient after all, an internal resistor (R_t) can be soldered in to suppress a greater base load / tare.

With version -15B- (bipolar ± 15 V supply voltage), the strain gauge excitation and the analogue output are not isolated galvanically. With version -12E- and -24E- they are.

With option -DA- a 3 ½ digit display for each channel is available, in which the physical value (pressure / force) corresponding to the analogue output is displayed.

4 Terminal assignment

The electrical connections are made via the 64-pin VG ledge (a+c DIN 41612). The numbering is located on said ledge.

PIN	Description
1	AGND / screen
2	n.c.
3	+ signal sensor channel 1
4	n.c.
5	– signal sensor channel 1
6	n.c.
7	+ sense channel 1
8	+ excitation channel 1
9	n.c.
10	– sense channel 1
11	– excitation channel 1
12	n.c.
13	analogue output channel 1 (0 … 10 V/ ±10 V)
14	analogue output channel 1 (4 … 20 mA)
15	n.c.
16	n.c.

PIN	Description
17	AGND / screen
18	n.c.
19	+ signal sensor channel 2
20	n.c.
21	– signal sensor channel 2
22	n.c.
23	+ sense channel 2
24	+ excitation channel 2
25	n.c.
26	– sense channel 2
27	– excitation channel 2
28	analogue output channel 2 (0 … 10 V/ ±10 V)
29	analogue output channel 2 (4 … 20 mA)

Version -15B-	
30	+ supply (+15 VDC)
31	AGND
32	– supply (-15 VDC)

Version -12E/24E-	
30	+ supply (10 … 18 VDC / 18 … 30 VDC)
31	n.c.
32	GND supply

The analogue ground (AGND, pin 31) is to be led to the central grounding point at the power supply directly and must not be looped through other devices. We strongly recommend against a switched-mode power supply! It is strongly recommended to use a linear power supply instead (e.g. Schroff, Serie PSx-215).

When an amplifier and a 4-wire transducer was ordered simultaneously, 2 intern soldering points (S-x10; Sx11) are bridged. If no transducers were ordered, pins 7 and 8, as well as 10 and 11 are to be bridged. That applies also with version -2K- for pins 23 and 24, as well as 26 and 27.

If a 6-wire transducer is being used, the above-mentioned bridges are located inside the sensor and should be removed, if still on the VG ledge.

The maximum disturbance (i.e. noise) immunity will be achieved by clamping the cable-screen directly to a clean and low-impedance ground potential (PE). To connect the cable-screen, a grounding clamp is recommended.

If direct clamping to PE is not possible, or the noise doesn't matter that much, the cable screen may be connected to pin 31 (AGND). In that case a sufficient disturbance immunity is to be checked and ensured.

4.1 Supply voltage

Version -15B-: The amplifier is to be operated with a regulated, bipolar supply voltage of ± 15 V. We strongly recommend against the usage of switched-mode power supplies. It is strongly recommended to use a linear power supply instead (e.g. Schroff, Serie PSx-215). The electronics are to be fused externally:

Si_{extern} ... 0,2 A slow (Version -1K- (1 channel)
Si_{extern} ... 0,4 A slow (Version -2K- (2 channels)

Power consumption depends on the bridge resistances of the used sensors and the used sensor excitation voltage.:

P_{max} ... approx. 4 Watt (version -1K-)
P_{max} ... approx. 8 Watt (version -2K-)

Notice: The analogue ground (AGND, pin 31) is to be led to the central grounding point at the power supply directly and must not be looped through other devices.

Version -12E-: With this version the supply voltage is nominal 12 V, but can be in the range of 10 ... 18 V. The amplifier is equipped with a resettable "Polyswitch- Resettable"® fuse. It is to be checked, if an external additional fuse is necessary. An additional external fuse of

Si_{extern} ... 0,315 A slow (Version -1K-)
Si_{extern} ... 0,5 A slow (Version -1K-)

is recommended.

Power consumption depends on the bridge resistances of the used sensors and the used excitation voltage.:

P_{max} ... approx. 4 Watt (version -1K-)
P_{max} ... approx. 8 Watt (version -2K-)

Version -24E-: With this version the supply voltage is nominal 24 V, but can be in the range of 10 ... 18 V. The amplifier is equipped with a resettable "Polyswitch- Resettable"® fuse. It is to be checked, if an external additional fuse is necessary. An additional external fuse of

Si_{extern} ... 0,315 A slow (Version -1K-)
Si_{extern} ... 0,5 A slow (Version -1K-)

is recommended.

Power consumption depends on the bridge resistances of the used sensors and the used excitation voltage.:

P_{max} ... approx. 4 Watt (version -1K-)
P_{max} ... approx. 8 Watt (version -2K-)

4.1.1 Galvanic isolation

Version -15B-: The supply voltage and the analogue output are NOT isolated galvanically.

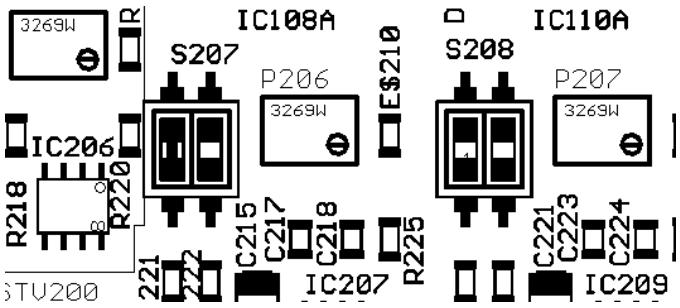
Version -12E- and -24E-: The supply voltage and the analogue output are isolated galvanically. To deactivate this isolation, GND supply and AGND are to be bridged.

4.2 Strain gauge excitation voltage

The described measuring amplifier is able to supply up to two strain gauge transducers, depending on the version. Any strain gauge full bridge sensor with a bridge resistance of 300 Ohms or more may be connected. The excitation of the sensors takes place with a highly stable, bipolar DC voltage of either ± 5 V (=10V) or ± 2,5 V (=5V).

This value can be selected for each channel by DIP-switches S-x07 (+ voltage) and S-x08 (– voltage). The voltage can be fine adjusted by potentiometers Px06 and Px07.

S-x07/1	S-x07/2	S-x08/1	S-x08/2	Strain Gauge Supply
ON	OFF	ON	OFF	10 Vdc (±5 Volt)
OFF	ON	OFF	ON	5 Vdc (±2,5 Volt)



DIP-switches and potentiometers for adjustment (channel 2 in this example)

Notice: In case of operating a 6-wire transducer, it is imperative to connect the sense-wires. If not, the sensor is likely to be damaged. Wiring examples are shown in the chapters 4.2.x.

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 is 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 excitation and sense clamps must be bridged. 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.

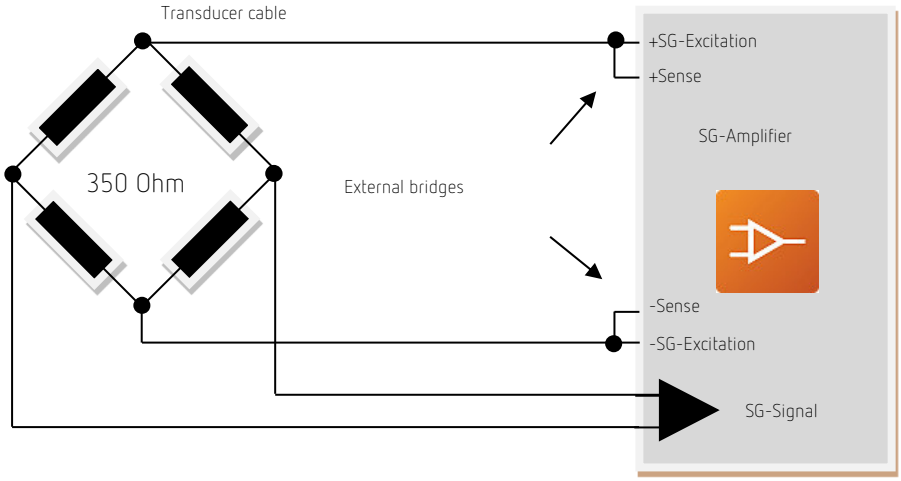


Fig. 1: Connection in 4-wire technology

4.2.3 Lengthening 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.

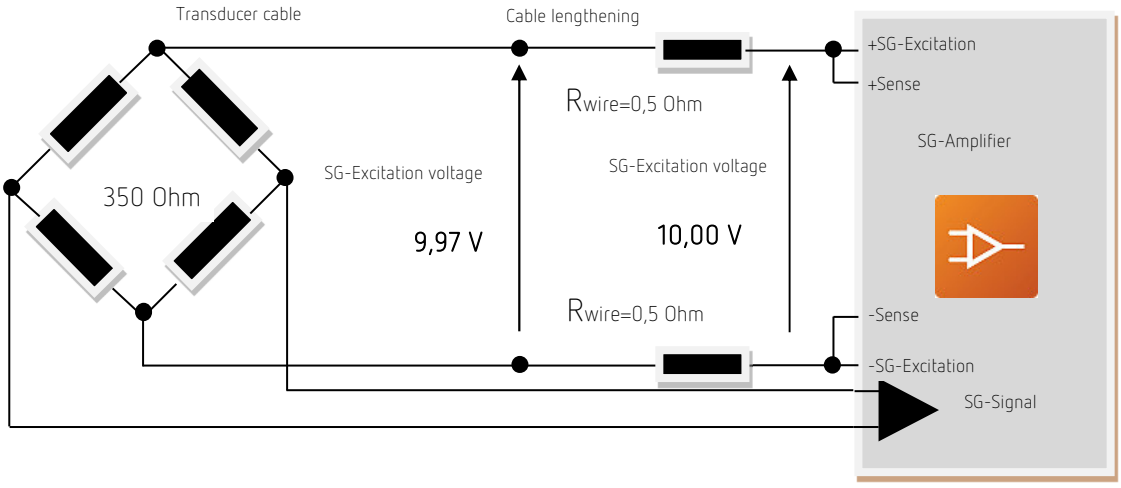


Fig. 2: Connection in 4-wire technology; drop of SG-Excitation voltage caused by cable lengthening (0,5 Ohm)

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

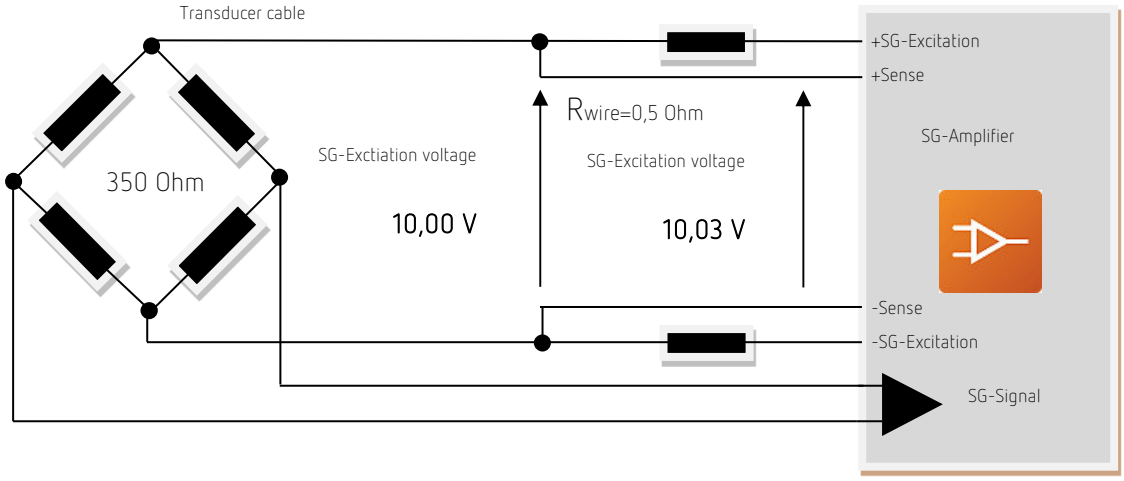


Fig. 3: Sensor with 4 wire cable. Lengthened with 6 wire cable

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 bridges between sense and excitation clamps must be removed. Otherwise the 6-wire technology does not have the desired effect.

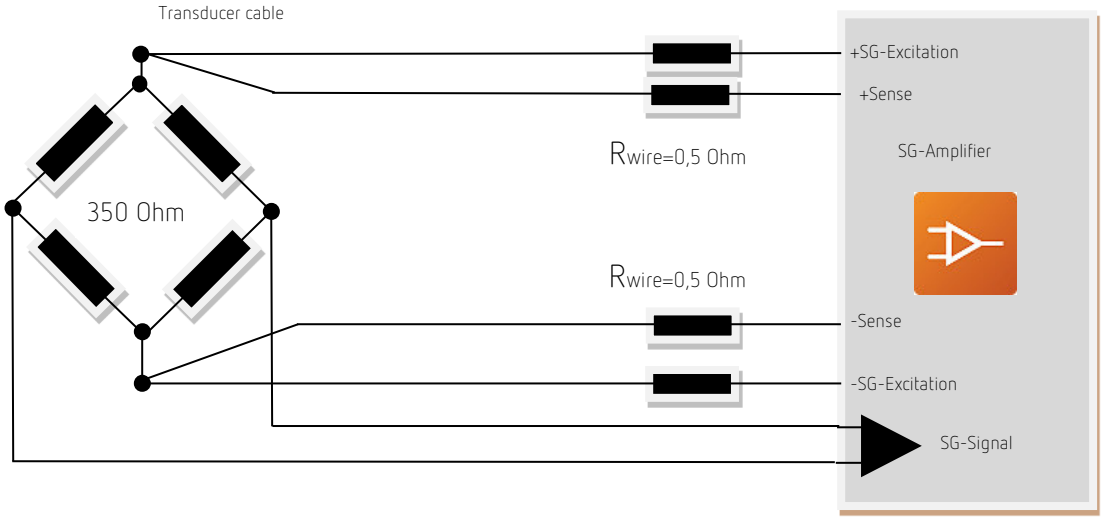


Fig. 4: Connection in 6-wire technology

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)

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 a 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 chapter 5.1

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.

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 assignment of transducer / amplifier is to be complied with. After replacing a transducer, the calibration has to be checked.

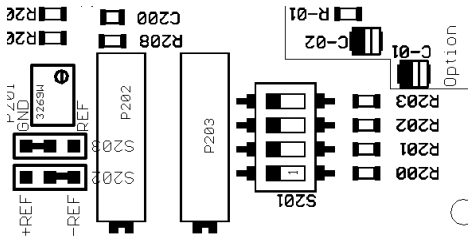
5.1 Zero-point adjustment range

It is to be noted that there is a slight dependence between zero-point adjustment and amplification (gain).

The range can be changed by setting the dip-switch according to the table below:

Sx01-1	Sx01-2	Sx01-3	Sx01-4	corresponding to the analogue voltage output
ON	ON	ON	ON	– 0,85 V ... + 0,85 V
ON	OFF	OFF	ON	– 2,1 V ... + 2,1 V
ON	OFF	ON	OFF	- 0,8 V ... - 4 V
OFF	ON	OFF	ON	+ 0,8 V ... + 4 V

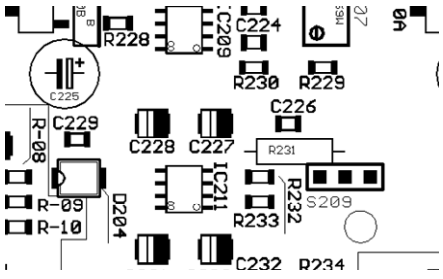
Notice: A base load reduces the remaining load capacity by just that value. Overloading may cause damage!



5.2 Resistor Rt (Tare)

A potential base load can be electrically suppressed by an additional resistor on the pcb, if an expansion of the zero-point adjustment range is not sufficient. (R_{tara})

The value of the resistor can be found in the table below. The resistor is then to be soldered to the solder pins (R_{tara}) on the pcb. In addition, the solder point (S-x09) has to be set to + or –, corresponding to the tare-load.



Rtara and S-x09

Rt=180k +1 Volt bzw. -1 Volt

Rt=100k +1,6 Volt bzw. -1,6 Volt

Rt=47k 3 Volt bzw. -3 Volt

Rt=20K 5 Volt bzw. -5 Volt

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

5.3 Check/Adjustment of the amplifier

In order to check or adjust the amplifier, at least one multimeter has to be connected to one of the analogue outputs. Please refer to page "component diagram".

Before a check or an adjustment, a warm-up time of approx. 30 mins should be kept.

Functional Check:

- Unload the measuring device.*
- Connect the multimeter (refer to chapter 4 "Terminal Assignment").
- Set the analogue output to 0 Volts resp. 4 mA using P103, resp. P203.
- Load the measuring device (i.e. the transducer) at least 3 times with full 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 adjusted. Above that, the installation position and the overall setup might need an inspection.

Adjustment:

- Unload the measuring device.*
- Connect the multimeter (refer to chapter 4 "Terminal Assignment").
- Set the analogue output to 0 Volts resp. 4 mA using P103, resp. P203.
- Load the measuring device (i.e. the transducer) at least 3 times with full 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.
  The analogue output value, corresponding to the load is to be set by a qualified person by using Px02

*Unloaded means with:

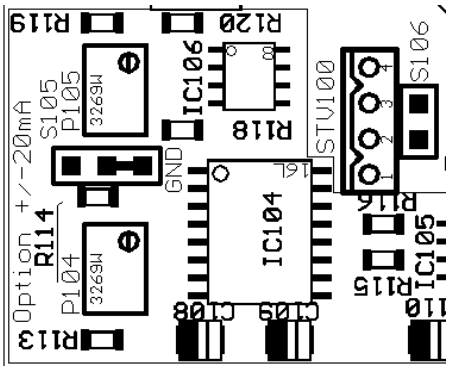
Force transducers:	no applied force at all
Pressure transducers	no pressure, except atmospheric influence

In this unloaded state adjust the zero-point by using potentiometer Px03.

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

5.3.1 Correction of the analogue current output

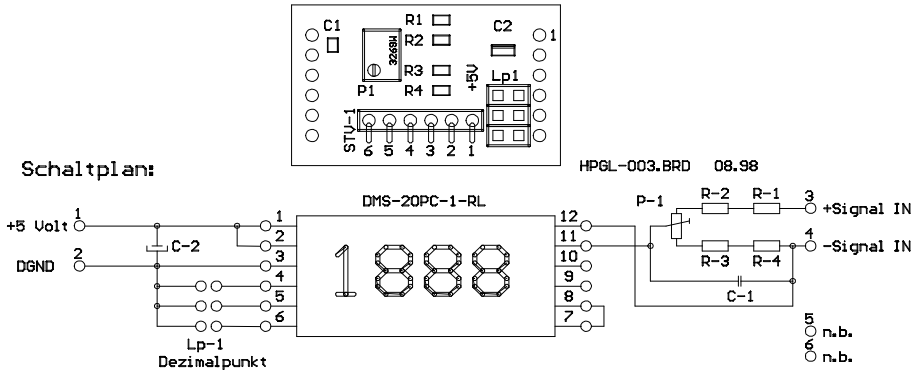
The amplifier is being done adjusted with the potentiometers "NULLPUNKT" Nx and "VERSTÄRKUNG" / "ENDWERT" Vx. This basic calibration adjusts the analogue voltage output. The analogue current output follows the voltage output. Thus, the analogue current output does not need to be corrected – it is been done right in the factory. If, however, the current output does need an adjustment, it can be done by 2 potentiometers inside the amplifier: Px05 for zero and Px04 for gain / final value.



5.3.2 Optional Display

With option -DA- a 3 ½ digit display for each channel is available, in which the physical value (pressure / force) corresponding to the analogue output is displayed.

An input voltage of 2 V on PIN 11 equals 1999 displayed. The desired scaling can be determined by resistors R1 to R4 and fine adjusted by potentiometer P-1



Schematic display

5.4 Calculation of the 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 appliance 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

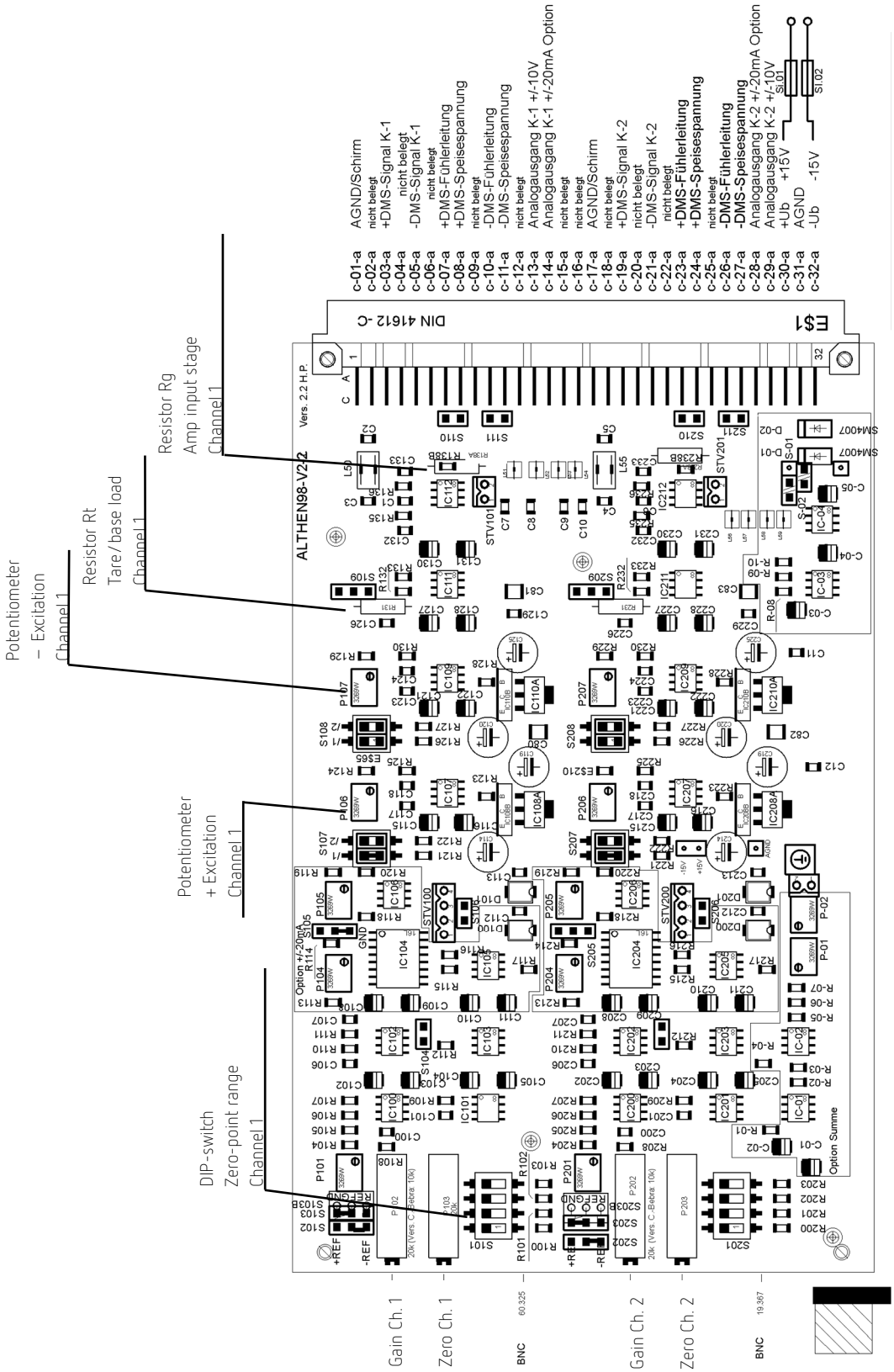
Datasheet

Number of measuring channels:	1 (SG-1K-...) Strain gauge-full bridge >300 Ω 2 (SG-2K-...) Strain gauge-full bridge >300 Ω	
Supply voltage:	±15 VDC 10 ... 18 VDC 18 ... 30 VDC	
Power consumption:	max. 8 W	
Strain gauge excitation:	± 2,5 VDC / ± 5 VDC	
Analogue output:	0 ... 10 V / ±10 V 4 ... 20 mA	max. 1 mA max. 500 Ω
Limit frequency (-3 dB):	1 kHz	optional up to 30 kHz
Input resistance:	>3 MΩ	
Gain factor:	10 ... 2000	
Non linearity:	±0,05 % v.E.	
Electrical connection:	VG-ledge (64-pole, a+c, DIN 41612) BNC-connector on front	
Housing:	Euroboard (Version -EK-) 19"-rack mounting case (Version -KA-)	
PCB installation depth	160 mm	
Front plate:	7TE/3HE (Version -15B-) 14TE/3HE (Version -12E; Version -24E-) 10TE/3HE (Version –DA)	
Weight:	max. 500 g, depending on front plate version	
Temperature, storage:	-20°C ... +60°C	
Temperature, operating:	0°C ... +50°C	

Order designation

SG-1K-...	1-channel strain gauge amplifier			
SG-2K-...	2-channel strain gauge amplifier			
	...-EK-...	Euroboard		
	...-KA-...	19"-rack mounting case		
		...-15B-...	Supply voltage: ±15 VDC	
		...-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: 4 ... 20 mA
				...-DA 3½-digit display

Component diagram



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