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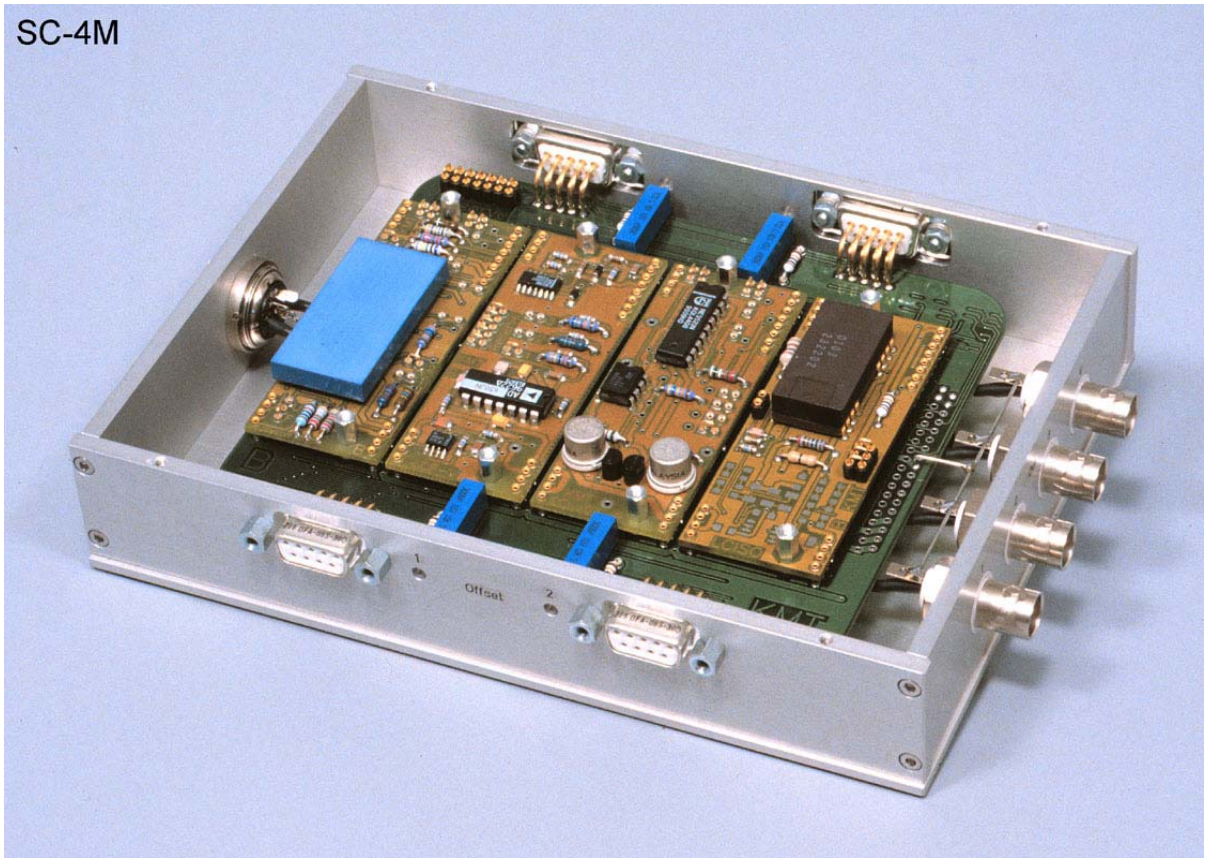
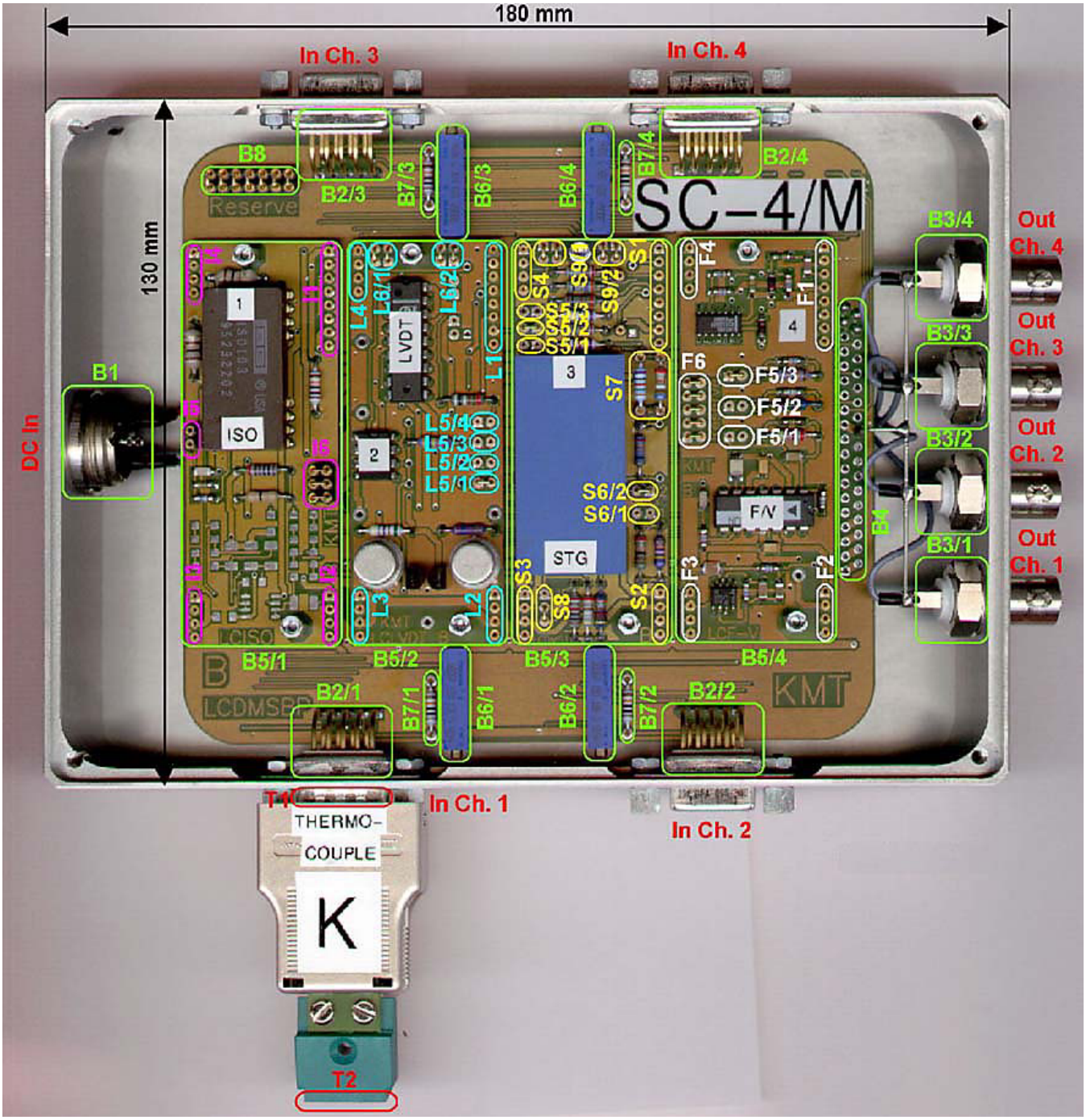
SC-4/M

User manual

4-channel measuring amplifier

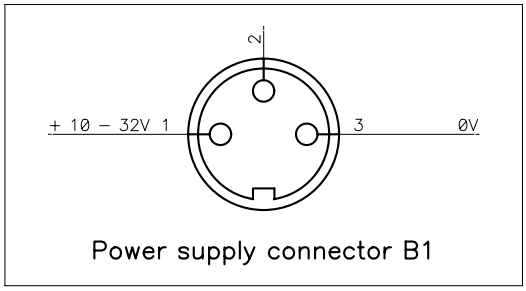


including signal conditioning modules
STG, ACC, LVDT, ISO, THERMO,
F/V, ICP, FILTER


180 mm
130 mm
In Ch. 3
In Ch. 4
SC-4/M
Reserve
B8
B2/3
B7/3
B6/3
B6/4
B7/4
B2/4
B3/4
Out Ch. 4
B3/3
Out Ch. 3
B3/2
Out Ch. 2
B3/1
Out Ch. 1
B1
DC In
ISO
LVDT
STG
F/V
F1
F2
F3
F4
F5/3
F5/2
F5/1
F6
B4
B5/1
B5/2
B5/3
B5/4
B2/1
B2/2
B7/1
B6/1
B6/2
B7/2
KMT
LCDMSB
T1
THERMO-
COUPLE
K
T2
In Ch. 1
In Ch. 2

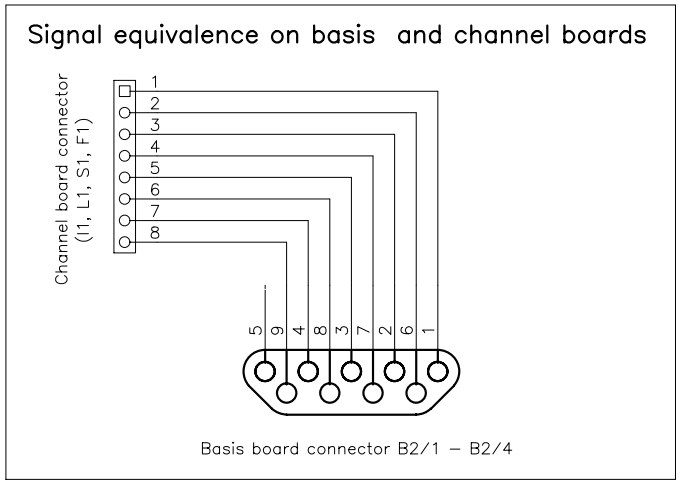
Basis board

- 4 signal conditioning modules per unit (B5/1 - B5/4)
- Daisy chaining of up to 4 units (16-channel system)
- Power supply: 10 - 36V DC (B1)

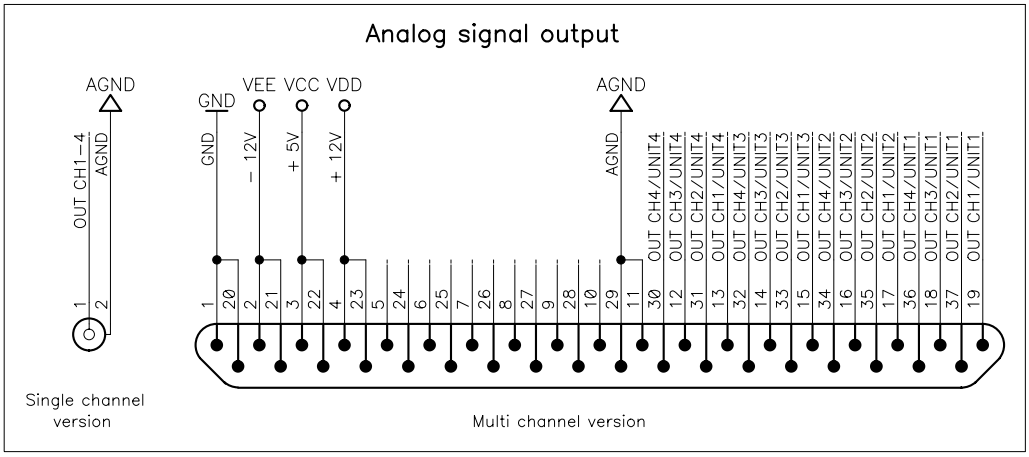


Power supply connector B1

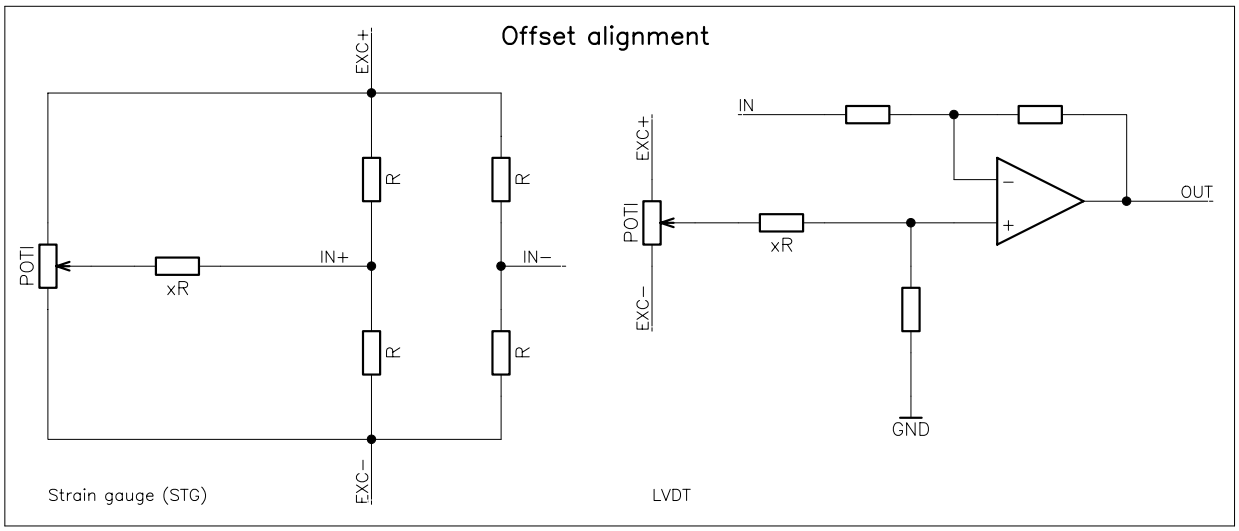
- Size: 180 x 130 x 35 mm
- Weight: 700g including 4 signal conditioning modules
- Signal input connector (B2/1 - B2/4): direct connected with channel board connectors (I1, L1, S1, F1)



- Signal output connector: single output via BNC (B3/1 - B3/4) or common connector (B4)



- Offset alignment over variable resistor (B6/1 - B6/4) for STG and LVDT channels



The resistors named R symbolize the full bridge of strain gauge (STG) modules. An off-tuned branch of the bridge can be compensated using the variable resistor POTI (B6/1 - B6/4). The offset range will determined by the fixed resistor named xR (B7/1 - B7/4) with the default value 100kΩ. General the following formula are valid:

$$\Delta V_{ALIGN} = \frac{\pm V_{EXC}}{4x} \quad \text{with} \quad V_{EXC} = V_{EXC+} - V_{EXC-} \quad \text{and} \quad x = \frac{xR}{R}$$

Example: $xR = 100k\Omega,\ R = 120\Omega,\ V_{EXC} = 8V$

$$\Rightarrow \quad x = \frac{100k\Omega}{120\Omega} \quad \text{and} \quad \Delta V_{ALIGN} = \pm\frac{8V}{4x} = \pm\frac{8V \cdot 120\Omega}{4 \cdot 100k\Omega} = \pm 2{,}4mV$$

Is with the default configuration an zero offset alignment not possible, the fixed resistor (B7/1 - B7/4) is to decrease (for example xR = 10kΩ increases the offset range to ±24mV).

At the LVDT module the offset alignment takes place on the final amplifier. Here the offset range additional depend on the adjusted gain. But general two basic laws are also valid as at the STG module:

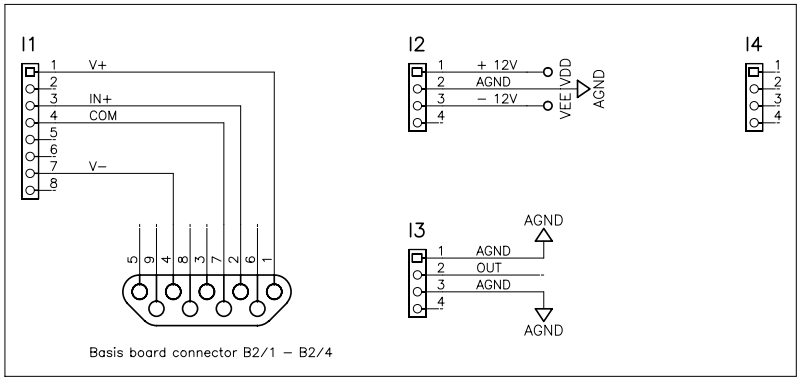
⇒ Decreasing the fixed resistor xR (B7/1 - B7/4) will increases the alignment range.

⇒ Increasing the fixed resistor xR (B7/1 - B7/4) will increases the alignment accuracy.

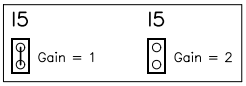
- Spare jumpers (B8)

Isolation amplifier (ISO)

- Combination with Thermo module possible
- Optional fixed filter on board (4-pole Butterworth, 3dB at 4Hz, 0.05dB at 1Hz, > 80dB at 50Hz)
- Optional Filter on adaptive board
- Pin description of connectors to basis board (I1, I2, I3, I4)



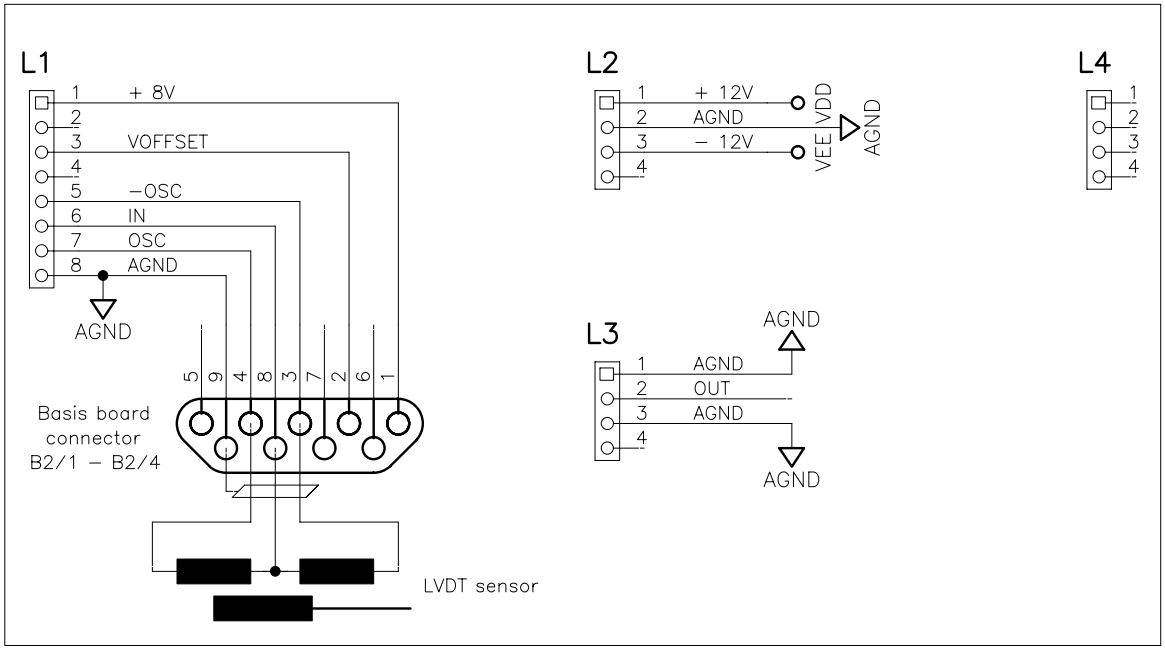
- Gain: 1 (optional G = 2 also available, I5)



- Input and output voltage range: ± 5V
- Isolated power outputs
- Band width (small signal): 20kHz
- Offset: typ. ± 20mV (max. ±60mV)
- Slew rate: 1.5V/µs
- Operating temperature range: - 40°C ... + 80°C
- Spare jumpers (I6)

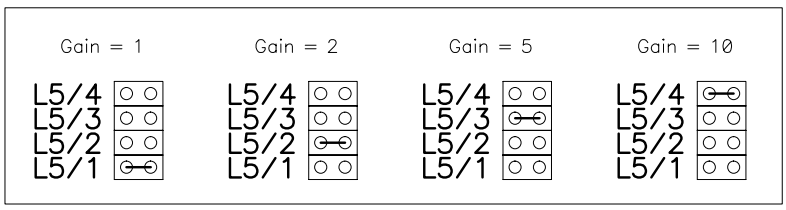
LDVT module

- Optional Filter on adaptive board
- Pin description of connectors to basis board (L1, L2, L3, L4)



- Sensor supply: 5 kHz sinusoidal, $\hat{V}$ = 2.5V, 300Ω max. load
- Programmable gain: 1, 2, 5, 10 (L5/1 - L5/4)

Measuring range:
G=1: ± 5V correspond to ± 10mm
G=2: ± 5V correspond to ± 5mm
G=5: ± 5V correspond to ± 2mm
G=10: ± 5V correspond to ± 1mm

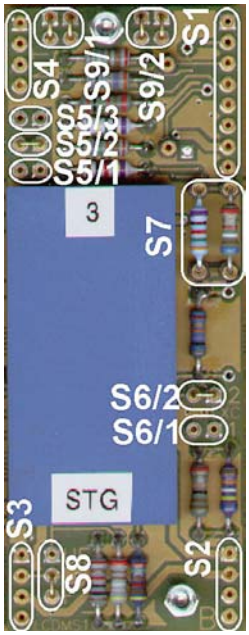


- Signal band width: 400Hz
- Output voltage range: ± 5V, I_{max} = 5mA
- Linearity error: ± 1%
- Operating temperature range: - 40°C ... + 80°C
- Spare jumpers (L6/1, L6/2)

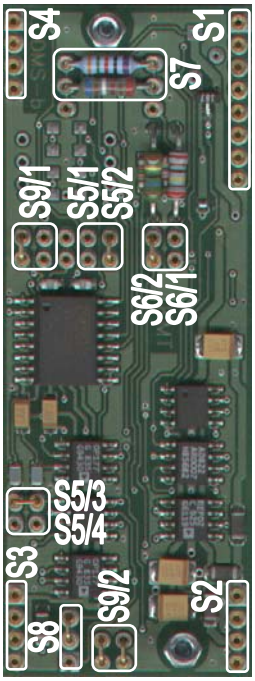
Strain gauge amplifier (STG)

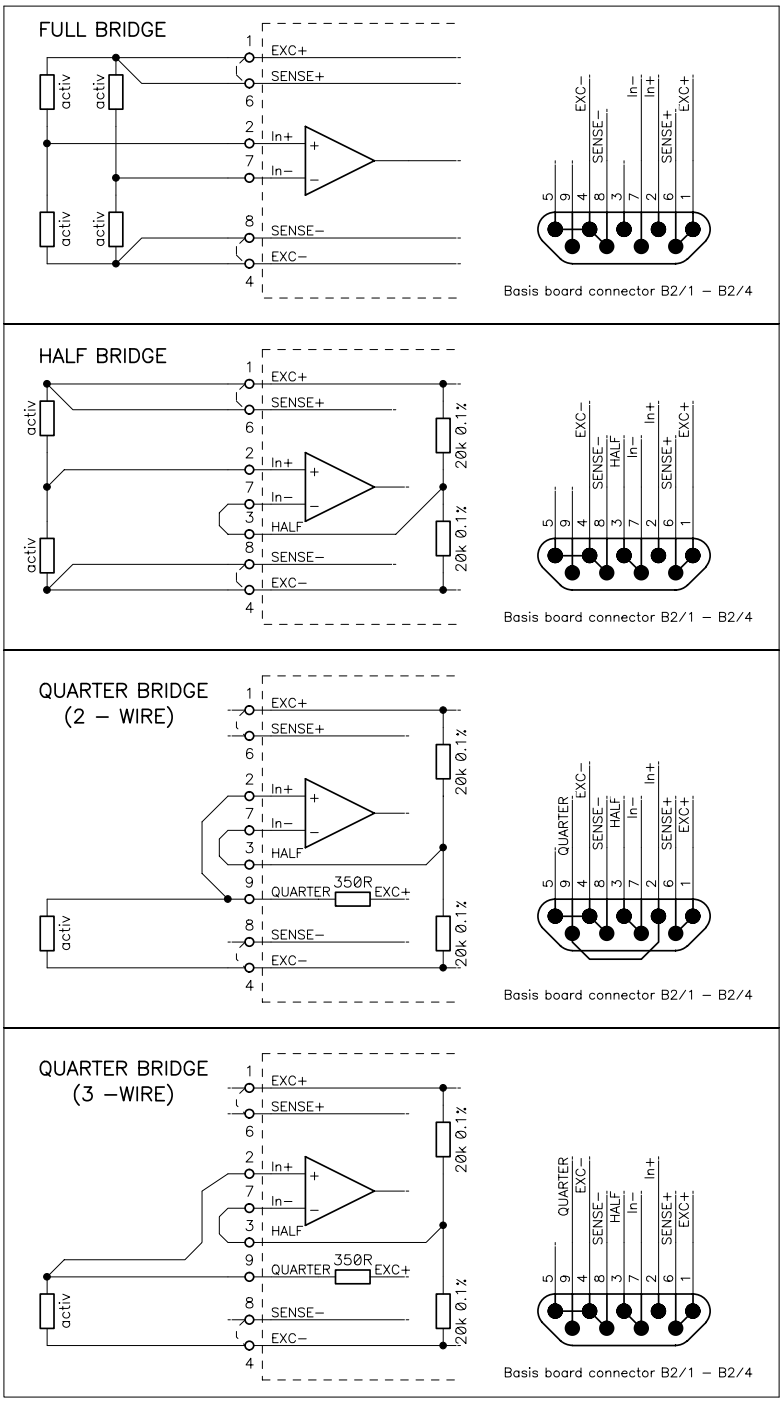
- Optional Filter on adaptive board
- 2- and 3-wire quarter bridges as also half and full bridges from 120Ω to 1kΩ

STG module version 2



STG module version 3

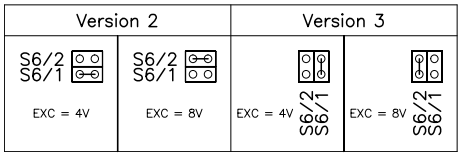




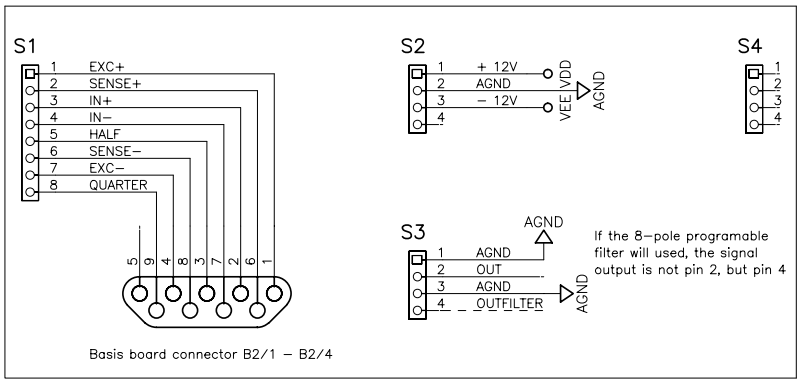
- Programmable gain: 1 or 2, 10, 100, 1000 (S5/1 - S5/4)

Version 2				Version 3			
S5/3 S5/2 S5/1	S5/3 S5/2 S5/1	S5/3 S5/2 S5/1	S5/3 S5/2 S5/1	S5/1 S5/2	S5/1 S5/2	S5/1 S5/2	S5/1 S5/2
Gain = 2	Gain = 10	Gain = 100	Gain = 1000	Gain = 1	Gain = 10	Gain = 100	Gain = 1000
				S5/3 S5/4	S5/3 S5/4	S5/3 S5/4	S5/3 S5/4

- Programmable excitation voltage: 4V, 8V (S6/1 S6/2)

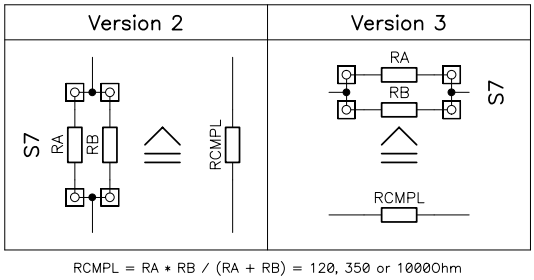


- Pin description of connectors to basis board (S1, S2, S3, S4)

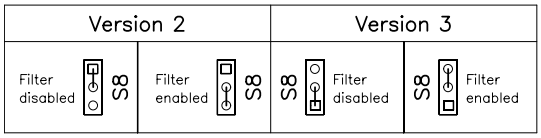


- Zero offset alignment over full measure range using variable resistor (see Basis board)

- Quarter bridge completion can be altered by plugged resistors (S7)



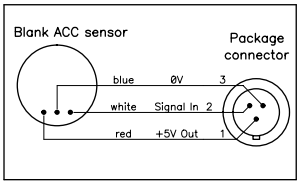
- The output of the amplifier pass through a fixed 2-pole Butterworth low pass filter with 3dB at 5kHz and 40dB attenuation per decade. With the jumper S8 it is possible to disable this filter with the exception, that for version 2 the set gain is divided by -2. That means if you select a gain of 1000, you have on the unfiltered output an inverted signal with a gain of 500. For version 3 the gain of the filtered and unfiltered output is equal.



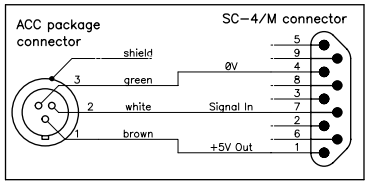
- Input voltage range: ± 5V, Z_{in} = 10MΩ
- Output voltage range: ± 5V, I_{max} = 5mA
- Linearity error: ± 0.1%
- Operating temperature range: - 40°C ... + 80°C
- Spare jumpers (S9/1, S9/2)

ACC sensor and module

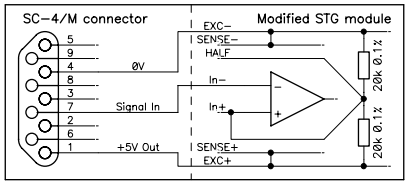
- The capacitive acceleration sensor ACC measures accelerations and vibrations as well as inclination of objects and are conceived for measurements on vehicles, machines, buildings and plants. They also guarantee for fast diagnosis of errors and are extraordinarily appropriated for stress control at strained components. Very remarkable properties are the shock resistance up to 10000g, the high long-term stability, the hermetically sealed housing (IP65), the true DC response and the very low temperature drift.
- Next drawing shows the pin assignment from the sensor to the module.



ACC inside package connections



ACC cable to SC−4/M



SC−4/M inside connections

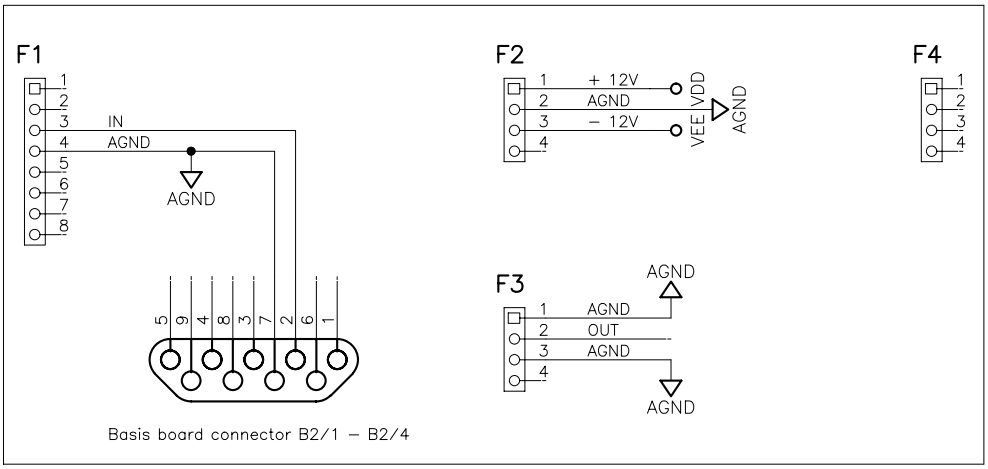
- By rectangular mounting of 3 sensors on a cube the acceleration vector in a 3-dimensional area can be determined. The sensor integrated circuit converts the capacitive response from the gas-dynamical damped spring-mass-system in a non-calibrated small analog voltage. The sensor assigned module amplifies this signal in a calibrated output voltage in the ±5V range and enables the possibility of jumper programmable measuring ranges.
- From point of hardware the signal conditioning module is equivalent to the STG module (see previous chapter) with the exception of only one excitation voltage and gain calibration assigned to the specific sensor. Therefore pay attention to the fact, that the serial number of the sensor is equal to that labeled on module. Three different acceleration sensor models are available.

Model	B1	B2	B3
Sensor range	± 3g	± 10g	± 50g
Jumper Programmable Ranges on Module (see STG)	±3g ±1g S5/3 S5/3 S5/2 S5/2 S5/1 S5/1	±10g ±5g ±1g S5/3 S5/3 S5/3 S5/2 S5/2 S5/2 S5/1 S5/1 S5/1	±50g ±20g ±5g S5/3 S5/3 S5/3 S5/2 S5/2 S5/2 S5/1 S5/1 S5/1
Sensor supply voltage	EXC = 5V (fixed) S6/2 S6/1	EXC = 5V (fixed) S6/2 S6/1	EXC = 5V (fixed) S6/2 S6/1
Band width	0-160 Hz	0-350 Hz	0-550 Hz
Resolution	10^{-3}g	10^{-2}g	10^{-1}g

- Zero offset alignment of at least the earth gravitation (±1g) using variable resistor (see Basis board)
- Fixed filter on board (2-pole Butterworth, 3dB at 2kHz, 40dB per decade, see previous chapter for S8)
- Optional Filter on adaptive board
- Input voltage range: ± 5V, Z_{in} = 10MΩ
- Output voltage range: ± 5V, I_{max} = 5mA
- Linearity error: ± 0.1%
- Operating temperature range: - 40°C ... + 80°C
- Spare jumpers (see previous chapter for S9/1, S9/2)

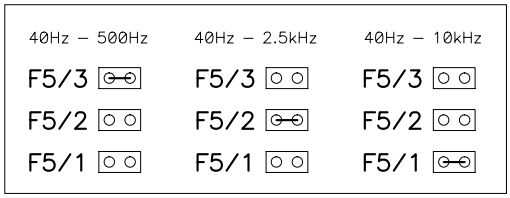
Frequency to voltage converter (F/V)

- Pin description of connectors to basis board (F1, F2, F3, F4)



- Programmable frequency range: 40Hz - 500Hz, 40Hz - 2.5kHz, 40Hz - 10kHz

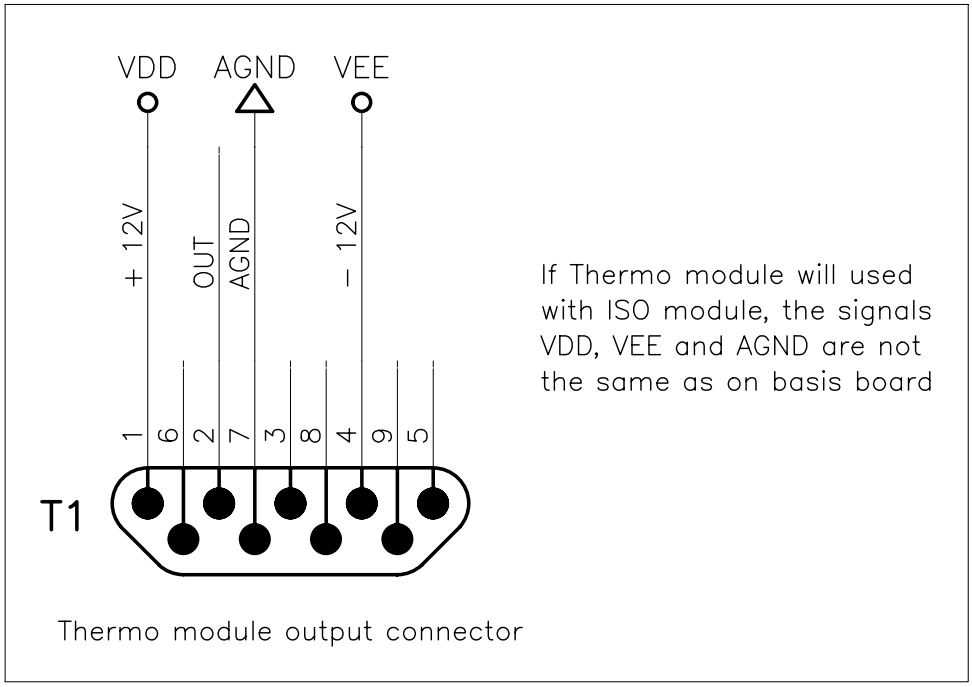
  (maximum frequency is equivalent to 5V output voltage, F5/1 - F5/3)



- Input voltage range: U_A = 0.3V - 10V
- Wave forms: sine, square, and triangle
- Fixed output filter on board (2-pole Butterworth, 3dB at 10Hz, 40dB at 100Hz)
- Output voltage range: 0V - 5V, I_{max} = 5mA
- Linearity error: ± 0.2%
- Operating temperature range: - 40°C ... + 80°C
- Spare jumpers (F6)

Thermo amplifier

- Temperature measurement on voltage isolated parts
- Cold junction compensation
- Thermo couples type J and K available (T2)
- not galvanic isolated (possible by combining with Isolation amplifier)
- Pin description of connectors to basis board (T1)



- Temperature measurement range: -20°C - +600°C
- Gain: 10mV/°C (pay attention to non-linearity !)
- Output voltage range: 0V - 6.5V
- Linearity error: ± 3% additional the error of thermo couple

  (compensation with linearization table possible)
- Operating temperature range: - 40°C ... + 80°C

- Linearization table for thermo couple type K

Temperature °C	Thermo couple Type K output voltage (mV)	Thermo amplifier output voltage (mV)
- 200,0	- 5,891	- 1454,0
- 180,0	- 5,550	- 1370,0
- 160,0	- 5,141	- 1269,0
- 140,0	- 4,669	- 1152,0
- 120,0	- 4,138	- 1021,0
- 100,0	- 3,553	- 876,0
- 80,0	- 2,920	- 719,0
- 60,0	- 2,243	- 552,0
- 40,0	- 1,527	- 375,0
- 20,0	- 0,777	- 189,0
- 10,0	- 0,392	- 94,0
0,0	0	2,70
10,0	0,397	101,0
20,0	0,798	200,0
25,0	1,000	250,0
30,0	1,203	300,0
40,0	1,611	401,0
50,0	2,022	503,0
60,0	2,436	605,0
80,0	3,266	810,0
100,0	4,095	1015,0
120,0	4,919	1219,0
140,0	5,733	1420,0
160,0	6,539	1620,0
180,0	7,338	1817,0
200,0	8,137	2015,0
220,0	8,938	2213,0
240,0	9,745	2413,0
260,0	10,560	2614,0
280,0	11,381	2817,0
300,0	12,207	3022,0
320,0	13,039	3327,0
340,0	13,874	3434,0
360,0	14,712	3641,0
380,0	15,552	3849,0
400,0	16,395	4057,0
420,0	17,241	4266,0
440,0	18,088	4476,0
460,0	18,938	4686,0
480,0	19,788	4896,0
500,0	20,640	5107,0
520,0	21,493	5318,0
540,0	22,346	5529,0
560,0	23,198	5740,0
580,0	24,050	5950,0
600,0	24,902	6161,0

- Linearization table for thermo couple type J

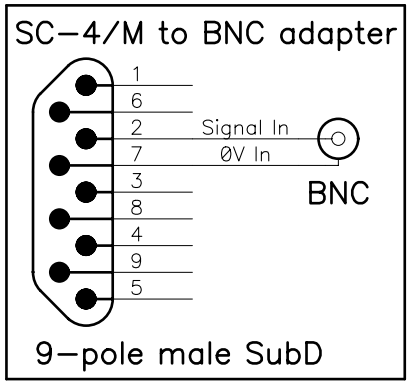
Temperature °C	Thermo couple Type J output voltage (mV)	Thermo amplifier output voltage (mV)
- 200,0	- 7,890	- 1523,0
- 180,0	- 7,402	- 1428,0
- 160,0	- 6,821	- 1316,0
- 140,0	- 6,159	- 1188,0
- 120,0	- 5,426	- 1046,0
- 100,0	- 4,632	- 893,0
- 80,0	- 3,785	- 729,0
- 60,0	- 2,892	- 556,0
- 40,0	- 1,960	- 376,0
- 20,0	- 0,995	- 189,0
- 10,0	- 0,501	- 94,0
0,0	0,0	3,10
10,0	0,507	101,0
20,0	1,019	200,0
25,0	1,277	250,0
30,0	1,536	300,0
40,0	2,058	401,0
50,0	2,585	503,0
60,0	3,115	606,0
80,0	4,186	813,0
100,0	5,268	1022,0
120,0	6,359	1233,0
140,0	7,457	1445,0
160,0	8,560	1659,0
180,0	9,667	1873,0
200,0	10,777	2087,0
220,0	11,887	2302,0
240,0	12,998	2517,0
260,0	14,108	2732,0
280,0	15,217	2946,0
300,0	16,325	3160,0
320,0	17,432	3374,0
340,0	18,537	3588,0
360,0	19,640	3801,0
380,0	20,743	4015,0
400,0	21,846	4228,0
420,0	22,949	4441,0
440,0	24,054	4655,0
460,0	25,161	4869,0
480,0	26,272	5084,0
500,0	27,388	5300,0
520,0	28,511	5517,0
540,0	29,642	5736,0
560,0	30,782	5956,0
580,0	31,933	6179,0
600,0	33,096	6404,0

ICP Amplifier

- Acceleration and acoustics measurement with all ICP and compatible sensors
- 4 programmable excitation currents: 1, 2, 4 and 20mA (optional others)
- 7 programmable gains: 0.5, 1, 2, 4, 8, 16, 32 (optional others)
- Changed jumpers will only initialized after power off/on !

Gain settings				Excitation settings
	0.5		8	1mA
	1		16	2mA
	2		32	4mA
	4		32	20mA

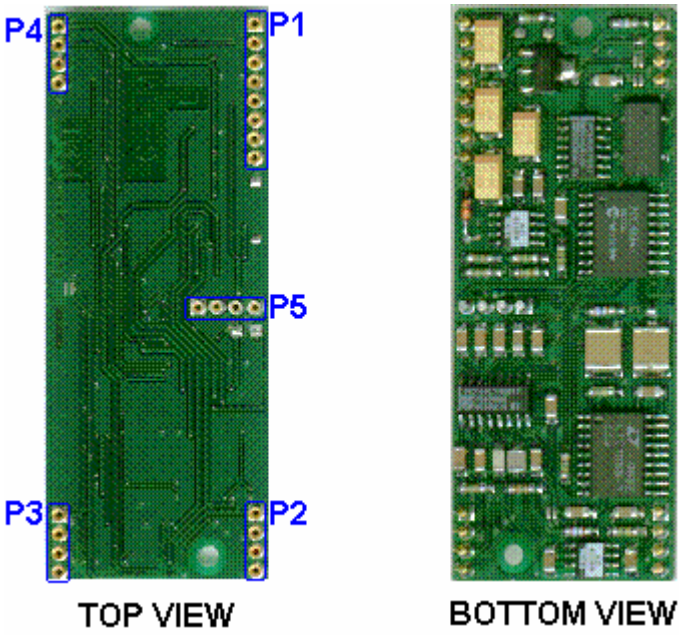
- Pin description of connectors to basis board compatible to all other signal conditioning modules



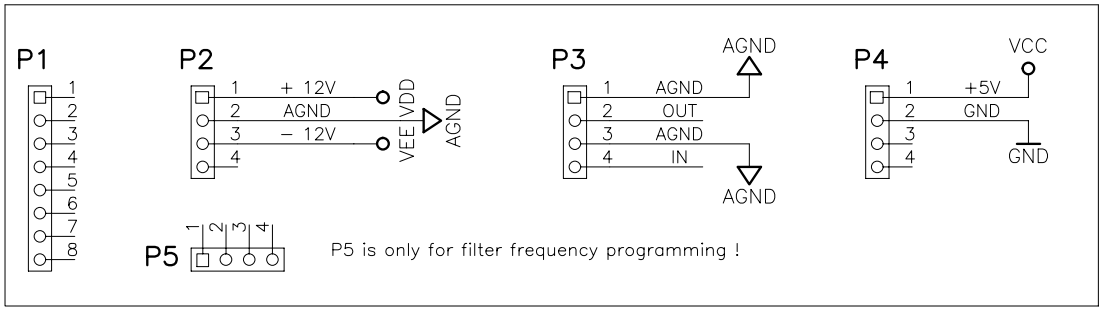
- Signal band width: 5 –16000Hz
- Output voltage range: ± 5V, I_{max} = 5mA
- Linearity error: ± 1%
- Operating temperature range: - 40°C ... + 80°C
- Offset adjustment disabled (not necessary)

Filter module

- Combination with ISO, LVDT and STG modules possible (filter board will plugged under module board)
- 8th order elliptic or linear phase frequency response available
- For an elliptic frequency response are over 2000 cutoff frequencies with a range from 10Hz to 7,5kHz fixed programmable (reciprocal scale)
- For a linear phase frequency response are over 1000 cutoff frequencies with a range from 10Hz to 3,8kHz fixed programmable (reciprocal scale)
- Frequency characteristic and cutoff frequency are specified by order (reprogramming of filters are every time in our company possible)



- Pin description of connectors to basis board (P1, P2, P3, P4)



- ATTENTION! The signal outputs of the modules (ISO, LVDT, STG) are situated over pin2 of P3. Will modules equipped with filters later (not delivered of our company), then cut the output signal of module from pin2 (I3, L3, S3) and connect it with pin4. If you work with modules, delivered with filters from our company, without using the filter, then connect pin2 with pin4.

- Input and output signal voltage range: ±5V
- Resolution without post filtering: 14 bit
- Offset: ±2mV
- Operating temperature range: - 40°C ... + 80°C
- Measured frequency response: