bmc messsysteme gmbh

MA-UNI

Isolating universal measuring amplifier (5B)

Perfectly conditioned. Universal.

The measuring amplifier MA-UNI adjusts signals of different type and size to the 5V input of a PC data acquisition system. With 10kHz bandwidth, it is ideal for dynamic signals. An all-rounder in signal conditioning optimizing performance and accuracy of your measuring system.

5B technology. Industrial standard.

The pin assignment of the 5B module corresponds to the 5B module standard of Analog Devices and Burr Brown. An additional 0EX pin has been introduced for sensors requiring unipolar supply to be suitable for connection.

Measure. Whatever you need.

You want to measure voltage, current, or resistance? Feasible, of course, with the MA-UNI: All common sensors as well as LVDTs (carrier frequency) and measuring bridges (strain gauge) can be connected directly. Numerous measuring ranges are provided for optimum signal conditioning.

Sensors well supplied.

The MA-UNI features a 100µA current source for resistance measurement in addition to the galvanically isolated ±2.5V sensor supply.

Clearly safe.

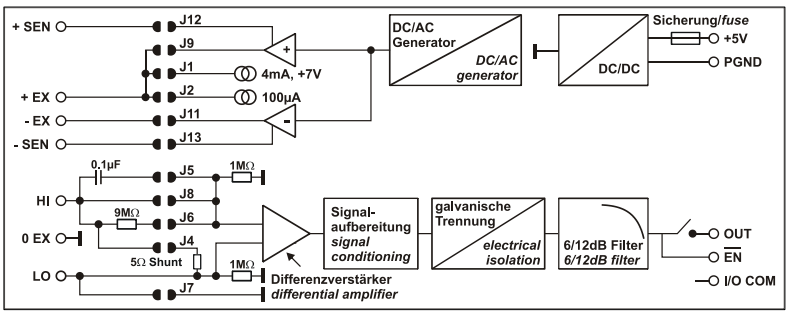
If using several modules, the channels are galvanically isolated to each other and to the DAQ system. This perfectly protects the whole system against high potentials and interferences.

Undisturbed.

Common-mode interferences often produced by machinery or other loads are effectively suppressed by the balanced input of the differential amplifier. If an output filter is set, disturbing frequencies can be eliminated.

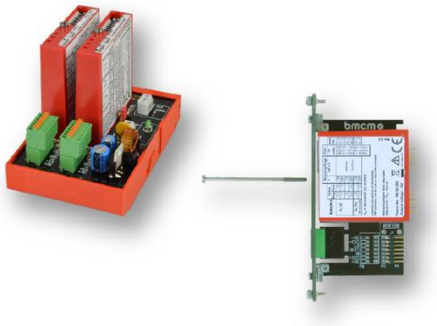
It's the setting that matters.

The selection of the measuring quantities, ranges, and the three filter cut-off frequencies is done via DIP switches and soldering bridges. Offset and gain are adjustable with potentiometers.



Functional diagram

1 Installation

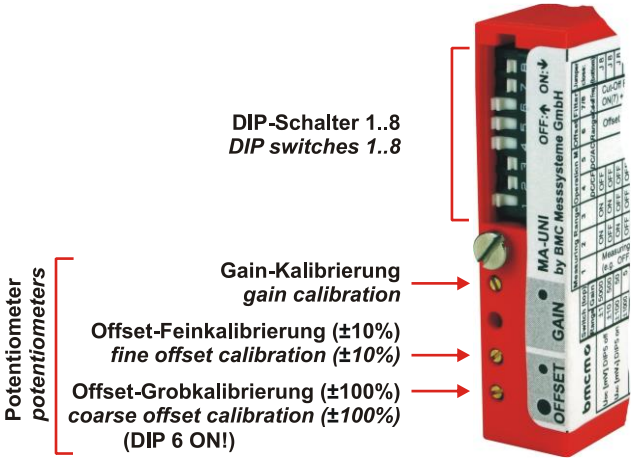


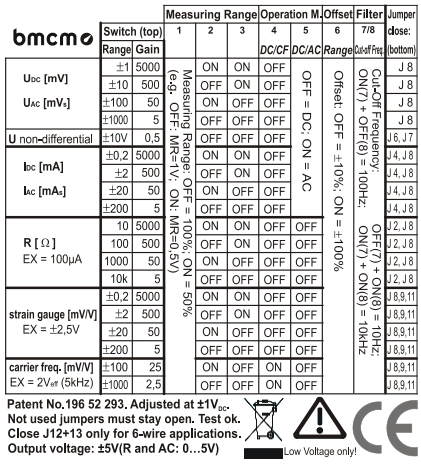
For a tight installation, the 5B module is plugged into a backplane (AP series) or into an amplifier system (AMS series) from bmcm and fixed with a screw (see chapter 4). The sensor or signal is attached to the relevant connector provided by the backplane or the amplifier system.
If the module is integrated in systems of other manufacturers (e.g. Analog Devices, Burr Brown), the additional 0EX pin (see chapter 2.4) introduced for special measuring applications and for screening purposes must be removed.

- **Ensure that the settings of the DIP switches and the soldering bridges are correct (see chapters 2.1 and 2.3) before installing the modules.**
- **When inserting the modules, the power of the connection system must be turned off.**
- **Detailed information about the installation and functions of the 5B measuring amplifier is available in the MA-UNI user manual, which can be downloaded as PDF from the website at www.bmcm.de.**

2 Connections, operating elements, and assignments

The connectors and operating elements are located on the front and back side of the 5B module.





bmcm	Switch (top)		Measuring Range			Operation M.		Offset	Filter	Jumper close:
	Range	Gain	1	2	3	4 DC/CF	5 DC/AC	6 Range	7/8 Cut-off Freq.	(bottom)
U_{DC} [mV]	±1	5000	Measuring Range: OFF = 100%; ON = 50% (e.g. OFF: MR=1V; ON: MR=0.5V)	ON	ON	OFF	OFF = DC; ON = AC	Offset: OFF = ±10%; ON = ±100%	Cut-Off Frequency: ON(7) + OFF(8) = 100Hz; ON(7) + ON(8) = 10kHz; OFF(7) + ON(8) = 1kHz	J 8
U_{AC} [mV_s]	±10	500		OFF	ON	OFF				J 8
	±100	50		ON	OFF	OFF				J 8
	±1000	5		OFF	OFF	OFF				J 8
U non-differential	±10V	0,5		OFF	OFF	OFF				J 6, J 7
I_{DC} [mA]	±0,2	5000		ON	ON	OFF				J 4, J 8
	±2	500		OFF	ON	OFF				J 4, J 8
I_{AC} [mA_s]	±20	50		ON	OFF	OFF				J 4, J 8
	±200	5		OFF	OFF	OFF				J 4, J 8
R [Ω] EX = 100µA	10	5000		ON	ON	OFF	OFF			J 2, J 8
	100	500		OFF	ON	OFF	OFF			J 2, J 8
	1000	50		ON	OFF	OFF	OFF			J 2, J 8
	10k	5		OFF	OFF	OFF	OFF			J 2, J 8
strain gauge [mV/V] EX = ±2,5V	±0,2	5000		ON	ON	OFF	OFF			J 8,9,11
	±2	500		OFF	ON	OFF	OFF			J 8,9,11
	±20	50		ON	OFF	OFF	OFF			J 8,9,11
	±200	5		OFF	OFF	OFF	OFF			J 8,9,11
carrier freq. [mV/V] EX = $2V_{eff}$ (5kHz)	±100	25		ON	OFF	ON	OFF			J 8,9,11
	±1000	2,5		OFF	OFF	ON	OFF			J 8,9,11

Patent No.196 52 293. Adjusted at ±$1V_{DC}$.
Not used jumpers must stay open. Test ok.
Close J12+13 only for 6-wire applications.
Output voltage: ±5V(R and AC: 0...5V)
Low Voltage only!

2.1 DIP switches

The amplification, operating mode, offset calibration range, and filter cut-off frequency are selected with the 8 DIP switches on the front of the measuring amplifier (see picture above). The configuration table (see figure chapter 2), which is also provided on the module case, shows which DIP switches must be "ON" to set the desired configuration.

DIP switch	Function
1	half measuring range / double amplification
2, 3	choose measuring range or amplification
4	switch to carrier frequency mode
5	change between DC and AC voltage/current
6	turn on coarse offset calibration (±100%)
7, 8	set filter cut-off frequency

Example:
With the switch setting (switches white) in the figure on the right, 100-times amplification is reached. Depending on the jumper configuration, the input range is ±50mV for DC voltage (J8 closed), ±10mA for DC current (J4, J8 closed), 500Ω for resistance (J2, J8 closed), or ±10mV/V for strain gauge measurement (J8, J9, J11 closed).

The offset calibration range is ±10% of the measuring range, the coarse offset calibration is turned off (see chapter 2.2). The filter cut-off frequency is 10kHz.

2.2 Trim potentiometers

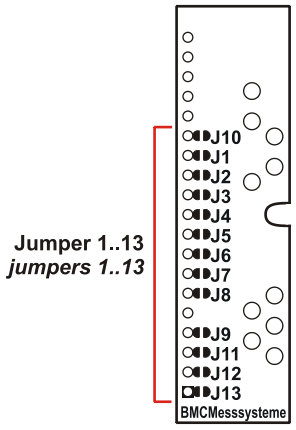
To calibrate the 5B module, offset and gain are adjusted at three trim potentiometers on the front side of the MA-UNI (see picture chapter 2).
The connected sensor is brought to the zero position first and the offset is adjusted at the module output. Then a known load is applied and the module is adjusted with the gain potentiometer at the output.
The offset calibration range is usually ±10% of the measuring range. To additionally turn on the relevant potentiometer for the ±100% coarse offset calibration, DIP 6 must be set to "ON".

- **The module is calibrated in the ±1V measuring range ex works.**
- **Recalibration is required after changing the measuring range or the operation mode.**
- **As the coarse offset calibration (±100%) causes a higher temperature drift of the module, DIP 6 should only be turned on to activate the relating potentiometer if needed.**

2.3 Solder jumpers

The solder bridges on the bottom of the module provide several functions. The configuration table (see figure chapter 2), which is also provided on the module case, shows which jumpers must be closed to set the desired configuration.

Jumper	Function
J1	4mA current source to +EX (max. +7V)
J2	100µA current source to +EX
J4	5Ω current shunt
J5	AC decoupling
J6	±10V measuring range (non-differential)
J7	LO to 0EX (input ground)
J8	HI direct input
J9	+2.5V EX
J11	-2.5V EX
J12	+SEN
J13	-SEN
J3, J10	(without function)

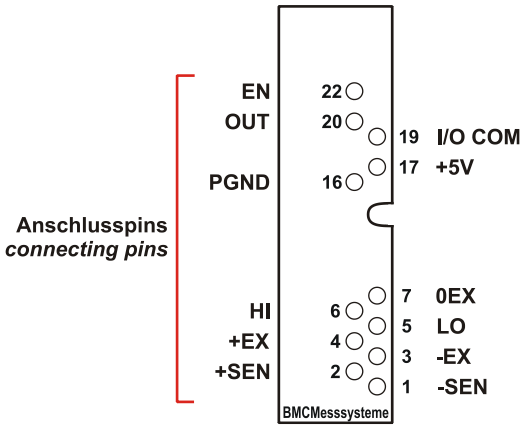


To prevent the modules from being damaged, close only jumpers required for the relevant application (see table chapter 2 and interfacing examples chapter 3). This applies especially to the power supply (close either J1 or J2 or J9!).

2.4 Connection pins

The following table and figure show the assignment of the connection pins of the measuring amplifier.

Pin	Assignment	Function
22	EN	enable input
20	OUT	output signal
19	I/O COM	output ground
17	+5V	+5V supply
16	PGND	power ground
7	0EX	0V potential of the input amplifier
6	HI	positive measuring amplifier input
5	LO	negative measuring amplifier input
4	+EX	positive supply voltage
3	-EX	negative supply voltage
2	+SEN	positive sense input
1	-SEN	negative sense input

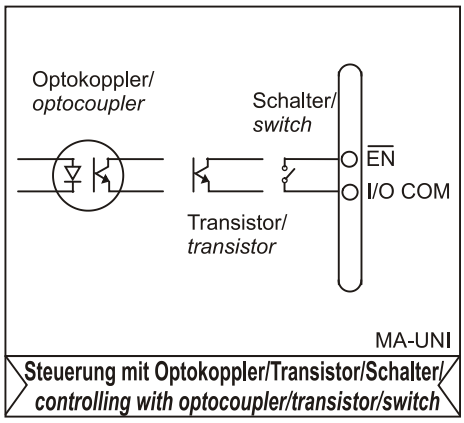


The pin assignment of the MA-UNI corresponds to the 5B modules of Analog Devices and Burr Brown. An additional 0EX pin (pin 7) has been introduced as reference for +EX and -EX. If using a non-bmcm backplane that does not provide a relating connection, this pin has to be removed. Then, however, a reference of the ±EX pins is only possible via the LO pin with J7 being closed. This is a specific assignment of BMC Messsysteme GmbH. The 0EX pin is not connected in modules of other manufacturers.
If using backplanes from other manufacturers, such as Analog Devices or Burr Brown, with integrated cold-junction compensation, the sensor terminals -SEN and +SEN of the measuring amplifier have to be deactivated (open J12, J13), or the cold-junction compensation on the backplanes must be disabled.

2.5 Output switch

The module features a semiconductor switch at the output, which is controlled by the enable input (EN, pin 22) with a TTL/CMOS level (also see figure chapter 2.4). It can also be activated with a switch, transistor, or optocoupler.

- **The enable input (EN) of the module is low-active.**
- **If not used, the EN input must be connected to I/O COM (pin 19)!**



The output switch and EN have a reference to I/O COM. If the EN control signal is referred to PGND, a high-ohmic connection (e.g. 10kΩ) must be made between I/O COM and PGND (This influences the galvanic isolation between PGND and I/O COM!).

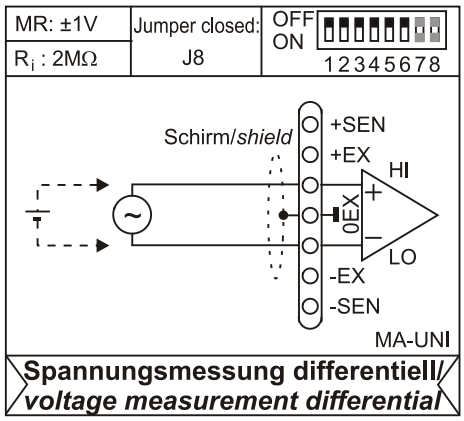
3 Interfacing examples

The module output is proportional to the input voltage in all operation modes and measuring ranges. Always use shielded cables. Apply cable shield at one end only. If earthing is required, connect the screen only at one end, otherwise there is a risk of hum pick-up.

- **All unneeded solder bridges must stay open!!**
- **Further information about the MA-UNI and additional examples are provided in the user manual (download PDF at www.bmcm.de).**

3.1 Voltage measurement (DC or AC decoupled)

The input is differential. For single-ended (non-differential) measurement, LO must be connected with 0EX (J6, J7 closed). In this operation mode, the input resistance R_i is 1MΩ.
Close J5 and J7 for AC decoupling (J8 open) removing DC components from the measuring signal. This operation mode exclusively works in single-ended mode because the connectable capacitor (0.1µF) is only provided in the HI path (see functional diagram, page 1). Extending the measuring range can always be achieved with an external voltage divider, of course.

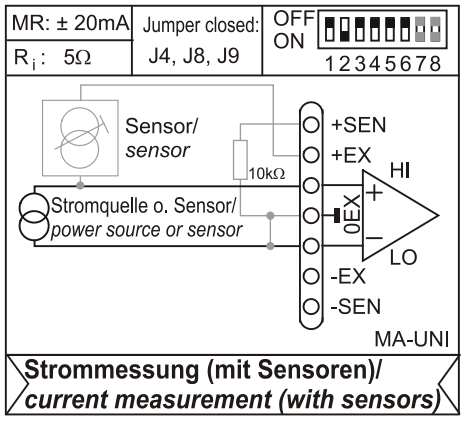


Spannungsmessung differentiell/
voltage measurement differential

3.2 Current measurement (alt. with active current sensor)

Closing solder bridge J4 activates the internal shunt (5Ω). The module input is differential.
A current sensor can also be operated with 5V (J12 closed, 10kΩ external). The produced sensor current must be drained from LO to 0EX (J7 closed).

Do not apply any voltage sources as you might overload the shunt!

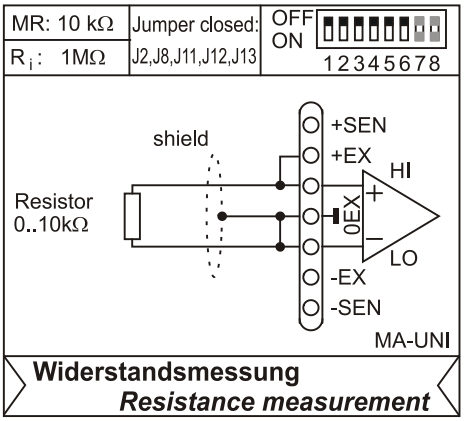


Strommessung (mit Sensoren)/
current measurement (with sensors)

3.3 Resistance measurement (2 wire measurement)

The resistance measurement is done using an impressed +100µA current. The output voltage is positive and proportional to the resistance.
The error measurement (because of R_i = 1MΩ) behaves as follows and for R? applies:

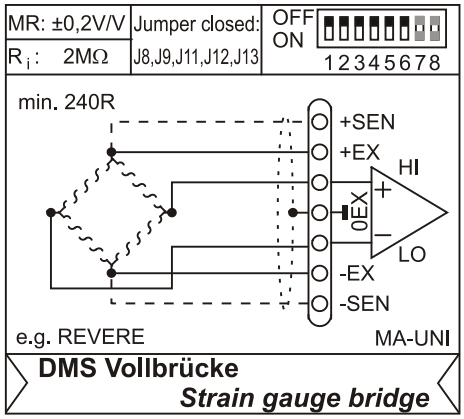
$$\frac{1}{R_{measured}} = \frac{1}{R?} + \frac{1}{1M\Omega} \qquad R? = \frac{R_{measured} * 1M\Omega}{1M\Omega - R_{measured}}$$



Widerstandsmessung
Resistance measurement

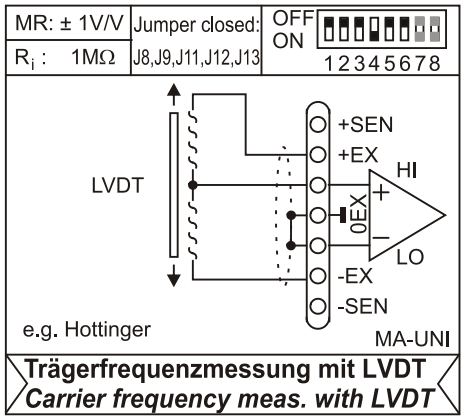
3.4 Strain gauge measurement with DC

Strain gauges are resistors which are operated in bridge circuits. The EX voltage is ±2.5V DC. The input amplifier is operated in differential mode. If necessary, the sensor lines compensate for line losses.
If using 100Ω bridges, supply is only possible with +2.5V reducing the measuring range to 50%. The zero position of the sensor shifts to the half sensor supply (1.25V).
J12, J13 must only be closed in the case of 6-wire applications.



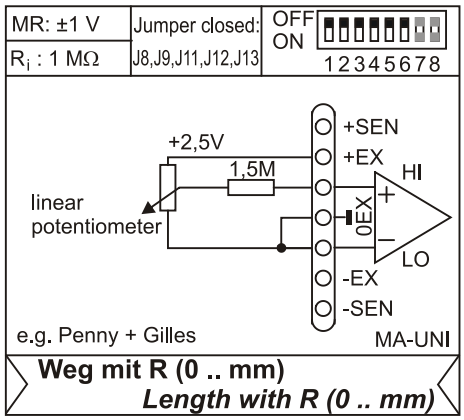
3.5 Distance measurement with carrier frequency

Carrier frequency measurement is required if using differential suppressors and LVDTs.
A 5kHz sine voltage with $2V_{eff}$ is present at the module EX terminals. The sensor signal is converted into a proportional DC voltage at the amplifier output.
Using the carrier frequency mode, f_g is 200Hz at the maximum (if DIP 7+8 set to "ON"), filtered with a 3-pole filter (18dB/oct.)



3.6 Distance measurement with potentiometer

Distances or angles can be determined using precise linear potentiometers.
The 1.5MΩ resistor provides an extended measuring range.



4 Supplementary products for MA-UNI

Amplifier systems and backplanes from bmcm allow the comfortable connection to the data acquisition system and the sensor supply. A variety different in size and design is available. The 5B modules can be used in any combination.
Further information about supplementary products is available on the website at www.bmcm.de.

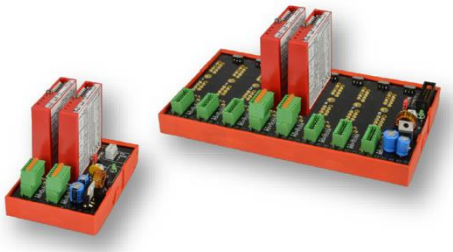
4.1 Amplifier measurement systems (AMS series)

The AMS systems in robust aluminum housing are available as a 19'' rack version (AMS84 series) or as a ½ 19'' tabletop unit (AMS42 series) with or without integrated PC data acquisition system (USB or LAN).
The 5B measuring amplifiers are fixed on plug-in cassettes, which are mounted in the AMS device.
Various cassettes with different connectors on the bracket are available for individual sensor or signal connection.
The following AMS amplifier measurement systems from bmcm are available:

Product	Description
AMS42 / AMS84	amplifier measurement systems for 5B modules with 8/16 slots
AMS42/84-USB	amplifier measurement syst. for 5B modules, 8/16 slots, integrated DAQ system (USB)
AMS42/84-LAN16f	amplifier measurement syst. for 5B modules, 8/16 slots, integrated DAQ system (LAN)

4.2 Backplanes (AP series)

Up to eight (AP8a) or two (AP2a) 5B modules can be plugged into the backplanes. Sensors or signals are attached at terminal connectors.
The AP backplanes are suitable for DIN rail mounting.



4.3 Other 5B modules (MA series)

The 5B measuring amplifiers from bmcm allow for the professional signal adjustment to a data acquisition system.
The amplifier output is ±5V or 0..5V. Most of the modules are electrically isolating and provide sensor supply.
The following 5B modules from bmcm are available:

Product	Description
MA-UI	multi-range amplifier with galvanic isolation for U, I
MA-U	voltage measuring amplifier with galvanic isolation, 50kHz bandwidth
MA-P09/12/15	power supply modules ±9V/ ±12V/±15V

5 Important notes for using the MA-UNI

- The module is only suitable for extra-low voltages - please observe the relevant regulations! The measuring amplifier must only be operated in closed housings (for reasons relating to EMC).
- All accessible pins are electrostatic sensitive devices. Provide for a grounded conductive work place. ESD voltages on open lines may cause malfunction. Only use an electrical isolated power supply unit (with CE).
- Only use non-solvent detergents for cleaning. The product is designed to be maintenance-free.
- As reference for the EX voltages (not overload-proof!) or for screening purposes, a 0EX terminal was defined, which, however, can be removed if necessary. Turn off the power before mounting the module into the backplane.
- Factory-balanced in the ±1V range; recalibration required after changing measuring range or operation mode.
- If the fastening screw is fixed too tightly, the module or the backplane may be damaged.
- The module must not be used for safety-relevant tasks. With the use of the product, the customer becomes manufacturer by law and is therefore fully responsible for the proper installation and use of the product. In the case of improper use and/or unauthorized interference, our warranty ceases and any warranty claim is excluded.

Do not dispose of the product in the domestic waste or at any waste collection places. It has to be either duly disposed according to the WEEE directive or can be returned to bmcm at your own expense.

6 Technical data (typ. at 20°C, after 15min., +5V supply)

- Measuring ranges

	Measuring range 1	Measuring range 2	Measuring range 3	Measuring range 4
Gain:	5000	500	50	5
max. Bandwidth at 6dB/oct. [kHz]:	1	5	10	10
Voltage DC [mV] // Current DC [mA]:	±1 // ±0.2	±10 // ±2	±100 // ±20	±1000* // ±200
Voltage AC [mV_S] // Current AC [mA_S]:	±1 // ±0.2	±10 // ±2	±100 // ±20	±1000 // ±200
U_{drop} current range DC [mV] // AC [mV_S]:	±1 // 1	±10 // 10	±100 // 100	±1000 // 1000
Resistance [Ω]:	10	100	1k	10k
Sensitivity (strain gauge) at 2.5V DC [mV/V]:	0.2	2	20	200
Sensitivity (carrier frequ.) at $2V_{eff}$ AC [mV/V]:	--	--	100	1000

At the output referring to: +5V .. -5V DC (i.e. 0 .. +5V DC to resistance test and rectifying); Turning on DIP 1 reduces the respective measuring range to 50%.

* The module is factory-balanced in the ±1V measuring range. Opening solder bridge J8 and closing J6+J7 extends the ±1V measuring range to ±10V.

- Generator

Generator voltage (DMS // LVDT):	±2.5V DC // $2V_{eff}$ at 5kHz AC
Generator current // Internal resistance:	100µA or 4mA, max. swing 5V // max. 50Ω
Connectable pickups:	strain gauge 100Ω-1000Ω; ind. 8mH-20mH

- Accuracy (typical)

Range calibration (gain) // Filter accuracy of f_g:	app. ±10% // max. ±15%
Zero balance (offset) fine // coarse:	±10% // ±100% (temperature drift approximately 200ppm)
Generator current // Generator voltage:	±0.25% max. 1%; temp. coefficient=25ppm/°C, for 4mA ±5% // ±0.25% DC, max. 1%; ±2% AC
Relative range accuracy // Residual ripple CF:	0.1%; if MR/2 typ. 1%; if MR=±10V typ. ±2% // max. 0.2%
Measuring accuracy current DC // resistance:	typ. ±0.2% // typ. 0.1%; max. 1%
Measuring accuracy current AC // voltage AC:	±5% // ±5%
Amplifier accuracy // Non-linearity:	typ. 0.01%; max. 0.1% // typ. 0.01%; max. 0.1%
Temperature drift offset // gain:	typ. 100 ppm/°C, max 200ppm/°C // typ. 100 ppm/°C, max 200ppm/°C

The values for accuracy always relate to the respective measuring range. Errors might add at worst.

- Input range / Output range

Input resistance (voltage // current):	single-ended: 1MΩ, differential: 2MΩ, turned off: 100kΩ // 5Ω shunt (voltage drop max. 1V)
Input suppressor circuit:	max. 240V AC for 1sec. (not in current measurement and resistance test)
Input AC decoupling (with J5):	0.1µF and 1MΩ for f_g >10Hz
Output switch // Output switching time:	CMOS switch with TTL-level or open collector switchable (low active) // 10µs at 200pF
Switch resistance // Output load:	typ. 50Ω; max. 100Ω (short-circuit proof) // >1kΩ, recommended >10kΩ for 0.1% accuracy
Output voltage // Output hum/ripple:	±5V DC // typ. $10mV_{ss}$, max. $80mV_{ss}$ in the ±1mV measuring range and f_g=10kHz
Output filter // Demodulator filter CF range:	2-pole (12dB/oct) for 10kHz; 1-pole (6dB/oct) for 10Hz, 100Hz // 3-pole (18dB/Okt.) at 200Hz
Supply sensitivity of the output:	typ. ±5mV/V

- General data

Voltage supply (regulated):	+5V DC (±5%), 70mA, max. 250mA, protected by a Multifuse
CE standards:	EN61000-6-1, EN61000-6-3, EN61010-1; for decl. of conformity (PDF) visit www.bmcm.de
ElektroG // ear registration:	RoHS and WEEE compliant // WEEE Reg.-No. DE75472248
Temperature ranges // Relative humidity:	operating temp. -25..50°C, storage temp. –25°C..+70°C // 0 - 90% (not condensing)
Max. permissible potentials // Protection type:	**60V DC acc. to VDE**, max. 1kV ESD on open lines // IP30
Dimensions // Patent:	plastic housing 52 * 70 * 15mm // German patent no.:196 52 293
Delivery:	product, description (download user manual (PDF) at www.bmcm.de/us)
Warranty:	2 years from date of purchase at bmcm, claims for damages resulting from improper use excluded

Manufacturer: BMC Messsysteme GmbH. Subject to change due to technical improvements. Errors and printing errors excepted. Rev. 8.0 **13.10.2023**