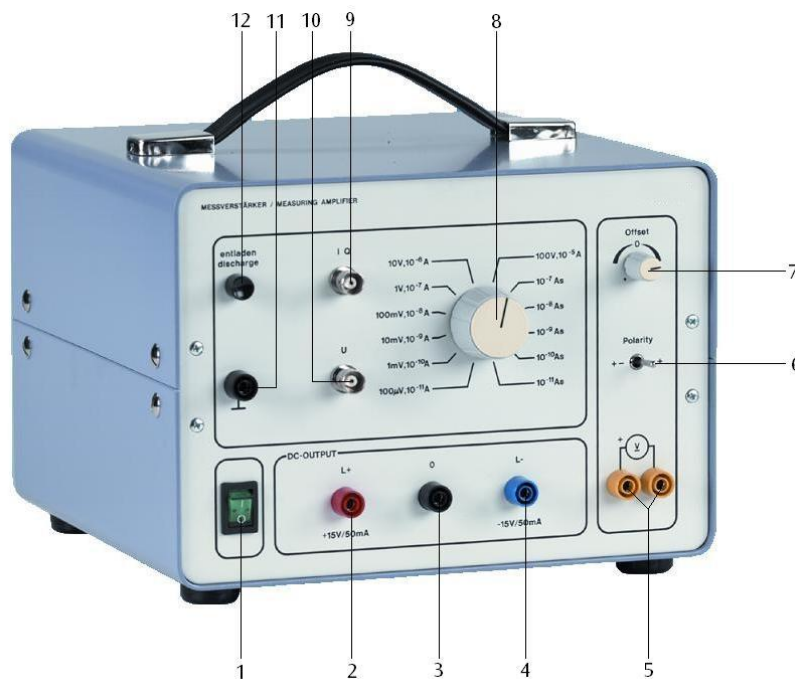


Measurement Amplifier @115 V 1001021
Measurement Amplifier @230 V 1001022

Instruction sheet

06/15 SP/ALF



- 1 Mains switch
- 2 Voltage output +15 V
- 3 Voltage output reference point
- 4 Voltage output -15 V
- 5 Voltmeter terminals
- 6 Polarity reversal switch
- 7 Offset calibration knob
- 8 Range switch
- 9 Current/charge input, BNC
- 10 Voltage input, BNC
- 11 Ground terminal
- 12 "Discharge" button

1. Safety instructions

The measurement amplifier conforms to all safety regulations for electrical measuring, control, monitoring and laboratory equipment, as specified under DIN EN 61010, Section 1, and the equipment has been designed to meet protection class I. It is intended for operation in a dry environment, suitable for the operation of electrical equipment and systems.

Safe operation of the equipment is guaranteed, provided it is used correctly. However, there is no guarantee of safety if the equipment is used in an improper or careless manner.

If it may be assumed for any reason that non-hazardous operation will not be possible (e.g. visible damage), the equipment should be switched off immediately and secured against any unintended use.

In schools and other educational institutions, the operation of the measurement amplifier must be supervised by qualified personnel.

- Before using the measurement amplifier for the

first time, confirm that the specifications printed on the rear side of the housing are compatible with the local mains voltage.

- Before using the measurement amplifier for the first time, check the housing and the mains lead for any damage. In the event of any malfunction/operational defect or visible damage, switch off the unit immediately and secure it against unintended use.
- The instrument may only be connected to the mains via a socket that has an earth connection.
- Before making any connections, check the experiment leads for damaged insulation and exposed wires.
- Never cover the air vents in the housing. This is necessary in order to ensure sufficient circulation of air required for cooling the internal components of the equipment.
- The equipment may only be opened/repared by qualified and trained personnel.

2. Description

The measuring amplifier can be used for measuring very small voltages, currents and charges.

The design involves a highly sensitive DC amplifier utilising the modulation principle and featuring silicon varicap diodes. The voltage to be measured is connected to a bridge composed of varicap diodes along with a constant high-frequency voltage. The modulator then outputs a high-frequency signal that is proportional to the voltage being measured. This signal is then amplified by a high-frequency amp. The signal is demodulated by a rectifier that is controlled from the modulation generator by means of an in-phase control signal. Additional amplifiers output the signal to terminals for a display instrument. Due to having been inverted twice, the input and output signals are in phase.

The direct input of the amplifier (terminal "I Q") can handle voltages of up to 300 V for a prolonged period, so that no damage due to overvoltage need be expected in the course of normal operation. Caution: voltages in excess of 300 V may **only** be applied to terminal "U" (10) with a measuring range of 100 V/1 V and under no circumstances to terminal "I Q".

Changes in the measuring range alter the feedback by decades. This also changes the gain factor (and the measuring range) in decade steps.

The input signal may be positive or negative. The output voltage is in-phase with the measured voltage. A toggle switch (6) can be used to alter the polarity of the output. For a positive input voltage, set the switch to the right, for a negative input set it to the left.

Any DC instrument can be used to display the results. An output of 1 V to the display instrument corresponds to the value given by the range setting of the amplifier. Generally instruments with 10 V or 3 V ranges will be used for display purposes. The limit of the scale thus corresponds to 10 times or 3 times the number indicated on the front panel of the amplifier. Display instruments with ranges of 1 V or less should only be used when utmost sensitivity is required (e.g. for 100 μ V or 10^{-11} A). Using 10 V or 3 V instruments allows a finer granulation of ranges to be achieved (1 : 0.3). It is not necessary to adapt the display.

The maximum output to the display is 12 V so that instruments in the range 10 V/3 V should not be subjected to damage due to overvoltage. Overloading or short circuits across the output will not damage the amplifier.

In highly sensitive ranges there may be some drifting of the zero point. This can be corrected using the "Offset" knob (7). For this terminal "U" (10) must be connected to the ground terminal (11) (via a conductor or a zero-voltage generator).

The "Discharge" button (12) can be used to short circuit the amplifier.

The operating voltage of the amplifier is +15 V and -15 V. This is supplied by a built-in stabilised power supply. The supply voltage can be connected to external circuitry (e.g. measuring bridges) via the +15 V and -15 V sockets. They have a common zero connected to ground. Resistors (10 kilohms) limit the load capacity of the voltage output (no short circuit hazard).

The apparatus 1001021 is for operation with a mains voltage of 115 V ($\pm 10\%$), and the unit 1001022 is for operation with a mains voltage of 230 V ($\pm 10\%$).

3. Technical data

Ranges (with reference to 1 V output voltage):

Voltage:	0.1 mV – 100 V (7 ranges)
Current:	10^{-11} – 10^{-5} A (7 ranges)
Charge:	10^{-11} – 10^{-7} As (5 ranges)

Input resistance:

Voltage:	10 M Ω
Current/charge:	0 Ω , for voltages up to 300 V

Precision: 3%

Measurement output: 0 – 10 V
Zero point calibration and reversible polarity

Output voltage: ± 15 V or 30 V, max. 50 mA

Operating voltage: See reverse of apparatus

Dimensions: 235 x 230 x 180 mm

Weight: 2.8 kg approx.

4. Operation

4.1 Voltage measurements

Caution:

Voltages in excess of 300 V may **only** be applied to terminal "U" (10) with a measuring range of 100 V/1 V.

- Connect voltmeter to terminal pair (5).
- Calibrate the zero point for the voltmeter using the "Offset" knob (7) where necessary (only relevant for highly sensitive ranges).
- Connect the voltage to be measured via a BNC cable to socket "U" (10) and ground (11).
- Set the polarity switch (6) to the right for positive voltages or to the left if the measured voltage is negative.

Range	Gain	Value corresponding to scale limit of display instrument		
		10 V	3 V	1 V
100 V	0.01	1000 V	300 V	100 V
10 V	0.1	100 V	30 V	10 V
1 V	1	10 V	3 V	1 V
100 mV	10	1 V	300 mV	100 mV
10 mV	100	100 mV	30 mV	10 mV
1 mV	1000	10 mV	3 mV	1 mV
100 μ V	10000	1 mV	300 μ V	100 μ V

4.2 Current measurements

- Connect voltmeter to terminal pair (5).
- Calibrate the zero point for the voltmeter using the "Offset" knob (7) where necessary (only relevant for highly sensitive ranges).
- Connect the current to be measured via a BNC cable to socket "I Q" (9) and ground (11).

An output of 1 V to the display from the amplifier corresponds to the current value selected for the range.

Measured current = range value on front panel x deflection of voltmeter.

4.3 Charge measurements

- Connect voltmeter to terminal pair (5).
- Press "Discharge" button (12) to discharge any existing charge.
- Conductors in the circuit may lead to inaccuracies in the measurement (due to innate capacitance, magnetic leakage). For this reason it is practical to plug a contact pin directly into terminal (9) to measure the charge directly.

The voltage displayed by the voltmeter corresponds to the value of the charge. Here too, an output of 1 V to the display instrument corresponds to the charge given by the range setting of the amplifier.

Since the displayed value for a charge is held static, charges can be applied repeatedly. The value displayed then corresponds to the sum of all the individual charges. Any charge applied to the measuring amplifier can be cancelled out by another charge of opposing sign.

4.4 Use of the measuring amplifier as a DC power supply

To output a fixed DC voltage of 15 V:

- Connect the positive pole of the load to either terminal "L+" or "L-" (2 or 4). Connect the negative pole to terminal "0" (3).

To output a fixed DC voltage of 30 V:

- Connect the positive pole of the load to terminal "L+" (2) and the negative to terminal "L-" (4).

5. Storage, cleaning and disposal

- Keep the equipment in a clean, dry and dust-free place.
- Before cleaning the equipment, disconnect it from its power supply.
- Do not clean the unit with volatile solvents or abrasive cleaners.
- Use a soft, damp cloth to clean it.
- The packaging should be disposed of at local recycling points.
- Should you need to dispose of the equipment itself, never throw it away in normal domestic waste. Local regulations for the disposal of electrical equipment will apply.

