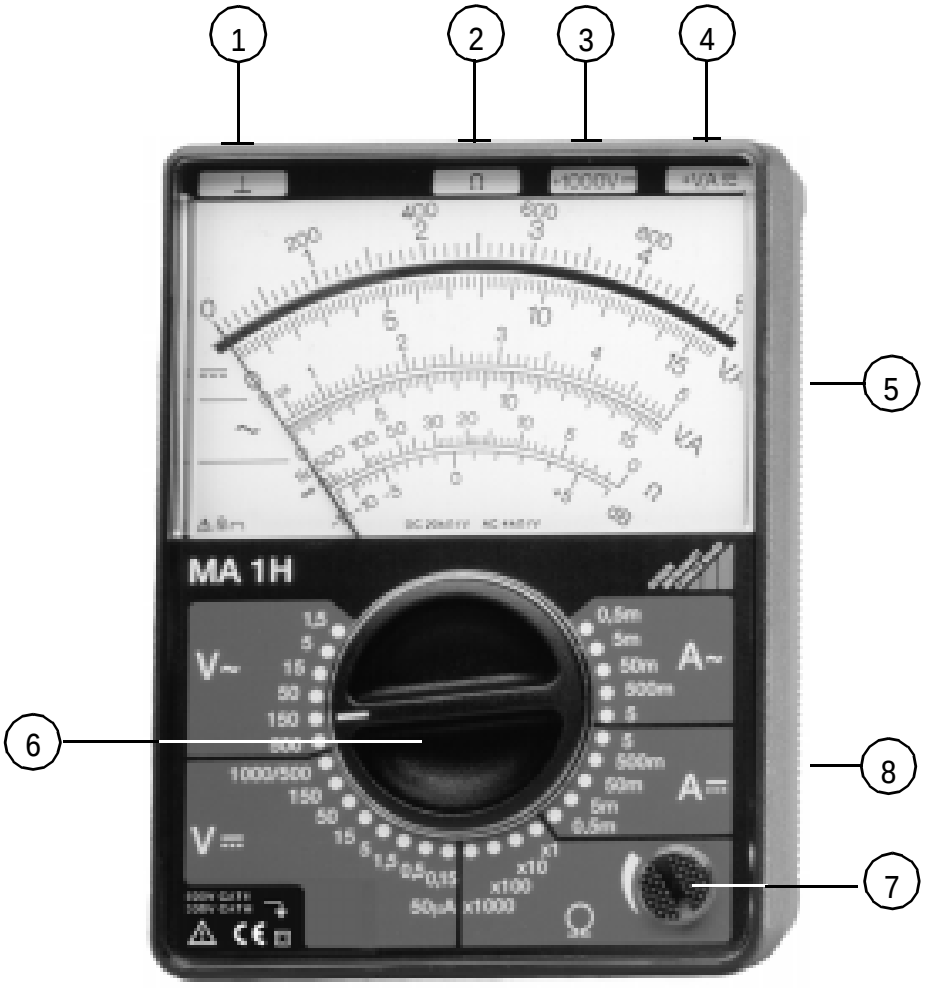
Operating Instructions

MA 1H

Analog Multimeter

3-348-322-02
6/12.98



1 Common connection for all measuring ranges (Instrument earth)

2 Connection for resistance measurement and capacitance measurement (negative potential)

3 Connection for voltage range 1000 V—

4 connection for all voltage and current ranges (apart from the 1000 V— ranges)

5 Catch for locking the rear of the apparatus

6 Range switch

7 Potentiometer knob

8 Set screw for mechanical zero setting of the pointer

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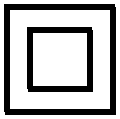
1 Safety precautions

The multimeter has been built in accordance with the safety requirements of IEC 61010-1/EN 61010-1/VDE 0411-1. When used as prescribed, the safety of the operator and of the apparatus are guaranteed. They are not guaranteed if the apparatus is used incorrectly or carelessly. It is therefore essential to read the present Operating Instructions carefully and in full, and to observe all the points therein before using the multimeter.
The following general safety precautions are to be observed:

- The apparatus must only be used by persons who are in a position to appreciate the danger of accidental contact and to take safety precautions.
- There is a danger of shock in every case when there is a likelihood of voltages in excess of 50 V against earth.
- When measurements are being taken during which there is a risk of shock, no work must be effected alone. A second person is to be informed.
- Allowances must be made for the possibility that equipment being measured (e.g. defective appliances) can give rise to the presence of unexpected voltages; capacitors, for example, may be dangerously charged!
- The test leads must not be damaged, e.g. tears or broken areas.
- No measurements are to be taken using the multimeter in circuits with corona discharge (high voltage!).
- Particular caution is recommended when measuring HF circuits. Dangerous undulating voltages rnay be present.
- Measurements should not be effected in damp ambient conditions. Hands, shoes, floor and working area must be dry.
- It is absolutely essential to ensure that the measuring ranges are not excessively overloaded; cf. table entitled "Overload Capacity" in chapter 5. Connection of a current, low voltage or resistance measurement range to the 220 V mains, for example, would result in the immediate destruction of the apparatus. The operator would be in the greatest danger!

Meaning of symbols on the device

Warning concerning a point of danger
(Attention: observe documentation)



Continuous, doubled or reinforced insulation

Indicates EU conformity

Earth

2 Application

The a multimeter for voltage, current and resistance measurements and for the rough measurement of capacitance. It is suitable for universal use in electronics, radio and television technology and digital technology and can be used for many measuring tasks in the field of general electrical technology. The meter is used chiefly by the handyman and in the fields of servicing, training and further training.

3 Description

The multimeter has 36 measuring ranges for direct and alternating voltage, direct and alternating current and resistance. Capacitance values can be ascertained by rough measurements.
A mirror is placed behind the scale for accurate reading of the measured values. The pivots of the measuring element and the measuring range switch are located in line one above the other, so that it is also possible to provide long scales for the Ω and dB measurements. The robust plastics case and the core-magnet moving-coil measuring element with its sprung jewel bearings protect the meter against damage when subjected to rough mechanical stress.

The connection sockets are protected against accidental contact. Both the special instrument leads with shock protection KS 17) and all measuring leads with conventional banana plugs (4 mm diameter) can be plugged in. The unit is constructed for easy maintenance. Subject to safety regulations, defective components can be readily exchanged by qualified engineers.

4 Operation

4.1 Controls

Measuring range switch

The multimeter has only one rotary switch by which all the measuring ranges are selected. The meter can be switched from the direct voltage ranges to the corresponding alternating voltage ranges, or from the direct current ranges to the corresponding alternating current ranges, without switching off the measured value. The measuring circuit is not interrupted upon switching over the current measuring ranges.
It must be ensured that the measuring range switch is first set to the highest measuring range when measuring voltage and current. The switch then has to be switched to lower ranges until the optimum deflection is obtained.

Connection sockets

The meter has 4 connection sockets with shockproof protection.
Their functions are as follows:

Socket „⊥“	=	common connection for all measuring ranges (instrument earth)
Socket „Ω“	=	connection for resistance measurement and capacitance measurement (negative potential)
Socket „+ 1000 V ⎓“	=	connection for highest DC voltage range 1000 V ⎓
Socket „+ V, A ≂“	=	connection for all voltage and current ranges (apart from the ranges 15 A ≂ and 1000 V ⎓

The sockets can accommodate the instrument leads with shock protected attaching plugs that can be supplied as well as all measuring cables with banana plugs (diameter 4 mm).

Potentiometer knob

The rotary knob is used to set the full deflection 0 Ω when measuring resistance as per chapter 4.5 and capacitance according to chapter 4.6.

4.2 Starting the Instrument

Inserting battery

Bottom half must be removed from the instrument in order to install or exchange the battery.

Attention!
Before opening the apparatus, the instrument leads must be disconnected from the test circuit!

- ➪ Press the catch on the rear of the apparatus, using a test point, banana plug or similar object, in the direction of the arrow and remove the lower portion
- ➪ Place the 1.5 V miniature battery in the battery compartment in accordance with the symbol and pole sign.

Attention!
Only use a leak-proof 1.5 V miniature battery according to IEC R 6!

- ➪ Place the apparatus in the lower portion of the housing and gently press the two halves together until they lock into place.

Mechanical zero point check

- ➪ Place the multimeter flat on the edge of a table. The lower third of the apparatus should project over the edge.
- ➪ Check the mechanical zero setting of the pointer.
- ➪ If necessary, adjust the set screw on the rear of the apparatus with a screwdriver to correct the setting.

Battery check

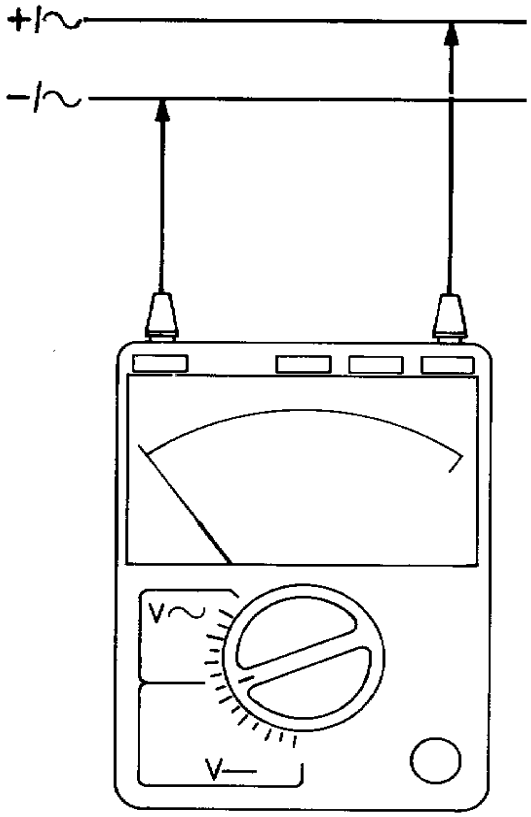
- ➪ Set the range switch to the „Ω x 1“ position.
- ➪ Short-circ. connecting sockets „⊥“ and „Ω“ using an instrument lead.
- ➪ Set the pointer to full deflection position 0 Ω using potentiometer knob.

If it is no longer possible to set the full deflection or if the reading does not remain constant after setting, the miniature battery is spent. Replace as described above.

Attention!
Whatever the value of the measured voltage, as a safety precaution, do not exceed the sum of 1000 V CAT I; 600 V CAT II; 300 V CAT III for measured voltage plus voltage against earth when directly connecting up the multimeter!

The left-hand connection socket marked „⊥“ should be connected whenever possible and for all voltage measurements to the point with the lowest potential against earth.

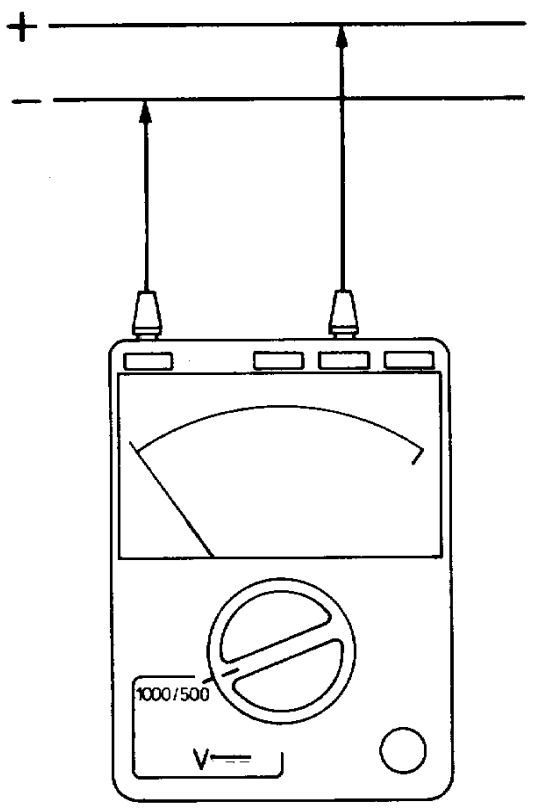
4.3.1 DC and AC Voltage up to 500 V



- Set the range switch to the position 500 V — or 500 V ~.
- Plug the test leads into the apparatus (black) test lead to socket „⊥“ and (red) lead to socket „+ V, ⎓~ “.
- For safety, the test leads with anti-shock protected attaching plugs should be used.
- Apply the measured voltage to the test leads. For DC voltage, the socket „⊥“ must be connected to the negative pole of the measured voltage and socket „+ V, A ⎓~“ to its positive pole.
- If the measured voltage is less than 150 V, set range switch, in the case of DC voltage, to the lower Dc voltage ranges and, in the case of AC voltage, to the lower AC voltage ranges, proceeding until optimum deflection is obtained.
- Read off the measured value: in the case of DC voltage, on the two upper scales 0 ... 5 or 0 ... 15 V, A ⎓ , in that of AC voltage, on the scales beneath 0 ... 5 or 0 ... 15 V, A ~ .

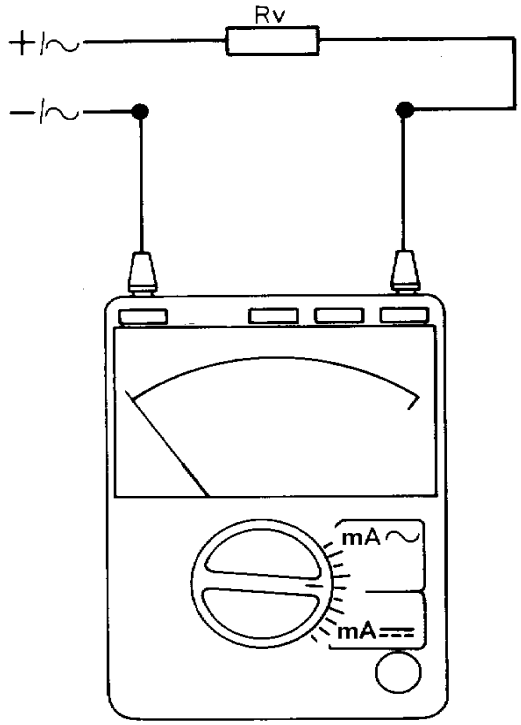
4.3.2 DC Voltages up to 1000 V

- ⇨ Set range switch to the position 1000/500 V ⎓.
- ⇨ Plug test leads into the apparatus; (black) test lead to socket „⊥“ and (red) lead to socket „+ 1000 V ⎓ “.
- ⇨ For safety, the test leads with anti-shock protected attaching plugs should be used.
- ⇨ Apply the voltage measured to the test leads. Socket „⊥“ should be connected to the negative pole of the measured voltage and socket „+ 1000 V ⎓“ to the positive pole.
- ⇨ Read the measured value off the upper scale 0 ... 1000 V ⎓



4.4 DC and AC current measurements up to 5 A

- ⇨ Set range switch to the position 5000 mA — or 5000 A ∼.
- ⇨ Plug test leads into the apparatus; (black) test lead to socket „⊥“ and (red) lead to „+ V, A ≂ “.
- ⇨ Disconnect the power supply to the measuring circuit, and/or the power consumer (R_V) and discharge all capacitors, if available.
- ⇨ Interrupt the measuring circuit and safely connect the measuring leads (without transient resistance!) in series with the power consumer R_V. Note polarity sign when measuring direct current! Negative to „⊥“ socket and positive to „+V, A ≂ “ socket.



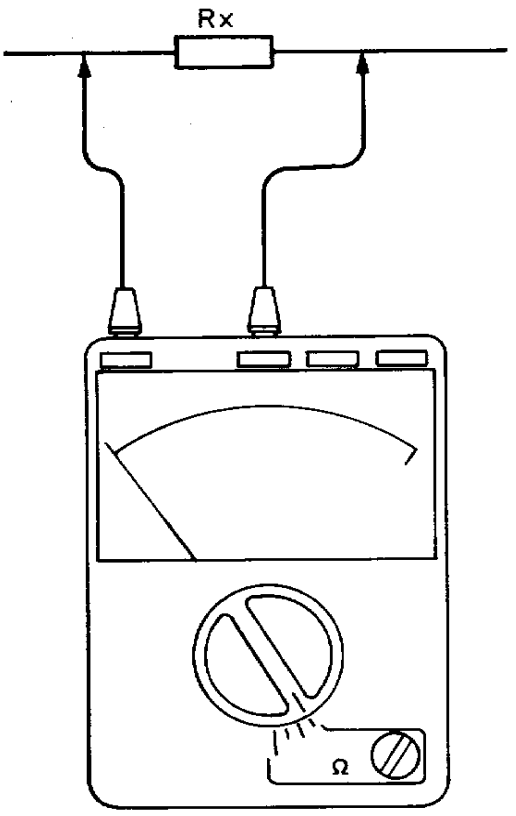
Attention!

The multimeter must always be connected into the lead whose voltage is the lowest relative to earth. For safety reasons, the voltage relative to earth must not exceed 1000 V CAT I; 600 V CAT II; 300 V CAT III! The multimter must never be connected in the current measuring ranges to a voltage source which can supply a current higher than the maximum admissible current (see chapter 5). The unit would be immediately destroyed if a current measuring range were connected direct to, for example, a productive source of current with low voltage, or direct to the 230 V mains. The operator would then be in great danger!

- ⇨ Connect power supply to measuring circuit again
- ⇨ If the measuring current is less than 500 mA. set the measuring range switch to lower direct current ranges in the case of direct current, and to lower alternating current ranges in the case of alternating current, until the optimum deflection is obtained. The measuring circuit is not interrupted during switchover!
- ⇨ Read measured value: On the upper scale 0 ... 5 V, A ⎓ in the case of direct current, on the third scale from the top 0 ... 5 V, A ∼ in the case of alternating current..

4.5 Resistance measurement

Resistance is measured with direct voltage from the 1.5 V miniature cell used. The measuring range table in chapter 5 shows the maximum measuring currents with full deflection and with a battery voltage of 1.5 V.
The polarity on the sockets is as follows:
Positive pole on the socket „⊥“
Negative pole on the socket „Ω“



- ➪ Set measuring range switch to one of the measuring ranges Ω x 1 ... Ω x 1000 according to the measured value to be anticipated.
- ➪ Plug measuring leads into the sockets „⊥“ and „Ω“.
- ➪ Short circuit measuring leads.
- ➪ Set measuring element needle to full deflection 0 Ω with potentiometer rotary knob.
  The battery must be changed in accordance with chapter 4.2 if the full deflection can no longer be obtained by adjustment or if the reading does not remain constant after adjustment.

Attention!
Connect the resistance R_x to be measured to the measuring leads.

Attention!
Only voltage-free objects must be measured. External voltages would falsify the measurement resuit. They can also damage or destroy the unit and endanger the operator!

- ➪ Read the value indicated on the Ω scale and multiply by the factor corresponding to the measuring range set.

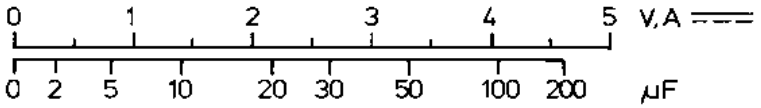
The measuring range should, as far as possible, be chosen such that a reading is obtained in the range 5 ... 50. Measurement error, relative to the actual resistance value, is at a minimum in the centre of the range of deflection. The full deflection Ω must be occasionally checked during resistance measurements lasting over a long period of time and, as far as possible, should always be checked when switching from one resistance measuring range to another and, when necessary, it must be readjusted.

Attention!

Contact resistances on the battery connections can cause inaccurate setting of the full deflection 0 Ω, particularly in the low-resistance measuring ranges. Thus, satisfactory contact must be ensured by, for example, removing and replacing the battery (see chapter 4.2)

4.6 Rough measurement of capacitance

Capacitance values can be ascertained in the resistance measuring ranges by rough measurements. The procedure is exactly the same as that described in the case of resistance measurement in chapter 4.5. The capacitor to be measured, and which must be previously discharged, is connected in place of the resistor R_X. On connection of the capacitor, the needle of the instrument is deflected to a maximum value and then returns to its starting position (mechanical zero point). The pointer which the deflection of the needle is reversed is indicative of the capacitance value. It can be read from the scale 0 ... 5 V, A ⎓.The measured value can be ascertained from the following comparison scale and the capacitance measurement factor which corresponds to the measuring range set:



Meas. range	Factor for capacity measurement	Scale range
Ω x 1000	µF x 1	2 ... 200 µF
Ω x 100	µF x 10	20 ... 2000 µF
Ω x 10	µF x 100	200 ... 20000 µF
Ω x 1	µF x 1000	2000 ... 200000 µF

The capacitor must be discharged again before repeating the measurement!

Example:

Selected meas. range:	Ω x 100
Reversal point of needle:	3.3 on the upper scale 0 ... 5 V, A ⎓
Capacitance value ascertained from the comparison scale:	50 µF
Multiplied by the factor for capacitance measurement:	50 µF x 10 = 500 µF

4.7 Measurement of amplitude and attenuation

In communications engineering, amplification and attenuation is almost exclusively given in dB as the logarithm of the ratio of measured voltage to a defined reference voltage. Thus, in fourpole networks, it is a simple matter to ascertain the total amplification or total attenuation by addition or subtraction of the individual values. The reference voltage is 0.775 V (1 mW in 600 Ω); the attenuation at this voltage is 0 dB.

The procedure for the measurement of amplification and attenuation is exactly the same as that given in chapter 4.3.1 for the measurement of alternating voltage; however, the measured values are read from the dB scale.

The range – 15 ... + 6 dB given on the scale corresponds to the alternating voltage measuring range 1,5 V. In the higher voltage measuring ranges 5 V ∼, 15 V ∼, 50 V ∼ ... have to be added to the following values: 10 dB, 20 dB, 30 dB ... ; see voltage measuring ranges given in the Table in chapter 5.

If a direct voltage is superimposed on the alternating voltage to be measured, it can be cut out by means of a suitable capacitor which is to be connected in series with the measuring input.

The operating voltage of the series capacitor must be at least equal to the peak value of the voltage applied. With an additional error of 1% from the measured value, its value can be calculated from the following formula:

$$C_V \approx \frac{1}{0{,}89 \cdot \frac{f}{Hz} \cdot \frac{R_i}{M\Omega}} \cdot \mu F$$

in which R_i is the internal resistance of the multimeter in the selected measuring range..

Example:

With a superimposed alternating voltage of 1 kHz a series capacitor of C_V = 0.0056 µF = 5,6 nF results for the measuring range 50 V ∼ .

Attention!

The capacitor is charged to the value of the direct voltage component. The charge can assume dangerous values and maintain them for a long period of time. The capacitor must therefore be discharged after the measurement!

4.8 Testing of diodes and transistors

The resistance measuring range Ω x 1000 is suitable for making rough tests of the function of diodes and transistors. A shortcircuit or an interruption of a diode or of a diode path between the base, collector and emitter of a transistor can be detected in a simple manner by a resistance measurement (see chapter 4.5). The polarity of a diode and the base terminal of a transistor can be ascertained by means of this test.

Attention!
Positive pole is connected to the socket „⊥“ and negative pole is connected to the socket „Ω“.

The component to be tested is not destroyed during this measurement, since the voltage does not exceed 1.75 V and the test current does not exceed 100 µA.

5 Specifications

Measuring ranges

Voltage	Output [1]	Internal resistance approx. —	Internal resistance approx. ~
0.15 V —	—	3.15 kΩ	—
0.50 V —	—	10.00 kΩ	—
1.50 V ≂	–15 ... + 6 dB	31.50 kΩ	6.50 kΩ
5.00 V ≂	– 5 ... + 16 dB	100.00 kΩ	20.00 kΩ
15.00 V ≂	+ 5 ... + 26 dB	315.00 kΩ	65.00 kΩ
50.00 V ≂	+15 ... + 36 dB	1.00 MΩ	200.00 kΩ
150.00 V ≂	+25 ... + 46 dB	3.15 MΩ	650.00 kΩ
500.00 V ≂	+35 ... + 56 dB	10.00 MΩ	2.00 MΩ
1000.00 V —	—	20.00 MΩ	—

Voltage-related input resistance with — : 20.0 kΩ/V
with ~ : 4.0 kΩ/V

Current	Voltage drop approx. —	Voltage drop approx. ~
50.00 µA —	0.158 V	—
0.50 mA ≂	1.15 V	1.00 V
5.00 mA ≂	1.25 V	1.25 V
50.00 mA ≂	1.25 V	1.25 V
500.00 mA ≂	1.30 V	1.30 V
5000.00 mA ≂	1.30 V	1.30 V

Resistance	Measuring range	Value in centre of scale (R_i)	Max. meas. curr. I_{max} [2] approx.
Ω x 1	1 Ω ... 1 kΩ	18.00 Ω	83 mA
Ω x 10	10 Ω ... 10 kΩ	180.00 Ω	8.3 mA
Ω x 100	100 Ω ... 100 kΩ	1.80 kΩ	0.83 mA
Ω x 1000	1 kΩ ... 1 MΩ	18.00 kΩ	0.083mA

[1] 0 dB ≙ 0.775 V in the range 1.5 V ~; 0 dB ≙ 1 mW at 600 Ω

[2] at battery voltage 1.5 V

Capacity [3]	Measuring range
µF x 1000	2000 ... 200000 µF
µF x 100	200 ... 20000 µF
µF x 10	20 ... 2000 µF
µF x 1	2 ... 200 µF

[3] Rough measurement in the resistance measurement ranges; ascertaining the measured valuesby comparison scale (see chapter 4.6).

Curve shape and its evaluation

Curve shape with ~: sine

The meter has half-wave rectification and is calibrated in effective values. It evaluates the arithmetical mean value of a half-wave and indicates differing values in the case of undulatory voltage or current depending on the terminal polarity.

Overload capacity

Range	permanently loadable up to
0.15 V —	20 V ≂
0.5 V —	50 V ≂
1.5 V —	100 V ≂
5.0 V —	150 V ≂
15.0 V —	250 V ≂
50.0 V —	250 V ≂
150.0 V —	300 V ≂
500.0 V —	600 V ≂
1000.0 V —	1000 V —
50.0 µA —	5.0 mA ≂
0.5 mA —	10.0 mA ≂
5.0 mA —	30.0 mA ≂
50.0 mA —	100.0 mA ≂
500.0 mA —	800.0 mA ≂
5000.0 mA —	3.0 A ≂
	5.0 A ≂
	max 2 min.

Range	permanently loadable up to
—	—
—	—
1.5 V ~	25.0 V ≂
5.0 V ~	50.0 V ≂
15.0 V ~	150.0 V ≂
50.0 V ~	250.0 V ≂
150.0 V ~	300.0 V ≂
500.0 V ~	600.0 V ≂
—	—
—	—
0.5 mA ~	10.0 mA ≂
5.0 mA ~	30.0 mA ≂
50.0 mA ~	100.0 mA ≂
500.0 mA ~	800.0 mA ≂
5000.0 mA ~	3.00 A ≂
	5.00 A ≂
	max 2 min.

Power supply

Battery for resistance measurement: 1 miniature cell 1.5 V to IEC R 6, leakproof

Electrical safety

Protection class	II acc. to IEC 61010/EN 61010-1/ VDE 0411-1	
Overvoltage category	II	III
Nominal voltage	600 V	300 V
Test voltage	3.7 kV ~	
Contamination level	2	

Mechanical construction

Scale length	A, V – 0 ... 5.0: approx. 83 mm A, V – 0 ...15.8: approx. 77 mm A, V∼0 ... 5.0: approx. 67 mm A, V∼0 ... 15.8: approx. 59 mm Ω ∞ ... 0: approx. 52 mm dB – 15 ... +6: approx. 42 mm
Protection type	Housing IP 50, connections IP 20 to EN 60529/VDE 0470 Teil 1
Dimensions	92 x 126 x 45 mm
Weight	approx. 0.25 kg without batteries

6 Maintenance

6.1 Battery

The state of the battery should be checked from time to time. A discharged or decomposing battery should not be left in the battery compartment. The battery should be checked and changed in the manner described in chapter 4.2.

6.2 Housing

No special maintenance is required for the housing. Keep outside surfaces clean. Use a slightly dampened cloth for cleaning. Avoid the use of cleansers, abrasives or solvents.

7 Repair and Replacement Parts Service
DKD Calibration Lab and Rental Instrument Service

When you need service, please contact:

GOSSEN-METRAWATT GMBH
Service-Center
Thomas-Mann-Straße 16 - 20
90471 Nürnberg, Germany
Phone +49 911 86 02 - 410 / 256
Fax +49 911 86 02 - 2 53
e-mail fr1.info@gmc-instruments.com

This address is for Germany only.
Abroad, our representatives or establishments are at your disposal.

8 Product Support

When you need support, please contact:

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