

## Multimeter Escola 10 1006810

### Instruction sheet

11/14 SD/UD



- 1 Meter display with mirror scale
- 2 Slotted screw for zero calibration
- 3 Adjustment knob for zero calibration
- 4 Measurement range dial
- 5 Operating mode switch
- 6 Voltage measurement socket
- 7 Current measurement socket for up to 3 A
- 8 Current measurement socket for up to 10 A
- 9 Safety ground socket

### 1. Safety instructions/using the equipment safely

The Escola 10 multimeter is designed to display electrical measurements in the ranges and measurement environments specified in its technical data.

It conforms to safety regulations for electrical measurement, control and laboratory equipment, as specified in DIN EN 61010-1, protection class 2 and to excess voltage category CAT I for up to 600 V. It is intended for measurements on experiments and laboratory apparatus. It is **not** approved for measurements on low-voltage distribution equipment, such as sockets, fuses, etc.

CAT I: Signal layer, telecommunications, electronic equipment with only minor excess voltage transients

CAT II: Domestic appliances, mains sockets, portable instruments etc.

CAT III: Supply via buried cabling, built-in switches, automatic circuit breakers, sockets or contactors

CAT IV: Equipment and installations supplied, for example, by overhead mains cables and therefore subject to greater risk of lightning strikes. This includes, for example, main switches at the building mains feed, electricity meters and ripple control receivers.

Safe operation of the multimeter is guaranteed if it is solely used as specified. Safety cannot be guaranteed, however, if the multimeter is used incorrectly or handled without due care and attention. In order to avoid serious injury due to current or voltage shocks, the following safety instructions are to be observed at all times:

- Carefully read the instruction manual before using the multimeter and obey the instructions therein.
- The multimeter may only be used by persons who are able to recognise the risks of contact and take due precautions to avoid them.

This multimeter is not a toy and must not fall into the hands of children.
















- Do not place it, keep it or use it anywhere within reach of children.
- When the multimeter is used by teenagers, trainees etc., a suitable person should supervise to ensure the equipment is used safely.
- If measurements are made where there are any risks of coming into contact with electricity, a second person is to be informed.

The assumption needs to be made that unforeseen voltages may be present in the vicinity of objects being measured (e.g. faulty equipment or capacitors).

- Before using the multimeter, check the housing and measuring leads for damage and if there should be any malfunctions or visible damage, the multimeter is not to be used. Pay specific attention to the insulation for the measuring sockets.
- Be particularly careful when measuring voltages in excess of 33 V AC (RMS) or 70 V DC.
- For voltages which are in excess of 33 V AC or 70 V DC, only use safety measurement leads conforming at least to CAT II.
- The authorised measuring range is not to be exceeded. If measurements are made when the magnitude of the variable is unknown, always select a large measuring range before shifting down to lower ones.
- The multimeter may not be used to make measurement on circuits which exhibit corona discharge (high voltage).
- Particular care is to be taken when making measurements on high-frequency circuits where dangerous voltages may arise due to superimposition of components.
- Make very sure that the voltage value between the measured contact and earth or between the ground socket and the measurement socket does not exceed 1000 V.
- In order to check that the multimeter is ready to use, select the battery test function. Afterwards, it is then possible to check that the voltage source is disconnected and no voltage is present.

- The multimeter may only be used in a dry, dust-free environment with no risk of explosions occurring.
- When measuring current in a circuit, make sure to switch off the power before connecting the multimeter into the circuit.
- When making measurements, always connect the ground lead first. Disconnect the signal measurement lead before unplugging the ground.
- Turn off the multimeter before opening the casing, disconnect the power to the circuit and the measuring leads from the multimeter.

## 2. Symbol legend

	Hazard, read instruction sheet
<b>V</b>	Voltage
<b>A</b>	Current
	Moving coil galvanometer
	Apparatus with electronic amplifier
	DC quantities accuracy class 2
	AC quantities accuracy class 3
	Use in horizontal position
	Use in vertical position
	DC quantities
	AC quantities
	Needle position zero centre
	"OFF" position
	Measuring category as per IEC EN 61010-1
	Double insulated casing
<b>CE</b>	EU conformity mark
	Earth symbol
	Ground symbol
	Battery symbol

## 3. Technical data

Dimensions:	98 x 148 x 49 mm approx.
Weight:	300 g approx.
Scale length:	80 mm
Pointer deflection	0...90°

Operating alignment:	Vertical/horizontal
Power supply:	1x 1.5 V, AA IEC LR6
Connectors:	4-mm safety sockets
Voltage ranges:	0.1, 0.3, 1, 3, 10, 30, 100, 300, 600 V AC/DC
Current ranges:	0.1, 0.3, 1, 3, 10, 30, 100, 300 mA; 1, 3, 10 A AC/DC
Input resistance:	1 MΩ AC/DC
Voltage drop when measuring current:	100 mV approx. AC/DC
Accuracy:	DC class 2, AC class 3
Electrical zero-point offset:	in all DC ranges
Accuracy with zero-point offset:	Class 5
Frequency ranges:	
1 V – 600 V:	20 Hz... <u>50 Hz</u> ...20 kHz
0.3 V:	20 Hz... <u>50 Hz</u> ...9 kHz
Current ranges:	20 Hz... <u>50 Hz</u> ...43 kHz
Signal form:	Sine (1% max. discrepancy)
Peak factor:	$\sqrt{2}$
Overload protection Voltage:	600 V long-term in all voltage ranges
Current ranges:	
Current limit integral:	450 A <sup>2</sup> s
Transient limit $I_{FMS}$ :	300 A
Long-term current limit $I_{FAV}$ :	20 A
Ambient temperature:	5°C... <u>23°C</u> ...40°C
Storage temperature:	-20...70°C
Relative humidity:	< 85% with no condensation
Shock tests:	max. 147 m/s <sup>2</sup>
Electrical safety:	
Safety specifications:	EN 61010-1
Excess voltage category:	CAT I: 600 V
Contamination level:	2
Protection type:	IP20
Electromagnetic compatibility:	
Interference emission:	EN 55011:2009
Interference resistance:	EN 61326-1:2013

#### 4. Description

The Escola 10 multimeter enables precision measurements by analogue means in education, training and practical applications. It measures AC and DC voltage or current and provides for measurements with the needle centred on the dial for DC quantities. Resistance (R) and conductance (G) or impedance (Z) and admittance (Y) can be obtained by division.

All measurement ranges are selected by means of the measurement range dial. Two linearised mirror scales, graded in a 1:3 ratio, guarantee easy readability of the measured values.

The equipment is turned on by means of the operating mode switch, which is also used to select between AC, DC or centre zero-point.

The trimmer for setting the zero point in the centre allows the zero point to be set precisely when it drifts electrically.

Isolation of the sockets for voltage and current measurement allow both to be measured in succession simply by turning the range selector switch, without any need for reconnecting or changing the measuring leads.

Use of a robust core-magnet measuring instrument set-up and an impact resistant casing allows the instrument to withstand rough handling in awkward conditions.

The Escola 10 is protected in such a way that overloads in the selectable current ranges automatically cause the power to be limited.

#### 5. Operation

- Switch the multimeter on by select the desired operating mode,  $\text{=}$ ,  $\sim$  or  $\text{A}$ .
- To turn off the multimeter, set the mode switch to the off position  $\text{⏻}$ .
- To test the battery, disconnect all leads from the multimeter, set the operating mode switch to  $\text{=}$  and the measuring range switch to  $\text{—|—}$ . In the  $\text{—|—}$  range, the needle should deflect all the way to the end. If this is not the case, the battery must be replaced immediately.

### 5.1 Current measurement



The nominal voltage of the voltage source may not exceed 600 V. Do not make measurements in the low-voltage mains region.

The multimeter is to be connected in series with the load on the side where the voltage with respect to ground is lowest.

- Before making any current measurements, set the mode switch to  $\equiv$  or  $\sim$  as appropriate.
- Connect the terminal at the lower potential to the earth socket.
- Currents of less than 3 A can be measured between the earth socket and measuring socket "A".
- Currents of less than 3 A can be measured between the earth socket and measuring socket "A". Currents higher than 3 A should be measured between the earth socket and measuring socket "10A".
- Set the switch to **A** mode and select the desired measuring range. If the current to be measured is unknown beforehand, set the measurement range dial to the highest range and work down.

The fact that measurements can be made without disconnecting the instrument and using overload protection without fuses means that converters may also be connected into the circuit.

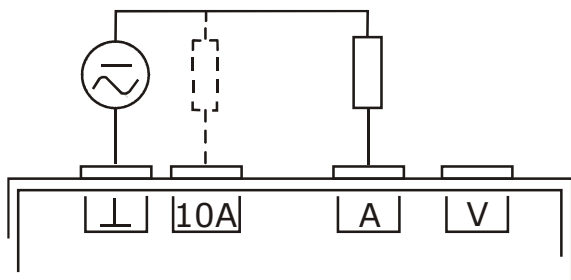


Fig. 1 Current measurement

### 5.2 Voltage measurement



The nominal voltage of the voltage source may not exceed 600 V. Do not make measurements in the low-voltage mains region.

- Before making any voltage measurements, set the mode switch to  $\equiv$  or  $\sim$  as appropriate.
- Use the "V" socket on the right for voltage measurements.

- Set the switch to **V** mode and select the desired measuring range. If the voltage to be measured is unknown beforehand, set the measurement range dial to the highest range and work down. The 100 mV voltage range is associated with a current range of 0.1 mA.

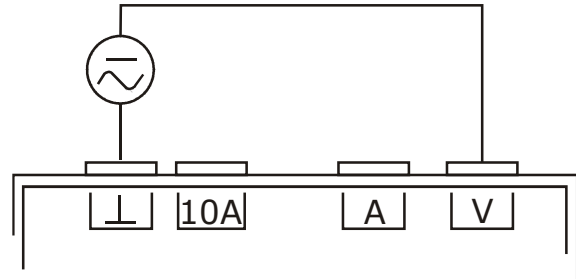


Fig. 2 Voltage measurement

### 5.3 Measuring current and voltage without reconnecting

Isolated current and voltage sockets allow measurements of both current and voltage to be made in sequence without disconnecting the measuring leads. That means that in both AC and DC modes, resistance, conductance, impedance and admittance can all be calculated forming the appropriate quotients.

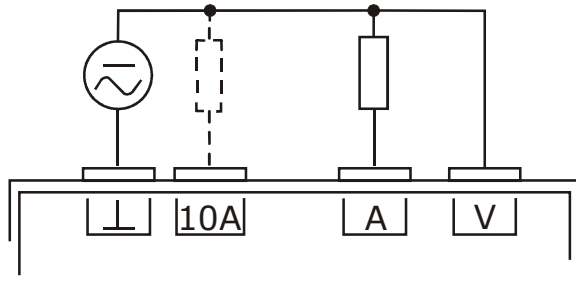


Fig. 3 Simultaneous current and voltage measurement

### 5.4 Resistance and conductance

According to the defining equation for a linear resistance,  $R = V/I$ , or conductance  $G = I/V$ , the Escola 10 can be connected in circuit as in Fig. 3 so that current and voltage can be measured one after the other, allowing for resistance measurements to be made over a range from m $\Omega$  up to several M $\Omega$ .

Therefore conductances in a range from under 1  $\mu$ S up to 30 S can be measured by taking the reciprocal of the resistance.

One very key advantage of the Escola 10 is that the instrument, when connected as in Fig. 3, can measure both current and voltage ranges without having to disconnect it.


## 5.5 Impedance and admittance

If the circuit in Fig. 3 is powered by a sinusoidal AC voltage source instead of a DC source, using the definitions for impedance  $Z = V/I$  and admittance  $Y = I/V$  means that AC measurements can also be measured in a variety of ranges in a similar way to the DC quantities in 5.4.

The Escola 10 is particularly useful in this respect because it allows for measurements to be made not only at 50 Hz, but right across the low-frequency range.

## 5.6 Measurements with the zero point of the needle centred

This kind of measurement can only be made in DC ranges.

- To make a measurement with the zero point in the centre, push the mode switch to .
- Before measuring the external quantity, calibrate the zero point using the trimmer to set the point in the direct centre of the scale.


The full extent of the measuring remains available so there is no separate labelling for the range selector switch.

For a range 0 V ... 10 V, for example, the limits now become -5 V ... 0 V ... +5 V absolute or 0 V ...  $\pm 5$  V. Positive values of voltage at the V socket or current at the A socket cause the needle to move to the right while negative values cause it to move to the left. The scales are labelled accordingly (smaller auxiliary numbering).

## 5.7 Calibrating zero-point

- Turn on the multimeter, set the maximum voltage range of 600 V and connect the ground socket to the voltage socket using a short lead.
- Set up the multimeter in a horizontal position and correct the zero-point of the dial with the help of the adjustment knob.

## 5.8 Switching off

- Always set the measuring mode to  after completion of measurements to avoid unnecessary use of the battery.

## 6. Maintenance

### 6.1 Changing the battery



All measuring leads must be disconnected from the multimeter before the casing is opened.

- From time to time, check the state of the battery (see 5. Operation).



Remove discharged or corroded batteries from the multimeter.



During prolonged periods of disuse, also remove the battery from the multimeter.

- Unscrew the back of the casing.
- Replace flat batteries with 1.5-V alkaline batteries of size AA IEC LR6.
- Place the negative pole of the battery on the spring.

The polarity is also marked on the board with plus and minus symbols. Additionally, a mechanical clip on the positive side prevents battery contact when polarity is reversed.

- Close casing again.

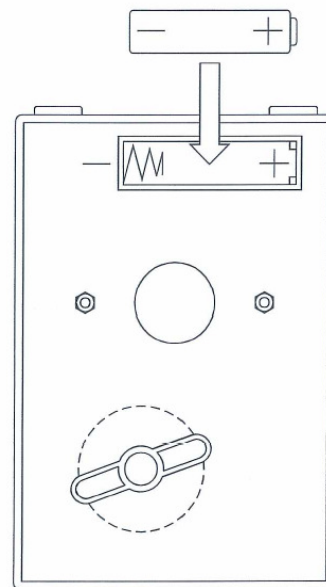
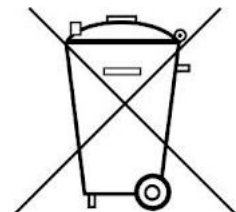


Fig. 4 Changing the battery

- Do not dispose of the battery in regular household refuse. Follow the local regulations (In Germany: BattG; EU: 2006/66/EG).



## 6.2 Cleaning

- For cleaning, use a soft cloth, slightly moistened with alcohol, or a brush.
- In order to remove a potential electrostatic charge from the meter display window, which can easily influence measurements, follow the instructions above.

Dirt or moisture in the measurement sockets can affect readings.

- Shake out any dirt that may be in the measurement sockets.
- Soak a new swab with isopropyl alcohol and work around the inside of each measurement socket.

## 7. Disposal

- 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.
- Do not dispose of the battery in regular household refuse. Follow the local regulations (In Germany: BattG; EU: 2006/66/EG).

