MI-10kV

Technical specifications
Operating instructions

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Specifications of the equipment	**MI-10kV**
Specifications of the user manual	Ref 001 - May 2004 Number:

WARNING

There are hazardous voltages involved in assays carried out using this megohmmeter. Although output current of the megohmmeter is limited, external capacities are charged to very high potentials and there is no protection against them. So, a suitably trained and competent person, strictly applying corresponding security standards should only use this equipment.

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Description

The Nieaf Instruments MI-10kV electronic megohmmeter is a versatile, portable, user friendly, rugged instrument. It uses an efficient, well experienced technology providing reliable, safe and accurate insulation resistance measurements up to 2.000.000M Ω, with four test voltages: 1.000, 2.000, 5.000 and 10.000V.

Due to its compact size and reduced weight, mechanical strength, self-contained battery supply, this apparatus is particularly suitable for field tests under severe environments. It is easy to be carried, very simple to be operated and stands severe handling conditions including frequent shocks, extreme temperatures, vibrations during transportation through hard roads, long direct exposure to solar radiation, dust, sand and other air-borne impurities etc.

Accuracy is not affected by all these conditions and it is still comparable with that of the best laboratory instruments.

Immunity against electric and magnetic fields

The Nieaf Instruments megohmmeters feature an effective filtering system that improves immunity against electromagnetic disturbances and prevents variations induced by industrial frequency fields.

Operator's Safety

Due to the high voltages involved, operator's safety is a must. Nieaf Instruments megohmeters were designed considering this outstanding aspect:
***ENCLOSURE**: Moulded in high dielectric strength plastic.*
***HIGH-VOLTAGE INDICATOR LIGHT**: An indicator light (LED) is warning the presence of high voltage at the output terminal during a measurement and remains lit until the discharge process is completed.*

Technical Specifications

Test Voltage (Volts)	MEASURING RANGES (MΩ)				Scale Multiplier	Output Resistance
	A	B	C	Cx10		
1.000	0 – 20	10 – 300	200 – 20.000	2.000 – 200.000	X 1	1MΩ
2.000	0 – 40	20 – 600	400 – 40.000	4.000 – 400.000	X 2	2MΩ
5.000	0 – 100	50 – 1.200	1.000 – 100.000	10.000 – 1.000.000	X 5	5MΩ
10.000	0 – 200	100 – 3.000	2.000 – 200.000	20.000 – 2.000.000	X 10	10MΩ

TEST VOLTAGES ACCURACY
±2% of nominal test voltage on R≥10GΩ

MEGOHMMETER ACCURACY
Class 2 (± 2% of full scale deflection)

SHORT-CIRCUITCURRENT
1,0mA

ANALOGUE INDICATOR
Up to 100 mm. Scale length, tautband, with Mirror (thus avoiding parallax errors)

ENVIRONMENTAL PROTECTION
IP54 with closed lid.

SAFETY CLASS
Meets the requirements of IEC 61010-1/1990, IEC 61010-1/1992-2

E.M.C.
In accordance with IEC61326-1

ELECTROSTATIC IMMUNITY
In accordance with IEC1000-4-2

POWER SUPPLY
Internal rechargeable 12V – 7Ah sealed lead acid battery

BATTERY CHARGER
For 200/240V~, 50/60Hz, 40VA, mains supply

OPERATING TEMPERATURE RANGE
-5°C to 50°C

STORAGE TEMPERATURE RANGE
-25°C to 65°C

HUMIDITY RANGE
95% RH (non condensing)

BATTERY TEST
Allows checking battery status under real consumption conditions without interrupting the generation of test voltages

GUARD TERMINAL
Allows the measurement of very high resistance values, avoiding the effect of stray resistance.

DIMENSIONS
378 x 308 x 175 mm. (housing only)

WEIGHT
9,5 kg (including accessories)

SUPPLIED ACCESSOIRES
Every megohmmeter is supplied with a full set of test leads, rechargeable battery, charger, carrying bad and operating manual.

Control Panel

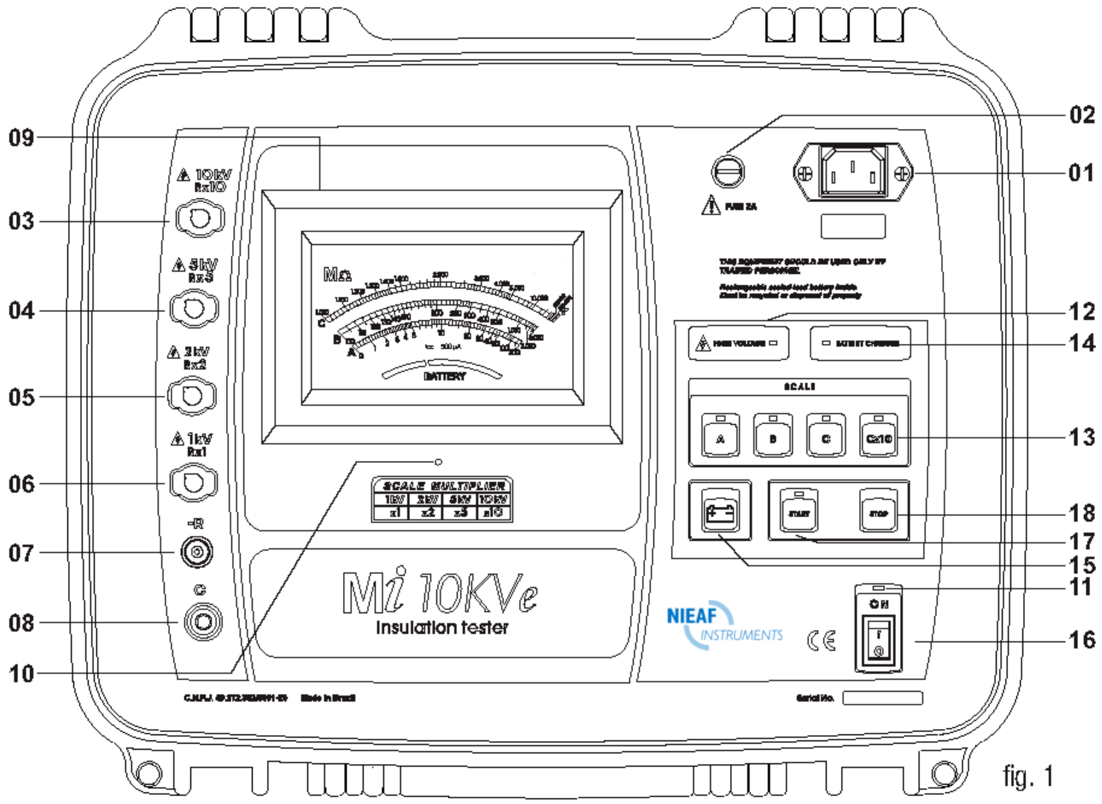


fig. 1

1. Power input (220/240V~)
2. Fuse
3. 10kV test voltage
4. 5kV test voltage
5. 2kV test voltage
6. 1kV test voltage
7. Current return terminal (-R)
8. GUARD terminal (G)
9. Analogue indicator
10. Mechanical adjust (Infinite
11. ON indicator
12. High voltage indicator
13. Key board range (A,B,C&CX10)
14. Battery charger indicator
15. Battery check key
16. ON/OFF switch
17. START key
18. STOP key

Operating Instruction

1) Be sure that there are no voltage differences between the points at which the megohmmeter will be connected, or between them and ground.

Caution *This megohmmeter is inhibited to generate test voltage while it is connected to mains. Therefore, the power cable has to be unplugged from mains prior to press the start button.*

2) Determine the value of test voltage to be used in the insulation resistance measurement.

*3) Connect the connector **red pin** of the **red cable** to the 10kV**(3)**, 5.kV **(4)**, 2kV **(5)**, of 1kV **(6)**, V terminal in accordance with the desired test voltage.*

*4) Connect the **black cable** to the **–R (7)** megohmmeter terminal (See fig. 2)*

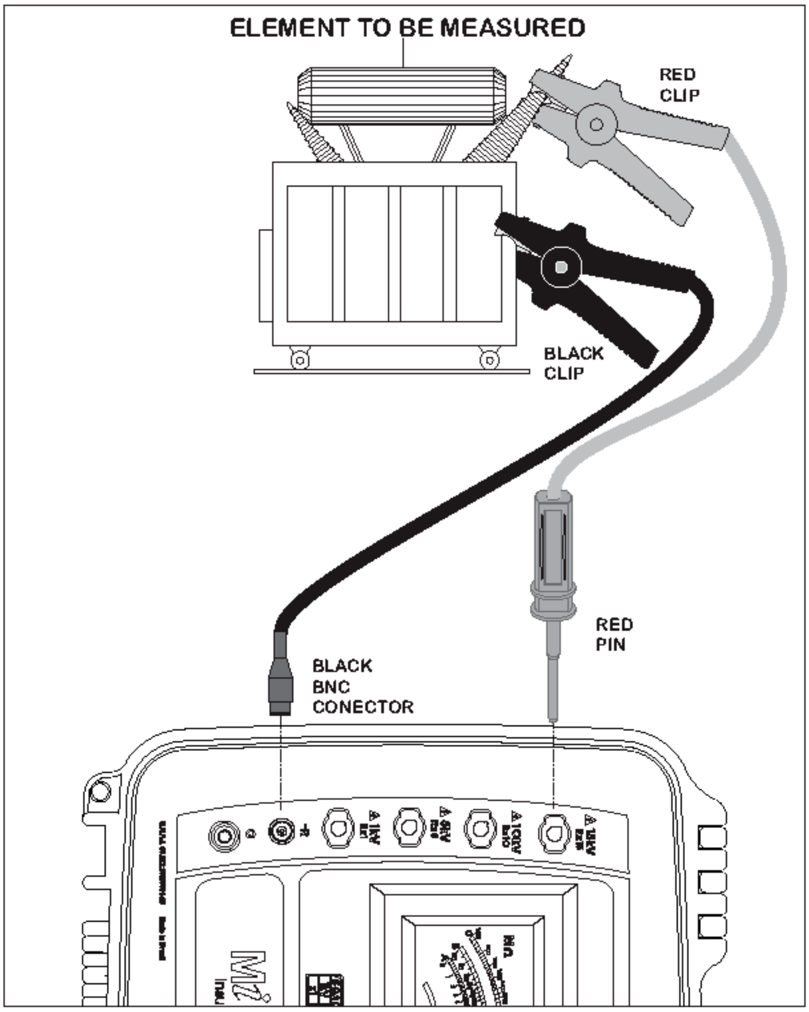


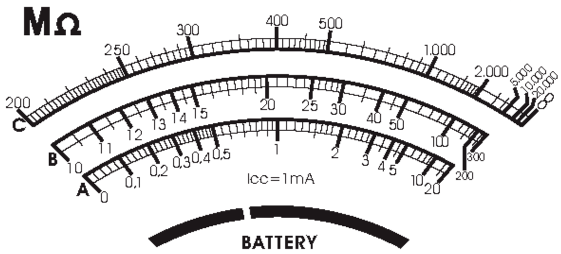
fig. 2

5) *The green GUARD **(8)** terminal is not always used. Application Note #32 explains the use of GUARD **(8)** terminal is order to minimizing the effect of stray resistances. When measurements is carried out between parts which is none of them is grounded, (like between high-side and low-side windings of a transformer), GUARD **(8)** terminal must be connected to ground in order to fix the apparatus potential. **At any time a measurement is performed, either the –R (7) or GUARD (8) terminals must be connected to ground but never both simultaneously.** If non of these terminals are connected to ground, the megohmmeter can reach a high potential that may result in a stable reading. **If both terminals are simultaneously connected to ground**, there is a short-circuit between them and consequently the megohmmeter **will measure with error.***

6) *Connect the free ends of cables (dolphin clips) to the element to be measured.*

7) *Turn of the apparatus by pressing the ON/OFF **(16)** key. The ON LED **(11)** begins to bright.*

8) *Press the START KEY **(17).** Then the high-voltage generator starts operating and the corresponding indication light turns on at the front panel. The meter pointer will indicate the value of the unknown resistance. If the element to be measured is strongly capacitive it will initially indicate a low resistance value, which will be gradually increased while the charging of that capacitance takes place. The instrument will always begin in the scale ‘A’. See fig. 3.*



9) *When the measured resistance exceeds the maximum value in range A, press range B key, and if still the value is not achieved, press keys of ranges C or Cx10, as required.*

10) *Always remember to multiply the reading by the factor stated in the following table, depending on selected test voltage:*

SCALE MULTIPLIER			
1kV	2kV	5kV	10kV
x1	x2	x5	x10

11) *When key C x 10 is used, reading shall be carried out in range C and shall be multiplied by 10, in addition to the factor corresponding to the test voltage.*

12) *When you press STOP KEY **(18)**, the megohmmeter will start discharging the potentials accumulated in the apparatus internal capacitances and in those of the element under test as well. When this discharging process is over (up to 60 seconds after turn off) the HIGH-VOLTAGE LED **(12)** will turn off automatically. The test leads may be disconnected. To finish measurement press again and release ON/OFF switch **(16)**.*

13) *In certain instances, when the apparatus is disconnected the pointer exceeds the infinite position to the right side. This is a normal behaviour.*

14) ***Checking battery status.** Battery measurement can be performed without interrupting high-voltage generation, which will proved a better evaluation of the battery status, by pressing the Battery Icon key **(15)** during the measurement. So, the battery test is performed under actual consumption conditions and, for long lasting measurements, (i.e. Polarisation Index), the evolution of battery status can be checked without affecting the measurement. The meter pointer should stop over the blue zone. If the pointer stop over the red zone, this means that the battery is discharged and shall be charged.*

15) ***Infinite setting (10)**. The mechanical zero of galvanometer must be periodically checked. In order to perform this checking, be sure that the megohmmeter is off. The pointer should stay on the right end of the scale just over the infinite mark on scale C. In other case, the plastic screw at the bottom of the galvanometer acrylic cover shall be adjusted.*

Battery Charger

This equipment has an intelligent built-in circuit that controls the battery charge and does not allow the equipment to operate during the charging process.

In order to charge the battery, follow the following procedure:

- *Verify that the ON/OFF switch **(16)** is switched off.*

- *Connect the equipment to mains with power cord at the Power Input **(01)** of the equipment*
  .
- *After a while, the luminous indicator LED **(14)** will blink alternatively in green and red during one second, while the charger verifies the initial condition of the battery to select the optimised parameters of the charge.*

- *Later, the LED indicator **(14)** will keep on being lit in red, up to completing the charge. When the indicator changes to green and will keep being like this up to the equipment is unplugged from mains.*

- *If during the charge the system detects that for any reason the battery is not receiving the normal charging current the LED indicator **(14)** will blink in red.*

- *If at the end of the maximum charging time, the battery has not reached the complete charge, LED **(14)** will keep on blinking in green.*

- *The following chart summarises the meaning of LED luminous indications **(14):***

Green and red flashing alternatively	*Test of the initial condition of the battery when plugging the mains, during one second.*
Permanent red	*Battery under charge.*
Flashing red	*Charging current is less than normal.*
Permanent green	*The charging process has been successfully finished. Battery OK.*
Flashing green	*The charging process has finished, nevertheless the battery has not received the complete charge.*

Note: *The battery looses part of its charge while being stored. Thus, before using the megohmmeter for the first time, or after a time being out of use, the battery should be recharged.*

Application not #32

Use of the GUARD terminal in megohmmeters

When insulation resistance measurements are performed with megohmmeters, specially with high-sensitivity instruments measuring high resistance values, the use of the GUARD terminal avoids the harmful influence of stray resistances.

In order to better explain the function of this terminal, let us start reviewing the megohmmeter basic circuit diagram of Fig. 1.

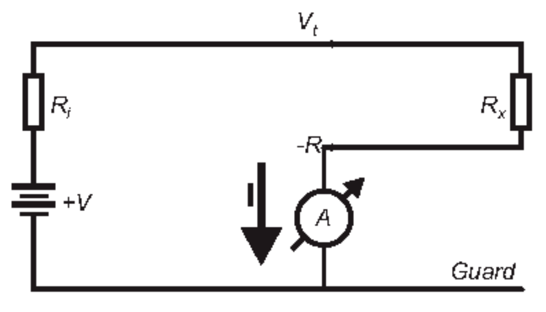


Fig. 1

Where:

V:	*DC high-voltage generator*
Ri:	*Generator internal resistance*
A:	*Indicator meter (microammeter)*

The unknown resistance (Rx) is connected between Vt and R terminals. Its value determines the current through the circuit, which in turn is indicated by the microammeter. The value of Rx can be determined as follows:

$$Rx = \frac{V}{I} - Ri$$

In many cases the resistance to be measured is in parallel with other stray resistances which influence on Rx should be minimum and if possible, zero.

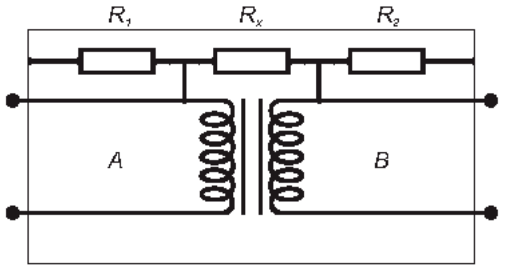


Fig. 2

A typical example of this situation is when the insulation resistance between primary and secondary windings of a transformer mounted inside a metal housing is be measured.

Rx: *Insulation resistance between primary and secondary winding.*

R1: *Insulation resistance between primary winding and housing.*

R2: *Insulation resistance between secondary winding and housing.*

If megohmmeter (terminals Vt and R) is connected to transformer terminals A and B, and considering that the resistance of the turns on each side of the transformer may be disregarded as compared with the insulation resistance between primary and secondary windings measured by Megohmmeter, Rx appears to be in parallel with (R1+R2).

The situation is changed if we connect the transformer housing to GUARD terminal.

Then the resulting circuit will be:

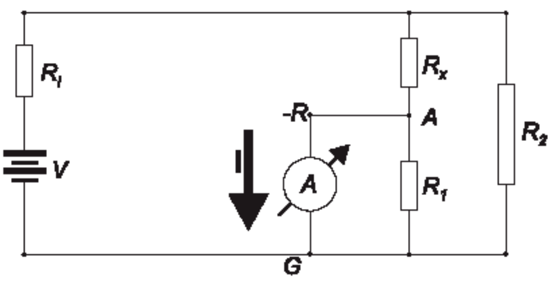


Fig. 3

In the circuit of Fig. 3, it may be noted that R1 is in parallel with a low-value resistance (the one from the microammeter) therefore its influence is reduced during reading.

Through resistance R2 circulates a current which is not passing through the meter and consequently does not affect the reading. In fact, current through R2 originates a certain error, since is creates an additional voltage drop in R1, which was not regarded during megohmmeter calibration.

As regards the practical use of megohmmeter, it shall be considered that if R1 and R2 are higher than 100MΩ, any value of Rx will be measured with an error lower than 10%.

For example: Let us consider Rx = 3.000MΩ and R1 = R2 = 100MΩ, the reading without using the GUARD terminal would be 187,5MΩ, which is quite wrong. On the other hand, if the GUARD terminal is properly used, we would have 3.000MΩ, with an error lower than 10%.