Microohmmeters

MMR-650

Index: WMGBMMR650

CAT III 600V

CAT IV 300V

IP 54 open case

IP 67 close case

Standard accessories of meter:

- two-wire 3m test lead (2pcs),	WAPRZ003DZBBU1I1 / WAPRZ003DZBBU2I2
- Kelvin's clamp (2pcs),	WAKROKELK06
- double pin probe (2pcs),	WASONKEL2OGB
- Power Cord,	WAPRZLAD230
- Carrying case for meter and accessories,	
- USB cable,	
- User Manual,	
- Calibration Certificate,	
- PC software (Sonel Reader).	

DO YOU KNOW...

MMR-650 enables measurement of inductive objects of amorphous core (including transformers)

Measurement of resistance

Range	Resolution	Measurement current	Accuracy
0...999,9 µΩ	0,1 µΩ	10 A (20 mV)	±(0,25% + 2 digits)
1,0000...1,9999 mΩ	0,0001 mΩ		
2,000...19,999 mΩ	0,001 mΩ	10A (200 mV)	
20,00...199,9 mΩ	0,01 mΩ	10 A/1 A (2 V/200 mV)	
200,0...999,9 mΩ	0,1 mΩ	1 A/0,1 A (2 V/200 mV)	
1,0000...1,9999 Ω	0,0001 Ω		
2,000...19,999 Ω	0,001 Ω	0,1 A (2 V)	
20,00...199,99 Ω	0,01 Ω	10 mA (2 V)	
200,0...1999,9 Ω	0,1 Ω	1 mA (2 V)	

Measurements of objects of resistance nature:

Designed to measure very low resistances of both resistive and inductive types of objects, including amorphous core transformers. This product is made for variety of applications and branches of industry e.g. power plants, railway and maintenence companies etc. The device can be used to measure welded and soldered connections, equipotential bondings, earthing conductors, contacts, bolted connections, windings of motors and power transformers and other resistive and inductive objects.

MMR-650 can be also utilized on a production lines (e.g. at the final production control stage). An innovative combination of a high-performance measuring device with a modern user interface and advanced data management system. Wireless data transmission, enhanced system of 2D codes and ability to print labels to identify test items, all contribute to bringing new quality of work and allow the user to perform a wide range of measurements.

Additional features:

- Measurement of resistive and inductive loads (including transformers with amorphous core)
- Automatic temperature compensation (temp. probe)
- Function to determine the temperature of the engine under load,
- Demagnetization of the transformer core function,
- High noise immunity,
- 4-wire measurement,
- Measuring voltage up to 10V,
- Limits and signaling setup,
- Rechargeable Li-Ion battery and mains adapter 90 - 260 VAC,
- IP54 - opened case, IP67 – closed case.
- Robust shock-resistant design of the meter,
- available printer and a 2D code reader,
- Touch screen, intuitive user interface,
- USB, WiFi, Wireless LAN (optional)
- Operating temperature -10 to + 50 ˚C,
- Category 600 V CAT III / 300 V CAT IV,
- Protection against external voltage up to 600 VDC,
- Software: Sonel PE and Sonel Reader.

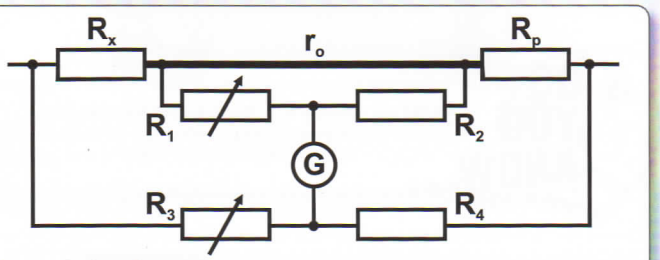
Additional accessories of meter:

- Kelvin vice with 2.6m two-wire cable,	WAZACKEL1
- Sticker - printer ribbon SATO D2 - 100m,	WANAKD2BAR
- Sticker - paper tape for SATO D2 printer,	WANAKD2
- Portable USB report/bar code printer,	WAADAD2
two-wire 10m test lead with crocodile clip,	
two-wire 25m test lead with crocodile clip,	
LAN cable	

LOW RESISTANCE MEASUREMENTS

Low resistanace measurements are performed using special meters called micro-ohm-meters. Low resistance can be measured on objects such as: welded connections, equipotential bondings, joints, cable connections, low resistance coils etc. Most important feature of low resistance tests are capability of quality veryfication of conductor continuity and of all types of joints for instance welded and soldered joints. Special application of micro-ohm-meters involves winding testing of electrical equipment such as transformers and motors.

The most popular methods are: measurement with the Thomson bridge (six-arm bridge) and Technical Method. The popularity of these two methods is related to their insensitivity to the resistance of connections and test leads. Because for very small values of resistance (in the micro-ohm range), the resistance of test leads and contacts is comparable to the measured resistance. The Thomson bridge is presented in the image below. The measured resistance is Rx. All auxilary resistors except Rp have to have resistance 1000-times higher than resistance of test leads. 1000-times higher than the resistance of test leads.



Thomson bridge schematic

In the bridge balanced state, current flowing through the galvanometer (G) branch equals zero. The formula for the measured resistance is:

$$R_x = \frac{R_p R_1}{R_2}$$

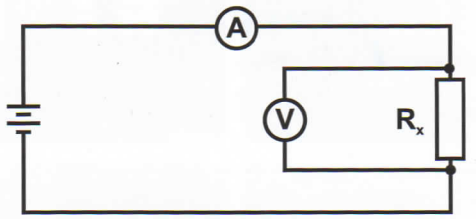
The accuracy of measurement with the Thomson bridge is affected by the insensitivity error, especially visible for small resistances $R_x = 10^{-6} .. 10^{-5}\ \Omega$. The accuracy of the measurement depends on the quality of individual resistor elements of the bridge. During the measurement, additional errors can be encountered, resulting from current overload of the tested and reference resistances, temperature changes as well as the occurrence of additional electromotive forces in the circuit.

There exist a tendency for constructing electronic resistance meters that are reliable and are capable of measuring low resistance ranging from single microohms up to higher resistance of hundred ohms. Due to flaws and limitations of the Thomson bridge, a Technical Method offers more reliable and simpler way for measuring low resistance. The instruments based on this method allow the measurement of very small resistance with the resolution as high as 0.1 uOhm.

Important features of modern microohm meters are: their ease of use, short time of measurement, insensitivity to external noise and capability of cooperation with a computer. These instruments measure resistance with the use of Technical Method, which is based on a simple circuit shown in the image below. Any conductive element can be described with the Ohm law formula:

$$R_x = \frac{U_x}{I}$$

U_x - voltage drop on the measured element,
I - current flowing through the element,
R_x - resistance of the element.



Measurement of resistance with the use of the technical method (a circuit with properly measured voltage)

The circuit shown in the image above is used to measure low resistance R_x. The measurement of a total current is done by the ammeter and voltage drop on the resistor element Rx is measured by the voltmeter. The total curent is a sum of two currents according to the Kirchhoff's law i.e. it is the sum of the current flowing through the element and through the voltmeter $I = I_{tot} - I_v$. The resistance resulting from the measurement is calculated by the formula:

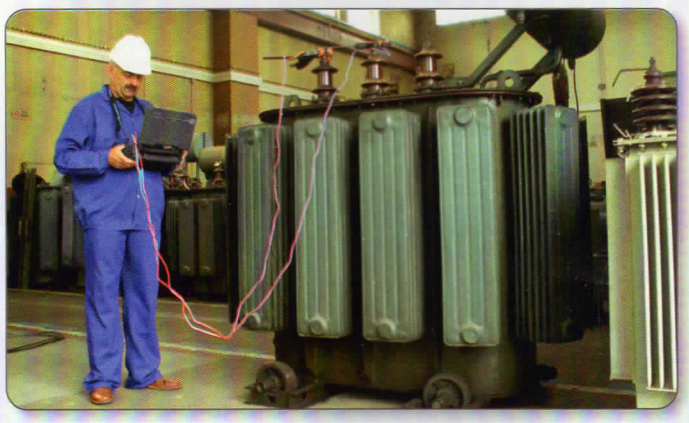
$$R_x = \frac{U_x}{I_{tot} - I_v}$$

I_{tot} - total current
I_v - current flowing through the voltmeter.

For a very large resistance of the voltmeter, the current flowing through it is negligible, and also the resistance of all leads connected to the resistor Rx does not affect the result of the measurement. This is the, so-called, four-lead method. Such a measurement type, eliminating the influence of test lead resistance, is employed in the MMR series of low resistance meters.

Measurements with MMR-620 and MMR-630 instruments

The application of four-lead method allows the measurement of very low values of resistance. Such method employed in our devices eliminates the influence of the resistance of test leads and the need for calibration of the meter. However the calibration capability is still available in the meters and any type of test leads can be used with the calibration procedure. It is always possible to restore factory settings and original callibration parameters.



Before starting the measurement, it is necessary to select, using the rotary switch, the maximal measurement current from the range of 0.1 mA to 10 A. The measurement range and current are selected manually or automatically. In some cases, the maximal power dissipaded in the object during the measurement can not be exceeded. In this case the upper limit for current can be set in the meters.

The instrument measures resistance by forcing a flow of current through the measured object, and simultaneously checks the voltage drop across the terminals of its voltage leads. Opening any of the circuits will be signalled appropriately, and the measurement of resistance will not be possible.

Modes of operation:

The user selects the method of measurements in one of several available modes:

- in the manual mode, each measurement must be triggered by the user with the "Start" button,
- in the automatic mode, the measurement starts when, the last test terminal is connected,
- in the continuous mode, measurements are performed cyclically every 3 seconds (resistive mode) or continuously (inductive mode).

Measurements can be performed with current flowing in one direction or with current flowing in two opposite directions. Testing with unidirectional current speeds up the measurements, whereas testing with bidirectional current allows for the elimination of errors resulting from internal voltages and electrothermal forces present in the measured object. In the case of measurement with bidirectional current, the mean value of resistance from two measurements with currents flowing in opposite directions, is displayed as the main result. Besides that, the supplementary results are displayed, i.e. the RF resistance for current flowing in the conventional "forward" direction, and the RR resistance for current flowing in the "reverse" direction.

Duration of a normal measurement is 3 seconds. In order to measure an object of inductive nature, an extended measurement time can be selected. For objects of high inductance, duration of measurement can be extended up to several minutes. The object is discharged after finishing the measurement.

It is possible to use an accelerated mode of measurement for devices of inductive nature (FAST mode), allowing for faster measurement procedure at the cost of slightly worse accuracy.

Another mode is the window mode, allowing for setting the upper and lower limits for the result. Results outside of such a range are signalled with two prolonged sound signals.

The limits of allowable result range are defined by the user.
In the case of automatic and continuous modes, exceeding the defined range causes interrupting the measurement series and awaiting user action.