INSTRUCTION MANUAL

BATTERY OPERATED DIGITAL INSULATION & CONTINUITY RESISTANCE TESTER

MODEL 3001B

KYORITSU ELECTRICAL INSTRUMENTS WORKS, LTD., TOKYO, JAPAN

Distributor

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Table of Contents

1 Features

- High power digital insulation tester permitting accurate measurements.
- Insulation tester reading to 200MΩ at 500V for general purpose testing or where electronic components may be present in the circuits under test.
- Insulation tester reading to 200 MΩ at 1000V for special high voltage testing.
- Continuity and low resistance tester suitable for cable resistance measurements.
- Live circuit neon indicator plus audible warning signal.
- Press to test button with lock down feature. Releasing the press to test button will automatically discharge the capacitance of the circuit under test.
- Compact, lightweight and portable
- Front panel zero adjust.

2 Specification

Insulation Resistance Tester	Test voltage	500V	1000V
	Measuring ranges	0~200MΩ	0~200MΩ (2/20/200MΩ autoranging)
	Terminal voltage	500V$^{+20}_{-0}$% from 0.5MΩ to ∞	1000V$^{+20}_{-0}$% from 1MΩ to ∞
	Output short circuit current	1.4mA approx.	1.6mA approx.
	Accuracy	±2% of rdg ±1 dgt	
Ohmmeter	Measuring range	0–200MΩ (20/200Ω autoranging)	
	Output voltage on open circuit	600mV approx.	
	Output short circuit current	6mA approx.	
	Accuracy	±2% of rdg ±0.1Ω ±1 dgt	
	Dimensions LWD	144 × 93 × 61 mm	
	Weight	460g approx.	
	Batteries	8 × 1.5V SUM 3 battery or HP 7, size AA or equivalent	
	Accessories	Test Leads / Carrying Case	

3 Instrument Layout

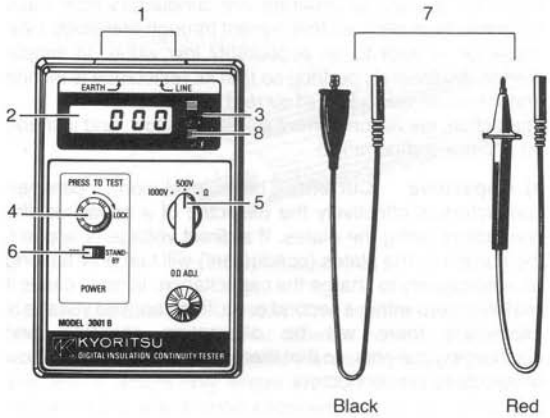

Fig. 1

1. Terminals
2. Digital Display
3. Battery Check Lamp
4. Press to Test Button with Lock Down Feature
5. Range Switch Knob
6. Off – Stand-By Button
7. Test Leads
8. Live Circuit Warning Lamp 70V AC to 550V AC

4. The Nature of Insulation Resistance

Insulation is used to separate live conductors from each other and from earth so that current through and across the insulation is kept to an acceptably low value. In simple theory, insulation is perfect, so that its resistance is infinite and there can be no flow of current past it.
In practice, insulation current will always flow, and is made up of three components:

a) Capacitive Current: The insulation between conductors is effectively the dielectric of a capacitor, the conductors being the plates. If a direct voltage is applied, the current to the plates (conductors) will last only as long as is necessary to charge the capacitance. In most cases it will fall to zero within a second or so. If the applied voltage is alternating there will be alternating charging and discharging currents, so that there will be a continuous flow of current to the conductors.

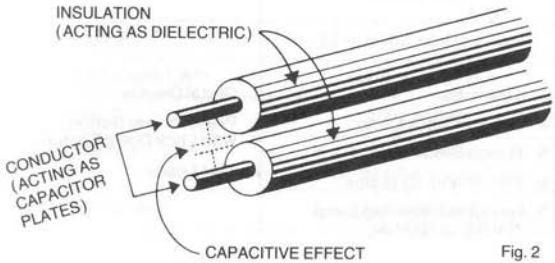

Fig. 2

b) Conduction Current: This is current flowing through the insulation itself because the insulation resistance is not infinite. Ohm's law applies.

$$\text{So leakage current } (\mu A) = \frac{\text{applied voltage (V)}}{\text{insulation resistance (M}\Omega\text{)}}$$

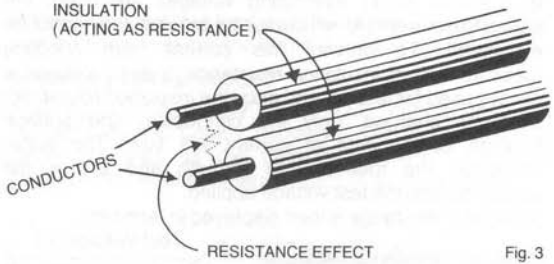

Fig. 3

c) Surface Leakage Current: This current flows between the conductors which are at different potentials along the surface of the insulation where there is dirt and/or moisture present. It occurs only where the continuous insulation is removed, i.e. where conductors are connected together or into terminals.

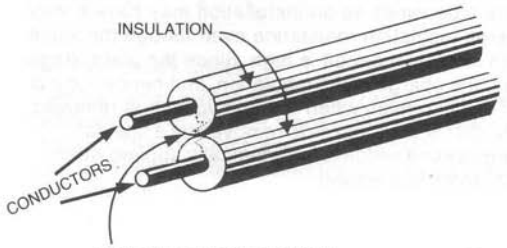

Fig. 4

Effectively, the total current flowing between conductors or from live conductors to earthed metal is the sum of the three components a, b & c explained above. All three currents, and thus their total, are affected by factors such as temperature, humidity and applied voltage.

In a circuit where alternating voltages are used, the capacitive current (A) will always be present and cannot be eliminated. To prevent this current from affecting measurement of insulation resistance, a direct voltage is always used for testing, and once the insulation (dielectric) becomes charged, only the conduction and surface leakage components of current will flow. The tester measures the total current through and across the insulation, and the test voltage applied.

Insulation resistance is then displayed in terms of:

$$\text{Insulation resistance (M}\Omega\text{)} = \frac{\text{Test Voltage (V)}}{\text{Insulation current } (\mu\text{A})}$$

In the event of an otherwise healthy system having wet and dirty connections, the surface leakage current will be high and the insulation resistance correspondingly low.

Similarly, if a very large installation is tested, the overall insulation resistance will be made up of the insulation resistances of all its circuits connected in parallel. The more resistors we connect in parallel, the lower the total resistance becomes so an installation may have a very low overall insulation resistance even though the value for each individual circuit is high. Since the test voltage is direct, the charge in the insulation, and hence the p.d. across it, will remain when the test voltage is removed. In the K3001B, this charge is removed by a special discharge circuit which is automatically applied when the test button is released.

5 Preparation for Measurements

a. How to connect test leads

Connect the red test lead into the terminal marked 'Line' and the black lead into the terminal marked 'Earth'.

b. Battery voltage check

Flashing of the battery check LED during operation indicates normal battery condition. The LED flashes at longer intervals as the batteries become exhausted. Replace the batteries when the LED stops flashing.

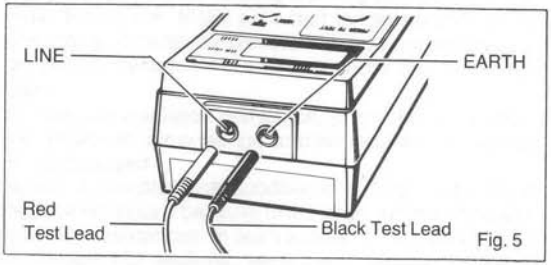

Fig. 5

c. Test Leads Check

Set the range switch to the ohm range. With the tip and alligator clip of the test leads connected press the test button. The indicator should read zero [0.00] . When the leads are not connected the display will read infinity indicated by "1".

d. Disconnection and check of power source of circuit under test

Turn off the power source of the circuit under test and connect the test leads to it. Make certain that the live circuit warning lamp is not on and the audible warning is not present. If the lamp lights up and the beeper sounds recheck the power source is disconnected before proceeding.

6 Insulation Resistance Measurements

a) Measurements at 500V

This is the voltage used for the majority of insulation resistance tests on normal installations.

First, set the range switch to 500V, and attach the test leads to the instrument. Connect the crocodile clip on the black lead to one side of the circut to be tested (for example, to earth) and place the probe on the red lead in contact with the other side (for example, phase, or neutral). Should the "live circuit" lamp on the instrument scale light up and the audible warning sound, the circuit under test is live. Make sure that the test button is not pressed, and carefully remove the test connections to the circuit. Switch off the circuit under test, and start again.

To measure insulation resistance, press the test button. The "power on" lamp will light and the insulation resistance will be displayed.

Section 4 indicated that subdivision of large installations might be necessary because of the large number of parallel insulation resistances. In such a case, an installation may be divided into sections, each being separately tested. Each section must have not less than fifty outlets, an outlet being a switch, socket, lighting point, etc. A switched socket counts as one outlet. The minimum acceptable insulation resistance is 1MΩ.

For a large installation, the capacitance of the insulation will be high, and it will take longer for it to become charged by the direct testing voltage. Care must be taken not to take a reading until there is a steady reading, indicating that the charging process is complete.

Note: The charge stored in the insulation will be discharged

automatically when the test button is released. Be careful not to turn the range switch knob whilst the test button is pressed, or the instrument will be damaged.

b) Measurements at 1000V

Some specifications require testing at 1000V. This voltage must also be selected where the supply voltage of the installation is between 500V and 1000V. First, set the range switch to 1000V and then proceed as indicated in **a)** above for 500V testing. The above note also applies to testing at 1000V. In addition the following applies.

Note: Make sure that the circuit under test does not include components which will be damaged by the 1000V applied. Many normal components of an installation are likely to be damaged if tested at 1000V. Examples are power factor correction capacitors, low voltage mineral-insulated cables, electronic light dimmers, electronic ballasts and starters for fluorescent lamps etc. etc.

c) Lock Down Feature

For hands free operation a lock down feature is incorporated on the press to test button. Pressing and turning clockwise locks the button in the operating position.
The button is released by turning it anticlockwise.

7 The Nature of Low-Resistance Systems

Traditionally the installation electrician has been concerned with continuity tests which simply confirmed the presence of a closed circuit. The low resistance range of the Model 3001B can be used for this purpose, a low resistance reading indicating satisfactory continuity. Increasingly, however, the electrician is being required to make definitive measurements of conductor resistance.
For example, if the earth-fault loop impedance at the mains intake position is known, a measurement of the phase/protective conductor loop resistance from this point to any point in the installation can be added to give the total earth fault loop impedance at the latter point. (I.E.E. Wiring Regs. Appendix 15 item 5 (ii)).
Again I.E.E. Wiring Reg. 613-2 requires two different low resistance measurements to verify the correctness and continuity of a final ring circuit. These measurements are usually low, typically being less than 1 Ω, and the scale reading of 20 Ω on the Model 3001B makes such readings both easy and accurate.
Note The voltage between the test prods on the lowresistance range is about 0.6V, which will often be insufficient to turn on a forward—biased silicon-diode. In any case, the forward resistance of such a diode is often of the order of 1000 Ω, which is beyond the range of the resistance scale. For this reason, resistance-measuring instruments are usually unsuitable for testing circuits which contain non-linear (electronic) components.

8 Low Resistance (Continuity) Measurements

a) Set the range switch to Ω position.
b) Connect the tips of the test leads to both ends of the circuit under test. Press the test button and read resistance in Ω on the Ω scale.

Zero Adjustment

A convenient front panel zero adjust feature is incorporated.
Check and adjust the zero position on the Ω scale as follows:
Short the tips of the test leads and press the test button. If the display does not read zero [0.00] turn the zero adjust to obtain a zero reading.

9 Battery Testing and Replacement

Flashing of battery check LED during operation indicates normal battery condition. The LED flashes at longer intervals as the batteries become exhausted. Replace the batteries when LED stops flashing.

10 Using the Carrying Case

The carrying case cover may be stowed beneath the case. This permits the instrument to be used without removal from its case. The strap can be put round the neck of the user so that the case and instrument are horizontal, leaving both hands free for testing.

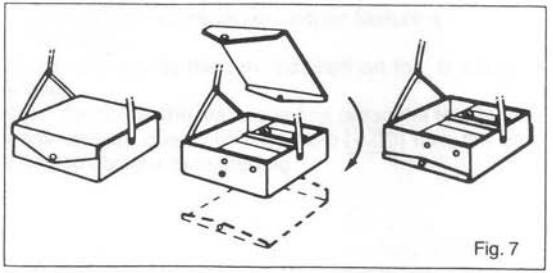

Fig. 7

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