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(Analog & Digital)

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- Transformers
- Relays
- Thermometers
  (Bi-metal & Glass)
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Caution

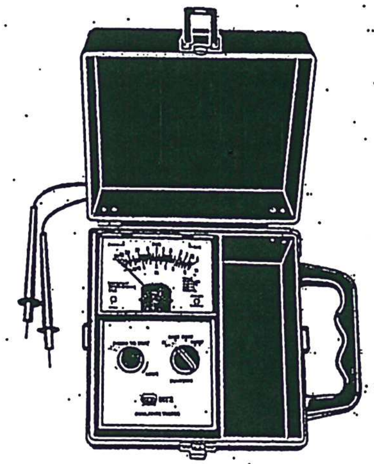
To eliminate possibility of injury to operator and damage to the instrument and equipment, the following procedure is recommended. Exercise care and caution on all ranges, particularly the voltage ranges, and follow all standard published safety rules. Misuse, abuse and carelessness cannot be prevented by any written word and is fully the operator's responsibility.

universal UEI enterprises

UEI
5500 SW Arctic Drive
Beaverton, OR 97005
503-644-8723

Printed in Korea

IRT2



OPERATING INSTRUCTIONS

universal UEI enterprises

UEI
5500 SW Arctic Drive
Beaverton, OR 97005
503-644-8723

WARNING: *OBSERVE ALL SAFETY PRECAUTIONS WHEN MAKING MEASUREMENTS. TURN OFF POWER TO THE CIRCUIT UNDER TEST, SET THE IRT2 CONTROLS, CONNECT THE TEST LEADS TO THE TESTER AND THEN TO THE CIRCUIT UNDER TEST. REAPPLY POWER.*

The IRT2 Insulation Resistance Tester is a precision electronic test instrument. Take this opportunity to read these instructions and familiarize yourself with the IRT2, its features, and operations.

Features

- Battery operated
- Solid state circuitry
- Battery check feature
- Automatic circuit discharge
- Color coded scale
- Three megohm voltages
- Fuse protected
- Three Year Limited Warranty

Introduction

The IRT2 Insulation Resistance Tester is a completely portable, self-contained solid state test instrument. Power is provided by eight internal, standard 1.5V, size AA batteries. An electronically regulated constant voltage generator supplies the test voltage for the 200MΩ range (1000V), the 100MΩ range (500V) and the 250V range. The internal batteries supply power directly for the 0-50Ω low resistance (continuity) range. This rugged precision instrument can locate intermittent shorts, defective electrical connections, insulation breakdowns or conductor failures due to the effects of temperature, moisture, abrasion, corrosion, or other environmental conditions.

Specifications

Ranges:
0-200MΩ (1000 DCV test voltage)
0-100MΩ (500 DCV test voltage)
0-50MΩ (250 DCV test voltage)
0-50Ω (2 ohms midscale)

Specifications Cont.

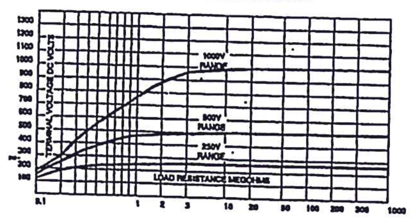
Open Circuit Terminal Voltages:
(refer to Chart 1)
0-200MΩ: +1000 DCV ±10%
0-100MΩ: +500 DCV ±10%
0-50MΩ: +250 DCV ±10%
0-50Ω: +600 DCmV (approximately)

Short Circuit Terminal Current:
0-200MΩ: 2 DCmA
0-100MΩ: 2 DCmA
0-50MΩ: 2 DCmA
0-50Ω: 170 DCmA

Accuracy:
±5% of indicated value (approximately)

Batteries:
Eight 1.5V, size AA batteries, included

IRT2
TERMINAL VOLTAGE VS. LOAD RESISTANCE



Selector Switch
The SELECTOR Switch is a four station rotary switch and is used to select the range, or function desired.

Position	Function
Ω	This is the low resistance or "continuity" position. It is color coded green to correspond to the 0-50Ω scale on the panel meter. The main purpose of this position on the SELECTOR switch is to identify low resistance circuits such as motor run and start windings which may differ by only a few ohms. With a midscale reading of 2 ohms, the OHMS position can also be used to check relay contact resistance.
50MΩ (250V)	In this position approximately 250 VDC is applied to the circuit under test when the TEST switch is pressed.
100MΩ (500V)	In this position approximately 500 VDC is applied to the circuit under test when the TEST switch is pressed. The 0-100MΩ range is used primarily to test insulation resistances which have begun to degrade.
200MΩ (1000V)	In this position approximately 1000 VDC is applied to the circuit under test when the TEST switch is pressed. This is the range which is normally used for preventative maintenance measurements on electrical equipment. Insulation resistance values in this application typically exceed 400MΩ.

Test Switch
The TEST switch is normally OFF, spring loaded, momentary action switch which "turns on" the IRT2. The momentary action is a safety feature. The test voltage generated by the IRT2 is automatically discharged when the TEST switch is released.

Typical Applications

Preventative Maintenance
One of the most effective applications, and one of the most overlooked applications, for the IRT2 is in the field of preventative maintenance. For example, when the insulation properties of a hermetic compressor motor begins to fail it usually does so gradually at first. A routine, periodic, monitoring of the insulation resistance of the start and run windings will usually show evidence of a potential burn out well in advance of the actual occurrence.

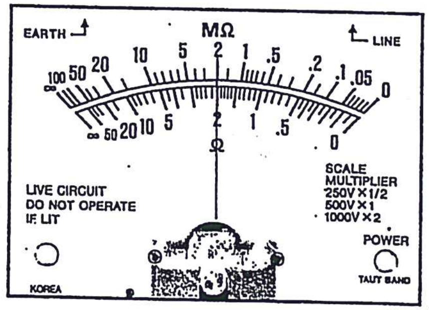
Trouble Shooting
Current leakage paths are difficult, if not impossible, to detect with a conventional multitester. The resistance of such leakage paths may be too high to measure with a multitester but still be low enough to cause inefficient operation, overheating, and other indications of operating problems.

Determining Moisture Content
The amount of insulation resistance, when drying out or baking transformers, motors, and generators is an excellent indicator of the amount of moisture remaining in the device. The insulation resistance reading will increase as the moisture is driven off. In this way optimum curing times can be determined.

Reading The Meter Scale Plate

The two resistance scales on the IRT2 meter scale plate correspond to the resistance positions of the SELECTOR switch, OHMS, 100MΩ, 200MΩ. The resistance value of the circuit under test are read from the appropriate scale. Multiplication factors are required. The top scale is the insulation resistance scale. The second scale from the top (color coded green) is the low ohms scale. Note that the zero resistance position of the top (insulation resistance) scale is located at the **right** hand end of the scale. The zero resistance position of the OHMS scale is located at the **right** hand end of the scale.

As an illustration, refer to the figure below:



With the SELECTOR switch set to the OHMS position, the indicated resistance value would be read on the green 0-50 OHMS scale. This scale is the second scale from the top. The value indicated on the above scale is 2 ohms.
With the SELECTOR switch set to the 100MΩ position, the indicated insulation resistance value would be read on the top scale. In this example, the indicated resistance value is 2 Megohms.
With the SELECTOR switch set to the 200MΩ position the indicated insulation resistance value would be read on the top scale. In this example, the indicated resistance value is 4 Megohms.

Operation

Caution

Observe all safety precautions when the CONTROL switch is set to either the 100MΩ (500V) or the 200MΩ (1000V) position. Connect the IRT2 test leads to the circuit under test before operating the TEST switch. Do not touch the battery clip ends of the test leads when the TEST switch is in the TEST position.
Some electrical equipment, especially cables, may retain an electrical charge when disconnected from the line. It is good practice to discharge such equipment with grounding straps, or other suitable devices, before touching or making connections. The IRT2 automatically discharges the test circuits when the spring loaded TEST switch is released.

Important

Remove all power to the circuit under test when making resistance measurements. If any voltage is present in the test circuit the red LED on the IRT2 scale plate will light. Immediately disconnect test leads and turn off power to test circuit.

General Instructions

Many factors will affect the measurement of insulation resistance. This is discussed in detail in the next chapter. Good housekeeping practices are of value not only for the routine operation of electrical equipment but also for the making of insulation resistance measurements. Dust, oil, grease, moisture, etc., may affect the test results by causing higher, or lower, readings. Point of measurement contact should be as clean as practicable.

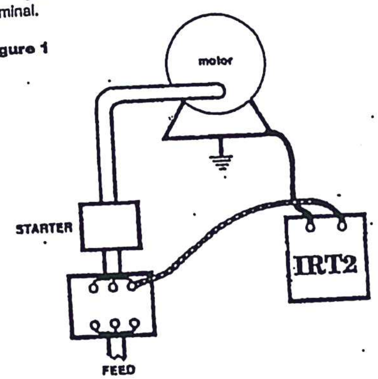
Motors/Generators

Disconnect the motor from the line either by opening the main switch or by disconnecting the wires at the motor terminals. If the main switch is opened and measurements are made at the switch contact, then the insulation resistance of all components between switch and motor will be measure simultaneously. If a fault is indicated it will be necessary to test each section separately.

Motors/Generators Cont.

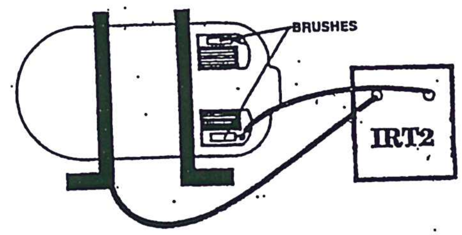
AC Devices:
The basic test is to connect the red lead of the IRT2 to one of the motor terminals, or wire, and the black lead to the frame or housing, see Figure 1. Start and run windings may be checked for correct resistance by setting the SELECTOR switch to OHMS and connecting one test lead to the common winding terminal and the other test lead to the start or run terminal.

Figure 1



DC Devices:
Independent insulation tests may be carried out between the electrical sections of a DC generator, or motor, and ground. Separate the brushes from the communicator as in Figure 2 to isolate the brushes and field coil functions from the rotor. These separated sections may be easily tested independently of each other. This does not apply, however, when an overall insulation test is intended. In this case the brushes remain in contact with the commutator so that the three sections (brushes, coils, and rotor) may be tested integrally.

Figure 2

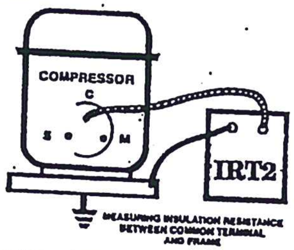


Hermetic Compressors
Most hermetic compressors utilize a three terminal block for making electrical connections to the sealed unit, refer to Figure 3. The connection may be made by an "umbilical" cord or a screw terminal, but the most common connection method is usually with a relay that pushes onto the S and M terminals and an overload protector that pushes on to the C terminal. Refer to the Manufacturer's manual.

Shut off power to the unit under test and remove the connections to the compressor terminal block. Connect the red test lead of the IRT2 to the C terminal and black test lead to the frame, or ground. Measure the insulation resistance. Low values of insulation resistançe may indicate the presence of contaminated refrigerant. Refer to the chapter on interpreting test results.

Winding continuity may be checked by setting the SELECTOR switch on OHMS. Check the start and run windings by measuring the resistance between the C terminal and the S or M terminal.

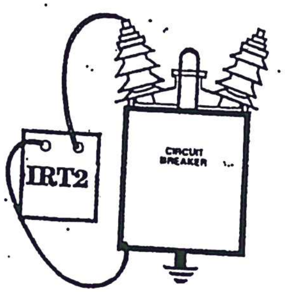
Figure 3



Circuit Breakers and Switches

Disconnect the circuit breaker or switch from the line. Trip or open the device and check the insulation resistance between the pole terminals by connecting one test lead to one pole and the other test lead to the remaining pole pair. Low values of insulation resistance may be caused by the presence of contaminants or by carbon arc lines in the insulator block. If the cause of the low readings is determined to be caused by carbon arcing, the device should be replaced, refer to Figure 4.

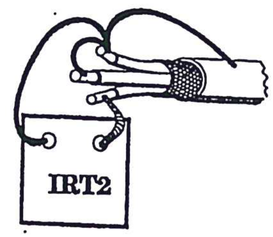
Figure 4.



Cables

Disconnect the cable from the line. As a safety precaution, discharge the cable by shorting the individual leads to the sheath. This is especially necessary when testing coaxial cables. Disconnect the cable from the equipment to which the cable is attached. This will eliminate any influence of the equipment on the test readings.

Several types of insulation resistance measurement are normally made: lead to lead(s), lead to sheath, lead to ground, etc. As an example, when only one of the conductors in a multi-conductor cable is to be insulation tested the conductor to be tested should be connected to the test lead of the IRT2. All of the other conductors should be connected to the cable shield, which is then connected to the test lead.



Factors Affecting Actual Insulation Resistance Values

Unlike most basic electrical measurements, such as voltage, current, and resistance, the actual insulation resistance of a device may differ from the measured value of insulation resistance. This is because of the temperature at which the measurement was made, the relative humidity at the time of measurement, and the duration of the measurement may all affect the reading. It may be necessary to correct the measured insulation resistance value to arrive at a more true value of insulation resistance. The effect of these factors are discussed on the following pages.

Temperature

Most electrical insulation materials have a negative temperature coefficient. This means that the magnitude of insulation resistance decreases as the temperature at which the measurement is taken increases. For example, the insulation resistance of a transformer measured at 68°F may be three times the value of the same transformer measured at a temperature of 100°F.

If periodic measurements of a device are made at different temperatures then the temperature must be adjusted to a base value, usually 68°F. Otherwise, the insulation resistance of a device may appear to fluctuate widely (the sign of unstable or deteriorating insulation) when in reality the actual insulation resistance may be quite stable. Of course, if the insulation resistance measurements are always made at, or near, the same temperature then the use of temperature correction charts may be omitted.

Chart 2 is a temperature correction chart for Class A rotating equipment. For example, if a reading of 100 Megohm were obtained at a temperature of 110°F the corrected insulation resistance is Rc = KRm = 6 x 100 = 600 Megohms, where Rc is the corrected resistance, K is the temperature correction factor obtained from the graph, and Rm is the measured resistance. Chart 3 is a temperature correction chart for oil filled transformer windings.

Chart 2

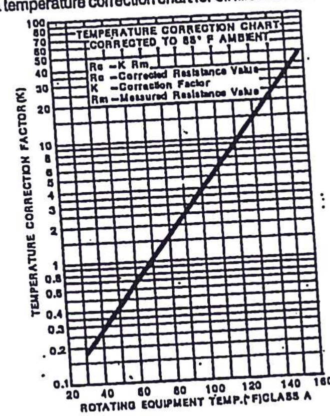
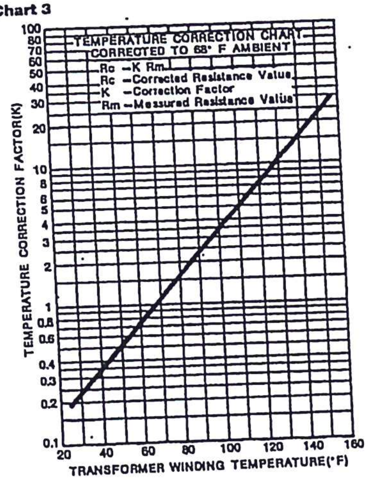


Chart 3



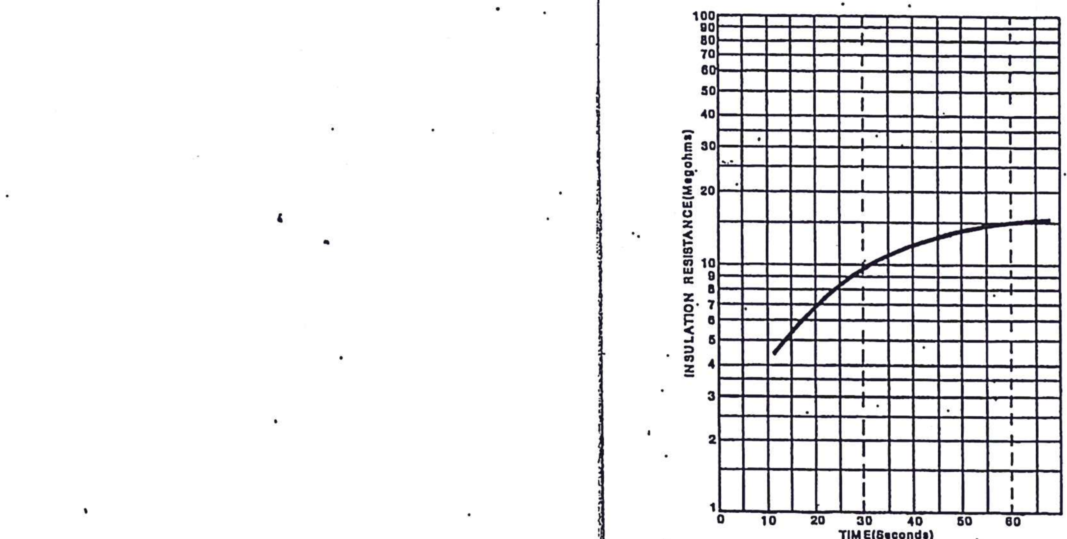
Humidity

Measurements made in a humid environment will result in lower insulation resistance values than measurements taken in a dry environment. The geometry of the equipment will also have an influence on the measurements. For example, rotating machinery has many more leakage paths, especially on the commutators and armatures, where moisture can be trapped than would a sealed transformer or shielded cable.

Time Duration of Measurements

The amount of time during which the test voltage is applied will also affect the reading. Typically, with a good insulation, the measured value of insulation resistance will slowly increase as long as the test voltage is applied. This is due to the dielectric absorption effect of the applied DC voltage on the bulk insulation resistance. Refer to Figure 6 for a representative graph of insulation resistance as a function of the time duration which the test voltage is applied.

Figure 6



A standard test of insulation integrity is to measure the insulation resistance at 30 seconds to 60 seconds after the test voltage is applied. The ratio of the reading at 60 seconds to the reading at 30 seconds is called the Dielectric Absorption Ratio.
Typically, a ratio of 1.25 represents the borderline between an insulation resistance of questionable integrity and fair integrity. A ratio of 1.6 and above is indicative of insulation of very good integrity.
The Dielectric Absorption Ratio method of testing insulation resistance is generally not affected by the temperature at which the measurements are taken. This is one of the advantages of this method. The Dielectric Absorption Ratio of the example shown in Figure 6 is 1.5.

Interpretation and Recording of Data

Periodic measurements of insulation resistance of a device, taken under the same conditions, generally result in much more meaningful results than measurements taken just once, or at random intervals. The measurement interval may be weekly, monthly, quarterly or yearly. This interval chosen will depend in general upon the conditions under which the device is operated and the cost of suffering an unexpected breakdown.
A device which operates under conditions of high temperatures, humidity, load, and vibration should be tested more frequently than the same device which operates under less stressful conditions. A device breakdown which would result in expensive downtime, safety hazards, etc., should likewise be tested more frequently than the same device used in a much less critical application.
The following 'rules' are guidelines which may be used to help determine whether a piece of equipment is operating normally or whether it should be pulled out of service and repaired or replaced. However, the equipment manufacturer's data on insulation resistance values and test procedures should be consulted first, when available.

One Kilovolt/One Megohm Rule
This is an old, generalized rule that states that electrical equipment rated up to 1000 volts should have minimized insulation resistance of one-Megohm. Above 1000 volts rating the minimum insulation resistance should be one Megohm for each 1000 volts or rating. Note: this rule of thumb does not apply to the testing of hermetic compressors.

Trend Rule

Insulation Resistance Values	Interpretation
High and holding steady	Condition good
High but tapering off	Breakdown may be starting. Decrease test interval or repair equipment.

Moderately Low	May be alright. Depends on history of device. Should try to identify cause of low reading.
Low and declining	Failure probable in near future. Repair or replace.

Hermetic Compressor

Insulation Resistance Values	Interpretation
100 megohms and above	Condition good.
50 to 100 Megohms	Evidence of moisture in refrigerant. Check drier.
25 to 50 Megohms	Excessive moisture in refrigerant. Examine system.
Below 20 Megohms	Failure of system is likely. Repair or replace.

Dielectric Absorption Ratio Rule

Ratio	Interpretation
Above 1.6	Condition good
1.25 to 1.6	Condition moderately good.
1.1 to 1.25	Condition questionable to unstable.

Recording Data

A package of Data Log Cards is supplied with the IRT2. The use of these log cards will facilitate the recording and plotting of data necessary to monitor and evaluate the insulation resistance history and integrity of an individual piece of equipment.
Space is provided on the front of the card to record the equipment identity and to plot a graph of insulation resistance values from 0.1 to 1000 Megohms. Space is provided on the back of the card to record the supporting tabular data: date of measurement, reading, correction factor, corrected reading, temperature, and relative humidity. It is not necessary to make an entry in every column on the back of the Data Log Card each time a measurement is taken. However, the more data that is recorded the easier it will be to determine the reason for changes in the measured insulation resistance.

Maintenance

The IRT2 is a precision test instrument. Do not operate the IRT2 where it will be subjected to high levels of temperature, humidity, or mechanical shock.

Batteries

The internal batteries supply the operating power for the IRT2. To test for defective or weak batteries:

1. Press the TEST switch.
2. The LED on the IRT2 scale plate should flash.
3. If the LED does not flash then replace the batteries:
   a. Remove the four screws which secure the battery cover on the case back.
   b. Remove the battery cover and replace the batteries.
   c. Replace the battery cover and the four screws.

If the IRT2 is to be stored, or left unused for long periods of time, remove the eight internal 1.5V batteries. This is a standard precaution with battery operated equipment and is intended to prevent damage to the equipment in the event the batteries begin to corrode or leak.

Fuse

To test for an open fuse first assure that the batteries are not defective. See section on Batteries, above.

Fuse Cont.

Then, proceed as follows:

1. Insert the test leads in the input jacks at the top of the IRT2 and short the free ends of the test leads together.
2. Set the SELECTOR switch to any one of three resistance positions.
3. Press the TEST switch.
4. If the fuse is open the pointer will indicate an open circuit. That is, in the OHMS position of the SELECTOR switch the pointer will remain at the left side of the meter scale plate. In the 100MΩ and 200MΩ position of the SELECTOR switch the pointer will remain at the left side of the meter scale plate. NOTE: An open test lead will give the same indication as an open fuse.
5. If the fuse is determined to be open then remove the four screws in the IRT2 back.
6. Replace the fuse (stock no. AF21) which is located in the fuse holder inside the battery compartment.
7. Replace the battery compartment cover.

Mechanical Zero Adjust

The pointer should indicate 0 on the green 50Ω scale when the SELECTOR switch is in the OHMS position, the test leads are shorted together, and the TEST switch is pressed. If the pointer does not indicate 0, then adjust the black plastic mechanical zero adjust screw, located in the plastic panel meter lens cover as follows:

1. Insert the test leads in the IRT2 input jacks and short the free ends of the test leads together.
2. Set the SELECTOR switch to OHMS.
3. Push the TEST switch to the TEST position.
4. Carefully adjust the zero screw until the pointer indicates zero.

Accessories

	Stock No.
Batteries 1.5V, size AA alkaline (set of 8)	AB8
Test Leads (set)	ATL135
Fuse 1A, 0.2Ω, (pkg. of 3)	AF21
Data Log Cards	ADC1

Returning for Repair

Before returning your instrument for repair, please make a quick check to insure the failure is not due to one of the following:

1. Low or dead batteries
2. Open test lead(s)

Three Year Limited Warranty

This product is warranted to the purchaser against defects in material and workmanship Three year from the date of purchase.

What is covered: Repair parts and labor, or replacement at the company's option. Transportation charges to the purchaser.

What is not covered: Transportation charges to the company. Damages from abuse or improper maintenance, see operating instructions. Any other expense, consequential damages, incidental damages, or incidental expenses, including damages to property. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

How to Obtain Warranty Performance: Attach to the product your name, address, description of problem, phone number and proof of date of purchase. Package and return to:

Service Center
UEI
5500 S.W. Arctic Drive
Beaverton, OR 97005

Implied Warranties: Any implied warranties including implied warranties of merchantability and fitness for a particular purpose, are limited in duration to one year from the date of purchase. To the extent any provision of this warranty is prohibited by federal or state law and cannot be preempted, it shall not be applicable. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.