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USER GUIDE CAL5000 CALIBRATION VERIFICATION SYSTEM:

This guide is intended to assist professionals in the operation of the CAL5000 verification system.

The CAL5000 is supplied with the following materials, verify you have received them:

Items required to deploy the CAL5000

Qty: 1: #100-2-001 CAL5000 Calibration Verification System.

Qty: 1: Transport Case.

Qty: 1 Multiple Vendor test lead adapter kit.

Qty: 1 Calibration certificate, showing NIST traceability, valid for 1 year from date of invoice.

Optional:

MTX3281B or equivalent Digital Multi-Meter for Readout Function.

PT9800PCN Thermal Label printer, or equivalent, for printing verification stickers.

Fluke 80K-40 HV Probe with RE0203-6 Cal & Data Certificate (1256480)

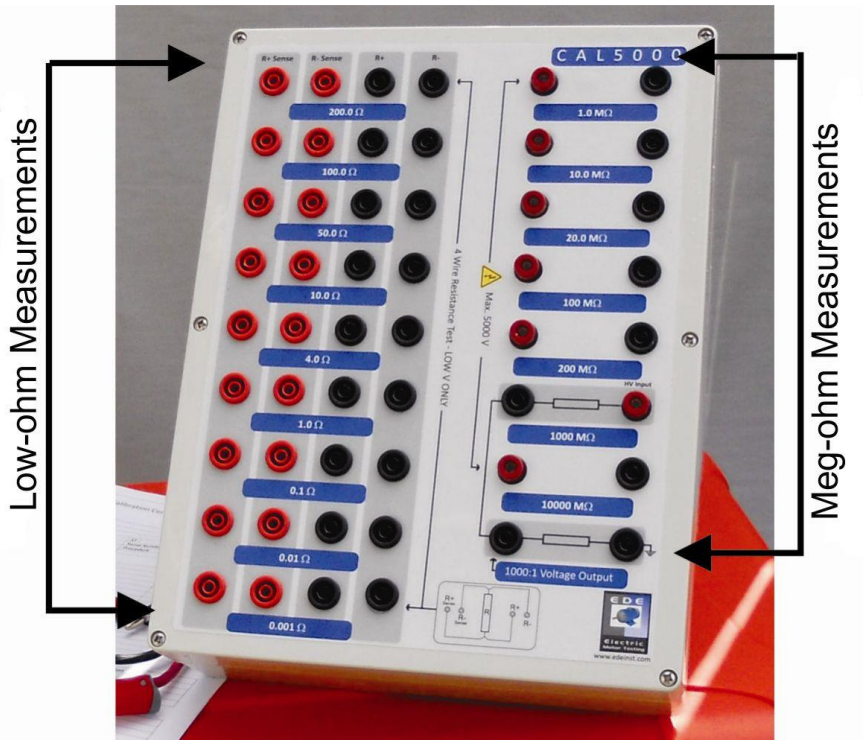


FIG 1: CAL5000 FRONT VIEW

CAL5000 Calibration Verification System:

The CAL5000 is a passive device designed to be used as a calibration verification system for leading vendor's electric motor test equipment. It is of value to companies that want to periodically self certify the performance of certain types of electric test equipment. Technicians or engineers can verify performance of their equipment versus this calibrated apparatus. It is intended to help provide timely calibration verification, to

avoid shipment of expensive and sensitive test equipment. The CAL5000 is provided in a rugged transport shipment case, for its own periodic certification need.

This self contained device contains an array of calibrated resistances. The values in the device enclosure are selected based upon those generally required for verification of several leading manufacturer's electric motor test equipment. The CAL5000 Calibration Verification System carries an ANSI Z540 NIST traceable certificate, valid for 1 year after deployment.

Values present in the CAL5000 standard.

Low Ohm Resistance Values:

0.0010 Ω $\pm 1\%$, absolute max power dissipation 100 Watts, permissible duty cycle 1% (At 25°C)

0.0100 Ω $\pm 1\%$, absolute max power dissipation 100 Watts, permissible duty cycle 1% (At 25°C)

0.1000 Ω $\pm 1\%$, absolute max power dissipation 25 Watts, permissible duty cycle 1% (At 25°C)

1.000 Ω $\pm 1\%$, absolute max power dissipation 25 Watts, permissible duty cycle 1% (At 25°C)

4.000 Ω $\pm 1\%$, absolute max power dissipation 25 Watts, permissible duty cycle 1% (At 25°C)

10.000 Ω $\pm 1\%$, absolute max power dissipation 25 Watts, permissible duty cycle 1% (At 25°C)

50.00 Ω $\pm 1\%$, absolute max power dissipation 10 Watts, permissible duty cycle 1% (At 25°C)

100.0 Ω $\pm 1\%$, absolute max power dissipation 5 Watts, permissible duty cycle 1% (At 25°C)

200.0 Ω $\pm 1\%$, absolute max power dissipation 25 Watts, permissible duty cycle 1% (At 25°C)

Meg Ohm Resistance Values:

1.00 MΩ $\pm 1\%$, Maximum rating 5000 V, in clean, dry conditions, hands free operation, permissible duty cycle 1% (At 25°C)

In uncontrolled conditions, 1000 V is max rating.

10.0 MΩ$\pm 1\%$, Maximum rating 5000 V, in clean, dry conditions, hands free operation.

In uncontrolled conditions, 1000 V is max rating.

20.0 MΩ$\pm 1\%$, Maximum rating 5000 V, in clean, dry conditions, hands free operation.

In uncontrolled conditions, 1000 V is max rating.

100.0 MΩ$\pm 1\%$, Maximum rating 5000 V, in clean, dry conditions, hands free operation.

In uncontrolled conditions, 1000 V is max rating.

200.0 MΩ$\pm 1\%$, Maximum rating 5000 V, in clean, dry conditions, hands free operation.

In uncontrolled conditions, 1000 V is max rating.

1000.0 MΩ$\pm 1\%$, Maximum rating 5000 V, in clean, dry conditions, hands free operation.

In uncontrolled conditions, 1000 V is max rating.

10,000 MΩ$\pm 1\%$, Maximum rating 5000 V, in clean, dry conditions, hands free operation.

In uncontrolled conditions, 1000 V is max rating.

Intended use

The CAL5000 is used for the periodic verification of electric motor test equipment indicated values. This device can be used with, but is not limited to the following types of equipment:

- Winding Resistance Meter's using both 2 wire and 4 wire i.e Kelvin technique.
- Varieties of current sources.
- Insulation Testers; i.e. Meg ohm meter's or Meg ohm meter function.
- Certain parameters of High potential tester's (including AC VLF and DC types).
- Certain parameters of standard bench multi-meters

Specifications and absolute maximum ratings:

In a calibration laboratory with a controlled environment, the CAL5000 is able to be used to provide verification to values which

might exceed it's ratings in an uncontrolled environment. This concept is important to consider.

As an example, it is not at all uncommon for electrostatic discharge voltages to build up to 10,000 or more volts when a person walks across a carpet floor. The voltage that person has charged on their skin and clothing is not usually considered hazardous yet it very clearly exceeds the ratings of many types of high voltage apparatus. One reason why this extremely high voltage is not hazardous is because its energy content is quite limited. This concept is important to consider when checking calibration with the CAL5000.

Voltage, in and of itself is only part of the reason. High voltage is capable of jumping across an air gap. Once it jumps across a gap, it establishes a path of conductive, ionized gas. This path has impedance. In the case of our hypothetical person who walked across the carpet, they can only carry so much charge on their body. When the person touches a light switch or wall outlet, the stored voltage charge instantly jumps across the person's fingertip and conducts via the safety ground on the wall switch. The path formed by the electricity behaves according to the impedance. Low impedance means a very large/high current can flow. High impedance limits the current that could flow. When a person touches the wall switch, the arc that occurs is because there is relatively low impedance. Yet, the charge transferred is not lethal or dangerous to the person involved. This is true in any normal home, office, workshop or properly controlled calibration laboratory. (Not rated for use in an explosive atmosphere, the CAL5000 is not rated for use in any such environment)

The same concept of controlled energy content is important in the calibration concept of the CAL5000.

Ratings

In an uncontrolled industrial environment, with any power supplies that are capable of providing high fault currents, the **CAL5000 should not be operated at any value beyond those listed below:**

Maximum suggested ratings	**Voltage**	**Current**
Low voltage inputs for low ohms resistance verification		
R+ Sense (all inputs)	<50 V	<36 A
R- Sense (all inputs)	<50 V	<36A
R+ (all inputs)	<50 V	<36A
R- (all inputs)	<50 V	<36A
Maximum suggested ratings	**Voltage**	**Current**
High voltage inputs for Meg Ohms resistance verification		
1.0MΩ inputs	1000V	
10.0 MΩ inputs	1000 V	
20.0 MΩ inputs	1000 V	
100.0 MΩ inputs	1000 V	

200.0 MΩ inputs	1000 V
1000.0 MΩ inputs	1000 V
10,000 MΩ inputs	1000 V

AC or DC Voltage impressed on R+ Sense, R- Sense, R+ or R- must not exceed the power rating of the associated resistor. In no case, should 500 or more AC or DC volts be impressed. The intent is that these circuits should only be excited by those typical instrument level signals used to measure relatively low values of resistance. This is a signal level of less than 12 Volts in many types of resistance meters available at the time of this writing. If in any doubt, observe the power calculation limits prescribed in this guide.

Absolute Maximum Rating for power dissipation for low ohm resistances (0.001 through 200.0 ohms)

Absolute maximum ratings for resistive power dissipation, attainable at 25°C, based upon the formula: P = I x V. Duty cycle information is given to provide thermal limits to the use of the device. Do not exceed these limits. If using a high current source to attempt to verify resistances, do not overheat the CAL5000.

In brief, 10 Seconds of test time “on” at 100% rated load, require 1000 Seconds of “off” time to allow resistors to cool.

For example: If 36A is impressed, 10S should be enough time to make a reading. Most of the DLRO’s and bridges available in the

market today apply less than 10 Amps, so this effect is a non-issue for most scenarios.

Absolute Maximum Voltage rating for low ohm resistances (0.001 through 200.0 Ohms)

Absolute maximum voltage allowed during DC resistance measurement is 500V, for electrical isolation purposes only. In practical use, less than 50V should be present. In practice, DLRO's from most leading vendors will apply less than approximately 10A at a low voltage. The heat sink on the rear side of the CAL5000 is electrically insulated to 500V from the DC resistance inputs. The Power resistors for DC resistance verification are mounted to the heat-sink. Provision is present on the rear for an external safety ground/protective earth (PE) connection.

Temperature

Recommended use is at ambient temperature between 0° C and 40°C. Dissipated power rating is affected by temperature. De-rate power rating by 3% per degree C above 25°.

Humidity

Not rated for use in the presence of condensing humidity. System indicated results may be affected by deposit of water on its surfaces. The system should be kept clean and dry. The device is provided in an enclosure that carries an ingress protection rating, but because of the nature of its intended use, do not use it outdoors.

Maximum Voltage for Meg-Ohm resistance inputs (1.0 Meg Ohm through 10,000 Meg Ohm)

The maximum voltage that may be impressed to the high meg-ohm resistance jacks (1 Meg-Ohm through 10,000 Meg Ohm) in a controlled laboratory or shop environment :

Is 5000 Volts DC 1%, and 3,500V AC 50/60Hz (RMS)

Hands free operation only! Do not contact the CAL5000 or the test leads during test sequences for any reason. Lead switching/value switching should only occur when test equipment is de-energized!

Do not apply more than 5000 V DC or 3500 V AC (RMS) under any circumstance. If higher voltages must be verified, a recommended probe such as the Fluke® 80K-40 should be procured, and applied according to all instructions and ratings.

Periodic Calibration:

The CAL5000 is provided with an ANSI Z540 traceable calibration certificate. This calibration certificate is valid for 1 year after the date of issue. The CAL5000 manufacturers recommended calibration re-certification interval is suggested to be on an annual basis. (12 months)

It is recommended that the unit be returned to EDE Electric, or through authorized distribution channels, for re-certification. New certification will provide another 12 months of calibration traceability. Since the unit is pre-packaged, in a robust, lightweight, shipment container, this should not be a challenge in most cases.

Third party calibration laboratories that can provide ANSI Z540 certificates, and show ISO9001:2008 listing, are probably capable of providing a periodic calibration certificate for the CAL5000. If the CAL5000 is found to be out of calibration by any third party calibration laboratory, it must be returned to the CAL5000 factory for repair. The CAL5000 Calibration verification procedure is available from EDE Electric upon request.

Guide for use:

Identify the type of equipment that will be verified. Typical types of testers that the CAL5000 can verify calibration include a meg-ohm meter, AC/DC HiPot (High Potential Tester), and the meg-ohm, AC or DC High Potential functions of electric motor test equipment.

To begin your verification procedures locate the following:

- CAL5000 Calibration Verification System sticker/labels. These are needed to provide for the annual calibration labeling for the tester.
- CAL5000 Multiple Vendor Adapter Kit. This will be needed to verify performance of testers that do not use standard “Banana” type plugs, or have provision for “Banana” type connections. Examples of this are test sets that have only ‘Alligator” or “Crocodile” type test lead clips. Each kit will have provision for both 4 wire, i.e. Kelvin type resistance measurements, or 2 wire type resistance measurements. An adapter for AC and DC voltage verification is present as well.

- CAL5000 Example Calibration Verification Documents.
- Digital multi-meter. Verify that is carries a valid calibration label. The CAL5000 provides a calibrated, 1000:1 voltage divider for indication of voltage. It is designed to provide for this, using Multi-meters that have a measuring circuit input impedance of 10.0 Meg Ohms. This is a standard type of meter at the time of this writing. Other types of meters, such as those that carry an input impedance of 3.0 Meg Ohms, will result in slight performance de-rating.

NOTE: It is important to consult your vendor's equipment data/specification sheets. This is how you may verify various vendors equipment. EDE Electric is not a source for them. Say for example, you have an electrical insulation tester that is rated for +/- 5% accuracy on its DC output test voltage. It will define this rating on the spec sheet. This rating determines your acceptable tolerances.

Determine acceptable calibration verification points. An insulation tester may have rated output voltages of 250VDC, 500VDC, 1000VDC, 2500VDC, and 5000VDC. These will form the voltage verification points on your worksheet.

Based upon the above, you could verify voltage at 250V +/- 5%, 500V +/-5%, 1000V +/- 5% (as a minimum)

In a controlled, hands free environment, you may elect to add points to verify at 2500V and perhaps 5000V (DC)

Verification Procedure: Insulation Testers/Insulation Resistance testers/ Meg-Ohm Meters:

Quickly determine the performance of your equipment with the CAL5000.

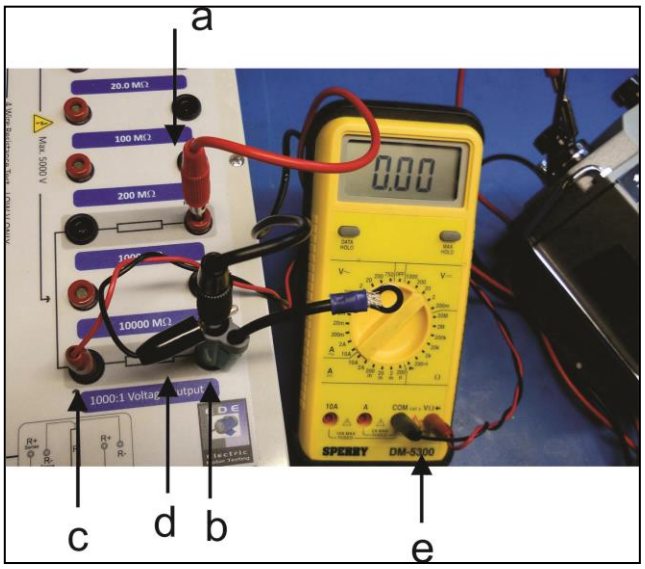


FIG 2: 1000:1 VOLTAGE DIVIDER CIRCUIT

1. Verify the output voltage of the apparatus by using the 1000:1 voltage divider circuit as explained below and in fig. 1. Voltage is important, as many insulation testers are operated at specific target voltages recommended by IEEE, NEMA or other authorities. This function is contained in two areas of the system. You will use the set of jacks labeled 1000 Meg Ohm and the other set of jacks labeled 1000:1 Output Voltage. The concept of a voltage divider is used. (e.g. 1000 Volts applied to the 1000 Meg Ohm input circuit will result in a lower, proportionate output voltage of 1 Volt.) This table will illustrate the concept further.

500 Volts applied = 0.5 Volts present at the Output Voltage Jacks 1000 Volts applied = 1.0 Volts present at the Output Voltage Jacks 2500 Volts applied = 2.5 Volts present at the Output Voltage Jacks

Within the limitation of the instrument, this relationship is linear, and used to provide verification information.

2. Identify the output leads of your Insulation tester. Do they have Banana Jacks or do they have Alligator clips? (Some manufacturer's devices have both. Banana Jacks generally make the verification procedure more rapid and accurate). Once you have verified the output leads, keep them handy.

3. Next, locate and identify the test leads on your digital multi-meter. Place the multi-meter in the DC V scale. The best scale is typically 0-10V DC, or the auto-range scale for DC volts.

    a. Hook the voltage input connector to ***only*** the "HV Input: connector on the CAL5000.

    b. Hook ground to the ground connector.

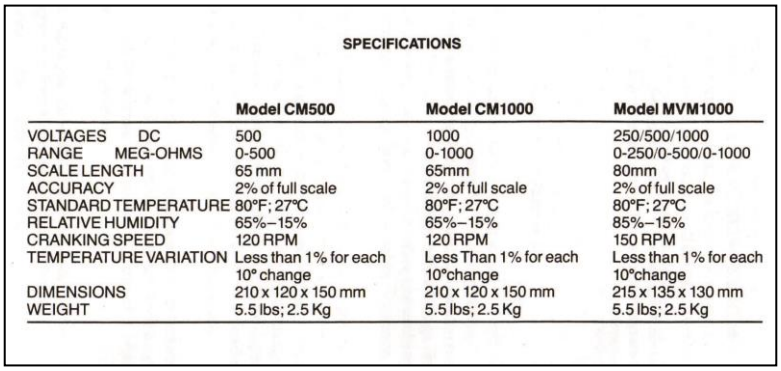
    c. Hook the digital multimeter across the 1000:1 voltage output.

d. The COM on the meter typically connects to ground also.

e. Hook the volt input on meter to market input plug on 1000:1 – Typically it is also the volts input on your meter.

f. Select appropriate input on equipment being verified. –example 1000 V.

4. Determine if voltage is within manufacturers spec – Typically this will be found in the operation manual for the equipment.



SPECIFICATIONS

	Model CM500	Model CM1000	Model MVM1000
VOLTAGES DC	500	1000	250/500/1000
RANGE MEG-OHMS	0-500	0-1000	0-250/0-500/0-1000
SCALE LENGTH	65 mm	65mm	80mm
ACCURACY	2% of full scale	2% of full scale	2% of full scale
STANDARD TEMPERATURE	80°F; 27°C	80°F; 27°C	80°F; 27°C
RELATIVE HUMIDITY	65%–15%	65%–15%	85%–15%
CRANKING SPEED	120 RPM	120 RPM	150 RPM
TEMPERATURE VARIATION	Less than 1% for each 10° change	Less Than 1% for each 10°change	Less than 1% for each 10°change
DIMENSIONS	210 x 120 x 150 mm	210 x 120 x 150 mm	215 x 135 x 130 mm
WEIGHT	5.5 lbs; 2.5 Kg	5.5 lbs; 2.5 Kg	5.5 lbs; 2.5 Kg

FIG 3: MANUFACTURERS SPECS FOR HAND CRANK MEG-OHM METER

5. If the voltage matches the published specifications within the tolerances, the instrument should be considered acceptable.

Verifying Meg-Ohm Specs

NOTE: Make sure to plug the jacks according to color. Plug the red

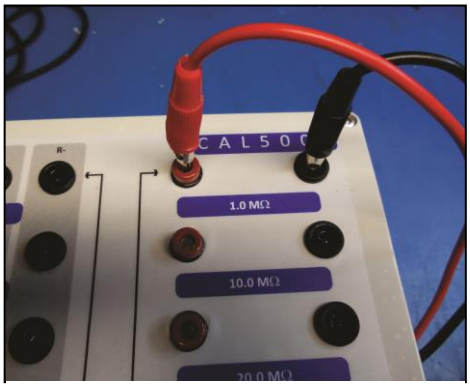


FIG 4: COLOR COORDINATION OF JACKS

jacks to red and the black jacks to black.

1. Plug the jacks into the 1.0 MΩ jacks and run the test to verify the tester will register 1.0 MΩ or within the manufacturer's specification. Log your readings into the verification test sheets that EDE has supplied or into your companies required forms.

2. If the reading is within spec move the jacks to the 10 MΩ reading and repeat your test. If this reads within specification, repeat the procedure for each level that your tester has.

3. Upon completion of all tests and results logging you can do several items:

    a. If the tester met manufacturer's specification, you can now self certify the tester with one of the calibration stickers.

b. If the tester did not meet manufacturer's specification, then you can make plans to repair the tester so that it will meet specifications.

c. If the tester is equipped with resistance, you can run those tests also.

Resistance Verification

In order to verify the resistance measurement of your test equipment you must use the correct jacks and the special adaptors that have been supplied with the CAL5000. After you locate the adaptor kit for your associated tester, make sure you have them plug into the correct slots. Take one of the red/black adaptors and plug into the first red from the left and first black jack from the left on whatever level of resistance that you want to test first. Then take the second set and plug into the second red and second black. This will make sure that you are getting accurate readings.

The concept you should keep in mind is that a winding resistance meter may have rated accuracy at 0.001 Ohms, 0.01 Ohms and 0.1 Ohms. These values will form the resistance verification points on your worksheet.

View figure 5 for more information.

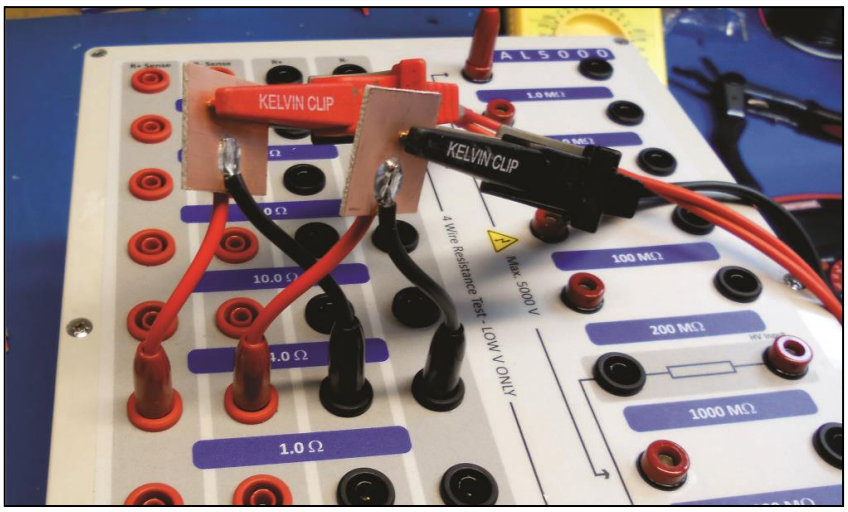


FIG 5: RESISTANCE JACK HOOKUP

1. In order to get a base line reading on your tester it may be best to start with the 1.0 Ω connections. This is to get a reasonable value that most resistance meters can read. NOTE: Do not expect extremely accurate results below 1.0 Ω on Non-Kelvin Bridges or Non-4 Wire Technique Resistance. Kelvin bridges and 4-Wire Techniques have more enhanced accuracies to read lower resistances than 1.0 Ω. This is a good starting point to verify operation of your resistance meter.

2. After doing the 1.0 Ω reading, starting at the top of the CAL5000 and moving the jacks accordingly, run your test for each level of resistance. Log all of your results in the calibration form provided by EDE or your companies required forms.

3. Calculate your deviations from manufacturer's specification. NOTE: Remember to calculate the deviations using the actual values not nominal values of the CAL5000. These values are located on the calibration certificate that came with the unit.

4. If your calculations result in your tester matching the published specifications, within tolerances, the tester should be considered acceptable.

5. Upon completion of all tests and results logging and calculations you can do several items:

    a. If the tester met manufacturer's specification, you can now self certify the tester with one of the calibration stickers.

    b. If the tester did not meet manufacturer's specification, then you can make plans to repair the tester so that it will meet specifications.

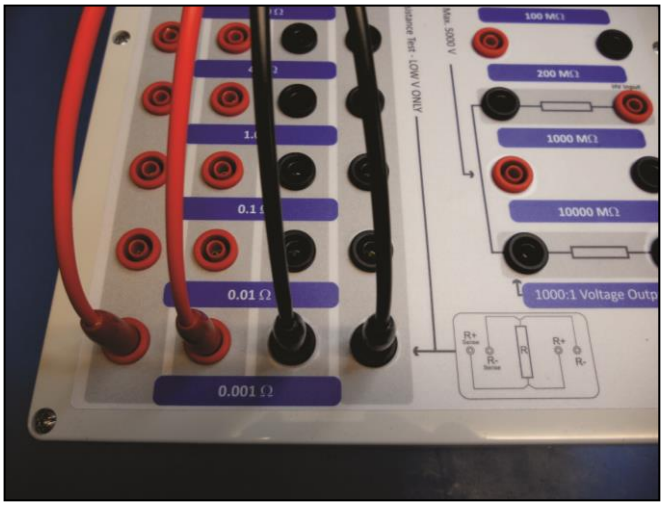


FIG 6: 4 WIRE RESISTANCE HOOKUP

4-Wire Resistance Verification

Certain manufacturers use a 4-Wire Resistance Technique. If your tester uses this technique you must plug in 4 wires to the CAL5000 in order to get accurate verification readings.

On the wires from the tester two will be labeled “+sense” and perhaps “-sense” and the other two will be labeled with the + and – for current. Look closely at the CAL5000 unit, there is a small schematic that details the way the internal connections are made.

Some vendors may name these connections “high sense, low sense” or “Hi” and “Lo” or some other variation of this theme. The net result is that you must plug in all 4 of the wires in order to do the resistance verification. They must hook across the resistances as shown on the panel schematic, or erroneous readings may result!

If the tester uses banana type jacks, this method is used in order to verify your resistance. All other portions of the procedure will remain the same as for a tester that has clips and you use the adapter kit. You simply move down the CAL5000 accordingly the level of resistance that your tester does.

Using the CAL5000 with DLRO Point Contacts

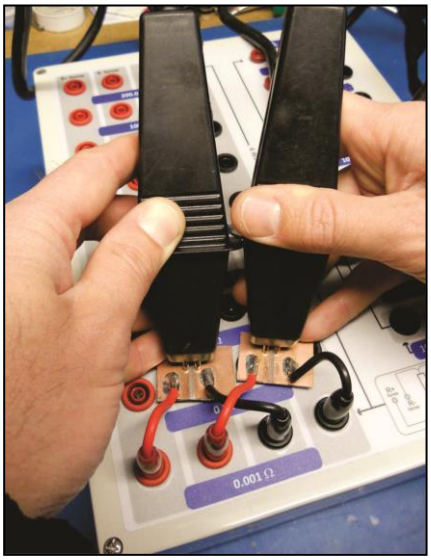


FIG 7: DLRO POINT CONTACTS

Many DLRO instruments use point contacts instead of clips. In order to verify the calibration on these types of instruments, use the appropriate adaptors included in your adapter set and perform the verification as seen above in Fig 7.

Application Summary

These instructions are a basic guideline and by no means show every option that the CAL5000 can verify. If you have additional test equipment with different test ends, leads or clips, please

contact us at 970-581-6797. We will make every effort to develop a test adapter or work through the application with you. For further products and services that EDE Electric Motor Testing offers, please visit our website at www.edeinst.com.