A DIVISION OF IKONIX USA

Operation & Service Manual

Model 2205

Item 99-10268-01, Ver. 1.08

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1 YEAR WARRANTY

RoHS 2 COMPLIANT 2011/65/EU

Warranty Policy

Slaughter Company, certifies that the instrument listed in this manual meets or exceeds published manufacturing specifications. This instrument was calibrated using standards that are traceable to the National Institute of Standards and Technology (NIST).

Your new instrument is warranted to be free from defects in workmanship and material for a period of (1) year from date of shipment. You must return the "Owners Registration Card" provided within (15) days from receipt of your instrument.

Slaughter Company recommends that your instrument be calibrated on a twelve-month cycle. A return material authorization (RMA) must be obtained from Slaughter Company. Please contact our Customer Support Center at 1-800-504-0055 to obtain an RMA number. Damages sustained as a result of improper packaging will not be honored. Transportation costs for the return of the instrument for warranty service must be prepaid by the customer. Slaughter Company will assume the return freight costs when returning the instrument to the customer. The return method will be at the discretion of Slaughter Company.

Except as provided herein, Slaughter Company makes no warranties to the purchaser of this instrument and all other warranties, express or implied (including, without limitation, merchantability or fitness for a particular purpose) are hereby excluded, disclaimed and waived.

Any non-authorized modifications, tampering or physical damage will void your warranty. Elimination of any connections in the earth grounding system or bypassing any safety systems will void this warranty. This warranty does not cover batteries or accessories not of Slaughter Company manufacture. Parts used must be parts that are recommended by Slaughter Company as an acceptable specified part. Use of non-authorized parts in the repair of this instrument will void the warranty.

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INTRODUCTION

This section is prepared to assist the user of Slaughter manually operated bench type test equipment with the use, installation, inspection and maintenance of the equipment.

Since any electrical equipment can be hazardous, all procedures described should be conducted by qualified personnel familiar with safety rules applying to electrical equipment and who have been thoroughly instructed as to the nature of the procedure, the hazards involved, and the necessary safety precautions.

Defects and weaknesses in the electrical insulation system must be detected to insure that the product is safe for use by the consumer. In most windings there are two basic types of insulation systems. The **ground insulation** separates the windings from a magnetic core material or an exposed conductive frame or exterior. The second insulation system is the **wire insulation**, which in lower voltage windings is typically a thin film coating of the wire. These two insulation systems perform different functions in the winding and require different tests to evaluate their integrity. **The Dielectric Withstand Test** is used to evaluate the ground insulation system.

This test has been described by many names; Hi-pot Test, Dielectric Withstand Test, Insulation Leakage and Breakdown Test, Shorts Check, Ground Check and others. What ever the name, the purpose is to detect failure of the insulation system that separates the current carrying portions of an electrical device from any exposed conductive components.

WARNING **For operator safety reasons, and to avoid possible tester damage, the product under test SHOULD NOT BE CONNECTED in any way to the AC power lines.**

Typically, it is the responsibility of the manufacturer to establish the proper tests needed for a particular product to insure they comply with all agency requirements.

INSTALLATION AND SAFETY

CAUTION **For operator safety reasons, and to avoid possible tester damage, the product under test SHOULD NOT BE CONNECTED in any way to the AC power lines.**

When first received, unpack the equipment carefully and inspect for any hidden damage. If damage is evident, keep the carton and file a claim with the carrier.

Packed with all Slaughter equipment is a certificate of conformance, operator's manual, test leads and any required interface connectors.

To check the unit quickly, install any interface connectors, plug the unit into the proper voltage and follow the steps outlined under operating instructions. If the unit does not operate, contact the factory for instructions.

Of prime consideration and importance in the layout and installation of a test station is to insure the safety both to the operator and any visitors or casual bystanders, invited or otherwise. As a general rule it is suggested that each test area be in a location with minimum distractions and not subject to extremes of temperature and moisture.

One of the more important ways to promote safety is through operator training. Benefits of training are twofold. First, thorough training promotes safety which may significantly reduce injuries on the job. Second, it ensures adequate testing of the product which helps increase product reliability. Both of these can have a positive impact on profits.

An additional consideration in any test station is operator comfort. This is affected by the operator's position, which includes the chair, table, test equipment, the object under test and the test procedure itself. The chair and work bench or table should be nonconductive and the table as large as possible to allow sufficient room for the test equipment and the object under test. Studies should be made of the test requirements and work habits and steps taken to ensure that any unusual or unnatural motion is not required and to eliminate any repetitive motions that may produce injuries such as carpel tunnel syndrome.

After the equipment has been installed, a careful study should be made of the test station to determine what, if any, safeguards are needed. It is suggested that any electrical test station involving voltages in excess of 42.4 volts peak (approximately 30 volts RMS) should be equipped with safeguards. These should operate both for the protection of the operating personnel and for the protection of casual bystanders. At the minimum, safeguards should prevent the operating personnel or casual bystanders from coming into contact with the test circuit. In the event electrical interlocks of any sort are required, either to insure that guards are in place, or to insure that the operator's hands are in a safe location, the installer should refer to the proper schematic drawing and install these interlocks in series with the external interlock terminals provided in the tester. All testers may be safety interlocked with series manual or automatic safety switches, relays, etc. as desired. In the simpler units, this is done by inserting such interlocks in the AC supply ahead of the tester. In some units adapter plugs with remote interface controls are provided for this purpose. We will be happy to provide suggestions and schematics for safety interlocking our test equipment.

Any electrical power receptacle utilized to operate this equipment must be a properly grounded three wire receptacle that has been checked for proper polarity.

The test procedure should be well thought out to ensure that it adequately tests the product to the desired criteria but, that the procedure does not require the operator to perform tasks that are unsafe. The product should never be touched during a test and in the case of a grounded part the conductive table or conveyor should not be touched during a test.

Several models of high voltage test equipment are designed with the high voltage output "floating". There is no ground on either the High side or the Low side of the high voltage transformer. One of the test leads of the HV transformer is considered the Low side due to the winding pattern of the transformer, but it is NOT grounded. This arrangement provides a one type of safety margin to the operator because someone must come in contact with both leads to receive a shock.

Some models of test equipment have one lead of the output grounded or production requirements are such that it is impossible or impractical to test a product in an "ungrounded" configuration. When the tester and the product are grounded, it is important to remember that the operator is also grounded and need only touch the ungrounded lead to receive a shock.

A major consideration in testing products that are "grounded" (touching a conductive conveyor or table) is to insure that the operator or bystanders cannot or will not come in contact with the table or conveyor during a test. Under some product failure conditions, the table or conveyor may become "live" and present a high voltage potential to true earth ground if the table or conveyor is not properly grounded.

It should never be assumed that a conveyor or conductive table is "grounded" just because it is bolted to the floor. A proper ground is one that has been verified to return to the input power line ground (earth ground) with a resistance of less than 1/2 ohm. This will help eliminate "floating" grounds, ground loops and "phantom" voltages between the object under test and the tester case which is grounded to the power line ground.

The testing of very large items such as recreational vehicles and mobile homes poses special problems because the safety hazards involved are considerably greater than those involved in testing smaller objects.

This is because it is possible under fault conditions for the entire outer skin of the object being tested to become charged to a high voltage. This is particularly bad because these units are so large that the person conducting the test is in no position to observe whether or not any other people are in a potentially dangerous position during the test.

If proper precautions are taken, there will be no hazard, but even so, it is highly desirable that care be taken to isolate the test object when a test is being conducted. Suggested methods of doing this are the use of rope barriers, warning signs, and fully enclosed test areas.

Before conducting a test on these units, care should be taken to see that the frame and skin of the unit are connected to a solid ground, and also that the ground conductor of the electrical system is connected to a solid ground. This will eliminate most test hazards, but bear in mind it is possible for some sections of the skin to have poor electrical connection and that they thereby, can become a potential safety hazard in the event of a fault. This is why isolation of the vehicle during the test is recommended.

Once these safety precautions have been taken and it has been established that the frame and skin are properly grounded, the operator can proceed with the dielectric test.

Good safety practice dictates labeling of hazards properly. Since high voltage testing can be hazardous, the work station should be labeled. Naturally, the location of the label should be carefully selected so that it can be placed in a location that will do the most good.

In some cases, this may be on the test instrument itself, and in others, it may be in a location directly in front of the operator, somewhat removed from the instrument.

In addition to instrument labeling, we are supplying labels that you should apply in accordance with the above suggestions. If you need a couple more, please let us know... we will gladly supply them. If you need a large quantity, these are available at a nominal price.

A final word about high voltage testers: Generally, commercial high voltage test equipment is not in itself hazardous. The hazards come about when the equipment is improperly used. These testers, when used properly and in a safe manner, can be a check on the quality and reliability of your product. If used incorrectly and without proper consideration for safety, they represent a hazard for both operating personnel and casual bystanders. We strongly recommend proper training for all personnel involved in testing.

High Voltage Testing

High Voltage Testing has historically been the most misunderstood, misapplied, misinterpreted inspection function in the average factory. Some manufacturers have looked upon the High Voltage Dielectric Withstand test or Hipot test as it is more commonly known, as an extra operation that must be performed to satisfy some agency requirement. Though many times the high voltage test is simply a safety measure, its value in quality control should not be overlooked.

First and foremost, the hipot test is done to ensure the safety of customers by detecting "grounded" or "shorted" products. By applying a high voltage between "live" current carrying parts of the product and the framework which is normally supposed to be "dead," or well insulated from the "live" parts, the product is "proof tested" against grounds or shorts which at the least might cause inconvenience and at the most can cause fire or injury. During the hipot test, all insulation is abnormally stressed for the duration of the test. Additionally, it is possible to detect "potential" shorts. Consider there is a bare conductor about .015" from the frame. In the factory, the product is clean and new, but after a year or two of service, contaminants, dust, and moisture may cause this gap to bridge at line voltage resulting in a shock hazard to the consumer.

Secondly, hipot testing is done as a quality control measure. Incipient failures in the insulation of any portion of the product, whether due to workmanship, components or materials are detected by the hipot test before the product is shipped out to cause inconvenience, dissatisfaction and expense in the field.

The most often asked questions are, "Is hipot testing destructive?" and "Should I use AC or DC for the hipot test?"

Today's modern, commercially available high voltage production line testing equipment is generally not destructive. For most consumer product testing, testers have sufficient sensitivity and response time that short circuit currents can be held to non-destructive levels.

The question of AC or DC is best answered by the question, "What do the specs say?" For the production hipot test, agency requirements almost invariably specify an AC test.

Generally, AC hipot testing is considered by many to be more stressful to the insulation than DC hipot testing because of the periodic polarity reversal. Some believe AC testing tends to accelerate breakdown due to material flaws. During use, products are more likely to experience AC voltage transients than to experience DC voltage transients. Therefore, AC hipot tests provide more realistic conditions than DC hipot tests.

The next most common question about hipot testing is, "How much voltage should I use?" Again, "What do the specs say?" As a rule-of-thumb, many applications will require 1000 volts plus twice the normal operating voltage for one minute. Increasing the test voltage by 20% usually allows the test time to be reduced to one second. Automotive products will generally specify 500 volts.

Armatures are produced in both a "single insulated" and a "double insulated" configuration. With **single insulated** armatures, the commutator and windings are insulated from the iron stack and the shaft which, electrically speaking, are common. Double insulated armatures additionally have the iron stack insulated from the shaft. This provides "double insulation" between the current carrying components, the commutator and the windings, and any exposed dead metal components, normally the shaft.

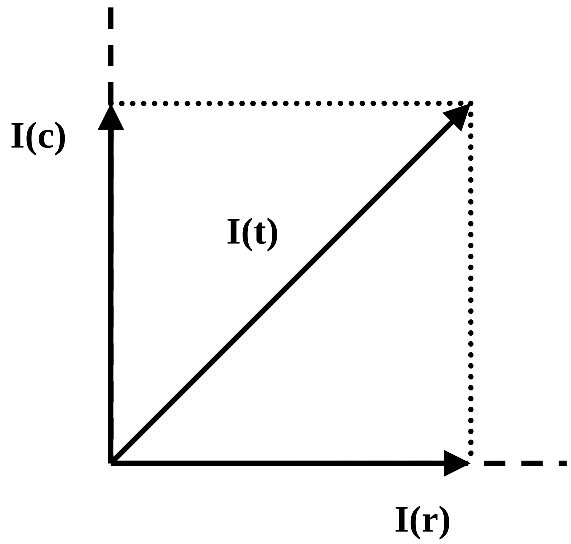
On single insulated armatures, the dielectric withstand test voltage is normally applied between the commutator and the shaft.

Double insulated armatures, however, will normally have a dielectric withstand voltage applied between the commutator and the iron stack and another dielectric withstand voltage between the iron stack and the shaft. If these two voltages are applied simultaneously and the voltage sources are properly phased, a consequential voltage equal to their sum will be applied between the commutator and the shaft.

A hipot test attempts to detect or measure phenomena that indicate electrical problems such as leakage, breakdown and arcing.

Leakage is a flow of current. Leakage becomes significant under two conditions. Any increase in resistive leakage is a "red flag" indication that quality in insulating materials used in the device has in some manner deteriorated. Total leakage becomes significant if it reaches such a level that it becomes perceptible to the user of the equipment. UL extensively researched the area of perception threshold and electrical shock. They found that, generally, "women are more sensitive to leakage current than men and a current flow of 0.5 milliamperes or less at 60 hertz does not produce a reaction which is considered to be hazardous to the individual or to those nearby."

Some leakage exists in any product, though, in many cases, it will be so minute to defy measurement. It exists for two reasons; first leakage current exists simply because no insulating materials are perfect and have infinite resistance. This is generally referred to as **resistive leakage** and can be calculated from Ohms Law, $E=IR$ where E is the applied voltage, I is current flow in amperes and R is the resistance in ohms. Second, any electrical device, by virtue of the fact that it is made of conductive material with electrical circuits in close proximity, exhibits what can be called an "inherent capacity effect." This is actually a capacity and, if we apply AC voltage, current will flow. This is generally referred to as **capacitive leakage**. The equivalent resistive value of the capacitance (X_c) may be calculated from the formula, $X_c=1/(2\pi fC)$ where X_c is the equivalent resistance in ohms, f is frequency of the applied voltage in hertz and C is the capacitance in farads. The combination of these two components of leakage (figure 1.) is referred to as the **total or complex leakage**.

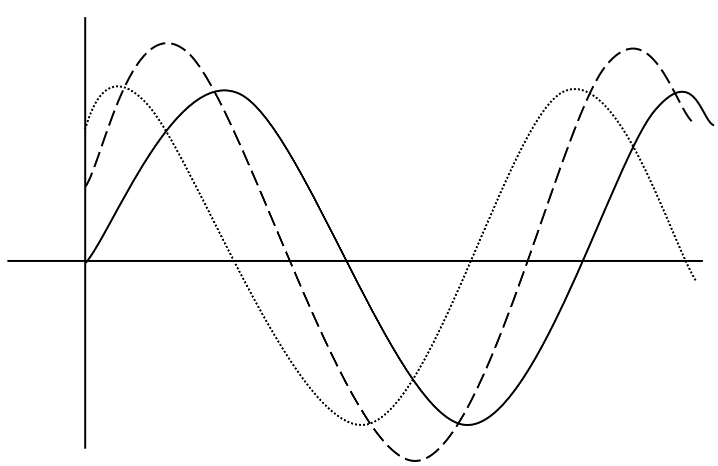


I(c) = CAPACITIVE CURRENT
I(r) = RESISTIVE CURRENT
I (t) = TOTAL CURRENT

Current Vector
figure 1.

The capacitive leakage is an inherent characteristic of the device controlled primarily by design details. The resistive leakage is a characteristic of insulating materials used and the amount of resistive leakage is generally an indication of the quality of the insulation. This is particularly true when identical devices are being comparatively tested. Both capacitive and resistive leakages vary, almost linearly, with the applied test voltage.

In the average electrical device during AC hipot tests, the resistive current flow is normally much smaller than the capacitive current flow, so changes in the resistive current do not have a significant effect on the total current. The capacitive current, however, is out of phase with the resistive current and can be cancelled in the measurement (figure 2.). With this type of test arrangement, the masking effect of the capacitive current is greatly reduced or eliminated and small variations in insulation resistance become detectable.



RESISTIVE CURRENT

CAPACITIVE CURRENT
TOTAL CURRENT

figure 2.

Breakdown is also a flow of current. However the term is usually used to denote an actual insulation failure. It is readily distinguishable from leakage because the current does not vary linearly with the applied voltage, but instead rises suddenly when the critical or breakdown voltage is reached. Often, but not always, arcing is associated with breakdown.

Arcing occurs in solids and liquids as well as gases. Arcing typically involves currents on the order of 0.4 amperes or more and indicates a potentially dangerous breakdown of insulation or abnormal current flows inside a device.

The ability of high voltage test equipment to react to the excessive current flow or failure of the product under test is often referred to as "**sensitivity**."

For many years, users of high potential (hipot) dielectric testers tolerated considerable sensitivity differences between individual testers. Products rejected by one tester might be accepted by another. If the two testers were distinctly different models or were made by different manufactures, the question of which tester to rely upon was a difficult one. Unfortunately, the tester chosen was sometimes the one that would accept the products. In a majority of these situations, the real problem was a lack of an acceptable standard for tester sensitivity. Many low cost production line testers in the past were essentially designed as "go/no-go" testers and sensitivity was often whatever was convenient for the manufacturer.

The variance of the sensitivity curves between different manufacturers and different models was a major factor in U.L.'s (Underwriters Laboratories) move to try and standardize production line hipot test equipment sensitivity. These tester performance requirements have come to be commonly known as the **"120 K requirement."**

Unless the hipot tester was designed to meet the "120 K" specifications, it is unlikely that it will meet all of the requirements. The tester's suitability must be verified.

In general, the original U.L. "120 K" specifications require the tester to reject within .5 seconds when connected to an impedance of 120,000 (120 K) ohms at the specified testing voltage. Additionally, the output voltage sign wave tolerance is specified and the output voltage regulation is required to be -0%, +20%.

Various agencies other than U.L. have their own versions of the "120 K" type specifications. As with all testing specifications, the manufacturer must ensure that they are in compliance with the latest testing requirements for their particular product.

The Insulation Resistance Test

Some dielectric analyzers today come with a built in insulation resistance tester. Typically, the IR function provides test voltages from 500 to 1,000 volts DC and resistance ranges from kilohms to gigaohms. This function allows manufacturers to comply with special compliance regulations. BABT, TÜV, and VDE are agencies that may under certain conditions require an IR test on the product before a Hipot test is performed. This typically is not a production line test but a performance design test.

The insulation resistance test is very similar to the hipot test. Instead of the go/no go indication that you get with a hipot test the IR test gives you an insulation value usually in Megohms. Typically the higher the insulation resistance value the better the condition of the insulation. The connections to perform the IR test are the same as the hipot test. The measured value represents the equivalent resistance of all the insulation which exists between the two points and any component resistance which might also be connected between the two points.
Although the IR test can be a predictor of insulation condition, it does not replace the need to perform a Dielectric Withstand test.

TYPES OF FAILURES DETECTABLE ONLY WITH A HIPOT TEST

- Weak Insulating Materials
- Pinholes in Insulation
- Inadequate Spacing of Components
- Pinched Insulation

SERVICE AND MAINTENANCE

User Service

To prevent electric shock do not remove the instrument cover. There are no user serviceable parts inside. Routine maintenance or cleaning of internal parts is not necessary. Any external cleaning should be done with a clean dry or slightly damp cloth. Avoid the use of cleaning agents or chemicals to prevent any foreign liquid from entering the cabinet through ventilation holes or damaging controls and switches, also some chemicals may damage plastic parts or lettering. Schematics, when provided, are for reference only. Any replacement cables and high voltage components should be acquired directly from Slaughter Company. Refer servicing to a Slaughter Company authorized service center.

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Service Interval

The instrument and its power cord, test leads, and accessories must be returned at least once a year to a Slaughter Company authorized service center for calibration and inspection of safety related components. Slaughter Company will not be held liable for injuries suffered if the instrument is not returned for its annual safety check and maintained properly.

User Modifications

Unauthorized user modifications will void your warranty. Slaughter Company will not be responsible for any injuries sustained due to unauthorized equipment modifications or use of parts not specified by Slaughter Company. Instruments returned to Slaughter Company with unsafe modifications will be returned to their original operating condition at your expense.

GLOSSARY OF TERMS

ACCURACY is the condition or quality of conforming exactly to a standard. The accuracy of an instrument is the extent to which the average of many measurements made by the instrument agrees with the true value or standard being measured. The difference between the average and the true value is the error. When this condition is a result of the measuring instrument, it is known as *out of calibration*. An instruments measuring accuracy must be considered over the whole range of the measuring instrument. This is often expressed as *linearity*.

AVERAGE VOLTAGE is the sum of the instantaneous voltages in a half cycle wave shape divided by the number of instantaneous voltages. In a sine wave, the average voltage is equal to .637 times the peak voltage.

EMF (electromotive force) is the energy per unit charge supplied by a source of electricity (normally expressed in volts).

The **FULL SCALE VALUE** is equal to the largest value of the actuating electrical quantity which can be indicated on the scale or, in the case of instruments having their zero between the ends of the scale; the full scale value is the arithmetic sum of the values of the two ends of the scale.

IMPEDANCE is the apparent resistance, expressed in ohms, offered by an alternating current circuit to the passage of electrical energy. Since frequency is one of the factors affecting impedance, the frequency of applied energy must be specified.

INDUCTANCE is the property of an electric circuit by which a varying current induces an emf in that circuit or a neighboring circuit.

$L = a^2n^2/(9a + 10b)$

a = coil radius in inches
b = coil length in inches
n = number of turns

LOADED TEST(ing) VOLTAGE is the actual testing voltage developed across the load (product under test). This voltage will be lower than the open circuit voltage because of the internal impedance of the H.V. transformer and any series limit resistance of the tester.

OPEN CIRCUIT VOLTAGE is the output voltage of the tester prior to the connection of a load (product under test).

PEAK VOLTAGE is the maximum value present in a varying or alternating voltage. This value may be either positive or negative. The peak value is equal to 1.414 ($\sqrt{2}$) times the R.M.S. value.

PRECISION or REPEATABILITY is the variation in readings obtained when repeating exactly the same measurement. The precision of an instrument is the ability to repeat a series of measurements on the same piece and obtain the same results for each measured value. The variation in the measured values can be expressed in terms of a standard deviation of the measuring error. The instrument will be more precise if the standard deviation is smaller.

Accuracy versus Precision: Confusion often exists between the terms accuracy and precision because the terms are often interchanged in their usage, but they are *two different concepts*. The accuracy of an instrument can be improved by recalibrating to reduce its error, but recalibrating generally does not improve an instrument's precision.

R.M.S. (ROOT MEAN SQUARE) is the square root of the mean of the instantaneous values squared.

R.M.S. VOLTAGE is the effective value of a varying or alternating voltage. The effective value is that value which would produce the same power loss as if a continuous voltage were applied to a pure resistance. In sine wave voltages, the R.M.S. voltage is equal to .707 times the peak voltage.

SENSITIVITY is the impedance through which a tester will detect a fault. Sensitivity is usually expressed in Ohms. One of the most common examples is the UL 120K ohm minimum sensitivity requirement.

VOLT AMPERE (VA) is the product of the R.M.S. voltage applied to a circuit and the R.M.S. current, in amperes, flowing through it.

SPECIFICATIONS
KEY FEATURES & BENEFITS OF MODEL 2205

1. Pass/fail operation
   A programmable limit can be set for pass/fail operation, eliminating operator judgments. An audio alarm and reject lamp notify the operator of failures.

2. No load setup of trip current and output voltage.
   Operators can set output voltage and resistance limits to the desired levels in the absence of high voltage.

3. Automatic storage of test program.
   The instruments will power up with the parameters that were used during the last test to avoid operator set-up errors.

4. All parameters for the setups can be adjusted through a simple menu driven program.
   The easy to follow setup screens ensure that the operator correctly sets up all test parameters.

5. Line and load regulation.
   Tests are more repeatable and reliable, since proper voltage is consistently applied to all devices being tested, regardless of fluctuations in the line input voltage or the load created by the device under test.

6. PLC Remote Control.
   Inputs and outputs for PLC control are available through a 9-pin D type connector on the back panel.

7. LED display with meter memory.
   Easy-to-read digital display simplifies the task of setting test parameters and interpreting test results, which reduces errors and makes the operator's job easier. Meter memory allows operators to review the last test results.

8. Flashing high voltage indicator.
   A flashing LED located to the right of the display clearly indicates when high voltage is active to provide maximum operator safety.

9. Tamper-resistant front panel design.
   Prevents operators from inadvertently or accidentally modifying test parameters and ensures consistent and reliable test results, minimizing the need for costly and time consuming product re-testing.

Model 2205 Functional Specifications
Insulation Resistance Tester

INPUT	
Voltage	115 / 230 V selectable, ± 15% variation
Frequency	50 / 60 Hz ± 5%
Fuse	1 Amp 250VAC fast acting

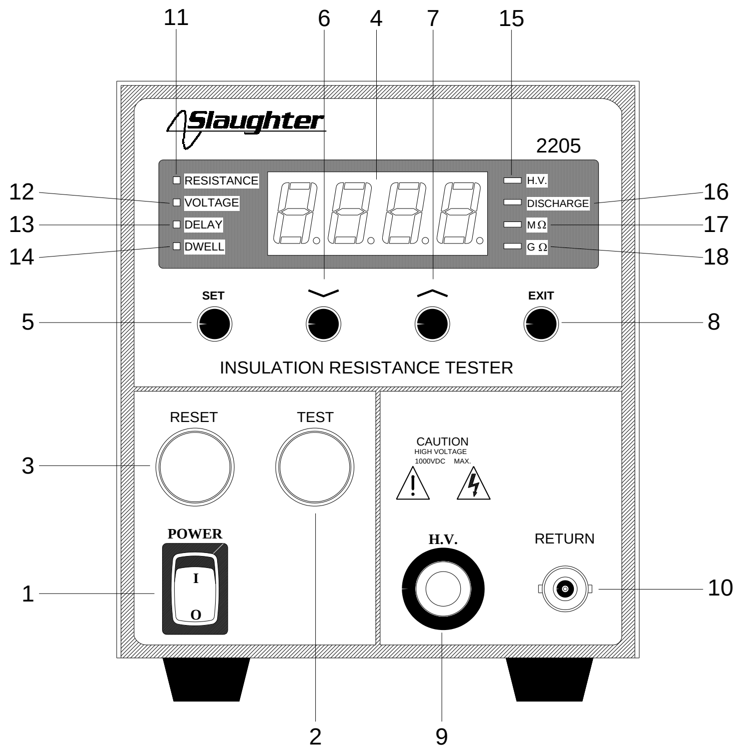
INSULATION RESISTANCE TEST		
Output Voltage	Range:	30 – 1000VDC
	Resolution:	1 Volt
	Accuracy:	± (1% of Setting + 1V) (relative to displayed output)
	Ripple:	< 2%
Voltage Display	Low Range:	0.0V – 100.0VDC
	High Range:	101V – 1000VDC
	Resolution:	0.1V (Low Range), 1V (High Range)
	Accuracy:	± (2% of reading +2V)
Resistance Display	Range:	0.01MΩ – 200.0GΩ (4 Digit, Auto Ranging)
	Accuracy:	30 – 499V 0.1MΩ – 1GΩ ± (3% of reading + 2 counts) 1 – 20GΩ ± (5% of reading + 2 counts) 500 – 1000V 0.1MΩ – 1GΩ ± (2% of reading + 2 counts) 1 – 20GΩ ± (3% of reading + 2 counts) 20 – 200GΩ ± (10% of reading + 2 counts)
Timer Display	Range:	0.0 – 999.9 seconds
	Resolution:	0.1 second
	Accuracy:	± (0.1% of reading + 0.05 seconds)
Failure Settings	Low Limit:	0.1MΩ – 999.9MΩ 1000MΩ – 9999MΩ

INSULATION RESISTANCE TEST	
	10.0GΩ – 200.0GΩ
Dwell Time Setting	1.0 – 999.9 seconds, 0.1 second / step "0" for continuous running
Delay Time Setting	0.1 – 999.9 seconds, 0.1 second / step
Discharge	Automatic Discharge of Device Under Test Indicator: Green < 30 V, Red > 30 V

GENERAL		
Remote Interface	Provided through 9 pin D type connector 1. Inputs: test , reset, safety interlock 2. Outputs: pass, fail and test in progress	
Line Cord	Detachable 6 ft. (1.8m) power cable terminated in a three prong grounding plug.	
Terminations	High Voltage Output – Alden Socket Shielded Return – BNC Connector	
Mechanical	Dimensions: (W x H x D):	(120mm x 133mm x 300mm)
Environmental	Operating Temperature: Relative Humidity:	32° – 104°F (0° – 40°C) 0 – 80%
Calibration	Traceable to National Institute of Standards and Technology (NIST). Calibration controlled by software. Adjustments are made through front panel keypad in a calibration mode activated by rear panel switch. Calibration information stored in non-volatile memory.	

Why use the term "Counts"?
Slaughter publishes some specifications using COUNTS which allows us to provide a better indication of the tester's capabilities across measurement ranges. A COUNT refers to the lowest resolution of the display for a given measurement range. For example, if the resolution for voltage is 1V then 2 counts = 2V.

FRONT PANEL CONTROLS



1. **POWER SWITCH:** Rocker-style switch with international ON (|) and OFF (0) markings.

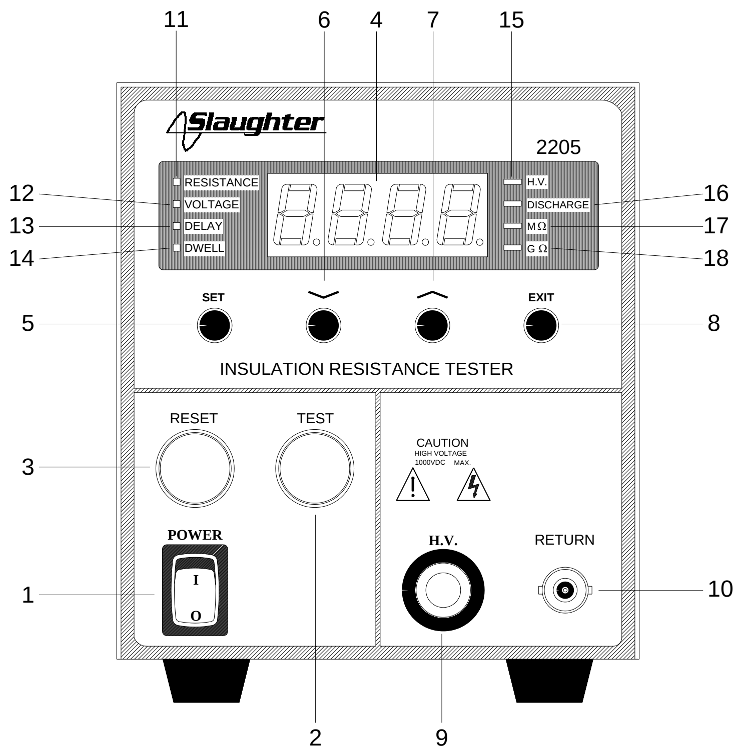
2. **TEST SWITCH:** This is a momentary contact switch. Press the green switch to energize the high voltage output. When the dwell function is "0," high voltage will remain ON until a reject occurs or the RESET button is pushed. If the dwell function is anything other than "0", the high voltage will be present only for the programmed time.

3. **RESET SWITCH:** This is a momentary contact switch. If a failure is detected during a test, the red Failure lamp within the switch will light. To reset the system for the next test, press and release this switch. This switch may also be used to abort a test in progress.

4. **DISPLAY:** The Display is the main readout for the test settings and test results. Scalar values are indicated via a digital display.

5. **SET KEY:** Use this key to enter **Setup Mode** and advance forward through the setup menus.

6. **DOWN ARROW (∨):** Use this key to decrement numeric values in the setup mode.



7. **UP ARROW (∧):** Use this key to increment numeric values in the setup mode.

8. **EXIT KEY:** Use this key when you desire to exit **Setup Mode** enter the **Run Mode** to initiate a test. This key will also toggle the digital display between Resistance, Voltage and Dwell during and after tests.

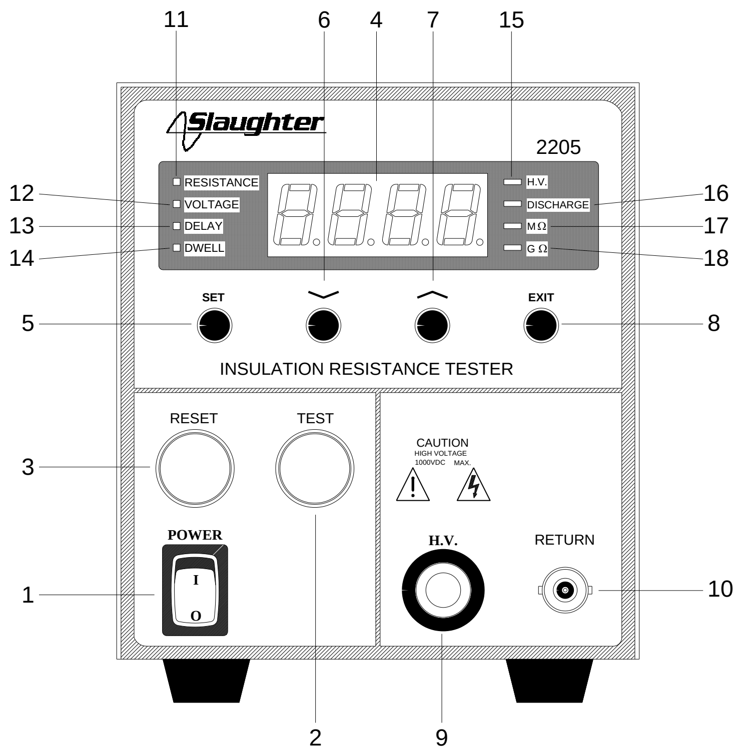
9. **HIGH VOLTAGE OUTPUT JACK:** For the connection of the detachable 6 foot (1.82 m) red high voltage test lead. The jack is recessed for safety when this lead is not being used.

10. **RETURN JACK:** For the connection of the detachable 6 foot (1.82 m) black, shielded return test lead.

11. **RESISTANCE LED INDICATOR:** This indicator illuminates when resistance is displayed in either test or setup mode.

12. **VOLTAGE LED INDICATOR:** This indicator illuminates when voltage is displayed in either test or setup mode.

13. **DELAY LED INDICATOR:** This indicator illuminates when delay time is displayed in either test or setup mode.



14. DWELL LED INDICATOR: This indicator illuminates when dwell time is displayed in either test or setup mode.

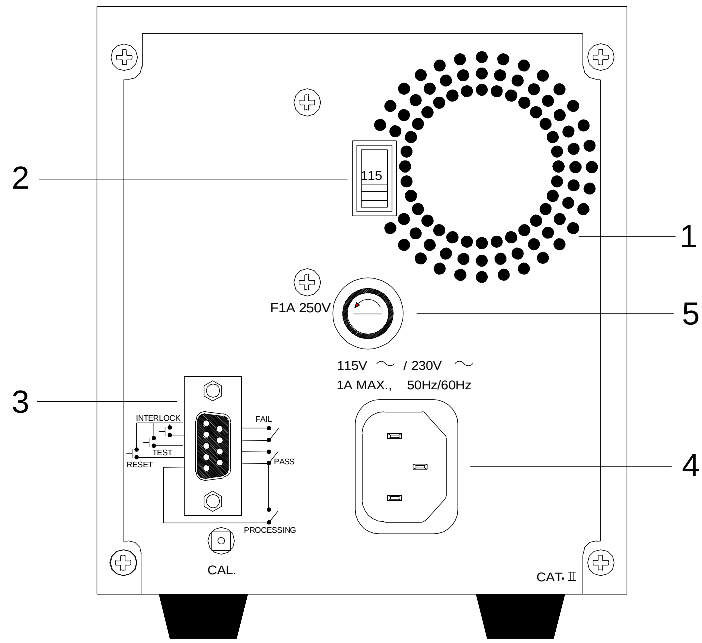
15. HIGH VOLTAGE LED INDICATOR: This indicator flashes to warn the operator that high voltage is present at the high voltage output terminal.

16. DISCHARGE LED INDICATOR: Indicates charge status of device under test. Green < 30V, Red > 30V

17. MEGOHM RANGE LED INDICATOR: This indicator illuminates when the displayed resistance measurement or limit is in megohms.

18. GIGOHM RANGE LED INDICATOR: This indicator illuminates when the displayed resistance measurement or limit is in gigohms.

REAR PANEL CONTROLS



1. **VENTILATION:** To cool the instrument.

2. **INPUT POWER SWITCH:** Line voltage selection is set by the position of the switch. In the down position it is set for 115 volt operation, in the up position it is set for 230 volt operation.

3. **PLC REMOTE I/O:** 9 pin D subminiature male connector for remote I/O.

4. **INPUT POWER RECEPTACLE:** Standard IEC 320 connector for connection to a standard NEMA style line power (mains) cord.

5. **FUSE RECEPTACLE:** To change the fuse unplug the power (mains) cord and turn the fuse cap counter clockwise to remove the fuse.

QUICK START

This quick start guide presumes the operator has some familiarity with hipot testing and desires to use the **"default"** settings on the instrument. The default settings shown will remain in memory unless you choose to override them with your own test program. The instrument default settings are as follows:

DEFAULTS

- **Input Voltage:** 115 or 230 volts AC, country specific (rear-panel switch selectable)
- **Resistance Lo-Limit:** 0.1 megohms
- **Voltage Output:** 500 V
- **Delay:** 1 (1 second)
- **Dwell:** 1 (1 second)

A). Unpack this instrument from its special shipping container.

B). Connect the provided 9-pin "D" type plug to the mating connector on the back panel of the tester. This plug includes a jumper for the safety interlock. **This plug must be connected for the tester to operate**.

C). Locate a suitable testing area and be sure you have read all safety instructions for the operation of the instrument and suggestions on the test area set-up in the SAFETY section of this manual. Locate a three prong grounded outlet. Be sure the outlet has been tested for proper wiring before connecting the instrument to it.

CAUTION

D). Check to be sure the correct input line voltage has been selected on the rear panel. Either 115 volts AC or 230 volts AC. Connect the power input plug into its socket on the rear panel of the instrument. Connect the male end of the plug to the outlet receptacle.

E). Turn on the POWER switch located on the lower left hand side of the front panel. Upon powering the instrument up a POWER ON SELF TEST (POST) will automatically be performed. This test will check for the condition of all critical components. You will see the model number briefly appear on the LED readout as well as the firmware version number and then clear itself.

F). If the instrument **DEFAULTS** are acceptable, then be sure to connect the appropriate test leads to the device under test (DUT) or test fixture. Be certain that the unit is connected to suitable power with a known good ground before energizing this instrument, then connect the return lead first (black) to the test fixture or item followed by the high voltage output lead (red).

WARNING **G).** Please check your connections to be sure they are making good contact and that the test station or area is clear of debris and other personnel. DO NOT TOUCH THE DEVICE UNDER TEST ONCE THE TEST HAS BEEN STARTED. To initiate the test press the GREEN test button on the front panel. This is a momentary button. The instrument will then cycle ON and begin the automated test using the defaults. If a failure occurs you will HEAR an audible alarm go off. To stop the alarm you must depress the RED button marked RESET. This will silence the alarm and reset the instrument to begin another test. This RESET button can also be used to ABORT a test and cut off the HIGH VOLTAGE.

When HIGH VOLTAGE is present a RED flashing High Voltage LED indicator located to the right of the display will remain flashing until the HIGH VOLTAGE is OFF. Once a test has ended, the Discharge LED indicator illuminates to notify you of any voltage stored in the DUT. This LED will be RED if the voltage is greater than 30 Volts, and GREEN if the voltage is less than 30 volts. You should wait until this LED is green before touching the DUT or removing the test leads. If the device under test PASSED the test, then no audible alarm will sound. In the case of a FAIL condition the instrument will provide a visual and audible alarm. Pressing the reset button will reset the instrument alarm.

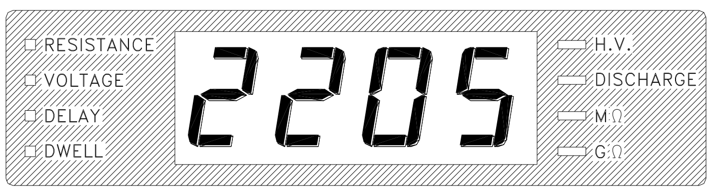
SETUP INSTRUCTIONS FOR Model 2205

Check to be sure the correct input line voltage has been selected on the rear panel (115 volts AC or 230 volts AC). Connect the power input plug into its socket on the rear panel of the instrument. Connect the male end of the plug to the outlet receptacle.

Please be sure that the safety ground on the power line cord is not defeated and that you are connected to a grounded power source. Also connect the rear panel chassis ground for additional safety.

This tester has a safety interlock that must be closed in order for the tester to operate. The 9-pin "D" type plug provided with the unit includes a jumper for the safety interlock. This plug must be connected for the tester to operate.

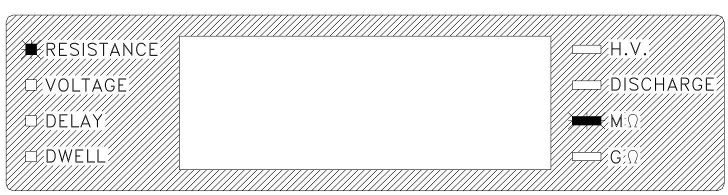
Turn on the POWER switch located on the lower left hand side of the front panel. Upon powering the instrument up a POWER ON SELF TEST (POST) will be automatically performed. This test will check for the condition of all critical components. In addition the display will briefly flash the model number and firmware version.



The instrument will recall the last setup that was active. The digital display will show 0.0 and the Resistance LED will be illuminated. To view the last settings, press the set button once and the Resistance LED will flash and the display will show the programmed resistance limit. Pressing the Set button again will cause the Voltage LED to flash and the display will show the programmed voltage. Pressing the Set button a third time will cause the Delay LED to flash and the display will indicate the delay time. Pressing the Set button a fourth time will cause the Dwell LED to flash and the display to indicate the programmed dwell time. Press the Exit button to ready the instrument for testing.

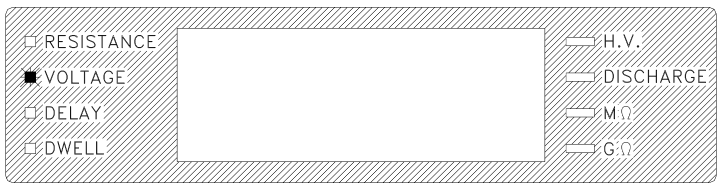
1. To set the Resistance Limit

Press the SET key until the Resistance LED is illuminated and flashing.



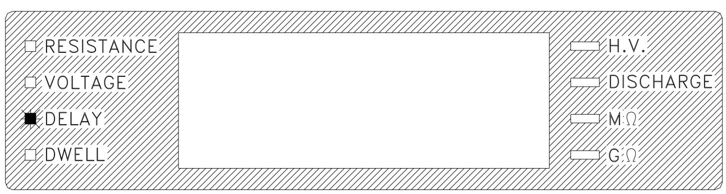
Use the Up/Down Arrow keys to enter the desired resistance low limit, then press the EXIT key to exit to the run mode or toggle to another setting using the SET key. The limit is set in either gigohms or megohms as shown by the two LED indicators to the lower right of the numeric display. The maximum resistance that may be entered is 200.0 gigohms.

2. To set the Output Test Voltage
Press the SET key until the Voltage LED is illuminated and flashing.



Use the Up/Down Arrow keys to enter the desired test voltage, then press the EXIT key to exit to the run mode or toggle to another setting using the SET key. The maximum voltage that may be entered is 1000 volts.

3. To set the Delay Time
Press the SET key until the Delay LED is illuminated and flashing.



Use the Up/Down Arrow keys to enter the delay time setting, then press the EXIT key to exit to the run mode or toggle to another setting using the SET key. The unit of measure is in seconds with 999.9 seconds as the maximum setting.

4. To set the Dwell function

Press the SET key until the Dwell LED is illuminated and flashing. Dwell time is the length of time the instrument will apply the programmed test voltage.

Use the Up/Down Arrow keys to set the dwell time, then press the EXIT key to exit to the run mode or toggle to another setting using the SET key. The unit of measure is in seconds with 999.9 seconds as the maximum setting. If the dwell is set to "0," the instrument will operate in a continuous ON mode when the TEST button is depressed and released. It will stop when the DUT (Device Under Test) goes into failure or the manual reset button is pressed. The instrument will 'beep' at the end of a timed test. Pressing the red Reset button will terminate the test in progress.

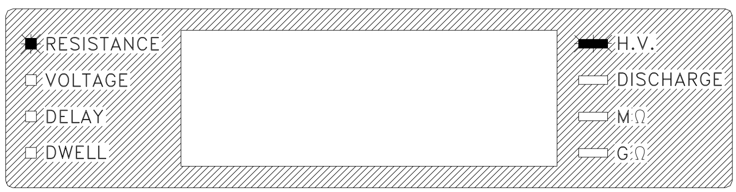
OPERATING INSTRUCTIONS FOR MODEL 2205

1. After the instrument's test parameters are programmed, connect the appropriate test leads to the device under test (DUT) or test fixture. Be certain the unit is connected to suitable power with a known good ground before energizing this instrument. Then connect the return lead first to the test fixture or the DUT followed by the high voltage lead.

WARNING

Check your connections to be sure they are making good contact and that the test station or area is clear of debris or other personnel.
DO NOT TOUCH THE DEVICE UNDER TEST ONCE THE TEST HAS BEEN STARTED.

2. To initiate a test, press the TEST switch on the front panel. The red High Voltage LED indicator will flash to indicate that high voltage is present. The display will show the Resistance of the DUT.



If dwell is set to “0,” the instrument will continue to output voltage indefinitely or until a reject or the RESET button is pressed. If dwell is set to anything other than “0” the voltage will continue only until the dwell time has elapsed, then shut off.

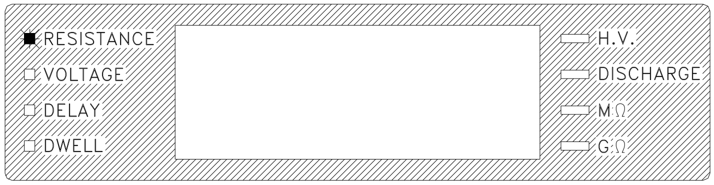
3. To stop the test at any time, press the RESET switch.

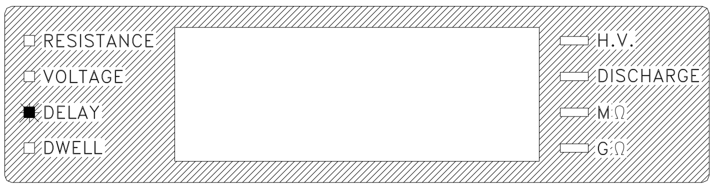
At the completion of the dwell time, if the DUT passed the test, the instrument will ‘chirp’ to signal the operator that the test cycle has been completed and the green light in the TEST switch will illuminate. The instrument is now ready to perform another test.

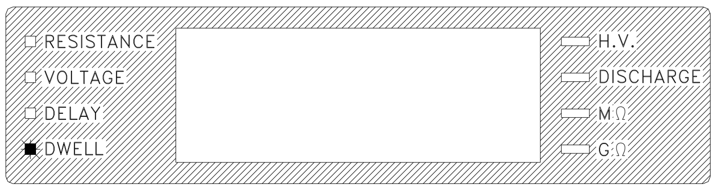
4. If there is a failure in the DUT during the test, the voltage will shut off, the red indicator light will illuminate on the RESET switch and an alarm will sound.

5. To stop the alarm, please press the RESET switch once. The alarm will stop. The instrument is now ready for the next test. If the RESET switch is pressed again, the data on the display screen will be cleared.

6. To change the parameter shown on the display, press the EXIT key on the front panel. The display will toggle from Resistance to Voltage, and then to Delay or Dwell as shown below. The display will default to the last parameter selected with the exit key. Pressing the SET key will allow you to view the results of the last test.





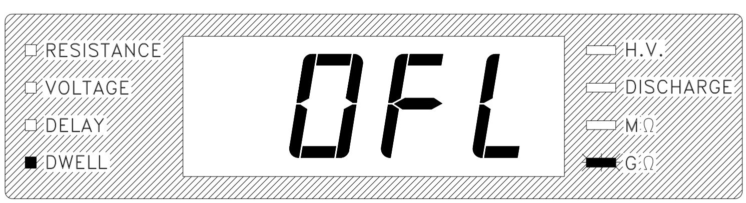


Total cycle time is the delay time plus the dwell time. At the completion of the dwell time, the instrument will ‘chirp’ to signal the operator that the test cycle has been completed.

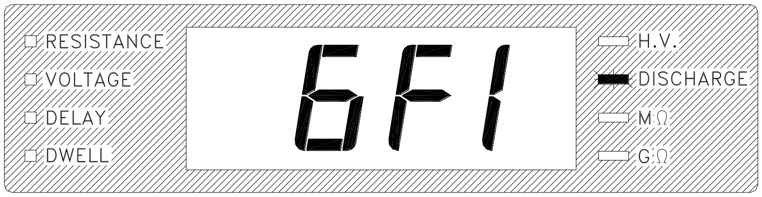
Press the TEST switch to initiate another test.

Displayed Messages

The following message is displayed when the IR test results in a DUT measurement that is greater than the range of the instrument.



The following message is displayed when the unit detects a ground current that exceeds the GFI threshold.



The high voltage power supply of the instrument is internally referenced to earth ground. The leakage current measuring circuits monitor only currents that flow through the Return lead. Therefore, the possibility exists for current to flow directly from the High Voltage output to earth ground that typically would not be monitored.

GFI is a circuit that monitors the current between the High Voltage output and earth ground. The GFI's main purpose is to protect the operator from prolonged exposure to High Voltage in the case of an accidental contact with the High Voltage lead and earth ground. If the operator accidentally touches the High Voltage lead and earth ground, the High Voltage will be shut off immediately and the test aborted.

REMOTE I/O

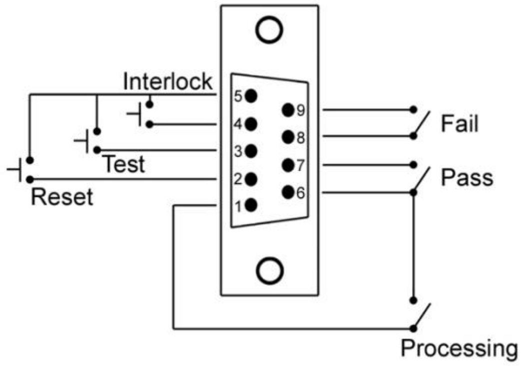
All inputs are connected through the 9-pin “D” type connector mounted on the back panel of the unit. This connector mates with the standard 9-pin “D” subminiature female connector included with the unit. For best performance, a shielded cable should be used. To avoid ground loops, the shield should not be grounded at both ends of the cable

The remote interface includes a SAFETY INTERLOCK. This interlock must be closed to allow a test to start. The SAFETY INTERLOCK is wired between pins 4 and 5 of the interface connector. For manual operation, the provided 9-pin “D” type connector has a jumper between pins 4 and 5. ***This mating connector must be in place for manual operation.*** For remote operation, the interlock can be appropriately connected to test station guarding.

The interface allows remote operation of the TEST and RESET functions. A normally open momentary switch across pins 3 and 5 allows remote operation of the TEST function. A normally open momentary switch can also be wired across pins 2 and 5 to allow remote operation of the RESET function. The TEST and RESET switches on the front panel remain active during remote operation.

The remote interface also provides signals to remotely monitor the PASS, FAIL, and PROCESSING conditions. These signals are provided by three normally open internal relays that switch on to indicate the current condition of the tester. These are normally open, free contacts and do not provide any voltage or current. The ratings of these contacts are 1Amp/120VAC (1Amp/24VDC).

Remote I/O Connection



Pins 1 and 6 provide the PROCESSING signal.
Pins 6 and 7 provide the PASS signal.
Pins 8 and 9 provide the FAIL signal.

A description of the output relay operation follows:

PROCESSING – The relay contact closes the connection between pin 1 and pin 6 while the instrument is performing a test. The connection is opened at the end of a test.

PASS – The relay contact closes the connection between pin 6 and pin 7 after detecting that the device under test passed the test. The connection is opened when the next test is initiated or the reset function is activated.

FAIL – The relay contact closes the connection between pin 8 and pin 9 after detecting that the device under test failed the test. The connection is opened when the next test is initiated or the reset function is activated.

Suggested AMP part numbers for interconnecting to the Remote I/O are shown below.

205203-3	RECEPTACLE SHELL
745253-7	CRIMP SNAP-IN SOCKET CONTACT (for receptacle)
745171-1	SHIELDED CABLE CLAMP (for either plug or receptacle)
747784-3	JACKSCREW SET (2)

CAUTION DO NOT CONNECT VOLTAGE OR CURRENT TO THE SIGNAL INPUT, THIS COULD RESULT IN DAMAGE TO THE CONTROL CIRCUITRY.

CALIBRATION PROCEDURE

Calibration Equipment Required
High Impedance, Direct Reading, High Voltage, Standard Voltmeter
Set of High Voltage Leads
Standard Resistors: 100kΩ, 100MΩ, 1GΩ

- **Step 1**. Plug the instrument into a properly grounded receptacle and switch the instrument "OFF".
- **Step 2**. Attach the High Voltage and Return leads to the front of the instrument
- **Step 3**. Press the "Cal." button on the rear panel, and while holding it in, power up the instrument to enter the calibration mode. Release the "Cal." button. The screen will display "2205", the firmware version number and then "Cal.".
- **Step 4.** Use the ∧ (up) or ∨ (down) button to select "HI".
- **Step 5.** Short the High Voltage and Return leads together and press TEST. There will be a slight delay and then a short beep. The screen will display "OPEN".
- **Step 6.** Disconnect the leads from the front panel and connect a standard, high voltage voltmeter between high voltage and return. Press TEST, and enter the reading shown on the standard voltmeter by using the ∧ (up) and ∨ (down) buttons. When finished, press the "Set" button to enter the voltage.
- **Step 7.** The instrument will then display "LO". Repeat **Steps 5** and **6** for this item.
- **Step 8.** The instrument will then display "AOFF". With the leads removed from the front panel, press the TEST button. After a short delay the screen will display A1.
- **Step 9.** Connect a standard 100kΩ resistor between High Voltage and Return, and press the TEST button. After a short delay and a small beep the screen will display A2.
- **Step 10.** Repeat Step 9 for items A2 – A7 by connecting the standard resistor as indicated by an "X" in Table 1.
- **Step 11.** After items A1 – A7 are calibrated, the instrument will display "END" and the TEST button will be illuminated. Switch the instrument "OFF" and disconnect the leads.
- **Step 12.** Seal the "Cal." Button.

Table 1

	100kΩ	100MΩ	1GΩ
A1	**X**		
A2	**X**		
A3	**X**		
A4		**X**	
A5		**X**	
A6			**X**
A7			**X**

REPLACEMENT PARTS LIST
Rev. B ECO 5739

Part Number	Qty.	Reference Designator	Description
102-045-901	1		Return Cable
102-055-913	1		High Voltage Cable
125-013-001	1		Power Cord (6 ft.)
175-974-003	4		Tilt-Up Leg Kit
330-112-001	1		Power Switch
330-113-001	1		Test Switch
330-113-002	1		Reset Switch
575-705-001	1		Red LED
99-10040-01	1		Interlock Connector
99-10681-01	1		Microcontroller (SM89516AC25J)
99-10258-01	1		Fuse (1A Fast Blow)
99-10259-01	1	CON2205	Main Control Board
99-10260-01	1	DCP1KV	High Voltage Board
99-10261-01	1	DSP2205	Display Board
99-10275-01	1		Multicolor LED
99-10671-01	1	Test/Pass	Replacement Bulb
99-10672-01	1	Reset/Fail	Replacement Bulb