Extech Electronics Co.

ESA
Electrical Safety Compliance Analyzer
Operation Manual

ER 1.01

WARRANTY

EEC certifies that the instrument listed in this manual meets or exceeds published manufacturing specifications. This instrument was calibrated using standards that are traceable to Chinese National Laboratory Accreditation (CNLA).

Your new instrument is warranted to be free from defects in workmanship and material for a period of (3) year from date of shipment. During the warranty period, you must return the instrument to EEC or its branches or its authorized distributor for repair. EEC reserves the right to use its discretion on replacing the faulty parts or replacing the assembly or the whole unit.

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 EEC manufacture. Parts used must be parts that are recommended by EEC as an acceptable specified part. Use of non-authorized parts in the repair of this instrument will void the warranty.

This warranty does not cover accessories not of EEC manufacture.

Except as provided herein, EEC 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.

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1.1. Safety Symbols

1.1.1 Product Marking Symbols

Product will be marked with this symbol when it is necessary to refer to the operation and service manual in order to prevent injury or equipment damage.

Product will be marked with this symbol when hazardous voltages may be present.

Product will be marked with this symbol at connections that require earth grounding.

1.1.2 Caution and Warning Symbols

WARNING Calls attention to a procedure, practice, or condition that could possibly cause bodily injury or death.

CAUTION Calls attention to a procedure, practice, or condition that could possibly cause damage to equipment or permanent loss of data

1.2. Glossary of Terms

Alternating Current, AC: Current that reverses direction on a regular basis, commonly in the U.S.A. 60 per second, in other countries 50 times per second.

Breakdown: The failure of insulation to effectively prevent the flow of current sometimes evidenced by arcing. If voltage is gradually raised, breakdown will begin suddenly at a certain voltage level. Current flow is not directly proportional to voltage. Once breakdown current has flown, especially for a period of time, the next gradual application of voltage will often show breakdown beginning at a lower voltage than initially.

Conductive: Having a volume resistivity of no more than 10^3 ohm-cm or a surface resistivity of no more than 10^5 ohms per square.

Conductor: A solid or liquid material which has the ability to let current pass through it, and which has a volume resistivity of no more than 10^3 ohm-cm.

Current: The movement of electrons through a conductor. Current is measured in amperes, milliamperes, microamperes, nanoamperes, or picoamperes. Symbol = **I**

Dielectric: An insulating material that is positioned between two conductive materials in such a way that a charge or voltage may appear across the two conductive materials.

Direct Current, DC: Current that flows in one direction only. The source of direct current is said to be polarized and has one terminal that is always at a higher potential than the other.

Hipot Tester: Common term for dielectric-withstand test equipment.

Insulation: Gas, liquid or solid material which has a volume resistivity of at least 10^{12} ohm-cm and is used for the purpose of resisting current flow between conductors.

Insulation Resistance Tester: An instrument or a function of an instrument capable of measuring resistance's in excess of 200 megohms. Usually employs a higher voltage power supply than used in ohmmeters measuring up to 200 megohms.

Leakage: AC or DC current flow through insulation and over its surfaces, and AC current flow through a capacitance. Current flow is directly proportional to voltage. The insulation and/or capacitance are thought of as a constant impedance, unless breakdown occurs.

Resistance: That property of a substance that impedes current and results in the dissipation of power, in the form of heat. The practical unit of resistance is the ohm. Symbol = **R**

Trip Point: A minimum or maximum parameter set point that will cause an indication of unacceptable performance during a run test.

Voltage: Electrical pressure, the force which causes current through an electrical conductor.
Symbol = **V**

1.3. Safety

This product and its related documentation must be reviewed for familiarization with safety markings and instructions before operation.

This product is a Safety Class I instrument (provided with a protective earth terminal). Before applying power verify that the instrument is set to the correct line voltage (115± 15% or 230±15%) and the correct fuse is installed.

WARNING A Hipot produces voltages and currents that can cause **harmful or fatal electric shock.** To prevent accidental injury or death, these safety procedures must be strictly observed when handling and using the test instrument.

1.3.1 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. Avoid the use of cleaning agents or chemicals on the instrument, some chemicals may damage plastic parts or lettering. Any external cleaning should be done with a clean dry or slightly damp cloth. Schematics, when provided, are for reference only. Any replacement cables and high voltage components should be acquired directly from EEC. Refer servicing to EEC customer support department.

Service Interval

The instrument, its power cord, test leads, and accessories must be returned at least once a year to EEC customer support department for calibration and inspection of safety related components. EEC will not be held liable for injuries suffered if the instrument is not properly maintained and safety checked annually.

User Modifications

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

1.3.2 Test Station

Location

Select an area away from the main stream of activity which employees do not walk through in performing their normal duties. If this is not practical because of production line flow, then the area should be roped off and marked for **HIGH VOLTAGE TESTING**. No employees other than the test operators should be allowed inside.

If benches are placed back-to-back, be especially careful about the use of the bench opposite the test station. Signs should be posted: **"DANGER - HIGH VOLTAGE TEST IN PROGRESS - UNAUTHORIZED PERSONNEL KEEP AWAY."**

Work Area

Perform the tests on a non-conducting table or workbench, if possible. If you cannot avoid using a conductive surface, be certain that it is connected to a good earth ground and the high voltage connection is insulated from the grounded surface.

There should not be any metal in the work area between the operator and the location where products being tested will be positioned. Any other metal in the work area should be connected to a good ground, never left "floating".

Position the tester so the operator does not have to reach over the product under test to activate or adjust the tester. If the product or component being tested is small, it may be possible to construct guards or an enclosure around the device to be tested. Construct the guards of a non-conducting material such as clear acrylic, so that the item being tested is within the guards or enclosure during the test. If possible, the guards or enclosure should also contain safety switches that will not allow the tester to operate unless the guards are in place or the enclosure closed.

Keep the area clean and uncluttered. All test equipment and test leads not necessary for the test should be removed from the test bench and put away. It should be

apparent to both the operator and to any observers, the product that is being tested and the product that is waiting to be tested, or has already been tested.

Do not perform Hipot tests in a combustible atmosphere or in any area where combustible materials are present.

Power
Dielectric Voltage-Withstand Test Equipment must be connected to a good ground. Be certain that the power wiring to the test bench is properly polarized and that the proper low resistance bonding to ground is in place.

Power to the test station should be arranged so that it can be shut off by one prominently marked switch located at the entrance to the test area. In case of an emergency, anyone can cut off the power before entering the test area to offer assistance.

1.3.3 Test Operator

Qualifications
This instrument generates voltages and currents that can cause **harmful or fatal electric shock** and must only be operated by a skilled worker trained in its use.

The operator should understand the electrical fundamentals of voltage, current, and resistance. They should recognize that the test instrument is a variable high-voltage power supply with the return circuit directly connected to earth ground, therefore, current from the high-voltage output will flow through any available ground path.

Rules
Operators should be thoroughly trained to follow all of the aforementioned rules, in addition to any other applicable safety rules and procedures. Defeating any safety system should be considered a serious offense with severe penalties such as removal from the Hipot testing job. Allowing unauthorized personnel in the area during a test should also be dealt with as a serious offense.

Dress
Operators should not wear jewelry that could accidentally complete a circuit.

Medical Restrictions
Personnel with heart ailments or devices such as pacemakers should be informed that the voltages and currents generated by the instrument are very dangerous. If contacted it may cause heart-related problems that a person of good health may not experience. Please have the test operator consult their physician for recommendations.

1.3.4 Instrument Connections

WARNING Never perform a hipot test on energized circuitry or equipment.

The instrument is equipped with a safety ground connection, be sure that this is connected to a good earth ground.

Always connect the return lead first, regardless of whether the item under test is a sample of insulating material, a component tested with the high voltage test lead, or a cord-connected device with a two or three prong plug. The return lead should be connected first for any type of hipot testing.

Plug in the high voltage test lead only when it is being used. Handle its clip only by the insulator---**never touch the clip directly.** Be certain that the operator has control over any remote test switches connected to the Hipot. Double check the return and high voltage connections from the Hipot and the Line, Neutral, Ground and Case connections from the Line Leakage tester to be certain that they are proper and secure.

1.3.5 Device Under Test

WARNING Never touch the Device Under Test (DUT) or anything connected to it while high voltage is being applied by the hipot.

When testing with DC, always discharge the capacitance of the item under test and anything the high voltage may have contacted--such as test fixtures--before handling it or disconnecting the test leads.

HOT STICK probes can be used to discharge any capacitance in the device under test as a further safety precaution. A hot stick is a non-conducting rod about two feet long with a metal probe at the end that is connected to a wire. To discharge the device under test, two hot sticks are required. First, connect both probe wires to a good earth ground. Then touch one probe tip to the same place that the return lead was connected. While holding the first probe in place, touch the second probe tip to the same place where the high voltage lead was connected.

1.3.6 Key Safety Points to Remember

- Keep unqualified and unauthorized personnel away from the test area.
- Arrange the test station in a safe and orderly manner.
- Never touch the product or connections during a test.
- In case of any problem, turn off the high voltage first.
- Properly discharge any item tested with DC before touching connections.

1.4. Introduction to Product Safety Testing

1.4.1 The Importance of Safety Testing

Product Safety Tests are specified during the design and development stages of a product as well as in the production of the products to insure that it meets basic safety requirements. These tests are designed to verify the safety of the electrical products in that they do not jeopardize the safety of the people, domestic animals, and property of anyone who may come in contact with these products. In an era of soaring liability costs, original manufacturers of electrical and electronic products must make sure every item is as safe as possible. All products must be designed and built to prevent electric shock, even when users abuse the equipment or by-pass built in safety features.

To meet recognized safety standards, one common test is the "dielectric voltage-withstand test". Safety agencies which require compliance safety testing at both the initial product design stage and for routine production line testing include: Underwriters Laboratories, Inc. (UL), the Canadian Standards Association (CSA), the International Electrotechnical Commission (IEC), the British Standards Institution (BSI), the Association of German Electrical Engineers (VDE) and (TÜV), the Japanese Standards Association (JSI). These same agencies may also require that an insulation resistance test and high current ground bond test be performed.

1.5. The Different Types of Safety Tests

1.5.1 Dielectric Withstand Test
The principle behind a dielectric voltage - withstand test is simple. If a product will function when exposed to extremely adverse conditions, it can be assumed that the product will function in normal operating circumstances.

Common Applications of the Dielectric Withstand Test:

- Design (performance) testing: Determining design adequacy to meet service conditions.

- Production Line testing: Detecting defects in material or workmanship during processing.

- Acceptance testing: Proving minimum insulation requirements of purchased parts.
- Repair Service testing: Determine reliability and safety of equipment repairs.

The specific technique used to apply the dielectric voltage - withstand test to each product is different. During a dielectric voltage - withstand test, an electrical device is exposed to a voltage significantly higher than it normally encounters, for a specified duration of time.

During the test, all current flow from the high voltage output to the return is measured. If, during the time the component is tested, the current flow remains within specified limits, the device is assumed safe under normal conditions. The basic product design and use of the insulating material will protect the user against electrical shock.
The equipment used for this test, a dielectric-withstand tester, is often called a "hipot" (for high potential tester). The "rule of thumb" for testing is to subject the product to

twice its normal operating voltage, plus 1,000 volts.
However, specific products may be tested at much higher voltages than 2X operating voltages + 1,000 volts. For example, a product designed to operate in the range between 100 to 240 volts can be tested between 1,000 to 4,000 volts or higher. Most "double insulated" products are tested at voltages much higher than the "rule of thumb".

Testing during development and prototype stages is more stringent than production run tests because the basic design of the product is being evaluated. Design tests usually are performed on only a few samples of the product. Production tests are performed on every item as it comes off the production line.

The hipot tester must also maintain an output voltage between 100% and 120% of specification. The output voltage of the hipot must have a sinusoidal waveform with a frequency between 40 to 70 Hz and has a peak waveform value that is not less than 1.3 and not more than 1.5 times the root-mean-square value.

Types of Failures only detectable with a Hipot test

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

Dielectric Withstand Test; AC verses DC
Please check with the Compliance Agency you are working with to see which of the two types of voltages you are authorized to use. In some cases, a Compliance Agency will allow either AC or DC testing to be done. However, in other cases the Compliance Agency only allows for an AC test. If you are unsure which specification you must comply with please contact our CUSTOMER SUPPORT DEPT.

Many safety agency specifications allow either AC or DC voltages to be used during the hipot test. When this is the case, the manufacturer must make the decision on which type of voltage to utilize. In order to do this it is important to understand the advantages and the disadvantages of both AC and DC testing.

AC testing characteristics
Most items that are hipot tested have some amount of distributed capacitance. An AC voltage cannot charge this capacitance so it continually reads the reactive current that flows when AC is applied to a capacitive load.

AC testing advantages
AC testing is generally much more accepted by safety agencies than DC testing. The main reason for this is that most items being hipot tested will operate on AC voltages. AC hipot testing offers the advantage of stressing the insulation alternately in both polarities, which more closely simulates stresses the product will see in real use.

Since AC testing cannot charge a capacitive load the current reading remains consistent from initial application of the voltage to the end of the test. Therefore, there is no need to gradually bring up the voltage since there is no stabilization required to monitor the current reading. This means that unless the product is sensitive to a sudden application of voltage the operator can immediately apply full voltage and read current without any wait time.

Another advantage of AC testing is that since AC voltage cannot charge a load there is no need to discharge the item under test after the test.

AC testing disadvantages
One disadvantage of AC testing surfaces when testing capacitive products. Again, since AC cannot charge the item under test, reactive current is constantly flowing. In many cases, the reactive component of the current can be much greater than the real component due to actual leakage. This can make it very difficult to detect products that have excessively high leakage current.

Another disadvantage of AC testing is that the hipot has to have the capability of supplying reactive and leakage current continuously. This may require a current output that is actually much higher than is really required to monitor leakage current and in most cases is usually much higher than would be needed with DC testing. This can present increased safety risks as operators are exposed to higher currents.

DC testing characteristics
During DC hipot testing the item under test is charged. The same test item capacitance that causes reactive current in AC testing results in initial charging current which exponentially drops to zero in DC testing.

DC testing advantages
Once the item under test is fully charged, the only current flowing is true leakage current. This allows a DC hipot tester to clearly display only the true leakage of the product under test.

Another advantage to DC testing is that the charging current only needs to be applied momentarily. This means that the output power requirements of the DC hipot tester can typically be much less than what would be required in an AC tester to test the same product.

DC testing disadvantages
Unless the item being tested has virtually no capacitance, it is necessary to raise the voltage gradually from zero to the full test voltage. The more capacitive the item the more slowly the voltage must be raised. This is important since most DC hipots have failure shut off circuitry which will indicate failure almost immediately if the total current reaches the leakage threshold during the initial charging of the product under test.

Since a DC hipot does charge the item under test, it becomes necessary to discharge the item after the test.

DC testing unlike AC testing only charges the insulation in one polarity. This becomes a concern when testing products that will actually be used at AC voltages. This is an

important reason that some safety agencies do not accept DC testing as an alternative to AC.

When performing AC hipot tests the product under test is actually tested with peak voltages that the hipot meter does not display. This is not the case with DC testing since a sinewave is not generated when testing with direct current. In order to compensate for this most safety agencies require that the equivalent DC test be performed at higher voltages than the AC test. The multiplying factor is somewhat inconsistent between agencies which can cause confusion concerning exactly what equivalent DC test voltage is appropriate.

1.5.2 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.

1.5.3 Ground Bond Test

The Ground Bonding test determines whether the safety ground circuit of the product under test can adequately handle fault current if the product should ever become defective. A low impedance ground system is critical in ensuring that in case of a product failure, a circuit breaker on the input line will act quickly to protect the user from any serious electrical shock.

International compliance agencies such as CSA, IEC, TÜV, VDE, BABT and others, have requirements calling out this test. This test should not be confused with low current continuity tests that are also commonly called out in some safety agency specifications. A low current test merely indicates that there is a safety ground connection. It does not completely test the integrity of that connection.

Compliance agency requirements vary on how different products are to be tested. Most specifications call for test currents of between 10 and 40 amps. Test voltages at these currents are typically required to be less than 12 volts. Maximum allowable resistance readings of the safety ground circuit are normally between 100 and 200 milliohms.

If you are testing a product that is terminated in a three-prong plug, you are required to

perform a continuity or ground bond test on the ground conductor to the chassis or dead metal of the product.

1.5.4 Run Test

All manufacturers of a product that runs on line power normally need to run the DUT (Device Under Test) after final safety testing so that they can verify the functionality of their products. In addition to running the DUT to test its basic functionality many customers also require some basic test data to be recorded while the DUT is powered up. A Run Test System allows the product to be powered up immediately after the safety tests are completed with a single connection to the DUT. Measurements that are commonly made while the DUT is running can include Amperage, Voltage, Watts and Power Factor.

1.5.5 Touch Current Test

The Line Leakage test is one of many product safety tests that are normally specified for electrical products by safety testing agencies such as Underwriters Laboratories (UL) and the International Electrotechnical Committee (IEC). The line leakage specifications vary as well as the method in which the measurements are taken depending upon the application or function of a product and the standard to which the product is being tested.

Current Leakage or Line Leakage tests are general terms that actually describe three different types of tests. These tests are Earth Leakage Current, Enclosure Leakage Current, and Applied Part Leakage Current. The main differences in these tests are in the placement of the probe for the measuring device. The Earth Leakage Current is the leakage current that flows through the ground conductor in the line cord back to earth. The Enclosure Leakage Current is the current that flows from any enclosure part through a person back to ground if it were contacted by a person. The Applied Part Leakage Current or Patient Lead Leakage Current is any leakage that flows from an applied part, between applied parts or into an applied part. The Applied Part Leakage Current test is required only for medical equipment. All of these tests are used to determine if products can be safely operated or handled without posing a shock hazard to the user.

Line Leakage Testers provide the capability of meeting the line leakage test specified in the following standards; UL 544, IEC 950, UL 1950, IEC 601-1, UL 2601, UL 1563, UL 3101, IEC 1010 and others. The Line Leakage test, is a test which measures the leakage current of a product, through a circuit that is designed to simulate the impedance of the human body. The simulation circuit is called the Measuring Device (MD). The instrument has five different MD circuits, selectable through the menu, which are representative circuits designed to simulate the impedance of the human body under different conditions. The impedance of the human body will vary depending upon point of contact, the surface area of the contact and the path the current flows. For these reasons, the specifications of the Measuring Devices are different depending upon the type of test being performed as well as the maximum allowable leakage current. Leakage current measurements are performed on products under normal conditions and single fault conditions as well as reversed polarity. This simulates possible problems, which could occur if the product under test is faulted or misused while the product is operating under high line conditions (110%

of the highest input voltage rating of the product).
Line Leakage tests are normally specified as “Type Tests” or “Design Tests” which are performed during the development of the product. This helps verify that the design is safe but it does not guarantee the safety of the products being produced on the production line. The only way to be sure you are shipping safe products is to test each product at the end of the production line. The user may perform a Leakage Current test along with other common safety test such as Dielectric Withstand, Insulation Resistance, and Ground Bond on the production line with a single connection to the device under test.

1.6. Key Features and Benefits: ESA

COLOR TFT DISPLAY	800 x 480 color TFT display makes setting up test files, viewing results and performing tests easier than ever. Color coded test steps clearly indicate pass/fail conditions. Choose from 3 color schemes.
MY MENU INTERFACE	Personalize menu settings with the My Menu interface. Create shortcuts to your favorite screens and preferences.
DUAL CHEK	Perform simultaneous hipot and ground bond tests.
MULTIPLE LANGUAGE	View the menu in English or Chinese.
PHASE LOCK CAPABILITY	Matches the phase angle of the output waveform with the DUT’s power source for effective hot hipot testing.
EXPANDED TEST MEMORIES	Users can link a total of 10,000 test steps in any configuration.
PATENTED SMART GFI	SmartGFI™ disables the instrument’s output voltage in less than 1 millisecond if excessive leakage to ground is detected. If enabled, SmartGFI™ automatically detects if the DUT is floating or grounding and turns ON or OFF accordingly.
FOUR WIRE MEASUREMENT (KELVIN METHOD) AND MILLIOHM OFFSET CAPABILITY IN THE GROUND BOND MODE	The four-wire measurement technique factors out test lead resistance, making measurements more accurate. The Milliohm Offset features allows the operator to factor out additional lead and fixture resistance.
VERI-CHEK	Allows the operator to self-verify the instrument’s failure detectors.

2. Getting Started

This section contains information for the unpacking, inspection, preparation for use and storage of your EEC product.

2.1. Unpacking and Inspection

2.1.1 Packaging

Your instrument was shipped in a custom foam insulated container that complies with ASTM D4169-92a Assurance Level II Distribution Cycle 13 Performance Test Sequence

If the shipping carton is damaged, inspect the contents for visible damage such as dents, scratches or broken display. If the instrument is damaged, notify the carrier and EEC's customer support department. Please save the shipping carton and packing material for the carriers inspection. Our customer support department will assist you in the repair or replacement of your instrument. Please do not return your product without first notifying us .

- Please retain all of the original packaging materials.

2.1.2 Returning the Instrument

When it is necessary to return the instrument for servicing or calibration, repackage the instrument in its original container, please include all accessories and test leads. Indicate the nature of the problem or type of service needed. Also, please mark the container "FRAGILE" to insure proper handling.

If you do not have the original packaging materials, please follow these guidelines:

- Wrap the instrument in a bubble pack or similar foam. Enclose the same information as above.
- Use a strong double-wall container that is made for shipping instrumentation. 350 lb. test material is adequate.
- Use a layer of shock-absorbing material 70 to 100 mm (3 to 4 inch) thick around all sides of the instrument. Protect the control panel with cardboard.
- Seal the container securely.
- Mark the container "FRAGILE" to insure proper handling.

2.2. Installation

2.2.1 Work Area

WARNING 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. Make sure the work area you choose has a three-prong grounded outlet. Be sure the outlet has been tested for proper wiring before connecting the instrument to it.

2.2.2 Power Requirements

This instrument requires a power source of either 115 volts AC ± 15%, 50/60 Hz single phase or 230 volts AC ± 15%, 50/60 Hz single phase. Please check the rear panel to be sure the proper switch setting is selected for your line voltage requirements before

turning your instrument on. For operation at 115 and 230 Volts AC use a 10 A, 250VAC slow-blow fuse. ESA series max. rated power is 750VA.

CAUTION Do not switch the line voltage selector switch located on the rear panel while the instrument is on or operating. This may cause internal damage and represents a safety risk to the operator.

2.2.3 Basic Connections

Power Cable

WARNING Before connecting power to this instrument, the protective ground (Earth) terminals of this instrument must be connected to the protective conductor of the line (mains) power cord. The main plug shall only be inserted in a socket outlet (receptacle) provided with a protective ground (earth) contact. This protective ground (earth) **must not be defeated** by the use of an extension cord without a protective conductor (grounding).

The instrument is shipped with a three-wire power cable. When the cable is connected to an appropriate AC power source, the cable will connect the chassis to earth ground. The type of power cable shipped with each instrument depends on the country of destination.

Return Connection

CAUTION The output power supplies of this instrument are referenced directly to earth ground. Any conductor that completes a path between the high voltage and earth ground will form a completed circuit.

When the instrument Return is grounded, any internal and external stray leakage will be monitored due to currents that flow from High Voltage to earth ground (such as from HV to the chassis of the instrument). This current is inherent and will cause errors when trying to monitor very low leakage currents in the micoamp range.

2.2.4 Environmental Conditions

This instrument may be operated in environments with the following limits:

Temperature…….. 0° - 40° C
Relative humidity ……20 - 80%
Altitude ……6,560 feet (2,000 meters)

Storage and Shipping Environment

This instrument may be stored or shipped in environments with the following limits:

Temperature.....- -40°- 75°C
Altitude.....25000 feet (7,620 meters)

The instrument should also be protected against temperature extremes that may cause condensation within the instrument.

Ventilation: Do not block any ventilation openings, insure that there is at least 6 inches (15 cm) of space from the rear panel to any wall or obstruction behind the unit.

3. Specifications and Controls

3.1. ESA Functional Specifications

MODEL	ESA-140		ESA-150*1
AC WITHSTAND VOLTAGE			
Output Rating	5kVac / 50mAac		5kVac / 100mAac
	Range	Resolution	Accuracy
Output Voltage, Vac	0 - 5000	1	± (1.5% of setting + 5V)
Output Voltage, Vac (Opt.770)	0 - 5000	1	± (2.5% of setting + 10V)
Output Frequency, Hz	50 / 60 ±0.1%		
Output Waveform	Sine Wave, Crest Factor = 1.3 - 1.5		
Output Regulation	± (1% of output + 5V), From no load to full load and Low Line to High Line (combined regulation)		
SETTINGS			
HI and LO-Limit (Total) current, mAac	0.000 - 9.999	0.001	± (2% of setting + 2 counts)
	10.00 - 50.00 (for ESA-140)	0.01	
	10.00 - 100.00 (for ESA-150)		
HI and LO-Limit (Real) current, mAac	0.000 - 9.999	0.001	± (3% of setting + 50µA)
	10.00 - 50.00 (for ESA-140)	0.01	
	10.00 - 99.99 (for ESA-150)		
Ramp Up Timer, second	0.1 - 999.9	0.1	± (0.1% of setting + 0.05s)
Ramp Down Timer, second	0.0 - 999.9		
Dwell Timer, second	0, 0.3 - 999.9 (0 = continuous)		
Ground Continuity	Current: DC 0.1 A ± 0.01A, fixed Max. Ground Resistance: 1.0 Ω ± 0.1Ω		
Current Offset	0.000 - 50.00mA (Total current + current offset ≤ 50mA) for ESA-140 0.000 - 99.99mA (Total current + current offset ≤ 100mA) for ESA-150		
Arc Detection	The range is from 1 - 9 (9 is the most sensitive)		
DC WITHSTAND VOLTAGE			
Output Voltage, Vdc	0 - 6000	1	± (1.5% of setting + 5V)
DC Output Ripple	< 4% (6kV/20mAdc at Resistive Load)		
SETTINGS			
HI and LO - Limit current, µAdc	0.0 - 999.9	0.1	± (2% of setting + 2 counts)
	1000 - 20000	1	
Ramp Up Timer, second	0.4 - 999.9	0.1	± (0.1% of setting + 0.05s)
Ramp Down Timer, second	0.0, 1.0 - 999.9		
Dwell Timer, second	0, 0.3 - 999.9 (0 = continuous)		
Ramp-HI current	> 20mApeak maximum, ON / OFF User Selectable		
Charge LO currentt, µAdc	0.0 - 350.0		
Discharge Time	0.05uF / 10ms		
Maximum Capacitive Load	1µF < 1kV, 0.08µF < 4kV		
	0.75µF < 2kV, 0.04µF < 5kV		

DC Mode	0.5µF < 3kV		
Ground Continuity	Current: DC 0.1 A ± 0.01A, fixed Max. Ground Resistance: 1.0 Ω ± 0.1Ω		
Current Offset	0.0 - 20000uA (Total current + current offset ≤ 20mA)		
Arc Detection	The range is from 1 - 9 (9 is the most sensitive)		
INSULATION RESISTANCE			
Output Voltage, Vdc	30 - 1000	1	± (1.5% of setting + 2 counts)
Charging Current	Maximum > 20mApeak		
SETTINGS			
HI and LO-Limit resistance, MΩ	0.05 - 99.99 (HI-Limit: 0 = OFF)	0.01	0.05 - 999.9, ± (2% of setting + 2 counts)
	100.0 - 999.9	0.1	1000 - 9999, ± (5% of setting + 2 counts)
	1000 - 50000	1	10000 - 50000, ± (15% of setting + 2 counts)
Ramp Up Timer, second	0.1 - 999.9	0.1	± (0.1% of setting + 0.05s)
Ramp Down Timer, second	0.0 , 1.0 - 999.9		
Dwell Timer, second	0, 0.5 - 999.9 (0 = continuous)		
Delay Timer, second	0.5 - 999.9		
Charge LO current, µAdc	0.000 - 3.500		
GROUND BOND			
Output AC Current, Aac	1.00 - 40.00	0.01	± (2% of setting + 2 counts)
Output Voltage, Vac	3.00 - 8.00	0.01	± (2% of setting + 3 counts)
Output Frequency, Hz	50 / 60 ± 0.1%		
Output Regulation	± (1% of output + 0.02A), Within maximum load limits, and over input voltage range		
Maximum Loading	1.00 - 10.00A / 0 - 600mΩ, 10.01 - 30.00A / 0 - 200mΩ, 30.01 - 40.00A / 0 - 150mΩ		
SETTINGS			
Lead Resistance Offset, mΩ	0 - 200	1	± (2% of setting + 2 counts)
HI and LO-Limit Resistance, mΩ	0 - 150 (30.01 - 40.00A)	1	6.00 - 40A, ± (2% of setting + 2 counts)
	0 - 200 (10.01 - 30.00A)		
	0 - 600 (6.00 - 10.00A)		
	0 - 600 (1.00 - 5.99A)		1.00 - 5.99A, ± (3% of setting + 3 counts)
Dwell Timer, second	0, 0.5 - 999.9 (0 = continuous)	0.1	± (0.1% of setting + 0.05s)
CONTINUITY TEST			
Output Current	0.1A for 0 - 10.00Ω, 0.01A for 10.1 - 100.0Ω, 0.001A for 101 - 1000Ω, 0.0001A for 1001 - 10000, 0.1A is Max.		
SETTINGS			
Max and Min - Limit Resistance ,Ω	0.00 - 10.00	0.01	± (1% of setting + 3 counts)
	10.1 - 100.0	0.1	
	101 - 1000	1	
	1001 - 10000	1	± (1% of setting + 10 counts)
Dwell Timer, second	0.0, 0.3 - 999.9 (0 = continuous)	0.1	± (0.1% of setting + 0.05s)
Resistance Offset, Ω	0.00 - 10.00	0.01	± (1% of reading + 3 counts)

MEASUREMENT				
	Range		Resolution	Accuracy
Voltage, kV (AC / DC)	0.00 - 6.00		0.01	±(1.5% of reading) ≥ 500V ±(1.5% of reading + 1 count) < 500V
Voltage, Vdc (IR only)	0 - 1000		1	± (1.5% of reading + 2 counts)
AC Current (Total), mAac	0.000 - 3.500		0.001	± (2% of reading + 2 counts)
	3.00 - 100.00		0.01	
AC Current (Real), mAac	0.000 - 9.999		0.001	± (3% of reading + 50µA) All Ranges PF > 0.1, V > 250Vac
	10.00 - 99.99		0.01	
DC Current, µAdc	0.0 - 350.0		0.1	± (2% of reading + 2 counts)
DC Current, mAdc	0.300 - 3.500		0.001	
	3.00 - 20.00		0.01	
AC Current, Aac (GB)	0.00 - 40.00		0.01	± (3% of reading + 3 counts)
Resistance, MΩ (IR)	30 - 499Vdc	500 - 1000Vdc		30 - 499V 0.05 - 999.9, ± (7% of reading + 2 counts) 500 - 1000V 0.05 - 999.9, ±(2% of reading + 2 counts) 1000 - 9999, ±(5% of reading + 2 counts) 10000 - 50000, ±(15% of reading + 2 counts)
	0.050 - 1.999	0.050 - 9.999	0.001	
	2.00 - 19.99	10.00 - 99.99	0.01	
	20.0 - 199.9	100.0 - 999.9	0.1	
	200 - 50000	1000 - 50000	1	
Resistance, mΩ (GB)	0 - 600		1	1.00 - 2.99 A, ± (3% of reading + 3 counts) 3.00 - 40.00 A, ± (2% of reading + 2 counts)
Resistance, Ω (Continuity)	0.00 - 10.00		0.01	± (1 % of reading + 3 counts)
	10.1 - 100.0		0.1	
	101 - 1000		1	
	1001 - 10000		1	± (1 % of reading + 10 counts)

GENERAL	
Input Voltage AC	115/230Vac±15% auto range, 50 / 60Hz ± 5%, 5Aac / 250Vac Slow-Blow for ESA-140, 10Aac / 250Vac Slow-Blow for ESA-150
PLC Remote Control	Input : Test, Reset, Interlock, Recall File 1 through 3, Recall File 1 through 7 Output: Pass, Fail, Test-in-Process
Memory	It has 10000 steps and allow the user to create different memories and steps
TFT LCD	800 x 480 resolution digital TFT LCD and 9 ranges contrast setting
DualCHEK	5kVac / 25mAac and 25Aac / 150mΩ for ESA-140 5kVac / 50mAac and 30Aac / 150mΩ for ESA-150
Safety	Built-in Smart GFI circuit,GFI trip current 5.0mA max., HV shut down speed: <1mS (on 50/60Hz and test under 1000V)
Hot Hipot Tests	To detect the line input voltage to produce a simultaneous sine wave of line power at hipot output
MyMenu	The menu can be customized and created the most favorite used functions by the user
Interface	Standard USB & RS232 PC Control Card, Optional Ethernet, GPIB (IEEE-488.2), Multi-function Interface card (USB-A / RS-485 / RS-232 / BAR Code PS / 2 type)
Multinational Language	English / Traditional Chinese / Simplified Chinese
Alarm Volume Setting	Range: 0 - 9; 0 = OFF, 1 is softest volume, 9 is loudest volume.

Calibration	Adjustments can be made through the front panel		
Environment	0 - 40ºC, 20 - 80%RH		
Dimensions / Net Weight	430mm(W) × 133mm(H) × 500 mm(D) / 30kg		
STANDARD ACCESSORIES			
Power Cord (10A)	x 1		
Fuses	x 2 (Including a spare contained in the fuse holder)		
Interlock Disable Key (1505)	x 1		
Hipot Test Lead, 1.5m (1101)	x 1		
Ground Bond Test Lead 40A ,1.6m (1137)	x 1		
Ground Bond Return Lead 40A ,1.6m (1138)	x 1		
USB Link Cable, 1.8m	x 1		
3U Rack Mount Bracket	x 2		
3U Rack Mount Handle	x 2		
OPTION			
MATRIX SCANNER (for Opt.794)			
High Voltage Rating	5kVac / 6kVdc		
High Current Rating	40A		
Number of HV Channel	8		
Number of HA Channel	8		
Point to Point Continuity	To use the scanner to reach point to point continuity test and this function will be a standard feature when built-in scanner is added		
RUN TEST (for Opt.767, Opt.768, Opt.769)			
DUT POWER			
AC Voltage, Vac	0 - 277.0V, Single phase unblance		
Current, Aac	16		
Power, W	4500		
Short Circuit Protection	23Arms or Inrush Current 68Apeak, Response time RMS < 3 sec ; Peak < 10uS		
SETTINGS			
HI and LO-Limit AC Voltage, Vac	30.0 - 277.0	0.1	± (1.5% of setting + 0.2V)
HI and LO-Limit AC Current, Aac	0.00 - 16.00	0.01	± (2% of setting + 2 counts)
HI and LO-Limit AC Power, W	0 - 4500	1	± (5% of setting + 3 counts)
HI and LO-Limit Power Factor	0.000 - 1.000	0.001	± (8% of setting + 2 counts)
HI and LO-Limit Leakage Current	0.00 - 10.00 Hi-Limit: 0 = OFF	0.01	± (2% of setting + 2 counts)
Delay Time, second	0.2 - 999.9	0.1	± (0.1% + 0.05s)
Dwell Time, second	0, 0.1 - 999.9 (0 = continuous)		
MEASUREMENT			
	Range	Resolution	Accuracy
Voltage, Vac	0.0 - 277.0	0.1	± (1.5% of reading + 2counts) at 30 - 277V
Current, Aac	0.00 - 16.00	0.01	± (2% of reading + 2 counts)
Power, Watts	0 - 4500	1	± (5% of reading + 3 counts)
Power Factor	0.000 - 1.000	0.001	± (8% of reading + 2 counts)

Leakage Current, mA	0.00 - 10.00		0.01	± (2% of reading + 2 counts)
MD	Leakage current measuring resistor = 2kΩ ± 1%			
TOUCH CURRENT TEST (for Opt.768, Opt.769)				
DUT				
DUT Input Power Rating	0 - 277V,AC@ 16Aac max			
Current, Aac	16A			
Short Circuit Protection	23Arms or Inrush Current 68Apeak, Response time RMS < 3 sec ; Peak < 10uS			
SETTINGS				
Leakage HI and LO-Limit (RMS), µAac	Range	0.0 - 999.9µA (0 = OFF)	Resolution	0.1µA
		1000 - 10000uA		1µA
Leakage HI and LO-Limit (peak), µAac	Range	0.0 - 999.9µA (0 = OFF)	Resolution	0.1µA
		1000 - 10000uA		1µA
Dwell Time, second	0, 0.5 - 999.9 for AC+DC 0.1 - 999.9 for AC / DC only) (0 = continuous)		0.1	± (0.1% + 0.05s)
Delay Time, second	0.5 - 999.9 for AC+ DC 1.8-999.9 for AC / DC only (Auto range) 1.3-999.9 for AC / DC only (Fixed range)			
Measuring Device (MD)	A. UL544 Non Patient, UL484, IEC60598, UL1363,UL923, UL471, UL867, UL697			
	B. UL544 Patient Care			
	C. UL2601-1, IEC60601-1, EN60601-1			
	D. UL1563			
	E. IEC60990 Fig4 U2, IEC 60950-1, IEC60335-1, IEC60598-1, UL484, IEC60065, IEC61010,IEC60065			
	F. IEC60990 Fig5 U3, IEC60598-1			
	G. Basic measuring element 1k ohm of frequency check			
MD A - G components	Resistance accuracy: ± 1%, Capacitance accuracy: ± 1%			
MD Voltage Limit	Maximum 30V peak or 30Vdc			
Probe settings	G-L, PH-PL, PH-L (Use HV relay and HV terminal connector)			
Internal Leakage	1. Internal Leakage current = 65uA, 2. 277V applied to Ph max leakage current = 70uA.			
External MD	User can add one extra MD for his application.			
Current Measurement	The leakage current is fitting range by leakage current Hi-limit setting value			
Frequency Range	DC, 15Hz≤ F ≤ 1MHz			
Leakage Current Range (RMS)				
Auto Range	MD Major Resistance is 0.5kΩ		MD Major Resistance is 1kΩ	MD Major Resistance is 1.5kΩ
Range 1	0.0uA - 64.0uA		0.0uA - 32.0uA	0.0uA - 22.0uA
Range 2	56.0uA - 260.0uA		28.0uA - 130.0uA	18.3uA - 85.0uA
Range 3	240.0uA - 999.9uA, 1000uA - 1050uA		120.0uA - 525.0uA	80.0uA - 350.0uA
Range 4	800.0uA - 999.9uA, 1000 - 4200uA		400.0uA - 999.9uA, 1000uA - 2100uA	266.6uA - 999.9uA, 1000uA - 1400uA
Range 5	3600uA - 8399uA, 8.4mA - 10.00mA		1800uA - 8400uA	1200uA - 5600uA
Range 6	NA		8000uA - 8399uA, 8.40mA - 10.00mA	5300uA - 8399uA, 8.40mA - 10.00mA

Fixed Range > 6% of Range	MD Major Resistance is 0.5kΩ	MD Major Resistance is 1kΩ	MD Major Resistance is 1.5kΩ
Range 1	0.0uA - 64.0uA	0.0uA - 32.0uA	0.0uA - 22.0uA
Range 2	15.6uA - 260.0uA	7.8uA - 130.0uA	5.1uA - 85.0uA
Range 3	63uA - 1050uA	31.5uA - 525.0uA	21.0uA - 350.0uA
Range 4	252uA - 4200uA	126uA - 2100uA	84uA - 1400uA
Range 5	600uA - 8399uA, 8.4mA - 10.00mA	504uA - 8400uA	336uA - 5600uA
Range 6	600uA - 8399uA, 8.40mA - 10.00mA	600uA - 8399uA, 8.40mA - 10.00mA	600uA~8399uA, 8.40mA~10.00mA
Fixed Range < 6% of Range	**MD Major Resistance is 0.5kΩ**	**MD Major Resistance is 1kΩ**	**MD Major Resistance is 1.5kΩ**
Range 1	NA	NA	NA
Range 2	0.0uA - 15.6uA	0.0uA - 7.8uA	0.0uA - 5.1uA
Range 3	0uA - 63uA	0.0uA - 31.5uA	0.0uA - 21.0uA
Range 4	0uA - 252uA	0uA - 126uA	0uA - 84uA
Range 5	0uA - 600uA	0uA - 504uA	0uA - 336uA
Range 6	0uA - 600uA	0uA - 600uA	0uA - 600uA

Resolution	
Auto Range, Fixed Range 1 - 2, Fixed Range 3 (1k&1.5k MD)	0.1uA (*< 1000uA), 1uA (1000uA < * < 8400uA), 0.01mA (* > 8400uA)
Fixed Range 3 (0.5k MD), Fixed Range 4 - 6	1uA (* < 8400uA), 0.01mA(* > 8400uA)

Accuracy For Auto Range			
Range	Mode	Frequency	Basic Accuracy
Range 1 - 5[*1]	AC + DC	DC	± (2% of reading + 3 counts)
		15Hz < f <100kHz	± (2% of reading + 3 counts)
		100kHz ≤ f ≤ 1MHz	± (5% of reading) > 10.0uA
	AC only[*2]	15Hz < f <30Hz	± (3% of reading + 5 counts)
		30Hz < f <100kHz	± (2% of reading + 3 counts)
		100kHz < f < 1MHz	± (5% of reading) > 10.0uA
	DC only[*3]	DC	± (2% of reading + 3 counts) > 10.0uA
Range 6[*1]	AC + DC	DC	± (5% of reading) > 10.0uA
		15Hz < f <100kHz	
	AC only[*2]	15Hz < f <30Hz	
		30Hz < f <100kHz	
	DC only[*3]	DC	

Accuracy For Fixed Range				
Range	Mode	Frequency	Basic Accuracy(> 6% of Range)	Additional Error(< 6% of Range)
Range 1 - 5[*1]	AC + DC	DC	± (2% of reading + 3 counts)	add (2% of reading + 0.2% of range)
		15Hz < f <100kHz	± (2% of reading + 3 counts)	add (2% of reading + 0.2% of range)
		100kHz ≤ f ≤ 1MHz	± (5% of reading) > 10.0uA	add (2% of reading + 0.5% of range)

	AC only*2	15Hz < f <30Hz	± (3% of reading + 5 counts)	add (2% of reading + 0.2% of range)
		30Hz < f <100kHz	± (2% of reading + 3 counts)	add (2% of reading + 0.2% of range)
		100kHz < f < 1MHz	± (5% of reading) >10.0uA	add (2% of reading + 0.5% of range)
	DC only*3	DC	± (2% of reading + 3 counts) > 10.0uA	add (2% of reading + 0.2% of range)
Range 6*1	AC + DC	DC,	±5% of reading (> 10.0uA)	add (2% of reading + 0.2% of range)
		15Hz < f <100kHz		
	AC only*2	15Hz < f <30Hz		
		30Hz < f <100kHz		
	DC only*3	DC		

Leakage Current Range (PEAK)			
Auto Range	MD Major Resistance is 0.5kΩ	MD Major Resistance is 1kΩ	MD Major Resistance is 1.5kΩ
Range 1	0.0uA - 64.0uA	0.0uA - 32.0uA	0.0uA - 22.0uA
Range 2	56.0uA - 260.0uA	28.0uA - 130.0uA	18.3uA - 85.0uA
Range 3	240.0uA - 999.9uA, 1000uA - 1050uA	120.0uA - 525.0uA	80.0uA - 350.0uA
Range 4	800.0uA - 999.9uA, 1000 - 4200uA	400.0uA - 999.9uA, 1000uA - 2100uA	266.6uA - 999.9uA, 1000uA - 1400uA
Range 5	3600uA - 8399uA, 8.4mA - 10.00mA	1800uA - 8400uA	1200uA - 5600uA
Range 6	NA	8000uA - 8399uA, 8.40mA - 10.00mA	5300uA - 8399uA, 8.40mA - 10.00mA
Fixed Range > 6% of Range	MD Major Resistance is 0.5kΩ	MD Major Resistance is 1kΩ	MD Major Resistance is 1.5kΩ
Range 1	0.0uA - 64.0uA	0.0uA - 32.0uA	0.0uA - 22.0uA
Range 2	15.6uA - 260.0uA	7.8uA - 130.0uA	5.1uA - 85.0uA
Range 3	63uA - 1050uA	31.5uA - 525.0uA	21.0uA - 350.0uA
Range 4	252uA - 4200uA	126uA - 2100uA	84uA - 1400uA
Range 5	600uA - 8399uA, 8.4mA - 10.00mA	504uA - 8400uA	336uA - 5600uA
Range 6	600uA - 8399uA, 8.40mA - 10.00mA	1200uA - 8399uA, 8.40mA - 10.00mA	1200uA - 8399uA, 8.40mA - 10.00mA
Fixed Range < 6% of Range	MD Major Resistance is 0.5kΩ	MD Major Resistance is 1kΩ	MD Major Resistance is 1.5kΩ
Range 1	NA	NA	NA
Range 2	0.0uA - 15.6uA	0.0uA - 7.8uA	0.0uA - 5.1uA
Range 3	0uA - 63uA	0.0uA - 31.5uA	0.0uA - 21.0uA
Range 4	0uA - 252uA	0uA - 126uA	0uA - 84uA
Range 5	0uA - 600uA	0uA - 504uA	0uA - 336uA
Range 6	0uA - 600uA	0uA - 600uA	0uA - 600uA

Resolution	
Auto Range, Fixed Range 1 - 2, Fixed Range 3 (1k & 1.5k MD)	0.1uA (* < 1000uA), 1uA (1000uA < * < 8400uA), 0.01mA (* > 8400uA)
Fixed Range 3 (0.5k MD), Fixed Range 4 - 6	1uA (* < 8400uA), 0.01mA(* > 8400uA)
Accuracy For Auto Range	

Range	Mode	Frequency	Basic Accuracy
Range 1 - 5*1	AC + DC	DC	± (2% of reading + 2uA)
		15Hz ≤ f ≤ 1MHz	± (10% of reading + 2uA)
	AC only*2	15Hz < f < 1MHz	± (10% of reading + 2uA)
Range 6*1	AC + DC	DC,	± (2% of reading+ 3 count)
		15Hz < f <100kHz	± (10% of reading+ 2 counts)
	AC only*2	15Hz < f <100kHz	± (10% of reading + 2 counts)

Accuracy For Fixed Range				
Range	Mode	Frequency	Basic Accuracy(> 6% of Range)	Additional Error(<6 % of Range)
Range 1 - 5*1	AC + DC	DC	± (2% of reading + 2uA)	add (2% of reading + 0.2% of range)
		15Hz < f <100kHz	± (10% of reading + 2uA)	add (2% of reading + 0.2% of range)
		100kHz ≤ f ≤ 1MHz	± (10% of reading +2uA)	add (2% of reading + 0.5% of range)
	AC only*2	15Hz < f <100kHz	± (10% of reading + 2uA)	add (2% of reading + 0.2% of range)
		100kHz < f < 1MHz	± (10% of reading +2uA)	add (2% of reading + 0.5% of range)
Range 6*1	AC + DC	DC	± (2% of reading + 3counts)	add (2% of reading + 0.2% of range)
		15Hz < f <100kHz	± (10% of reading + 2counts)	
	AC only*2	15Hz < f <100kHz	± (10% of reading +2counts)	

Leakage Voltage Range (RMS)			
Auto Range	MD Major Resistance is 0.5kΩ	MD Major Resistance is 1kΩ	MD Major Resistance is 1.5kΩ
Range 1	0.0mV - 32.0mV	0.0mV - 32.0mV	0.0mV - 32.0mV
Range 2	28.0mV - 130.0mV	28.0mV - 130.0mV	28.0mV - 130.0mV
Range 3	120.0mV - 525.0mV	120.0mV - 525.0mV	120.0mV - 525.0mV
Range 4	400.0mV - 999.9mV, 1000mV - 2100mV	400.0mV - 999.9mV, 1000mV - 2100mV	400.0mV - 999.9mV, 1000mV - 2100mV
Range 5	1800mV - 5000mV	1800mV - 8400mV	1800mV - 8400mV
Range 6	NA	8000mV - 8399mV, 8.40V - 10.00V	8000mV - 8399mV, 8.40V - 15.00V
Fixed Range > 6% of Range	MD Major Resistance is 0.5kΩ	MD Major Resistance is 1kΩ	MD Major Resistance is 1.5kΩ
Range 1	0.0mV - 32.0mV	0.0mV - 32.0mV	0.0mV - 32.0mV
Range 2	7.8mV - 130.0mV	7.8mV - 130.0mV	7.8mV - 130.0mV
Range 3	31.5mV - 525.0mV	31.5mV - 525.0mV	31.5mV - 525.0mV
Range 4	126mV - 2100mV	126mV - 2100mV	126mV - 2100mV
Range 5	300mV - 5000mV	504mV - 8400mV	504mV - 8400mV
Range 6	300mV - 5000mV	600mV - 8399mV, 8.40V - 10.00V	900mV - 8399mV, 8.40V - 15.00V
Fixed Range < 6% of Range	MD Major Resistance is 0.5kΩ	MD Major Resistance is 1kΩ	MD Major Resistance is 1.5kΩ
Range 1	NA	NA	NA
Range 2	0.0mV - 7.8mV	0.0mV - 7.8mV	0.0mV - 7.8mV
Range 3	0.0mV - 31.5mV	0.0mV - 31.5mV	0.0mV - 31.5mV
Range 4	0mV - 126mV	0mV - 126mV	0mV - 126mV

Range 5	0mV - 300mV		0mV - 504mV	0mV - 504mV
Range 6	0mV - 300mV		0mV - 600mV	0mV - 900mV
Resolution				
Auto Range, Fixed Range 1 - 2, Fixed Range 3 (1k & 1.5k MD)	0.1mV(* < 1000mV), 1mV (1000mV < * < 8400mV), 0.01V (* > 8400mV)			
Fixed Range 3 (0.5k MD), Fixed Range 4 - 6	1mV (* < 8400mV), 0.01V (* > 8400mV)			
Accuracy For Auto Range				
Range	Mode	Frequency	Basic Accuracy	
Range 1~5*1	AC + DC	DC	± (2% of reading + 3 counts)	
		15Hz < f <100kHz	± (2% of reading + 3 counts)	
		100kHz ≤ f ≤ 1MHz	± (5% of reading) > 10.0mV	
	AC only*2	15Hz < f <30Hz	± (3% of reading + 5 counts)	
		30Hz < f <100kHz	± (2% of reading + 3 counts)	
		100kHz < f < 1MHz	± (5% of reading) > 10.0mV	
	DC only*3	DC	± (2% of reading + 3 counts) > 10.0mV	
Range 6*1	AC + DC	DC	± (5% of reading) > 10.0mV	
		15Hz < f <100kHz		
	AC only*2	15Hz < f <30Hz		
		30Hz < f <100kHz		
	DC only*3	DC		
Accuracy For Fixed Range				
Range	Mode	Frequency	Basic Accuracy(>6% of Range)	Additional Error(<6% of Range)
Range 1~5*1	AC + DC	DC	±(2% of reading + 3 counts)	add (2% of reading + 0.2% of range)
		15Hz < f <100kHz	± (2% of reading + 3 counts)	add (2% of reading + 0.2% of range)
		100kHz ≤ f ≤ 1MHz	± (5% of reading) > 10.0mV	add (2% of reading + 0.5% of range)
	AC only*2	15Hz < f <30Hz	± (3% of reading + 5 counts)	add (2% of reading + 0.2% of range)
		30Hz < f <100kHz	± (2% of reading + 3 counts)	add (2% of reading + 0.2% of range)
		100kHz < f < 1MHz	± (5% of reading) > 10.0mV	add (2% of reading + 0.5% of range)
	DC only*3	DC	± (2% of reading + 3 counts) >10.0mV	add (2% of reading + 0.2% of range)
Range 6*1	AC + DC	DC	±5% of reading (>10.0mV)	add (2% of reading + 0.2% of range)
		15Hz < f <100kHz		
	AC only*2	15Hz < f <30Hz		
		30Hz < f <100kHz		
	DC only*3	DC		
Leakage Voltage Range (Peak)				
Auto Range	MD Major Resistance is 0.5kΩ		MD Major Resistance is 1kΩ	MD Major Resistance is 1.5kΩ

Range 1	0.0mV - 32.0mV	0.0mV - 32.0mV	0.0mV - 32.0mV
Range 2	28.0mV - 130.0mV	28.0mV - 130.0mV	28.0mV - 130.0mV
Range 3	120.0mV - 525.0mV	120.0mV - 525.0mV	120.0mV - 525.0mV
Range 4	400.0mV - 999.9mV, 1000mV - 2100mV	400.0mV - 999.9mV, 1000mV - 2100mV	400.0mV - 999.9mV, 1000mV - 2100mV
Range 5	1800mV - 5000mV	1800mV - 8400mV	1800mV - 8400mV
Range 6	NA	8000mV - 8399mV, 8.40V - 10.00V	8000mV - 8399mV, 8.40V - 15.00V
Fixed Range > 6% of Range	MD Major Resistance is 0.5kΩ	MD Major Resistance is 1kΩ	MD Major Resistance is 1.5kΩ
Range 1	0.0mV - 32.0mV	0.0mV - 32.0mV	0.0mV - 32.0mV
Range 2	7.8mV - 130.0mV	7.8mV - 130.0mV	7.8mV - 130.0mV
Range 3	31.5mV - 525.0mV	31.5mV - 525.0mV	31.5mV - 525.0mV
Range 4	126mV - 2100mV	126mV - 2100mV	126mV - 2100mV
Range 5	300mV - 5000mV	504mV - 8400mV	504mV - 8400mV
Range 6	300mV - 5000mV	600mV - 8399mV, 8.40V - 10.00V	900mV - 8399mV, 8.40V - 15.00V
Fixed Range < 6% of Range	MD Major Resistance is 0.5kΩ	MD Major Resistance is 1kΩ	MD Major Resistance is 1.5kΩ
Range 1	NA	NA	NA
Range 2	0.0mV - 7.8mV	0.0mV - 7.8mV	0.0mV - 7.8mV
Range 3	0.0mV - 31.5mV	0.0mV - 31.5mV	0.0mV - 31.5mV
Range 4	0mV - 126mV	0mV - 126mV	0mV - 126mV
Range 5	0mV - 300mV	0mV - 504mV	0mV - 504mV
Range 6	0mV - 300mV	0mV - 600mV	0mV - 900mV

Resolution	
Auto Range, Fixed Range 1 - 2, Fixed Range 3 (1k & 1.5k MD)	0.1mV(* < 1000mV), 1mV (1000mV < * < 8400mV), 0.01V (* > 8400mV)
Fixed Range 3 (0.5k MD), Fixed Range 4 - 6	1mV (* < 8400mV), 0.01V (* > 8400mV)

Accuracy For Auto Range			
Range	Mode	Frequency	Basic Accuracy
Range 1~5*1	AC + DC	DC	± (2% of reading + 2mV)
		15Hz ≤ f ≤ 1MHz	± (10% of reading +2mV)
	AC only*2	15Hz < f < 1MHz	± (10% of reading +2mV)
Range 6*1	AC + DC	DC	± (2% of reading + 3 counts)
		15Hz < f <100kHz	± (10% of reading +2 counts)
	AC only*2	15Hz < f <100kHz	± (10% of reading +2 counts)

Accuracy For Fixed Range				
Range	Mode	Frequency	Basic Accuracy(> 6% of Range)	Additional Error(< 6% of Range)
Range 1~5*1	AC + DC	DC	± (2% of reading + 2mV)	add (2% of reading + 0.2% of range)
		15Hz < f <100kHz	± (10% of reading + 2mV)	add (2% of reading + 0.2% of range)
		100kHz ≤ f ≤ 1MHz	± (10% of reading +2mV)	add (2% of reading + 0.5% of range)
	AC only*2	15Hz < f	± (10% of reading +	add (2% of reading + 0.2% of

		<100kHz	2mV)	range)
		100kHz < f < 1MHz	± (10% of reading 2mV)	add (2% of reading + 0.5% of range)
Range 6*1	AC + DC	DC	± (2% of reading +3 counts)	add (2% of reading + 0.2% of range)
		15Hz < f <100kHz	± (10% of reading +2 counts)	
	AC only*2	15Hz < f <100kHz	± (10% of reading +2 counts)	
To explain with notes for leakage				
*1. If the final measured signal is > range 5, then the maximum composite signal can be measured is 28 volts peak. If the final measured signal is ≤ range 5, then the maximum composite signal can be measured is 12 volts peak.				
*2.AC cutoff frequency for High Pass Filter is 15Hz on AC only mode。				
*3.AC cutoff frequency for Low Pass Filter is 15Hz on DC only mode。				
Leakage Imax Range				
The specification is as same as leakage current(RMS)				
The specification is as same as leakage current(Peak)				
Line Voltage Measurement				
Range	0.0 - 277.0 Vac			
Resolution	0.1 V			
Accuracy	± (1.5% of reading +0.2V), at 30.0 - 277.0V			
GENERAL				
Continous Power Output selection (like Continuous Run) for both LLT and Run testing.	To create continnuous parameter selection for both TCT and RUN testing. When continuous = ON, the power is not shut down between steps. But in the TCT mode when the steps setting are different than line condition, DUT output will momentary power off 25ms then power on.			
AC SOURCE (for Opt.769)				
Power, VA	500VA Maximum			
Voltage, Vac	0 - 150.0V / 0 - 277.0V			
Current, Aac	4.2 / 2.1			

*product specifications are subject to change without notice.
*1 ESA-150 short circuit current > 200mA

Ordering Information

Opt.731 GPIB Interface Card

Opt.751 Multi-function Interface Card

Opt.758 Ethernet Card

Opt.763 USB & RS232 PC Control Card

Opt.768 Run Test + TCT

Opt.769 Run Test + TCT+ AC Source

Opt.770 Output 400/800Hz for ACW

Opt.771 External HV (P-G/S-G/P-S) for Opt.767, Opt.768 or Opt.769

Opt.772 AC / DC / AC + DC Touch Current Measurement for Opt.768 or Opt.769

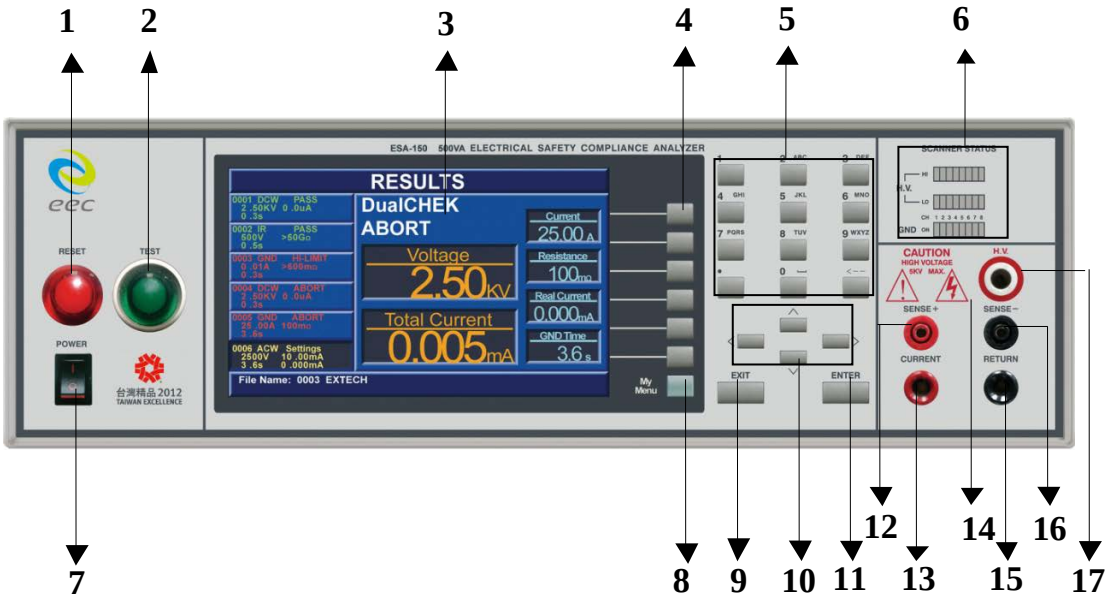
Opt.773 Power Control for Opt.767, Opt.768 or Opt.769

Opt.774 Cold Resistance for Opt.767, Opt.768 or Opt.769

Opt.785 Connection Kit for ESA link with 7630
Opt.787 Connection Kit for ESA link with 6600
Opt.790 IR Output 6000V
Opt.794 Scanner 8W+8G
Opt.7020 MD 1k ohm (non-inductive resistor)
Opt.7021 MD NFPA99 Figure A.8.4.1.3.3
Opt.7022 MD IEC60974
Opt.7023 MD IEC60598-1
Opt.7024 MD NFPA99 Figure A.4.3.3.1.3b
Opt.7025 MD NFPA99 Figure A.4.3.3.1.3a
Opt.7027 MD 2k ohm (non-inductive resistor)
1945 3kVA Hot-Hipot Transformer Box

3.2. Instrument Controls

3.2.1 Front Panel Controls



1. **RESET BUTTON:** Resets the instrument. If a failure condition occurs during a test, pressing this button will reset the system, shut off the alarm and clear the failure condition. The Reset button must be pressed before performing another test or changing any of the setup parameters. This button also serves as an abort signal to stop any test in progress.

2. **TEST BUTTON:** Starts a test.

3. **GRAPHIC TFT:** 800 X 480 Color TFT display.

4. **SOFT KEYS:** Multifunction keys used to select screens and change parameters.

5. **NUMERIC DATA ENTRY:** Keys used to enter numeric data.

6. **SCANNER STATUS LED's:** LED's that indicate the status of the 8 H.V. and 8 GB channels on the internal scanner.

7. **POWER SWITCH:** Turns the Hipot tester ON or OFF.

8. **MY MENU KEY:** Selects the My Menu screen with user-customizable soft keys.

9. **EXIT KEY:** Key used to escape from parameter editing and return to prior screens.

10. **UP, DOWN, LEFT, AND RIGHT, ARROW KEYS:** Keys used to scroll the highlighted area or cursor, up and down, left and right. When more than 5 steps are programmed in a test file, the left and right arrow keys will page through the screens of steps. The screens where the paging function is available are as follows: Setup Tests, Perform Tests, Results Summary, and Results.

11. **ENTER KEY:** Key used to finalize parameter entries. The ENTER key may also be used to scroll the highlighted area to different parameters in the parameter setting screens.

12. **SENSE + TERMINAL:** Connector used to attach the + sense lead for 4-wire Kelvin current measurement. This connection provides for accurate current measurement during the Ground Bond test.

13. **CURRENT OUTPUT TERMINAL:** Connector used to attach the high current output lead, adapter box high current lead or test fixture high current lead to the instrument. This connection provides the output current for the ground bond and continuity.

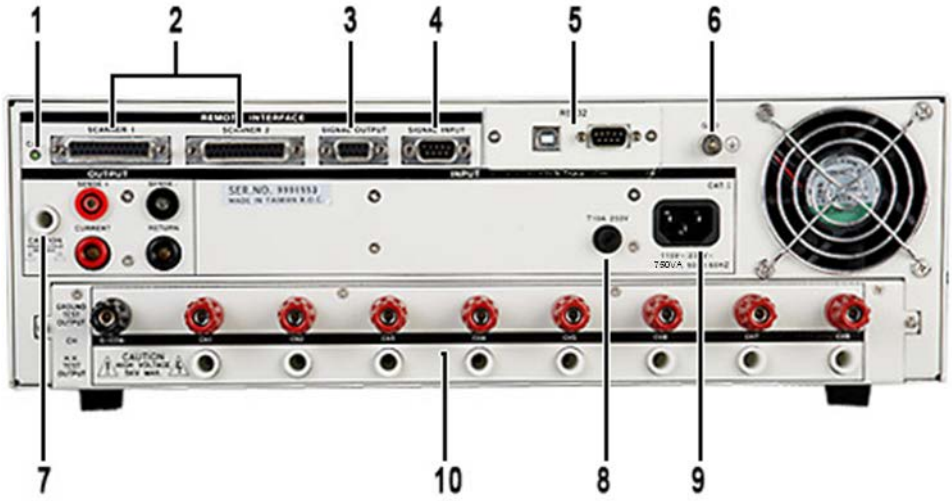
14. **HIGH VOLTAGE INDICATOR:** This indicator flashes to warn the operator that high voltage is present at the high voltage output terminal.

15. **RETURN OUTPUT TERMINAL:** Connector used to attach the return test lead, adapter box return lead or test fixture return lead to the instrument. This connection provides the return current path.

16. **SENSE - TERMINAL:** Connector used to attach the - sense lead for 4-wire Kelvin current measurement. This connection provides for accurate current measurement during the Ground Bond test.

17. **HIGH VOLTAGE OUTPUT TERMINAL:** Connector used to attach the high voltage test lead, adapter box high voltage lead or test fixture high voltage lead to the instrument. This connection provides the high voltage used during a Hipot test.

3.2.2 Rear Panel Controls



1. **CALIBRATION BUTTON:** To put the instrument into the calibration mode push this button and turn on the power switch simultaneously.

2. **SCANNER CONNECTOR:** For connection of optional external Scanner.

3. **REMOTE SIGNAL OUTPUT:** 9-Pin D sub-miniature female connector for monitoring PASS, FAIL, and PROCESSING output relay signals**.**

4. **REMOTE SIGNAL INPUT:** 9-Pin D subminiature male connector for remote control of TEST, RESET, and REMOTE INTERLOCK DISABLE functions, as well as MEMORY SELECTION

5. **BUS INTERFACE:** Standard connector for interconnection to the RS-232 Bus interface. Optional IEEE 488, Ethernet, USB interface may be substituted for the RS-232.

6. **CHASSIS GROUND (EARTH) CONNECTION:** This terminal should be connected to a good earth ground before operation.

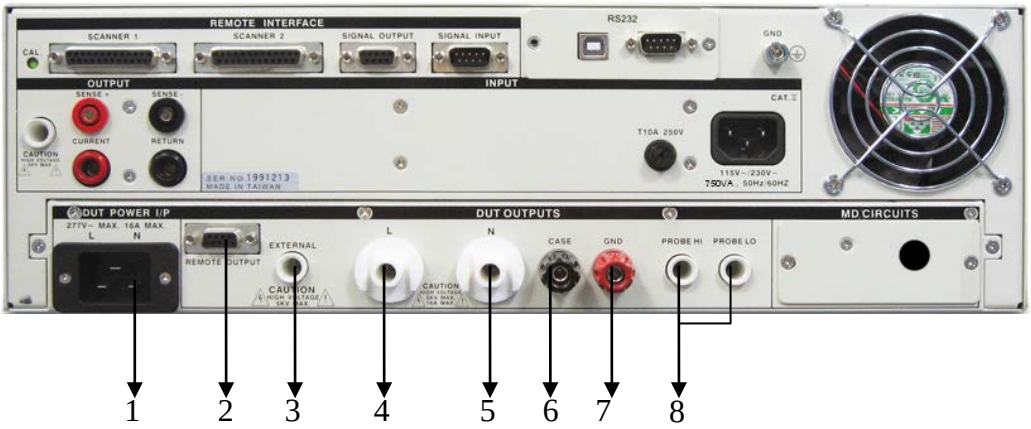
7. **REAR PANEL OUTPUT TERMINALS:** 2nd set of output connectors in parallel with the front panel connectors.

8. **FUSE RECEPTACLE:** To change the fuse, unplug the power (mains) cord and turn the fuse receptacle counter-clockwise. The fuse compartment will be exposed. Please replace the fuse with one of the proper rating.

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

10. **SCANNER OUTPUTS (for Opt.794):** Optional scanner matrix that provides 8 HV/Return connections and 8 Ground Bond connections. Please refer to the Options section of this manual for additional connection information.

3.2.3 Additional Rear Panel Controls OPT.768 and OPT.769



1. **DUT POWER INPUT CONNECTOR:** This connector provides the Line and Neutral input power connections on pin 1 and 2 respectively. An external single phase unbalanced AC power supply with a single Hot or Line conductor should be connected here, to supply power to the DUT while performing the leakage test. This input is rated for 0-277 volts 50/60 Hz.

2. **REMOTE OUTPUT:** Optional connector used to interface the ESA with an AC power source for remote memory selection

3. **EXTERNAL H.V./RTN TERMINAL:** This terminal provides the external H.V. / RTN terminal when Dielectric Withstand or Insulation Resistance are being performed.

4. **L TERMINAL:** Connector used to attach the adapter box high voltage test lead to the instrument. Line power is supplied to the DUT during the run test or line leakage test through this connector and High Voltage is supplied to the DUT through this connector during the Dielectric Withstand or Insulation Resistance tests. This terminal and the “N” terminal are shorted together when the Dielectric Withstand or Insulation Resistance tests are being performed.

5. **N TERMINAL:** Connector used to attach the adapter box return test lead to the instrument. Line power is supplied to the DUT during the run test or line leakage test through this terminal and High Voltage is supplied to the DUT through this terminal during the Dielectric Withstand or Insulation Resistance tests. This terminal and the “L” terminal are shorted together when the Dielectric Withstand or Insulation Resistance tests are being performed.

6. **CASE TERMINAL:** Connector used to attach the return lead to the DUT case or dead metal. Provides the return for the Ground Bond, Dielectric Withstand, and Insulation Resistance tests. During a Run test or Line Leakage test, this terminal is isolated from the test circuits.

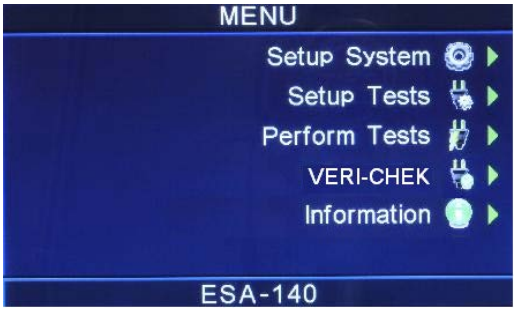
7. **GND TERMINAL:** Connector used to attach the adapter box Ground or Earth lead to the instrument.

8. **PROBE HI / PROBE LO :** Probe HI terminal is an input to one side of the MD(measuring device) and will be enabled during a line leakage test when ever Probe-HI has been selected at setup. This terminal is provided for performing Enclosure leakage or Applied Part leakage tests. When run tests and line leakage tests are not being performed, this terminal is isolated from the run test and line leakage test circuits. Probe LO terminal is an input to one side of the D(measuring device) and will be enabled during a line leakage test when ever Probe-LO has been selected at setup. This terminal is provided for performing Applied Part leakage tests and is always used in conjunction with the Probe-HI terminal. When run tests and line leakage tests are not being performed, this terminal is isolated from the run test and line leakage test circuits.

4. Programming Instructions

4.1. Power Up

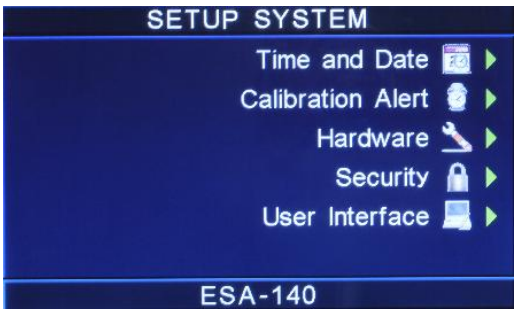
The ESA automatically defaults to the Main Menu screen upon power up. The Main Menu screen will appear as follows:



From the Main Menu screen five menus screens may be accessed: Setup System, Setup Tests, Perform Tests, VERI-CHEK and Information

4.2. Setup System

From the Main Menu screen, press the “Setup System” soft key. The Setup System screen will now be displayed. From the Setup System screen, five different hardware and software controls may be accessed: Time and Date, Calibration Alert, Hardware, Security and User Interface. Pressing the EXIT key at any time will return you to the Main Menu screen.



4.2.1. Setup System Keys

Soft Keys

In the Setup System screen, the soft keys correspond to several setup screens. Use the soft keys to enter the corresponding system screen. Once a system screen has been entered, the soft keys can be used to edit parameters. Press the soft key to edit the corresponding parameter. ENTER does not need to be pressed to confirm the values that pertain to the soft keys.

Directional soft keys

The Directional soft keys are used to scroll the cursor to the different system parameters.

ENTER

The ENTER key is used to confirm a value for a particular parameter.

EXIT
The EXIT key is used to return to the Perform Tests screen from the Setup System screen or will bring you back to the Setup System screen from the editing menu screens.

4.2.2. Time and Date
From the Setup System screen press the “Time and Date” soft key. The Time and Date Setting screen will now be displayed**.** From this screen, five different parameters may be accessed: Set Date, Set Time, Set Day, Date Format and Time Format. The Time and Date Setting screen will appear as follows:

Set Date
From the Time and Date Setting screen, highlight the Set Date parameter by using the left and right arrow keys.

Within the Set Date parameter are three separate fields: month, day, and year. Using the left and right arrow keys select the field within the date that you want to edit. Using the numeric keypad enter the new number. Once you begin typing a new number the parameter will blank and the cursor will begin blinking. This indicates that the parameter is being edited.

Once a parameter is edited, it is necessary to complete the edit either by pressing the ENTER key to accept the new number or the EXIT key to escape from the edit and return to the original number.

Set Time
From the Time and Date Setting screen highlight the Set Time parameter by using the left or right arrow keys.

Within the Set Time parameter are three separate fields, hours, minutes, and seconds. Using the left and right arrow keys to select the field within the time parameter you want to edit. Using the numeric keypad enter the new number. Once you begin typing a new number, the parameter will blank and the cursor will begin blinking. This indicates that the parameter is being edited.

Once a parameter is edited, it is necessary to complete the edit either by pressing the ENTER key to accept the new number or the EXIT key to escape from the edit and return to the original number.

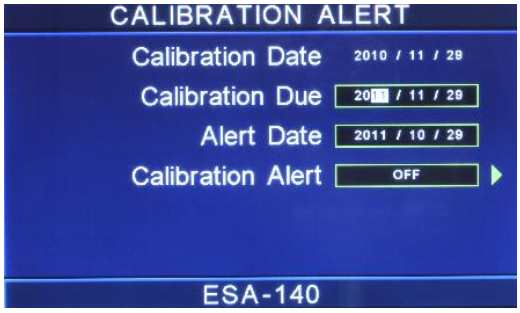
Set Day
From the Time and Date Setting screen, press the “Set Day” soft key.
Once a parameter is edited, it is necessary to complete the edit either by pressing the ENTER key to accept the new value or the EXIT key to escape from the edit and return to the original value.

Date Format
From the Time and Date Setting screen, press the “Date Format” soft key.

Once a parameter is edited, it is necessary to complete the edit either by pressing the ENTER key to accept the new value or the EXIT key to escape from the edit and return to the original value.

Time Format
From the Time and Date Setting screen, press the “Time Format” soft key. As the soft key is pressed, the time format will toggle between 12 hour and 24 hour modes.

4.2.3. Calibration Alert
Calibration Alert is a feature that will allow the instrument to give an advanced alert that the calibration for the instrument is coming due. From the System Setup screen, press the “Calibration Alert” soft key. The Calibration Alert Setting screen will now be displayed**.** From the Calibration Alert Setting screen, three different parameters may be accessed: Calibration Due, Alert Date, Calibration Alert. The Calibration Alert Setting screen also displays the date of the last performed calibration. The Calibration Alert Setting screen will appear as follows:



Calibration Due Date
It is recommended that calibration should be performed at least once a year. It is recommended that the Calibration Due Date not bet set greater than one year from the Calibration Date displayed.

From the Calibration Alert Setting screen, highlight the Calibration Due parameter by using the left or right arrow keys. The left and right arrow keys will toggle the highlighted area of the screen between the Calibration Due and Alert Date.

Using the left and right arrow keys and the numeric keypad enter the Calibration Due Date. Press the ENTER key to finish.

Alert Date
The Alert Date is like an alarm clock that will warn you in advance of the actual calibration due date. After a calibration is performed the Alert Date is automatically set

11 months after the calibration date. For example, if the calibration is performed on 12/15/2012 the Alert Date will automatically be set to 11/15/2013. Although this date is automatically written into the Alert Date location, it may be manually overwritten to any advanced date desired.

At the Calibration Alert setting screen, highlight the Alert Date parameter by using the left or right arrow keys. The left and right arrow keys will toggle the highlighted area of the screen between the Calibration Due and Alert Date.

Within the Alert Date parameter are three separate fields: month, day, and year. Using the left and right arrow keys select the field you want to edit. Using the numeric keypad enter the new number. Once you begin typing a new number, the parameter will blank and the cursor will begin blinking. This indicates that the parameter is being edited. Once a parameter is edited, it is necessary to complete the edit either by pressing the ENTER key to accept the new number or the EXIT key to escape from the edit and return to the original number.

Calibration Alert On/Off
From the Cal. Alert Setting screen you may turn the Calibration Alert function ON and OFF by pressing the “Calibration Alert” soft key. If the “Show this screen again?” function has been turned OFF at the Calibration Alert Warning screen, this parameter will automatically be set to OFF. Turning this parameter ON will activate the Cal Alert function and when the date matches the Alert Date, the instrument will display the Calibration Alert Warning screen upon power up.

4.2.4. Hardware
From the System Setup screen, press the “Hardware” soft key. The Hardware Setting screen will now be displayed. From the Hardware Setting screen, four different parameters may be accessed: Smart GFI, Continuity Scanner, GPIB Address, PLC Remote and Measurement. The Hardware Setting screen will appear as follows:

Smart GFI (Ground Fault Interrupt)
The high voltage power supply of the ESA SERIES is internally referenced to earth ground. Since the leakage current measuring circuit of the instrument monitors only current that flows through the return lead the possibility exists for current to flow directly from the high voltage output to earth ground without being measured. The SmartGFI (Ground Fault Interrupt) circuit monitors the current between the high voltage output and earth ground. Therefore, if the operator touches the high voltage lead and earth ground, the instrument will detect this hazardous condition and shut off immediately.

SmartGFI goes beyond a standard GFI circuit by automatically determining the return configuration of the DUT (grounded or floating) and enabling or disabling depending on the situation. When the ESA SERIES's Return lead is floating, the SmartGFI circuit enables, protecting the test operator from electric shock. When the ESA SERIES's Return lead is earth grounded, the SmartGFI circuit disables and the instrument operates in a grounded return mode of operation. If the GFI were to remain active in this state, the tester would continuously fail since all current is returning through earth ground. By disabling the SmartGFI circuit and operating in a grounded return mode, ESA SERIES allows the user to perform tests on devices that have their chassis's earth grounded by the test fixture or test environment.

In the Hardware Setting screen, highlight the SmartGFI parameter by using the up or down arrow keys.

Use the numeric keypad to set the mA value of the SmartGFI in the instrument. The SmartGFI can be set to 0 or adjusted from 0.4-5.0mA (where 0 = OFF).

Selecting the Smart GFI = 0, will only disable the ground current failure detectors. It does not disable the capability to externally earth ground the return lead.

Continuity Scanner
From the Hardware Setting screen, highlight the Continuity Scanner parameter by using the up or down arrow keys. NOTE: This selection will only be available if option 01: Internal Scanner is installed on the unit. For more information on this option, please refer to Chapter 8: Options.

You may toggle between the HV Channel (High Voltage) and GND Channel (Ground Bond) selection by pressing the "Continuity Scanner" soft key.

The Continuity Scanner setting allows the user to set the function of the scanner channels for a DC Continuity test. The High Voltage/Continuity channels can be set to a High or Low level, giving the capability to test from one channel to another channel or from any channel to a common Low or Return point. The channels can be connected in parallel if desired but there is only one leakage current measurement for all channels.

The Ground Bond/Continuity channels can only be used to test from one channel to the common Return. Only one channel may be used for each Ground Bond or Continuity test. The Ground Bond or Continuity test will be performed between the output channel selected and the Ground Bond/Continuity common terminal.

GPIB Address
From the Hardware Setting screen, highlight the GPIB Address parameter by using the up or down arrow keys.

Use the numeric keypad to select the GPIB Address number between 0 and 30. Finish by pressing the ENTER key.

PLC Remote
From the Hardware Setting screen, you may turn the PLC remote ON and OFF by

pressing the “PLC Remote” soft key.

When the PLC remote is turned ON, the front panel TEST button is disabled and a test may only be started through the rear panel I/O. If you attempt to start a test from the front panel TEST button when the PLC Remote function is turned “ON”, a pop-up message will be displayed.

Measurement
From the Hardware Setting screen, press the “Measurement” soft key. As the soft key is pressed, the measurement method will toggle between True RMS or Average.

4.2.5. Security
From the System Setup screen press the “Security” soft key. The Security screen appears as follows:

Security
From the Security screen you may turn the Security function ON and OFF by pressing the “Security” soft key. Selecting Security OFF disables all security features and User ID settings. Selecting security ON restricts access to parameter settings. The level of security is determined by the User Setup function.

User Setup
From the Security screen, press the User Setup soft key. As the soft key is pressed, you will be taken to the User Setup screen. There are three functions available in the User Setup screen: Add User, Edit User and Delete User. The User Setup screen will appear as follows:

From the User Setup screen, you can view the list of users currently setup and the associated security level. The ESA SERIES will have a default User ID named ADMIN with Full System Access security level. This User ID cannot be deleted.

Add User
From the User Setup screen, press the Add User soft key. As the soft key is pressed, you will be taken to the Add User screen.
From this screen, a new user can be added by entering an alpha/numeric User ID, Password, Password Confirmation and desired security level.

User ID
To enter a User ID, use the up and down arrow keys to select the User ID parameter. Use the alpha/numeric keypad to add a User ID. The User ID is limited to 8 characters.

Once the User ID parameter is edited, it is necessary to complete the edit either by pressing the ENTER key to accept the new User ID or the EXIT key to escape from the edit and delete the User ID.

Password
Each User ID must have a password associated with it. To enter a Password, use the up and down arrow keys to select the Password parameter. Use the alpha/numeric keypad to enter a password. The password is limited to 8 characters.

Once the password is entered, it is necessary to complete the edit either by pressing the ENTER key to accept the new password or the EXIT key to escape from the edit and delete the password.

Confirm Password
In order to complete the password entry, the password must be confirmed by retyping the password into the Confirm Password parameter. To confirm the password, use the up and down arrow keys to select the Confirm Password parameter. Use the alpha/numeric keypad to retype the password.

Once the password is entered, it is necessary to complete the edit either by pressing the ENTER key to accept the new password or the EXIT key to escape from the edit and delete the password. NOTE: Once the ENTER key is pressed, the User ID will be set. Edit the Security Level parameter prior to confirming the password.

Security Level
From the Add User screen, press the “Security Level” soft key. As the soft key is pressed, the “Security Level” pop up screen will appear as follows:

Use the up or down arrow keys to select the Security Level.

Once a parameter is edited, it is necessary to complete the edit either by pressing the ENTER key to accept the new value or the EXIT key to escape from the edit and

return to the original value.

The security levels are as follows:

- Run Only: This is the most restricted mode of user access. The user can only initiate a test, reset a failure or abort a test from the Perform Tests screen.

NOTE: whenever a user's security level is Run Only, "Single Step" and "Fail Stop" soft keys will be disabled at the Perform Test screen.

NOTE: whenever a user's security level is Run Only, you may only start at test step 1.

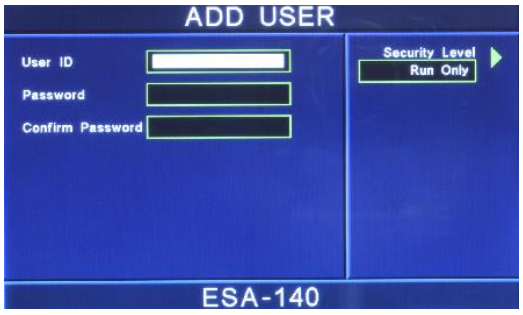
- Recall Setups: This mode allows the user to load previously configured test files but it does not allow any editing of the parameters. In this mode the user is restricted from access to the "Setup Test Parameters" screen.

- Edit Setups: In this mode the user can load files and edit test parameters.

- Full System Access: In this mode the user has full access level to all instrument setup parameters as well as system configuration and security levels. Access at this level should be restricted to System Administrators.

Edit User

From the User Setup screen, use the up and down arrows to select the User ID you would like to edit. Press the Edit User soft key. As the soft key is pressed, the Edit User screen appear as follows:



From this screen, the User ID, Password and Security Level can be changed by entering an alpha/numeric User ID, Password, Password Confirmation and desired security level. Please refer to the "User ID", "Password", "Confirm Password" and "Security Level" sections above for more information.

Delete User

From the User Setup screen, use the up and down arrows to select the User ID you would like to delete. Press the Delete User soft key. As the soft key is pressed, the selected User ID will be deleted from the User ID list. NOTE: Once a User ID is deleted, it cannot be recovered. The User ID must be recreated by adding a new user. Please refer to the "Add User" section above for more information.

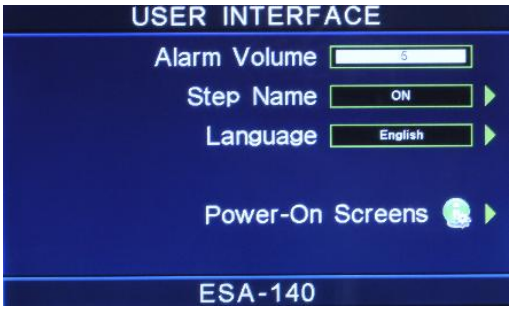
Forgotten Password

If you have forgotten your password you may access a User ID by typing in the

number “8000” into the password field. The old password cannot be recovered. A new password should be entered by editing the USER ID in the Edit User screen. Please refer to the “Edit User” section above for more information.

4.2.6. User Interface

From the System Setup screen press the “User Interface” soft key. From the User Interface screen, five different parameters may be accessed: Alarm Volume, Step Name, Language, Color Style and Power-On Screens. The User Interface screen will appears as follows:



Alarm Volume

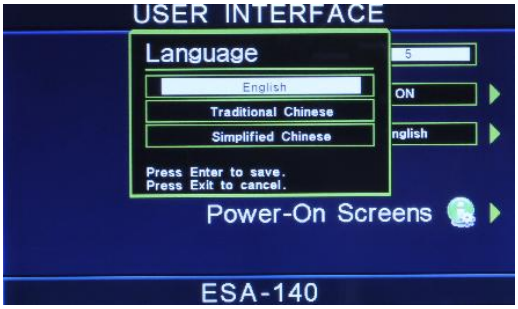
In the User Interface screen, the Alarm Volume parameter will automatically be highlighted. Use the alpahnumeric keypad to set the volume of the alarm in the instrument, then press the ENTER key. The numbers corresponding to the different volume settings are 1 through 9, 1 meaning the volume is off, and 9 being the loudest setting. After the number is entered, a momentary alarm chirp will occur to indicate the volume of the new setting.

Step Name

From the User Interface screen, press the “Step Name” soft key. As the soft key is pressed, the step name parameter will toggle between ON and OFF. Setting the step name parameter to ON will allow the user to enter an alphanumeric name for each individual step in a test sequence. Please refer to section X.X.X for more information.

Language

From the User Interface screen, press the “Language” soft key. As the soft key is pressed, the “Language” pop up screen will appear as follows:

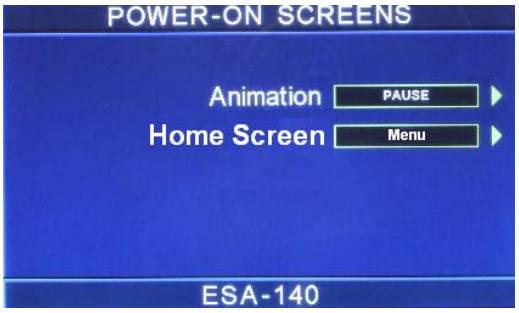


Use the up or down arrow keys to select the preferred language setting for the unit. The language options are English, Traditional Chinese and Simplified Chinese. Once a parameter is edited, it is necessary to complete the edit either by pressing the ENTER key to accept the new value or the EXIT key to escape from the edit and return to the original value.

4.2.7. Power-On Screen

You may configure the ESA SERIES to power-on at the Main Menu screen, the Perform Tests screen or the My Menu screen. From the User Interface screen, press the “Power-On Screens” soft key. The Power-On Setting screen will now be displayed. From the Power-On Setting screen, two different parameters may be accessed:

Animation and Home Screen. The Power-On Screens will appear as follows:



Animation

The ESA SERIES Animation screen is the very first screen to appear when the instrument is powered up. You have the option to PAUSE the instrument at this screen after power up or CONTINUE through to the next screen after the Animation screen is displayed for four seconds or SKIP the Animation screen completely. The option to PAUSE, CONTINUE or SKIP may be selected by pressing the “Animation” soft key. When PAUSE is selected, the words “Press any key to continue“ will appear at the bottom of the ESA SERIES Animation screen.

From the Power-On Screens, press the “Animation” soft key.

Use the up or down arrow keys to select the preferred animation setting for the unit. The animation setting options are Continue, Pause and Skip.

Once a parameter is edited, it is necessary to complete the edit either by pressing the ENTER key to accept the new value or the EXIT key to escape from the edit and return to the original value.

Home Screen

The Home Screen parameter allows you to select the first screen to appear on the ESA SERIES after the Animation screen. If the Animation screen is set to Skip, the selected Home Screen parameter will be the first screen to appear upon power up.

From the Power-On Screens, press the “Home Screen” soft key.

Configure ESA SERIES to go directly to the Perform Test screen

1. Set ESA SERIES Animation to CONTINUE or SKIP.
2. Set the Home Screen selection to Perform Tests. Now when the instrument is powered on it will go directly to the Perform Test screen.

4.3. Setup Tests Menu

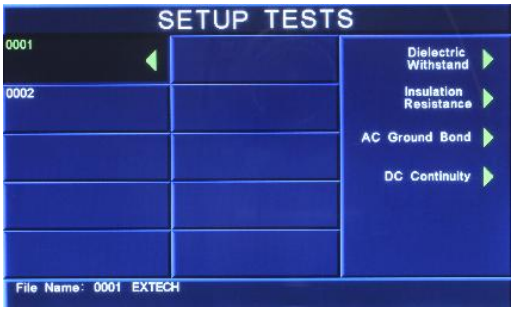
From the Main Menu screen press the “Setup Tests” soft key. The Setup Tests screen will now be displayed. From the Setup Tests screen, six different software controls may be accessed: Add, Edit, Delete, Prompt, File, and Fail Stop. The Setup Tests screen will appear as follows:

The Setup Tests screen is the central starting point for programming tests into the instrument. From this screen, test parameters are entered and edited, and the order of the test steps can be arranged and then stored to test files. The ESA SERIES is capable of performing a 10,000-step sequential test from a single test file.

The Setup Tests screen is separated into two main sections. The left half of the screen lists the steps and the parameters contained within each step. The right half of the screen contains the soft key menu. When more than 12 steps are programmed in a test file, the left and right arrow keys will page through the screens of steps. Individual steps may be scrolled to using the up and down arrow keys.

4.3.1. Add

From the Setup Tests screen, press the “Add” soft key. The Test Selection screen will now be displayed. From this screen you may select what type of test you wish to add to a test sequence: Dielectric Withstand, Insulation Resistance, AC Ground Bond and DC Continuity. The Test Selection screen will appear as follows:



For a detailed description of how to set up a test sequence, please refer to section **4.5. Setting Up a Test.**

For a detailed description of the screens and parameters that are associated with test selection soft keys on this screen please refer to section **4.4. Test Parameters.**

4.3.2. Edit

From the Setup Tests screen, use the up, down arrow keys, and scroll the highlighted area to the step you wish to edit. Press the “Edit” soft key. The Parameter Setting screen for the type of test that is in that location will now be displayed. The

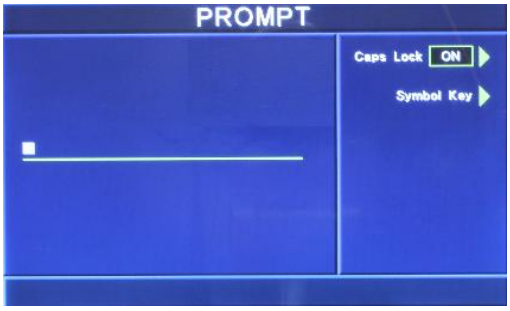
parameters for the test may now be edited.

For a detailed description of the screens and parameters that are associated with the “Edit” soft key on this screen please refer to section **4.4. Test Parameters.**

4.3.3. Delete
From the Setup Tests screen, use the up and down arrow keys to scroll the highlighted area to the step you wish to delete. While pressing the Delete soft key, a pop will appear to confirm the step deletion:

Press ENTER to confirm and delete the selected step or EXIT to cancel and return to the Setup Tests screen.

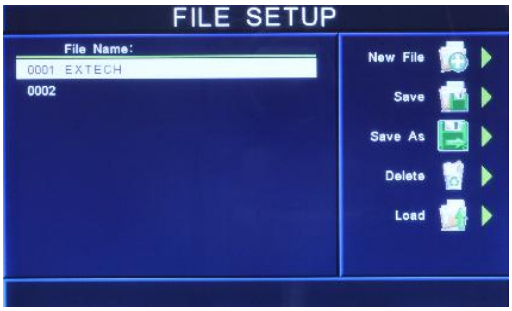
4.3.4. Prompt
The Prompt function allows you to insert a short line of text in a step. The Prompt will appear on the screen before the step is initiated and remain on the screen until the TEST button is pressed. After the TEST button is pressed, the Prompt will clear and the step will initialize. Use the up and down arrow keys to scroll the highlighted area to the step where you would like to insert the text prompt and press the “Prompt” soft key. The Prompt screen will now be displayed. The Prompt screen will appear as follows:



To enter a text prompt, use the alphanumeric keypad. At the text prompt edit, the letter or symbol will be inserted at the point where the cursor is flashing. The cursor will then increment to the next position and wait for an additional character insertion. If you make a mistake or want to change the character, press the backspace key in the alphanumeric keypad. The cursor will decrement and erase the character. If you wish to use capital letters in the prompt, press the “Caps Lock” soft key. While pressing the Caps Lock soft key, the Caps Lock parameter will toggle between ON and OFF. If you wish to use symbols in the prompt, press the “Symbol Key” soft key. While pressing the Symbol Key soft key, the symbol values will toggle between !, *, _, and ~.

When you have finished editing the prompt press the ENTER key. After a prompt is inserted in a step, a “P” will appear within the step parameters below the step number.

4.3.5. File
From the Setup Tests screen, press the “File” soft key. The File Setup screen will now be displayed. From the File Setup screen, five different file-handling controls may be accessed: New File, Save, Save As, Delete, and Load. The File Setup screen will appear as follows:



New File
From the File Setup screen, press the “New File” soft key. The Create File screen will now be displayed. For a detailed description of creating a new file, refer to the section **4.5. Setting Up a Test**.

Save
To save a file with its current name press the “Save” soft key from the File Setup screen.

Save As
To save an edited file without overwriting the original or to give a file a new name, press the “Save As” soft key from the File Setup screen. The Create File screen will now be displayed. For a detailed description of creating a new file, refer to the section **4.5. Setting Up a Test**.

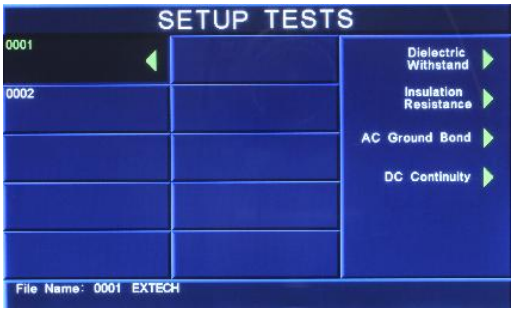
Delete
To delete a file, use the up and down arrow keys and scroll the highlighted area to the file you wish to delete and press the “Delete” soft key. A warning will appear on the screen asking if you want to delete the file. Press the ENTER key to complete the deletion or press the EXIT key to escape.

Load
To load a test file, use the up and down arrow keys and scroll the highlighted area to the file you wish to load and press the “Load” soft key.

4.3.6. Fail Stop
Fail Stop is a function that will stop a sequence of tests if a failure occurs. If this function is turned OFF the sequence of tests will continue to the end of the sequence regardless of whether or not a failure has occurred. If the Fail Stop is OFF and a failure occurs during the test sequence, the RESET button will light and a short alarm will sound but the sequence will continue. At the end of the test sequence, the RESET button will light and alarm will sound indicating failure during the sequence. Pressing the RESET button will silence the alarm and reset the instrument. Turn the Fail Stop function ON and OFF by pressing the “Fail Stop” soft key. Fail Stop is a parameter that is stored within the test file but may also be turned ON and OFF temporarily from the Perform Tests screen. If security is enabled you may not turn Fail Stop ON and OFF using the “Fail Stop” soft key. Fail Stop automatically defaults to the setting stored in the file when security is activated.

4.4. Test Parameters

From the Setup Tests screen, press the “Add” soft key. The Test Selection screen will now be displayed. From this screen, you may choose what type of test to perform: Dielectric Withstand, Insulation Resistance, AC Ground Bond or DC Continuity. The Tests Selection screen will appear as follows:



4.4.1. Description of Test Parameters

Voltage: The voltage that is applied to the high voltage and return terminals during a test.

Current: The Current that is applied between the Current and Return lead during a ground bond test.

Current-HI: The maximum allowable current-flow through the DUT that triggers a failure when exceeded.

Current-LO: The minimum allowable current-flow through the DUT triggers a failure when not exceeded.

Leakage-HI: The maximum leakage current allowable through the measuring device that triggers a failure when exceeded.

Leakage-LO: The minimum leakage current allowable through the measuring device that triggers a failure when not exceeded.

HI-Limit: A maximum threshold set point that when exceeded triggers a failure. A “T” or an “R” designator is shown in AC withstand parameters and means, “T” total current or “R” real current.

LO-Limit: A minimum threshold set point that when not exceeded triggers a failure. A “T” or an “R” designator is shown in AC withstand parameters and means, “T” total current or “R” real current.

Ramp Up: The length of time that is allowed for the test voltage to climb from 0 to the programmed test voltage.

Dwell Time: The length of time that is allowed for the programmed test voltage to be applied.

Delay Time: The length of time that the programmed test voltage is applied but no judgment of the set parameters is made. Judgment of the parameters is not made until the end of the delay time.

Ramp Down: The length of time that is allowed for the test voltage to decay from programmed test voltage to 0.

Arc Sense: During hipot testing some low current arcing may be allowable. Arc sense is a maximum allowable threshold for arcing.

Arc Detect: If the Arc Fail mode is set to ON, the program will indicate an arc failure when the arc current is exceeds this setting. Arc Detect may be selected ON or OFF using a soft key.

Ramp-HI: The Ramp-HI function is active during the Ramp period only. Ramp-HI will allow current higher than the normal Max-Lmt current setting of the DC Withstand Voltage test to avoid false failure due to charging current.

Charge–LO: The Charge-LO function is used to check if the cables are connected properly at the beginning of a test. This function is only available in DC Withstand and Insulation resistance testing. A description of how to set up this parameter is given in the **4.5.2. DC Withstand** and **4.5.3. Insulation Resistance** parameter sections of this manual.

Offset: This function allows the instrument to compensate for lead and test fixture resistance during a Ground Bond or Continuity test. A description of how to set up this parameter is given in **the 4.5.4.Continuity** and **4.5.5. Ground Bond** parameter sections of this manual.

Frequency: This parameter is available in AC tests only and is selectable using a soft key between 50 and 60Hz.

Continuity in ACW and DCW: This function checks for a connection between the current and return lead. This is a basic DC continuity check and will not disclose a Continuity value. Continuity may be selected ON or OFF using a soft key in the ACW and DCW parameters.

Scanner Setup: (This parameter will only be seen on units equipped with a scanner). This parameter allows for set up of the Scanner channels. The three different selectable scanner states are: L (scanner channel set to the return point), H (scanner set to the high voltage point) and O (OFF).

Defaults: Pressing this soft key will default the test parameters to their predetermined default values (refer to section **4.4.2. Default Parameters**). Once the default soft key is pressed it is necessary to complete the edit either by pressing the ENTER key to accept the parameter overwrite or the EXIT key to escape from the edit and return to the original values.

4.4.2. Default Test Parameters

In each of the Test Parameter Setting screens there is a “Defaults” soft key. When this key is pressed the test will load with a set of predetermined Default Parameters. The following table is a listing of the Default Parameters for each of the different types of tests that are available in the ESA SERIES**.** The Default Parameters are as follows:

Default Parameters.

TEST TYPE	PARAMETER	VALUE
ACW	Voltage	1240VAC
	HI-Limit T	10.00mA
	LO-Limit T	0.000mA
	Ramp Up	0.1s
	Dwell Time	1.0s
	Ramp Down	0.0s
	Arc Sense	5
	HI-Limit R	10.00mA
	LO-Limit R	0.000mA
	Offset	0.000mA
	Scanner	OOOOOOOOOOOOOOO
	Frequency	60Hz
	Arc Detect	OFF
	Continuity	OFF
DCW	Voltage	1500VDC
	HI-Limit	10000μA
	LO-Limit	0.0μA
	Ramp Up	0.4s
	Dwell Time	1.0s
	Ramp Down	1.0s
	Charge-LO	0.0μA
	Arc Sense	5
	Offset	0.0uA
	Scanner	OOOOOOOOOOOOOOO
	Ramp-HI	OFF
	Arc Detect	OFF
	Continuity	OFF
IR	Voltage	500VDC
	HI-Limit	0.00MΩ
	LO-Limit	0.05MΩ
	Ramp Up	0.1s
	Dwell Time	1.0s
	Delay	1.0s
	Ramp Down	0.0s
	Charge-LO	0.000μA
	Scanner	OOOOOOOOOOOOOOO
TEST TYPE	**PARAMETER**	**VALUE**
GND	Current	25.00A
	Voltage	8.00V
	HI-Limit	100mΩ

	LO-Limit	0mΩ
	Dwell	1.0s
	Frequency	60Hz
	Offset	0mΩ
	Scanner	00
	DualCHEK	OFF
CONT.	HI-Limit	10.00Ω
	LO-Limit	0.00Ω
	Dwell	1.0s
	Offset	0.00Ω
	Scanner (GND Channel)	00
	Scanner (HV Channel)*	OOOOOOOOOOOOOOO
Setup Sys.	PLC Remote	OFF
	Address (GPIB only)	8
	Measurement	True RMS
	Language	English
	Volume	5
	Step Name	OFF
	Color Style	Arctic
	Smart GFI	0.4mA
Security	User ID	Admin
	Password	8000
	Security	OFF
OPT.768 AND OPT.769		
Run Test	Voltage-HI	100.0V
	Voltage-LO	0.0V
	Amp-HI	10.00A
	Amp-LO	0.00A
	Dwell Time	1.0s
	Delay Time	0.1s
	Leakage-HI	10.00mA
	Leakage-LO	0.00mA
	Power-HI	1000W
	Power-LO	0W
	PF-HI	1.000
	PF-LO	0.000
	Continuous	OFF
OPT.768 AND OPT.769		
LLT	Leakage-HI	3000μA
	Leakage-LO	0.0μA
	Voltage-HI	100.0V
	Voltage-LO	0.0V
	Dwell Time	1.0s
	Delay Time	1.0s
	Offset	0.0uA
	Leakage	RMS
	Continuous	OFF
	Reverse	OFF

Neutral	CLOSED
Ground	CLOSED
Meas. Device	UL544NP
Probe	Ground to Line
AC/DC	AC+DC
Ranging Mode	Auto

4.5. Setting Up a Test

Upon power up, ESA SERIES will initialize with the test file that was last used before power down. If the instrument is new it will come loaded with one default file that the instrument will boot up with until it is changed.

1. From the Setup Tests screen, press the “File” soft key. The File Setup screen will now be displayed.

2. From the File Setup screen, press the soft key “New File”. The Create File screen will now be displayed.

3. The Create File screen is separated into two main sections: File Name Edit and Soft Key Menu.

4. From the Create File screen you must give your new test file a name. The file name can be a maximum of fifteen characters in length and may use any combination of the character set plus numbers and symbols. To name your file, use the alphanumeric keypad. If you make a mistake or want to change the character, press the backspace key in the alphanumeric keypad. If you wish to use capital letters in the prompt, press the “Caps Lock” soft key. While pressing the Caps Lock soft key, the Caps Lock parameter will toggle between ON and OFF. If you wish to use symbols in the prompt, press the “Symbol Key” soft key. While pressing the Symbol Key soft key, the symbol values will toggle between !, *, _, - and ~. When you have finished editing the file name press the ENTER key.

5. From the Setup Tests screen, press the “Add” soft key. The Test Selection screen will now be displayed. From this screen you may choose what type of test to perform: Dielectric Withstand, Insulation Resistance, AC Ground Bond or DC Continuity.

6. From the Test Selection screen, press the soft key next to the type of test you wish to add to the test sequence. If you press the “Dielectric Withstand” soft key, the AC-Withstand and DC-Withstand test soft keys will be displayed. Press the AC-Withstand or DC-Withstand soft key to choose a dielectric withstand test type. The Parameter Setting screen for the type of test you have chosen will now be displayed.

7. From Parameter Setting screen you may set your own custom parameters for the test or choose the defaults from the soft key menu. All of the individual parameters for the test may be accessed using the up and down arrow keys, and the ENTER key. As the arrow keys are pressed, the highlighted area will scroll to the different parameters. The ENTER key may also be used to scroll to the different parameters. At the bottom

of the screen is the Scanner Setup parameter (for a detailed explanation of how this feature works, refer to the section **5.1.5. Scanner Connections**).

8. Scroll to a parameter you wish to edit. The parameter that is highlighted may now be edited (refer to section **4.4. Test Parameters**). Enter a new number via the alphanumeric keypad. Once you begin typing a new number the parameter will blank and the cursor will begin blinking. This indicates that the parameter is being edited. Once a parameter is edited it is necessary to complete the edit either by pressing the ENTER key to accept the new number or the EXIT key to escape from the edit and return to the original number.

9. Press the EXIT key to “Add” this test to the sequence of tests. The Setup Tests screen will now be displayed again, this time with the new parameters.

10. At this point, you may add more tests to the sequence, insert tests, insert prompts, perform the test sequence, or store the sequence to the file name you created.

Test Parameter Notes

- Once you begin typing a new number, the parameter will go blank and the cursor will begin blinking. This indicates that the parameter is being edited. Once a parameter is edited, it is necessary to complete the edit either by pressing the ENTER key to accept the new number or the EXIT key to escape from the edit and return to the original number. The one exception to this rule is the Scanner parameter. The Scanner parameter will not go blank when being edited.

- When the ENTER key is pressed to accept a parameter change, the instrument will automatically bring up the next Test Parameter Edit screen.

- The Test Parameter Edit screen displays the Range of the parameter that is highlighted. Use this as a guide when setting your parameters.

- The soft keys in the Parameter Menus select different conditions and no data entry is required, i.e. the “Frequency”soft key in the AC Withstand displays a Frequency pop up screen that allows for choices between 50Hz,60Hz or Sync. It is necessary to press the ENTER key to accept the new parameter or press EXIT to cancel from the edit.

- If the “Step Name” parameter is enabled in the System Menu, then each step will have a “Step Name” soft key in the Parameter Menus. The step name can be a maximum of 24 characters in length and may use any combination of the character set plus numbers and symbols. To name the step, use the alphanumeric keypad. If you make a mistake or want to change the character, press the backspace key in the alphanumeric keypad. The cursor will decrement and erase the character. If you wish to use capital letters in the prompt, press the “Caps Lock” soft key. While pressing the Caps Lock soft key, the Caps Lock parameter will toggle between ON and OFF. If you wish to use symbols in the prompt, press the “Symbol Key” soft key. While pressing the Symbol Key soft key, the symbol values will toggle between !, *, _, - and ~. When you have finished

editing the file name press the ENTER key.

- Selecting the test type (ACW, DCW, and IR) automatically loads the default parameters for that particular type of test. Refer to section **4.4.2. Default Test Parameters** for the preset default parameters.

- Scanner and External scanner parameters will only appear in the Parameter screens if the options are installed.

Adding More Tests to the Sequence
To add more tests to the sequence simply repeat steps 5-10 of this section.

Performing a Test from the Setup Tests screen
To perform the test you have just created press the ENTER key. The Perform Tests screen will now be displayed along with a pop-up message that appears.

Pressing the ENTER key will store the file with the file name you gave it and go to the Perform Test screen. You may now perform a test (refer to section **5.2. Perform Tests Menu**).

Pressing the EXIT key will return you to the Main Menu without saving the file. Even though the file has not been saved, the file will be retained in RAM until another file is loaded or created, or until the instrument is powered down.

Saving the Test File
From the Setup Tests screen, press the “File” soft key. The File Setup screen will now be displayed.

From the File Setup screen, press the “Save” soft key. The file will save to the name you created and the Setup Tests screen will now be displayed with the new file loaded. While hitting the “Save” soft key, the following pop up will be displayed indicating the file is being saved.

The instrument is now ready to perform tests with the new file. You may now press the ENTER key to go to the Perform Tests screen or press the EXIT key to return to the Main Menu.

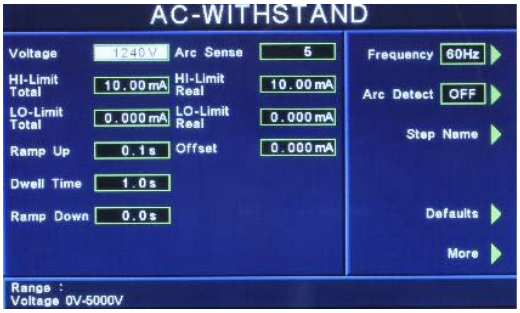
Inserting Tests
From the Setup Tests screen, scroll the highlighted area to the step in the sequence where you would like to insert a test.

Press the “Add” soft key. The highlighted area will blank and the test that was originally at this step in the sequence, as well as all of following steps, will increment. At the same time the Setup Test, Tests Selection screen will be displayed.
You may now select the type of test you wish to insert from the soft key menu.

Inserting a Text Prompt
Refer to section **4.3.4. Prompt** for a detailed description of inserting text prompts.

4.5.1. AC Withstand

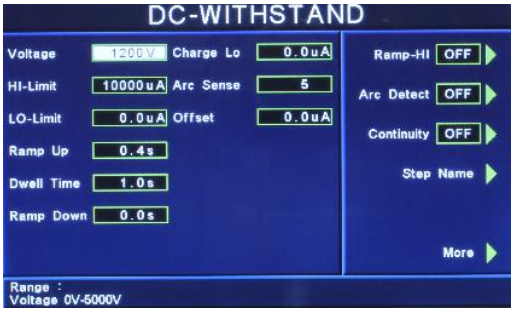
From the Setup Tests Selection screen, press the “Add”” soft key. The test types soft keys will now be displayed. Pressing the “Dielectric Withstand” soft key will display the “AC-Withstand” and “DC-Withstand” soft keys. Press the “AC-Withstand” soft key The AC Withstand Parameter Setting screen will now be displayed. The AC Withstand Parameter Setting screen will appear as follows:



From the AC Withstand Parameter Setting screen the following parameters may be controlled: Voltage, HI-Limit Total, LO-Limit Total, Ramp Up, Dwell Time, Ramp Down, Arc Sense, HI-Limit Real, LO-Limit Real, Offset, Frequency, Arc Detect (ON/OFF), Step Name, Scanner Channel Output Select, Defaults and More. Pressing the More soft key will display the additional parameters Continuity selection (DC continuity or OFF) and Select Meter.

4.5.2. DC Withstand

From the Setup Tests Selection screen, press the “Add”” soft key. The test types soft keys will now be displayed. Pressing the “Dielectric Withstand” soft key will display the “AC-Withstand” and “DC-Withstand” soft keys. Press the “DC-Withstand” soft key The DC Withstand Parameter Setting screen will now be displayed. The DC Withstand Parameter Setting screen will appear as follows:



From the DC Withstand Parameter Setting screen the following parameters may be controlled: Voltage, HI-Limit, LO-Limit, Ramp Up, Dwell Time, Ramp Down, Charge-LO, Arc Sense, Offset, Ramp-HI (ON/OFF), Arc Detect (ON/OFF), Continuity (DC continuity or OFF), Scanner Channel Output Select, Step Name and More. Pressing the More soft key will display the additional parameter Defaults.

Charge–LO

The Charge-LO function is used to check if the cables are connected properly at the beginning of a test. A capacitive DUT will draw charging current on the DC Withstand Voltage test when the Output is activated. If the charging current is lower than the setting, the test cables may not be connected properly.

The instrument can set the Charge-LO parameter manually or automatically. To

manually set the Charge-LO current, use the up and down arrow keys or the ENTER key and scroll the highlighted area to the Charge-LO current parameter. Enter the new Charge-LO current via the alphanumeric keypad and then press the ENTER key to accept the new parameter or press the EXIT key to escape from the edit.
To automatically set the Charge-LO current, use the up and down arrow keys or the ENTER key and scroll the highlighted area to the Charge-LO current parameter. Set the voltage and ramp times to the values that will be used on the DUT and connect the test cables or test fixture between the instrument and DUT. Press the TEST button.

WARNING **Please be aware that the program will activate high voltage on the output connector when the Test button is pressed.**

The program will read the charging current of DUT and set the Charge-LO current at approximately one half (1/2) of the reading. The highlighted parameter field will briefly show the word “READING” and then the display the new value. The new value is automatically updated in the field and does not allow an escape to the original value or require that the ENTER key be used to accept the new parameter.

Ramp-HI
The Ramp-HI function is active during the Ramp period only. Ramp-HI will allow current higher than the normal HI-Limit current setting of the DC Withstand test to avoid false failure due to charging current.

4.5.3. Insulation Resistance
From the Setup Tests Selection screen, press the “Add”” soft key. The test types soft keys will now be displayed. From the Setup Tests, Tests Selection screen, press the “Insulation Resistance” soft key. The Insulation Resistance Parameter Setting screen will now be displayed. The Insulation Resistance Parameter Setting screen will appear as follows:

From the Insulation Resistance Parameter Setting screen the following parameters may be controlled: Voltage, HI-Limit, LO- Limit, Ramp Up, Dwell Time, Delay Time, Ramp Down, Charge-LO, Scanner Channel Output Select, Select Name and Defaults.
Charge–LO
The Charge-LO function is used to check if the cables are connected properly at the beginning of a test. A capacitive DUT will draw charging current on the DC Withstand Voltage test when the Output is activated. If the charging current is lower than the setting, the test cables may not be connected properly.

The instrument can set the Charge-LO parameter manually or automatically. To manually set the Charge-LO current, use the up and down arrow keys or the ENTER

key and scroll the highlighted area to the Charge-LO current parameter. Enter the new Charge-LO current via the numeric keypad and then press the ENTER key to accept the new parameter or press the EXIT key to escape from the edit.
To automatically set the Charge-LO current, use the up and down arrow keys or the ENTER key and scroll the highlighted area to the Charge-LO current parameter. Make sure that the voltage and ramp times are set to the values that will be used on the DUT and connect the test cables or test fixture between the instrument and DUT. Press the test button.

WARNING **Please be aware that the program will activate high voltage on the output connector when the Test button is pressed.**

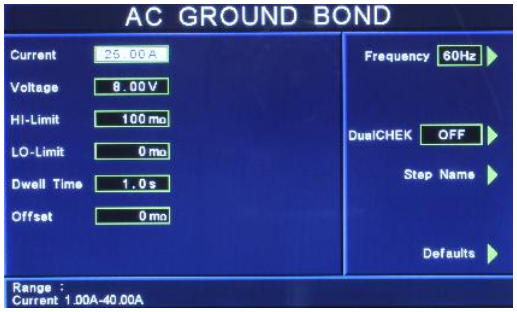
The program will read the charging current of DUT and set the Charge-LO current at approximately one half (1/2) of the reading. The highlighted parameter field will briefly show the word “READING” and then the display the new value. The new value is automatically updated in the field and does not allow an escape to the original value or that the ENTER key be used to accept the new parameter.

4.5.4. Continuity and Ground Bond
The Continuity test is generally used to test the ground conductor of a line cord. If the resistance exceeds the HI-Limit trip point or drops below the LO-Limit trip point the ESA SERIES will signal a continuity failure.

NOTE: When testing products with two pronged plugs do not activate the continuity circuit.

When the Ground Bond test is selected on the ESA SERIES, the High Current will be applied through the Current lead and flow back through the Return lead. The resistance is measured and compared to the HI and LO-Limit trip points stored in memory.

4.5.5. AC Ground Bond
From the Setup Tests Selection screen, press the “Add”” soft key. The test types soft keys will now be displayed. From the Setup Tests Selection screen, press the “AC Ground Bond” soft key. The Ground Bond Parameter Setting screen will now be displayed. The Ground Bond Parameter Setting screen will appear as follows:



From the Ground Bond Parameter Setting screen, the following parameters may be controlled: Current, Voltage, HI-Limit, LO- Limit, Dwell Time, Offset, Scanner Channel, Frequency, DualCHEK, Step Name and Defaults.

Offset
This function allows the instrument to compensate for lead and test fixture resistance during a Ground Bond or Continuity test. Using the up and down arrow keys or the ENTER key, scroll the highlighted area to the Offset parameter. You may now manually or automatically set an Offset value.

To manually set an Offset value enter a milliohm value via the numeric keypad and then press the ENTER key to accept the new value or press the EXIT key to escape from the edit.

To automatically set an Offset value set the output voltage, current, and frequency to the values that will be used on the DUT and connect the test cables, test fixture, or Scanner channel to the instrument. Next, short the ends of the test cables and press the TEST button. The highlighted parameter field will briefly show the word “READING” and then display the new value. The new value is automatically updated in the field and does not allow an escape to the original value or require that the ENTER key be used to accept the new parameter.

DualCHEK
This function allows the instrument to simultaneously run a hipot and AC Ground Bond test. While pressing the “DualCHEK” soft key, the DualCHEK pop up screen will appear as follows:

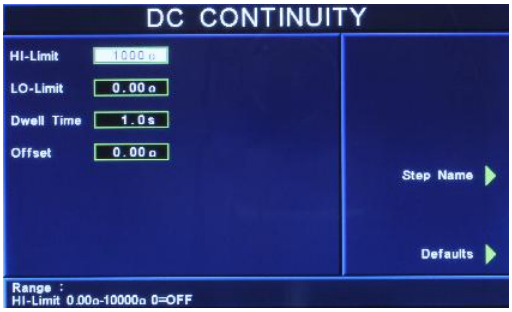
Use the up or down arrow keys to select the DualCHEK setting for this test. The DualCHECK setting options are ACW, DCW or OFF.

Once a parameter is edited, it is necessary to complete the edit either by pressing the ENTER key to accept the new value or the EXIT key to escape from the edit and return to the original value.

For the DualCHEK to function properly, the test immediately following the AC Ground Bond test in the sequence must be the test specified in the DualCHEK parameter. For example, if DualCHEK is set to ACW, the next test in the sequence after the AC Ground Bond test must be an ACW test. If the test immediately following the AC Ground test does not match the DualCHEK setting, the AC Ground Bond test and following test will run sequentially.

4.5.6. DC Continuity
From the Setup Tests Selection screen, press the “Add”” soft key. The test types soft keys will now be displayed. From the Setup Tests Selection screen, press the “DC Continuity” soft key. The DC Continuity Parameter Setting screen will now be

displayed. The DC Continuity Parameter Setting screen will appear as follows:



From the Continuity Parameter Setting screen, the following parameters may be controlled: HI-Limit, LO- Limit, Dwell Time, Offset, Scanner Channel, Step Name and Defaults.

Offset
This function allows the instrument to compensate for lead and test fixture resistance during a Ground Bond or Continuity test. Using the up and down arrow keys or the ENTER key, scroll the highlighted area to the Offset parameter. You may now manually or automatically set an Offset value.
To manually set an Offset value enter a milliohm value via the numeric keypad and then press the ENTER key to accept the new value or press the EXIT key to escape from the edit.

To automatically set an Offset value set the output voltage, current, and frequency to the values that will be used on the DUT and connect the test cables, test fixture, or Scanner channel to the instrument. Next, short the ends of the test cables and press the TEST button. The highlighted parameter field will briefly show the word “READING” and then display the new value. The new value is automatically updated in the field and does not allow an escape to the original value or require that the ENTER key be used to accept the new parameter.

4.5.7. Run Test (OPT.768 and Opt.769)
EEC recommends performing a Hipot test with the Fail Stop ON prior to performing a Run Test or Line Leakage test. Performing a Hipot test first can detect if a DUT is shorted line to ground before applying line power to it.

From the Setup Tests, Tests Selection screen, press the “Run Test” soft key. The Run Test Parameter Setting screen will now be displayed. The Run Test Parameter Setting screen will appear as follows:

From the Run Test Parameter Setting screen, the following parameters may be controlled: Voltage-HI, Voltage-LO, Amp-HI, Amp-LO, Dwell Time, Delay Time, Leakage-HI, Leakage-LO, Power-HI, Power-LO, PF-HI and PF-LO, AC Source, Active Link, Select Meter and Step Name.

PF (Power factor)
Power Factor = W/VA where W =Watts (Real Power) and VA =Volts x Amps (apparent power). It is important to note that the closer the power factor is to "1" the more resistive the DUT is. The closer the power factor is to 0 the more reactive (inductive or capacitive) the DUT is.

Leakage (Leakage-HI and Leakage-LO)
Leakage in the Run Test mode refers to the amount of current, which flows from the enclosure (case) of the DUT, to the neutral side of the line input. The Leakage-HI trip limit is used to program the maximum allowable earth leakage current of the DUT before failure. The Leakage-LO trip limit is used to program the minimum allowable earth leakage current of the DUT before failure. The Leak HI trip limit also controls the earth leakage configuration as shown in FIG.1.

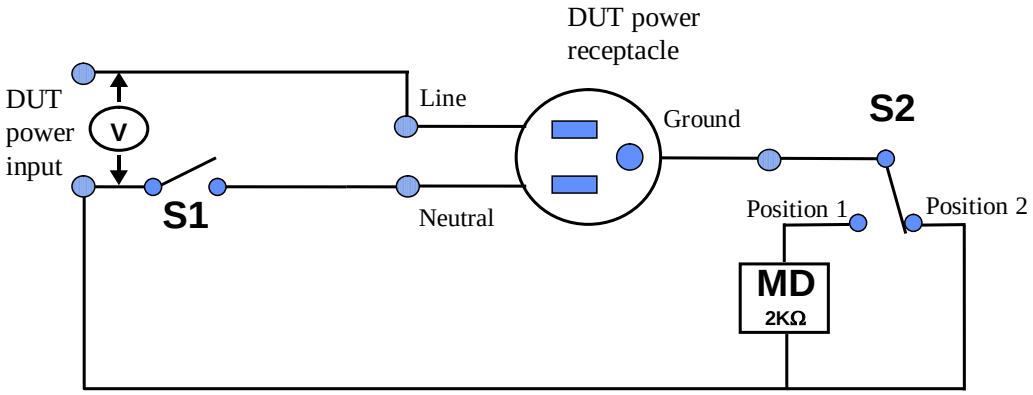
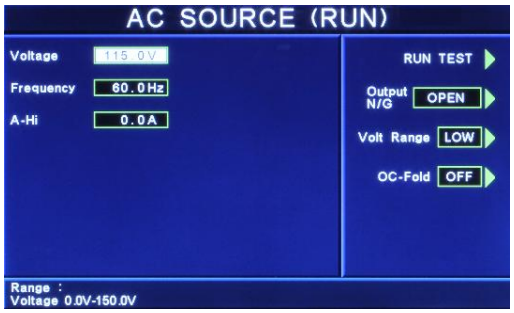


Figure 1

When the Leakage-HI trip limit is set to 0, S2 is placed in position 2 which disables the earth leakage test and connects the neutral of the DUT input to the ground of the DUT.

AC Source for OPT.769
Press the “AC Source” soft key to enter the AC Source Test Parameter screen. The screen will look as follows:

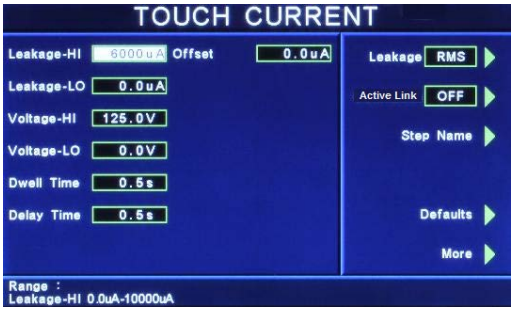


From this screen, you can control the following test parameters: Voltage, Frequency, A-Hi, Output N/G, Volt Range and OC-Fold. The A-Hi parameter allows you to set the

AC Source high current limit. The Output N/G parameter allows you to configure the AC Source output to either open or close the ground connection. The Volt Range parameter controls the output range of the AC Source (high or low). See specifications for more details. The OC-Fold parameter allows you to set the output of the AC source in constant current mode. When active, the A-Hi parameter can be used to set the output current of the AC source.

4.5.8. Touch Current Test (OPT.768 and Opt.769)
EEC recommends performing a Hipot test, with the Fail Stop “ON”, prior to performing a Run Test or Line Leakage test. Performing a Hipot test first can detect if a DUT is shorted line to ground before applying line power to it.

From the Setup Tests, Tests Selection screen, press the “TOUCH CURRENT” soft key. The Line Leakage parameter-setting screen will now be displayed. The Line Leakage parameter-setting screen will appear as follows:



From the TOUCH CURRENT Parameter Setting screen, the following parameters may be controlled: Leakage-HI, Leakage-LO, Voltage-HI, Voltage-LO, Dwell Time, Delay Time, Offset, Leakage, Active Link, Step Name, Defaults and More. Pressing the More key will bring up additional parameters: Reverse, Neutral, Ground, Measuring Device and Probe. Pressing the More soft key again will bring up additional parameters: AC Source, AC/DC, Select Meter, and Ranging Mode.

Line Configuration Soft keys
The LINE configuration is determined by the relays S1, S2 and S3 (refer to Figure 2) and is set using the corresponding Line Configuration Soft keys. S1 relay is represented as NEUTRAL and is controlled by the Neutral soft key. S2 relay is represented as REVERSE and is controlled by the Reverse soft key. S3 relay is represented as GROUND and is controlled by the Ground soft key. Pressing the relays corresponding soft key will toggle it between its two available states

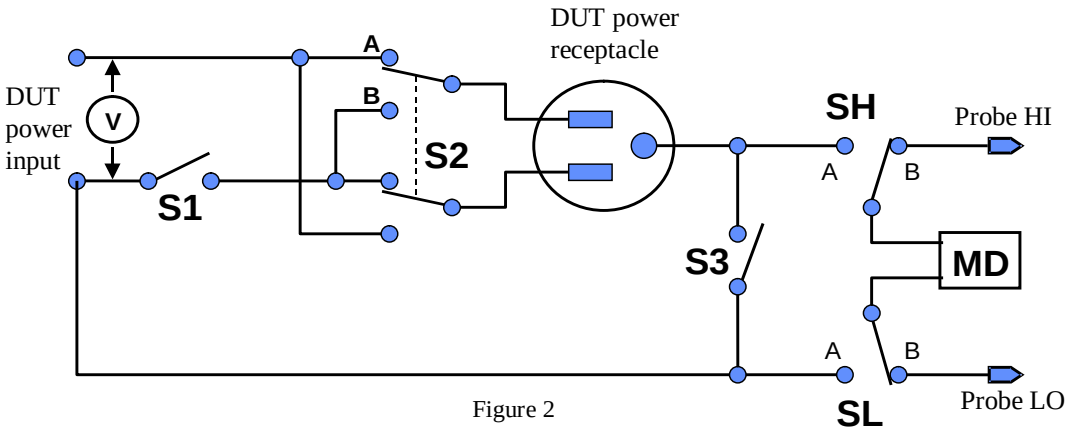


Figure 2

Line Configuration Setting

When the Neutral or Ground relays are set to the CLOSED position they are in a normal operating condition. When the Neutral or Ground relays are set to the OPEN position they are in a fault condition that represents a fault in the line input wiring.

When the REVERSE relay is set to ON, the relay is in position B (refer to Figure 2) and the Line and Neutral conductors are reversed at the DUT power outputs. The power output is represented as the power receptacle in Figure 2.

The three relays may be configured into eight different combinations of Line conditions. The different combinations are represented in the table below (refer to Figure 2).

LINE CONFIG.	**NEUTRAL**		**REVERSE**			**GROUND**	
	Relay/ Soft key	Fault	Soft key	Relay	Fault	Relay/ Soft key	Fault
1	Open	Yes	OFF	A	No	Open	Yes
2	Open	Yes	ON	B	Yes	Open	Yes
3	Open	Yes	OFF	A	No	Closed	No
4	Open	Yes	ON	B	Yes	Closed	No
5	Closed	No	OFF	A	No	Open	Yes
6	Closed	No	ON	B	Yes	Open	Yes
7	Closed	No	OFF	A	No	Closed	No
8	Closed	No	ON	B	Yes	Closed	No

Probe Configuration

The Probe configuration is controlled by the relays SH and SL shown in Figure 2 and are set by the Probe soft key. These two relays configure the current measuring device into three possible positions. Repeatedly pressing the Probe soft key allows the selection of the three different states. The three positions are described in the table below.

MEASURING DEVICE POSITION	SH	SL	DISPLAY INDICATION	AGENCY TEST APPLICATION
Ground to Line	A	A	Ground to Line	Earth Leakage
Probe HI to Line	B	A	Probe-HI to Line	Enclosure Leakage or Patient Leakage
Probe-HI to Probe-LO	B	B	Probe-HI to Probe-LO	External Applied Part or Surface to Surface Leakage

Ground to Line, indicates the MD is connected to measure the leakage current in the earth ground conductor in the line cord back to the system neutral and is referred to as an EARTH LEAKAGE TEST.

Probe-HI to Line indicates the MD is connected between the PROBE HI terminal on the instrument, which should be connected to the ENCLOSURE of the DUT and the system neutral. This is known as an ENCLOSURE LEAKAGE TEST.

Probe-HI to Probe-LO indicates the MD is connected between the PROBE HI and the PROBE LO terminals on the instrument which allow the operator to connect the MD between applied parts.

Measuring Device
The Measuring Device is an impedance circuit that simulates the human body. The Measuring device is specified differently for different agencies, applications and specifications. Repeatedly pressing the Measure Device soft key will allow you to select one of the many measuring devices listed in the table below. The table below indicates the available measuring devices and the appropriate agency standard to which it correlates.

Cross Reference Number	Agency Specification	Application
1	UL544 Non patient equipment	Medical Equipment
2	UL544 Patient care equipment	Medical Equipment
3	IEC601-1, UL2601, EN60601-1	Medical Equipment
4	UL1563	Electric Spas, Equipment Assemblies and Associated Equipment
5	IEC60990 Fig4-U2, IEC60950	Laboratory Equipment Information Technology
6	IEC60990 Fig5-U3	Laboratory Equipment Information Technology
External	User configurable	User configurable

Frequency Check	The Line Leakage test can be configured to verify the bandwidth of the leakage current “voltmeter”, by setting the Probe configuration, “Probe-HI to Probe-LO”, and selecting the measuring device “Frequency Check”.	The selection is intended to be used for meter verification only and has no application for normal testing.

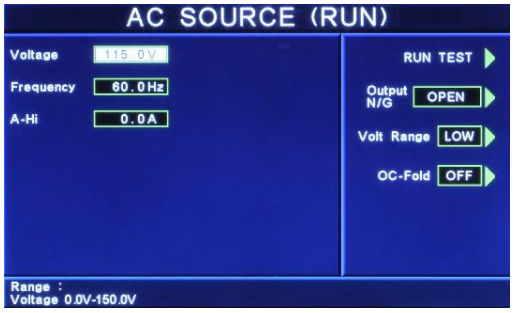
External Measuring Device
The OPT.768, OPT.769 have an access panel on the back of the instrument that can be removed to access the MD external PCB. The MD external PCB may be configured for a simple resistive measuring device. No components are supplied for the population of the PCB.

Frequency Check
The Line Leakage test can be configured to verify the bandwidth of the leakage current “voltmeter” by setting the Probe configuration to “Probe-HI to Probe-LO” and selecting the medical device “Frequency Check”. The selection is intended for meter verification purposes only and has no application for normal testing.

The calculation of the displayed leakage current will use 1000 Ω for R in the calculation of V/R=I where I is the leakage current displayed and V is voltage across the measuring device (MD). When an external frequency generator is applied to the probe inputs, the current display will be equal to Voltage generator/1000. The readings can then be correlated to verify the voltmeter bandwidth.

Since the voltage is being applied directly across the MD voltmeter amplifier inputs, it is not necessary to actually install a 1KΩ resistor to the external MD input. It is necessary to have the 0Ω resistors installed in position R1 and R3 on the external measuring device PCB to operate in this mode. If the external Measuring Device has been populated in a different configuration, it will be necessary to create a temporary short on R1 and R3 to operate in this mode. Another option would be to acquire a spare external measuring device PCB for the meter verification purpose.

AC Source for OPT.769
Press the “AC Source” soft key to enter the AC Source Test Parameter screen. The screen will look as follows:



From this screen, you can control the following test parameters: Voltage, Frequency, A-Hi, Output N/G, Volt Range and OC-Fold. The A-Hi parameter allows you to set the

AC Source high current limit. The Output N/G parameter allows you to configure the AC Source output to either open or close the ground connection. The Volt Range parameter controls the output range of the AC Source (high or low). See specifications for more details. The OC-Fold parameter allows you to set the output of the AC source in constant current mode. When active, the A-Hi parameter can be used to set the output current of the AC source.

4.6. My Menu

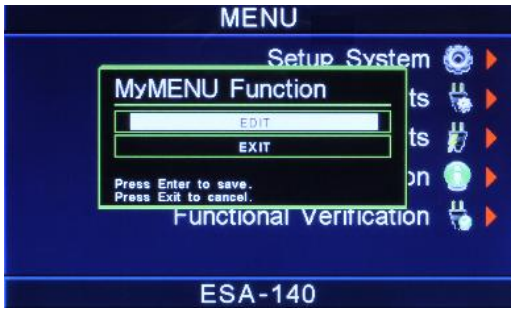
From the System Setup screen press the “My Menu” soft key. The My Menu screen appears as follows:

The My Menu function allows the user to configure a custom menu. In order to customize a softkey selection, press and hold one of the softkeys until the My Menu pop appears as follows:

Use the up or down arrow keys to select the preferred function. The My Menu setting options are EDIT and DELETE. EDIT will allow the user to select a system, test or file parameter. DELETE will clear the current softkey selection.

Once a parameter is edited, it is necessary to complete the edit either by pressing the ENTER key to accept the new value or the EXIT key to escape from the edit and return to the original value.

When selecting EDIT, the user will be directed to the main MENU screen. All softkey selections highlighted in red can now be added as a My Menu softkey selection. To add a selection as a My Menu softkey, press and hold the desired softkey until the My Menu Function pop up appears as follows:



Use the up or down arrow keys to select the preferred function. The My Menu setting options are EDIT and DELETE. Selecting EDIT will input the selected parameter as a My Menu softkey. DELETE will clear the current softkey selection.

Once a parameter is edited, it is necessary to complete the edit either by pressing the ENTER key to accept the new value or the EXIT key to escape from the edit and return to the original value.

To navigate to other menus within the unit, simply press the softkey selection without holding it down.

5. Operating Instructions

5.1. Instrument Connections

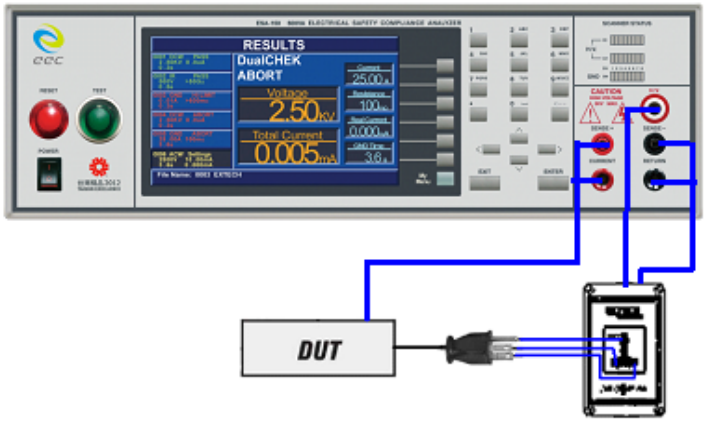
The test leads and the adaptor box may be connected to the receptacles located on the front or the back of the ESA SERIES. The HV, Current, Return, Sense+, and Senseand receptacles located on the front panel of the ESA SERIES are wired in parallel with another set located on the back of the instrument.

5.1.1. Connecting the Test Leads

The instrument comes with all cables necessary for performing a Hipot, Continuity, Ground Bond, and Insulation Resistance test. Connect the HV lead with the alligator clip and white insulating tip into the HV receptacle on the ESA SERIES. Connect the Return lead with the black alligator clip into the Return receptacle and the Sense- receptacle. Connect the Ground Bond lead with the red alligator clip into the Current and Sense+ receptacles.

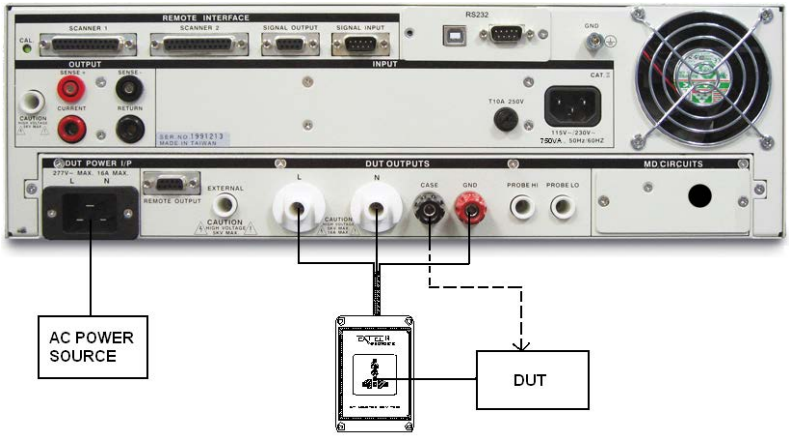
5.1.2. Adapter Box Connections

The adapter box provides an easy way to connect a line-cord terminated DUT to the ESA SERIES. The following diagrams show how to connect the adapter box to the ESA series to the device under test.



The rear output connections may be used for connecting the adapter box as well.

Adapter Box Connections OPT.768 and OPT.769



DUT Input Voltage Connections for OPT.768 and OPT.769

WARNING

The Power Source to the device under test (DUT) inputs must be an unbalanced single-phase supply. This means that there is only one HOT or LINE conductor and the other conductor of the power source must be at a low voltage reference potential. The low voltage reference does not need to be physically earth grounded but should not carry any large voltage potential. The 220 - 240V US style line power **IS NOT** suitable to connect to the DUT inputs. This style of power distribution is a balanced type with two HOT or LINE conductors. Be sure that the hot lead of the power source is connected to pin 1, L (line) terminal of the DUT input connector and the Reference or low voltage lead is connected to pin 2, N (neutral) terminal of the DUT input connector. **DO NOT** connect a line conductor to the N or Neutral terminal of the DUT inputs. This condition can be very dangerous to the LINECHEK user.

If voltage is applied to pin 2, N (neutral) terminal of the DUT input and you attempt to execute a Run Test or Line Leakage test, a warning message will appear in the displayed messages portion of the screen that says **Neutral-V**. If you see this message, you will need to correct the voltage problem before the instrument will allow you to execute Run Tests or Line Leakage tests.

5.1.3. Interlock Connector

ESA SERIES is equipped with a Remote Interlock feature. Remote Interlock utilizes a set of closed contacts to enable the instrument's output. If the Remote Interlock contacts are open the output of the instrument will be disabled. Remote Interlock can also be referred to as a remote system lockout, utilizing "fail when open" logic. To disable the Remote Interlock feature connect the Interlock Key into the Signal Input port located on the back of the tester.

5.1.4. Scanner Connections

WARNING

The Scanner provides 8 High Voltage channels and 8 Ground Bond channels on the rear panel. The High Voltage channels can be set to a High or Low level giving the capability to test from one channel to another channel or from any channel to a common Low or Return point. The channels can be connected in parallel if desired but there is only one leakage current measurement for all channels. The Ground Bond channels can test only from one channel to the common Return and only one channel may be used for each test.

Instructions for setting the Scanner channels are in the section **4.4. Test Parameters** of this manual.

The Scanner will provide output to multiple test points and will have the same operation specifications that apply to the standard instrument with the exception of one Ground Bond channel limitation. Due to the characteristics of general-purpose

High Current relays, some additional contact resistance cannot be prevented. Although this contact resistance can be offset using the milliohm offset feature of the instrument, there will be some variation of the contact resistance because the relay must open and close. Each relay closure may represent a different resistance value. The Ground Bond channels will have the following characteristics:

Ground Bond/Continuity Channel Resistance Deviation	
Deviation (Relay Contact)	Test Current
6m□□maximum	≥10A

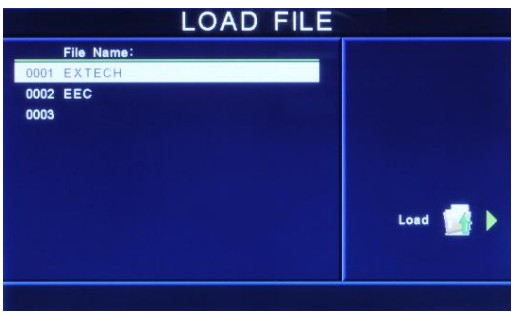
5.2. Perform Tests Menu

From the Main Menu screen, press the soft key “Perform Tests”. The Perform Tests Menu will now be displayed. From the Perform Tests screen, four different software controls may be accessed: Single Step (ON/OFF), Fail Stop (ON/OFF), Load File, Results. The arrow keys may also be used to scroll the highlighted area to a specific test or page of tests if the file is larger than 10 steps. The Perform Tests screen will appear as follows:

The Perform Tests screen is the main operational screen of instrument. From this screen individual steps are monitored while the test is being performed. At the end of a sequence of tests, all of the step results may be recalled via the “Results” soft key on this screen. This screen may also be used to debug test files with the use of the single step and fail stop functions.

5.2.1. Load File

From the Perform Tests screen, press the “Load File” soft key. The Load File screen will now be displayed. The Load File screen will appear as follows:



Using the up and down arrow keys, scroll the highlighted area to the File you would like to load and press the “Load” soft key. The file you selected will now load and the screen will revert to the Perform Tests screen.

5.2.2. Single Step

Single step is a function that allows you to run one step at a time from a sequence of tests. At the Perform Tests screen, use the up and down arrow keys or the ENTER key to scroll the highlighted area to the step you wish to perform. Press the TEST button and the instrument will initiate the single step and stop when finished without continuing to the next step.

You may single step through an entire sequence in this way as long as you do not press RESET. Once RESET is pressed it will return you to the originally selected step.

Turn the Single Step function ON and OFF by pressing the “Single Step” soft key. If Security is enabled, single step may not be turned ON and OFF at the Perform Test screen. The state Single Step is in at the time security is enabled is the state at which it shall remain.

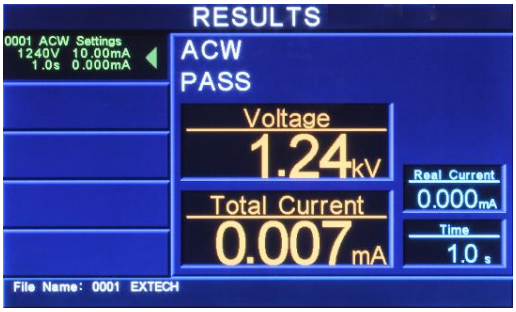
5.2.3. Fail Stop

Fail Stop is a function that will stop a sequence of tests at the step that fails. If the Fail Stop is turned ON and a failure occurs (stopping the test), pressing the TEST button will start the test sequence at the original step. If Fail Stop is turned OFF, the sequence of tests will continue to the end of the sequence regardless of whether or not a failure has occurred. If the Fail stop is OFF and a failure occurs during the test sequence, the RESET button will light and a short alarm will sound but the sequence will continue to the end. At the end of the test sequence, the RESET button will light and alarm will sound indicating failure during the sequence. Pressing the RESET button will silence the alarm and reset the instrument.

Turn the Fail Stop function ON and OFF by pressing the “Fail Stop” soft key. If security is enabled you may not turn Fail Stop ON and OFF using the “Fail Stop” soft key. Fail Stop automatically defaults to the setting stored in the file when security is activated.

5.2.4. Results

At the end of a test sequence or single step test, you may review the measurements of each test by pressing the “Results” soft key. Results may be accessed from the end of test Summary screen or from the Perform Tests screen.



Using the up and down arrow keys, scroll the highlighted area to the step results you wish to review. The left and right arrow keys may be used to page through results if the test contains more than five steps. When the highlighted area is on the step you are reviewing, the test settings will be displayed in the highlighted area and the results will appear on the right in the form of metering screens. The result screens will appear differently for each type of test. The results screens are based on the Performing

Tests metering screens and are identical in appearance except for the title. Refer to section **5.4. Perform Tests Metering** for the meters that will be displayed.

5.3. Performing a Test

1. As instructed in section **4.2. System Setup**, select a memory and step that is suitable for the test you would like to perform.

2. Attach the appropriate DUT to the instrument (refer to section **5.1. Instrument Connections**).

3. Press the TEST button.

4. The instrument will now perform the test or connected sequence of tests. If the test is started from any other step than 01, the instrument will return to the originally selected step when you push RESET or TEST buttons.

5. If a Prompt is embedded within a step, the test will pause at that step and display the Prompt as a pop-up message.

6. In order to clear the Prompt and continue the test, push the TEST button. The highlighted area of the screen remains on the test that is being performed until it is finished. At the same time on the right half of the screen will be the appropriate metering display for the type of test that is being performed (refer to section **5.4. Perform Tests Metering**). When the step is complete the highlighted area will sequence to the next step and the new metering display will appear (unless there is a prompt embedded within the step). When the highlighted area moves to the next step, the previous step area will now display the results of the test just performed.

7. At the end of the test sequence, the right side of the screen will display a flashing PASS if all the tests have completed successfully or a flashing FAIL if any of the tests did not complete successfully. If a test fails, the right side of the screen will indicate the step that failed and which parameter of the step failed.

5.4. Perform Tests Metering

Each test performed by the ESA SERIES contains a unique set of parameters and therefore requires specialized metering for each test. The following table describes what meters will be displayed for each of the different test types.

Metering Screens					
Test Type	Current(T)	Current(R)	Voltage	Time	Resistance
AC Withstand	X	X	X	X	
DC Withstand	X		X	X	
IR			X	X	X
Continuity				X	X
Ground Bond	X			X	X

The meter layout on the Perform Tests screen can be customized to show the most relevant information in the larger meter windows. Please refer to **Section 4. Programming Instructions** for more information.

5.5. Displayed Messages

Directly above the Metering screens is the Test Status display. This portion of the display is active during the test and allows you to view the type of test being performed and status of the test step. At the end of a test, the Test Status display will either inform you that the test has passed or give a direct indication of the kind of failure that occurred during the test.

5.5.1. Test Status Messages
The following is a complete listing of the messages that appear in the Test status display and an explanation for each.

Dwell
This message appears on the display while a test is in process, the values update in real time.

Delay
This message appears on the display while a test is in process, the values update in real time.

Ramp Up
This message appears on the display at the beginning of the test, when the output voltage is ramping up.

Ramp Down
This message appears on the display at the end of the dwell cycle, when the output voltage is ramping down.

Pass
This message appears on the display when the test process is complete and the DUT passed the test.
5.5.2. Error Messages

Abort
This message appears on the display if the test in process is aborted with the RESET button or remote Reset control.

HI-Limit
This message appears on the display if the DUT measurement exceeds the HI-Limit setting of any parameter (except AC withstand).

LO-Limit
This message appears on the display if the DUT measurement drops below the LO-Limit setting of any parameter (except AC withstand).

HI-Lmt T
This message appears on the display if the DUT leakage current exceeds the HI-Limit setting, of the Total current parameter in AC withstand.

LO-Lmt T
This message appears on the display if the DUT leakage current drops below the LO-Limit setting, of the Total current parameter in AC withstand.

HI-Lmt R
This message appears on the display if the DUT leakage current exceeds the HI-Limit setting, of the Real current parameter in AC withstand.

LO-Lmt R
This message appears on the display if the DUT leakage current drops below the LOLimit setting, of the Real current parameter in AC withstand.

CONT-Fail
This message appears on the display if the DUT fails the basic Continuity check performed during an AC/DC Withstand test when Continuity is selected ON.

Arc-Fail
This message appears on the display if the DUT arcing current exceeds the Arc Sense limit (Arc Sense = 1…9) and the Arc function is active.

Short
This message appears on the display if the DUT current is well beyond the metering range of the test.

Charge-LO
This message appears on the display if the leakage current during Ramp-up falls below the Charge -LO setting.

Breakdown
This message appears on the display if the DUT current is well beyond the metering range of the test and the arcing condition beyond the arc sense limit.

Interlock Open
This message appears on the display if the Remote Interlock feature is activated before or during a test. The Remote Interlock feature utilizes a set of closed contacts which will disable the instrument's output if they are opened before or during a test. Remote Interlock could also be referred to as a remote system lockout, utilizing "fail when open" logic. The Remote Interlock feature may be disabled by plugging the "Interlock Disable Key" provided into the Signal Input connector. See section 6.2 Remote Signal Inputs and Memory Access for more information.

GND-Fault
This message appears on the display if the GFI threshold is exceeded during the test.

Out-Error
This message appears on the display if the instrument's output reading does not match the set value. If the instrument has an output problem when the TEST button is pressed.

OTP-Fail
This message appears on the display if the Power Amplifier has overheated. This is abnormal condition; please call to the factory for assistance.

5.5.3 Test Status Messages (OPT.768 and OPT.769)

Volt-HI
This message appears on the display if the DUT input voltage exceeds the Volt-HI Trip setting.

Volt-LO
This message appears on the display if the DUT input voltage drops below the Volt-LO Trip setting.

Amp-HI
This message appears on the display if the current exceeds the Amp-HI Trip setting.

Amp-LO
This message appears on the display if the current drops below the Amp-LO Trip setting.

Line-OC
This message appears on the display if the 20 Amp < 1 s, short circuit protection is tripped.

Power-HI
This message appears on the display if the DUT input wattage exceeds the Power-HI Trip setting.

Power-LO
This message appears on the display if the DUT input wattage drops below the Power-LO Trip setting.

PF-HI
This message appears on the display if the Power Factor exceeds the PF-HI Trip setting.

PF-LO
This message appears on the display if the Power Factor drops below the PF-LO Trip setting.

Leak-HI
This message appears on the display if the enclosure to neutral leakage current exceeds the Leak-HI Trip setting.

Leak-LO
This message appears on the display if the enclosure to neutral leakage current drops below the Leak-LO Trip setting.

Neutral-V
This message appears on the display if there is voltage present on the Neutral of the DUT input receptacle.

Leak-OC
This message appears on the display if the voltage of MD circuit exceeds the rating voltage.

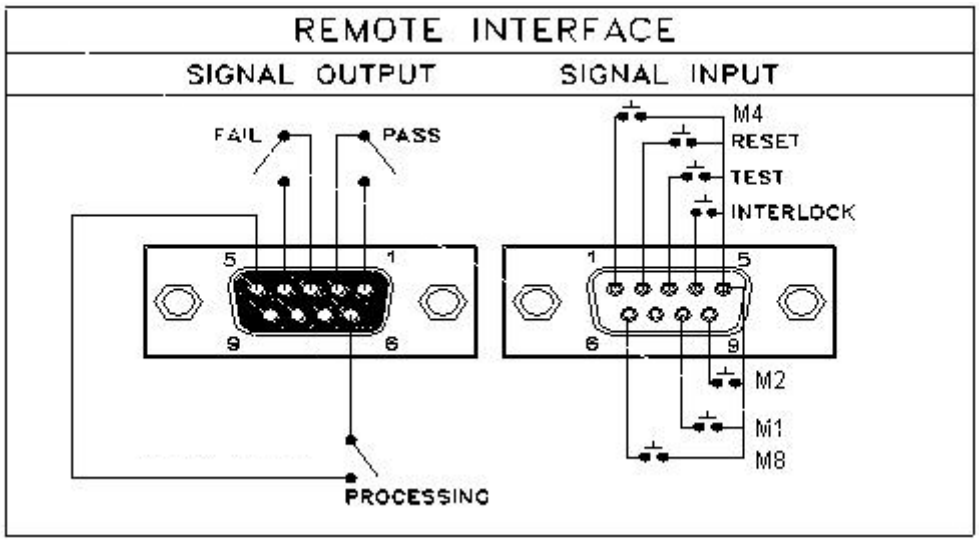
OCP
This message appears on the display if the maximum current draw exceeds the capability of the internal power source (>4.2A).

OTP-Fail
This message appears on the display for two reasons. First, if the power amplifier has overheated. This is an abnormal condition; please call the factory for assistance. Second, if the power transistors on the DUT Power Switch Board are overheated. When the OTP trips, the calibration function will be disabled until the power transistors cool down.

6. Connection of Remote I/O

Two 9-pin “D” type connectors are mounted on the rear panel that provide REMOTE-INPUT-OUTPUT control and information. These connectors mate with standard 9 pin D-sub-miniature connector provided by the user. The output mates to a male (plug) connector while the input mates to a female (receptacle) connector. 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. Suggested AMP part numbers for interconnecting to the Remote I/O are shown below:

Remote Interface Rear Panel:



6.1. Signal Outputs on Remote I/O

The rear panel connector provides three output signals to remotely monitor PASS, FAIL, and PROCESSING conditions. The monitoring 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 will not provide any voltage or current. The ratings of the contacts are 1A / 125 VAC (0.5 ADC). The signal outputs are provided on the 9-pin female D connector. Below is a listing that indicates what conditions activate each pin. When a terminal becomes active the relay closes thereby allowing the external voltage to operate an external device.

Pins 1 and 2 provide the PASS signal.
Pins 3 and 4 provide the FAIL signal.
Pins 5 and 6 provide the PROCESSING signal.
The following describes how the relays operate for each test condition.

PROCESSING - The relay contact closes the connection between pin (5) and pin (6) while the instrument is performing a test. The connection is opened at the end of the test.
PASS - The relay contact closes the connection between pin (1) and pin (2) after detecting that the item under test passed all tests. 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 (3) and pin (4) after detecting that the item under test failed. The connection will open when the next test is initiated or the reset function activated.

6.2. Signal Inputs of Remote I/O and Programmed Test Files

The ESA Series remote connector enables remote operation of the TEST, RESET and REMOTE INTERLOCK functions, and allows the operator to select one of 10 pre-programmed test files.

When the PLC Remote mode is on, the ESA Series will respond to simple switch or relay contacts closures. A normally open momentary switch can be wired across pins 3 and 5 to allow remote operation of the TEST function. A normally open momentary switch can be wired across pins 2 and 5 to allow remote operation of the RESET function. When the PLC remote function is (ON) the TEST switch on the front panel will be disabled to prevent a test from being activated through this switch. For safety, the front panel RESET switch remains active even when a remote reset switch is connected so that high voltage can be shut down from either location.

The Remote File Select function gives the user the capability to quickly change parameters and initiate a test remotely. Ten pre-programmed test files can be accessed by connecting pins 1,6,8, and 9 to the common pin 7, in different combinations. The **Remote File Select Truth Table** (binary) shows the different combinations of momentary switch (relay) closures, and which memory programs that will be selected as the result. It may be necessary to "OR" the momentary switches (relay contacts) to prevent incorrect program selection due to timing errors.

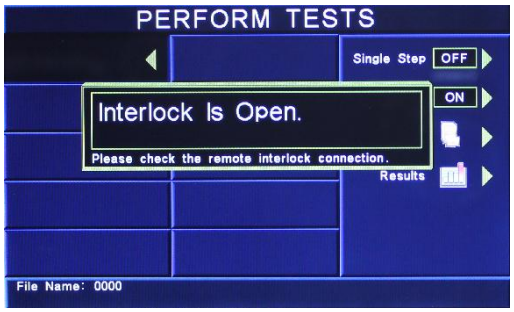
REMOTE FILE SELECT TRUTH TABLE				
BIT 4	BIT 3	BIT 2	BIT 1	FILE #
0	**0**	**0**	**1**	01
0	**0**	**1**	**0**	02
0	**0**	**1**	**1**	03
0	**1**	**0**	**0**	04
0	**1**	**0**	**1**	05
0	**1**	**1**	**0**	06
0	**1**	**1**	**1**	07
1	**0**	**0**	**0**	08
1	**0**	**0**	**1**	09
1	**0**	**1**	**0**	10
1= Momentary Contact closure between BIT and COMMON				
0= No Contact closure between BIT and COMMON				

WARNING Activating file program functions through the remote connector selects the file and starts the test that is pre-programmed into that file.

CAUTION Do not connect voltage or current to the signal inputs. Applying voltage to the signal input could result in damage to the control circuitry.

Remote Interlock

ESA SERIES is equipped with a Remote Interlock feature. Remote Interlock utilizes a set of closed contacts to enable the instrument's output. If the Remote Interlock contacts are open the output of the instrument will be disabled. Remote Interlock could also be referred to as a remote system lockout, utilizing "fail when open" logic. If the Remote Interlock contacts are open and the TEST button is pushed, a pop-up message will be displayed on the screen for two seconds. The message will appear as follows:



If the Remote Interlock contacts are opened during a test, the pop-up message will be displayed and the test will abort. The hardware and has been configured to provide the interlock connections on pins 4 and 5 of the Remote Interface, Signal Input port. The instrument can still be used without the external interlock device as long as the Interlock Disable Key (1505 provided with unit) is plugged into the Remote Interface, Signal Input port. If there is nothing connected to the Remote Interface, Signal Input port to provide a connection to the Remote Interlock, the instrument will not perform tests.

7. Bus Remote Interface GPIB / RS-232

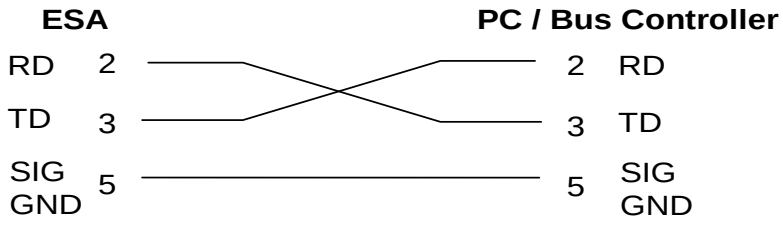
This section provides information on the proper use and configuration of bus remote interface. The RS-232 remote interface is standard on model 810X but the GPIB (IEEE-488) interface option can be substituted for the RS-232 interface. Please refer to the Option section of this manual for details on the ESA SERIES options. The RS-232 interface also uses the same command set as the GPIB interface for setting of test parameters. However there are many functions of the GPIB 488.2 interface that are not available through RS-232. The IEEE-488 interface included with ESA SERIES conforms to the requirements of the IEEE-488.2 standard.

7.1. RS-232 Interface

This interface provides all of the control commands and parameter setting commands of the GPIB interface with the exception of some of the 488.2 Common Commands and SRQ capability. All commands can be found in section **7.4. RS-232/GPIB Command List**. The identification command *IDN and the Status Reporting commands are also available through RS-232.

7.1.1. RS-232 Connector

The RS-232 cabling should be configured as follows for a 9-pin serial port interface



7.1.2. Communications Port Configuration

The COM port should have the following configuration:

- 9600 baud
- 8 data bits
- 1 stop bit
- No parity

This interface does not support XON/XOFF protocol or any hardware handshaking. The controller should be configured to ignore the handshaking lines DTR (pin 4), DSR (pin 6) CTS (pin 8) and RTS (pin 7). If the port cannot be configured through software to ignore these lines the handshake lines should be jumpered together in two different sets. Pins 4 and 6 should be jumpered together and pins 7 and 8 should be jumpered together at the controller end of the cable.

7.1.3. Sending and Receiving Commands

Sending Data

Once a command is sent to the instrument over the RS-232 bus the instrument will send one of two responses. If the transfer was recognized and completed the

instrument will return with 06 hex or 6 decimal, the Acknowledge (ACK) ASCII control code. If there is an error with the command string that is sent, the instrument will respond with 15 hex or 21 decimal, the Not Acknowledge (NAK) ASCII control code. The ACK or NAK response allows for software handshaking to monitor and control data flow.

Receiving Data
When requesting data from the instrument it will automatically send the data back to the controller input buffer. The controller input buffer will accumulate data being sent from the instrument, including the ACK and NAK response strings, until it has been read by the controller.

7.2. GPIB Interface

This interface is optional on the ESA SERIES and provides all of the control commands and parameter setting commands of the RS-232 interface along with 488.2 Common Commands and SRQ capability. All commands can be found in section **7.4. RS- 232/GPIB Command List**.

7.2.1. GPIB Connector

Connection is usually accomplished with a 24-conductor cable with a plug on one end and a connector at the other end. Devices may be connected in a linear, star or a combination configuration.

The standard connector is the Amphenol or Cinch Series 57 Microribbon or AMP CHAMP type. The GPIB uses negative logic with standard transistor-transistor logic (TTL) levels. When DAV is true, for example, it is a TTL low level (□□0.8 V), and when DAV is false, it is a TTL high level (□□2.0 V).

Restrictions and Limitations on the GPIB

- A maximum separation of 4 m between any two devices and an average separation of 2 m over the entire bus.
- A maximum total cable length of 20 m.
- No more than 15 device loads connected to each bus, with no less than two thirds powered on. For example 1 GPIB controller and a maximum of 14 GPIB instruments.

NOTE: A bus extender, which is available from numerous manufacturers, is available to overcome these limitations.

7.2.2. GPIB Address

Each device on the GPIB (IEEE-488) interface must have a unique address. You can set the address of the ESA SERIES to any value between 0 and 30. The address can only be set from the front panel. The address is stored in non-volatile memory and does not change when the power has been off or after a remote reset.

The address is set to 8 when the instrument is shipped from the factory.

7.3. Interface Functions

The capability of a device connected to the bus is specified by its interface functions. These functions provide the means for a device to receive, process, and send messages over the bus. The interface functions are listed in the chart below.

GPIB 488.1 INTERFACE FUNCTIONS

INTERFACE FUNCTION	SUBSET	DESCRIPTION
Source Handshake	SH1	Complete Source handshake capability
Acceptor Handshake	AH1	Complete Acceptor handshake capability
Talker	T6	Talker functions (unaddress if MLA)
Listener	L4	Listener functions (unaddress if MTA)
Service Request	SR1	Complete Service request capability
Remote Local	RL0	No remote/local capability
Parallel Poll	PP0	No parallel poll capability
Device Clear	DC1	Complete Device clear capability
Device Trigger	DT0	No device trigger capability
Controller	C0	No controller capability
Electrical Interface	E2	Three-state drivers

Controllable Items	Test and Reset control. Setting of test parameters for tests. Reading of instrument status and test results.
Data Codes	ASCII
Delimiter	NL (+ EOI)

7.4. RS-232 / GPIB Interface Command List

7.4.1. Echo and Response Considerations

RS-232 Responses

The RS-232 bus will automatically send any response back to the controller's input buffer.

GPIB Queries and Responses

The ESA SERIES GPIB bus will not send any data to the controller without being queried.

A GPIB read command must be sent after a command string to retrieve any data from a query command (?).

Rules for Sending Commands to the Instrument

The following conventions are used to describe the commands syntax for the ESA SERIES:

- Braces ({ }) enclose each parameter for a command string.
- Triangle brackets (< >) indicate that you must substitute a value for the enclosed

parameter.

- The Pipe (|) is used to separate different parameter options for a command.
- The command and the parameter data must be separated with a space.
- Each command string should be terminated by the ASCII control code, New Line (NL), (0Ah) or the end of line (EOL) message for GPIB.
- All commands that end with a question mark (?) are query commands and required an IEEE-488 read command to retrieve the data from the device's output buffer.

7.4.2. Test Execution Commands

The following commands are used to control actual output voltage and current from the instrument. Please observe all safety precautions.

COMMAND	DESCRIPTION
TEST	Execute a Test
RESET	Abort a test in Process or Reset Failures
SAO	Set Auto-Offset
SACG	Set Auto-Charge-LO

TEST
Starts the test sequence at the selected step loaded into memory (RAM).

RESET
Stop or abort a test. Also used to reset a latched failure condition.

SAO
Set the offset for the Ground bond test or Continuity test. The cables and any test fixture should be connected before executing the command. This command will perform an actual test and all safety precautions should be observed when using this command.

SACG
Set the Charge-LO parameter for the DCW or IR test. The cables and any test fixture should be connected before executing the command. The test parameters that are set for the step will be used when performing the auto setting. This command will perform an actual test and all safety precautions should be observed when using this command.

7.4.3. File Editing Commands

The following commands are used to create or modify Test Setup Files.

COMMAND	DESCRIPTION	VALUE
FL nn	File Load nn	*nn* = 01-9999
FD	File Delete	Active selected File
FD nn	File Delete by Number	*nn* = 01-9999
FS	File Save	Active selected File

COMMAND	DESCRIPTION	VALUE
FSA nn,xxxx	File Save-as	nn = 01-9999, xxx = name
FN nn,xxxx	File New	nn = 01-9999, xxxx = name
SS nn	Step Select	*nn = 01-9999*
ADD **<***test,p1,p2,p3…***>**	Adds all parameters	
ADD2<test,p1,p2,p3…>	Adds all parameters	
SAA	Step Add ACW test	
SAD	Step Add DCW test	
SAI	Step Add IR test	
SAG	Step Add GND test	
SAC	Step Add CONT test	
SAGA	Step Add GND, ACW tests	
SAGD	Step Add GND, DCW tests	
SAR	Step Add RUN test	
SAL	Step Add TCT test	
SD	Step Delete	Active selected Step
SD nn	Step Delete by Number	*nn = 01-9999*
SP <*prompt message*>	Step Prompt Create	*prompt message* = Valid ASCII (1) maximum 31 characters
SP	Step Prompt Delete	
SF {1|0}	Step Fail Stop	1=On, 0=Off

(1) "Valid ASCII" is the character set that is available from the front panel LCD user interface. Consisting of upper case alphabet (A-Z), numbers (0-9) and decimal point (.), asteric (*), dash (-), underbar (_), tilde (~) and space (SP).

FL <file number>
Load a file from non-volatile memory into random access memory RAM.

FD
Deletes the file loaded into RAM from the non-volatile memory space as well as RAM. A new file must be loaded before and tests can be run.

FD <file number>
Deletes a file from non-volatile memory indicated by the file number.

FS
Saves the file from RAM to the non-volatile memory space.

FSA {<file number>,<file name>}
Saves the current file from RAM into the non-volatile memory space with the indicated file number and file name. The original file will not be modified with this operation. If there is a file already located at the desired number it will be moved to the next higher number and inserted in its place. New files may be added to the bottom of the file list but there must not be any numbers that do not have a file defined.

FN {<file number>,<file name>}
Creates a new file name at the specified file number. If there is a file already located at the desired number it will be moved to the next higher number and inserted in its place. New files can be added to the bottom of the file list but there must not be any numbers that do not have a file defined.

SS <step number>
Selects the active selected step to load into RAM. The step must first be selected before any specific parameters can be edited.

ADD <test,p1,p2,p3…>
This command inserts or adds a new step to the test sequence. This command will add or insert the test at the step location that has been selected. When a test has already been created at a selected step then the new step will be inserted and the previous step will move down to the next step and all other step will be renumbered accordingly.

The parameter <*test*> indicated the test type. The values ACW, DCW, IR, GND, CONT, RUN or LLT must be used. The parameters <*p1,p2*> etc. indicate the individual settings for each test. All parameters must be included with the command and should appear in the same order that is shown on the actual setting screens. The correct order is shown in the tables below. When the scanner is installed it should be the last parameter for all test types except GND. For the GND test type, the scanner settings should be inserted between offset and frequency. The list of parameters can also be found in the default parameters section of the manual.

The parameter values should use complete text and not use the coded values that are associated with the individual parameter setting commands. Such as "ON" and "OFF" and any toggle field that use words or phrases like "OPEN", "CLOSE". The LS? companion command will also list all parameters in complete text as they appear on the setting screen.

	ACW	DCW	IR
1	Voltage	Voltage	Voltage
2	HI-Limit T	HI-Limit	HI-Limit
3	LO-Limit T	LO-Limit	LO-Limit
4	Ramp Up	Ramp Up	Ramp Up
5	Dwell Time	Dwell Time	Delay Time
6	Ramp Down	Ramp Down	Ramp Down
7	Arc Sense	Charge-LO	Charge-LO

8	HI-Limit Real	Arc Sense	DUT Output
9	LO-Limit Real	Ramp-HI *(ON/OFF)*	Scanner Setup
10	Frequency	Arc Detect *(ON/OFF)*	
11	Arc Detect *(ON/OFF)*	Continuity *(ON/OFF)*	
12	Continuity *(ON/OFF)*	DUT Output	
13	DUT Output	Scanner Setup	
14	Scanner Setup		

	GND	**CONT**	**RUN**	**LLT**
1	Current	HI-Limit	Voltage-HI	Leakage-HI
2	Voltage	LO-Limit	Voltage-LO	Leakage-LO
3	HI-Limit	Dwell	Amp-HI	Voltage-HI
4	LO-Limit	Offset	Amp-LO	Voltage-LO
5	Dwell	Scanner Channel	Dwell Time	Delay Time
6	Offset	Continuity	Delay Time	Neutral *(OPEN/CLOSED)*
7	Scanner Channel		Leakage-HI	Reverse *(ON/OFF)*
8	Frequency		Leakage-LO	Ground *(OPEN/CLOSED)*
9			Power-HI	Meas. Device *(UL544NP/UL544P/IEC601UL2601/ UL1563/IEC60990FIG4-U2/ IEC60990FIG5-U3/IEC60990FIG3-U1/ EXTERNAL)*
10			Power-LO	Probe *(Ground To Line/ Probe-HI to Line/Probe-HI To Probe-LO)*
11			PF-HI	Leakage Mode *(Peak/RMS)*
12			PF-LO	PLC Control
13			Continuous	
14			PLC Control	

ADD2

This command inserts or adds a new step to the test sequence. This command will add or insert the test at the step location that has been selected. When a test has already been created at a selected step then the new step will be inserted and the previous step will move down to the next step and all other step will be renumbered accordingly.

The parameter <*test*> indicated the test type. The values ACW, DCW, IR, GND, CONT, RUN or LLT must be used. The parameters <*p1,p2*> etc. indicate the individual settings for each test. All parameters must be included with the command and should appear in the same order that is shown on the actual setting screens. The correct order is shown in the tables below. When the scanner is installed it should be the last parameter for all test types except GND. For the GND test type, the scanner settings should be inserted between offset and frequency. The list of parameters can also be found in the default parameters section of the manual.

The parameter values should use complete text and not use the coded values that are associated with the individual parameter setting commands. Such as "ON" and "OFF" and any toggle field that use words or phrases like "OPEN", "CLOSE". The LS2? companion command will also list all parameters in complete text as they appear on the setting screen.

	ACW	DCW	IR
1	Voltage	Voltage	Voltage
2	HI-Limit T	HI-Limit	HI-Limit
3	HI-Limit R	LO-Limit	LO-Limit
4	Ramp Up	Ramp Up	Ramp Up
5	Dwell Time	Dwell Time	Dwell Time
6	Ramp Down	Ramp Down	Delay Time
7	Arc Sense	Charge-LO	Ramp Down
8	LO-Limit T	Arc Sense	Charge-LO
9	LO-Limit R	Offset	Scanner
10	Offset	Ramp HI	
11	Frequency	Arc Detect	
12	Arc Detect	Continuity (ON/OFF)	
13	Continuity (ON/OFF)	Scanner	
14	Scanner		

	GND	CONT	RUN	LLT
1	Current	HI-Limit	Voltage-HI	Leakage-HI
2	Voltage	LO-Limit	Voltage-LO	Leakage-LO
3	HI-Limit	Dwell	Amp-HI	Voltage-HI
4	LO-Limit	Offset	Amp-LO	Voltage-LO
5	Dwell	Scanner	Dwell Time	Dwell Time
6	Offset	Continuity	Delay Time	Delay Time
7	Scanner		Leakage-HI	Neutral *(OPEN/CLOSED)*
8	Frequency		Leakage-LO	Reverse *(ON/OFF)*
9	Dual-Chek		Power-HI	Ground *(OPEN/CLOSED)*
10			Power-LO	Meas. Device *(UL544NP/UL544P/IEC60601UL2601/ UL1563/IEC60990FIG4-U2/ IEC60990FIG5-U3/ EXTERNAL/Frequency Check)*
11			PF-HI	Probe *(Ground To Line/ Probe-HI to Line/Probe-HI To Probe-LO)*
12			PF-LO	Leakage Mode *(Peak/RMS)*
13			Continuous	Continuous
14			PLC Control	AC/DC

			Voltage	
15			Frequency	Ranging Mode
16			A-Hi	PLC Control Voltage
17			Output N/G	Frequency
18			Volt-Range	A-Hi
19			OC-Fold	Output N/G
20				Volt Range,
21				OC-Fold
22				Scanner Setup

SAA, SAD, SAI, SAG, SAC, SAGA, SAGD, SAL, SAR
These commands insert or add a new step to the test sequence. This command will add or insert the test at the step location that has been selected. When a test has already been created at a selected step then the new step will be inserted and the previous step will move down to the next step and all other step will be renumbered accordingly. See the command summary tables to see the specific test type for each of these commands.

SD
Deletes the active step from the setup file sequence. All step after this step will move up and be renumbered accordingly.

SD <*step number*>
Deletes the step indicated by the number from the setup file sequence. All step after this step will move up and be renumbered accordingly.

SP <*prompt message*>
Adds or edits a prompt message for the active step.

SP
Removes or deletes the prompt that had been created for the active step.

SF {1|0}
Sets the Fail Stop function OFF or ON for the active setup file loaded into RAM. 1 sets the Fail Stop = ON, 0 sets the Fail Stop = OFF.

7.4.4 Test Parameter Editing Commands and Companion Queries
These commands are used to modify the test parameter within each step. These commands require a parameter value to be included with the command. The companion query command will read the parameter. The writing of the parameter requires that the unit not be included with the value, only the numeric value should be included with the command. Also when the query commands are used the response will not include the units characters. Many of the commands will function the same way for multiple test types however the input range may be different and therefore used a different possible set of values.

COMMAND	NAME	TEST TYPES	VALUE
EA < *value* > EA?	Edit Arc	ACW DCW	1 - 9
EAD {1|0} EAD?	Edit Arc-Detect	ACW DCW	1= On, 0=Off

COMMAND	NAME	TEST TYPES	VALUE
ECG < *value* > ECG?	Edit Charge-Lo	IR DCW	0.0 - 350uA 0.000 - 3.5000uA
ECT {1|0} ECT?	Edit Continuity	ACW DCW	1= On, 0=Off
EC < *value* > EC?	Edit Current	GND	1.00 - 40.00A
ECH < *value* > ECH?	Edit Current-HI	RUN	0.00 - 16.00A
ECL < *value* > ECL?	Edit Current-Lo	RUN	0.00 - 16.00A
EDE < *value* > EDE?	Edit Delay	IR RUN LLT	0.0 - 999.9s
EDO {1|0} EDO?	Edit DUT-Output Voltage	ACW DCW IR	1= On, 0=Off
EDW < *value* > EDW?	Edit Dwell	ACW DCW GND CONT RUN	0.0 - 999.9s
EF {1|0} EF?	Edit Frequency	ACW GND	1=60Hz, 0=50Hz, 2=400Hz (option), 3=800Hz (option), 4=SYNC
EG {1|0} EG?	Edit Ground	LLT	1=Open, 0=Close
EH < *value* > EH?	Edit HI-Limit	DCW IR GND CONT	0.0 - 20000uA 0.05 - 50000MΩ 0 - 600mΩ 0.00 - 10.00Ω
EHR < *value* > EHR?	Edit HI-Limit-R	ACW	0.000 - 50.00mA
EHT < *value* > EHT?	Edit HI-Limit-T	ACW	0.000 - 50.00mA
EL < *value* > EL?	Edit LO-Limit	DCW IR GND CONT	0.0 - 20000uA 0.05 - 50000Ω 0 - 600mΩ 0.00 - 10000Ω
ELR < *value* > ELR?	Edit LO-Limit-R	ACW	0.000 - 50.00mA
ELT < *value* > ELT?	Edit LO-Limit-T	ACW	0.000 - 50.00mA
ELM {1|0} ELM?	Edit Leakage Mode	LLT	1=Peak, 0=RMS

COMMAND	NAME	TEST TYPES	VALUE
EM {0|1|2|3|4|5|6|7|8} EM?	Edit Meas-Device	LLT	0=UL544NP 1=UL544P 2=IEC601, UL2601 3=UL1563 4=IEC60990 FIG4-U2 5=IEC60990 FIG5-U3 6=NAK 7=External 8=Frequency Check
EN {1|0} EN?	Edit Neutral	LLT	1=Open, 0=Close
EO < *value* > EO?	Edit Offset	GND CONT	0 - 200mΩ 0.00 - 10.00Ω
EPFH < *value* > EPFH?	Edit PF-HI	RUN	0.000 - 1.000
EPFL < *value* > EPFL?	Edit PF-LO	RUN	0.000 - 1.000
EPOH < *value* > EPOH?	Edit Power-HI	RUN	0 - 4500W
EPOL < *value* > EPOL?	Edit Power-LO	RUN	0 - 4500W
EP {0|1|2} EP?	Edit Probe	LLT	0=Ground to Line 1=Probe-HI to Line 2=Probe-HI to Probe-LO
ERD <*value* > ERD?	Edit Ramp-Down	ACW DCW IR	0.0 - 999.9s
ERH {1|0} ERH?	Edit Ramp-HI	DCW	1= On, 0=Off
ERU < *value*> ERU?	Edit Ramp-Up	ACW DCW IR	0.0 - 999.9s
ER {1|0} ER?	Edit Reverse	LLT	1= On, 0=Off
ES <*scanner string*> ES?	Edit Scanner High Voltage Multi-port	ACW DCW IR	*scanner string* = 1-16 element ASCII string consisting of H, L, or O. H=HV, L=RETURN, O=OPEN
ESN <*value*> ESN?	Edit Scanner Low Voltage Single-port	GND CONT	*value* = 0 - 16, 0 = ALL OPEN
EV <*value*> EV?	Edit Voltage	ACW DCW IR GND	1 - 5000V 1 - 6000V 1 - 1000V 3.00 - 8.00V

COMMAND	NAME	TEST TYPES	VALUE
EVH < *value* > EVH?	Edit Voltage-Hi	RUN LLT	0.0 - 277.0V
EVL < *value* > EVL?	Edit Voltage-Lo	RUN LLT	0.0 - 277.0V
EO < value > EO?	Edit Offset	ACW DCW GND CONT	0-50mA 0-20000uA 0-200mΩ 0-10.00Ω
SN < value > SN?	Edit Step Name	ACW DCW IR GND CONT	20 character max
EDC < value > EDC?	Edit Dual Chek	GND	0 = off, 1 = ACW, 2 = DCW

EDOC
This command is used to control the Continuity and Ground Bond tests at the DUT outputs of the LLT and RUN test interface. It should only be used when Continuity or Ground Bond tests are routed through the HS-16 external, PC controlled scanner. When the EDOC command is set to 0 the Continuity or Ground Bond test will be disconnected from the GND and Case terminals of the DUT-outputs to eliminate possible parallel paths with the scanner outputs.

7.4.5. System Parameter Editing Commands and Companion Queries
These commands are used to modify the system parameters for the instrument. These commands require a parameter value to be included with the command. The companion query command will read the parameter using the same value that is used for setting the parameter.

COMMAND	NAME	VALUE
SA < *value* > SA?	Alert Date	mm,dd,yy or yy,mm,dd or dd,mm,yy ; same as SDF setting
SAL < *value* > SAL?	Alarm Volume	0-9
SCA {1|0} SCA?	Cal Alert	1= On, 0=Off
SCDA < *value* > SCDA?	Cal Date	mm,dd,yy or yy,mm,dd or dd,mm,yy ; same as SDF setting
SCDU < *value* > SCDU?	Cal Due	mm,dd,yy or yy,mm,dd or dd,mm,yy ; same as SDF setting
SDAY {6|5|4|3|2|1|0} SDAY?	Day of the week	0,1,2,3,4,5,6= Sun,M,T,W,T,F,Sat
SDF < *value* >	Date Format	0=yy,mm,dd, 1=mm,dd,yy

COMMAND	NAME	VALUE
SDF?		2=dd,mm,yy
SDH{1|0} SDH?	DUT-HV	1= On, 0=Off
SDT < *value* > SDT?	Date	mm,dd,yy or yy,mm,dd or dd,mm,yy ; same as SDF setting
SF {1|0} SF?	Fail Stop	1= On, 0=Off
SL {1|0} SL?	Lock	1= On, 0=Off
SMM {2|1|0} SMM?	Main Menu page	2 = My Menu, 1= Perform Tests, 0=Menu
SPR {1|0} SPR?	PLC Remote	1= On, 0=Off
SSG {1|0} SSG?	Smart GFI	1= On, 0=Off
SSG2 < value > SSG2?	Smart GFI value	0.4 – 5.0, 0
SSI {1|0} SSI?	Single Step	1= On, 0=Off
STM < *value* > STM?	Time	hh,mm (24hr) hh,mm,AM or hh,mm,PM (12hr) according to STF setting
STF {1|0} STF?	Time Format	0=12hr, 1=24hr
CAD {1|0} CAD?	System Alert Date	1 = On, 0 = Off
SAN {1|0} SAN?	Set Animation	2 = Skip, 1 = On, 0 = Off
SLA < value > SLA?	Set Language	0 = English, 1 = Traditional Chinese, 2 = Simplified Chinese
SCS < value > SCS?	Set Color Scheme	3 = Midnight, 2 = Arctic, 1 = Granite, 0 = Basic
SSN {1|0} SSN?	Set Step Name	1 = On, 0 = Off
SUL < value >?	Current User	0 – 8
SUA < p, p, p, p >	Add User	Pointer, name, password, level Pointer: 1-8 Name: 8 character max Password: 8 character max Level: 0 = Run only, 1 = Edit step, 2 = recall step, 3 = full system
SUD < value >	Delete User	1 – 8
SUE < p, p, p, p >	Edit User	Pointer, name, password, level

COMMAND	NAME	VALUE
		Pointer: 1-8 Name: 8 character max Password: 8 character max Level: 0 = Run only, 1 = Edit step, 2 = recall step, 3 = full system

7.4.6. Query Commands

These query commands will retrieve data from the instrument. The GPIB bus application requires an IEEE-488 read command to be sent after the query command. These commands include functions for retrieving test data, test results and remote hardware status as well as setup file information.

COMMAND	NAME	VALUE
TD?	List Testing Data	Test In Process
RD nn?	List Results Data	*nn* = 1-10000
RR?	Read Remote Reset	1=Open, 0=Closed
RI?	Read Remote Interlock	1=Open, 0=Closed
LF?	List File Name	Active selected file
LF nn?	List File Name by file number	*nn* = 1-10000
LP?	List Prompt	Active selected Step
LP nn?	List Prompt by step number	*nn* = 1-10000
FT?	File Total quantity stored	
ST?	Step Total quantity in file	
LS?	List Step Parameters	
LS <*step number*>?	List Step Parameters by step number	*step number* = 1-30
LS2 < step number>?	List Step Parameters by step number	Step number = 01-9999
RS?	Read scanner port status	0 = none, 1 = external 1, 2 = external 2, 3 = both
SS?	Select Step	nn = 01-9999

TD?

Read the active data being displayed on the LCD display while the test is in process. Will also read the last data taken when the test sequence has completed. Each parameter is separated by commas and includes step number, test type, test status, and metering. The syntax for this command response is {step, test type, status, meter 1, meter 2, meter 3}. ACW test displays 4 meters. Each meter will contain only the value and not the units. In the case of DCW current where both uA and mA are used on the display, the command response will always indicate the current in uA for example 2.0mA will respond with 2000 for 2000uA.

RD <*step number*>?

Read the results for an individual step. The step number is the actual step number that has been saved within the file, not the order of which the steps were executed.

For example if the test was executed starting from step 3 and ending with step 5 then the first step test results will be found in location 3 not in location 1. Each parameter is separated by commas and includes step number, test type, test status, and metering. The syntax for this command response is {step, test type, status, meter 1,meter 2,meter 3}. ACW test displays 4 meters. Each meter will contain only the value and not the units. In the case of DCW current where both uA and mA are used on the display the command response will always indicate the current in uA for example 2.0mA will respond with 2000 for 2000uA.

RR?
Read the remote Reset input signal. When the remote reset has be activated by closing the contacts the query will return a value of 1 to indicate the instrument is being Reset.

RI?
Read the remote Interlock input signal. When the remote Interlock has be activated by opening the contacts the query will return a value of 0 to indicate the instrument is in the Interlock state and will not be able to generate output voltage or current.

LF?
Lists the file name of the file loaded into active memory (RAM).

LF <*file number*>?
List the file name of any saved file within the directory structure. The file number is given to the file when the file is save into non-volatile memory.

LP?
Lists the prompt that is created for the individual step that has been selected within active memory (RAM).

LP <*step number*>?
Lists the prompt that has been created for of one of the steps of the file within active memory (RAM).

FT?
Returns the total quantity of files stored in memory.

ST?
Returns the total quantity of step created in the file.

LS?
Lists all the Parameters for the individual step that is currently selected.
The response will be formatted as follows; <*step, test, p1, p2, p3…*> Where <*step*> is the step number, <*test*> is the test type and <*p1,p2*> etc., indicates the parameters of the test. Please refer to the ADD command for a list of parameters for each test type.

LS <*step number*>?
Lists all the Parameters for the individual step indicated by *step number* = 1-30.
The response will be formatted as follows; <*step, test, p1, p2, p3…*> Where <*step*> is the step number, <*test*> is the test type and <*p1,p2*> etc., indicates the parameters of

the test. Please refer to the ADD command for a list of parameters for each test type.

LS2?
Lists all the Parameters for the individual step that is currently selected.
The response will be formatted as follows; <*step, test, p1, p2, p3…*> Where <*step*> is the step number, <*test*> is the test type and <*p1,p2*> etc., indicates the parameters of the test. Please refer to the ADD command for a list of parameters for each test type.

LS2 <step number>?
Lists all the Parameters for the individual step indicated by *step number* = 1-30.
The response will be formatted as follows; <*step, test, p1, p2, p3…*> Where <*step*> is the step number, <*test*> is the test type and <*p1,p2*> etc., indicates the parameters of the test. Please refer to the ADD command for a list of parameters for each test type.

RS?
Reads the instrument's scanner port status. The query will return either a 0 (none), 1 (external 1), 2 (external 2) or 3 (both external 1 and 2) which describes the number of local scanners connected to the instrument.

SS?
Reads the selected step from the instrument.

7.4.7. IEEE 488.2 Common Commands
These commands are required by the IEEE-488.2 standard with the exception of *PSC, *PSC?. Most of these commands are not available over the RS-232 bus except for the *IDN? command which can be used to retrieve the instrument identification information, and the four status reporting commands *ESR?, *ESE, *ESE? and *STB?.

COMMAND	NAME	DESCRIPTION
*IDN?	Identification Query	ARI, Model Number, Serial Number, Firmware Revision
*RST	Reset Command	Resets OMNIA
*TST?	Self-Test Query	00H=OK 01H=TEST EEPROM ERROR
*CLS	Clear Status Command	Clear Standard Event Status Register Clear Service Request Register
*OPC	Operation Complete Command	When TEST command ok setting ESR BIT0 =1
*OPC?	Operation Complete Query	1 = TEST completed ok 0 = TEST in process
*WAI	Wait-to-Continue Command	
*PSC {1|0}	Power-on Status Clear Command	1 = Power-on clear enable registers 0 = Power-on load previous enable registers
*PSC?	Power-on Status Clear Query	
*ESR?	Standard Event Status Register	0 - 255

	Query	
*ESE <*value*>	Standard Event Status Enable Command	*value* = 0 - 255
*ESE?	Standard Event Status Enable Query	0 - 255
*STB?	Read Status Byte Query	Read Status Byte
*SRE <*value*>	Service Request Enable Command	*value* = 0 - 255
*SRE?	Service Request Enable Query	0 - 255

***IDN?**
Read the instrument identification string. Company =EEC.

***RST**
Reset the instrument to original power on configuration. Does not clear Enable register for Standard Summary Status or Standard Event Registers. Does not clear the output queue. Does not clear the power-on-status-clear flag.

***TST?**
Performs a self test of the instrument data memory. Returns 0 if it is successful or 1 if the test fails.

***CLS**
Clears the Status Byte summary register and event registers. Does not clear the Enable registers.

***OPC**
Sets the operation complete bit (bit 0) in the Standard Event register after a command is completed successfully.

***OPC?**
Returns an ASCII "1" after the command is executed.

***WAI**
After the command is executed, it prevents the instrument from executing any further query or commands until the no-operation-pending flag is TRUE.

***PSC {1|0}**
Sets the power-on status clear bit. When set to 1 the Standard Event Enable register and Status Byte Enable registers will be cleared when power is turned ON. 0 setting indicates the Enable registers will be loaded with Enable register masks from non-volatile memory at power ON.

***PSC?**
Queries the power-on status clear setting. Returns 0 or 1.

***ESR?**
Queries the Standard Event register. Returns the decimal value of the binary-weighted sum of bits.

***ESE <value>**
Standard Event enable register controls which bits will be logically ORed together to generate the Event Summary bit 5 (ESB) within the Status Byte.

***ESE?**
Queries the Standard Event enable register. Returns the decimal value of the binary-weighted sum of bits.

***STB?**
Read the Status Byte. Returns the decimal value of the binary-weighted sum of bits.

***SRE <value>**
Service Request enable register controls which bits from the Status Byte should be use to generate a service request when the bit value = 1.

***SRE?**
Queries the Service Request enable register. Returns the decimal value of binary-weighted sum of bits.

7.4.8. Status Reporting
The status reporting system is a way of determining the condition of the tester and is configured using two types of registers. An Event register and a Summary register. The Summary register is known as the Status Byte register and records high-level summary information acquired by the Event registers.

An Event register report defines conditions or messages at each bit. The bits are latched and remain in an active state until the register is either Read or Cleared. Reading the Event register automatically clears the register and sets all bits to an inactive state or 0. When querying an Event register the information is returned as a decimal number representing the binary-weighted sum of all bits within the register.

The Enable register bits represent the selection of bits that will be logically OR'd together to form the summary bit in the Status Byte. The *CLS command will not clear the Enable registers and if you wish to clear the register you must set it to a value of 0. Like the Event register, the Enable register is represented as a decimal number that equals the binary-weighted sum of all bits.

The Enable register will clear to a value of 0 at power-on unless the *PSC 0 command has been executed before power-off. The *PSC command tells the device whether or not it should clear the Enable registers at power-on. Using this command will allow SQRs to function immediately after power-on.

		EVENT REGISTER		STATUS BYTE REGISTER	
Bit	Binary weight	Event Register	Enable Register	Summary Register	Enable Register
0	1	Operation Complete		ALL PASS	
1	2	not used		FAIL	
2	4	Query Error		ABORT	
3	8	Device Error		TEST IN PROCESS	
4	16	Execution Error		Message Available (MAV)	
5	32	Command Error		Event Summary Bit (ESB)	
6	64	not used		Request Service (RQS) or Master Summary Status (MSS)	not used
7	128	Power On		PROMPT	
		*ESR?	*ESE *ESE?	*STB? | SPOLL	*SRE *SRE?

7.4.9. GPIB Service Request

The service request capability is not available with the RS-232 interface. The SRQ line will be activated only after one or more of the service request functions have been enabled using the Status Byte Enable register command *SRE.

The Status Byte bit assignments are as described in the previous section for status reporting. When the instrument has requested service, the enabled bit or bits and the RQS bit 6 will be active or 1. Bits 4, 5, and 7 are not used and will be set to false, or 0 for all Status Byte reads.

After the serial poll (SPOLL) is executed the RQS bit will be cleared to 0 and the remaining bits will remain unchanged. The Status Byte will not change value until the Event register is read and cleared for the corresponding Status Byte bit.

For example, after the All Pass SRQ has been enabled, when the test(s) have finished with pass indications the instrument will set the hardware SRQ line and output the Status Byte of 41 hex. This means that bit 6 and bit 0 are set to a value of After reading the Status Byte the Status Byte value will change to 01 hex.

7.5. Non Volatile Memory

The instrument saves or deletes each parameter in non-volatile memory when the file save "FS", file save as “FSA”, file new “FN” and file delete “FD” commands are used to save, create and delete the files. The non-volatile memory has a limited write cycle life. Therefore, for programmers who wish to send all parameters before executing each test, the following commands should not be used:

FS – File Save
FSA – File Save As
FN – File New
FD – File Delete

The parameters will be stored in the CPU's Random Access Memory (RAM) until another memory location is selected. However, settings written to RAM from GPIB/USB/RS-232 mode will be lost when power is shut down. Parameter changes to RAM are unlimited and will not affect the life of the internal non-volatile memory chip.

A flowchart for an example program is shown on the next page. This flowchart exhibits how a program could be written to minimize wear to the write life cycle of the non-volatile memory. First, the “FN” command is used to create a blank file. In this case, the file is named TEMP. This file is then stored into the memory of the 7630. When the sequence needs to be recalled, the “FL” (File Load) command is used to recall the TEMP file. This creates a blank test sequence and steps can be added as necessary. Then the steps are added to the file via the “ADD” command and the sequence is executed. Programming in this fashion, the “FN” command is only used once to create a sequence. Then that sequence can be constantly loaded with the “FL” command and added to with the “ADD” command. This will avoid constantly writing to the non-volatile memory.

8. VERI-CHEK

VERI-CHEK (Verification) is the process by which an instrument's failure detectors are proven to be functioning properly. Verifying the failure detection circuitry of the electrical safety tester is required by safety agencies such as CSA, UL, and TÜV.

NOTE: Verification should be performed at the beginning of each day or each shift, before testing has begun.

8.1. VERI-CHEK Menu

From the Main Menu press the VERI-CHEK button.

The VERI-CHEK Menu screen will now be displayed. From the VERI-CHEK Menu screen, five different Verification processes may be accessed: Continuity, Ground Bond, AC Hipot, DC Hipot, and IR.

8.1.1. Continuity Verification

From the VERI-CHEK screen, press the "Continuity" soft key. A pop-up message will now be displayed. The message will appear as follows:

Follow the instructions given in the pop-up message and then press TEST to begin the verification process. During the Verification process, the metering screen for the related process will be displayed. Refer to section **5.4. Perform Tests Metering** for more information.

At the end of the Verification process, a pop-up message will appear indicating the outcome of the process. If the instrument passes the Verification (test failure, indicating the fail detectors are working properly) the RESET button will illuminate, the alarm will sound and the following pop-up message will appear over the metering screen:

If the instrument fails the Verification (test pass, indicating the fail detectors are not working properly) the TEST button will illuminate and the following pop-up message will appear over the metering screen:

8.1.2. Ground Bond Verification

From the VERI-CHEK screen, press the “Ground Bond” soft key. A pop-up message will now be displayed. The message will appear as follows:

Follow the instructions given in the pop-up message and then press TEST to begin the verification process. During the Verification process the metering screen for the related process will be displayed, refer to section **5.4. Perform Tests Metering** for more information.

At the end of the Verification process, a pop-up message will appear indicating the outcome of the process. If the instrument passes the Verification (test failure, indicating the fail detectors are working properly) the RESET button will illuminate, the alarm will sound and the following pop-up message will appear over the metering screen:

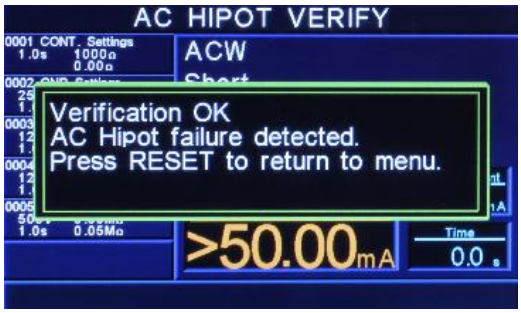
If the instrument fails the Verification (test pass, indicating the fail detectors are not working properly) the TEST button will illuminate and the following pop-up message will appear over the metering screen:

8.1.3. AC Hipot Verification

From the VERI-CHEK screen, press the “AC Hipot” soft key. A pop-up message will now be displayed. The message will appear as follows:

Follow the instructions given in the pop-up message and then press TEST to begin the verification process. During the Verification process the metering screen for the related process will be displayed, refer to section **5.4. Perform Tests Metering** for more information.

At the end of the Verification process, a pop-up message will appear indicating the outcome of the process. If the instrument passes the Verification (test failure, indicating the fail detectors are working properly) the RESET button will illuminate, the alarm will sound and the following pop-up message will appear over the metering screen:



If the instrument fails the Verification (test pass, indicating the fail detectors are not working properly) the TEST button will illuminate and the following pop-up message will appear over the metering screen:

8.1.4. DC Hipot Verification

From the VERI-CHEK screen, press the “DC Hipot” soft key. A pop-up message will now be displayed. The message will appear as follows:

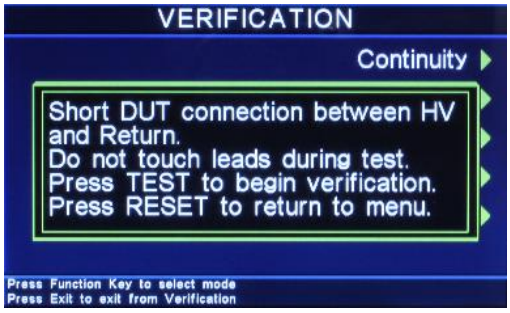
Follow the instructions given in the pop-up message and then press TEST to begin the verification process. During the Verification process the metering screen for the related process will be displayed, refer to section **5.4. Perform Tests Metering** for more information.

At the end of the Verification process, a pop-up message will appear indicating the outcome of the process. If the instrument passes the Verification (test failure, indicating the fail detectors are working properly) the RESET button will illuminate, the alarm will sound and the following pop-up message will appear over the metering screen:

If the instrument fails the Verification (test pass, indicating the fail detectors are not working properly) the TEST button will illuminate and the following pop-up message will appear over the metering screen:

8.1.5. IR Verification

From the VERI-CHEK screen, press the “IR” soft key. A pop-up message will now be displayed. The message will appear as follows:



Follow the instructions given in the pop-up message and then press TEST to begin the verification process. During the Verification process the metering screen for the related process will be displayed, refer to section **5.4. Perform Tests Metering** for more information.

At the end of the Verification process, a pop-up message will appear indicating the outcome of the process. If the instrument passes the Verification (test failure, indicating the fail detectors are working properly) the RESET button will illuminate, the alarm will sound and the following pop-up message will appear over the metering screen:

If the instrument fails the Verification (test pass, indicating the fail detectors are not working properly) the TEST button will illuminate and the following pop-up message will appear over the metering screen:

9. Calibration Procedure

This instrument has been fully calibrated at the factory in accordance to our published specifications. It has been calibrated with standards traceable to the National Institute Standards & Technology (NIST). You will find in this manual a copy of the "Certificate of Calibration". It is recommended that you have this instrument re-calibrated and a safety check done at least once per year. EEC recommends you use "Calibration Standards" that are NIST traceable, or traceable to agencies recognized by NIST to keep this instrument within published specifications.

End user metrology standards or practices may vary. These metrology standards determine the measurement uncertainty ratio of the calibration standards being used. Calibration adjustments can only be made in the Calibration mode and calibration checks or verifications can only be made while operating in Test mode.

NOTE: Verification should be performed before and after calibration. Calibration effects will only be noticeable after exiting calibration mode.

9.1. Warranty Requirements

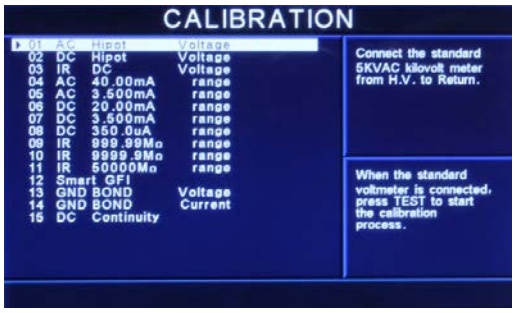
EEC offers a standard one-year manufacture's warranty. This warranty can be extended an additional four years provided that the instrument is returned each year to EEC for it's annual calibration. In order to be eligible for the extended warranty instruments must be returned to EEC for calibration service at least once every twelve months.

Required Calibration Equipment

0 - 5 KV AC/DC Metered Voltage Divider
40 mA AC, 20 mA DC Ammeter
0 - 30 mV AC Millivoltmeter
30 AAC Current Shunt
10□, 0.25 watt resistor, 250 volt
50M□, 0.25 watt resistor, 1000 volt
500M□, 0.25 watt resistor, 1000 volt
100K□, 175 watt resistor, 5000 volt
1M□, 20 watt resistor, 5000 volt
Adjustable DC power supply, 0.032 volts to 20 volts
Adjustable AC power supply 0-277 volts, 5KVA
Low impedance adjustable load 10□-30□, 4000 watts

9.2 Calibration Initialization

Press and hold the calibration key on the rear panel with a pen, pencil or small screwdriver while powering ON the ESA SERIES. The ESA SERIES enters calibration mode
after the power on sequence is complete. The Initial Calibration screen will appear as follows:



The Calibration screen is separated into three sections. The left half of the screen lists all of the calibration points necessary for an accurate calibration of the instrument. The right half of the screen is split into two smaller screens. The upper right section of the screen displays meter and load information required to perform the selected calibration. The lower right section of the screen contains prompts that will help guide you through the calibration process.

9.3 Selecting Specific Calibration points

When the calibration is initialized, the first calibration point is automatically selected. The calibration is set up so that as each calibration point is completed the highlighted area will automatically scroll to the next calibration point.

To manually select calibration points, use the up and down arrows to scroll the highlighted area to the desired calibration point. The load/meter screen and prompt screens will automatically update for the calibration point selected.

9.4. Calibration points

Each calibration point requires different loads, standards and process. As each point is selected, the load/meter screen and prompt screens will display the meter, load and process information required to complete the calibration process for the selected point.

Calibration of AC Hipot Voltage

The load/meter screen and prompt screens will contain the following text for this calibration point:

Upper Right Screen Load/Meter	**Lower Right Screen Prompt**	**Lower Right Screen Prompt (Cal. Active)**
Connect the standard 5KVAC kilovolt meter from H.V. to Return.	When the standard voltmeter is connected, press TEST to start the calibration process.	Enter Standard Voltage Reading.

Press the TEST button to activate the calibration. After the calibration is activated, the lower right screen will change to the text indicated in the table above (**Cal. Active**). Read the measurement from your standard and enter it using the numeric keypad. You may now store the new calibration number by pressing the ENTER key or escape by pressing the EXIT key or the RESET button.

Calibration of DC Hipot Voltage
The load/meter screen and prompt screens will contain the following text for this calibration point:

Upper Right Screen Load/Meter	Lower Right Screen Prompt	Lower Right Screen Prompt (Cal. Active)
Connect the standard 5KVDC kilovolt meter from H.V. to Return.	When the standard voltmeter is connected, press TEST to start the calibration process.	Enter Standard Voltage Reading.

Press the TEST button to activate the calibration. After the calibration is activated, the lower right screen will change to the text indicated in the table above (**Cal. Active**). Read the measurement from your standard and enter it using the numeric keypad. You may now store the new calibration number by pressing the ENTER key or escape by pressing the EXIT key or the RESET button.

Calibration of IR DC Voltage
The load/meter screen and prompt screens will contain the following text for this calibration point:

Upper Right Screen Load/Meter	Lower Right Screen Prompt	Lower Right Screen Prompt (Cal. Active)
Connect the standard 1KVDC kilovolt meter from H.V. to Return.	When the standard voltmeter is connected, press TEST to start the calibration process.	Enter Standard Voltage Reading.

Press the TEST button to activate the calibration. After the calibration is activated, the lower right screen will change to the text indicated in the table above (**Cal. Active**). Read the measurement from your standard and enter it using the numeric keypad. You may now store the new calibration number by pressing the ENTER key or escape by pressing the EXIT key or the RESET button.

Calibration of AC 50mA Range
The load/meter screen and prompt screens will contain the following text for this calibration point:

Upper Right Screen Load/Meter	Lower Right Screen Prompt	Lower Right Screen Prompt (Cal. Active)
Connect the 100KΩ load in series with the 50mAAC standard current meter.	When the load is connected, press TEST to start the calibration process.	Enter Standard Current Reading.

Press the TEST button to activate the calibration. After the calibration is activated, the lower right screen will change to the text indicated in the table above (**Cal. Active**). Read the measurement from your standard and enter it using the numeric keypad. You may now store the new calibration number by pressing the ENTER key or escape by pressing the EXIT key or the RESET button.

Calibration of AC 3.5mA Range
The load/meter screen and prompt screens will contain the following text for this calibration point:

Upper Right Screen Load/Meter	Lower Right Screen Prompt	Lower Right Screen Prompt (Cal. Active)
Connect the 100KΩ load in series with the 3.5mAAC standard current meter.	When the load is connected, press TEST to start the calibration process.	Enter Standard Current Reading.

Press the TEST button to activate the calibration. After the calibration is activated, the lower right screen will change to the text indicated in the table above (**Cal. Active**). Read the measurement from your standard and enter it using the numeric keypad. You may now store the new calibration number by pressing the ENTER key or escape by pressing the EXIT key or the RESET button.

Calibration of DC 20mA Range
The load/meter screen and prompt screens will contain the following text for this calibration point:

Upper Right Screen Load/Meter	Lower Right Screen Prompt	Lower Right Screen Prompt (Cal. Active)
Connect the 100KΩ load in series with the 20mADC standard current meter from H.V. to Return.	When the load is connected, press TEST to start the calibration process.	Enter Standard Current Reading.

Press the TEST button to activate the calibration. After the calibration is activated, the lower right screen will change to the text indicated in the table above (**Cal. Active**). Read the measurement from your standard and enter it using the numeric keypad. You may now store the new calibration number by pressing the ENTER key or escape by pressing the EXIT key or the RESET button.

Calibration of DC 3.5mA Range
The load/meter screen and prompt screens will contain the following text for this calibration point:

Upper Right Screen Load/Meter	Lower Right Screen Prompt	Lower Right Screen Prompt (Cal. Active)
Connect the 100KΩ load in series with the 3.5mADC standard current meter from H.V. to Return.	When the load is connected, press TEST to start the calibration process.	Enter Standard Current Reading.

Press the TEST button to activate the calibration. After the calibration is activated, the lower right screen will change to the text indicated in the table above (**Cal. Active**). Read the measurement from your standard and enter it using the numeric keypad. You may now store the new calibration number by pressing the ENTER key or escape by pressing the EXIT key or the RESET button.

Calibration of DC 350.0□A Range
The load/meter screen and prompt screens will contain the following text for this calibration point:

Upper Right Screen Load/Meter	Lower Right Screen Prompt	Lower Right Screen Prompt (Cal. Active)
Connect the 100KΩ load in series with the 350.0μADC standard current meter from H.V. to Return.	When the load is connected, press TEST to start the calibration process.	Enter Standard Current Reading.

Press the TEST button to activate the calibration. After the calibration is activated, the lower right screen will change to the text indicated in the table above (**Cal. Active**). Read the measurement from your standard and enter it using the numeric keypad. You may now store the new calibration number by pressing the ENTER key or escape by pressing the EXIT key or the RESET button.

Calibration of IR 999.99M Range
The load/meter screen and prompt screens will contain the following text for this calibration point:

Upper Right Screen Load/Meter	Lower Right Screen Prompt	Lower Right Screen Prompt (Cal. Active)
Connect the standard 50MΩ load from H.V. to Return.	When the standard load is connected, press TEST to start the calibration process.	Automatic Calibration Processing.

Press the TEST button to activate the calibration. After the calibration is activated, the lower right screen will change to the text indicated in the table above (**Cal. Active**). This calibration is automatic and does not require data entry.

Calibration of IR 9999.9M Range
The load/meter screen and prompt screens will contain the following text for this calibration point:

Upper Right Screen Load/Meter	Lower Right Screen Prompt	Lower Right Screen Prompt (Cal. Active)
Connect the standard 50MΩ load from H.V. to Return.	When the standard load is connected, press TEST to start the calibration process.	Automatic Calibration Processing.

Press the TEST button to activate the calibration. After the calibration is activated, the lower right screen will change to the text indicated in the table above (**Cal. Active**). This calibration is automatic and does not require data entry.

Calibration of IR 50000M Range
The load/meter screen and prompt screens will contain the following text for this calibration point:

Upper Right Screen Load/Meter	Lower Right Screen Prompt	Lower Right Screen Prompt (Cal. Active)
Connect the standard 500MΩ load from H.V. to Return.	When the standard load is connected, press TEST to start the calibration process.	Automatic Calibration Processing.

Press the TEST button to activate the calibration. After the calibration is activated, the lower right screen will change to the text indicated in the table above (**Cal. Active**). This calibration is automatic and does not require data entry.

Calibration of Smart GFI
The load/meter screen and prompt screens will contain the following text for this calibration point:

Upper Right Screen Load/Meter	Lower Right Screen Prompt	Lower Right Screen Prompt (Cal. Active)
Connect the standard 200k□□with the 5mAAC standard current meter from H.V. to Case.	When the standard load is connected, press TEST to start the calibration process.	Enter Standard Current Reading.

Press the TEST button to activate the calibration. After the calibration is activated, the lower right screen will change to the text indicated in the table above (**Cal. Active**). Read the measurement from your standard and enter it using the numeric keypad. You may now store the new calibration number by pressing the ENTER key or escape by pressing the EXIT key or the RESET button.

Calibration of GND Bond Voltage
The load/meter screen and prompt screens will contain the following text for this calibration point:

Upper Right Screen Load/Meter	Lower Right Screen Prompt	Lower Right Screen Prompt (Cal. Active)
Short the Current and Return leads together.	When the leads are shorted, press TEST to start the Calibration process.	Enter Standard Voltage Reading.

Press the TEST button to activate the calibration. After the calibration is activated, the lower right screen will change to the text indicated in the table above (**Cal. Active**). Read the measurement from your standard and enter it using the numeric keypad. You may now store the new calibration number by pressing the ENTER key or escape by pressing the EXIT key or the RESET button.

Calibration of GND Bond Current
The load/meter screen and prompt screens will contain the following text for this calibration point:

Upper Right Screen Load/Meter	Lower Right Screen Prompt	Lower Right Screen Prompt (Cal. Active)
Connect the standard	When the standard current	Enter Standard Current

40AAC current meter from Current to Return.	meter is connected, press TEST to start the calibration process.	Reading.

Press the TEST button to activate the calibration. After the calibration is activated, the lower right screen will change to the text indicated in the table above (**Cal. Active**). Read the measurement from your standard and enter it using the numeric keypad. You may now store the new calibration number by pressing the ENTER key or escape by pressing the EXIT key or the RESET button.

Calibration of DC Continuity

The load/meter screen and prompt screens will contain the following text for this calibration point:

Upper Right Screen Load/Meter	**Lower Right Screen Prompt**	**Lower Right Screen Prompt (Cal. Active)**
Step 1: Short the Current and Return leads together.	When the leads are shorted, press TEST to start the calibration process.	Automatic Calibration Processing.
Step 2: Connect the standard 10□□load from Current to Return.	When the load is connected, press TEST to start the calibration process.	Automatic Calibration Processing.
Step 3: Connect the standard 100□□load from Current to Return.	When the load is connected, press TEST to start the calibration process.	Automatic Calibration Processing.
Step 4: Connect the standard 1000□□load from Current to Return.	When the load is connected, press TEST to start the calibration process.	Automatic Calibration Processing.
Step 5: Connect the standard 10000□□load from Current to Return.	When the load is connected, press TEST to start the calibration process.	Automatic Calibration Processing.

Press the TEST button to activate the calibration. After the calibration is activated, the lower right screen will change to the text indicated in the table above (**Cal. Active**). This calibration is automatic and does not require data entry.

Calibration of Run Test Voltage

The load/meter screen and prompt screens will contain the following text for this calibration point:

Upper Right Screen Load/Meter	**Lower Right Screen Prompt**	**Lower Right Screen Prompt (Cal. Active)**
Step 1: Disconnect power to the DUT I/P input.	With the DUT I/P input open, press TEST to start the calibration process.	Automatic Calibration Processing.

Step 2: Connect 250VAC and a standard voltmeter to the DUT I/P input.	Press TEST to start the calibration process.	Enter Standard Voltage Reading.

Press the TEST button to activate the calibration. After the calibration is activated, the lower right screen will change to the text indicated in the table above (**Cal. Active**). Read the measurement from your standard and enter it using the numeric keypad. You may now store the new calibration number by pressing the ENTER key or escape by pressing the EXIT key or the RESET button.

Calibration of Run Test Current
The load/meter screen and prompt screens will contain the following text for this calibration point:

Upper Right Screen Load/Meter	**Lower Right Screen Prompt**	**Lower Right Screen** Prompt (Cal. Active)
Set DUT I/P 120-277VAC. Connect a 15 Amp load at DUT output in series with current meter.	When the load is connected, press TEST to start the calibration process.	Enter Standard Current Reading.

Press the TEST button to activate the calibration. After the calibration is activated, the lower right screen will change to the text indicated in the table above (**Cal. Active**). Read the measurement from your standard and enter it using the numeric keypad. You may now store the new calibration number by pressing the ENTER key or escape by pressing the EXIT key or the RESET button.

Calibration of Run Test Power
The load/meter screen and prompt screens will contain the following text for this calibration point:

Upper Right Screen Load/Meter	**Lower Right Screen Prompt**	**Lower Right Screen** Prompt (Cal. Active)
Set DUT I/P voltage to 225VAC. Connect a 25 ohm load. Connect power meter in series with the DUT.	When the load is connected, press TEST to start the calibration process.	Enter Standard Power Reading.

Press the TEST button to activate the calibration. After the calibration is activated, the lower right screen will change to the text indicated in the table above (**Cal. Active**). Read the measurement from your standard and enter it using the numeric keypad. You may now store the new calibration number by pressing the ENTER key or escape by pressing the EXIT key or the RESET button.

Calibration of Run Test Leakage
The load/meter screen and prompt screens will contain the following text for this calibration point:

Upper Right Screen Load/Meter	**Lower Right Screen Prompt**	**Lower Right Screen Prompt (Cal. Active)**
Connect 18 VAC to the DUT I/P input. Connect a	When the power supply and meter are connected,	Enter Standard Current Reading.

standard current meter to the DUT outputs from L to G.	press TEST to start the calibration process.	

Press the TEST button to activate the calibration. After the calibration is activated, the lower right screen will change to the text indicated in the table above (**Cal. Active**). Read the measurement from your standard and enter it using the numeric keypad. You may now store the new calibration number by pressing the ENTER key or escape by pressing the EXIT key or the RESET button.

Calibration of TCT Offset
The load/meter screen and prompt screens will contain the following text for this calibration point:

Upper Right Screen Load/Meter	**Lower Right Screen Prompt**	**Lower Right Screen** Prompt (Cal. Active)
Disconnect power to the DUT I/P input. Short Probe-HI and Probe-LO	When the leads are shorted, press TEST to start the calibration process.	Automatic Calibration Processing.

Press the TEST button to activate the calibration. After the calibration is activated, the lower right screen will change to the text indicated in the table above (**Cal. Active**). This calibration is automatic and does not require data entry.

Calibration of TCT x 0.1 DC Range
The load/meter screen and prompt screens will contain the following text for this calibration point:

Upper Right Screen Load/Meter	**Lower Right Screen Prompt**	**Lower Right Screen** Prompt (Cal. Active)
Connect 20VDC and a voltmeter to Probe-HI + and Probe-LO -.	When the power supply and meter are connected, press TEST to start the calibration.	Enter Standard Voltage Reading.

Press the TEST button to activate the calibration. After the calibration is activated, the lower right screen will change to the text indicated in the table above (**Cal. Active**). Read the measurement from your standard and enter it using the numeric keypad. You may now store the new calibration number by pressing the ENTER key or escape by pressing the EXIT key or the RESET button.

Calibration of TCT x 1 DC Range
The load/meter screen and prompt screens will contain the following text for this calibration point:

Upper Right Screen Load/Meter	**Lower Right Screen Prompt**	**Lower Right Screen** Prompt (Cal. Active)
Connect 8.0VDC and a voltmeter to Probe-HI + and Probe-LO -.	When the power supply and meter are connected, press TEST to start the calibration.	Enter Standard Voltage Reading.

Press the TEST button to activate the calibration. After the calibration is activated, the lower right screen will change to the text indicated in the table above (**Cal. Active**). Read the measurement from your standard and enter it using the numeric keypad. You may now store the new calibration number by pressing the ENTER key or escape by pressing the EXIT key or the RESET button.

Calibration of TCT x 4 DC Range
The load/meter screen and prompt screens will contain the following text for this calibration point:

Upper Right Screen Load/Meter	**Lower Right Screen Prompt**	**Lower Right Screen** Prompt (Cal. Active)
Connect 2.0VDC and a voltmeter to Probe-HI + and Probe-LO -.	When the power supply and meter are connected, press TEST to start the calibration.	Enter Standard Voltage Reading.

Press the TEST button to activate the calibration. After the calibration is activated, the lower right screen will change to the text indicated in the table above (**Cal. Active**). Read the measurement from your standard and enter it using the numeric keypad. You may now store the new calibration number by pressing the ENTER key or escape by pressing the EXIT key or the RESET button.

Calibration of TCT x 16 DC Range
The load/meter screen and prompt screens will contain the following text for this calibration point:

Upper Right Screen Load/Meter	**Lower Right Screen Prompt**	**Lower Right Screen** Prompt (Cal. Active)
Connect 0.5VDC and a voltmeter to Probe-HI + and Probe-LO -.	When the power supply and meter are connected, press TEST to start the calibration.	Enter Standard Voltage Reading.

Press the TEST button to activate the calibration. After the calibration is activated, the lower right screen will change to the text indicated in the table above (**Cal. Active**). Read the measurement from your standard and enter it using the numeric keypad. You may now store the new calibration number by pressing the ENTER key or escape by pressing the EXIT key or the RESET button.

Calibration of TCT x 64 DC Range
The load/meter screen and prompt screens will contain the following text for this calibration point:

Upper Right Screen Load/Meter	**Lower Right Screen Prompt**	**Lower Right Screen** Prompt (Cal. Active)
Connect 0.125VDC and a voltmeter to Probe-HI + and Probe-LO -.	When the power supply and meter are connected, press TEST to start the calibration.	Enter Standard Voltage Reading.

Press the TEST button to activate the calibration. After the calibration is activated, the

lower right screen will change to the text indicated in the table above (**Cal. Active**). Read the measurement from your standard and enter it using the numeric keypad. You may now store the new calibration number by pressing the ENTER key or escape by pressing the EXIT key or the RESET button.

Calibration of TCT x 256 DC Range
The load/meter screen and prompt screens will contain the following text for this calibration point:

Upper Right Screen Load/Meter	**Lower Right Screen Prompt**	**Lower Right Screen** Prompt (Cal. Active)
Connect 0.032VDC and a voltmeter to Probe-HI + and Probe-LO -.	When the power supply and meter are connected, press TEST to start the calibration.	Enter Standard Voltage Reading.

Press the TEST button to activate the calibration. After the calibration is activated, the lower right screen will change to the text indicated in the table above (**Cal. Active**). Read the measurement from your standard and enter it using the numeric keypad. You may now store the new calibration number by pressing the ENTER key or escape by pressing the EXIT key or the RESET button.

Calibration of TCT x 0.1 AC Range
The load/meter screen and prompt screens will contain the following text for this calibration point:

Upper Right Screen Load/Meter	**Lower Right Screen Prompt**	**Lower Right Screen** Prompt (Cal. Active)
Connect 18VAC and a voltmeter to Probe-HI + and Probe-LO -.	When the power supply and meter are connected, press TEST to start the calibration.	Enter Standard Voltage Reading.

Press the TEST button to activate the calibration. After the calibration is activated, the lower right screen will change to the text indicated in the table above (**Cal. Active**). Read the measurement from your standard and enter it using the numeric keypad. You may now store the new calibration number by pressing the ENTER key or escape by pressing the EXIT key or the RESET button.

Calibration of TCT x 1 AC Range
The load/meter screen and prompt screens will contain the following text for this calibration point:

Upper Right Screen Load/Meter	**Lower Right Screen Prompt**	**Lower Right Screen** Prompt (Cal. Active)
Connect 5VAC and a voltmeter to Probe-HI + and Probe-LO -.	When the power supply and meter are connected, press TEST to start the calibration.	Enter Standard Voltage Reading.

Press the TEST button to activate the calibration. After the calibration is activated, the lower right screen will change to the text indicated in the table above (**Cal. Active**). Read the measurement from your standard and enter it using the numeric keypad.

You may now store the new calibration number by pressing the ENTER key or escape by pressing the EXIT key or the RESET button.

Calibration of TCT x 4 AC Range
The load/meter screen and prompt screens will contain the following text for this calibration point:

Upper Right Screen Load/Meter	**Lower Right Screen Prompt**	**Lower Right Screen** Prompt (Cal. Active)
Connect 1.25VAC and a voltmeter to Probe-HI + and Probe-LO -.	When the power supply and meter are connected, press TEST to start the calibration.	Enter Standard Voltage Reading.

Press the TEST button to activate the calibration. After the calibration is activated, the lower right screen will change to the text indicated in the table above (**Cal. Active**). Read the measurement from your standard and enter it using the numeric keypad. You may now store the new calibration number by pressing the ENTER key or escape by pressing the EXIT key or the RESET button.

Calibration of TCT x 16 AC Range
The load/meter screen and prompt screens will contain the following text for this calibration point:

Upper Right Screen Load/Meter	**Lower Right Screen Prompt**	**Lower Right Screen** Prompt (Cal. Active)
Connect 0.32VAC and a voltmeter to Probe-HI + and Probe-LO -.	When the power supply and meter are connected, press TEST to start the calibration.	Enter Standard Voltage Reading.

Press the TEST button to activate the calibration. After the calibration is activated, the lower right screen will change to the text indicated in the table above (**Cal. Active**). Read the measurement from your standard and enter it using the numeric keypad. You may now store the new calibration number by pressing the ENTER key or escape by pressing the EXIT key or the RESET button.

Calibration of TCT x 64 AC Range
The load/meter screen and prompt screens will contain the following text for this calibration point:

Upper Right Screen Load/Meter	**Lower Right Screen Prompt**	**Lower Right Screen** Prompt (Cal. Active)
Connect 0.08VAC and a voltmeter to Probe-HI + and Probe-LO -.	When the power supply and meter are connected, press TEST to start the calibration.	Enter Standard Voltage Reading.

Press the TEST button to activate the calibration. After the calibration is activated, the lower right screen will change to the text indicated in the table above (**Cal. Active**). Read the measurement from your standard and enter it using the numeric keypad. You may now store the new calibration number by pressing the ENTER key or escape

by pressing the EXIT key or the RESET button.

Calibration of TCT x 256 AC Range
The load/meter screen and prompt screens will contain the following text for this calibration point:

Upper Right Screen Load/Meter	**Lower Right Screen Prompt**	**Lower Right Screen** Prompt (Cal. Active)
Connect 0.02VAC and a voltmeter to Probe-HI + and Probe-LO -.	When the power supply and meter are connected, press TEST to start the calibration.	Enter Standard Voltage Reading.

Press the TEST button to activate the calibration. After the calibration is activated, the lower right screen will change to the text indicated in the table above (**Cal. Active**). Read the measurement from your standard and enter it using the numeric keypad. You may now store the new calibration number by pressing the ENTER key or escape by pressing the EXIT key or the RESET button.

Calibration of TCT UL544NP
The load/meter screen and prompt screens will contain the following text for this calibration point:

Upper Right Screen Load/Meter	**Lower Right Screen Prompt**	**Lower Right Screen** Prompt (Cal. Active)
Connect 2VDC in series with a current meter to Probe-HI + and Probe-LO -.	When the power supply and meter are connected, press TEST to start the calibration.	Enter Standard Current Reading.

Press the TEST button to activate the calibration. After the calibration is activated, the lower right screen will change to the text indicated in the table above (**Cal. Active**). You may now store the new calibration number by pressing the ENTER key or escape by pressing the EXIT key or the RESET button.

Calibration of TCT UL544P
The load/meter screen and prompt screens will contain the following text for this calibration point:

Upper Right Screen Load/Meter	**Lower Right Screen Prompt**	**Lower Right Screen** Prompt (Cal. Active)
Connect 2VDC in series with a current meter to Probe-HI + and Probe-LO -.	When the power supply and meter are connected, press TEST to start the calibration.	Enter Standard Current Reading.

Press the TEST button to activate the calibration. After the calibration is activated, the lower right screen will change to the text indicated in the table above (**Cal. Active**). Read the measurement from your standard and enter it using the numeric keypad. You may now store the new calibration number by pressing the ENTER key or escape by pressing the EXIT key or the RESET button.

Calibration of TCT IEC60601 UL2601
The load/meter screen and prompt screens will contain the following text for this calibration point:

Upper Right Screen Load/Meter	**Lower Right Screen Prompt**	**Lower Right Screen** Prompt (Cal. Active)
Connect 2VDC in series with a current meter to Probe-HI + and Probe-LO -.	When the power supply and meter are connected, press TEST to start the calibration.	Enter Standard Current Reading.

Press the TEST button to activate the calibration. After the calibration is activated, the lower right screen will change to the text indicated in the table above (**Cal. Active**). Read the measurement from your standard and enter it using the numeric keypad. You may now store the new calibration number by pressing the ENTER key or escape by pressing the EXIT key or the RESET button.

Calibration of TCT UL1563
The load/meter screen and prompt screens will contain the following text for this calibration point:

Upper Right Screen Load/Meter	**Lower Right Screen Prompt**	**Lower Right Screen** Prompt (Cal. Active)
Connect 2VDC in series with a current meter to Probe-HI + and Probe-LO -.	When the power supply and meter are connected, press TEST to start the calibration.	Enter Standard Current Reading.

Press the TEST button to activate the calibration. After the calibration is activated, the lower right screen will change to the text indicated in the table above (**Cal. Active**). Read the measurement from your standard and enter it using the numeric keypad. You may now store the new calibration number by pressing the ENTER key or escape by pressing the EXIT key or the RESET button.

Calibration of TCT IEC60990 Fig4-U1
The load/meter screen and prompt screens will contain the following text for this calibration point:

Upper Right Screen Load/Meter	**Lower Right Screen Prompt**	**Lower Right Screen** Prompt (Cal. Active)
Connect 2VDC in series with a current meter to Probe-HI + and Probe-LO -.	When the power supply and meter are connected, press TEST to start the calibration.	Enter Standard Current Reading.

Press the TEST button to activate the calibration. After the calibration is activated, the lower right screen will change to the text indicated in the table above (**Cal. Active**). Read the measurement from your standard and enter it using the numeric keypad. You may now store the new calibration number by pressing the ENTER key or escape by pressing the EXIT key or the RESET button.

Calibration of TCT IEC60990 Fig4-U2
The load/meter screen and prompt screens will contain the following text for this calibration point:

Upper Right Screen Load/Meter	**Lower Right Screen Prompt**	**Lower Right Screen** Prompt (Cal. Active)
Connect 2VDC in series with a current meter to Probe-HI + and Probe-LO -.	When the power supply and meter are connected, press TEST to start the calibration.	Enter Standard Current Reading.

Press the TEST button to activate the calibration. After the calibration is activated, the lower right screen will change to the text indicated in the table above (**Cal. Active**). Read the measurement from your standard and enter it using the numeric keypad. You may now store the new calibration number by pressing the ENTER key or escape by pressing the EXIT key or the RESET button.

Calibration of TCT IEC60990 Fig5-U1
The load/meter screen and prompt screens will contain the following text for this calibration point:

Upper Right Screen Load/Meter	**Lower Right Screen Prompt**	**Lower Right Screen** Prompt (Cal. Active)
Connect 2VDC in series with a current meter to Probe-HI + and Probe-LO -.	When the power supply and meter are connected, press TEST to start the calibration.	Enter Standard Current Reading.

Press the TEST button to activate the calibration. After the calibration is activated, the lower right screen will change to the text indicated in the table above (**Cal. Active**). Read the measurement from your standard and enter it using the numeric keypad. You may now store the new calibration number by pressing the ENTER key or escape by pressing the EXIT key or the RESET button.

Calibration of TCT IEC60990 Fig5-U3
The load/meter screen and prompt screens will contain the following text for this calibration point:

Upper Right Screen Load/Meter	**Lower Right Screen Prompt**	**Lower Right Screen** Prompt (Cal. Active)
Connect 2VDC in series with a current meter to Probe-HI + and Probe-LO -.	When the power supply and meter are connected, press TEST to start the calibration.	Enter Standard Current Reading.

Press the TEST button to activate the calibration. After the calibration is activated, the lower right screen will change to the text indicated in the table above (**Cal. Active**). Read the measurement from your standard and enter it using the numeric keypad. You may now store the new calibration number by pressing the ENTER key or escape by pressing the EXIT key or the RESET button.

Calibration of TCT External
The load/meter screen and prompt screens will contain the following text for this calibration point:

Upper Right Screen Load/Meter	**Lower Right Screen Prompt**	**Lower Right Screen** Prompt (Cal. Active)
Connect 2VDC in series with a current meter to Probe-HI + and Probe-LO -.	When the power supply and meter are connected, press TEST to start the calibration.	Enter Standard Current Reading.

Press the TEST button to activate the calibration. After the calibration is activated, the lower right screen will change to the text indicated in the table above (**Cal. Active**). Read the measurement from your standard and enter it using the numeric keypad. You may now store the new calibration number by pressing the ENTER key or escape by pressing the EXIT key or the RESET button.