Extech Electronics Co.

EST-300 Series

EST-310/EST-320/EST-330

Electrical Safety Analyzer

User Manual

E1.05

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 (2) 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.

Extech Electronics Co.

1. Introduction

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

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

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.

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 and the correct fuse is installed (Please refer to 3.1 Specifications).

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

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

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.

1.6 Key Features and Benefits

CAL-ALERT™	Alerts the operator that the machine is due for calibration in advance of the calibration due date.
PATENTED SMARTGFI™	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.
SCREEN LOCK	Lock touch screen to avoid operator change the setting.
EXPANDED TEST MEMORIES	User can link up to 30 steps in a single test file with a total of 30 steps available in memory.
DIGITALLY CONTROLLED ARC DETECTION SYSTEM	Allows the operator to choose whether low-level arcs should be detected. The operator can select from multiple sensitivity levels.
ELECTRONIC RAMPING (UP AND DOWN)	Allows the operator to linearly increase or decrease the output voltage to the DUT over a specified period of time. Minimizes any damage to sensitive DUT's from quick high voltage changes.
PLC REMOTE INPUTS & OUTPUTS	Two standard 9 pin interfaces provide outputs for PASS, FAIL, RESET and TEST IN PROCESS signals. Inputs include TEST, INTERLOCK, RESET and remote recall of MEMORIES 1 - 3. Provides the user with the ability to operate the EST-300 through simple PLC relay control.
FAIL-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

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 100 - 120 volts AC ± 10%, 50/60 Hz single phase or 200 - 240 volts AC ± 10%, 50/60 Hz single phase. The instrument will autodetect the input voltage. For operation at 115 and 230 Volts AC use a 6.3A for EST-310, EST-320 and EST-330.

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)
Use insulation resistance function before, should be warmed-up 30 minutes.

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 Specifications

	ACW	DCW	IR
EST 310	V	-	-
EST 320	V	-	V
EST 330	V	V	V

Model		EST-310	EST-320	EST-330
INPUT RATING				
Voltage (AC)		100 - 120Vac / 200 - 240Vac±10% Auto Range		
Apparent Power		360 VA		
Frequency		50/60 Hz ± 5%		
AC WITHSTAND VOLTAGE				
Output Rating		5KVAC / 20mA		
Output Voltage Range		0 - 5.00 kVac		
Voltage Resolution		0.01 kVac		
Voltage Accuracy		(1% of setting + 0.5% of Range)		
Output Frequency		50Hz / 60Hz ± 0.1%		
Output Waveform		Sine Wave, Crest Factor = 1.3 - 1.5		
Output Regulation		± (1% of output + 5V), From no load to full load		
Voltage Meter Accuracy		± (1% of setting + 0.5% of Range)		
Current Measurement Range		0.000 - 20.00 mA		
Current Resolution		0.001 / 0.01 mA		
Current Accuracy	0.000 - 4.000 mA	(1% of reading + 1% of Range)		
	3.50 - 20.00 mA			
Ramp Up Timer		0.1 - 999.9s		
Ramp Down Timer		0 - 999.9s		
Dwell Timer		0, 0.3 - 999.9s , (0 = continuous)		
Timer Resolution		0.1 s		
Timer Accuracy		± (0.1% of setting + 0.05s)		
Arc Detection		The range is from 1 - 9 (9 is the most sensitive)		
DC WITHSTAND VOLTAGE				
Output Rating		-	-	6KVDC / 7500µA
Output Voltage Range		-	-	0 - 6.00 kVdc
Voltage Resolution		-	-	0.01 kVdc
Voltage Accuracy		-	-	(1% of setting + 0.5% of Range)
Output Ripple		-	-	< 5% (6KV / 7500µA at Resistive Load)

Voltage Meter Accuracy		-	-	± (1% of setting + 0.5% of Range)
Current Measurement Range		-	-	0.0 - 7500µA
Current Resolution		-	-	0.1µA/0.001mA/0.01mA
Current Accuracy	0.0 - 400.0µA	-	-	(1% of reading + 1% of Range)
	0.35 - 4.00 mA	-	-	
	3.50 - 7.50 mA	-	-	
Ramp Up Timer		-	-	0.1 - 999.9s
Ramp Down Timer		-	-	0, 1.0 - 999.9s
Dwell Timer		-	-	0, 0.4 - 999.9s , (0 = continuous)
Timer Resolution		-	-	0.1s
Timer Accuracy		-	-	± (0.1% of setting + 0.05s)
Ramp-HI Current Range		-	-	0.0 - 7500 µA
Charge-LO Current Range		-	-	0.0 - 350.0uA or Auto Set
Discharge Time		-	-	< 50 msec for no load[1]
Arc Detection		-	-	The range is from 1 - 9 (9 is the most sensitive)
INSULATION RESISTANCE				
Output Rating		-	1KVDC / 50000MΩ	
Output Voltage Range		-	30 - 1000 Vdc	
Voltage Resolution		-	1 Vdc	
Voltage Accuracy		-	(1% of setting + 0.5% of Range)	
Resistance Measurement Range		-	0.100 - 50000 MΩ	
Resistance Resolution		-	0.001 / 0.01 / 0.1 /1 MΩ	
Resistance Accuracy[2]	0.100 - 999.9 MΩ under 30-499V	-	±(7% of reading+0.1% of Range)	
	1000 - 10000 MΩ under 30-499V	-	±(15% of reading+0.1% of Range)	
	0.500 - 999.9 MΩ under 500-1000V	-	±(2% of reading+0.1% of Range)	
	1000 - 9999 MΩ under 500-1000V	-	±(5% of reading+0.1% of Range)	
	10000 - 50000 MΩ under 500-1000V	-	±(15% of reading+0.1% of Range)	
Ramp Up Timer		-	0.1 - 999.9s	
Ramp Down Timer		-	0, 1.0 - 999.9s , (0 = OFF)	
Dwell Timer		-	0, 0.5 - 999.9s , (0=continuous)	
Delay Timer		-	0.5 - 999.9s	
Timer Resolution		-	0.1s	
Timer Accuracy		-	± (0.1% of setting + 0.05s)	

Charge-Lo Current	-	0.000 - 3.500 µA or Auto Set
GENERAL		
Interface	USB , PLC Remote	
Memory	30 steps (Maximum 30 Steps in one File)	
Display	4.3" Color Display (Touch Panel)	
Safety	Built-in Smart GFI circuit, GFI trip current 450µA max	
Language	English, T Chinese, S Chinese, Japanese	
Security	Screen lock	
Environment	0 - 40ºC, 20 - 80%RH	
Dimension (W x H x D), mm	215 x 88.1 x 300	
Net Weight	5.46 Kg	

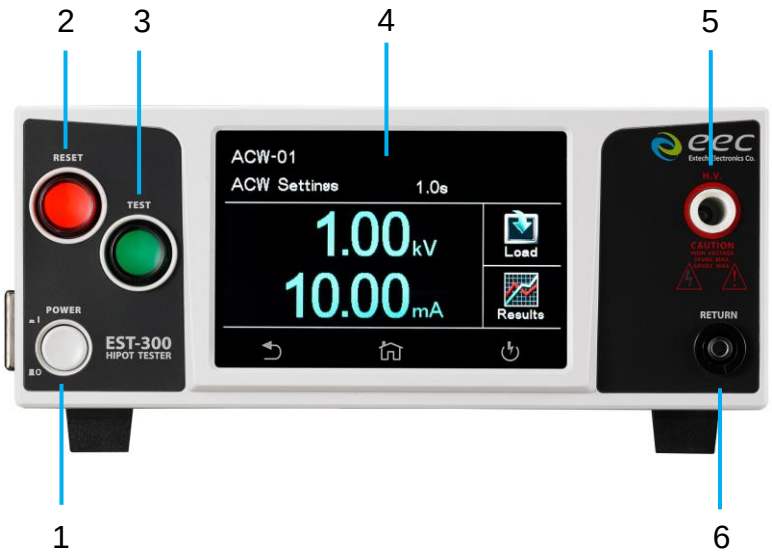
*product specifications are subject to change without notice.

*1. Discharge time < 100 msec for capcitor load (1µF < 1KV, 0.75µF < 2KV, 0.5µF < 3KV, 0.08µF < 4KV, 0.04µF < 5KV, 0.015uF < 6KV)

*2. Environment requirement: humidity < 60%RH (no condensation, no scanner), When I < 150nA.

3.2 Instrument Controls

3.2.1 EST-300 Series Front Panel Controls



1. **POWER SWITCH:** Powers the test instrument ON or OFF.

2. **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.

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

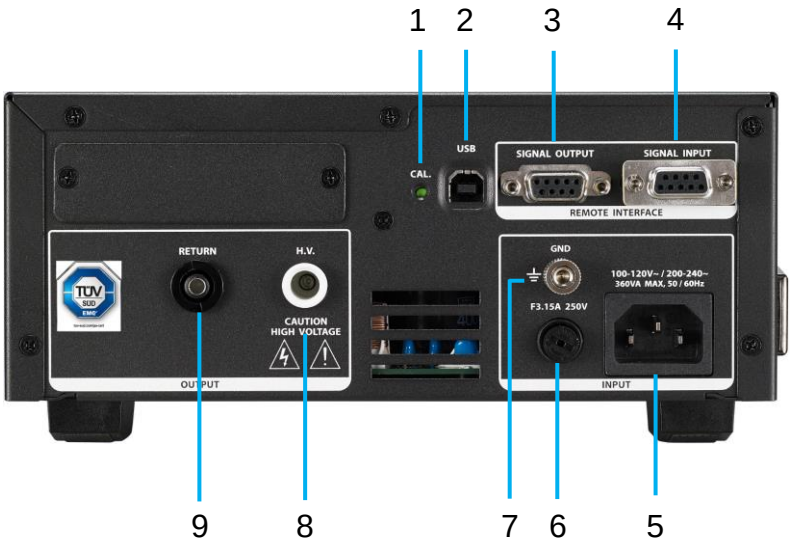
4. **TOUCH SCREEN GRAPHIC LCD:** Displays all the information and allows full control of the instrument.

   Note : This product has screen saver function. When the instrument is not operated for more than 30 minutes, it will automatically enter the screen saver. User can touch the screen of the instrument and RESET key to stop the screen saver function.

5. **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.

6. **RETURN 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.

3.2.2 EST-300 Series 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. **BUS INTERFACE:** USB interface may be substituted for the RS-232.

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

6. **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.

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

8. **REAR PANEL HIGH VOLTAGE OUTPUT TERMINAL:** 2nd high voltage output connector in parallel with the front panel connector.

9. **REAR PANEL RETURN TERMINAL:** 2nd return output connector in parallel with the front panel connector.

4. Programming Instructions

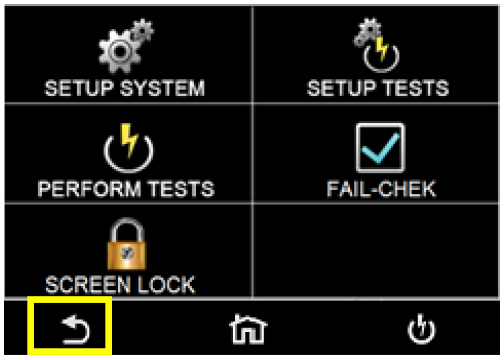
4.1 Using the Touch Screen

The touch screen display of the EST-300 provides full control of the instrument. The touch screen will be used to setup system and test parameters as well as security setup and calibration. EST-300's touch screen functions just like any other touch screen.

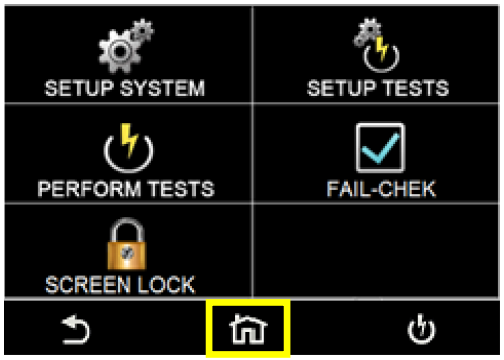
Soft Keys

The EST-300 touch screen has 3 soft keys: Back, Home and Perform Tests.

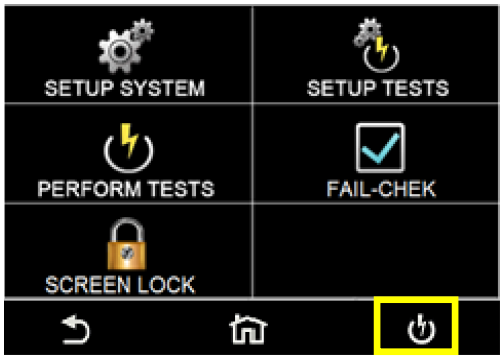
Use the Back key to return to a previous menu:



Use the Home key to return to the Main Menu:

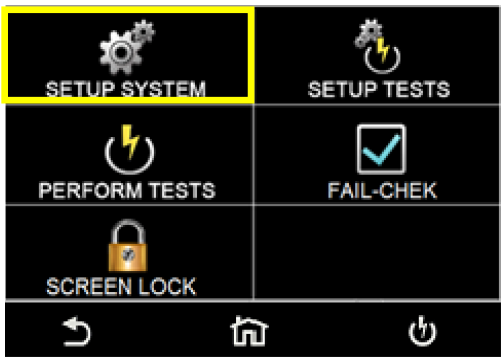


Use the Perform Tests key to navigate to the Perform Tests screen:



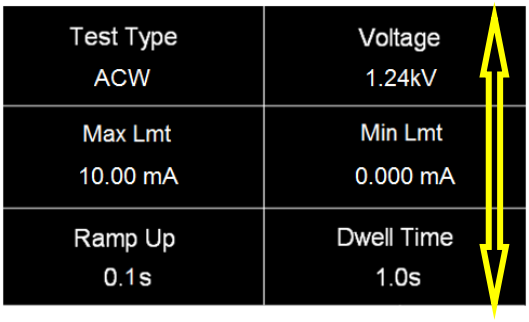
Touch

The various screens of the EST-300 will display icons and parameters. Touch the appropriate icon or parameter with the fingertip as shown in the image below:



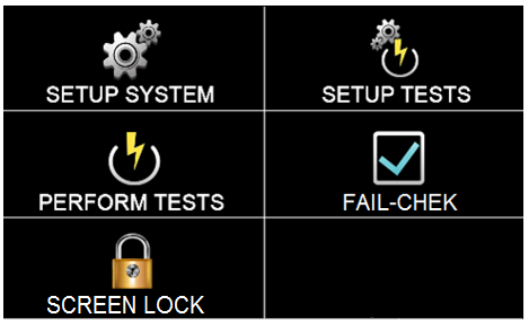
Scroll and Swipe

A scroll bar on the right side of the screen indicates that there are additional parameters or features. To scroll up and down between parameters touch the screen anywhere scroll upward or downward. Swipe left to right in order to change parameters when setting up test or system values:



4.2 Main Menu

The EST-300 automatically defaults to the main menu screen upon power up. The main menu screen will appear as follows:



The default screen is the main menu screen of the instrument. From this screen all the functions and settings of the instrument can be accessed:

Setup System – instrument global parameters such as time and date, calibration and hardware.

Perform Tests – navigate to the Perform Tests screen in order to run a test sequence.

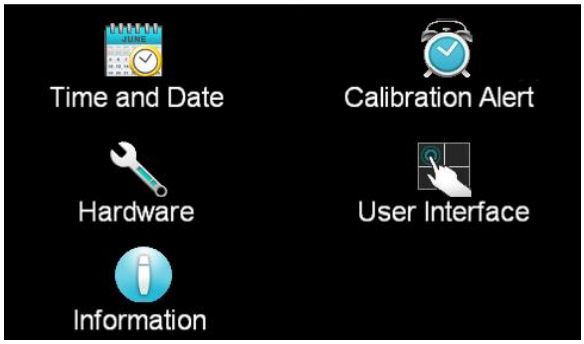
Screen Lock – Lock the touch screen .

Setup Tests – create test files

FAIL-CHEK – check the instruments failure detectors

4.3 Setup System

From the default main menu touch the Setup System icon to enter the Setup System sub menu. This is where all System Parameters are edited:



4.3.1 Time and Date

The next parameter in the System Setup is the Time and Date parameter. Touch the screen on the Time and Date icon and the following screen will appear:

From this screen the time and date can be set and the display format can be edited.

4.3.1.1 Set Date

Use the touchscreen numeric keypad to enter the desired value for the date, month and year. Upon entering a value the enter key (↵) will appear. Touch the enter key to save the value and

move to the next field. The < (back arrow) key can be used to toggle between date, month and year. The Prev and Next arrows can be used to toggle between different fields under the Time and Date menu.

4.3.1.2 Set Time

Use the touchscreen numeric keypad to enter the desired value for the hour, minute and second. Upon entering a value the enter key (↵) will appear. Touch the enter key to save the value and move to the next field. The < (back arrow) key can be used to toggle between hour, minute and second. The Prev and Next arrows can be used to toggle between different fields under the Time and Date menu.

4.3.1.3 Date Format

Touch the desired date format and the enter key (↵) will appear. Press the enter key to save the value and move to the next parameter under the Time and Date menu. The Prev and Next arrows can be used to toggle between different fields under the Time and Date menu.

4.3.1.4 Time Format

Touch the desired time format and the enter key (↵) will appear. Press the enter key to save the value and move to the next parameter under the Time and Date menu. The Prev and Next arrows can be used to toggle between different fields under the Time and Date menu.

4.3.2 Calibration Alert

Calibration Alert is a feature that allows the instrument to give an advanced alert that the calibration for the instrument is coming due.

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.

The Calibration Alert settings can be found in the Setup System screen. Click on the Calibration Alert icon and the following screen will appear:

Calibration Alert OFF	Calibration Date 10/12/2013
Calibration Due 10/12/2014	Alert Date 09/12/2012

The first field under the Calibration Alert screen allows the user to set the Calibration Alert to ON or OFF.

Touch the desired value and the enter key (↲) will appear. Press the enter key to save the value and move to the next parameter under the Calibration Alert menu. The Prev and Next arrows can be used to toggle between different fields under the Calibration Alert menu.

4.3.2.1 Calibration Due Date and Alert Date

It is recommended that calibration should be performed at least once a year. It is recommended that the Calibration Due Date not be set greater than one year from the Calibration Date displayed. After a calibration is performed, the Calibration Due Date is automatically set 1 year after the calibration date.
This parameter defaults to one year after the calibration date but may be overwritten to any date desired.

The Calibration Due Date and Alert Date can be set by selecting the appropriate fields on the touchscreen. The following screens will appear when the Calibration Due Date and Alert Date fields are selected.

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 12/15/2014 the Alert Date will automatically be set to 11/15/2015.

This parameter defaults to 11 months after the Calibration Date but may be overwritten to any advanced date desired. Use the numeric keypad to change the values in the date fields and press the enter key (↲) to accept the new number or press EXIT to cancel and return to the original number.
Use the touchscreen numeric keypad to enter the desired value for the date, month and year. Upon entering a value the enter key (↲) will appear. Touch the enter key to save the value and move to the next field. The < (back arrow) key can be used to toggle between date, month and year. The Prev and Next arrows can be used to toggle between different fields under the Time and Date menu.
Calibration Date is a non-editable parameter that indicates the date when calibration was last performed on the instrument. This parameter automatically updates after calibrating the instrument.

4.3.3 Hardware

The Hardware menu contains important system parameters which must be set prior to performing tests. Touch the Hardware icon and the following screen will appear:

Smart GFI ON	PLC Remote OFF
Single Step OFF	Fail Stop ON
Control mode EST-300	

4.3.3.1 Smart GFI

The high voltage power supply of the EST-300 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 EST-300's Return lead is floating, the SmartGFI circuit enables, protecting the test operator from electric shock. When the EST-300'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, EST-300 allows the user to perform tests on devices that have their chassis's earth grounded by the test fixture or test environment.

The EST-300's Smart GFI current is 450uA. Selecting the Smart GFI setting to ON or OFF.

4.3.3.2 PLC Remote

The PLC Remote function can be set to ON or OFF. To set the PLC Remote function, touch the ON/OFF key. To save the setting touch the enter key (↲) and move to the next parameter.

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.

4.3.3.3 Single Step

This function is used to temporarily override the automatic connection feature. When the Single Step function is ON the instrument will pause after each step is completed. To continue the test sequence, press the Test button to execute the next connected step. Each time the TEST button is pressed the next connected step will execute. If you press the RESET button before completing all connected steps, it will return you to the original starting step. If a step fails and you wish to continue to the next step, do not press RESET.

The Single Step function can be set to ON or OFF. To set the Single Step, touch the ON/OFF key. To save the setting touch the enter key (↲) and move to the next parameter.

4.3.3.4 Fail Stop

Fail Stop is a function that will stop a sequence 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 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. Pressing the RESET button a second time will reset the instrument.

The Fail Stop function can be set to ON or OFF. To set the Fail Stop function touch the ON/OFF key. To save the setting touch the enter key (↲) and move to the next parameter.

4.3.3.5 Control mode

The Control mode function can be set to EST 300
The format and command will compatible to 7100 series when the Control mode is 7100.

4.3.3.6 Screensaver

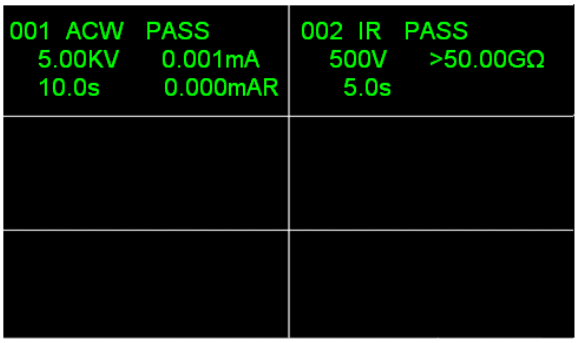
The Screensaver function can be set to ON or OFF. The default of the screensaver is ON.

4.3.4 User Interface

Results LAST	Touch Sound ON
Alarm Volume 5	Language English
Color States Vivid	

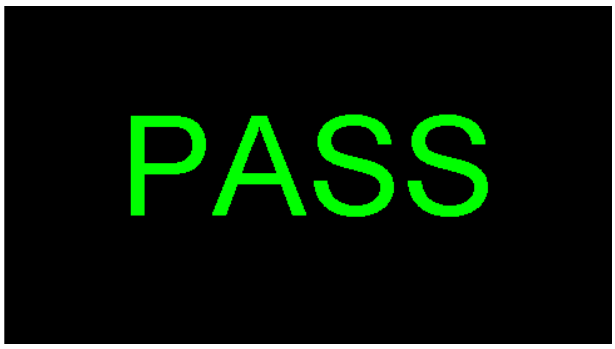
4.3.4.1 Results

The next parameter under User Interface is Results. This allows the user to set the desired results display after a test sequence has been run. The Results function can be set to ALL, LAST or P/F (Pass/Fail).
When ALL is selected, a Results summary screen will be displayed at the end of the test or sequence of connected steps displaying the results of all of the steps. The Results summary screen will appear as follows:



When Last is selected, the results of the last step performed will be displayed on the Perform Tests screen. There will not be a change in appearance or special screen displayed in this mode:

When P/F is selected, a Pass or Fail screen will be displayed at the end of the test. The Pass and Fail screens will appear as follows:



Touch the screen to select the desired value and the enter key (↵) to save the selection and move to the next parameter.

4.3.4.2 Touch Sound

Select Touch Sound icon on and choose between ON and OFF. If Touch Sounds = ON, the instrument will emit a short audible beep anytime the screen is touched.

4.3.4.3 Alarm Volume

Select Alarm Volume using the touchscreen and use the numeric keypad to enter a value. The numbers corresponding to the different volume settings are 0 through 9, 0 meaning the volume is

off, and 9 being the loudest setting.

Upon selecting a value, a momentary alarm chirp will occur to indicate the volume of the new setting, and the enter key (↵) will appear. Touch the enter key to save the value and move to the next field.

4.3.4.4 Language

Select Language from the touchscreen and choose the desired language. The available languages on the instrument are English, Chinese, Simplified Chinese.

4.3.4.5 Color States

Select the Dull and the following screen will appear:

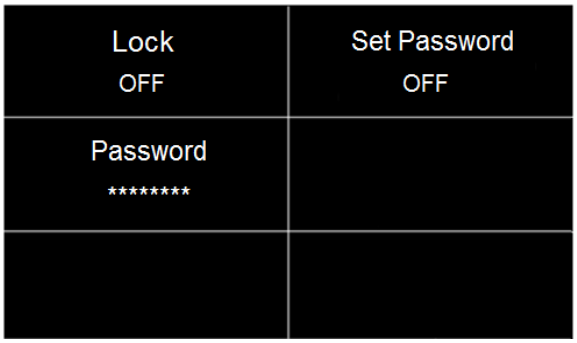
Select the Vivid and the following screen will appear:

4.3.5 Information

This gives the user the ability to view all instrument information including: Model Number, Serial Number, Calibration Date, Company Information and Firmware Version.

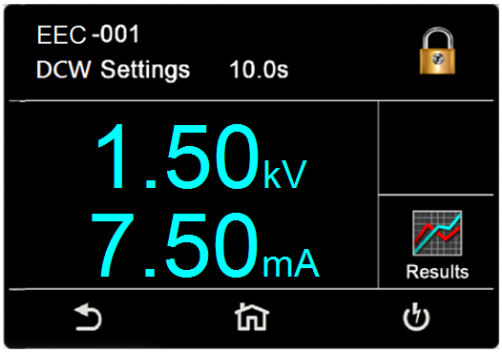
4.4 SCREEN LOCK

From the Main Menu select Screen Lock and the following screen will appear:



The first option under Screen Lock allows the user to set ON or OFF. Screen Lock using the touchscreen keypad and choose between ON or OFF.

The next option under Screen Lock is Set Password. User can set the password and select password ON or OFF.



To avoid touching the panel and changing to the test parameters during instrument operation, the lock function can be enabled. When the lock mode is enabled, a lock icon will be displayed in the upper right corner of the test screen. The display shows as follows. Click the lock icon to enter the password can be unlocked, if you do not set the password click the icon, you can unlock

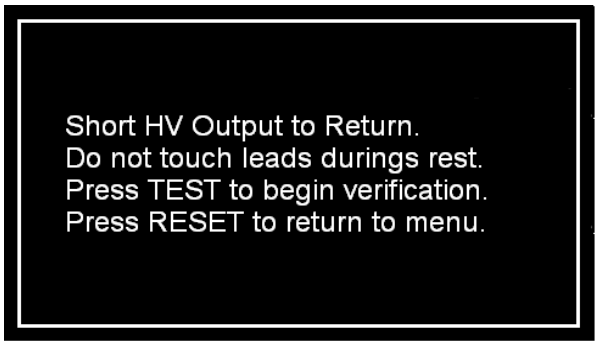
4.5 FAILCHEK

FAILCHEK is the process by which an instrument's failure detectors are proven to be functioning properly. Checking the failure detection circuitry of the electrical safety tester is required by safety agencies such as CSA, UL, and TÜV.

Select the FAILCHEK icon from the main menu and the following screen will appear:

4.5.1 AC Hipot FAILCHEK

To perform an AC Hipot FAILCHEK, touch the AC Hipot icon and the following screen will appear:

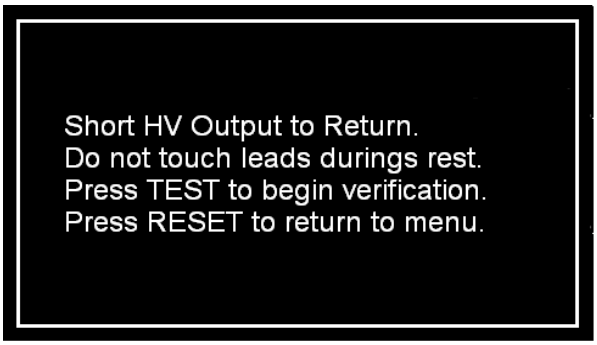


Follow the instructions on the screen. Press the Test button on the front panel of the instrument to start the test. If the FAILCHEK test passes, the following screen will appear:

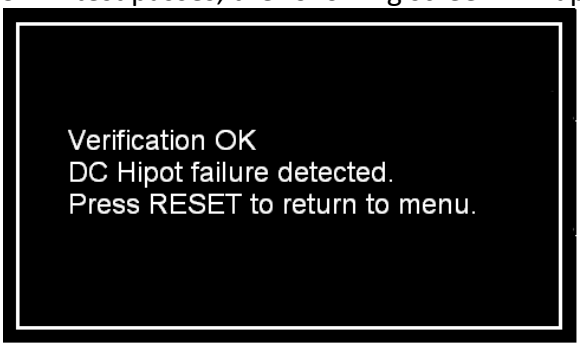
If the FAILCHEK test fails, the following screen will appear:

4.5.2 DC Hipot FAILCHEK

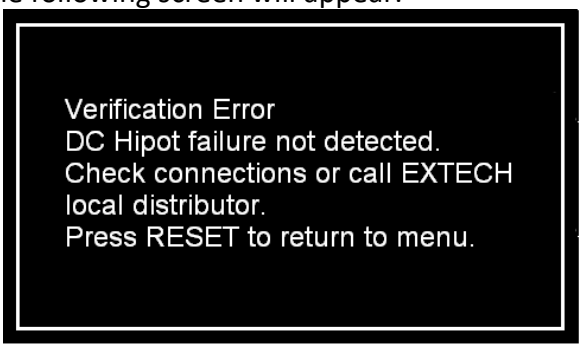
To perform a DC Hipot FAILCHEK, touch the DC Hipot icon and the following screen will appear:



Follow the instructions on the screen. Press the Test button on the front panel of the instrument to start the test. If the FAILCHEK test passes, the following screen will appear:

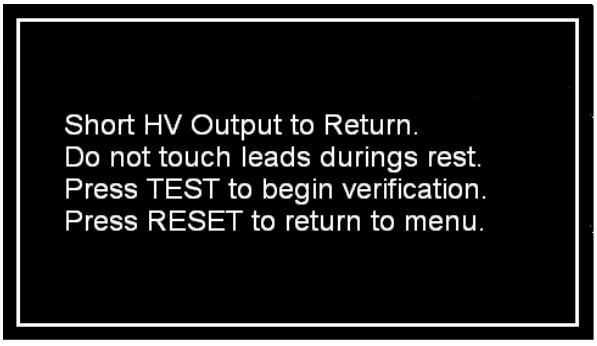


If the FAILCHEK test fails, the following screen will appear:



4.5.3 IR FAILCHEK

To perform an IR FAILCHEK, touch the IR icon and the following screen will appear:



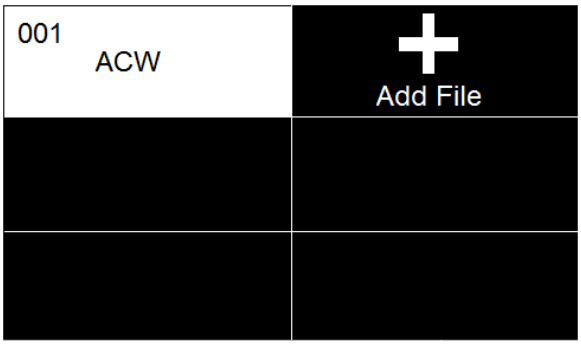
Follow the instructions on the screen. Press the Test button on the front panel of the instrument to start the test. If the FAILCHEK test passes, the following screen will appear:

If the FAILCHEK test fails, the following screen will appear:

4.6 Test Parameters

This section details the various test parameter descriptions. For information on setting up test sequences, refer to section 4.7. Setup Tests.

From the Main Menu select Setup Tests and the following screen will appear:



4.6.1 Description of Test Parameters

This section details each test parameter and test parameter description.

Test Type: Select the test item.

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

Max Lmt: The maximum current or resistance threshold that triggers a failure when exceeded.

Min Lmt: The minimum current or resistance threshold that triggers a failure when not exceeded.

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

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

Delay: 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 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.

Arc Sense: The maximum allowable threshold for arcing. The numbers 0 through 9 correspond to the different arc sensitivity levels, 1 meaning the maximum threshold of allowable arcing, 9 meaning the minimum threshold of allowable arcing, and 0 being OFF. Arc detection is not required for testing.

Frequency: This parameter is available in AC testing only and may be toggled between 50 and 60 Hz.

4.6.2 Additional Parameter Notes and Functions

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. A capacitive DUT will draw charging current on the DC Withstand 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.

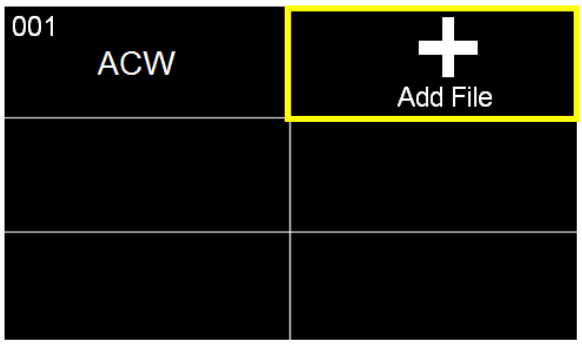
WARNING **Please be aware that the program will activate high voltage on the output connector while the TEST button is pressed.**

The program will read the charging current of the DUT and set the Charge-LO current at approximately one half (1/2) of the reading. The instrument will beep and the new value will automatically be updated in the field. You do not need to press the ENTER key for the new parameter to be accepted.

4.7 Setup Tests

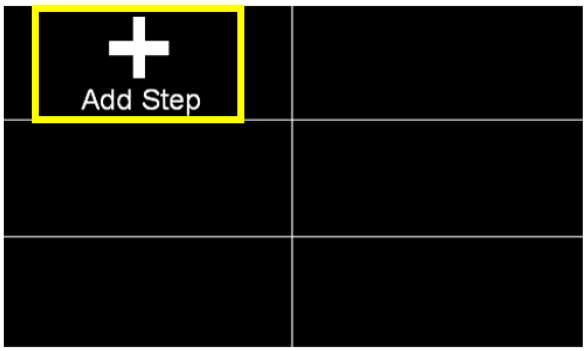
This section of the manual details how to setup a test sequence.

From the Main Menu select Setup Tests and the following screen will appear:



Touch the Add File icon and enter a name for the new file using the touchscreen keypad and use the enter key (↵) to save the name and move to the next screen.

Next, add a test to the newly created test file:



Touch the Add Step icon to enter the test parameters screen. In this screen, the test type is selected and all the relevant test parameters are programmed and saved:
Touch the add Bar icon to enter the barcode number. When you scan the barcode number the same as this parameter that the instrument will recall the test file.

Test Type DCW	Voltage 1.50kV
Max Lmt 7500uA	Min Lmt 0.0uA
Ramp Up 0.1s	Dwell Time 1.0s

4.7.1 ACW

Touch ACW for the test type and use the enter key (↵) to save the Test Type and move to the next test parameter:

Test Type ACW	Voltage 1.24kV
Max Lmt 10.00 mA	Min Lmt 0.000 mA
Ramp Up 0.1s	Dwell Time 1.0s

Ramp Down 0.0s	Arc Detect OFF
Arc Sense 5	Frequency 60 Hz

4.7.2 DCW

Select DCW for the test type and use the enter key (↵) to save the Test Type and move to the next test parameter:

Test Type DCW	Voltage 1.50kV
Max Lmt 7500uA	Min Lmt 0.0uA
Ramp Up 0.1s	Dwell Time 1.0s

Ramp Down 0.0s	Charge-Lo 0.0uA
Arc Detect OFF	Arc Sense 5
Ramp-HI 0.0uA	

Note:

1. Charge-Lo: The parameter can be set automatically or manually. To perform an auto Charge-Lo, connect the DUT and all the test leads as needed to perform a real test. Press the test button on the front panel. Reading will be displayed on the screen when the instrument is performing the auto Charge-Lo. Once the instrument is has finished performing the auto Charge-Lo the numeric value will be displayed on the screen and will be automatically saved to be used when the actual test is performed.

4.7.3 IR

Select IR for the test type and use the enter key (↵) to save the Test Type and move to the next test parameter:

Test Type IR	Voltage 500V
Max Lmt 0.00MΩ	Min Lmt 0.10MΩ
Ramp Up 0.1s	Delay Time 0.5s

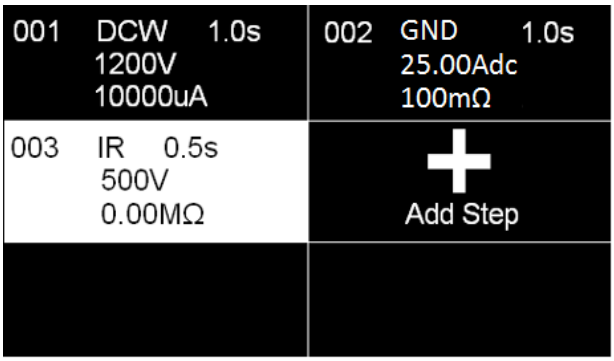
Dwell Time 0.5s	Ramp Down 0.0s
Charge-Lo 0.000uA	

Note: Charge-Lo: The parameter can be set automatically or manually. To perform an auto Charge-Lo connect the DUT and all the test leads as needed to perform a real test. Press the test button on the front panel. Reading will be displayed on the screen when the instrument is performing the auto Charge-Lo. Once the instrument is has finished performing the auto Charge-Lo the numeric value will be displayed on the screen and will be automatically saved to be used when the actual test is performed.

4.7.4 View Test Files

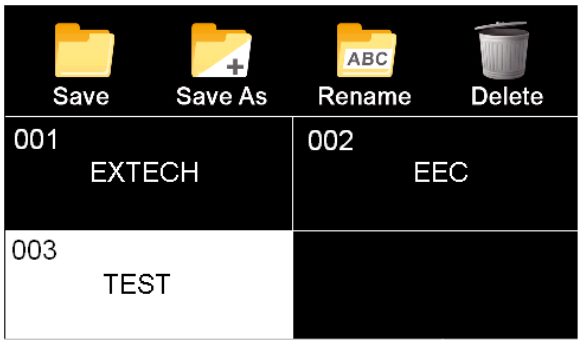
Once all tests have been programmed and saved, navigate to the Main Menu. Select the Setup Tests icon and select the test file that was previously created. The screen should display all tests that have been programmed in this test file.

For example:



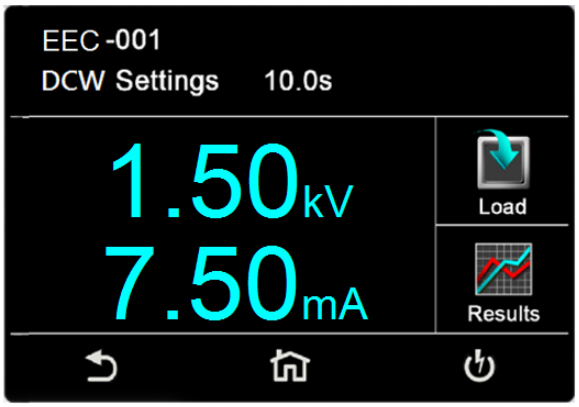
4.7.5 Edit Test Files

Once multiple test files have been programmed and saved the user can edit these files from the Setup Test menu. From the main menu select Setup Test.

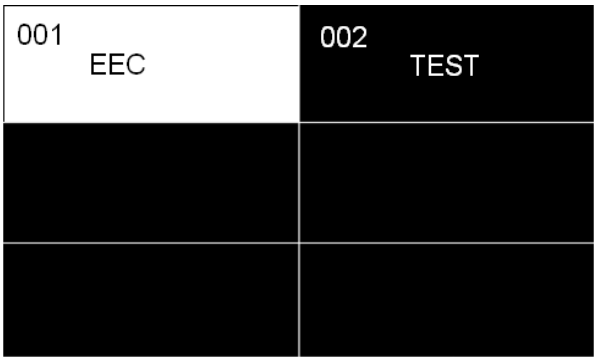


4.8 PERFORM TESTS

From the main menu select the Perform Test icon and the following screen will appear:



This screen will display the first test that was saved in the test file. If there are multiple test files saved in the instrument select the Load icon and all the test files will be displayed:

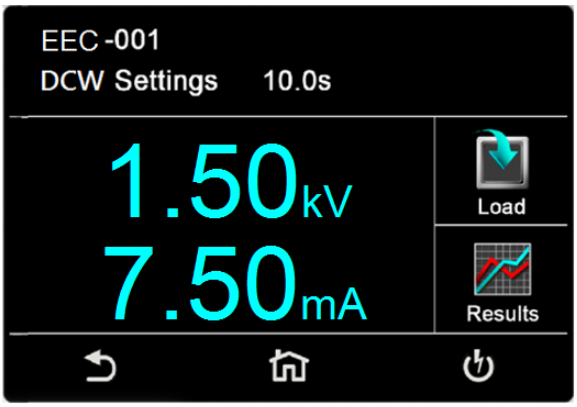


The user can select the desired test file and the first test step in the selected test file will be displayed.

Meters

The Perform Test screen of the EST-300 has several different meters depending on the type of test being performed. These meters can be arranged as desired by the user and can also be tied to the user security setup. The drag and drop feature of the instrument allows the user to set large and small meters.

For example the following screenshot shows the Perform Test screen of the DCW test:



In the image above, the two large meters display the DCW test voltage and the Max Limit current. The two small meters on the top of the screen display the Dwell Time. Touch any of the parameters and drag it on to the location of a different parameter and the two meters will be swapped.

Default System Parameters

EST-300 comes from the factory with the following system presets:

SYSTEM PARAMETERS		
Setup Sys.	PLC Remote	OFF
	Single Step	OFF
	Fail Stop	ON
	Alarm	5

Results	Last
Smart GFI	ON
Results	Last
Cal Alert	ON

5. Test Connections

5.1 Connecting the Test Leads

The instrument comes with all cables necessary for performing a Hipot and Continuity test. Plug the red alligator clip into the HV receptacle on the instrument. Connect one of two black alligator clip leads to the Return receptacle and the other to the Cont. Check receptacle.

5.2 Connecting the Adaptor Box

The adapter box provides an easy way to connect a line cord-terminated DUT to the instrument.

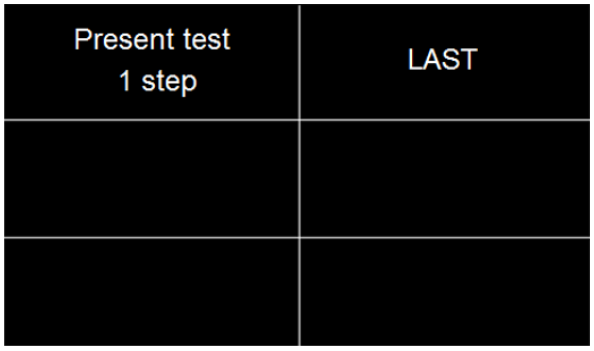
5.3 Interlock Connector

EST-300 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.

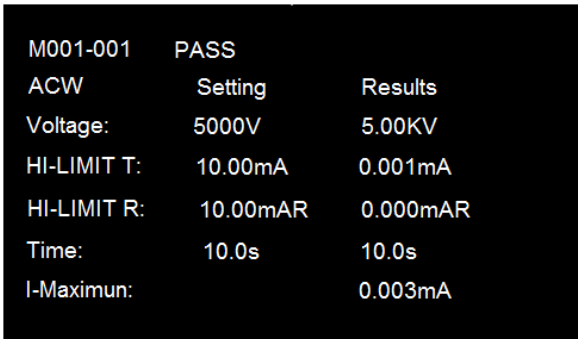
6. Results Screens

After a test has completed the Results icon will be available on the screen. For example:

Select the Results icon to enter the results screen. The Results screen will appear as follows:

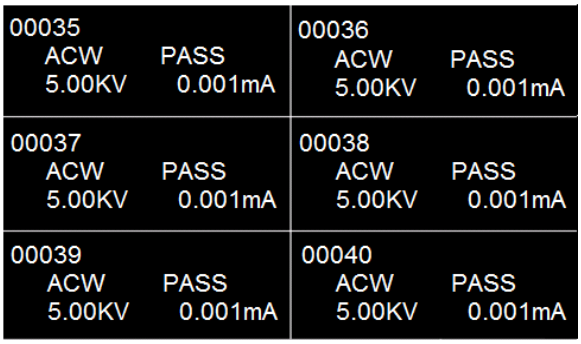


The Results screen allows you to view the results of the last test step the instrument performed and the results of the previously performed tests. Select Present Test to view test results from the current test sequence that was executed. Select any test step to view more details regarding the test:

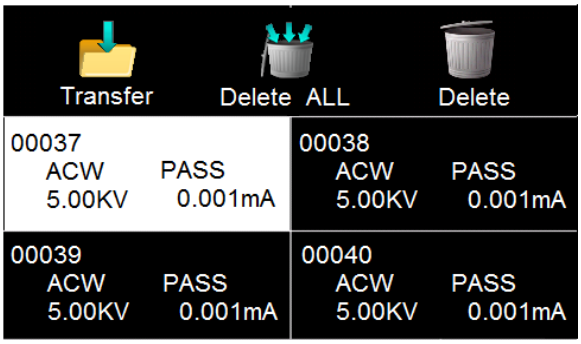


Select Int. Memory to view all the test results stored on the internal memory of the instrument.

Scroll down to view all the test results:



Touch and hold any test step result on the previous screen and a new screen will pop up:



6.1 Error Messages and Fail Messages

If there is an error during testing, the error description will be displayed on the screen. Below is a list of error messages that the EST-300 reports:

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

Max-Lmt: This message appears on the display if the DUT measurement exceeds the Max-Limit setting of any parameter.

Min-Lmt: This message appears on the display if the DUT measurement drops below the Min-Limit.

Arc-Fail: This message appears on the display if the DUT arcing current exceeds the Arc Sense limit and Arc function is active (Arc Sense = 1…9) of the AC/DC Withstand test.

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.

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

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.

Output Error: This message appears on the display, if the instruments output reading does not match the setting. This message will only be seen if the EXIT key is pressed at the Output Error screen. If the instrument has an output problem when the TEST button is pressed, the Output Error screen will appear as follows:

The RESET button is not active in this situation. Only the EXIT key will allow you to return to the Perform Test screen.

Fatal Error: If the instrument has a Fatal Error failure then the following screen will appear:

All of the buttons and keys are not active in this situation. You should contact EEC to receive further instruction.

Fatal Error identification number will represent type of the failure that occurs.

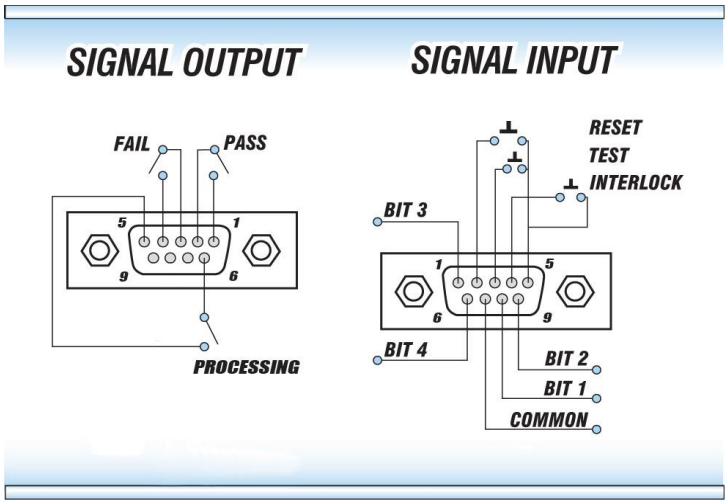
Error number of 9002 will appears on the display, if the instrument's System data or Model/Option/Serial Number data are corrupted and does not match the setting.

Error number of 9003 will appears on the display, if the instrument's Calibration data is corrupted.

Error code	Explain
EE ERROR	Abnormal code read when during reading step
MEMORY ERROR	Program is not functioning properly

7. Connection of Remote I/O

Two 9-pin “D” type connectors mounted on the rear panel provide REMOTE-INPUT-OUTPUT control and information. These connectors mate with a 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:



7.1 Remote Signal Outputs

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 toggle ON and OFF to indicate the condition of the tester. These are normally open free contacts and will not provide any voltage or current. The ratings of the contacts are 1 AAC / 120 VAC (0.5 ADC / 24 VDC). The signal outputs are provided on the 9-pin female “D” type connector. Below is a list 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.

7.2 Remote Signal Inputs and Memory Access

The EST-300 remote connector enables remote operation of the TEST, RESET, and REMOTE INTERLOCK functions, and allows the operator to select one of 3 pre-programmed test files.

When the PLC Remote mode is on, the EST-300 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 minimum pulse width or contact closure of 20mS is required to guarantee a test start. A normally open momentary switch can be wired across pins 2 and 5 to allow remote operation of the RESET function. A minimum pulse width or contact closure of 50mS is required to guarantee that a running test will abort. 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 8 and 9 to the common pin 7, in different combinations. The memory select bits should be set simultaneously and remain set for a minimum of 20ms to guarantee that the correct memory will be selected. However, the memory select bits may be set in sequential manner, provided that the time delay between each bit is less than 4ms. When the desired bit pattern has been established it should remain set for a minimum of 20ms to guarantee that the correct memory will be selected.

REMOTE FILE SELECT TABLE		
BIT 1	BIT 2	FILE #
1	0	01
0	1	02
1	1	03
1= Momentary Contact closure between BIT and COMMON		
0= No Contact closure between BIT and COMMON		

8. Bus Remote Interface USB

This section provides information on the proper use and configuration of bus remote interface. The USB remote interface is standard on EST-300 series. The USB communication speed of the EST-300 is 38400 baud.

8.1 USB Interface Command List

Echo and Response Considerations

USB Responses
The USB bus will automatically send any response back to the controller's input buffer.

8.1.1 Rules for Sending Commands to the Instrument

The following conventions are used to describe the commands syntax for EST-300:

- 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.

8.1.2 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 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.

8.1.3 File Editing Commands

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

- Commands should be separated from parameters by a space.
- If multiple parameters are entered, they should be separated by commas.

COMMAND	DESCRIPTION	VALUE
FL <*memory number*>	File Load	*memory number* = 001-30
FN nn,xxxx	File Name	*nn=01-30, xxxx=name*
FD	File Delete	*Current file in use*
FD nn	File Delete nn	*nn=1-30*
FS	File Save	*Current file in use*
FSA nn,xxxx	File Save As	*nn=1-30, xx=Name*
FT?	File Total	
ST?	Step Total	
SS <*step number*>	Step Select step number	*step number* = 1-30
SS?	Step Select ?	
SAA	Step Add ACW test	
SAD	Step Add DCW test	
SAI	Step Add IR test	
ADD2 **<***n,p1,p2,p3…***>**	Add all parameters of a test step	*n=test type, p=parameters*
SD	Step Delete current	
SD nn	Step Delete nn	*nn=01-30*

(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 (.), asterisk (*), dash (-), under bar (_), tilde (~) and space (SP).

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

FN < file name>
Creates a new file name for the active memory loaded into RAM.

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.

SAA, SAD, SAI, SAG, SAC
These commands add the appropriate test type within the memory at the step location that has been selected. The parameters of the previous test type will be deleted and the default values for the new test type will be recalled. If the same test type is selected that already exists, the default values will replace the previous parameters.

ADD2 <n, p1,p2,p3…>
This command edits all parameters in a step. Parameters will be edited at the step location that has been selected. See the command summary tables below to see the specific test type for each of these commands

The parameter <*n*> indicates the test type. The values ACW, DCW or IR must be used. The parameters <*p1,p2*> etc. indicate the individual settings for each parameter of the test. All parameters must be included with the command and should appear in the same order that is shown in the table below. Also, like the individual parameter editing commands, the unit should not be included with the value; only the numeric value should be included in the command string.

The list of parameters can also be found in the default parameters section of the manual.

The parameter values for file editing commands should use complete text (i.e. "ON" and "OFF" or “Real” and “Total”) and not use the coded values that are associated with the test parameter setting commands discussed in Test Parameter Editing Commands and Companion Queries. The LS? companion command will also list all parameters in complete text in the order as they appear in the following table, preceded by the step number.

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.

8.1.4 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 unit’s 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
EV <*value*> EV?	Edit Voltage	ACW DCW IR	10 - 5000V 10 - 6000V 10 - 1000V
ECG < *value* > ECG?	Edit Charge-Lo	DCW IR	0.0 - 350.0uA 0.000 - 3.500uA
ERU < *value*> ERU?	Edit Ramp-Up	ACW DCW IR	- 999.9s
ERD <*value* > ERD?	Edit Ramp-Down	ACW DCW IR	- 999.9s 0, 1.0 - 999.9s 0, 1.0 - 999.9s
ERH n ERH?	Edit Ramp-Hi n	DCW	n=0-7500uA
EDW < *value* > EDW?	Edit Dwell	ACW DCW IR	0, 0.3 - 999.9s 0, 0.4 - 999.9s 0, 0.5 - 999.9s
EDE < *value* > EDE?	Edit Delay	IR	0.5 – 999.9s
EA < *value* > EA?	Edit Arc	ACW DCW	1 – 9
EAD {1|0} EAD?	Edit Arc-Detect	ACW DCW	1= On, 0=Off
EH < *value* > EH?	Edit Max-LIMIT	ACW DCW IR	0, 0.001 - 20000uA 0, 0.0 - 7500uA 0, 0.1 – 50000MΩ
EL < *value* > EL?	Edit Min-LIMIT	ACW DCW IR	0, 0.001 - 20000uA 0, 0.0 - 7500uA 0, 0.1 – 50000MΩ
EF n EF?	Edit Frequency	ACW	n=0-1, 0=50Hz, 1=60Hz,

8.1.5 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
TD?	Testing data	Check the test result

Command	Name	Value
RD nn?	nn=1 - 30	Read the result of testing step
RDM?		Query the maximum current test results
RR?	0=CLOSE 1=OPEN	Query the status of RESET
RI?	0=CLOSE 1=OPEN	Query the status of INTERLOCK
SSG n	n=0, 1	Set the Smart GFI
SSG?		Query the status of Smart GFI
SPR n	n=0 - 1, 0=OFF, 1=ON	Set the PLC Remote
SPR?		Query the status of PLC Remote
SSI n	n=0 - 1, 0=OFF, 1=ON	Set the Single Step
SSI?		Query the status of Single Step
SF n	n=0 - 1, 0=OFF, 1=ON	Set the Fail Stop
SF?		Query the status of Fail Stop
SAL n	n=0 - 9	Set the Alarm Volume
SAL?		Query the status of Alarm Volume
SL n	n=0 - 1, 0=OFF, 1=ON	Set the Screen Lock
SL?		Query the status of Screen Lock
SSW n	n=0 - 1, 0=OFF, 1=ON	Set the status of Screen Lock password
SSW?		Query the status of Screen Lock password
SPW x	x=00000000-99999999	Set the password of screen lock
SPW?		Query the password of screen lock
SCA n	n=0 - 1, 0=OFF, 1=ON	Set the alarm of calibration date
SCA?		Query the alarm of calibration date
SCDA mm,dd,yy	Date Format by SDF mm=1-12, dd=1-31, yy=0-99	Set the calibration date
SCDA?	Date Format by SDF	Query the calibration date
SCDU mm,dd,yy	Date Format by SDF mm=1-12, dd=1-31, yy=0-99	Set the calibration date for next time
SCDU?	Date Format by SDF	Query the calibration date for next time
SA mm,dd,yy	Date Format by SDF mm=1-12, dd=1-31, yy=0-99	Set the date of alarm
SA?	Date Format by SDF	Query the date of alarm
SDT mm,dd,yy	Date Format by SDF mm=1-12, dd=1-31, yy=0-99	Set the date

Command	Name	Value
SDT?	Date Format by SDF	Query the date
SDF n	n=0 - 2 0=ymd 1=mdy 2=dmy	Set the form of date
SDF?		Query the form of date
STM hh,mm	Time Format by STF	Set the time
STM?	Time Format by STF	Query the time
STF n	n=0 - 1, 0=12hr, 1=24hr	Set the form of time
STF?		Query the form of time
SCT n	n=0 - 1 0=Dull , 1=Vivid,	Set the screen color
SCT?		Query the screen color
SCM n	n=0 - 1 0=EST-300 , 1=7100	Set the control interface (EST-300/7100)
SCM?		Query the control interface
SR n	n=0 - 2 0=LAST, 1=ALL, 2=P/F	Set the result status
SR?		Query the result status
STS n		Set the volume of touch screen
STS?		Query the volume of touch screen
SLA n		Set the language
SLA?		Query the language
SVA		ACW FailCHEK
SVA?		Query ACW FailCHEK status
SVD		DCW FailCHEK
SVD?		Query DCW FailCHEK status
SVI		IR FailCHEK
SVI?		Query IR FailCHEK status
SFW?		Query firmware version

8.1.6 Status Reporting

The status reporting system 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 at an active state until the register is either Read or Cleared. Reading the Event register

automatically clears the register and sets all bits to 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 registers 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 value of 0 at power up unless the *PSC 0 command had 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	

9. CALIBRATION

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.

NOTE1: Verification should be performed before and after calibration. Calibration effects will only be noticeable after exiting calibration mode.

NOTE2: Calibration before, should be warmed-up 30 minutes.

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.
- 20 mA AC, 10 mA DC Ammeter.
- 100KΩ, 250 watt resistor, 5000 volt.
- 1MΩ, 20 watt resistor, 5000 volt.
- 50MΩ, 0.25 watt resistor, 1000 volt.
- 1GΩ, 0.25 watt resistor, 1000 volt.

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 EST-300. The EST-300 enters calibration mode after the power on sequence is complete.

When the calibration is initialized the calibration screen will display each calibration point and appear as follows:

01 ACW VOLT	04 DCW VOLT
05 ACW 20.00 mA	06 ACW 3.500 mA
09 DCW 7.50 mA	10 DCW 3.500 mA

Scroll down on the screen to view the next page which will appear as follows:

11 DCW 350.0 uA	12 DCW 35.00 uA
13 DCW 3.500 uA	14 DCW 350.0 nA
Calibration Date 09/05/2017	

9.3 Calibration of Parameters

From the Calibration screens, use the touchscreen to select the parameter you wish to calibrate. A calibration prompt screen will now appear that describes the necessary load and connection information for the parameter being calibrated.

Once you press TEST, the Calibration data entry screen will appear for the selected parameter. Read the measurement from your standard and enter it using the numeric keypad. Once a value is entered the screen for the next step will appear.

- Calibration of AC Hipot Voltage

1. Connect the standard 5KVAC kilovolt meter from H.V. to Return.
2. When the standard voltmeter is connected, press TEST to start the calibration process.
3. Enter Standard Voltage Reading.

- Calibration of DC Hipot Voltage

1. Connect the standard 6KVDC kilovolt meter from H.V. to Return.
2. When the standard voltmeter is connected, press TEST to start the calibration process.
3. Enter Standard Voltage Reading.

- Calibration of 20mA AC Total Current Range

1. Connect the 100KΩ load in series with the standard current meter.
2. When the load is connected, press TEST to start the calibration process.
3. Enter Standard Current Reading.

- **Calibration of 3.5mA AC Total Current Range**

1. Connect the 100KΩ load in series with the standard current meter.
2. When the load is connected, press TEST to start the calibration process.
3. Enter Standard Current Reading.

- **Calibration of 7.50mA DC Current Range**

1. Connect the 100KΩ load in series with the standard current meter.
2. When the load is connected, press TEST to start the calibration process.
3. Enter Standard Current Reading.

- **Calibration of 3.500mA DC Current Range**

1. Connect the 100KΩ load in series with the standard current meter.
2. When the load is connected, press TEST to start the calibration process.
3. Enter Standard Current Reading.

- **Calibration of 350uA DC Current Range**

1. Connect the 1MΩ load in series with the standard current meter.
2. When the load is connected, press TEST to start the calibration process.
3. Enter Standard Current Reading.

- **Calibration of 35uA DC Current Range**

1. Connect the 50MΩ load in series with the standard current meter.
2. When the load is connected, press TEST to start the calibration process.
3. Enter Standard Current Reading.

- **Calibration of 3.5uA DC Current Range**

1. Connect the 500MΩ load in series with the standard current meter.
2. When the load is connected, press TEST to start the calibration process.
3. Enter Standard Current Reading.

- **Calibration of 350nA DC Current Range**

1. Connect the 1GΩ load in series with the standard current meter.
2. When the load is connected, press TEST to start the calibration process.
3. Enter Standard Current Reading.

- **Calibration Date 11/05/2014**

1. Enter the date of Calibration.