



7470 Series

# High Withstand Voltage Tester

User Manual

E1.05



# Compliance Information

Conforms with the following product standards:

## EMC Standard

EN 61326-1:2006  
EN 55011:1998 / A2:2002 Class A  
EN 61000-3-2:2006  
EN 61000-3-3:1995 / A1:2001 / A2:2005  
IEC 61000-4-2:1995 / A2:2000  
IEC 61000-4-3:2002  
IEC 61000-4-4:2004  
IEC 61000-4-5:1995 / A1:2000  
IEC 61000-4-6:2003  
IEC 61000-4-8:1993 / A1:2000  
IEC 61000-4-11:2004

1. The product is intended for use in non-residential/non-domestic environments. Use of the product in residential/domestic environments may cause electromagnetic interference.
2. Connection of the instrument to a test object may produce radiations beyond the specified limit.
3. Use high-performance shielded interface cable to ensure conformity with the EMC standards listed above.

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# 1. Introduction

## 1.1 Warranty Policies

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 the National Institute of Standards Taiwan.

Your new instrument is warranted to be free from defects in workmanship and material for a period of (2) years 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.

Follow below states, EEC will void your warranty.

- Operate under non-normal , contrived omission, or accidental calamity (including, temblor, floods, rebellion, and fire etc.)
- Any non-authorized modifications, tampering or physical damage.
- Elimination of any connections in the earth grounding system or bypassing any safety systems.
- Use of non-authorized parts in the repair of this instrument. Parts used must be parts that are recommended by EEC as an acceptable specified part.

**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.

EEC recommends that your instrument be calibrated on a twelve month cycle.

## 1.2 Safety Symbols

### 1.2.1 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.

### 1.2.2 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



### 1.3 Glossary of Terms (As used in this manual)

**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.

**Arc:** A partial momentary breakdown due to the force of a strong electric field on closely spaced conductors, sometimes evidenced by corona or a luminous flashover.

**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.

**Frequency:** The number of cycles an AC waveform repeats over time. Usually given in Hertz (Hz).

**Ground:** Refers to the point of low potential in a circuit to which all other voltages are referenced. May or may not be tied to the earth. Also referred to as Earth.

**Hot:** Used to refer to the test lead or output side of an instrument that is at high potential.

**Impedance:** The property of capacitive or inductive items to limit certain frequencies.

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

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

**Neutral:** The point of low potential in a circuit to which all other voltages are referenced. Also known as Common.

**Peak Current:** The maximum amplitude of an AC current waveform. For a sinusoid,  $1.414 \times$  the RMS value.

**Power:** The amount of work performed by an energy source over time, given in Watts (W).

**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.

**Reactive Current:** The current component due to the reactive impedance of a load. Also called imaginary current.

**Real Current:** The current component due to the resistance of a load.

**Resistance:** The 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* ( $\Omega$ ). Symbol = **R**

**Return:** The path by which current returns to a source.

**RMS:** The Root Mean Squared value of a voltage or current waveform. An RMS waveform delivers the same amount of energy to a load as a DC waveform of the same value. For a sinusoid, the RMS value is  $.707 \times$  the peak value.

**Total Current:** The vector sum of the real current component and the reactive current component produced by an applied voltage.

**VA:** A rating of instantaneous power found by multiplying an instrument's maximum output current by its maximum output voltage.

**Voltage:** The force which causes current through an electrical conductor, given in volts (V). Symbol = **V**

## 1.4 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 or 230) and the correct fuse is installed.

This product carries an NRTL (Nationally Recognized Testing Laboratory) and comes equipped with an audible and visual failure indicator.

### WARNING

747X Series 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.

### 1.4.1 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..

### SAFETY

This instrument meets UL requirements for audible and visual failure indication.

#### Service Interval

The instrument, its power cord, test leads, and accessories must be returned at least once a year to an EEC authorized service center 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.

### 1.4.2 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.

### ESD TESTING

Electrical safety tests should not be performed in or around ESD testing areas. ESD methods should not be employed during electrical safety testing, as this could cause a hazardous condition for equipment and test operators.

### 1.4.3 Test Operator

#### **WARNING**

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 national safety standard guidelines for electrical safety testing in the workplace. Defeating any safety system should be considered a serious offense with severe penalties. Allowing unauthorized personnel in the area during a test should also be dealt with as a serious offense. Test operators should be familiar with methods to properly discharge a device under test in case test leads become disconnected during testing.

Refer to the following standards for more information:

NFPA 70E  
OSHA 1910 subpart (S)  
EN50191

#### **Dress**

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

#### **WARNING**

ESD protocols should not be observed while performing electrical safety tests. Intentionally grounding the test operator could lead to a **harmful or fatal electric shock.**

#### **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.

#### **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.
- In case of any problem, turn off the high voltage first.

#### 1.4.4 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.

#### 1.4.5 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.

#### 1.4.6 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.



## 1.5 Introduction to Product Safety Testing

### 1.5.1 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.

## 1.6 The Different Types of Safety Tests

### 1.6.1 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.

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.

### **1.6.2 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 gigohms. 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.

### **1.6.3 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 30 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.

#### **1.6.4 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.

#### **1.6.5 Line Leakage 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.

## 1.7 Key Features and Benefits:

Patented SmartGFI®	The SmartGFI provides maximum operator protection. If the circuit detects excessive leakage to ground it shuts down the high voltage in less than 1 millisecond. SmartGFI is automatically activated if the DUT is not grounded. The operator does not need to make the decision whether to activate the SmartGFI.
Storage of up to 50 setups	A real benefit for manufacturers that test different products. The instrument can store 50 individual memories that may be performed individually or connected for a 50-step test.
RS-232 or GPIB interfaces	All the functions of the instruments can be programmed over a RS-232, GPIB or printer interface which makes them adaptable to any automated production environment.
Line and Load regulation	Maintains the output voltage to within 1% of setting even if the load or the line voltage varies. This ensures that the test results remain consistent and within safety agency requirements.
Digitally controlled arc detection system	Allows the operator to select whether low-level arcs should be detected and provides the operator with the ability to digitally select and program multiple sensitivity levels.
No load setup of trip current and output voltage	This provides the operator with an easy and safe way to set trip currents and output voltages since parameters are set without the high voltage activated.
TUV & UL listing	This assures you that this instrument meets or exceeds safety requirements to ensure operator safety.
Automatic storage of test program	High Withstand Voltage Tester powers up with the parameters that were used during the last test to avoid operator set-up errors.
All parameters for the setups can be adjusted through a simple menu driven program	The easy to follow setup screens ensure that the operator correctly sets up all test parameters
Tamper proof front panel controls	This makes it possible to limit user access to the setup screens so that only authorized personnel with a security code can change test parameters.
Electronic dwell settings	The electronic dwell control helps keep test results consistent by ensuring that the test duration is the same for each product tested.
PLC remote inputs and outputs	The standard 9 pin interfaces provide outputs for Pass,

	Fail, and Test in Process. Inputs include Test, Interlock and Reset. Remote recall of memory program #1, #2 and #3. This gives the user all the basic remotes required to configure the High Withstand Voltage Tester through simple PLC relay control.
Software calibration control	High Withstand Voltage Tester is calibrated through the front panel keypad. All calibration information is stored in non-volatile memory. This allows High Withstand Voltage Tester to be completely calibrated without removing any covers and exposing the technician to hazardous voltages.
User selectable output voltage frequencies of 50 or 60 hertz	High Withstand Voltage Tester was designed for the global market. This feature makes it simple for the user to select the output frequency in the AC hipot mode so that products can be tested at the same frequency they will be used at.
Output voltage fine adjustment	To make High Withstand Voltage Tester usable in all types of applications, the operator can manually bring the voltage up or down in 10 volt increments by simply pressing the up and down arrow keys. This makes it very easy to adjust the output voltage even while High Withstand Voltage Tester is in the dwell mode so you can analyze test results at different voltages.
Flashing high voltage indicator	A flashing LED located directly over the high voltage terminal clearly indicates when high voltage is active to provide maximum operator safety.
User selectable input voltage	High Withstand Voltage Tester can be switched for either 115 or 230 volt input operation through an easy access rear panel mounted switch to allow it to be used in any country.
Low-current sense	Monitors the minimum level of current flow, thus ensuring that the DUT is properly connected and that the hipot test is being performed.
Electronic ramping (up & down)	Provides a gradual and timed method to increase or decrease output voltage to the DUT minimizing any damage from quick high voltage changes to sensitive DUTs.

# 1 Getting Started

## Introduction

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

## 1.4 Unpacking and Inspection

### 1.4.6 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 carrier's 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.

- **Note** Please retain all of the original packaging materials.

### 1.4.7 Contents of the Carton

Inside the carton should be the following:

	747X SERIES INSTRUMENT	
	7470, 7472	7473, 7474
PART DESCRIPTION	PART NUMBER	PART NUMBER
High Voltage Cable	1142	1143
Return Cable	1144	1144
Fuse	X2(including a spare contained in the fuse holder)	X2(including a spare contained in the fuse holder)
Interlock Disable Key	1505	1505
Line Cord*	Standard	Standard

**NOTE:** The Line Cord listed is American. Other Line Cords are available upon request.

## CAUTION

Do not replace the included line cord with an improperly rated cord.

For North American : A UL listed and CSA labeled power cord must be used with the instrument in the United States and Canada. The power cord must include a NEMA5-15 style male plug, SVT or SJT cord sets, and be rated for at least 125VAC, 14A. Number 14 gauge wire or larger must be used.

For European: A certified power supply cord not lighter than light PVC sheathed flexible cord according to IEC 60227, designation H03 VV-F or H03 VVH2-F (for equipment mass not



exceeding 3 kg), or H05 VV-F or H05 VVH2-F2 (for equipment mass exceeding 3 kg), and be rated for at least 3G 0.75 mm<sup>2</sup> (for rated current up to 10 A) or 3G 1.0mm<sup>2</sup> (for rated current over 10 A up to 16 A) wire or larger, and the length of the cord does not exceed 2 m must be used.

## WARNING

Only accessories that meet the manufacturer's specifications shall be used.



### 1.4.8 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



- Please refer in all correspondence to your RMA number.
- **Do not ship more than 1 unit per box.**

## 1.5 Installation

### 1.5.6 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 1.4. Safety**. 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.

### 1.5.7 Power Requirements

This instrument requires a power source of either 115 volts AC  $\pm 10\%$ , 50/60 Hz single phase or 230 volts AC  $\pm 10\%$ , 50/60 Hz single phase. Before applying power verify that the instrument is set to the correct line voltage (115 or 230 volts). Adjust the voltage select switch to 115 for use with a 115 volt input. Adjust the voltage select switch to 230 for use with a 230 volt input. See section 3.2.2. Rear Panel Controls for an image of the rear panel.

#### 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.

#### WARNING

747X Series must be connected to a good ground. Be certain that the power wiring is properly polarized and that the proper low resistance bonding to ground is in place.

#### WARNING

The mains plug is used as the disconnecting device and shall remain readily operable.

The socket-outlet shall be installed near the equipment and shall be easily accessible.

### 1.5.8 Basic Connections

#### Power Cable

The instrument is shipped with a line cord containing a protective earth ground. When the line cord is connected to an appropriate AC power source the cable will connect the chassis to earth ground.

#### WARNING

The main plug shall only be inserted in a socket outlet with a protective ground (earth) contact. This protective ground **must not be defeated** by the use of an extension cord without a protective conductor.

#### 1.5.8.1

#### Return Connection

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 microamp range.

#### 1.5.9 Environmental Conditions

This equipment is intended for indoor use only. The equipment has been evaluated according to Installation Category II and Pollution Degree 2 as specified in IEC 664.

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

Temperature..... 32° - 104° F (0° - 40°C)  
Relative humidity..... 20 – 80%  
Altitude..... 6560 feet (2,000 meters)

**NOTE:** Keep the ventilation slits uncovered during operation. Failure to do so could cause the instrument to overheat and may damage internal components.

#### Storage and Shipping Environment

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

Temperature..... -40° - 167° F (-40° - 75°C)  
Altitude..... 50,000 feet (15,240 meters)

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

### CAUTION

Failure to operate this instrument within the specified conditions could result in damage.

#### Safe Lifting and Carrying Instructions

Proper methods of lifting and carrying can help to protect against injury. Follow the recommendations below to ensure that instruments are handled in a safe manner.

- 1.) Determine if the instrument can be lifted by one individual or requires additional support.
- 2.) Make sure that your balance is centered and your feet are properly spaced, shoulder width apart behind the instrument.
- 3.) Bend at the knees and make sure your back is straight.
- 4.) Grip the instrument with your fingers and palms and do not lift unless your back is straight.
- 5.) Lift up with your legs, not your back.

- 6.) Keep the instrument close to your body while carrying.
- 7.) Lower the instrument by bending your knees. Keep you back straight.

## 2 Specifications and Controls

### 2.4 Functional Specifications

MODEL	7470	7472	7473	7474
AC WITHSTAND VOLTAGE (7470 & 7473)				
Output Rating	10KVAC / 20mA	12KVDC / 10mA	20KVAC / 10mA	20KVDC / 5mA
	Range	Resolution	Accuracy	
Output Voltage, ACV (for 7473)	0 - 20000	10	± (1.5% of setting + 20V)	
Output Voltage, ACV (for 7470)	0 - 10000	10	± (1.5% of setting + 10V)	
Output Frequency	50Hz / 60Hz ± 0.1%, User Selectable			
Output Waveform	Sine Wave ,THD. < 3% at 2K - 20KV (Resistive Load), Crest Factor = 1.3 - 1.5			
Output Regulation	± (1% of output + 10V), From no load to full load			
SETTINGS				
Hi / Lo - Limit AC Current, mA (for 7473)	0 - 9.999	0.001	± (2% of setting + 2 counts)	
Hi / Lo - Limit AC Current, mA (for 7470)	0 - 9.999 / 10.00 - 20.00	0.001 / 0.01	± (2% of setting + 2 counts)	
Ramp Up Time, second	0.3 - 999.9	0.1	± (0.1% of setting + 0.05sec)	
Ramp Down Time, second	0.1 - 999.9	0.1		
Dwell Time	0, 0.3 - 999.9 sec (0 = continuous)	0.1		
	0, 0.1 - 999.9 min (0 = continuous)	0.1		
	0, 0.1 - 999.9 hr (0 = continuous)	0.1		
Cycle Test	0 - 9999 Times, (0 = continuous)			
Arc Detection	For 7470 : Range 1-9 at Output Voltage < 7.00KV, Range 1-8 at Output Voltage ≥ 7.00KV; For 7473: Range 1-9 at Output Voltage< 15.00KV, Range 1-7 at Output Voltage ≥ 15.00KV			
AC Current Offset, mA	0 - 2.000 or Auto Set (OPTION)			
MEASUREMENT				
Output Voltage, KV (for 7470)	0 - 10.00	0.01	± (2% of reading + 2 counts)	
Output Voltage, KV (for 7473)	0 - 20.00	0.01		
AC Current Range, mA	0 - 3.500	0.001	± (2% of reading + 3 counts)	
	3.00 - 10.00 (for 7473)	0.01		
	3.00 - 20.00 (for 7470)	0.01		
DC WITHSTAND VOLTAGE (7472 & 7474)				
Output Voltage, KV (for 7474)	0 - 20000	10	± (1.5% of setting + 20V)	
Output Voltage, KV (for 7472)	0 - 12000	10	± (1.5% of setting + 10V)	

Output Ripple	< 5%, 20KV / 5000µA for 7474, 12KV / 9999µA at Resistive Load for 7472			
SETTINGS				
Hi / Lo - Limit DC Current, µA (for 7474)	0.0 - 999.9 / 1000 - 5000	0.1 / 1	± (2% of setting + 2 counts)	
Hi / Lo - Limit DC Current, µA (for 7472)	0.0 - 999.9 / 1000 - 9999	0.1 / 1	± (2% of setting + 2 counts)	
Ramp Up Time, second	0.4 - 999.9	0.1	± (0.1% of setting+ 0.05 sec)	
Ramp Down Time, second	0, 1.0 - 999.9	0.1		
Dwell Time	0, 0.4 - 999.9 sec (0 = continuous)	0.1		
	0, 0.1 - 999.9 min (0 = continuous)	0.1		
	0, 0.1 - 999.9 hr (0 = continuous)	0.1		
Cycle Test	0 - 9999 Times, (0 = continuous)			
Arc Detection	1 - 9 ranges (9 is the most sensitivity)			
DC Current Offset, µA	0.0 - 200.0 or Auto Set (Option )			
Ramp High Current	ON / OFF, User Selectable			
Charge - Low Current, µA	0.0 - 350.0 or Auto Set			
Discharge Time	≤ 200 msec			
Maximum Capacitive Load	1.5µF < 2KV, 0.15µF < 8KV, 0.12µF < 14KV, 0.08µF < 20KV 0.28µF < 4KV, 0.15µF < 10KV, 0.1µF < 16KV 0.18µF < 6KV, 0.12µF < 12KV, 0.08µF < 18KV			
MEASUREMENT				
DC Voltage, KV (for 7474)	0 - 20.00	0.01	± (1.5% of reading + 2 counts)	
DC Voltage, KV (for 7472)	0 - 10.00	0.01	± (1.5% of reading + 2 counts)	
DC Current Range, µA	0 - 350.0	0.1	± (2% of reading + 3 counts)	
	300 - 3500	1		
	3000 - 5000 (for 7474)	10		
	3000 - 9999 (for 7472)			
GENERAL				
Input Voltage AC	115V / 230VAC ± 15%, 50Hz / 60Hz ± 5%, max. current 6.3A			
PLC Remote Control	Input : Test, Reset, Memory 1, 2, 3, Interlock Output : Pass, Fail, Processing			
Safety	Smart - GFI Function (< 1mA)			
Memory	50 memories			
Display	20 x 2 LCD with back light			
Key Lock	To prevent unauthorized alteration of the test Parameters			
Interface	Optional USB & RS232, GPIB, Printer Card			
Environment	0 - 40°C, 20 - 80%RH			
Dimension (W x H x D), mm	430 x 133 x 400			
Net Weight	24Kg	24Kg	23Kg	23Kg
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 (1142)	-	-	x 1	x 1
Hipot Test Lead, 1.5m (1143)	x 1	x 1	-	-
Hipot Return Lead, 1.8m (1144)	x 1	x 1	x 1	x 1

\*Product specifications are subject to change without notice

### 【Ordering Information】

7470 AC 10KV Withstand Voltage Tester

7472 DC 12KV Withstand Voltage Tester

7473 AC 20KV Withstand Voltage Tester

7474 DC 20KV Withstand Voltage Tester

Opt.731 GPIB Interface Card

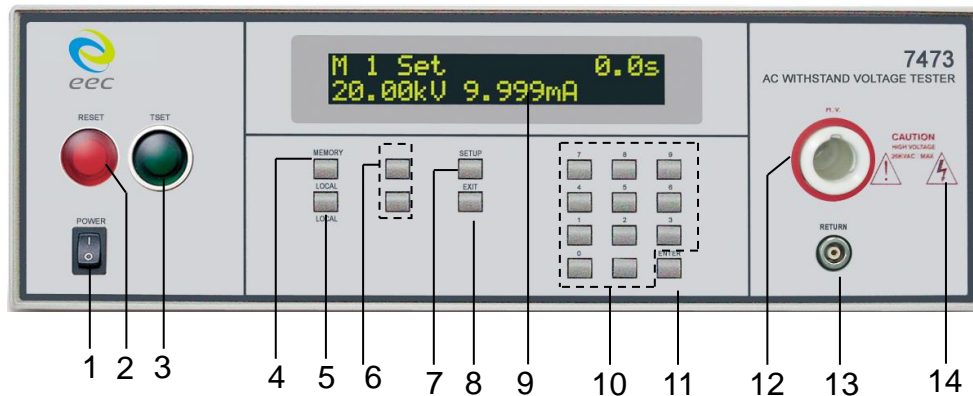
Opt.762 Offset Function

Opt.7011 Continuous Output during step link for 7470 & 7473

Opt.7012 Continuous Output during step link for 7472 & 7474

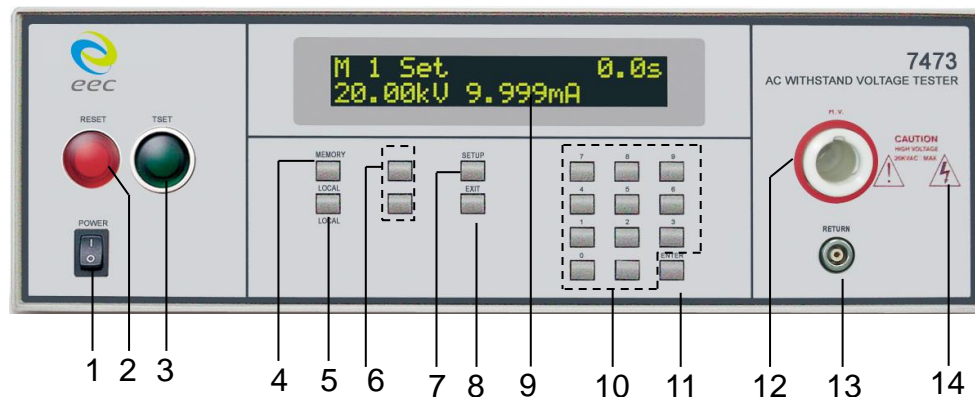
## 2.5 Instrument Controls

### 3.2.1 Front Panel Controls



1. **POWER SWITCH:** Rocker style power switch with international ON ( | ) and OFF ( 0 ) markings.
2. **RESET BUTTON:** Momentary contact switch used to reset the instrument. If a failure condition occurs during a test, you will need to reset the system to shut off the alarm and signal the system that you are aware of a failure condition. The reset button must be pressed before you can proceed to the next test or change any of the set-up parameters. This switch also serves as an abort signal to stop any test in progress controlled by the High Withstand Voltage Tester.
3. **TEST BUTTON:** Momentary contact switch used to start tests. Press the green button to activate the test that is set up in the test buffer shown on the display.
4. **MEMORY:** Use this key to select one of the 50 memories to modify or run stored test parameters.
5. **LOCK/LOCAL:** Use this key to select key lockout mode. A password may be used when setup in the calibration mode. Use this key when you wish to go from the Remote operation of the instrument to the Local mode.
6. **UP-DOWN ARROW KEYS:** Use these keys to enter and move through the function parameter menu for test parameter setup.
7. **SETUP:** Use this key to enter the setup menu and view or change the display contrast, alarm volume, and PLC remote settings.
8. **EXIT:** Use this key to exit any menu or to clear an unwanted entry in a parameter field.
9. **LCD DISPLAY:** The 2x20-character display indicates test function, memory location, test parameter and failure type as well as test measurements during a test.

- 10. DATA ENTRY KEYS:** Use these keys to input numeric parameters followed by the ENTER key.



- 11. ENTER:** Use this key as an ENTER key to accept numeric data for parameter settings.

- 12. HIGH VOLTAGE OUTPUT JACK:** Connector used to attach the High Voltage test lead or test fixture high voltage lead to the instrument. The connector is recessed for safety when not being used.

- 13. RETURN OUTPUT JACK:** Connector used to attach the Return test lead or test fixture return lead to the instrument. This connection provides the return current path for the high voltage.

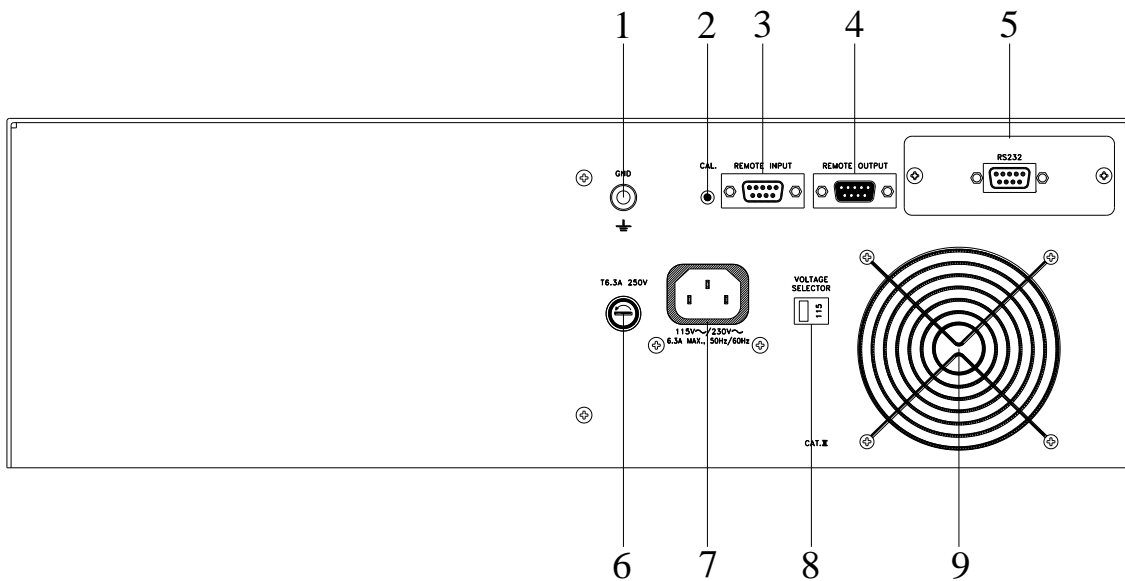
Notice: It need to increase core at RETURN lead when you have interference issue



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



### 3.2.2 Rear Panel Controls



1. **CHASSIS GROUND (EARTH) TERMINAL:** This terminal should be connected to a good earth ground before operation.
2. **CALIBRATION BUTTON:** To put the instrument into the calibration mode, push this button and turn on the power switch simultaneously.
3. **REMOTE SIGNAL INPUT:** 9-Pin D subminiature male connector for remote control of test, reset, and interlock functions, as well as remote program memory selection.
4. **REMOTE SIGNAL OUTPUT:** 9-Pin D sub-miniature female connector for monitoring PASS, FAIL, and PROCESSING output relay signals.
5. **BUS INTERFACE:** RS-232 Bus interface, IEEE 488 interface and PRINTER interface may be selected.
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. **INPUT POWER RECEPTACLE:** Standard IEC 320 connector for connection to a standard NEMA style line power (mains) cord.
8. **INPUT POWER SWITCH:** Line voltage selection is set by the position of the switch. The left position is set for 115 volt operation; the right position is set for 230 volt operation.
9. **THERMAL COOLING FAN:** Runs continuously to cool the instrument.



## 2.6 Quick Start

### WARNING

This quick start guide assumes the operator has some familiarity with automated Electrical Safety testing.

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. Locate a three prong grounded outlet. Be sure the outlet has been tested for proper wiring before connecting the instrument to it.

### CAUTION

Check to be sure that the correct input line voltage has been selected on the rear panel, either 115 volts AC or 230 volts AC. Connect the power-input plug into its socket on the rear panel of the instrument.

Connect the male end of the plug to the outlet receptacle. Please be sure that the safety ground on the power line cord is not defeated and that you are connecting to a grounded power source.

Turn on the POWER switch located on the lower left-hand side of the front panel. The initialization screen will appear.

After the initialization screen disappears, the Settings screen will be displayed. The Settings screen will appear as follows:

M XX	Set	XXX.X s
XX.XX KV		X.XXX xA

The High Withstand Voltage Tester comes with all of the memories loaded with the withstand default parameters. The initial test loaded for use is Memory 1. If this test is unacceptable for your DUT then refer to the section **5. Test Parameters Setup Procedure**, for instructions on how to program tests into the instrument.

If these parameters are acceptable, then connect an appropriate set of test leads to the device under test (DUT) or test fixture. Connect the return lead (Black alligator clip insulator) to the DUT or test fixture then connect the high voltage output lead (Red alligator clip insulator). Make sure the safety ground of this instrument is connected to a known good ground.

Refer to section **4.1.5 Smart GFI**, for an explanation of DUT grounding configurations.

### WARNING

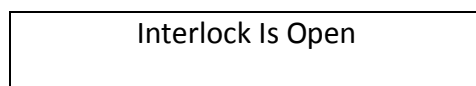
DO NOT TOUCH THE DEVICE UNDER TEST, HIGH VOLTAGE TEST LEAD, ALLIGATOR CLIP, OR CLIP INSULATOR ONCE THE TEST HAS BEEN STARTED.

This instrument is supplied with a high voltage test lead terminated with an alligator clip. This clip is designed to allow firm connection to the DUT without the need for an operator to

hold a probe or lead in place during the test. This clip and insulator will carry the voltage and current of this tester but they are not intended to be held by the operator during the test while the high voltage is energized. Please insure that you do not make contact with the alligator clip or the clip insulator while high voltage is energized.

### 3.3.1 Remote Interlock

High Withstand Voltage Tester is equipped with a featured referred to as “Remote Interlock”. Remote Interlock is a feature that utilizes a set of closed contacts to enable the instruments output. In other words, if the Interlock contacts 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 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 Interlock contacts are opened during a test, the pop-up message will be displayed and the test will abort. The hardware 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 Connector 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 interlock, the instrument will not perform tests.

Please check your connections to be sure they are making good contact. Clear the area of any debris that may create a hazardous situation and ask any unnecessary personnel to leave the area. To initiate the test, press the GREEN test button on the front panel. This is a momentary button and does not need to be held in the pressed position during the test. The instrument will then initiate the test presently loaded (in this case Memory 1).

If the DUT passes the test, you will hear a short audible beep. If a failure occurs, you will hear a long audible alarm and the red failure indicator will light up. If a failure occurs during the test, a continuous alarm will sound and the red indicator light in the RESET button will illuminate.

To stop the alarm you must press the illuminated RED button marked “RESET”. This will silence the alarm, clear the red fail light, and reset the instrument for the next test. The RESET button may also be used to quickly ABORT a test and cut off the power to the DUT.

When a test is being performed, a red lightning bolt indicator located in the lower right side of the front panel will illuminate and flash until the test is finished. If the DUT passed the test, you will hear a brief beep indicating the DUT passed and that the tests are complete.

### 3.3.2 Reviewing Results

The method for reviewing test results is to press the ENTER key at the end of the test sequence.

Results can be reviewed at any time before the next test is executed by pressing the ENTER key and then scrolling with the up and down arrow keys or repeatedly pressing the ENTER key.

The results of the last test in the process will be followed by the first test when scrolling through the results. All buffers are cleared at the start of the next test cycle.

Pressing the EXIT key will return you to the Settings screen.

### 3 System Settings

#### 3.4 SETUP Key Parameters

At the Setting, Pass, or Fail screen press the SETUP key. Use the SETUP key to progress through the menu of System Parameters. Successive key presses will advance the menu forward. The sequential forward menu items are: PLC Remote, Fail Stop, Contrast, Alarm, Smart GFI, GPIB address, BUS Remote Command Set, Memory Lock. The setting of system parameters affect the operating conditions of the instrument and are separate from the functional settings. The system settings are also global and are not specific to any memory location.

##### 3.4.6 PLC Remote

Press the SETUP key to advance to the PLC Remote parameter. The display will show:

PLC Remote =        ON <ENTER> to Select	or	PLC Remote =        OFF <ENTER> to Select
---	----	--

Use the ENTER key to select the mode PLC Remote Control.

If the Remote Control is set to ON, the test function will be controlled by the Remote Control via the remote connectors located on the rear panel. The TEST button on the front panel is disabled but the RESET button is still enabled.

The remote Memory Program recall functions can be performed only when the PLC Remote is set ON. In addition, when the PLC remote is set to ON, the remote TEST signal input is active while in the Bus Remote Mode.

If the Remote Control is set to OFF, the operation of the instrument will be controlled by the local TEST and RESET buttons on the front panel.

After selecting PLC Remote mode, press the SETUP key to advance to the Fail Stop setting. Press the EXIT key to exit from the PLC Remote selection to the operation mode. The instrument will store the PLC Remote selection automatically.

##### 3.4.7 Fail Stop

Press the SETUP key to advance the menu to the Fail Stop parameter. The display will show:

Fail Stop =        ON <ENTER> to Select	or	Fail Stop =        OFF <ENTER> to Select
--	----	---

Use the ENTER key to toggle the Fail Stop ON and OFF.

This mode allows the instrument to be setup to continue testing after detecting a failure, Fail Stop = OFF.

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. A display of the first eight connected memories PASS/FAIL results on items tested is provided at the conclusion of the last connected memory.

The display will show the results of the eight memories as follows:

<b>Test</b>	<b>P</b>	<b>F</b>	<b>P</b>	<b>F</b>	<b>P</b>	<b>F</b>	<b>P</b>	<b>F</b>
<b>Mem</b>	<b>22</b>	<b>23</b>	<b>24</b>	<b>25</b>	<b>26</b>	<b>27</b>	<b>28</b>	<b>29</b>

The pass-fail status is indicated by the letter F (Fail) or P (Pass).

Toggle the Fail Stop function or press the SETUP key to forward to the LCD Contrast selection. Press the EXIT key to return to the operation mode. The program will store the Fail Stop setting automatically.

### 3.4.8 LCD Contrast

Press the SETUP key to advance the menu to the Contrast parameter. The display will show:

Contrast	=	X
Range: 1 - 9		9=High

Use the Numeric keys to enter the LCD Contrast level, then press the ENTER key. The program will change the LCD Contrast immediately when the ENTER key is pressed, so the setting can be viewed.

The LCD Contrast level may be adjusted from 1 - 9. Level 1 is the lowest contrast and level 9 is the highest contrast.

Change the LCD Contrast again or press the SETUP key to advance to the Alarm Volume setting. Press the EXIT key to return to the operation mode. The program will store the Contrast setting automatically.

### 3.4.9 Alarm Volume

Press the SETUP key to advance the menu to the Volume parameter. The display will show:

Alarm	=	X
0 - 9	0=OFF	9=High

The Audible Alarm Volume range is from 0 - 9. Level 0 is used to disable the Audible Alarm. Level 1 is the lowest volume and level 9 is the loudest.

Use the Numeric keys to enter the Audible Alarm level, then press the ENTER key. The program will provide a sample sound for checking immediately when the ENTER key is pressed.

Change the Volume again or press the SETUP key to forward to the Smart GFI selection. Press the EXIT key to return to the operation mode. The program will store the Volume setting automatically.

#### 3.4.10 Smart GFI

Press the SETUP key to advance the menu to the Smart GFI parameter. The display will show:

Smart GFI = ON <ENTER> to Select	or	Smart GFI = OFF <ENTER> to Select
-------------------------------------	----	--------------------------------------

Use the ENTER key to toggle the Smart GFI ON and OFF.

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

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

Smart GFI allows the user to automatically configure the instruments return configuration. When the Return lead is earth grounded, the GFI circuit is disabled and the instrument operates in a grounded return mode of operation. Grounded Return allows the user to perform tests on devices that have their chassis earth grounded by the test fixture or test environment. The standard configuration of High Withstand Voltage Tester is a floating return connection that is not directly connected to Earth ground. The standard configuration allows monitoring of very low-level leakage current without internal or external stray earth ground leakage currents being measured and thereby causing errors in the reading. Grounding the return will create some amount of leakage current that is proportional to the High Voltage output and can cause small amounts of error depending on the test voltage and physical environment.

Toggle the Smart GFI function or press the SETUP key to forward to the GPIB address selection. Press the EXIT key to return to the operation mode. The program will store the Smart GFI setting automatically.

### 3.4.11 GPIB Address

#### 3.4.11.1

Only appears if the

**GPIB option 01 is installed**

Press the SETUP key to advance the menu to the GPIB address parameter. The display will show:

GPIB addr	=	XX
Range: 0-31		

Use the Numeric keys to enter the GPIB Address, then press the ENTER key.

Change the GPIB address again or press the SETUP key to advance to the Memory Lock parameter. Press the EXIT key to return to the operation mode. The program will store the GPIB address automatically.

### 3.4.12 BUS Remote Command Set

#### 3.4.12.1

Will not appear if

**the Printer Card option 02 is installed**

Press the SETUP key to advance the menu to the Command Set Format parameter. The display will show:

Command Set = 488.1 <ENTER> to Select
--

or

Command Set = 488.2 <ENTER> to Select
--

Use the ENTER key to toggle the remote command set between 488.1 and 488.2. Please refer to section **9.Bus Remote Interface GPIB/RS232** for additional information about this selection.

Change the BUS Remote Command Set again or press the SETUP key to advance to the Memory Lock parameter. Press the EXIT key to return to the operation mode. The program will store the BUS Remote Command Set automatically.

### 3.4.13 Memory Lock

Press the SETUP key to advance the menu to the Memory Lock parameter. The display will show:

Memory Lock = ON <ENTER> to Select
---------------------------------------

or

Memory Lock = OFF <ENTER> to Select
--

Use the ENTER key to toggle the Memory Lock ON and OFF.

Memory Lock is a sub-function of the Lock setting. In order for the Memory Lock function to work, the Lock must first be turned ON. Selecting the Memory Lock OFF will allow the user to access all available Memory locations but restricts access to memory editing capabilities. Selecting the Memory Lock ON will allow the user to only run the currently loaded memory.



Toggle the Memory Lock function or press the SETUP key to forward to the PLC Remote selection. Press the EXIT key to return to the operation mode. The program will store the Memory Lock setting automatically.

### 3.5 LOCK/LOCAL Key

#### 3.5.6 Lock Function

Press the LOCK/LOCAL key. If the Password is enabled, the display will show:

Password =    _ _ _ _ Range :   0 - 9 9 9 9
--

Use the Numeric Key to enter the password and then press the ENTER key. The program will switch the Key Lock function from LOCK to UNLOCK or UNLOCK to LOCK mode and advance the program to Operation mode automatically. If the wrong password is entered, the program will give a warning sound and the display will show:

Password =   ERROR Range :   0 - 9 9 9 9
---

And then the program will return to the original screen and wait to enter the new password. If the Password is disabled (Password is set "0"), the display will show:

Key Lock =    O N <ENTER> to Select
--

or

Key Lock =    O F F <ENTER> to Select
--

Use the ENTER key to select the Key Lock mode, and then press the EXIT key. The program will switch the Key Lock function from LOCK to UNLOCK or UNLOCK to LOCK mode and advance the program to the Operation mode automatically. If the Key Lock function is in the Lock mode, the LOCK indicator on the front panel will light.

If the Memory Lock function is selected to ON, the Memory selection Menu will be disabled when in the Lock Mode. If the Memory Lock is selected to OFF, the Memory selection Menu will be enabled when in the Lock Mode. Different memories can be recalled but the test parameters or steps cannot be changed.

Please refer to section 4.1.7, Memory Lock for instructions on this feature.

#### 3.5.7 Local Function

Use this key when you wish to go from the Remote operation of the instrument to the Local mode.

### 3.6 Password Setting

Press the "4" and "7" keys simultaneously and then turn the input power switch on. The



program will automatically enter to the Password Setting mode and the display screen will show:

Password	=	0
Range : 0 - 9 9 9 9		

or

Password	=	X X X X
Range : 0 - 9 9 9 9		

The Password can be any four (4) digit number. If the Password is set to 0, the keyboard lock out will be selected by the LOCK key on the front panel without a Password. The Password default is preset to 0 at the factory.

## 4 Test Parameters Setup Procedures

## 4.4 Test Parameters

### Description of Test Parameters

**Voltage:** The Voltage that is applied to the High Voltage and Return terminals or the Current and Return terminals during a test.

**HI-Limit:** A maximum current or resistance threshold that when exceeded triggers a failure.

**LO-Limit:** A minimum current or resistance threshold that when not exceeded triggers a failure.

**Ramp-UP:** A length of time that is allowed for the test voltage to climb from 0 to the voltage set point.

**Dwell Unit:** Allows for the selection of seconds or minutes as the Dwell timers base unit.

**Dwell:** A length of time that is allowed for the set point voltage to be applied.

**Ramp-DOWN:** A length of time that is allowed for the test voltage to decay from set point to zero.

**Arc Detect:** This function when turned on activates the Arc Detection threshold controlled by the Arc Sense parameter.

**Arc Sense:** The numbers corresponding to the different arc sensitivity levels are 1 through 9, 1 meaning the maximum threshold of allowable arcing, 9 meaning the minimum threshold of allowable arcing. During Hipot testing, some low current arcing may be allowable. Arc sense is a maximum allowable threshold for arcing.

**Frequency:** This parameter is available in AC tests only and is selectable using the settings menu between 50 and 60Hz.

**Connect:** This function when turned ON will connect or link the current memory to the next memory. This function allows all 50-memory locations to be connected together.

**Ramp-HI:** Ramp-HI will allow current higher than the normal HI-Limit current setting of the DC Withstand Voltage test, during the Ramp-Up time, to avoid false failure due to charging current. Ramp-HI may be selected ON or OFF using a softkey. A description of how to set up this parameter is given in the **5.2.11 Ramp-Hi selection** section of this manual.

**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 **5.2.10 Charge-Lo setting** section of this manual.

**Dwell Unit:** The operator can select between Second/Minute/Hour.

**Cycle Test:** Allows the operator to program the source to automatically repeat an overall testing sequence.

## 4.5 Setting Up Tests

Before going to setup the Test Parameters, make sure that the Keyboard is in the Unlock mode, and then follow this procedure to setup the Test Parameters.

Press the Memory key and using the numeric keypad enter the Memory number you would like to edit and then press the ENTER key.

Use the  $\wedge$  or  $\vee$  arrow keys to progress through the test parameters menu. The  $\vee$  key will advance forward and  $\wedge$  key will advance backward. The sequential forward menu items are Voltage, HI-Limit, LO-Limit, Ramp-UP, Dwell Unit, Dwell Time, Ramp-DOWN, Frequency, Arc Detect, Arc Sense, and Connect.

### 4.5.6.1

### Withstand

#### Display

M XX	Set	XXX.X s	Note: X = Numeric Note: x = milli or micro
XX.XX	KV	X.XXX xA	

M XX	:	Memory Program number
Set	:	Withstand Voltage test setting screen
XXX.X s	:	Dwell Time setting
X.XX KV	:	Output Voltage setting
X.XXX mA	:	High-Limit current setting (AC withstand instruments)
XXXX $\mu$ A	:	High-Limit current setting (DC withstand instruments)

### 1.1.1. Output Voltage setting

Advance the menu to the Voltage parameter. The display will show:

Voltage	=	XX.XX k
V		
Range:		0.00 – XX.00kV

Use the Numeric keys to enter the voltage setting, and then press the ENTER key. The program will store the voltage setting and advance to the High Limit parameter automatically.

Press the EXIT key to exit from the setting mode to the operation mode if all parameters have been set.

### 4.5.7 HI-Limit Current setting

Advance the menu to the HI-Limit parameter. The display will show:

<div> HI-Limit            =    X.XXX mA  Range:    0.000 – 9.999mA </div>	or	<div> HI-Limit =    XXXX <math>\mu</math>A  Range : 0 - 5000<math>\mu</math>A </div>
---	----	--

Use the Numeric keys to enter the HI-Limit setting, and then press the ENTER key. The program will store the HI-Limit setting and advance to the LO-Limit parameter automatically. Press the EXIT key to exit from the setting mode to the operation mode if all parameters have been set.

#### 4.5.8 LO-Limit Current setting

Advance the menu to the LO-Limit parameter. The display will show:

<div> LO-Limit            =    X.XXX mA  Range:    0.000 – 9.999mA </div>	or	<div> LO-Limit =    XXX.X <math>\mu</math>A  Range : 0.0 - 999.9<math>\mu</math>A </div>
---	----	--

Use the Numeric keys to enter the LO-Limit setting, then press the ENTER key. The program will store the LO-Limit setting and advance to the Ramp-UP parameter automatically.

Press the EXIT key to exit from the setting mode to the operation mode if all parameters have been set.

If the LO-Limit is set to “0”, the LO-Limit is disabled.

#### 4.5.9 Ramp-UP Time setting

Advance the menu to the Ramp-UP time parameter. The display will show:

ACW Units		DCW Units
<div> Ramp-UP            =    XXX.X s  Range:    0.3 - 999.9s </div>	or	<div> Ramp-UP            =    XXX.X s  Range:    0.4 - 999.9s </div>

Use the Numeric keys to enter the Ramp-UP time setting, then press the ENTER key. The program will store the Ramp-UP time setting and advance to the Dwell Time setting automatically.

Press the EXIT key to exit from the setting mode to the operation mode if all parameters have been set.

#### 4.5.10 Dwell Unit setting

Advance the menu to the Dwell Unit parameter. The display will show:

<div> Dwell Unit =    Second  &lt;ENTER&gt; to    Select </div>	or	<div> Dwell Unit =    Minute  &lt;ENTER&gt; to    Select </div>
---	----	---

Use the ENTER key to toggle between the Seconds and Minutes. The program will store the Dwell Unit setting and advance to the Dwell Time setting automatically.

#### 4.5.11 Dwell Time setting

Advance the menu to the Dwell Time parameter. The display will show:

Dwell Time = XXX.X s Range : 0.3 - 999.9s 0 = Const.	or	Dwell Time = XXX.X m Range : 0.4 - 999.9m 0 =Const.
---	----	--

Use the Numeric keys to enter the Dwell Time setting, and then press the ENTER key. The program will store the Dwell Time setting and advance to the Ramp -DOWN time setting automatically. The unit is “second” and 0.1 second per step. The display will show the elapsed time during the testing.

Press the EXIT key to exit from the setting mode to the operation mode if all parameters have been set.

If the Dwell Time is set to “0”, the timer will continue to count to the maximum test time then reset to “0” and start over automatically. The test will continue until a reset is executed or a failure occurs.

#### 4.5.12 Ramp-DOWN Time setting

Advance the menu to the Ramp-DOWN time parameter. The display will show:

ACW Units	or	DCW Units
Ramp-DOWN = XXX.X s Range: 0.1 - 999.9s		Ramp-DOWN = XXX.X s Range: 0, 1.0 - 999.9s

Use the Numeric keys to enter the Ramp-DOWN time setting, then press the ENTER key. The program will store the Ramp-DOWN time setting and advance to the Frequency Selection automatically.

Press the EXIT key to exit from the setting mode to the operation mode if all parameters have been set.

#### 4.5.13 Frequency Selection (AC units only)

Advance the menu to the Frequency parameter and the display will show:

Frequency = 60 Hz <ENTER> to Select	or	Frequency = 50 Hz <ENTER> to Select
--	----	--

Use the ENTER key to select the Output Frequency, then press the ^ or v key to advance to another test parameter or press the EXIT key to exit from the setting mode to the operation mode.

#### 4.5.14 Arc Detect and Arc Sensitivity Selection

Advance the menu to the Arc Detection selection. The display will show:

Arc Detect =      O N <ENTER> to Select	or	Arc Detect =      O F F <ENTER> to Select
--	----	--

Use the ENTER key to toggle the Arc Detect mode, then press the ^ or v key to advance the program to the Arc Sense parameter or press the EXIT key to exit from the setting mode to the operation mode.

Advance the menu to the Arc Sense parameter. The display will show:

Arc Sense    =                      X Range : 1 - 9      9 = High
--

For model 7470, 7472 and 7473, the range of ARC sense is from 1 to 9.

For model 7473, if the voltage is lower than 15KV, the range of Arc sense is from 1 to 9. If the voltage is higher than 15KV, the range is from 1 to 7.

Use the Numeric keys to enter the Arc Sense setting, and then press the ENTER key. The numeric value is proportional to the amount of sensitivity, i.e. "9" is the highest sensitivity. The program will store the Arc Sense setting and advance to the Connect mode selection automatically.

If the Arc Detect mode is set to ON, the program will indicate an arc failure when the arc current is over the setting and the program will shut down the test immediately.

If the Arc Detect mode is set to OFF, the program will not indicate an arc failure when the arc current is over the setting.

#### 4.5.15 Ramp-HI selection (DC units only)

Advance the menu to the Ramp-High parameter. The display will show:

Ramp-HI =      ON <ENTER> to Select	or	Ramp-HI =      OFF <ENTER> to Select
--	----	---

Use the ENTER key to select the Ramp-HI mode, then press the ^ or v key to advance the program to another test parameter or press the EXIT key to exit from the setting mode to the operation mode.

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 Voltage test to avoid false failure due to charging current.

#### 4.5.16 Charge-LO setting (DC units only)

Advance the menu to the Charge-LO parameter. The display will show:

Charge-LO =    XXX.X  $\mu$ A  
<TEST> to Auto Set

The Charge-LO function is used to check if the test 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 was lower than the setting, the test cables may not be connected properly.

This instrument can set the Charge-LO value manually or automatically. To set the Charge-LO value manually, use the numeric keys to enter the Charge-LO current setting and then press the ENTER key. The program will store the Charge-LO setting and advance to the Ramp-HI parameter. The setting range of Charge-LO is from 0.0 to 350.0  $\mu$ A. The unit is  $\mu$ A and 0.1 $\mu$ A per step.

To use Auto Set, be sure that the test parameter of Output Voltage and Ramp Time have been set to the values that will be used for the Final test and connect the test cables and/or test fixture between the instrument and DUT. If the scanner is to be used then the scanner channel must also be set, and then press the TEST button. The instrument will apply the voltage that has been entered for this memory-step selection.

**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 DUT and set the Charge-LO current at approximately one half (1/2) of the reading. The display will show:

Charge-LO =    XXX.X  $\mu$ A  
<TEST> to Auto Set

The value showing on the display is the Charge-LO setting and is not the reading of the charging current of the DUT.

Then press the  $\wedge$  or  $\vee$  key to advance the program to another test parameter or press the EXIT key to exit from the setting mode to the operation mode.

#### 4.5.17 Cycle Test

Advance the menu to the Cycle test parameter. The display will show:

Cycle test    =    XXXX  
0 – 9999 Times    0=Const.

Use the Numeric keys to enter the Cycle Test setting, and then press the ENTER key.

#### 4.5.18 Connect

Advance the menu to the Connect selection. The display will show:

Connect = O N <ENTER> to Select	or	Connect = O F F <ENTER> to Select
------------------------------------	----	--------------------------------------

Use the ENTER key to toggle the Connect Mode ON and OFF.

This function when turned ON will connect or link the current memory to the next memory.

This Allows High Withstand Voltage Tester to Run 50 consecutive tests in a sequence if desired.

## 4.6 Reviewing Test Results

The method for reviewing test results is to press the ENTER key at the end of the test sequence. Results can be reviewed at any time before the next test is executed by pressing the ENTER key and then scrolling with the up and down arrow keys or repeatedly pressing the ENTER key. The results of the last test in the process will be followed by the first test when scrolling through the results. All buffers are cleared at the start of the next test cycle. Pressing the EXIT or RESET key will return you to the Settings screen.

## 4.7 Default Test Parameters

The following table is a listing of the Default Parameters for the ACW tests available in the 7470 and 7473 High Withstand Voltage Tester and the DCW tests available in the 7472 and 7474 High Withstand Voltage Tester When you receive your High Withstand Voltage Tester all 50 memory locations will be loaded with these parameters. The Default Parameters are as follows:

Test Type	Parameter	Value
ACW units	Voltage	1.24kVAC
	HI-Limit (current)	5.000mA
	LO-Limit (current)	0.000mA
	Ramp UP	0.3s
	Dwell Unit	Second
	Dwell Time	1.0s
	Ramp-DOWN	0.0s
	Frequency	60Hz
	Arc Detect	OFF
	Arc Sense	5
	Connect	OFF
DCW units	Voltage	1.50kVDC
	HI-Limit	5000μA
	LO-Limit	0.0μA
	Ramp-UP	0.4s
	Dwell Unit	Second
	Dwell Time	1.0s
	Ramp-DOWN	0.0s



Arc Detect	OFF
Arc Sense	5
Ramp-HI	OFF
Charge-LO	0.0 $\mu$ A
Connect	OFF

## 5 Operating Instructions

### 5.4 Preparation and Instrument Connections

Before the operation of this instrument, make sure that all Test Parameters have been set properly according to the Test Parameters Setup Procedures. Also, check the system setting of Remote Control, LCD Contrast, the Alarm Volume, and Fail Stop.

Be sure to connect the appropriate test leads to the device under test (DUT) or test fixture. Be sure to connect the safety ground (on the rear panel) to a suitable known good ground before energizing this instrument. Then connect the return lead first to the test fixture or the DUT followed by the high voltage lead.

Please check your connections to be sure they are making good contact. Clear the area of any debris that may create a hazardous situation and ask any unnecessary personnel to leave the area.



DO NOT TOUCH THE DEVICE UNDER TEST, HIGH VOLTAGE TEST LEAD, ALLIGATOR CLIP, OR CLIP INSULATOR ONCE THE TEST HAS BEEN STARTED.

This instrument is supplied with a high voltage test lead terminated with an alligator clip. This clip is designed to allow firm connection to the DUT without the need for an operator to hold a probe or lead in place during the test. This clip and insulator will carry the voltage and current of this tester but they are not intended to be held by the operator during the test while the high voltage is energized. Please insure that you do not make contact with the alligator clip or the clip insulator while high voltage is energized.

## 5.5 Power Up

Turn on the Input Power Switch. The display will show the Trade Mark, Model Number, and Version Number first.

The program will then recall the Memory which was last executed.

## 5.6 Settings Screen

The settings screen will show parameter settings of the test that will be performed and the memory location that they are stored in. This screen can be accessed after a test is Aborted or Passed by pressing the RESET button or after a test failure by pressing the RESET button twice. The following is an example of a Settings Screen for the 7473 before any test has been executed.

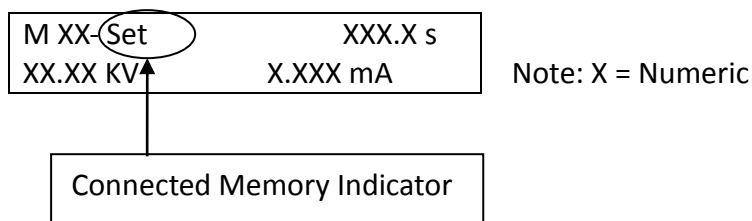
M XX	Set	XXX.X s	Note: X = Numeric Note: x = milli or micro
XX.XX	KV	X.XXX xA	

M XX	:	Memory Program number
Set	:	Withstand Voltage test setting screen
XXX.X s	:	Dwell Time setting
X.XX KV	:	Output Voltage setting
X.XXX mA	:	High-Limit current setting (AC withstand instruments)
XXXX $\mu$ A	:	High-Limit current setting (DC withstand instruments)

The Settings screen is the main operational screen of instrument. From this screen, test parameters are monitored while the test is being performed.

### 5.6.6 Connected Memory indicator

The connected memory indicator is an under score symbol located directly next to the Memory number and only will be displayed when the connect function has been turned ON in the Test parameters.



## 5.7 Metering

The same parameters described in section 6.3 **Settings Screen** are monitored live while performing tests. The following table describes what meters will be displayed.

Model	Test Type	Current	Voltage	Time
7470, 7473	AC Withstand	X	X	X
7472, 7474	DC Withstand	X	X	X

The memory location will also be indicated on the display as well as the connect function

## 5.8 Performing a Test

5.8.6.1.1 From the Settings screen, press the MEMORY key and select the memory you wish to perform using the numeric keypad then press the ENTER key to return you to the Perform Test screen.

5.8.6.1.2 Attach the appropriate load or DUT to the instrument (refer to section 6.1 for instrument connections).

**WARNING** DO NOT TOUCH THE DEVICE UNDER TEST, HIGH VOLTAGE TEST LEAD, ALLIGATOR CLIP, OR CLIP INSULATOR ONCE THE TEST HAS BEEN STARTED.

5.8.6.1.3 Press the TEST button.

5.8.6.1.4 The instrument will now perform the test or connected sequence of tests.

### 5.8.7 Discharge Function in DC units

The 7472 and 7474 units are equipped with a Discharge function that is designed to discharge the voltage of a capacitive DUT so that it may be safely disconnected from the test leads of the instrument. The discharge function monitors the voltage of the DUT and remains active until the voltage of the DUT falls below 40 volts. The instrument will also not allow another test to be executed until the voltage of the DUT falls below 40 volts. The discharge period will occur either directly after the Dwell time, if Ramp-DOWN is set to "0", or after the designating Ramp-DOWN time.

## WARNING

DO NOT TOUCH THE DEVICE UNDER TEST, HIGH VOLTAGE TEST LEAD, ALLIGATOR CLIP, OR CLIP INSULATOR DURING THE DISCHARGE CYCLE.

The Discharge cycle is a means by which the instrument drains any remaining charge from a DUT after the completion of a test. The Discharge cycle is active when the word "Discharge" appears on the screen and is also indicated by the flashing high voltage lamp, active voltmeter, and timer. Never attempt to remove a DUT from the instrument during the Discharge cycle. Always allow the Discharge cycle to complete before powering down the instrument.

During the Discharge time, the display will show:

MXX	Discharge	XXX.X s
XX.XX	KV	

If the capacitance of the DUT is very small it is possible that you will not see this display due to the short amount of time required to discharge the DUT. discharge the DUT.

The voltage and time of the discharging DUT will be displayed during the discharge period but this information is only intended for reference and cannot be reviewed after the end of the discharge period. The process signal of the remote I/O remains active during the discharge period and the high voltage lightning bolt indicator on the front panel of the instrument is also active during the discharge period.

As a safety precaution, if the RESET button is pressed during the discharge period, the instrument will log the RESET but will not discontinue the discharge function. Pressing the RESET during the discharge will only prevent a connected memory from executing after the discharge time.

The capacitance of the DUT should never exceed the maximum specification listed in this manual.

### 5.8.8 Manual Voltage Adjustment

When HIGH WITHSTAND VOLTAGE TESTER is performing a test, the ∨ (down) and ∧ (up) keys may be used to adjust the output voltage.

Pressing the ∧ (up) key will increase the output voltage, pressing the ∨ (down) key will decrease the output voltage. Manual voltage adjustment temporarily overrides the voltage setting and only remains in effect until the test is terminated by Pass, Fail, or Abort.

When the Lock parameter is selected ON in the system menu, manual voltage adjustment is disabled.

## 6 Displayed Messages

### 6.4 Running Test Messages all units

If the test in process is Aborted with the RESET button or remote control, the display will show:

MXX Abort	XXX.X s
XX.XX KV	XX.XX mA

If the test in process is Aborted with the RESET button or remote control before the meter readings are taken, the display will show:

MXX Abort	XXX.X s
--.--- KV	--.--- mA

 or 

MXX Abort	XXX.X s
XX.XX KV	--.--- mA

At the beginning of AC Withstand Voltage test when the voltage begins to ramp but before the meter readings are taken, the display will show:

MXX	Ramp-UP	XXX.X s
--. --	KV	--. -- mA

During the AC Withstand Voltage test when the values are being updated in real time during the ramp cycle, the display will show:

MXX	Ramp-UP	XXX.X s
XX.XX	KV	XX.XX mA

During the AC Withstand Voltage test when the values are being updated in real time during the dwell cycle, the display will show:

MXX	Dwell	XXX.X s
XX.XX	KV	XX.XX mA

If the ramp time is very short and the program has not read the meter readings, the display will show:

MXX	Dwell	XXX.X s
--. --	KV	--. -- mA

If the DUT current exceeds the HI-Limit of AC Withstand Voltage test and the leakage current is within the metering range, the display will show:

MXX	HI-Limit	XXX.X s
XX.XX	KV	XX.XX mA

If the DUT current exceeds the HI-Limit of AC Withstand Voltage test and the leakage current is not within the metering range, the display will show:

MXX	HI-Limit	XXX.X s
XX.XX	KV	> 10 mA

If the DUT current is well beyond the metering range of AC Withstand Voltage test the instrument assumes that the failure is due to a short circuit, the display will show:

MXX	Short	XXX.X s
--. --	KV	> 10 mA

If the DUT current is well beyond the metering range of AC Withstand Voltage test and an Arcing condition beyond the Arc Sense limit is indicated, the display will show:

MXX	Breakdown	XXX.X s
XX.XX KV	> 10	mA

If the DUT current falls below the LO-Limit of AC Withstand Voltage test, the display will show:

MXX	LO-limit	XXX.X s
XX.XX KV	XX.XX	mA

If the DUT current is within the metering range of the AC Withstand Voltage test and an Arcing current exceeds the Arc-Sense limit and the Arc function is set to ON, then an Arc failure has occurred and the display will show:

MXX	Arc-Fail	XXX.X s
XX.XX KV	XX.XX	mA

If a Ramp-DOWN time has been set and the dwell portion of the test is complete the display will show:

MXX	Ramp-DOWN	XXX.X s
XX.XX KV	XX.XX	mA

If the DUT has passed the AC Withstand Voltage test and the test process is complete the display will show:

MXX	Pass	XXX.X s
XX.XX KV	XX.XX	mA

## 6.5 Additional Displayed messages for DC units

If the Ramp-HI function is enabled and the leakage current during the Ramp cycle exceeds 5mA, then the display will show:

MXX	Ramp-HI	XXX.X s
XX.XX KV	>5000	μA

If the leakage current during the Ramp cycle falls below the Charge -LO setting, then the display will show:

MXX	Charge-LO	XXX.X s
XX.XX KV	XXX.X.	μA

When running capacitive DUTS the instrument will discharge the DUT at the end of the Dwell or Ramp-DOWN cycle depending on the test settings. The display will show the following screen during the discharge cycle:

MXX	Discharge	XXX.X s
XX.XX	KV	

If the capacitance of the DUT is very small it is possible that you will not see this display due to the short amount of time required to discharge the DUT.

## WARNING

DO NOT TOUCH THE DEVICE UNDER TEST, HIGH VOLTAGE TEST LEAD, ALLIGATOR CLIP, OR CLIP INSULATOR DURING THE DISCHARGE CYCLE.

The Discharge cycle is a means by which the instrument drains any remaining charge from a DUT after the completion of a test. The Discharge cycle is active when the word “Discharge” appears on the screen and is also indicated by the flashing high voltage lamp, active voltmeter, and timer. Never attempt to remove a DUT from the instrument during the Discharge cycle. Always allow the Discharge cycle to complete before powering down the instrument.

## 6.6 BUS Remote message

The REM indicator will be displayed when the instrument is in the Remote Control mode. When the BUS Remote is on the instrument is able to send and receive signals across the GPIB IEEE-488 or RS-232 bus.

M XX	Set	XXX.X s
XX.XX	KV	REM X.XXX mA

## 6.7 Fatal Error

The only active button or key in this situation is the RESET button. The only reason the RESET button is active is to allow you to silence the alarm and open the fail relay. This type of failure permanently locks the instrument in the “Fatal Error” mode and requires that the instrument be serviced by EEC. The customer should contact EEC to receive further instruction. An example of the Fatal Error screen appears as follows:

FATAL ERROR	9002
Call	1-800-858-8378

FATAL ERROR	9003
Call	1-800-858-8378

The following Fatal Error identification numbers will represent type of the failure that has occurred:

**Error Code 9002** will appear on the display, if the instrument’s System data or the



Model/Option/Serial Number data are corrupted and do not match the settings.

**Error Code 9003** will appear on the display, if the instrument's Calibration data is corrupted.

## 6.8 Output Error

If the instrument has an internal problem and the TEST button is pressed, the Output Error screen will appear as follows:

OUTPUT ERROR! Press EXIT Continue
--------------------------------------

The RESET button is not active while this screen is displayed. To clear this screen and return to test mode the EXIT key must be pressed. When the EXIT key is pressed, the instrument will continue with its normal failure indication process. The failure light and Alarm can then be cleared by pressing the RESET button. This message appears on the display after exiting from the Output Error screen.

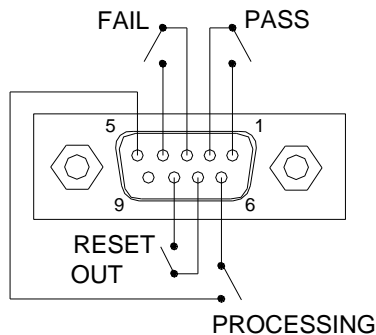
MXX	Out-Error	XXX.X s
XX.XX KV		XX.XX mA

## 7 Connection of Remote I/O

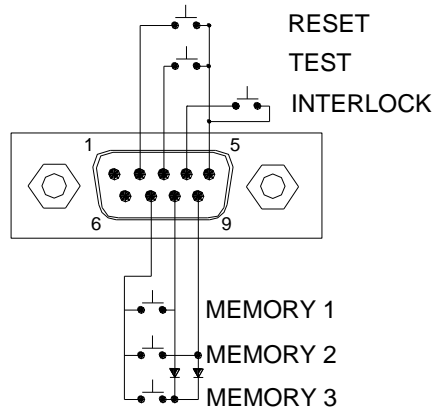
Two 9-pin "D" type connectors are mounted on the rear panel that provide REMOTE-INPUT-OUTPUT control and information. These connectors mate with standard 9 pin D-sub-miniature connector provided by the user. The output mates to a male (plug) connector while the input mates to a female (receptacle) connector. 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:

## SIGNAL OUTPUT



## SIGNAL INPUT



### 7.4 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 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 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.

Pins 7 and 8 provide the RESET OUT 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. The process contact is closed all the way through to the end of the discharge cycle in DC units.

**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.

**RESET OUT** – The relay contact closes the connection between pin (7) and pin (8) while the reset function is activated. This is only a continuous closure dependent on the length of time

the reset button is held in an active state.

## 7.5 Signal Inputs of Remote I/O and Memory Access

The High Withstand Voltage Tester remote connector enables remote operation of the TEST, RESET, and REMOTE INTERLOCK functions, and allows the operator to select Memory 1, Memory 2, and Memory 3.

When the PLC Remote mode is on, the High Withstand Voltage Tester 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 High Withstand Voltage Tester also allow access to three MEMORY PROGRAMS through the remote control connector. This gives the user the capability to quickly change parameters and initiate a test remotely. The built in memory programs of the instrument are used to accomplish this. Three internal memory programs can be accessed, by connecting terminals 7, 8, and 9 in different combinations. The memory select lines 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. It may be necessary to "OR" the momentary switches (relay contacts) to prevent incorrect program selection due to timing errors.

### **WARNING**

ACTIVATING MEMORY PROGRAM FUNCTIONS THROUGH THE REMOTE CONNECTOR, SELECTS THE PROGRAM AND STARTS THE TEST WHICH IS PREPROGRAMMED INTO THAT MEMORY

### **CAUTION**

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

MEMORY ONE – Momentarily connecting terminal 7 to 8 signals the instrument to immediately begin the test program that is stored in memory one.

MEMORY TWO – Momentarily connecting terminal 7 to 9 signals the instrument to immediately begin the test program that is stored in memory two.

MEMORY THREE – Momentarily connecting terminal 7 to terminals 8 and 9 signals the instrument to immediately begin the test program that is stored in memory three.

#### 7.5.6.1

#### Remote Interlock

High Withstand Voltage Tester is equipped with a featured referred to as “Remote Interlock”. Remote Interlock is a feature that utilizes a set of closed contacts to enable the instruments output. In other words, if the Interlock contacts 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 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:

Interlock Is Open

If the 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 Connector 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 interlock, the instrument will not perform tests.

#### 7.5.6.2

#### PLC Remote Pop-up

#### message

If you attempt to start a test from the front panel Test button and the PLC remote function is turned ON, a pop-up message will be displayed. The pop-up message will appear as follows:

PLC Remote ON

## 8 Bus Remote Interface USB/RS-232 and GPIB (Option)

This section provides information on the proper use and configuration of bus remote interface. The RS-232 interface also uses the same command set as the GPIB interface for setting of test parameters. However, many functions of the GPIB 488.2 interface are not available through RS-232. The IEEE-488 interface included with High Withstand Voltage Tester conforms to the requirements of the IEEE-488.2 standard.

### 8.4 GPIB Messages

There are typically two types of messages that GPIB devices use to communicate with other interconnected GPIB devices;

**Interface messages:** Often called commands or command messages and Device dependent messages often called data or data messages.

**Data Messages:** Contain information such as programming instructions or measurement results. Command Messages perform functions such as initializing the bus and addressing and unaddressing devices.

## 8.5 Functions

A GPIB device can be a Listener, Talker, and/or Controller. A Talker sends data messages to one or more Listeners, which receive data. A Controller manages the information flow on the GPIB by sending commands to all devices. The GPIB bus is much like a computer bus except a computer has circuit cards connected via a backplane and the GPIB has stand-alone devices connected via a cable.

## 8.6 Signals and Lines

The GPIB consists of 16 signal lines and 8 ground-return or shield drain lines. The 16 signal lines are grouped into 8 data lines, 3 handshake lines, and 5 interface management lines.

**Data Lines:** The eight data lines, DI01 through DI08 carry data and command messages. The 7-bit ASCII or ISO code set is used and the eighth bit DI08 is unused.

**Handshake Lines:** The transfer of message bytes between devices is done via three asynchronous control lines. Referred to as three-wire interlocked handshake. This guarantees that message bytes on the data lines are sent and received without transmission error.

**NRFD** (not ready for data) indicates when a device is ready or not ready to receive a message byte.

**NDAC** (not data accepted) indicates when a device has or has not accepted a message byte.

**DAV** (data valid) tells when the signals on the data lines are stable (valid) and can be accepted safely by devices.

**Interface Management Lines:** Five lines are used to manage the flow of information across the interface.

**ATN** (attention) ATN is driven true by the controller when it uses the data lines to send commands, and drivers ATN false when a Talker can send data messages.

**IFC** (interface clear) IFC is driven by the system controller to initialize the bus and become CIC.

**REN** (remote enable) The REN line is driven by the controller that is used to place devices in remote or local program mode.

**SRQ** (service request) The SRQ line can be driven by any device to asynchronously request service from the Controller.

**EOI** (end or identify) This line has two purposes- the Talker uses this line to mark the end of a message string, and the Controller uses it to tell devices to identify their response in a parallel poll.

## 8.7 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 ( $\leq 0.8$  V), and when DAV is false, it is a TTL high level ( $\geq 2.0$  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.

## 8.8 GPIB Address

This interface is optional on the High Withstand Voltage Tester. Each device on the GPIB (IEEE-488) interface must have a unique address. You can set the address of the High Withstand Voltage Tester to any value between 0 and 30. The address is set to 8 when the instrument is shipped from the factory. 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.

## 8.9 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	RLO	No remote/local capability

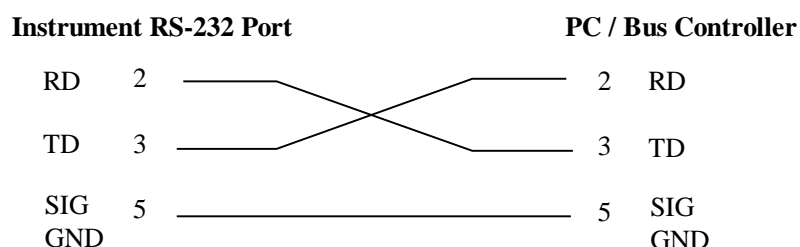
Parallel Poll	PP0	No parallel poll capability
Device Clear	DC1	Complete Device clear capability
Device Trigger	DT0	No device trigger capability
Controller	C0	No controller capability
Electrical Interface	E2	Three-state drivers

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)

## 8.10 RS-232 Interface

This interface is standard on High Withstand Voltage Tester. 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 the command list, section 8.11.6 to 8.11.11 of this manual. The identification command \*IDN and the Status Reporting commands are also available through RS-232.

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



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 the lines then the handshake lines should be jumpered together in two different sets. Pins 4 and 6 jumpered together and pins 7 and 8 jumpered together at the controller end of the cable.

When sending command over the RS232 bus the instrument will send a response string of 06 hex or 6 decimal, the Acknowledge (ACK) ASCII control code if the transfer was recognized and completed by the instrument. 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. 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.

## 8.11 GPIB / RS-232 Interface Command List

A GPIB read command must be sent after the command strings, to retrieve any data from a query command (?). The High Withstand Voltage Tester GPIB bus will not send any data to the controller without being queried. The RS-232 bus will automatically send any response back to the controller's input buffer. Each command string should be terminated by the ASCII control code, New Line <NL>, OAh or the end of line EOL message for GPIB.

The following conventions are used to describe the commands syntax for High Withstand Voltage Tester. 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, select one of these as the data for the command.

When sending the command none of the previous mentioned characters should be included, they are only for reference purposes in this manual. Nor should quotation ( " " ) marks be include when sending the commands. Also the command and the parameter data must be separated with a space.

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.

### 8.11.6 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
SACG	Set Auto-Charge-LO

#### TEST

Starts the test sequence at the selected memory location that has been loaded into the instruments memory (RAM).

#### RESET

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



## SACG

Set the Charge-LO parameter for the DCW test. The cables and any test fixture should be connected before executing the command. The test parameters that are set for the memory 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.

### 8.11.7 File Editing Commands

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

Command	Description	Value
FL <memory number>	File Load	memory number = 1-50
ADD <test,p1,p2,p3...>	Add all parameters of a test	
SF {1 0}	Fail Stop	1=On, 0=Off

#### FL <memory number>

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

#### ADD <test,p1,p2,p3...>

This command edits all parameters in a memory location. Parameters will be edited at the memory location that has been selected.

The parameter <test> indicates the test type. The test type values ACW or DCW 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 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, or refer to the Test Parameter Editing commands section for the proper values.

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". 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 memory number.

	ACW	DCW
1	Voltage	Voltage
2	HI-Limit	HI-Limit
3	LO-Limit	LO-Limit
4	Ramp Up	Ramp Up
5	Dwell Unit	Dwell Unit
6	Dwell Time	Dwell Time
7	Ramp Down	Ramp Down
8	Frequency (50/60)	Arc Detect (ON/OFF)
9	Arc Detect (ON/OFF)	Arc Sense

10	Arc Sense	Ramp-HI (ON/OFF)
11	DWELL UNIT	Charge-LO
12	Connect (ON/OFF)	DWELL UNIT
13		Connect (ON/OFF)

### 8.11.8 Test Parameter Editing Commands and Companion Queries

These commands are used to modify the test parameter within each memory. 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
EA < value > EA?	Edit Arc	ACW DCW	1 – 9
EAD {1 0} EAD?	Edit Arc-Detect	ACW DCW	1= On, 0=Off
ECT < value > ECT?	Edit Cycle Test nnnn	ACW DCW	0 - 9999
ECC {1 0} ECC?	Edit Connect	ACW DCW	1= On, 0=Off
ECG < value > ECG?	Edit Charge-Lo	DCW	0.0 - 350.0uA
EDWU < value > EDWU?	Edit Dwell Unit n	ACW DCW	0=SEC,1=MIN,2=HR
EDW < value > EDW?	Edit Dwell	ACW DCW	0, 0.3 - 999.9s (7470, 7473) 0, 0.4 - 999.9s (7472,7474) 0, 0.1 - 999.9m
EF {1 0} EF?	Edit Frequency	ACW	1=60Hz, 0=50Hz
EH < value > EH?	Edit HI-Limit	ACW DCW	0.000 – 9.999mA (7473, 7470) 10.00 - 20.00mA (7470) 0.0 – 999.9 uA (7472, 7474) 1000 – 9999uA(7472) 1000 - 5000uA (7474)
EL < value > EL?	Edit LO-Limit		
ERD <value > ERD?	Edit Ramp-DOWN	ACW DCW	0.0 - 999.9s (7470, 7473) 0, 1.0 - 999.9s (7472, 7474)
ERH {1 0} ERH?	Edit Ramp-HI	DCW	1= On, 0=Off

Command	Name	Test Types	Value
ERU <value> ERU?	Edit Ramp-UP	ACW DCW	0.1 - 999.9s (7470) 0.3 - 999.9s (7473) 0.4 - 999.9s (7472, 7474)
EV <value> EV?	Edit Voltage	ACW DCW	0 - 10.00kV (7470) 0 - 12.00kV (7472) 0 - 20.00kV (7473) 0 - 20.00kV (7474)

### 8.11.9 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
SPR {1 0} SPR?	PLC Remote	1= On, 0=Off
SF {1 0} SF?	Fail Stop	1= On, 0=Off
SAL <value > SAL?	Alarm Volume	0 - 9
SC <value > SC?	Contrast	1 - 9
SL {1 0} SL?	Lock	1= On, 0=Off
SML {1 0} SML?	Memory Lock	1= On, 0=Off
SSG {1 0} SSG?	Smart GFI	1= On, 0=Off
SD1 <value > SD1?	Device ID	0 - 9999999
SD2 {1 0} SD2?	Device ID	1= On, 0=Off
SPM {2 1 0} SPM?	Print Mode	0=AUTO, 1=MANUAL, 2=OFF
SPRE {1 0} SPRE?	Prn Result n	1=FAIL, 0=ALL
SPS {1 0} SPS?	Prn Setting n	1= On, 0=Off
SFF {1 0} SFF?	Form Feed n	1= On, 0=Off

### 8.11.10 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 < memory number>?	List Results Data	<i>memory number</i> = 1-50
RR?	Read Remote Reset	1=Open, 0=Closed
RI?	Read Remote Interlock	1=Open, 0=Closed
LS?	List Memory Parameters	
LS <memory number>?	List Memory Parameters by memory number	<i>memory number</i> = 1-50

#### TD?

Read the active data being displayed on the LCD display while the test is in process. It will also read the last data taken when the test sequence has completed. Each parameter is separated by commas and includes memory number, test type, test status, and metering. The syntax for this command response is {memory, test type, status, kV meter, mA meter, dwell time}. 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 <memory number>?

Read the results for an individual memory. The memory number is the actual memory number that has been saved within the file, not the order of which the memories were executed. For example if the test was executed starting from memory 3 and ending with memory 5 then the first test results will be found in location 3 not in location 1. Each parameter is separated by commas and includes memory number, test type, test status, and metering. The syntax for this command response is {memory, test type, status, kV meter, mA meter, dwell time}. 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 been 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 been 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.

## LS?

Lists all the Parameters for the individual memory that is currently selected. See the ADD command for the list of parameters. A comma (,) will separate each parameter and will be preceded with the memory number.

## LS <memory number>?

Lists all the Parameters for the individual memory indicated by *memory number* = 1-50. See the ADD command for the list of parameters. A comma (,) will separate each parameter and will be preceded with the memory number.

### 8.11.11 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	EEC Model Number, Serial Number, Firmware Revision
*RST	Reset Command	Resets
*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 all selected pending operations complete, ESR BIT0=1
*OPC?	Operation Complete Query	When all selected pending operations complete, Output Queue=1
*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 Query	0 - 255
*ESE <value>	Standard Event Status Enable Command	<i>value</i> = 0 - 255
*ESE?	Standard Event Status Enable Query	0 - 255
*STB?	Read Status Byte Query	Read Status Byte
*SRE <value>	Service Request Enable Command	<i>value</i> = 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 OR'd 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.

### 8.11.12 Status Reporting

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 reports defined 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-ORed 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 SRQs to function immediately after power-on.

Standard 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		not used	

\*ESR?

\*ESE  
\*ESE?

\*STB? | SPOLL

\*SRE  
\*SRE?

### 8.11.13 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. Bit 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, ESB bit 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 1. After reading the status byte the status byte value will change to 01 hex.

## 8.12 Example of Communicating Over the GPIB Bus

To write commands over the IEEE bus you must enter the code that is specific to the software language you are using. Then follow the example below.

To set the output voltage across the IEEE bus at 8000 volts do the following. First select a memory by sending, for example the string for memory one **"FL 1"**, then send the string **"EV 8.0"**. This tells the instrument to set the voltage at 8.0kV. A string is a list of ASCII characters, octal or hex bytes or special symbols. However do not include the quotation marks (" ") when sending the command string.

If you wish to set the Ramp-UP time of the test across the IEEE bus at 10 seconds, do the following, send the string **"ERU 10.00"**. This tells the instrument to set the Ramp-UP time at 10.00 seconds.

To read the live testing data, first send the string **"TD?"** then send the GPIB command to read. For RS-232 the response will be sent automatically to the controller. The instrument will send a string of parameters separated by commas for each meter on the display, for example the data for an ACW test might be as follows: **"01,ACW,Dwell,3.00,1.25,2.5"** this represents an ACW test at memory number 1, 3.00kV output voltage, 1.25mA total current and the elapsed time for the Dwell cycle is 2.5 seconds.



### 8.13 Non Volatile Memory

The instrument saves each parameter in non-volatile memory when the parameters are sent to the instrument. The non-volatile memory has a limited write cycle life, therefore for programmers who wish to send all parameters before executing each test, should use Memory 50. 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/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.

### 8.14 BUS Remote message

The REM indicator will be displayed when the instrument is in the Remote Control mode. When the BUS Remote is on the instrument is able to send and receive signals across the GPIB IEEE-488 or RS-232 bus.

M XX	Set		XXX.X s
XX.XX KV		REM	X.XXX mA

## 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 CNLA. 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 CNLA traceable, or traceable to agencies recognized by CNLA 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.

### 9.4 Required Calibration Equipment

- 0 - 10 kV RMS AC and DC Voltage Divider. Voltage divider must handle 14.14kV peak.
- 7470, 20mA AC Ammeter.
- 7473, 10 mA AC Ammeter.
- 7472, 10mA DC Ammeter.
- 7474, 5mA DC Ammeter.
- 7470, 7472, 100K $\Omega$ , 20-watt resistor, 1000 volt.
- 7472, 7473, 100K $\Omega$ , 10-watt resistor, 1000 volt.
- 7474, 100K $\Omega$ , 2.5-watt resistor, 1000 volt.
- 7472, 7474 1M $\Omega$ , 0.25-watt resistor, 300 volt

### 9.5 Calibration Initialization

Press and hold the calibration key on the rear panel with a pen, pencil, or small screwdriver while powering ON the High Withstand Voltage Tester. The High Withstand Voltage Tester enters calibration mode after the power on sequence is complete.

The program will automatically enter to the calibration mode and the display screen will show:

Calibration Mode

∨ : Forward    ∧ : Backward

Use the ∨ (Forward) and ∧ (Backward) keys to move through the calibration menu. The following instructions follow the sequence scrolling forward through the menu.

## 9.6 Calibration Procedure

### 9.6.6 Calibration of Hipot Voltage

The first screen to appear in the Calibration mode is the Voltage calibration display. The display will show:

ACW Voltage, 10KV <TEST>    to    Calibrate	or	DCW Voltage, 10KV <TEST>    to    Calibrate
--	----	--

Connect an AC standard voltage meter for 7470 and 7473 or a DC standard voltage meter for 7472 and 7474 which can measure up to 10KV to the output connectors and then press the TEST button, the program will automatically generate an output of about 10KV and the display will show:

HI-Voltage =                  V Enter Standard V-out
---

Use the Numeric keys to enter the standard value of voltage, unit V, and then press the ENTER key to store the standard value of AC or DC hipot voltage for calibration and display will show:

ACW Voltage, 10KV                  OK <TEST>    to    Calibrate	or	DCW Voltage, 10KV                  OK <TEST>    to    Calibrate
--	----	--

### 9.6.7 Calibration of 7470 AC Hipot Current

#### 9.6.7.1

#### AC Hipot, 20mA

##### current range

Press the ∨ key, the program will advance to the AC 20.00mA range calibration of the hipot test. The display will show:

AC 20.00mA, 100KΩ <TEST>    to    Calibrate
--

Connect a resistor about 100KΩ/40W in series with a AC standard Ammeter which can measure up to 20.00mA to the output leads. The Ammeter should be connected to the return lead, then press the TEST button, the program will automatically generate an output of about 2000V/20mA and the display will show:

Current    =                  mA Enter Standard I-out
--

Use the Numeric keys to enter the standard value of current, unit mA, and then press the ENTER key to store the standard value of AC 20.00mA range for calibration and the display will show:

AC 20mA, 100K $\Omega$	OK
<TEST> to Calibrate	

#### 9.6.7.2

#### AC Hipot, 3.500mA

##### current range

Press the  $\vee$  key, the program will advance to the AC 3.500mA range calibration of the hipot test. The display will show:

AC 3.500mA, 100K $\Omega$	OK
<TEST> to Calibrate	

Connect a resistor about 100K $\Omega$ /40W in series with a AC standard Ammeter which can measure up to 3.500mA to the output leads. The Ammeter should be connected to the return lead, then press the TEST button, the program will automatically generate an output on the output connectors about 300V/3.00mA and the display will show:

Current =	mA
Enter Standard I-out	

Use the Numeric keys to enter the standard value of current, unit mA, and then press the ENTER key to store the standard value of AC 3.500mA range of the hipot test and the display will show:

AC 3.500mA, 100K $\Omega$	OK
<TEST> to Calibrate	

#### 9.6.8 Calibration of 7473 AC Hipot Current

##### 9.6.8.1

#### AC Hipot, 10mA

##### current range

Press the  $\vee$  key, the program will advance to the AC 10.00mA range calibration of the hipot test. The display will show:

AC 10.00mA, 100K $\Omega$	OK
<TEST> to Calibrate	

Connect a resistor about 100K $\Omega$ /10W in series with a AC standard Ammeter which can measure up to 10.00mA to the output leads. The Ammeter should be connected to the return lead, then press the TEST button, the program will automatically generate an output of about 1000V/10.00mA and the display will show:

Current	=	mA
Enter Standard I-out		

Use the Numeric keys to enter the standard value of current, unit mA, and then press the ENTER key to store the standard value of AC 10.00mA range for calibration and the display will show:

AC 10mA, 100K $\Omega$	OK
<TEST>	to Calibrate

#### 9.6.8.2

#### AC Hipot, 3.500mA

##### current range

Press the  $\vee$  key, the program will advance to the AC 3.500mA range calibration of the hipot test. The display will show:

AC 3.500mA, 100K $\Omega$	OK
<TEST>	to Calibrate

Connect a resistor about 100K $\Omega$ /10W in series with a AC standard Ammeter which can measure up to 3.500mA to the output leads. The Ammeter should be connected to the return lead, then press the TEST button, the program will automatically generate an output on the output connectors about 350V/3.00mA and the display will show:

Current =	mA
Enter Standard I-out	

Use the Numeric keys to enter the standard value of current, unit mA, and then press the ENTER key to store the standard value of AC 3.500mA range of the hipot test and the display will show:

AC 3.500mA, 100K $\Omega$	OK
<TEST>	to Calibrate

#### 9.6.9 Calibration of 7472 DC Hipot Current

##### 9.6.9.1

#### DC Hipot, 10mA

##### current range

Press the  $\vee$  key, the program will advance to the DC 10.00mA range calibration of the hipot test. The display will show:

DC 10.00mA, 100K $\Omega$	OK
<TEST>	to Calibrate

Connect a resistor about 100K $\Omega$ /10W in series with a DC standard Ammeter which can measure up to 10.00mA to the output leads. The Ammeter should be connected to the

return lead, then press the TEST button, the program will automatically generate an output of about 1000V/10mA and the display will show:

Current	=	mA
Enter Standard I-out		

Use the Numeric keys to enter the standard value of current, unit mA, and then press the ENTER key to store the standard value of DC 10.00mA range for calibration and the display will show:

DC 10.00mA, 100K $\Omega$	OK
<TEST>	to Calibrate

#### 9.6.9.2

#### DC Hipot, 3500 $\mu$ A

##### current range

Press the  $\vee$  key, the program will advance to the DC 3500 $\mu$ A range calibration of hipot test. The display will show:

DC 3500 $\mu$ A, 100K $\Omega$	OK
<TEST>	to Calibrate

Connect a resistor about 100K $\Omega$ /10W in series with a DC standard Ammeter which can measure up to 3500 $\mu$ A to the output leads. The Ammeter should be connected to the return lead, then press the TEST button, the program will automatically generate an output of about 300V/3000 $\mu$ A and the display will show:

Current	=	$\mu$ A
Enter Standard I-out		

Use the Numeric keys to enter the standard value of current, unit  $\mu$ A, and then press the ENTER key to store the standard value of DC 3500 $\mu$ A range of hipot test and the display will show:

DC 3500 $\mu$ A, 100K $\Omega$	OK
<TEST>	to Calibrate

#### 9.6.9.3

#### DC Hipot, 350 $\mu$ A

##### current range

Press the  $\vee$  key, the program will advance to the setting and reading of DC 350 $\mu$ A range calibration of the hipot test. The display will show:

DC 350 $\mu$ A, 1M $\Omega$	OK
<TEST>	to Calibrate

Connect a resistor about  $1\text{M}\Omega/0.25\text{W}$  in series with a DC standard Ammeter which can measure up to  $300\mu\text{A}$  to the output leads. Connect the Ammeter to the return leads, then press the TEST button, the program will automatically generate an output of about  $300\text{V}/300\mu\text{A}$  and the display will show:

Current =	$\mu\text{A}$
Enter Standard I-out	

Use the Numeric keys to enter the standard value of current, unit  $\mu\text{A}$ , and then press the ENTER key to store the standard value of DC  $350\mu\text{A}$  range of the hipot test and the display will show:

DC $350\mu\text{A}$ , $1\text{M}\Omega$	OK
<TEST>	to Calibrate

### 9.6.10 Calibration of 7474 DC Hipot Current

#### 9.6.10.1

#### 9.6.10.2

**DC Hipot, 5.00mA**

#### current range

Press the  $\vee$  key, the program will advance to the DC 5.00mA range calibration of the hipot test. The display will show:

DC 5.00mA, $100\text{K}\Omega$
<TEST> to Calibrate

Connect a resistor about  $100\text{K}\Omega/2.5\text{W}$  in series with a DC standard Ammeter which can measure up to 5.00mA to the output leads. The Ammeter should be connected to the return lead, then press the TEST button, the program will automatically generate an output of about  $500\text{V}/5.00\text{mA}$  and the display will show:

Current =	mA
Enter Standard I-out	

Use the Numeric keys to enter the standard value of current, unit mA, and then press the ENTER key to store the standard value of DC 5.00mA range for calibration and the display will show:

DC 5.00mA, $100\text{K}\Omega$	OK
<TEST>	to Calibrate

#### 9.6.10.3

**DC Hipot,  $3500\mu\text{A}$**

#### current range

Press the  $\vee$  key, the program will advance to the DC  $3500\mu\text{A}$  range calibration of hipot test. The display will show:

DC 3500 $\mu$ A, 100K $\Omega$
<T E S T>      t o      C a l i b r a t e

Connect a resistor about 100K $\Omega$ /2.5W in series with a DC standard Ammeter which can measure up to 3000 $\mu$ A to the output leads. The Ammeter should be connected to the return lead, then press the TEST button, the program will automatically generate an output of about 300V/3000 $\mu$ A and the display will show:

Current = $\mu$ A
Enter Standard I-out

Use the Numeric keys to enter the standard value of current, unit  $\mu$ A, and then press the ENTER key to store the standard value of DC 3500 $\mu$ A range of hipot test and the display will show:

DC 3500 $\mu$ A, 100K $\Omega$	OK
<T E S T>      t o      C a l i b r a t e	

#### 9.6.10.4

#### DC Hipot, 350 $\mu$ A

##### current range

Press the  $\vee$  key, the program will advance to the setting and reading of DC 350 $\mu$ A range calibration of the hipot test. The display will show:

DC 350 $\mu$ A, 1M $\Omega$
<T E S T>      t o      C a l i b r a t e

Connect a resistor about 1M $\Omega$ /0.25W in series with a DC standard Ammeter which can measure up to 300 $\mu$ A to the output leads. Connect the Ammeter to the return leads, then press the TEST button, the program will automatically generate an output of about 300V/300 $\mu$ A and the display will show:

Current = $\mu$ A
Enter Standard I-out

Use the Numeric keys to enter the standard value of current, unit  $\mu$ A, and then press the ENTER key to store the standard value of DC 350 $\mu$ A range of the hipot test and the display will show:

DC 350 $\mu$ A, 1M $\Omega$	OK
<T E S T>      t o      C a l i b r a t e	

#### 9.6.11 Calibration Complete Message



When a complete calibration of Hipot voltage and current has been performed, a message will appear on the screen to confirm the calibration is finished. The message will appear as follows:

Calibration complete
-------------------------