

## MODEL 620A 4R WATER-RESISTANT IGNITER TESTER OPERATION/MAINTENANCE MANUAL

see website for latest contact information <http://www.amptec.com>

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## A MESSAGE FROM THE PRESIDENT

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We at AMPTEC RESEARCH would like to thank you, our customer, for selecting our Failsafe Igniter Tester/ Digital Ohmmeter. Over the past 36 years our experienced engineering staff have designed, manufactured and supplied earlier versions similar to the Model 620 and 620 Series Igniter Testers to the U.S. NAVY for the "TOMAHAWK CRUISE MISSILE", the U.S. ARMY for the "STANDARD MISSILE", the U.S.A.F. for the AIM-9 "SIDEWINDER", AIM-7 "SPARROW" and AIM-120 "AMRAAM" just to name just a few. We value the trust our customers have placed with us, and are looking forward to supporting any new requirement you may have ....

Kerry W Clark - Founder, AMPTEC RESEARCH CORP.

## U.S. N.I.S.T. CALIBRATION CERTIFICATE



AMPTEC RESEARCH, Inc. certifies that this instrument has been completely tested and inspected and found to meet published specifications as found in this manual on the date stated on the attached N.I.S.T. Certificate. AMPTEC RESEARCH, Corporation further certifies that its calibration measurements are traceable to the U.S. National Institute of Standards and Technology.

## 620 SERIES IGNITER TESTER WARRANTY

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Permission and a return authorization (RMA) number must be obtained directly from AMPTEC's customer service department (via phone, FAX, or email) for repairs (warranty or otherwise). We need to issue you an RMA number so we can keep track of the instrument and it's owner (i.e. who to contact). The warranty period for this instrument is 1 year from when it was first shipped. AMPTEC RESEARCH will repair or replace the instrument during the warranty period provided it is returned to AMPTEC RESEARCH, freight prepaid. No other warranty is expressed or implied. We are not liable for consequential damages. No liability will be accepted if returned without such permission.

Some AMPTEC products may have their design frozen, and no changes will be made without prior notice to the proper approving authority. Through out this manual, there is reference made using to the generic model 620 series Igniter Testers. There are any versions of the 620 Igniter Tester specifically developed to meet our customers requirements. The specification, operation, drawing and schematic sections of this manual contain the unique detail that define the 620ES. Due to continuing product refinement, due to possible parts going obsolete and other component manufacturer changes, AMPTEC RESEARCH reserves the right on rare occasions to change any of its products specifications.

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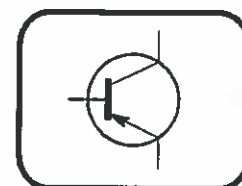
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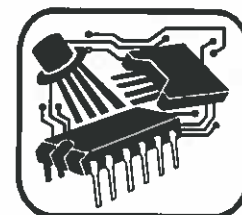
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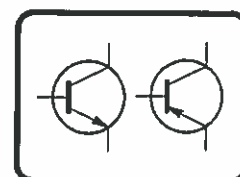


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## SECTION A - RECEIVING AND INITIAL INSPECTION



### A-1. Introduction to the AMPTEC 620A-4R

The AMPTEC 620A and the 630 Series Igniter Testers/Failsafe Ohmmeters are becoming the standard in the Safety Igniter Circuit Test industry, and are designed to provide extremely safe and reliable resistance testing of explosive or volatile devices. Safety Approvals from various Safety Boards include, the U.S. Air Force (620A-4) for generic use on Non-Nuclear munitions and the US NAVAL ORDNANCE CENTER (630AN and other versions pending). Some of the devices the 620A 4R Failsafe Ohmmeter may be used on include: fuses, squibs, igniters, explosive bolts, rocket motor squibs, automobile air-bag initiators and many others.

The AMPTEC 620A 4R is a 4-wire failsafe digital ohmmeter which has been designed to reliably use very low test currents for its resistance measurement. Failsafe Output Circuitry proprietary to AMPTEC RESEARCH ensures that test current levels do not exceed the specified "failsafe current" even in a worst-case component failure situation. The failsafe feature is tested in every instrument before shipment. Thru out this manual reference is made to both 620A-4 and 620A-4R (*ruggedized*) essentially water resistant packaging being the major difference.

The 620A-4 and the newer 620A-4R represent the latest in ultra-safe Igniter Tester measurements. The 620A 4R uses the same main printed circuit board (PCB) as the AMPTEC 620A Igniter Tester. The **620A 4R** has been **made water-resistant** and has many features which make it useful in a variety of applications. Please check the last chapter of this manual for addendums that may apply to any differences between new 620A 4Rs and 620A-4 Igniter Testers. Should the rechargeable batteries reach a low charge level a negative sign will appear on the display. The 620A 4R has a **battery monitoring** circuit that indicates it is time to plug in the battery charger.

### A-2. Receiving, Unpacking, and Initial Inspection

Should the AMPTEC shipping box appear damaged upon arrival, request that the carrier's agent (i.e. UPS) be present when the unit is unpacked. If the 620A 4R appears damaged, the carrier's agent should authorize repairs before the unit is returned to the factory. Even if the instrument appears undamaged, it may have suffered internal damage in transit that may not be evident until the unit is operated or tested to verify conformance with its specifications. You may refer to the *Functional Test section of Section D of this manual to help identify the problem* (i.e Test leads etc.)

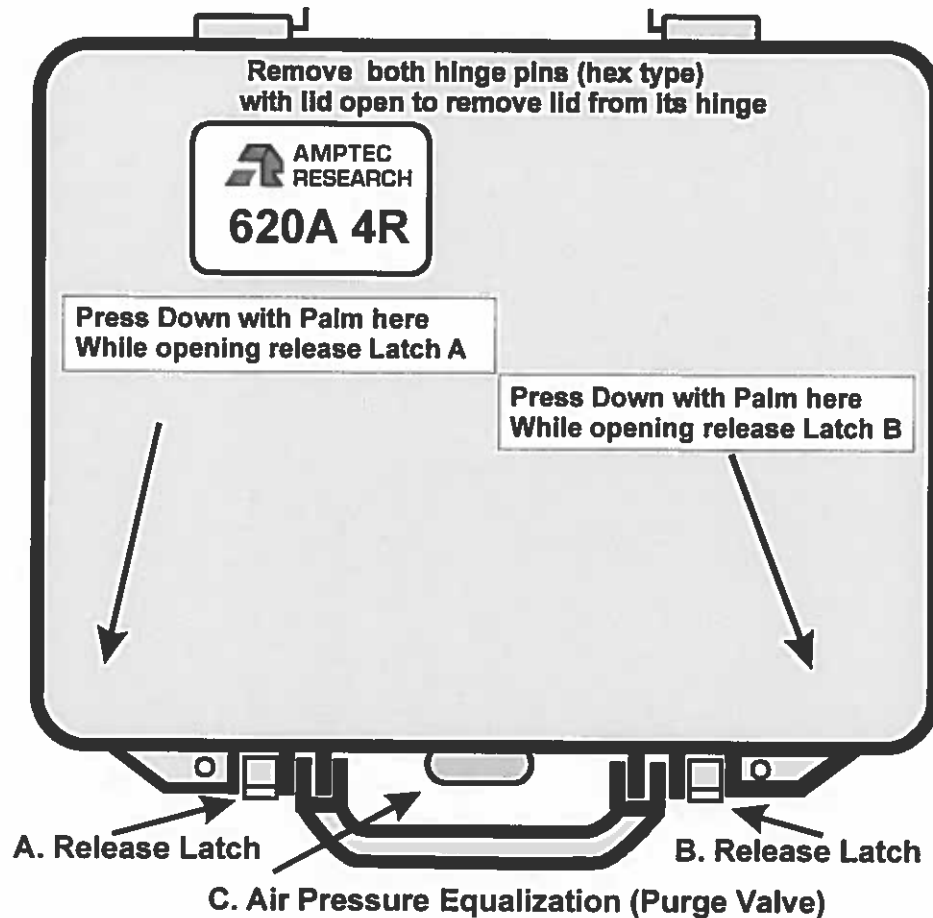
The 620A 4R has a set of test resistors built-in the Functional Test Section that can quickly help the user figure out where the problem is most of the time.

If the unit fails to operate or fails to meet the performance specifications of Section B, notify the carrier's agent and the nearest AMPTEC Sales Office. Retain the shipping carton for the carrier's inspection. **DO NOT return equipment to AMPTEC RESEARCH** or any of its sales offices *without first obtaining* an (RMA) Return Material Authorization number. We need to know who to contact and how to contact (i.e. phone number and FAX number) in order to properly coordinate the return of the repaired AMPTEC product.



**By calling AMPTEC RESEARCH first, prior to just returning the 620A 4R, we can often troubleshoot (based on the symptoms you describe) and identify the problem over the phone (i.e battery loose in the battery holder).**

We may possibly be able to fix the problem over the phone and prevent you from having to return the unit to AMPTEC for repair.



### A-3. Opening the 620A 4R Igniter Tester and removal of the Lid

When closed, the 620A 4R Ohmmeter has two large O-rings that provide a very water resistant and on occasion even an air tight seal. By pressing down with your palm as diagramed above you compress the O-ring in the lid of the 620A 4R. This makes it easier to flip up the release latch. Repeat the palm press step on the other corner of the 620A 4R while flipping up the release latch. At this point the 620A 4R lid will normally be able to be raised, and placed in an open lid state.

If the 620A 4R doesn't open after flipping up the release latches, a change in atmospheric pressure since the unit was last closed may be the culprit. *Turn the Air Pressure Equalization or "Purge Valve" counter-clockwise.* Once air-pressure is equalized, the 620A 4R can be opened. If the Purge Valve was opened, return the valve to the closed state (tighten = clockwise) once the 620A 4R lid is open.

The 620A 4R has a way to remove its lid *completely*, for example when used in an indoor laboratory environment. With the 620A 4R open, remove the units two hinge pins (hex type) by twisting them. The lid should come free at the hinge. Once the lid is removed replace the hinge pins in the hole they were pulled out of.

### A-4. AC/DC Battery Charger - Power Requirements

The AMPTEC 620A 4R is powered by an internal rechargeable heavy-duty nickel-cadmium battery pack (4 ea D cell - 5.7 Ahr). Replacement batteries may be purchased, contact the sale department at AMPTEC RESEARCH.

The battery charger is an external AC/DC converter that plugs into a standard 115VAC receptacle. The AC adapter provides 6 VDC @ 1.1 amperes. The AC Adapter Battery Charger is configured with a notched connector that plugs into the "mating" notched "J1" connector on the 620A 4R front panel.



***For safety reasons***, the battery charger will only recharge the units NICAD batteries when the charger is plugged into the charging jack ***and the 620A-4R main power switch is in the "off" position. In this way the 620A-4R user can not ever make a measurement while the unit is charging.*** The 620A 4R is power "On/Off" switch design makes it impossible to be powered (in operating - measurement mode) directly from the AC line adapter. As an additional note, the 620A 4R main power switch ***must also be*** in the "Off/Charging" mode in order for the connected battery charger to recharge the 620A 4R's batteries.

A fully charged battery pack typically powers the 620A 4R for approximately 8 hours before requiring a recharge. AMPTEC installs a quality set of 4 each Heavy Duty (5700 mAh) Ni-Cad batteries. The 620A 4R will also operate on a 4000 mAh D cell Ni-Cads with a shortened operating time between charges. Recharge time is typically twice the "Power On" time. An "Overnight" charge usually restores the 620A 4R to a "Fully Charged" ready to use state.

The "Power" switch has two separate modes. The "ON" position supplies internal battery isolated power to operate the 620A 4R when they are charged. If you turn on the 620A 4R, and the display does not come on, it may indicate the batteries need charging. The "OFF/CHARGING" power switch position is for use when the batteries need charging or the 620A 4R is not in use. As mentioned earlier of course the AC/DC Battery Charger must be plugged into the 620A 4R's notched connector to facilitate charging the batteries.

As mentioned earlier of course the AC/DC Battery Charger must be plugged into the 620A 4R's notched connector to facilitate charging the batteries.

Although the batteries are fully charged prior to shipment, it may be desirable to refresh the charge for 24 hours before use. As a rule of thumb, the 620A 4R requires twice as much time to fully recharge as the amount of discharge time. For example, if the instrument was used continuously for 2 hours, the AC adapter must be connected for 4 hours in order to fully restore the charge. If you need a replacement AC/DC Battery Charger for the 630, contact the AMPTEC customer service department and request an option "630DC" Battery Charger.

When the 620A 4R is first turned on, the unit draws more internal power to heat up the unit's ovenized zener voltage reference. If the "Low Battery" Indicator only comes on for a few (i.e. 10 to 15 seconds) seconds when the 620A 4R is first turned on then goes out, the battery levels are starting to indicate the charge level is low.

#### **A-5. Setup and Use**

The AMPTEC 620A 4R Igniter Tester may be setup to operate without the unit's lid intact. By removing the hinge pins the lid may be removed (i.e. for indoor lab bench use). Typically a test procedure will have the 620A 4R user test the 620A 4R with the units "Functional Test Section" to determine it is functioning properly and ready for use.

Once the AMPTEC 620A 4R has had it's batteries charged for 12 to 24 hours it is ready for use. The 620A 4R consumes little power and generates virtually no heat. Consequently, it may be used in any area where the environment does not exceed the specifications of Table B-2.

Avoid exposing the 620A 4R to extremes of temperature which will affect accuracy and shorten battery life-span.



# CHAPTER B - 620A 4R TESTER SPECIFICATIONS



**620A 4R RESISTANCE RANGE/DISPLAY RESOLUTION TABLE**

20Ω /1mΩ	200Ω /10mΩ	2.0 KΩ /0.1Ω	20 KΩ /1Ω
5mA/<8mA	0.5mA/1.8mA	50μA/180μA	5.0μA/20 μA

Actual fail-safe currents vary with each instrument and may be  $\pm 20\%$  from the typical value.

**Table B-2. Specifications**

**Accuracy:** (for 1 year @25°C  $\pm 10^\circ\text{C}$ )

20 ohms through 2.0 KOhm ranges  $\pm 0.02\%$  of reading  $\pm 0.02\%$  of range

20 Kohms range  $\pm 0.02\%$  of reading  $\pm 0.02\%$  of range

**Temperature Range**

Operating 0°C to 50°C

Storage -10°C to 70°C

**Temperature Coefficient**

20 ohms through 20 Kohms ranges  $\pm 0.002\%$  per °C (from 0°C-15°C and 35°C-50°C)

**Instrument Display** . . (20,000 count) 4½ digit Super Bright Light Emitting Diodes (LED)

**Over-Range Indication** . . . . . ( select next higher range) 620A 4R Display flashes

**Measurement Update Rate** . . . . . Approximately 300ms

**Voltage Protection - Maximum Input** . . . . 250VDC or AC<sub>peak</sub> without damage

**Open Circuit Current Source Compliance Voltage** . . . . . clamped at ~1.6 volts

**Power** . . . . (4 "D" 5.7AHr Heavy Duty) 1.2V rechargeable nickel-cadmium batteries

**AC/DC Battery Charger (Option 630DC)** provides 6 VDC at ~ 0.5 amperes nominal

**Dimensions** . . . . . 13.5" (34.3cm) W x 12" (30.5cm) D x 6"(15.2cm) H

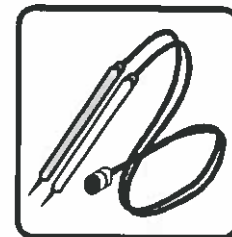
**Water Resistance** . . . . . To a 3 foot depth underwater - case closed with purge valve shut

**Weight** . . . . . 12 lbs net; 15 lbs shipping





## CHAPTER C - REPLACEMENT, OPTIONAL AND ACCESSORY ITEMS



### C-1. Available Accessories and Options

This manual does not list all possible accessories that AMPTEC RESEARCH is willing to provide as a support items for the 620A 4R Igniter Tester. Contact the sales department at AMPTEC if you have a request for an item that is not described here. Listed below are the options available for use with the AMPTEC 620A 4R Igniter Tester.



#### Option 620A4DC: Battery Charger

Option "620A4RDC" is an AC/DC converter that converts 115VAC line voltage to 6 VDC at 1.1A. The units battery charger is fitted with the mating plug that connects to the unit's charging jack connector. One charger is provided as a standard accessory with every 620A 4R Ohmmeter.

#### Replacement Batteries

The rechargeable NICAD batteries installed in the 620A 4R should provide trouble-free operation. Replacement, however, will eventually be necessary. The 620A 4R uses four 1.2V cells (5.0 AHr recommended) installed in a reusable battery box. The batteries are held in place by a metal retaining plate. When ordering replacement batteries, please specify AMPTEC Stock #05-10117, quantity four (4).

Replacement AMPTEC 620A 4R NICAD batteries come with an inspection sticker that verifies each individual replacement battery voltage (charge level), inspector signature, along with the inspection date.

### 3-2. Test Lead Sets and Probes



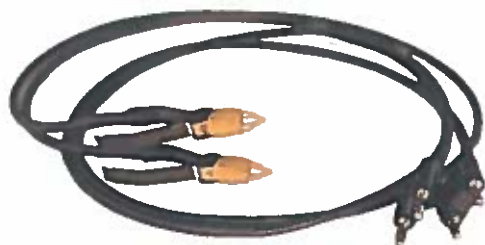
#### Option "290" Alligator Clip Lead Set

Option "290" is the recommended general purpose Alligator Clip lead set (red and black) . Option "290" is supplied as a standard item with all 620A-4R Igniter Testers/Ohmmeters as part of the standard package. Option "290" is a 48" long cable set with dual banana plugs at one end. The other end is terminated with an alligator clip ( red and black) . These alligator clips will measure (2 wire method) properly with either upper or lower jaw connected to the conductive socket center of plastic test panel jacks. Kelvin Clips (using the 4 wire method) may have connection difficulty because both jaws (both upper and lower) must make electrical contact with the EED .



#### Option 300: 4-Wire Kelvin Lead Set

Recommended for Calibration - Option "300" is a gold plated four wire Kelvin lead set for all AMPTEC 620A4 Ohmmeters. Option 300 is a shielded 48" lead set terminat-ing in ½" opening gold plated copper Kelvin clips. The option "300" can clip easily to wires, pins, and medium size (up to ½" diameter conductors). The dual banana plugs terminations connect directly to the 620A's front panel input terminals. (see Option "320" for a diagram of the clip ends)



**Option "300" - Gold Plated 4 Wire Kelvin Clip Test Lead Set - shown above**

### **Option 305: Banana-to-Banana Cable**

Option "305" is a 48" shielded cable terminated in dual banana plugs at both ends.

### **Option 320: Kelvin Clips**

Option "320" are the gold plated kelvin clips used on the Option "300" cable set. These clips may be used when making custom cables or when repairing Option "300". (see photo on previous page)

### **Option 360: Heavy-Duty Clips**

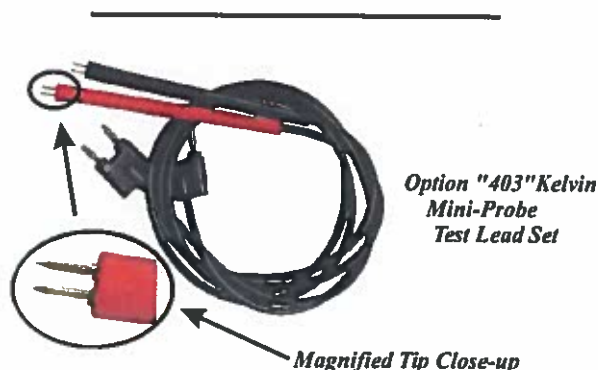
Option "360" are Gold-plated jumper cable (large jaws) type clips used on the Option "350" cable. They are still Kelvin Clips because the insulated upper and lower jaw integrity is maintained. These may be used when making custom cables or when repairing Option "350".



### **Option 401: Handheld Single Probe Leads**

Option "401" is a 620A handheld probe (one black probe & one red probe) lead set terminated in *single points*. The OP401 handheld probes allow for easy access to connector socket wiring (i.e. drone parachute squib sockets), recessed surfaces, and parts (i.e. flares) that alligator clip leads simply would not work well with.

Option "401" is partially a 4-wire lead set (up to the probe tip, 2 and 2 style) terminated with single handheld probe test points. The "401" also has the standard 620A 4R dual banana lead plugs that connect directly to the main 620A 4R measurement panel mount banana jacks (red and white). The 4-wire configuration is maintained up to the point of the probe, eliminating most cable resistance



### **Option "403" 4 Terminal Kelvin Mini-probes - (photo shown above)**

*Each probe has two spring loaded, gold plated, steel tips with 0.18" separation. (one red and one black handheld probe). Excellent general purpose 4 Wire Kelvin Mini-Probe, and along with the Option "300" Kelvin Clip Leads easily fit inside the AMPTEC 620A4R Test Lead Storage Area in the units lid.)*

### **Option 620ISO - Isolated Analog Output for automated resistance measurements**

This front panel mounted isolated analog output provides an Isolated Analog DC Voltage output signal that is directly proportional to 620A ohm display measurement. (i.e. 0.5 VDC for 5.000 ohms, 1 VDC for 10.000 Ohms). Option 500 is useful for tracking 620A Igniter Tester measurements for datalogging purposes with an external device (i.e. chart recorder, or *system DMM or DVM with GPIB*). The isolation (OP500) provided is rated @2000 Volts peak, to insure that any datalogging instrument connected to OP500 has virtually no danger of effecting or impacting the 620A Failsafe Ohmmeter's safety.

When the AMPTEC 620A4R is measuring 1.2345 Ohms the Option "620ISO" outputs 123.45 mV DC. The operator can connect any system DVM (i.e HP , Fluke etc,) with a ***GPIB interface*** which can be directly connected to a PC for automated measurements.

#### **Option 430 4000-ITS Mating Connector**

AMPTEC offers an adapter connector that provides equivalent circular socket connections found on SIMPSON 4000 ITS<sup>tm</sup>, and Alinco 101 series Circuit Igniter Testers.

The diagram below shows that the backside of the OP430 connector adapter has an acrylic tube filled with an insulating casting resin. The hardened tube provides additional mechanical support while handling and connecting the mating connector.

The Safety Board (U.S.A.F. Non-Nuclear Munitions ) approved adapter (OP430) has dual banana leads which provide a 4 wire Kelvin connection from the adapter to the 620A Ohmmeter (No lead resistance errors). *In some applications* (i.e. AIM-7 Missile harnesses) *regular alligator clip leads cannot properly connect to* ( screw on ring collar type connectors) *the small recessed electrical sockets inside a connector harness* that normally mates with the SIMPSON 4000ITS or Alinco 101 series Igniter Tester(s). The OP430 Adapter mimics the older 4000ITS Ohmmeter (pin into socket) connection. The "OP430" has the AMPTEC 620A Ohmmeter act as a 2- wire ohmmeter from the OP430 connector out to the resistance under test, just as the 4000ITS Ohmmeter or Alinco 101 series Igniter Testers would perform.

This for the most recent information regarding this adapter and related probes and accessories please refer to the accessories section of AMPTEC's website found at "<http://www.amptec.com>" .

*Refer to the previous page for information on "Option 620ISO" Isolated Analog Output.*



## CHAPTER D - OPERATION, FUNCTIONAL SELF-TEST AND USE

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### D-1. General Operation

A diagram and description of the front panel controls, connection instructions, and the theory behind resistance measurement is discussed in this section. This section of the manual contains complete operating instructions for the AMPTEC 620A 4R Igniter Tester.

### D-2. Front Panel Features and Operation

#### Power Switch

When the front panel power switch is placed in the OFF/CHARGE position, all circuitry is removed from the Igniter Testers panel mount banana jacks, and the battery pack is connected to the charging circuit. The battery charger may then be connected to the 620A-4R charging jack, in order to facilitate charging the batteries. For Safety reasons/purposes, when the power switch is placed in the "ON" position, the battery pack circuitry is disconnected from the charging circuit and the front panel charging jack.

#### Range Switches

The AMPTEC 620A 4R input range is selected by depressing the desired range switch (protected with the given silicone rubber boot for water resistance) on the front panel. Just above each resistance range switch (silicone rubber boot covered) is a red L.E.D. which illuminates when any one of the four given ranges is selected. The pushbutton for the (20 Ohm ) lowest resistance range is just below the display on the left, (see item 11 of the 620A 4R Front Panel Diagram.). When a given range is selected an indicator LED informs the user. Also note that *a resistance range must be selected after first powering up* the 620A 4R in order to place it in an *operational mode*, that is when first turned on a range must first be selected. If no range is selected upon first "powering up" the instrument may randomly set itself to a range that may not be desired until the operator selects the desired range.

#### Calibration Access Screws

Around the perimeter of the 620A 4R front panel you will note there are 10 screws (phillips head type) that are used for calibration access. These screws are meant to remain intact and should only be removed by authorized personnel (i.e. Calibration Lab staff).

A 0.1 ohm resistor can be used to check the 620A 4R's zero offset. The AMPTEC 620A 4R's zero offset can be adjusted while the test leads are connected to the 0.1 ohm resistor. The 620A 4R zero offset can be adjusted until the 620A 4R display shows 0.1 ohms. (see the calibration chapter)

Refer the AMPTEC 620A 4R to qualified service personnel (i.e Calibration Lab) if you suspect (i.e large error) the 620A 4R measurement display readings don't agree with a test resistors value. Do not attempt to repair the 620A 4R unless you are qualified.

***See Next Page for a Detailed  
620A-4R Front Panel Diagram***

(i.e. linearity) of a given 620A 4R resistance range.

### D-3. AMPTEC 620A 4R Front Panel Diagram

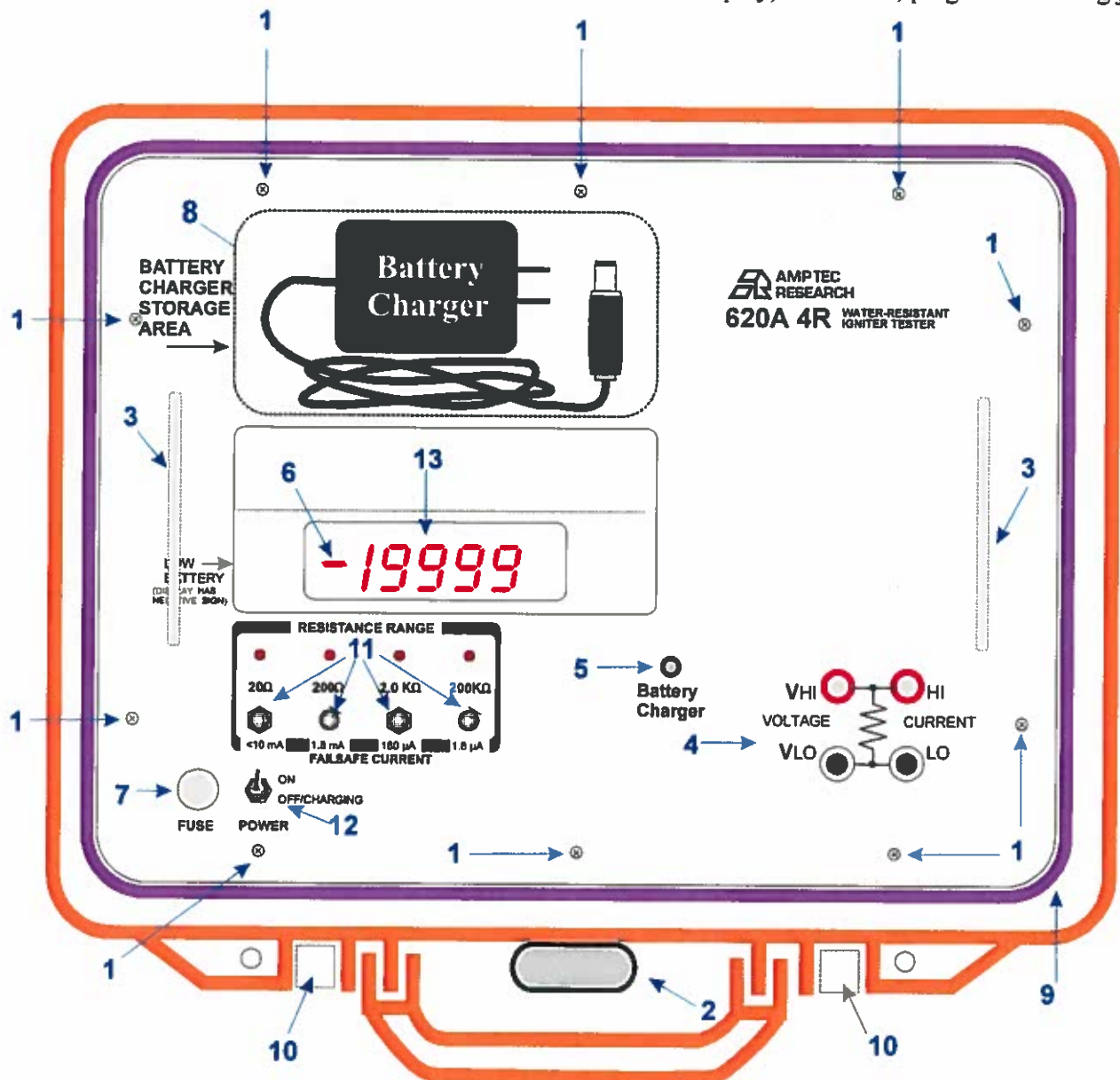
**1. Calibration/Maintenance access screws,** also can be easily protected with a tamper proof calibration sticker or seal.

**2. Purge Valve** provides air pressure equalization to open the 620A 4R case after a transit involving an altitude change if unit will not easily open.

**3. Handles** for lifting front plate, once the access screws have been removed, for calibration access.

**4. Test Lead Connection Panel Jacks** - The 48" long dual banana Alligator Test Leads plug directly into the Voltage High and Voltage low, and Current high and Current low panel jacks. The spacing of the panel jacks only allows vertical connection of the dual banana jack test leads to prevent mis-connection.

**5. Battery Charger Jack** - When the low battery indicator (negative sign in the front of the display) comes on, plug in the mating jack





from the AC line powered battery charger. Also the main power switch of the 620A-4R must be in the "OFF" position, in order to switch the unit into charging mode..

**6. Low Battery Indicator** - Negative sign at the front of the digital display indicates "low battery level" time to recharge.

**7. Fuse Access** required for general operation - 2 ampere slow blow type.

**8. Battery Charger Storage Area** -Press Battery Charger's Velcro™ against Velcro™ on the surface to attached/store the charger , cord and its mating connector. The 620 must also have the main power switch in the "off" (charging) position while charging the unit's batteries.

**9. Water Resistant O-ring seal(s)** in lid and under the edge of the front plate.

**10. Tight Squeeze Flip Latch Area** - provides a water resistant seal when closed. While pressing down with palm on corner of case, flip latch up to open.

**11. Resistance Ranges** 20ohms, 200ohms, 2.0 Kohms and 20.0 Kohms silicone rubber switch boots provide water resistance.

**12. Power On or Off/Charging Switch**

**13. Beveled Display Hood with Super Bright LED s** (five times brighter than normal LEDs).

#### D-4. Fuseholder and Charging System

##### Fuseholder

The fuseholder is mounted on the front panel and contains a 2 amp in-line fuse (see item #7 of the 620A-4R Diagram.). The fuse protects internal batteries from excessive charging currents. Replace blown fuses with the same type and rating only!

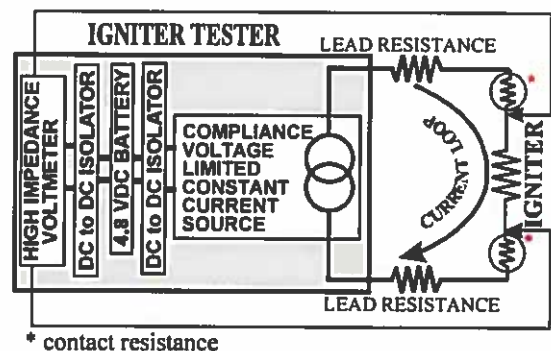
##### The Charging System

The slimline AC to DC battery charger with connector is a connector that mates

with the battery jack labeled "Battery Charger"). The connection is made on the front panel (see item # 5 of the 620 Series Igniter Tester Front Panel Diagram shown earlier). The power switch (item #12) must also be in the "Off/Charging" mode while the battery charger is connected to recharge the batteries.

The measurement test leads (dual banana style) connect to the Vhi, Vlow and other lead connects to the Current (IHi) and Current (ILo) low 620A-4R panel banana jacks. The charging requirements supplied to the internal battery pack are internally stepped down from the 6 VDC@1.1A supplied by the charger. The correct charging voltage is supplied by the adapter included with the instrument.

Additional AC/DC Battery Chargers are available as Option "620A-4RDC". An overnight charge (16 hours) will provide about an 6 to 8 hours continuous powered up life for the 620A 4R. The 620A 4R has an internal ovenized voltage reference the draws a considerable amount of battery power when first turned on. If you know you will be using the 620A 4R again in 10 to 15 minutes, you actually *conserve battery power by not turning it off.*



\* contact resistance  
Figure D1 - Igniter Tester Kelvin Block Diagram

#### D-5. 4-Wire Resistance Measurement

The four-terminal configuration of the 620A 4R eliminates errors normally caused by in series test lead resistance and contact resistances. In many applications the contact resistance and can exceed the value of the test resistance by several orders of magnitude. The 620A 4R overcomes



this potential error source by providing two terminals of constant current and an additional two terminals for high impedance voltage measurement. The result is a fast, accurate resistance measurement of the test resistance, independent of the resistance of the current carrying leads.

Figure D-1 illustrates the 4-wire principle eliminates lead, wire and contact resistances as potential error sources. The internal constant current source inherently overcomes all series resistance (within compliance voltage limits) and delivers a precise constant current.

***Separate DC to DC isolation circuitry provides independent circuit voltage supplies for both polarities of the constant current source circuit.*** The internal high-impedance Digital Voltmeter (DVM) senses the voltage drop across the test resistance (i.e. squib or detonator). There is negligible contact and lead resistance error created by the voltage measurement because the high input impedance of the DVM limits current flow in the voltage ( $V_{hi}$  and  $V_{low}$ ) leads.

#### **D-6. Connections**

Connections are made to the front panel terminals using a 4-wire configuration as described in section D-5. Use only AMPTEC test leads supplied with the 620A 4R Failsafe Ohmmeter. When using AMPTEC test leads, plug the test leads vertically into the 620A-4R banana jacks (they can't plug in horizontally) . of the 620A 4R. AMPTEC 620A 4R leads have the 4 wire current high, current low as well as the voltage sense high and voltage sense low routed to the end of the leads. The last tip or jaw part of the alligator leads becomes a 2 wire connection typically adding only 1 to 2 milliohms worth of in-series resistance to the measurement. One banana plug (red) for current and voltage high, and another banana plug (black) for current and voltage low.

For 620A 4R leads other than those terminated with banana plugs, RG-58 Shielded Coax Cabling is used. Maintaining the four wire Kelvin measurement, the current is in the largest conductor and the voltage input is shielded.

In addition, custom probes and test lead sets are optionally available for customized wiring connections , kelvin clips, cables terminated with spade lugs, and special banana jacks.

All AMPTEC ohmmeters use a high impedance voltmeter as part of the resistance measurement process. This voltmeter is a highly accurate and stable  $4\frac{1}{2}$  digit analog-to-digital converter (A to D). The unit's high impedance DVM (digital voltmeter) must receive a voltage input signal or drop in order to display the proper value. When the DVM is not receiving a definite input signal, the output reading from the Analog to Digital Convertor can appear random and wandering. The display may indicate a randomly wandering number or it may indicate an overrange (flashing) condition. This unpredictable display (No input to the DVM) condition may make it seem to appear that the instrument is experiencing some sort of malfunction. It is not a malfunction, in fact, just a characteristic of the high impedance voltmeter circuit and *should not be mistaken for a fault in the instrument* - As this condition is simply a state of an "open circuit" or "nothing connected" to the DVM circuitry. A flashing display (on and off usually all zeros) indicates an over-range condition whenever the terminals are open, or the resistance under test is a higher value than the selected 620 series Igniter Tester resistance range. By using a 4-wire Kelvin type lead set or by shorting the  $V_{hi}$  and  $I_{hi}$  terminals together and  $V_{low}$  and  $I_{low}$  terminals together the instrument is in the 2 wire resistance mode.

All wiring including harness wires from the two wire test connection out - are in series with the test squib resistance and become part of the actual two wire measurement (another potential source of measurement error if not compensated for) . Many Ordnance test procedures have the 620 series Igniter Tester user short their wiring harnesses at the very end (by the squib) and record the resistance value or offset. Then when the 620 series Igniter Tester leads, including the in-series harness wiring resistance, is connected to the test squib, the squib test resistance can be calculated (via subtraction of the 2 wire harness offset).

That is the 2 wire lead length shorted offset resistance (without the squib resistance) can be subtracted for the total resistance (including the squib resistance) to determine the actual squib (test) resistance.

The display should indicate a stable reading when the test leads are securely attached to the device under test. If the display appears to be erroneous when connected to the resistance under test, recheck the test leads for integrity and cleanliness. If all external items appear to be functioning properly, the next step in problem isolation and diagnosis involves general trouble-shooting principles. If a measurement problem appears on the 20 Ohm range of the meter, test for a zero offset problem first. Plug the 620A-4R with test leads into a 0.10 test resistor. If the meter doesn't display a value close to 0.1 Ohms adjust the zero (see calibration procedure chapter). The zero adjustment trimpot only has enough span to zero out the 620 series test leads. The meter's zero adjustment pot wasn't designed to zero out a 100 feet of 2 wire harness.

A 10.0 Ohm test resistor can be used for testing mid-scale performance of the 20 Ohm range. Performing a similar Functional Test with the 620A-4R across the 10.0 Ohm test resistor you should get a reading close to 10.0 Ohms (i.e 9.995 Ohms is OK). If the 620 Series Igniter Tester appears OK after checking a test resistor then the connection problem must be outside of the 620 series meter (i.e your wiring harness or the actual device under test connection.) If the 620 series meter doesn't agree with the test resistors, then the meter or it's test leads are most likely broken. If this case, please contact your local AMPTEC RESEARCH Service department at +1 (512) 858-4045 or via email at [info@amptec.com](mailto:info@amptec.com).

## **D-7. Failsafe Operation**

The AMPTEC 620 Series of Igniter Testers or failsafe ohmmeters incorporate a constant current source design that renders them incapable of delivering excessive voltage or current to the device under test. The typical fail-safe current for each range is indicated under the corresponding range switch on the 620 series meter front panel. Please refer to section E-6 for a technical description of the failsafe circuitry specifics.

As a further precaution the 620 Series Igniter Tester is isolated from the AC line whenever the POWER switch is in the ON position. The 620 series igniter tester receives its power from an internal rechargeable battery pack (4 "D" Cell Ni-Cad batteries). The 620 series igniter tester "main power" switch (see item 12 of the Front Panel Diagram) must be in the OFF/CHARGING position in order to charge the batteries. Of course, the battery charger must also be plugged into the unit's keyed single access connector. As mentioned earlier, the 620 tester's AC line powered slim-line battery charger must be connected to the front panel charging jack. This "main power switch" must be switched to "OFF" to charge safety feature electrically (mechanically also) prevents any possibility of the operator measuring with the 620 series igniter tester test leads while also connected to an AC line powered battery charger.

## **D-8. Battery Monitoring Circuitry**

The 620 series igniter tester display has a  $\pm$  polarity display indicator preceding the unit's regular 4 ½ digit numeric display. The negative polarity display LED (see item 6 of the 620 series igniter tester Front Panel Diagram) is used as a Low Battery indicator.

If the low battery LED is illuminated, 620 Series Igniter Tester readings should not be trusted. An overnight recharge should be performed before using the 620 series igniter tester for critical testing.

It is possible for the user to receive a low battery indication on a single range only (particularly the 20 ohm range), while the 620 series igniter tester remains well within operating limits on other ranges. Unless the user observes a continuous low battery indication during measurement, readings are still valid.

**Notice for Cal Lab:** The variable trimpot RV3 is factory adjusted to have the low battery indicator come on at 4.50 VDC. To make this adjustment, first **remove the fuse** from the fuseholder. With an adjustable DC power supply, set the power supply output to be 4.50 VDC. Be sure to observe power supply polarity. Connect the power supply to the test points labeled "MAIN" + pos. and - neg. located in the rear section of the MAIN PCB. (i.e + power supply output to the anode side). Adjust trimpot RV3 so the low battery indicator just comes on (negative sign on display). An increase in power supply voltage to 4.52 VDC should have the low battery indicator go out. Finally, disconnect the power supply, and return the fuse to the fuse holder in the rear panel.



## CHAPTER E GENERAL OPERATION AND DESIGN



### E-1. General

The AMPTEC RESEARCH 620A-4R Igniter Tester is shown in block diagram form in Figure E-1. All diagrams and information disclosed in this chapter is proprietary and is included in order to make troubleshooting to component level possible.

The AMPTEC 620A series Igniter Tester uses modern solid-state semiconductors exclusively and digital CMOS circuits extensively to minimize power requirements and make battery operation useful and practical. AMPTEC also maintains a spare parts inventory of all components found in the 620A Tester and it's customer service department can also provide additional assistance in the trouble shooting process.

### E-2. Troubleshooting

Since the 620A Tester is used to test potential deadly explosive force detonators and warheads of missiles etc., *personnel that are not qualified to make such electrical repairs on the 620A Tester should not even attempt to remove the calibration access screws or open the main panel or effect any repair whatsoever.*

Apparent 620A Tester malfunctions can sometimes be the result of bad test lead/connection wiring, wrong connections, misinterpretation of specifications, low battery levels, and in rare cases due to an incomplete understanding of the instrument and how to use it. A thorough review of the operating instructions for this instrument is recommended prior to any component replacement. Check to be sure that cables and other test equipment are in good working order before attempting to troubleshoot the 620A series igniter tester .

*If you turn on the AMPTEC 620A-4R, and the display does not come on, it may indicate the batteries need charging, or fuse needs replacing.*

If the 620A-4R exhibits problems that cannot be eliminated by reviewing Chapters B and D, the following guidelines have been established to help solve the problem.

#### E-2-1. Localizing the Problem

Chapter D-2 discusses how to use the *Functional Test Section* of the 620A Tester to help localize the problem. The key to successful troubleshooting is to localize the problem to a general electronic parameter as much as possible before trying to pin the problem down to a specific component. Certain questions should be asked such as "Does the problem occur on all ranges or on a specific range only?". If the 620A Tester does not come on when powered up, did you check the front panel fuse. The power supplies for both the current source and the digital voltmeter electronics are also one of the first things that should be tested.

As it is not possible to anticipate all failure modes of the 620A series igniter tester, servicing personnel should become familiar with this section to gain a complete understanding of the internal workings of the ohmmeter.

#### E-2-2. Component Replacement

If the malfunction is a faulty component, the accuracy of the 620A series igniter tester can be maintained only if the 620A is re-calibrated following the component replacement and the following precautions are taken:

Use only the specified component or its exact equivalent. Spare parts can be ordered from your nearest AMPTEC RESEARCH Service Center or directly from the factory by referring to the AMPTEC Stock Number listed in the Parts Lists section at the back of this manual.

The highest quality 63/37 grade rosin core electronic grade solder with a 50W or lower maximum power soldering iron should be used. Never use an acid core solder as corrosion of components leads and PCB etch loss can occur.

When soldering, heat the PCB pad and the lead of the component, not the solder. After several seconds of the component lead in contact with the hot soldering iron apply solder smoothly and evenly onto the PCB pad and component lead not the soldering iron. Do not touch or move the replacement part until the solder has cooled. Cold solder and bad solder joints can cause more problems.

Use the chassis ground (connect to the common terminal of the functional test section) connection - i.e. connect to an earth ground to avoid a static discharge to a static sensitive component. Handle all 620A internal components as if they are static sensitive if you are not sure.

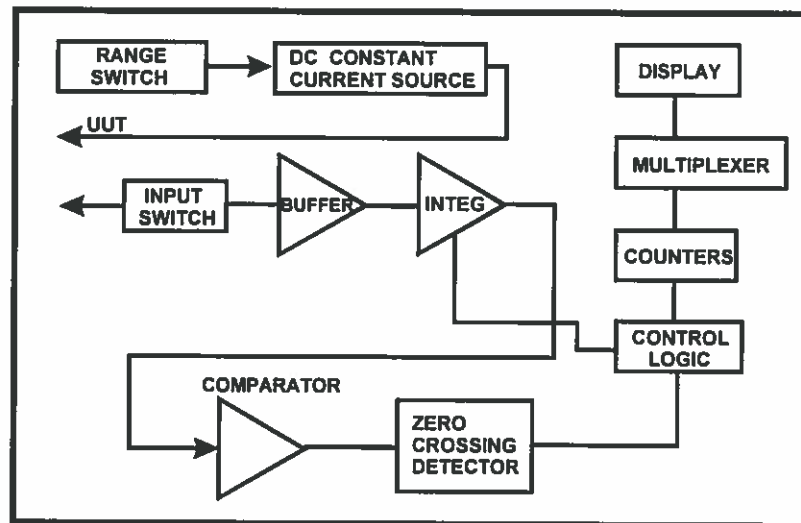
**See Next Page for Start of 620 Circuit Descriptions and Functional Diagrams**

### E-3. Circuit Descriptions

The circuit descriptions which follow are referenced to Figures E-1, E-2, E-3 and the schematic diagrams at the back of this manual. In the following descriptions, references to integrated circuits are given in the form "IC201-1", which refers to Integrated Circuit 201, pin 1.

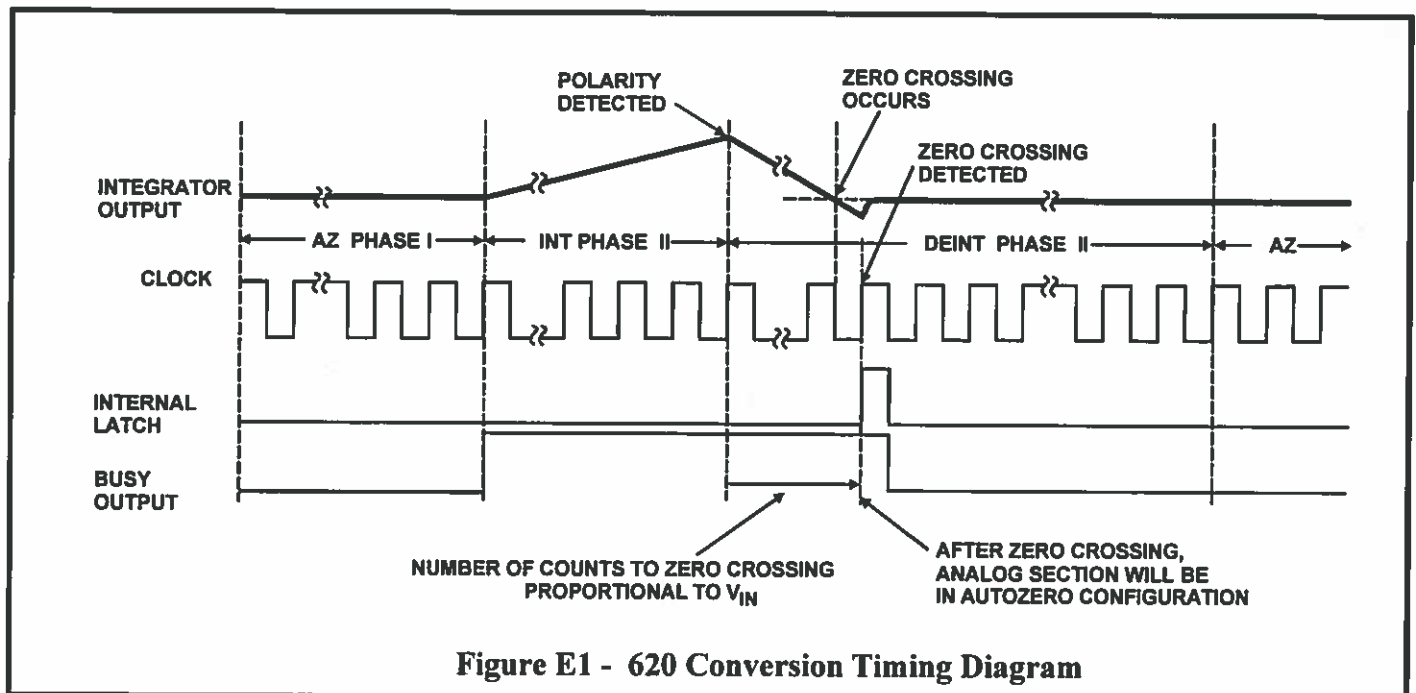
### E-4. Analog to Digital Conversion

The A to D conversion is done with a ICL8068 /ICL71C03 chip set. The ICL8068 takes care of the analog part and the ICL71C03 takes care of the digital part of the 4 ½ digit 20,000 count dual slope conversion.

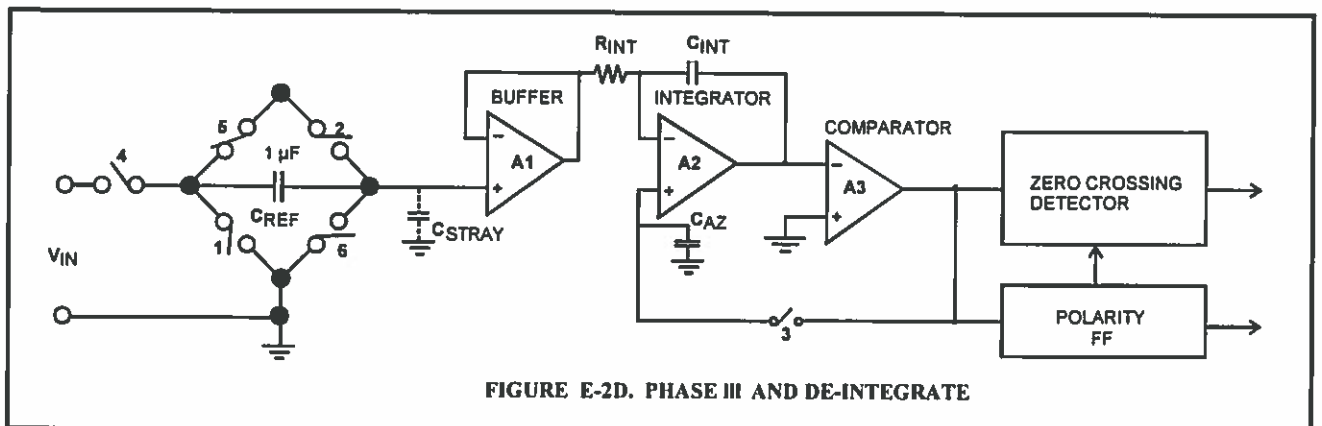
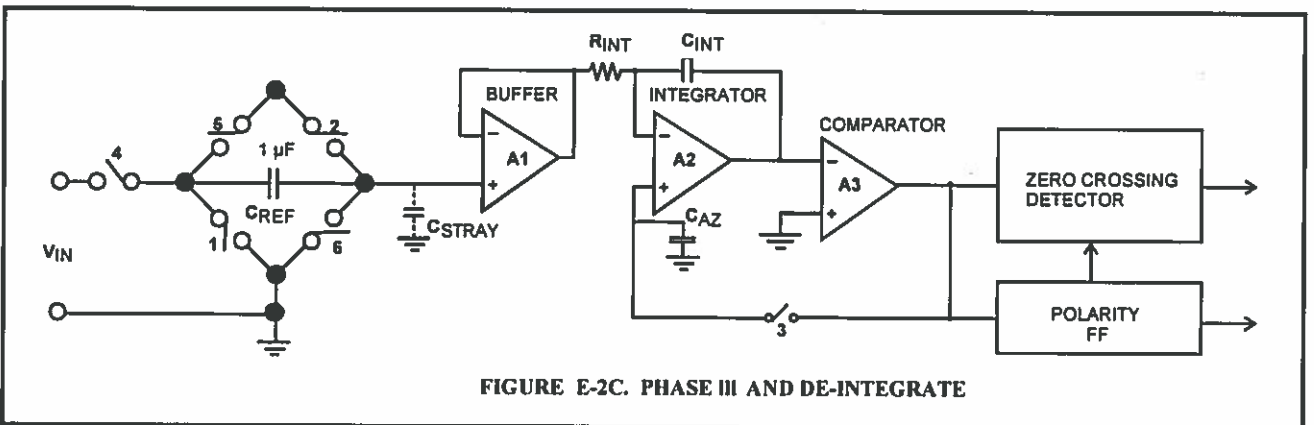
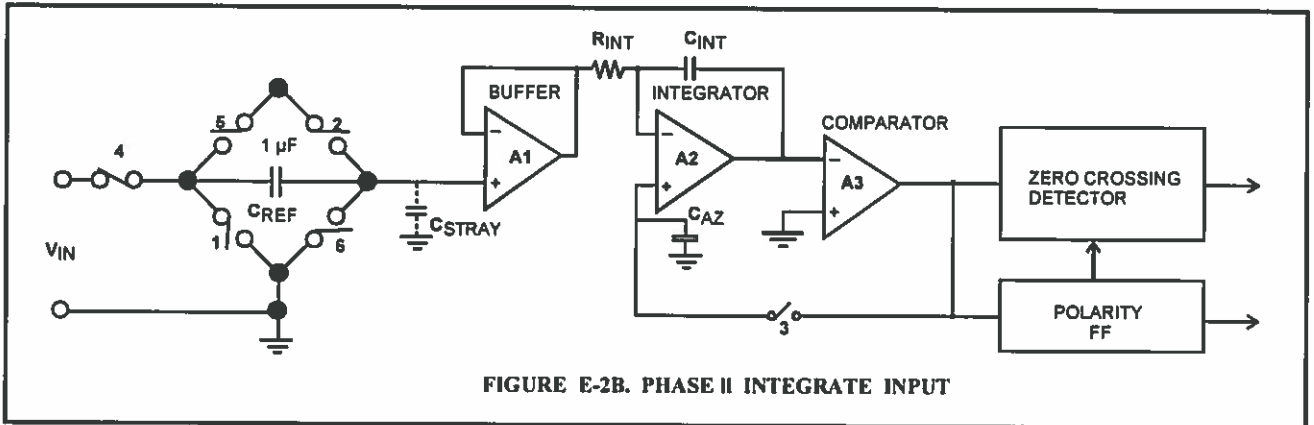
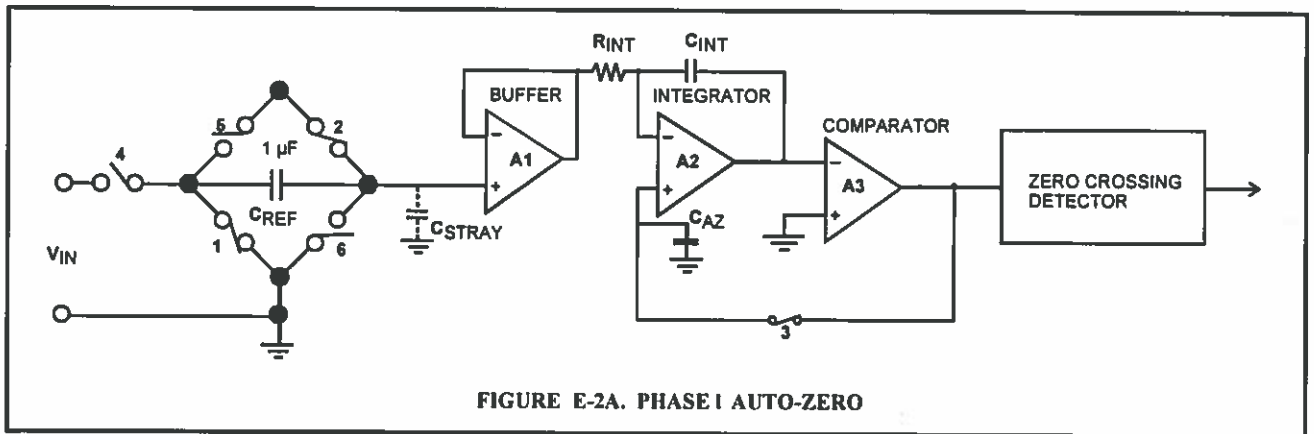


MODEL 620A-4R OHMMETER BLOCK DIAGRAM

COUNTS			
	PHASE I	PHASE II	PHASE III
4 ½ DIGIT	10.001	10.000	20.001







Figures E2. Main Analog Section of DVM Circuit - IC1 and IC2

## Detailed Description

### Analog Section

Figures E2 diagrams A thru D shows the equivalent circuit of the analog section in 3 different phases of operation. The system will perform conversions at a rate determined by the clock frequency 40,002 clock periods per cycle. (see Figure E1B shown earlier in this chapter for details of conversion timing).

#### Auto-Zero Phase I (Figure E2A)

During the Auto-Zero, the input of the buffer is connected to  $V_{REF}$  through switch 2, and switch 3 closes a loop around the integrator and comparator, the purpose of which is to charge the Auto-Zero capacitor until the integrator output does not change with time. Also, switches 1 and 2 recharge the reference capacitor to  $V_{REF}$ .

#### Input Integrate Phase II (Figure E2B)

During Input Integrate the Auto-Zero loop is opened and the Analog Input is connected to the Buffer Input through switch 4 and  $C_{REF}$  if the input signal is zero, the buffer, integrator and comparator will see the same voltage that existed in the previous state (Auto-Zero). Thus, the integrator output will not change but will remain stationary during the entire input integrate cycle. If  $V_{IN}$  is not equal to zero, and an unbalanced condition exists compared to the Auto-Zero Phase, the integrator will generate a ramp whose slope is proportional to  $V_{IN}$ .

#### Deintegrate Phase II (Figures E2C and Figures E2D)

During the Deintegrate phase, switch 5 is closed and a voltage which is  $V_{REF}$  more positive than during Auto-Zero is impressed on the BUFFER INPUT. Thus the reference capacitor stores the equivalent voltage. This returns the output of the integrator to the zero crossing point established in Phase I. The time, or number of counts, required to do this is proportional to the input voltage.

### E-4-1. Reference Voltage

The precision reference voltage required to do the A/D conversion is developed by IC201. The zener voltage is attenuated to approximately -0.5V. This voltage is applied to IC2-7.

### E-4-2. LED Display

The output format from IC2 is in Binary Coded Decimal (BCD) format. Each digit is scanned for 10 clock pulses. The scan sequence is D5 D4 D3 D2 D1. This drives Q1 thru Q5, which in turn drives the seven segment displays. The BCD data is converted to seven segment format by IC4. When the 620A-4R electronics are in open circuit or over-range mode the display flashes "0000". IC5 is a 1 MHz oscillator which is divided by 10 by IC6. The 100 KHz clock output then goes to IC2.

### E-5. Ohms-To-DC Converter

The ohms-to-DC converter generates a constant current which is passed through the device under test to develop the voltage measured by the A/D converter.

#### E-5-1. Constant Current Source

The constant current source is composed of IC201, IC202, Q202, D203 and their associated components. The input to the constant current source is approximately +1.05 volts, developed at IC201-7 and connected to IC201-13 through R209 and R210. The heart of the constant current source is the voltage-to-current converter. A simplified schematic of this circuit is shown in Figure E-4 and described in Section E-5-2. The amplifier of IC201-12 is an inverter, and its output is applied to IC201-9. The amplifier of IC201-8 has unity gain due to the feedback through R213. Its output is applied to the inverting input of IC202-3. The output of IC202-6 provides feedback to the non-inverting input of IC201-10. This circuit operates to maintain the inverting input at IC202-3 and the non-inverting input at IC202-2 at the same potential.

### E-5-2 Constant Current Circuit Operation

Assume that terminals  $I_{hi}$  and  $I_{lo}$  of Figure E-3 are shorted, and 1 volt is applied to  $E_{in}$  so that  $I_{hi}$  is positive. To equalize the 1 volt applied to  $E_{in}$ , the inputs of IC202, IC201 must be driven to zero. This condition occurs only when the voltage drops across R212 and R222 are equal to the drops across R213 and R221. For these voltage drops to be equal, the output of IC202 must be at +1 volt. Since the output of IC201-8 must be zero, the drop across R213 is 0.5 volts, making the inverting input 0.5 volts. The drops across R212, R221 and R222 will also be 0.5 volts. Since the inputs to IC201 are essentially equal, its output is zero (offset by the few microvolts required to drive IC202 to +1 volt). Under these conditions the sum of the voltages across R212, R213, R221 and R222 equals the sum of  $E_{in}$  plus the output of IC202.

Consider now that the short is removed from the  $I_{hi}$  and  $I_{lo}$  terminals and a 100-ohm resistor ( $R_L$ ) is connected in its place. The current through  $R_L$  increases the voltage at the input to IC201. A balanced condition will be reached when the output of IC201 is equal to the non-inverting input of IC202. Again, this condition occurs when the voltage drops across R212 and R222 are equal to the voltage drops across R213 and R221. At this time the output of IC202 is 1.1 volts. The voltage drop across the range resistor is 1 volt, just as it was when the output terminals were shorted. The current through  $R_L$  is 10 milliamperes, just as it was through the jumper when the output terminals were shorted.

### E-6. Failsafe Design

Reference to the AMPTEC 620A Tester Igniter Tester schematic will show that the output of IC202-6 is actually applied to the base of transistor Q202, *which acts as a current limiter. The worst-case component failure that could occur in this circuit would be a Q202 short*, which would effectively connect the -5 volt supply directly across R218, D202, the range resistor and  $R_L$ .

D203, however, acts as a 1.6 volt zener diode, limiting the voltage that can appear across these components. Even if every component in the amplifier circuit shorted, the current through the

igniter could not exceed safe limits, because the -5 volt and +5V supplies includes inherent current limiting. Because of the design of both supply isolation transformers T101 and T102, the  $\pm 5$  volt supplies can only deliver 20 to 25 milliamperes before the DC/DC converter disengages, dropping the -5 volt output to zero. See Section D-7.

The AMPTEC 620A Tester is powered by a rechargeable internal battery pack and cannot be operated directly from the battery charging adapter. This is to *eliminate the possibility* of an electrical short to/from the AC line. *Only when* the 620 POWER switch is in the "OFF/CHARGING" position are the batteries connected to front panel charging jack. *When the POWER switch is in the ON position*, the batteries are disconnected from the battery charger and connected to the internal circuits of the AMPTEC 620 Igniter Tester.

The 620A Tester measurement circuitry is also failsafe current limited, even under worst case component failure. A simple startup test procedure which also has the 620A Tester user perform a functional check using a milliammeter would also detect any current level even getting close to the Failsafe level.

For the 620A Tester the normal or typical operating current level is less than 5 mA, and <8mA on most 20 ohm range versions as a Failsafe Level .

## E-7 . Ultra-Safe Power Supply Scheme

The +5 volt power supply is provided directly by the batteries (for driving the LED displays and digital logic). The  $\pm 5V_D$  is used for driving IC8, the low battery detection circuit. The  $\pm 15V$  power supply is generated by IC7 for the digital voltmeter (DVM) chip set (IC1 and IC2).

The  $\pm 5V_A$  is developed by one DC to DC convertor circuitry: composed of Q103, Q104, T102, D103, D104, IC102 for the negative polarity. The other DC/DC convertor is composed is composed of Q101, Q102, T101, D101, D102 and IC101 for the positive polarity.

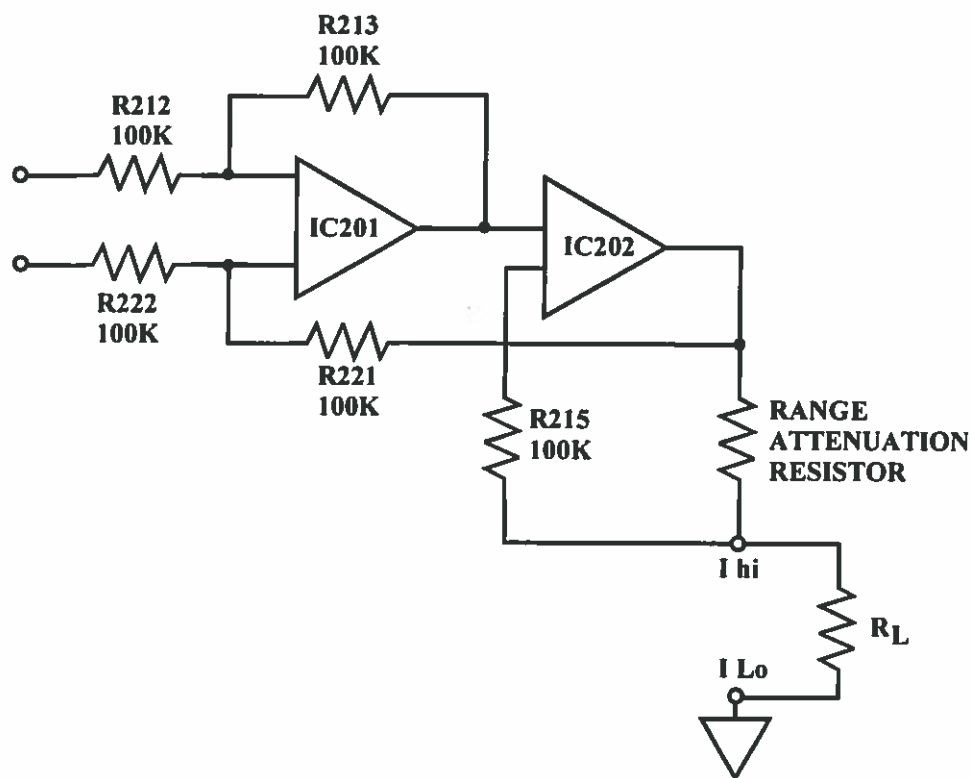
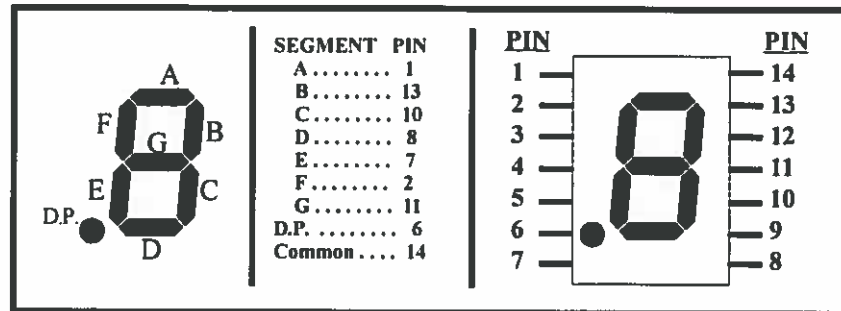


Figure E-3 Constant Current Circuit



**Figure E-4. LED Display Pin Functions**

### E-8. Relay Board General Operation

The internal 620A-4R PCB labeled “620-relay board” replaces the range switch S1 on the main board. IC-1 is actually a ribbon cable header that goes to the top panel and connects to the range push buttons (covered by silicone rubber boots) and their corresponding panel mount LEDs. IC-2 is a latch that will latch its output to the corresponding range push button input. Its output turns on the front panel LED (acts as an range mode indicator LED) and a corresponding relay that connects to the main PCB to select the range. RL1 is for the 20-Ohm range, RL2 is for the 200-Ohm range, RL3 is for the 2K Ohm range, and RL4 is for the 20K Ohm range.



## CHAPTER F CALIBRATION AND MAINTENANCE



### F-1. General

This section of the manual contains routine maintenance information regarding the AMPTEC RESEARCH Model 620A series igniter tester. Calibration should be performed on a regular basis to ensure continued instrument accuracy or following a main PCB electronic component repair/replacement. The recommended calibration interval is 1 year.

The AMPTEC 620A series igniter tester is a four wire Kelvin ohmmeter. *The 620A series igniter tester must be calibrated using four wire Kelvin connections to the resistance standard* in order to eliminate lead resistance and contact resistance errors. The Option "290" has 48" long coax test cabling terminated with twin single alligator clip jacks. One dual banana plug (Voltage high and Current High) and one other dual banana plug (Voltage low and Current low). The 4-wire configuration is maintained up to the point of the alligator clip, eliminating most cable resistance effects. Typically 2mΩ of in series resistance is associated with the AMPTEC "OP290" two alligator clip lead set.

**Note:** *Only for 620 versions with a 2 Ohm range:* the option "305" a 48" long replacement cable set normally supplied as part of the AMPTEC 620 package may have too much resistance offset for the actual calibration of 620 Igniter Testers versions fitted with a low 2.0 Ohm range. Contact AMPTEC for information on the "305" 48" long 4 wire Kelvin Calibration Lead Set all terminated with single banana jacks.

### F-2. Required Test Equipment

Following standard resistors are required to calibrate the 620A-4R Igniter Tester .

#### Precision Resistors:

0.1 ohm ± 0.01% Accuracy  
10 ohm ± 0.005% Accuracy  
100 ohms ± 0.005% Accuracy  
1000 ohms ± 0.005% Accuracy  
10000 ohms ± 0.005% Accuracy

#### Test Leads:

AMPTEC Alligator Clip Test Lead Set (OP290) or AMPTEC Option "305")

### F-3. Calibration Procedure

The 620A series igniter tester should be calibrated with fully charged batteries and should be allowed to **warm-up** for a minimum of **15 minutes** before beginning the procedure. The calibration adjustments are accessed by removing the 10 calibration access screws around the perimeter of the 620A series igniter tester front panel, then lifting off the top plate by the handles. The locations of the adjustments are shown on drawing number 620A-4R-600 at the back of this manual.

#### F-3-1. Zero Offset Adjustment

1. Select the 20 ohm range. Connect the Kelvin clips to the 0.1 ohm standard resistor.
2. Adjust potentiometer RV2 for a display indication of 0.100 .

#### F-3-2. Full Scale Adjustment

1. Select the 200 ohm range. Connect the Kelvin clips to the 100 ohm standard resistor.



2. Adjust RV1 for a display indication of 100.00.

3. Check the 2.0 KOhm range with the 1000 Ohm Standard Resistor. Check the 20 KOhm range with 10 KOhm Standard Resistor. All ranges must be within the specifications outlined in Chapter B. There are no adjustments necessary for the 2.0 KOhm and 20 KOhm ranges. Contact AMPTEC's customer service department if further technical support is necessary.

#### F-4. Battery Replacement Instructions

The rechargeable NICAD batteries (D cell 5.0 AHr each) used in the 620A series Igniter Tester are durable and should provide years of trouble-free operation. Some military maintenance procedures may require replacement of the 620A-4R NICAD batteries as part of the overall annual calibration plan, even if the batteries are working well. As with all batteries, replacement will eventually be necessary. Batteries may be ordered from AMPTEC RESEARCH as stock #05-10117, quantity: (4). The process of battery replacement is described below:

1) Remove the calibration access screws (10 of them) located around the perimeter of the 620A series igniter tester front panel. *Carefully* lift off the 620A series igniter tester front panel top plate by the handles. Note: ~16" of umbilical wire cabling connects the top plate electronics to the main PCB inside the bottom of the 620A series igniter tester case.

Delicately place the 620A series igniter tester front panel - top plate (face side up) on the top bezel, with the umbilical wiring intact.

2) Locate and cut the battery retaining tie wraps on the bottom of the 620A series igniter tester (next to the main PCB).

3) Remove the old batteries and replace.

**Observe polarity!**

4) Secure the new batteries in place by re-placing the tie wraps.

5) Replace the 620A-4R Igniter Tester front panel top plate and re-tighten the calibration access screws, taking care not to pinch any wiring.

#### Low Battery Indicator:

The variable potentiometer - trimpot RV3 is factory adjusted to have the low battery indicator come on at 4.50 VDC. To make this adjustment, **remove the fuse** from the fuseholder located next to the power switch on the 620 main operation top panel. Remove the 10 calibration access screws located around the perimeter of the 630 top panel, if the top panel has'nt already been lifted off or removed.

*Use caution when lifting the 620 top panel off by the handles*, as there is ~14" umbilical wiring and ribbon cabling that connect the top panel electronics to circuitry mounted inside the bottom of the 620 case.

With an adjustable DC power supply, set the power supply output to be 4.50 VDC. Observe power supply polarity. Connect the power supply to the wiring labeled "MAIN" + pos. and - neg. located in the rear section of the MAIN PCB. (i.e positive + power supply output to the anode side). Adjust trimpot RV3 to have the low battery indicator just come on (negative sign on display) with 4.50 VDC applied from the power supply. An increase in power supply voltage to 4.52 VDC should have the low battery indicator go out. The low battery indicator adjustment should now be complete.

Disconnect the power supply, and return the fuse to the fuse holder. Replace the 620 top panel to its original location. Return the calibration access screws to the perimeter of the 620 main top panel .

