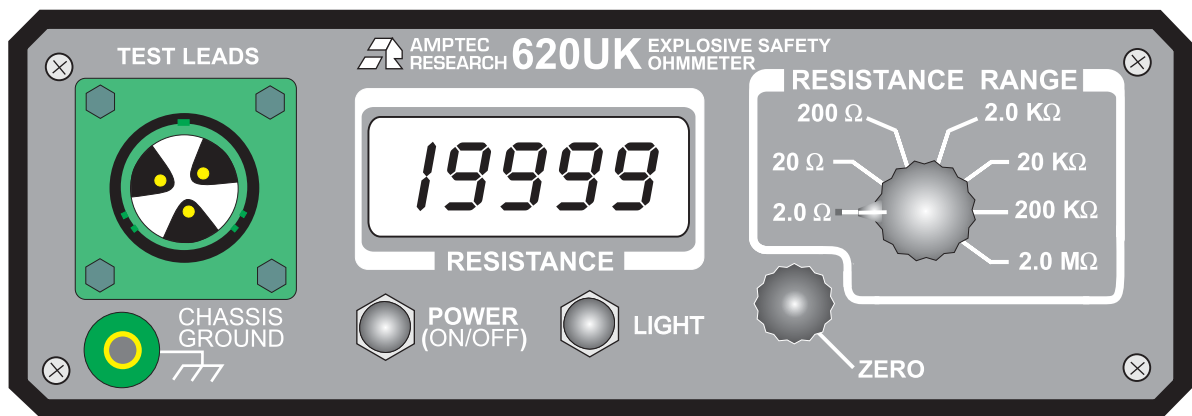




AMPTEC 620UK SAFETY OHMMETER



OPERATOR MANUAL

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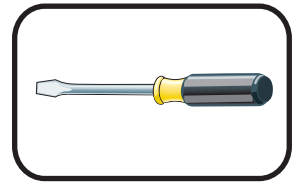


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SECTION A - RECEIVING AND INITIAL INSPECTION



A-1. Introduction - AMPTEC 620UK

The AMPTEC 630, 640 and now the AMPTEC 620 Series Igniter Testers/Failsafe Ohmmeters have become the standard in the Safety Ohmmeter/Igniter Circuit Test industry. They 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 explosive ordnance and munitions and the AMPTEC 620UK by an independent European Eex certifying body for Intrinsic Safety. The United Kingdom Ministry of Defense (UK MOD) and other versions also have approved the Ohmmeter. Devices the AMPTEC 620UK Safety Ohmmeter may be used on include: **1)** chassis ground connections on fighter jets in Explosive and Volatile environments, **2)** fuses, **3)** squibs, **4)** igniters, **5)** explosive bolts, **6)** rocket motor squibs, **7)** flares **8)** EED activated mortars, **9)** EED activated shells, **10)** EED activated rounds and many others. The AMPTEC 620UK Ohmmeter complies with the EU ATEX Directive and meets the **Intrinsic Safety standard Eex-ib-IIC-T4**. The AMPTEC 620UK Ohmmeter has passed EMC testing in accordance with **British Defence Standard 59-41** Radiated Emissions and Susceptibility. It is also complies with **British Defence Standards 66-31** (Environmental Heat, Cold, Altitude, Humidity and Atmospheric Stress tests), as well as **British Defence Standard 07-85** and **British Defence Standard 05-34**. The AMPTEC 620UK Ohmmeter provides a reliable and intrinsically safe means of measuring electrical resistance of aircraft chassis ground connections, rocket motor squibs, warhead squibs, explosive bridge wire and/on a variety of devices. Featuring seven resistance ranges and an all metal case with a separate battery compartment, the AMPTEC 620UK provides a safe and easy method of measuring resistance in explosive and volatile atmospheres. **The AMPTEC 620UK is approved by SIRA Test & Certification Limited for an intrinsic safety classification of EEx ib IIC T4 in accordance with the ATEX Directive. SIRA Test & Certification Limited is located in Chislehurst, Kent BR7 5EH ENGLAND**

The AMPTEC 620UK is a 2-wire failsafe digital ohmmeter which reliably uses very low test currents for its resistance measurement. The open circuit voltage on the main "Test Lead" connector (Pattern 104, 3 way NSN plug) is also diode protected (voltage clamped) and ideal for use in "volatile" environments. The AMPTEC 620UK Explosive Safety Ohmmeter is voltage limited (diode protected) to prevent arcing associated with the use of the meter. The field tested Failsafe Output Circuitry pioneered by AMPTEC RESEARCH ensures that test current levels do not exceed the specified "failsafe current" even in a worst-case component failure situation. To conserve battery power, the AMPTEC 620UK automatically shuts down, or turns itself off after approx. 20 minutes of "inactivity". The AMPTEC 620UK does not need to "warm-up", so the user may simply repress the power button to effectively reset the "auto-shutdown" timer. Should the internal batteries (4 ea. AA type) reach a low energy level the "LO BAT" indicator message will appear on the unit's display. (*see Section A-3*)

A-2. Unpacking, and Inspection

Should the AMPTEC shipping box appear damaged upon arrival notify the carrier immediately. If the 620UK 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.



If the unit fails to operate or fails to meet the performance specifications of Section B, notify the carrier's agent and your nearest AMPTEC Sales Agent's Office (i.e. see our website at <http://www.amptec.com> for contact info). 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's service agent first, prior to just returning the 620UK, 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).

A-3. DC Battery Power Requirements

The AMPTEC 620UK Explosive Safety Ohmmeter is powered by an internal battery pack (4 ea AA i.e. Alkaline type) that is housed in a separate metal box that requires a security screwdriver for removing the tamper resistant screws. Replacement batteries must be either of the following: **Duracell Plus Type MN1500**, Eveready Silver Seal type R65 or Eveready Ultra Plus, Silver Seal type R6F4UP, Varta Type 3006, or GP Type GP15 to maintain the Eex-ib-IIC-T4 Intrinsically Safe Certification. Contact the sales department at AMPTEC RESEARCH (i.e website <http://www.amptec.com>) for 620UK Ohmmeter battery replacements if necessary. Tamper resistant screws secure the battery cover plate in the rear of the 620UK Explosive Safety Ohmmeter. Calibration Lab personnel have the proper tools to remove the cover plate over the unit's battery compartment.

The main "Power" switch has two separate modes. The "ON" position supplies internal battery isolated power to operate the AMPTEC 620UK Ohmmeter. If you turn on the AMPTEC 620UK Ohmmeter, and the LCD display does not come on, it may indicate the batteries are dead and may need replacement by authorized service personnel. *To conserve internal battery power, the AMPTEC 620UK Ohmmeter turns off automatically after approx. 20 minutes.* Simply press the power switch to turn to turn the instrument back "On or Off".

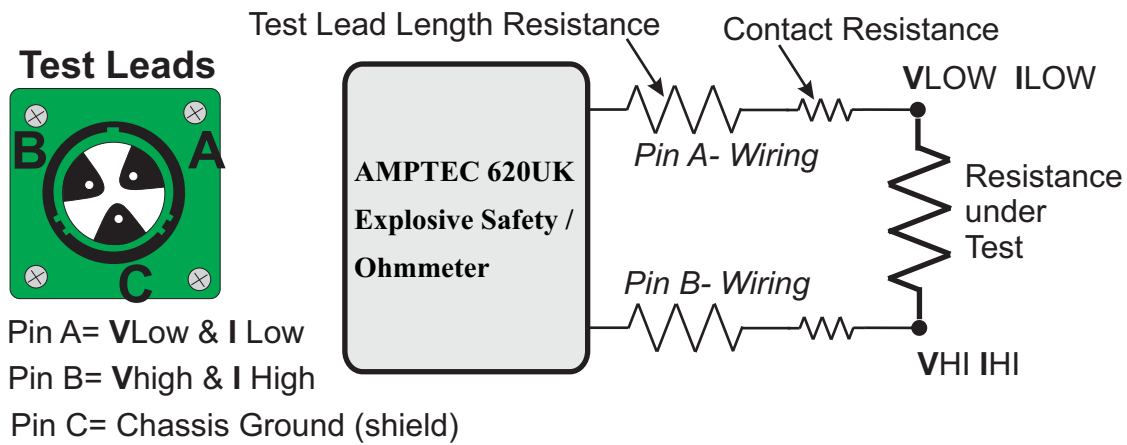
Located in upper left hand portion on the LCD display is a "LOW BAT" indicator area. Look for no "LOW BAT" indication prior to operating the AMPTEC 620UK Ohmmeter. The absence of the "LOW BAT" indication in the LCD display indicates the internal batteries have acceptable power levels. A new set of "AA" batteries in the AMPTEC 620UK battery pack is designed to last approximately 1 year, depending upon use.

A-4. Setup and Preparation for Use

The AMPTEC 620UK Explosive Safety Ohmmeter may be setup to operate as soon as power is "**turned ON**" (*requires pressing and holding down power switch for 2 seconds*). A quick check for no sign of the "low battery indicator" a test lead integrity check and/or test lead zero adjustment (see below) and it should be ready to use.

Consequently, it may be used in any area where the environment does not exceed the specifications of Table B-2. Avoid exposing the AMPTEC 620UK Ohmmeter to extremes of temperature which will affect accuracy and shorten battery life-span where possible.

The AMPTEC 620UK Explosive Safety Ohmmeter is a “2-Wire” type of ohmmeter. See diagram below.



The AMPTEC 620UK Explosive Safety Ohmmeter Test Lead Connection uses a 3 pin connector on it's front panel, labeled “Test Leads”. The output connector is a pattern 104, 3 way Type SB104-T4-BS-3PXO Nato Stock Number 5935-99-0131244 connector. The Pin A of the connector is the **Voltage Low** and **Current Low** Test Lead connection. Pin B of the Test Lead connector is **Voltage High** and **Current High**. The third pin (Pin C) is chassis ground and/or can be used as a “shield” around the other two lines (A and B) in your test lead wiring.

The AMPTEC 620UK Test Lead wiring can be a source of measurement error or offset, if not compensated for. The front panel “ZERO” knob allows the AMPTEC 620UK user to zero out the test lead resistance. Refer to **Chapter D: Operation, Function and Use** for the exact procedure and related details on “zeroing” the test lead and connection offsets.

Once the user has zero’ed the unit’s 2.0 Ohm range, re-zeroing the the AMPTEC 620UK’s other ranges (i.e. 20 Ohm, and 200 Ohm ranges) is not necessary. The front panel “**zero knob**” doesn’t have an effect on the unit’s 2.0K Ohm or higher ranges. After the “ZERO” adjustment of the test leads is accomplished, the AMPTEC 620UK Ohmmeter is ready to connect to the resistance under test.



SECTION B - 620UK EXPLOSIVE SAFETY OHMMETER - SPECIFICATIONS



620UK Resistance Range/Resolution Nominal Test Current/Fail-Safe Current

2.0 Ω	20.0 Ω	200 Ω	2.0 K Ω	20.0 K Ω	200 K Ω	2.0 M Ω
100 $\mu\Omega$	1.0 m Ω	10 m Ω	100 m Ω	1.0 Ω	10 Ω	100 Ω
5mA	5mA	0.5mA	50 μ A	5 μ A	0.5 μ A	50nA
8mA	8mA	1.5mA	150 μ A	15 μ A	1.5 μ A	15nA

Table B-2. Specifications

Accuracy: (for 1 year @25°C \pm 10°C)

2.0 ohm range thru 20K ohm ranges \pm 0.02% of reading \pm 0.05% of range

200K ohm range \pm 0.05% of reading \pm 0.05% of range

2.0M ohm range \pm 1.0% of reading \pm 0.2% of range

Temperature Range - Operating . . -20°C to +40°C, Storage -10°C to 70°C

Temperature Coefficient

2.0 ohm through 20 K ohm ranges . . . \pm 0.002% per °C (from 0°C-15°C and 35°C-50°C)

2.0 M ohm range \pm 0.02% per °C (from 0°C-15°C and 35°C-50°C)

Instrument Display . . (20,000 counts) 4½ digit Liquid Crystal Display (LCD) with a back light for viewing the 620UK display in dim ambient light conditions.

Low Battery Indication . .The 620UK LCD Displays shows “LOW BAT”

Over-Range Indication . . . “i and *blank digits*” in the 620UK LCD display

Measurement Update Rate. Approximately 3 readings per second

Open Circuit Current Source Compliance Voltage . diode clamped at <1.4 volts

Power Battery Pack inside separate metal box houses (4 ea "AA") 1.5V Alkaline batteries, requires tamper-proof security screwdriver: **use only Duracell Plus Type MN1500, or Eveready Silver Seal type R65 or Eveready Ultras Plus, Silver Seal type R6F4UP, Varta Type 3006, or GP Type GP15**

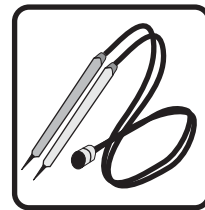
Dimensions 7.0" W x 8 " D x 2.5" H

Weight 13 lbs net; 16 lbs shipping

Calibration Access requires tamper-proof security screwdriver



SECTION C: REPLACEMENT & ACCESSORY ITEMS



The AMPTEC 620UK Explosive Safety Ohmmeter is available with a transit case (OP-101) with shoulder strap and front panel NSN connector compatible multi-function test lead set.



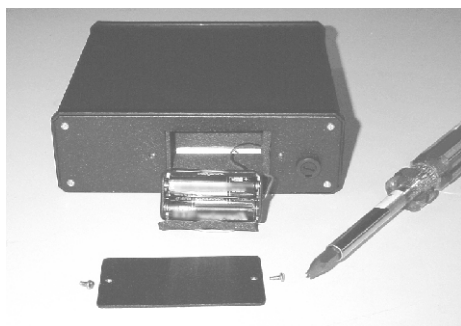
Option “620UK-101” Transit case with anti-static conductive coating - The case houses the AMPTEC 620UK Ohmmeter with alligator clip test lead set.



Option “620UK-290” Alligator Clip Test Lead Set (48” long) - ideal for connecting to wires, some jacks and most exposed posts.



Option “620UK-401” Handheld Probe Test Lead Set ideal for probing recessed socket wiring, and flat surfaces (i.e. flares, squib contacts, and primers).



Option “620UK-201” Security Screwdriver (snake-eye type) for calibration maintenance personnel to have access to the unit's battery compartment and internal electronics. Optionally available upon request, along with snake-eye security screws provide additional tamper resistance from unauthorized personnel.



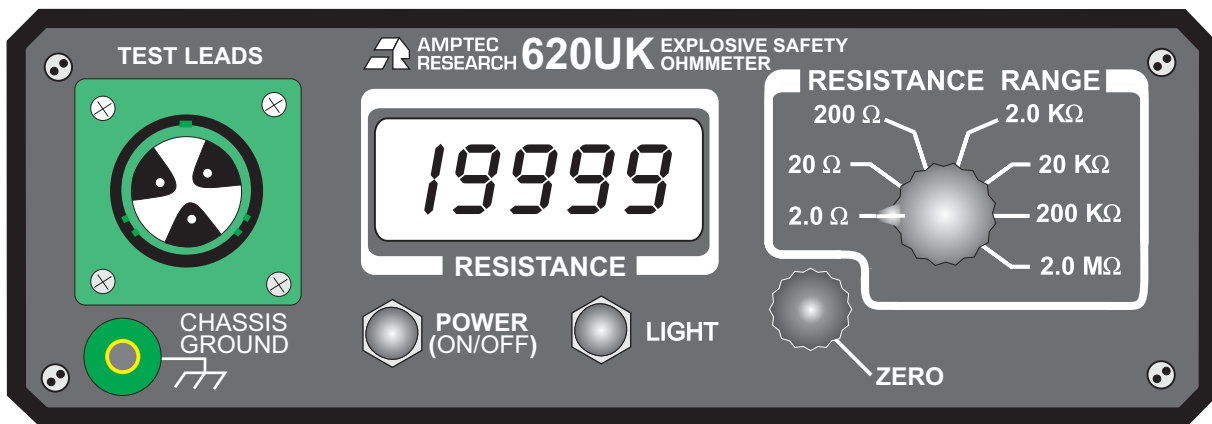
SECTION D : OPERATION , FUNCTION, AND USE



D-1 GENERAL USE

The AMPTEC 620UK is designed to operate for approximately 1 year under normal use before the 4 “AA” batteries need to be replaced. The “LOW BAT” indicator on the units LCD Display is factory adjusted to come on with the internal batteries need to be replaced. (Due to tamper-proof screw access to the separate metal battery compartment, located in the back of the 620UK, please refer to battery replacement to authorized CALIBRATION/MAINTENANCE personnel only.). The AMPTEC 620UK is DC current based, about 200 times more accurate ($\sim 0.02\%$) than AC current models and provide a solid reading rate of 3 readings per second. The AMPTEC 620UK also uses internal solid state voltage reference(s) that permit the product to be used immediately after the unit has been turned on (within the temperature range limits of use as stated in section B of this manual).

D-2 FRONT PANEL



D-2.1 Test Leads and Chassis Ground Connections

The Amptec 620UK Explosive Safety Ohmmeter Test Lead Connection uses a 3-pin connector on its front panel, labeled “Test Leads”. The output connector is a pattern 104, 3 way Type SB104-T4-BS-3PXO Nato Stock Number 5935-99-0131244. The pin A of the connector is the Voltage Low and Current Low Test Lead connection contact. Pin B of the Test Lead connector is Voltage High and Current High. The third pin (pin C) is chassis ground and/or can be used as a “shield” around the other two lines (A and B) if your test lead wiring is fitted with a shield wire. When first arriving at a location, the AMPTEC 620UK user should connect the unit's chassis ground panel jack on the transit case to a local earthy or ground connection. The unit's chassis ground panel jack is wired to the case, front panel, rear panel, battery compartment and also Pin “C” of the connector. The unit's chassis ground can also be plugged into an earth ground connection for example at the test site to preclude any static voltages from building up.

The AMPTEC 620UK Ohmmeter front panel chassis ground panel jack and pin C of the NATO test lead connector are both chassis ground. The AMPTEC 620UK user may use either chassis ground connection as a test lead shield (provided the test leads are the shielded variety). The unit's chassis ground can also be plugged into an earth ground connection for example at the test site to preclude any static voltages from building up.

D-2.2 Main Power Switch (Front Panel ON/OFF Button)

The main power switch for the AMPTEC 620UK Explosive Safety Ohmmeter is a momentary hold-down switch that needs to be **held down for approx. 2 seconds to turn “ON”**. This required momentary “hold down” routine (for 1 to 2 seconds) helps avoid accidental “Power On” whilst the AMPTEC 620UK Ohmmeter is riding around inside its carrying case. When first pressed and held, (the power switch) the instrument should turn “ON” (i.e. the LCD Digital Display comes on), if the switch is pressed again the unit will turn “OFF”. The main power switch is covered with a silicon rubber boot to provide added water/dust resistance in harsh environments.

D-2.3 Auto “TURNOFF” (Automatic Shutdown)

The AMPTEC 620UK Explosive Safety Ohmmeter conserves battery power (4 ea. AA batteries - see Section B for exact type/brand allowed) by turning itself off automatic-ally **after 20 minutes** of continual use (i.e. without a change in range). The AMPTEC 620UK Explosive Safety Ohmmeter operator may simply press the main power (momentary) switch to turn the unit back “ON” for 20 more minutes. The operator does not have to worry about warm-up time associated with turning the unit back “ON” if it automatically goes “OFF” (i.e. into “Auto Shutdown mode”). The AMPTEC 620UK Safety Ohmmeter operator may also simply make a range change and return (i.e. *either* flip the range switch up and back/return *or* press and temporarily hold the main power switch on again). This will keep the AMPTEC 620UK ohmmeter operating continuously for 20 more minutes. The benefit of conserving battery power far outweighs the second or two it takes to reset the AMPTEC 620UK's “Power Off” timer.

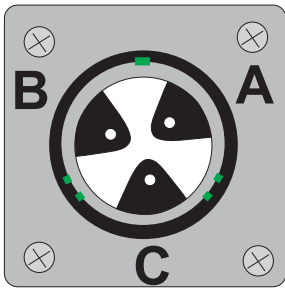
D-2.4 Light (Front Panel button)

The AMPTEC 620UK Ohmmeter has an LCD Display light switch to turn LCD display lights. If the 620UK Ohmmeter user is in a dim/poor ambient light environment and viewing the LCD display is difficult press and hold the front panel switch labeled “LIGHT”. The 620UK Ohmmeter LCD display will be lit and viewable in dim or dark ambient light conditions, as long as the user holds down the “LIGHT” button (assuming good batteries). If you press the Amptec 620UK ohmmeter front panel “LIGHT” switch and the LCD display light does not come on it probably indicates dead batteries or a repair is in order, refer battery replacement or any repairs to authorised personnel.

D-2.5 Resistance Range Selection

The AMPTEC RESEARCH 620UK Explosive Safety ohmmeter is fitted with seven resistance ranges. The lowest resistance range (2.0 Ohm) provides resistance measurement capability from zero ohms up to the level of 1.9999 Ohms Fullscale. The AMPTEC 620UK resistance range is selected by rotating the front panel resistance range selection knob to the desired resistance range. The AMPTEC 620UK Explosive Safety Ohmmeter resistance range selection continues in decades from 2.0 ohms, 20 Ohms, 200 Ohms, 2.0 K Ohms, 20 K Ohms, 200 K Ohms, 2.0 Megohms. If the level of resistance to be measured is not known the AMPTEC 620UK user should select the highest range (2.0 MegOhm Range) and continue down ranging until the user gets the optimal measurement for the unit's 4 ½ digit display.

Test Leads



AMPTEC 620UK Front Panel Test Connector

Pin A= **V Low & I Low**

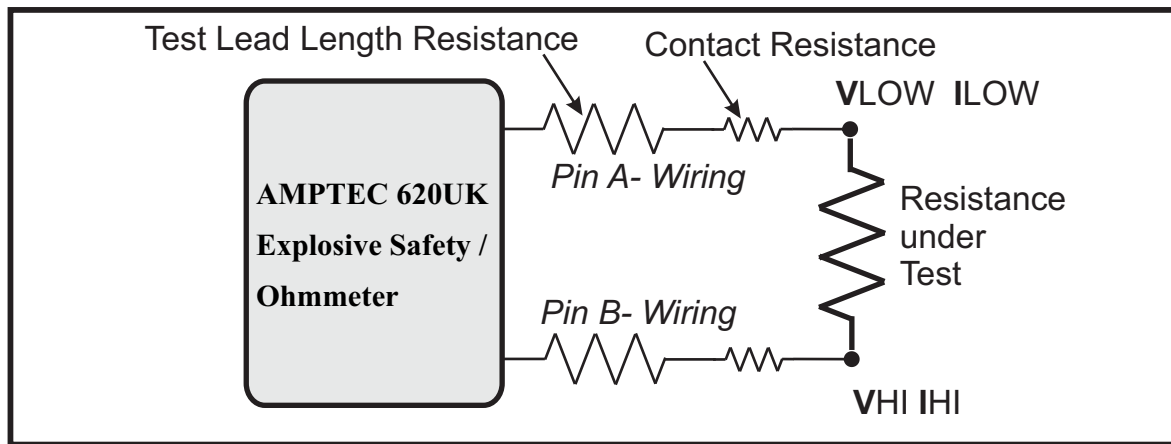
Pin B= **V High & I High**

Pin C= **Chassis Ground (shield)**

The AMPTEC 620UK Explosive Safety Ohmmeter Front Panel Test Lead Connection uses a 3 pin connector on it's front panel, labeled "Test Leads". The output connector is a pattern 104, 3 way Type SB104-T4-BS-3PXO Nato Stock Number 5935-99-0131244 connector. The Pin A of the connector is the **Voltage Low** and **Current Low** Test Lead connection. Pin B of the Test Lead connector is **Voltage High** and **Current High**. The third pin (Pin C) is chassis ground and/or can be used as a "shield" around the other two lines (A and B) in your test lead wiring.

D-2.6 Zero (Front Panel Knob)

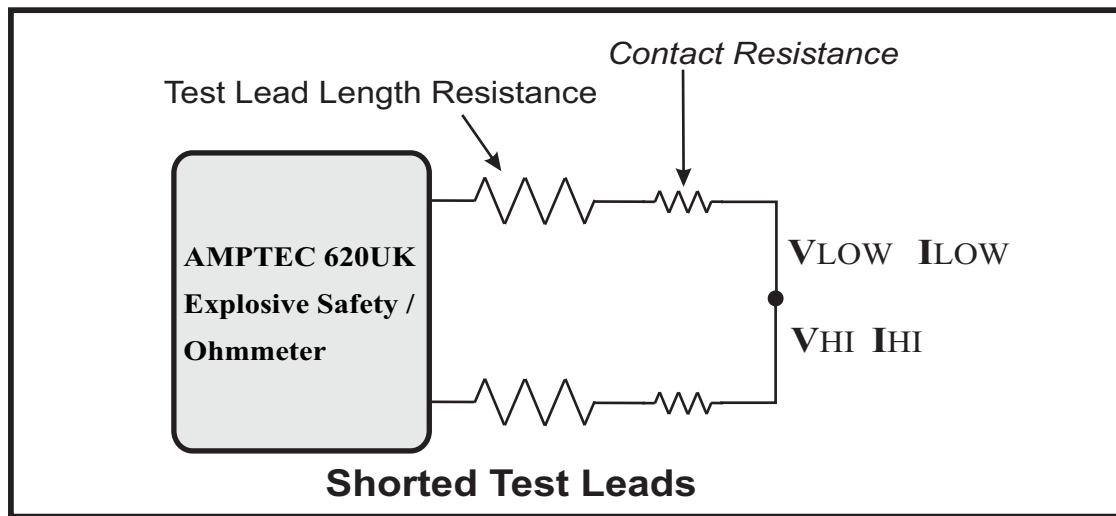
The AMPTEC 620UK Explosive Safety Ohmmeter externally a "2-Wire" type of ohmmeter.
See diagram below.



The AMPTEC 620UK Ohmmeter when measuring resistance - **measures the total** of : three "in-series" items as shown above. The first item is the actual test lead wiring resistance coming from pin A (**Voltage Low** and **Current Low**) and pin B (**Voltage High** and **Current High**). Test lead resistance depends upon lead length and gauge of wiring. The second "in-series" item in the resistance measurement loop is the "contact resistance" of the lead contact when connected to the "resistance under test" (i.e. squib). The third item in the resistance measurement loop is the "resistance under test" which can be virtually any level or magnitude of electrical resistance as shown in the diagram above. The AMPTEC 620UK Ohmmeter test lead wiring can be a source of measurement

error or offset, if not compensated for. The front panel “ZERO” knob allows the AMPTEC 620UK Safety Ohmmeter user to **zero out** most typical test lead resistance. *That is* - The zero knob is for “zeroing or nulling out” the typical 100-150 milliohms worth of test lead wiring resistance and contact resistance offset - which is determined when the leads are shorted (*see below*).

For measurements above 2.0 K Ohms and higher, the “zero knob” adjustment isn’t needed and has no effect (as the level of test lead resistance offset is so very small compared to the higher resistance level of the “resistance under test”) . **Repeat:** *The front panel “zero knob” doesn’t have an effect on the unit’s 2.0K Ohm or higher ranges.*



The steps to adjust the “ZERO” knob (up to 10 turns) are as follows:

1. **Select the 2.0 Ohm range** (by rotating the unit’s range selection switch to the 2.0 Ohm position).
2. With the NATO pattern 104 compatible test leads connected to the AMPTEC 620UK Ohmmeter, **connect or short the leads at the end together** . For example - if they are alligator clip (option 620UK-290) or banana jack ends (option 620UK-401), connect or short the ends to each other.
3. Adjust the ten turn (precision potentiometer) zero knob until the AMPTEC 620UK Ohmmeter LCD display indicates a reading of all zeros (0000) . Turning the front panel “**zero knob**” a counter clock-wise direction compensates by decreasing the resistance offset of the test leads. Turning the zero knob a clock-wise direction compensates in by increasing (more or higher) resistance offset. ***If you over-adjust the zero, beyond all zeros on the display, the negative polarity sign comes on the display*** indicating a condition of “**over-adjustment**”. Simply turn the knob in the clock-wise direction (pos +) until the negative sign in the display disappears . Once the “ZERO” adjustment of the test leads is accomplished, the AMPTEC 620UK Ohmmeter test leads are ready to connect to the resistance under test. Once the user has zero’ed the unit’s 2.0 Ohm range, re-zeroing the AMPTEC 620UK’s other ranges isn’t normally necessary.

ZERO (continued)

However if the test leads are changed (i.e from clips to probes) we recommend resetting the zero on the AMPTEC 620UK Ohmmeter.

After the “ZERO” adjustment of the test leads is accomplished, the AMPTEC 620UK Ohmmeter is ready to connect to the resistance under test. *The span of the “zero knob” is not infinite.* For ordnance test applications where the resistance offset of the “squib wire harness”, “*a.k.a* resistance under test” is greater than the span of the AMPTEC 620UK Explosive Safety Ohmmeter “Zero” knob most users record the “in-series” offset resistance.

end of zeroing description



D-3 *Photo of AMPTEC 620UK in Carry Case
Earth Connection between Case and Ohmmeter is shown*

The front panel of the AMPTEC 620UK houses the following components:

- A) Pattern 104 3-Way Plug Type SB104-T4-BS-3PXO (NSN 5935-99-0131-244).**
- B) Chassis Ground Connector.**
- C) 4½ Digit LCD Display** with Low Battery Indicator and Over-Range Indicator.
- D) Resistance range selector** (Seven way rotary switch with selectable ranges of 2.0 ohm, 20 ohm, 200 ohm, 2.0 K ohm, 20 K ohm, 200 Kohm and 2.0 Mohm).
- E) Zeroing** Potentiometer to zero the meter reading.
- F) Back-Light** selector switch to turn backlight on and off.
- G) Power** on/off switch (**hold down for 2 seconds** for “Power on”).

D-4 620UK METAL CHASSIS DESCRIPTION

The AMPTEC 620UK Ohmmeter chassis (case) is an aluminum enclosure that also acts as a Faraday cage surrounding the unit's internal electronics. The Chassis (enclosure) has a front panel earth/ground jack which enables it to be earthed to the same electrical potential as the equipment which the product will be testing. Internal AMPTEC 620UK Ohmmeter earthing connects all rear panel, battery compartment, PCBs and front panel aluminum shield behind the front panel labeling, are connected to the chassis and chassis ground front panel jack.

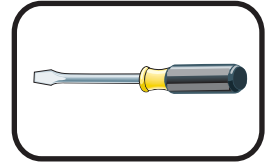
In summary, the AMPTEC 620UK Ohmmeter front and rear panels are *a)* aluminum shielded and *b)* have their individual chassis ground lug connections electrically wired to the units front panel “chassis” ground front panel connection.

The chassis is optionally fitted with tamper resistant screws (snake eye type) to ensure that only authorized access is possible. A special screwdriver is required to gain access to the internal electronics and battery compartment.

The AMPTEC 620UK Ohmmeter is supplied with a carrying case that is made of a durable water resistant material coated with a permanent conductive (anti-static) protective layer to prevent electrostatic discharge. An earth connection is made from the AMPTEC 620UK Ohmmeter to the Carrying Case. This is shown in the photograph on page 13.



SECTION E : MAINTENANCE , REPAIR AND CALIBRATION



E-1. General

The AMPTEC RESEARCH 620UK Ohmmeter is shown in PCB block diagram form on page 17.

The AMPTEC 620 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 **620UK spare PCB inventory** and it's customer service department can also provide additional assistance in the trouble shooting process.

E-2. Troubleshooting Only by Authorised Personnel

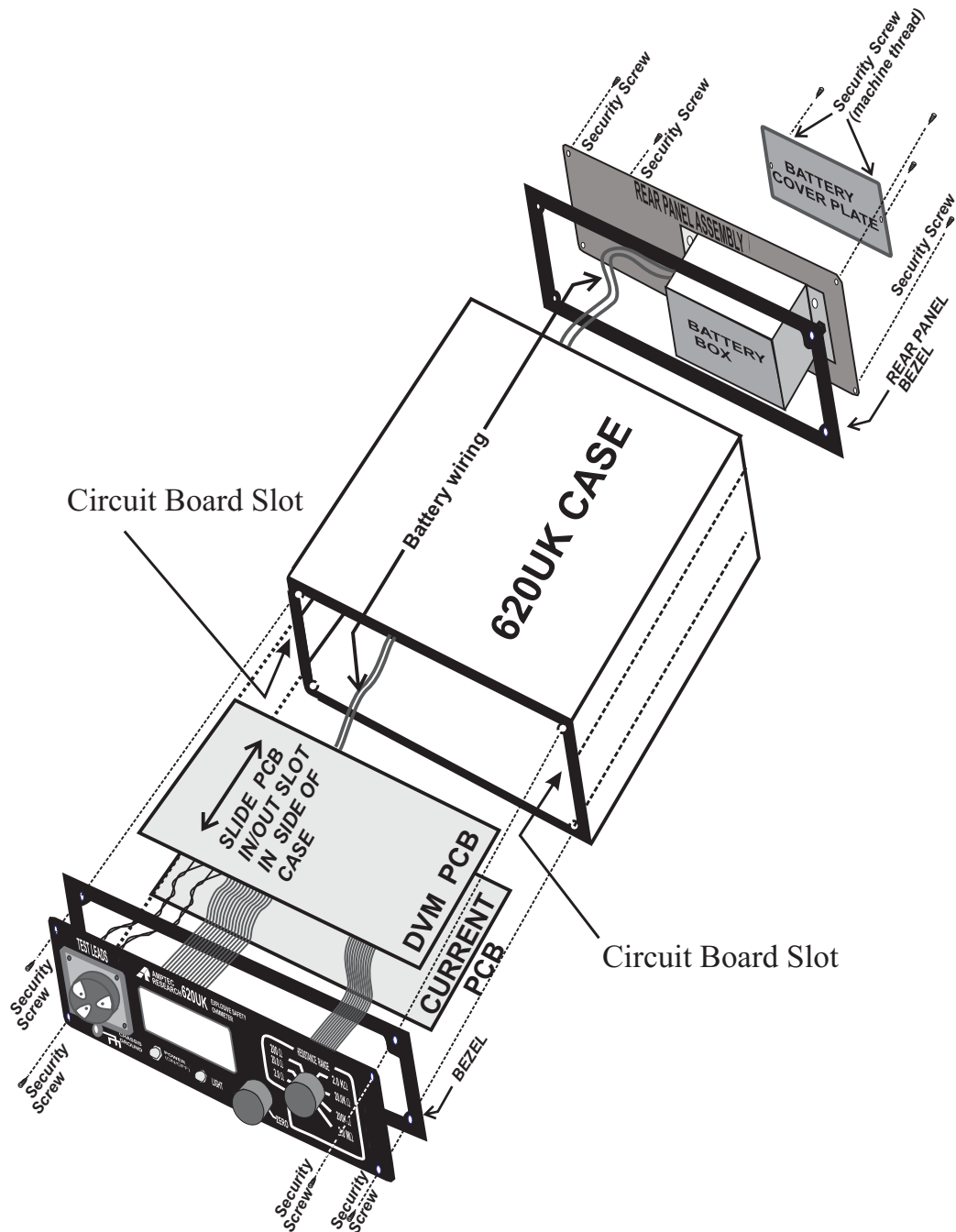
Since the 620 Ohmmeter is used to test potential deadly explosive force detonators and warheads of missiles etc., ***personnel that are not qualified to make such electrical repairs on the 620UK Tester should not even attempt to remove the calibration access screws or open the main panel or effect any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

Apparent 620 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 620 series igniter tester .

If you turn on the AMPTEC 620UK, and the display does not come on, it may indicate the batteries need replacing. If the 620UK exhibits problems that cannot be eliminated by reviewing Chapters B and D, the following guidelines have been established to help solve the problem.

E-3. CIRCUIT BOARD OPERATION OVERVIEW

There are two main internal printed circuit boards that perform the AMPTEC 620UK “Digital Ohmmeter” resistance measurement. The AMPTEC 620UK Explosive Safety Ohmmeter uses an ***independently certified “intrinsically safe”*** constant current source (current source PCB). When the intrinsically safe current constant source is combined with the ohmmeter's digital voltmeter PCB electronics a stable DC resistance measurement for 0.0001 Ohms to 2.0 Megohms is provided. The digital voltmeter electronics (DVM PCB) uses a high input impedance sense circuit. The digital voltmeter circuit draws very little current when it measures the DC voltage drop across the “resistance under test”. The worst case test current (<8mA or less) for each range is indicated on the AMPTEC 620UK Explosive Safety Ohmmeter/ Igniter Circuit Tester specification page of this manual (Section B). The AMPTEC 620UK DVM PCB slides in (slot) ***above*** the Failsafe Current Source PCB. ***The 620UK Ohmmeter’s front panel security screws must be removed to access either the DVM PCB (upper slot) or the Constant Current Source PCB (lower slot).***



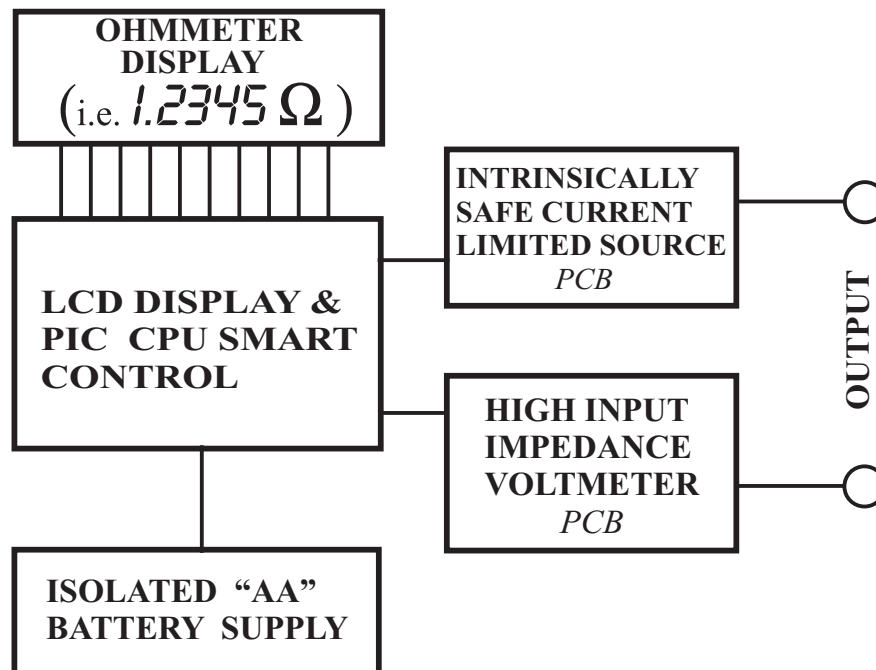
E-4 AMPTEC 620UK Ohmmeter Assembly/Disassembly Diagram

The AMPTEC 620UK Ohmmeter Current Source PCB and DVM PCB are epoxy **conformal coat** encapsulated both the top and bottom side of each PCB. This PCB encapsulation **provides** excellent **humidity resistance**, moisture **condensation resistance**, **dust and dirt PCB contamination resistance**. In addition, it provides PCB **electrical insulation preventing virtually** any kind of mechanical circuit damage (loose or broken wire(s), loose washer, accidental component substitution or component lead damage that can happen while servicing, etc.) and helps **prevent virtually all compromise of the AMPTEC 620UK Ohmmeter's EEx-ib IIC-T4 Intrinsically safe circuitry**. In the past, some safety ohmmeters (i.e. ALINCO 101 series) have a history of faulty service related (i.e. **wrong component or electrical current limit fault**) failures which have had catastrophic and deadly result when connected to an explosive device. (Virtually anything can fail when serviced wrong, i.e. missiles, rocket motors, smart munitions, vital Jet engines etc.)

E-5 BLOCK DIAGRAM AND CIRCUIT DESCRIPTION

The AMPTEC 620UK Explosive Safety Igniter Tester is a portable digital milli-ohmmeter specifically designed for ultra-safe resistance testing on explosive devices (i.e. squibs, igniters, flares, explosive bridge wire and detonators). With 4 1/2-digit resolution and a low Ohm range of 2.0 Ohms full-scale, the AMPTEC 620UK Ohmmeter provides ordnance safe resistance measurements and viewing even in direct sunlight.

The AMPTEC 620UK Ohmmeter is constructed in a metal EMI enclosure and internally contains 5 VDCt HC-MOSS clock operating at 100 KHz for the display, and an HC-MOSS clock operating at 32.7KHz for the PIC computer chip.



E-5.1 Principle of Operation

The AMPTEC 620UK Safety Ohmmeter **fundamentally measures on the principle of Ohm's Law**. In order to measure, it outputs a constant DC current through a given resistance then measures the voltage drop across it and displays the resistance. The unit's 2.0 Ohm range outputs an *intrinsically safe* 5mA level of test current. When the AMPTEC 620UK outputs 5mA through a 1.0 Ohm resistor you should measure a 5mV drop. When you put that voltage drop into the x10 (times ten) amplifier (only on the 2.0 Ohm range) it becomes 50mV, which inputs into the DVM PCB and ratiometrically displays the measurement as 1.0000 Ohm. The unit's 20 Ohm range outputs the same constant 5mA level (without the x10 amp). When this constant 5.0 mA level is put through a 10.0 ohm resistor, you get a 50mV drop, which inputs into the DVM PCB and is displayed as 10.000 Ohms. The 200 Ohm range outputs a constant 500uA DC current. When this current level (500uA) is routed across a 100 Ohm resistor you get a 50mV drop, which routes into the DVM PCB and is displayed as 100.00 Ohms. As the 620UK selected range resistance goes up by a factor of 10 the constant DC current level goes down by a factor of 10 keeping the voltage at 50mV.

Localizing the Problem to PCB level

The key to successful troubleshooting is to localize the problem to a general electronic parameter (i.e. current source or DVM PCB) as much as possible. Certain questions should be asked such as "Does the problem occur on all ranges or on a specific range only?". If the 620UK Ohmmeter does not come on when powered up, did you check the power switch.

PCB Exchange/Replacement

If the malfunction is a faulty component, the repair of the AMPTEC 620UK Ohmmeter can be maintained by replacing the proper internal PCB (Printed Circuit Board) that the faulty component is located on. AMPTEC 620UK Ohmmeter PCBs use ribbon cables with easy to disconnect connectors. There are no serviceable or faulty component replacements necessary on the 620UK PCBs, it is a case of PCB replacement. AMPTEC provides a "No-Charge" PCB replacement while the 620UK Ohmmeter is under warranty (1 year) and a small charge for "non-warranty" repairs.

Use only the specified component or its exact equivalent. Spare replacement PCBs 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.

E-6 Trouble-shooting or Diagnostic Test Procedure for AMPTEC 620UK Ohmmeter Printed Circuit Board (diagnosis or replacement)

The following steps will facilitate the proper repair personnel to diagnose whether the AMPTEC 620UK Ohmmeter **Current Source PCB** or the **Digital Voltmeter PCB** needs replacement.

E-6.1 Current Source PCB Diagnostic Routine (bottom internal PCB)

Place the AMPTEC 620UK Ohmmeter in the 20 Ohm range.

- Put output leads across a 10 Ohm resistance standard (0.005% or better).
- Measure the voltage drop with a DC Voltmeter, it should be 0.05V .
- Place the AMPTEC 620UK Ohmmeter in the 200 Ohm range.
- Measure the voltage drop with a DC Voltmeter, it should be 0.005V.

If any of these tests are not true then the Current Source PCB is faulty and needs replacing. See the PCB replacement procedure described below.

E-6.2 Digital Voltmeter PCB (DVM) Routine (top internal PCB)

- Place the AMPTEC 620UK Ohmmeter in the 20 Ohm range.
- Short the output leads.
- Adjust the Zero pot for a reading of 0.000
- Put the output leads across a 10 ohm resistor
- The display should read 10.000 \pm 100 counts depending upon the resistors accuracy.
- Place the AMPTEC 620UK Ohmmeter in the 200 Ohm range.
- The AMPTEC 620UK Ohmmeter LCD display should read 10.00

If any of these tests routines are not true then the DVM PCB is faulty and needs replacing. (see next page)

E-7 PCB replacement Procedure -

Use caution when pulling the PCB from the aluminum case, as there is umbilical wiring and ribbon cabling that connects the front panel electronics to circuitry mounted inside the 620UK case. Slide boards out to gain access to the main PCB.

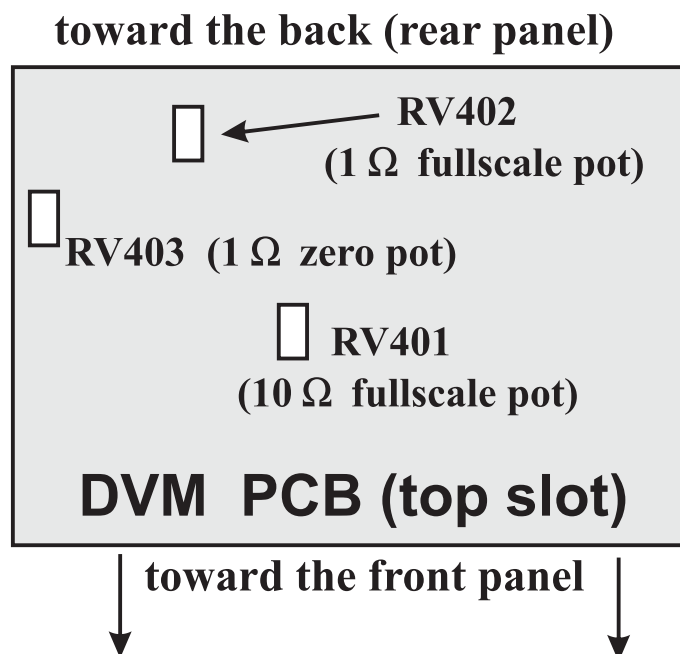
Use the snake eye screwdriver (option “620UK-201”) to remove the Ohmmeter’s 4 front panel screws, located in the corners.

- ‘ Pull the front panel forward and carefully slide out the two PCB's.
- ‘ Disconnect all wires and cables that go to the bad PCB.
- ‘ Reinstall all wires and cables on to the new PCB.
- ‘ Follow the calibration procedure (*below*).
- ‘ Slide the two PCB's back in and replace the front panel and screws.

E-8 620UK Calibration Adjustment Procedure.

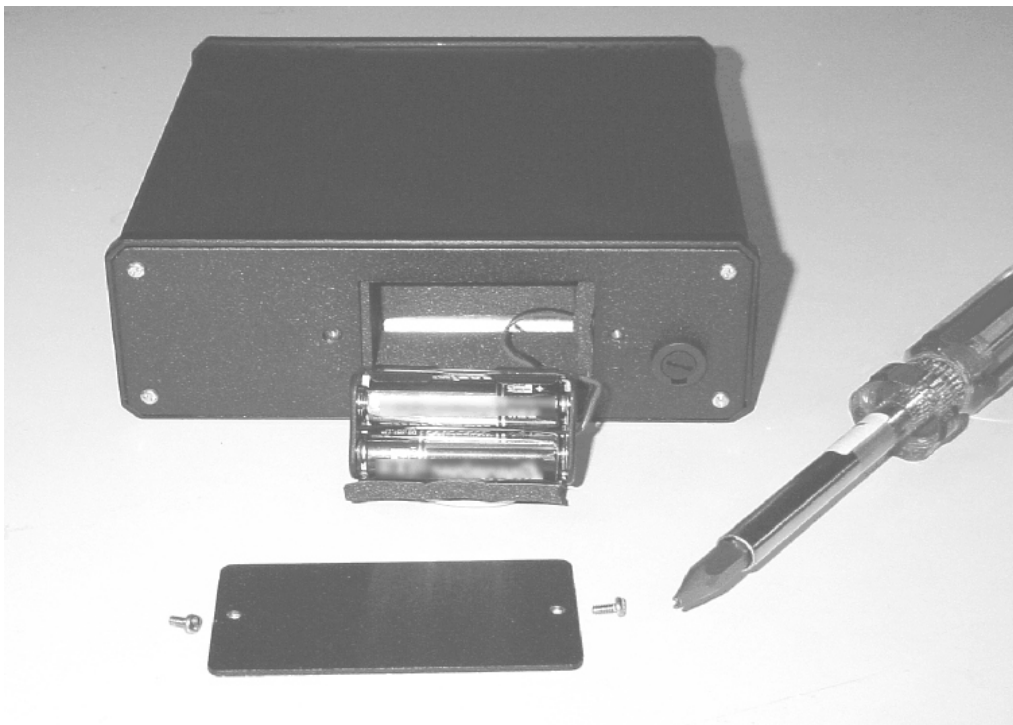
All the 620UK Ohmmeter calibration adjustments (trimpots) are located on the DVM PCB (top slot - see diagram below). The calibration adjustments must take place with the 620UK Ohmmeter Front panel and all PCBs assemblies must be out of the 620UK chassis.

- ‘ Place the 620UK in the 20 Ohm range and short the measurement test leads together.
 - ‘ Adjust the unit’s front panel “Zero” knob for a reading of 0.000 Ohms on the LCD display.
 - ‘ Put the measurement test leads across a known 10.0 Ohm resistance standard. (i.e 0.005% or better)
 - ‘ Adjust RV401 so the display is the value of the 10 ohm resistance standard.
 - ‘ Next short the measurement test leads together.
 - ‘ Place the 620UK Ohmmeter in the 2 Ohm range (front panel range select knob).
- Adjust RV403 (see diagram below) for a reading of .0000 on the display.
- ‘ Put the output leads across a known 1.0 Ohm resistance standard (0.005%).
 - ‘ Adjust RV402 so the ohmmeter displays the same value of the 1.0 Ohm resistance standard.
 - ‘ Reassemble and verify the other ranges (there are no other adjustments needed)



E-9 Battery Compartment Design and Description

The battery compartment of the 620UK Ohmmeter has been designed in accordance with **British Defence Standard 66-31** and is **separate to the main electronics**. The battery compartment houses four AA-size batteries and holder. The supply wires connect the batteries to the Printed Circuit Boards inside the Ohmmeter passes through a small hole in the side of the battery compartment. This hole is sealed to prevent any fluid leakage or other failure of the batteries causing damage to the main electronics of the ohmmeter and thus ensuring that the ohmmeter remains safe at all times. The battery compartment can be secured with standard screws (makes it easier for filed install new AA batteries) or can be optionally fitted with security screws. Tamper-resistant battery compartment lid screws make it extremely difficult for field personnel to install new batteries. ***Option “620UK-201” Security Screwdriver (snake-eye type) is available for calibration maintenance personnel to have access to the unit's battery compartment and internal electronics. The secure the batteries via a plastic cable tie in the holder to prevent dislodging from the spring contacts of battery holder.***



BATTERY HOLDER LABEL (4 each Type AA)

Only fit the following battery types:
Duracell Battery Type MN1500, Varta Battery Type 3006,
GP Battery Type GP15G-S4, Ever Ready Silver Seal Type R65,
Every Ready Ultra Plus Type R6F4UP

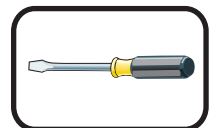
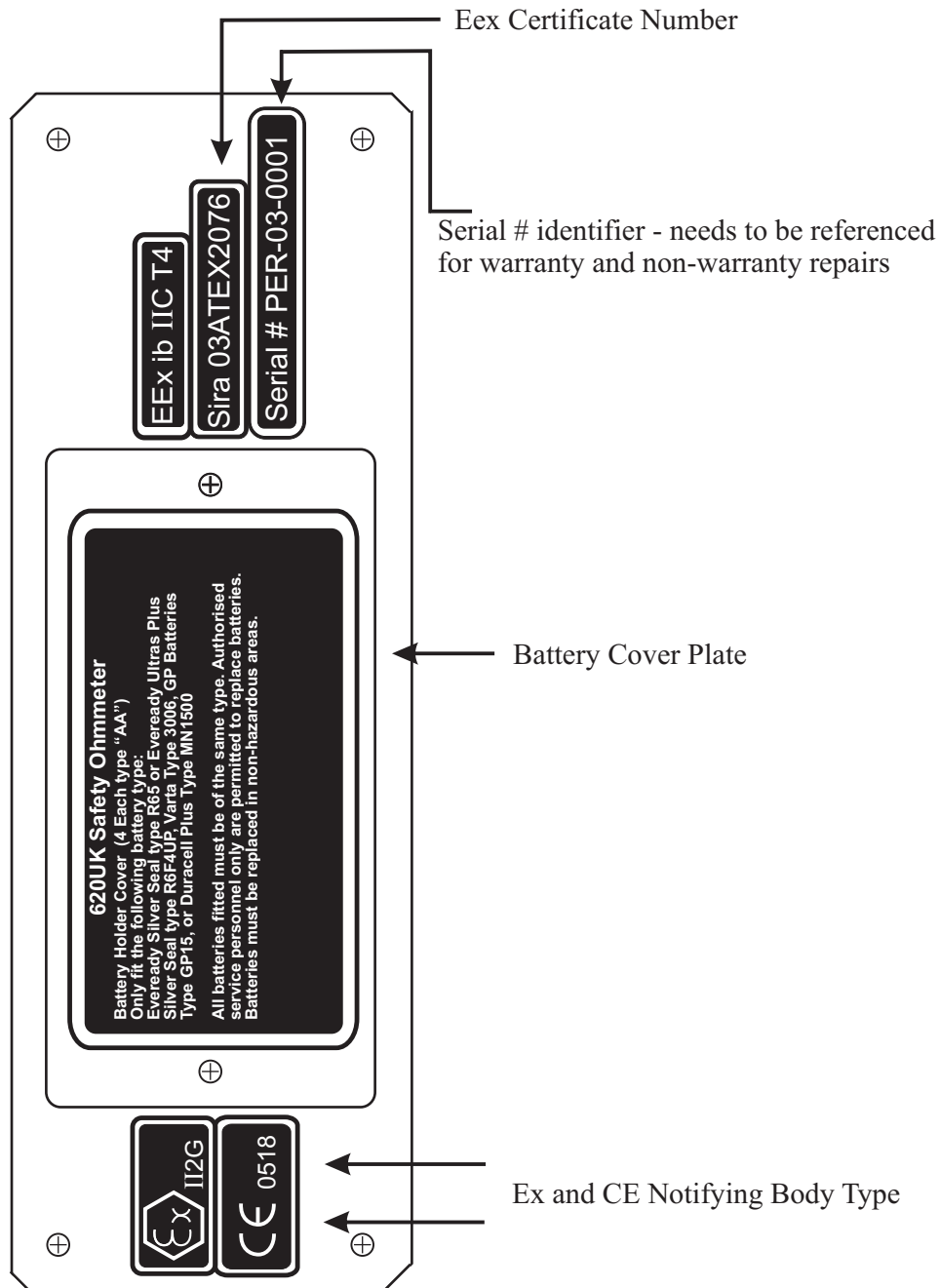
All batteries fitted must be of the same type.
Authorised service personnel only are to replace batteries.
Batteries must only be replaced in non-hazardous areas.

E-10 Low Battery Indicator:

The Low Battery Indicator is factory adjusted to have the low battery indicator come on at 4.50 VDC. This is a one time adjustment that is set for the life of the AMPTEC 620UK.

Replacement batteries must be either of the following: **Duracell Plus Type MN1500**, Eveready Silver Seal type R65 or Eveready Ultra Plus, Silver Seal type R6F4UP, Varta Type 3006, or GP Type GP15 to maintain the Eex-ib-IIC-T4 Intrinsically Safe Certification.

E-11 620UK REAR PANEL DIAGRAM



INSTRUCTIONS SPECIFIC TO HAZARDOUS AREA USAGE (REFERENCE EUROPEAN ATEX DIRECTIVE 94/9/EC, ANNEX II, 1.0.6.)

The following instructions apply to equipment covered by certificate number SIRA03ATEX2076.

The marking of the equipment shall include the following:



EEx ib IIC T4 (-20°C Ta +40°C)

- ` The equipment may be located where flammable gases and vapours of groups IIA, IIB and IIC may be present. The equipment is only certified for use in ambient temperatures in the range -20°C to +40°C and should not be used outside this range.
- ` The equipment has not been assessed as a safety-related device (as referred to by Directive 94/9/EC Annex II, clause 1.5).
- ` Installation of this equipment shall be carried out by suitably trained personnel in accordance with the applicable code of practice (EN 60079-14 within Europe).
- ` Repair of this equipment shall be carried out by the manufacturer or in accordance with the applicable code of practice (IEC 60079-19).
- ` If the equipment is likely to come into contact with aggressive substances, then it is the responsibility of the user to take suitable precautions that prevent it from being adversely affected, thus ensuring that the type of protection is not compromised.

Aggressive substances - i.e. acidic liquids or gases that may attack metals, or solvents that may affect polymeric materials

Suitable precautions - i.e. regular checks as part of routine inspections or establishing from the material's data sheet that it is resistant to specific chemicals

End of AMPTEC 620UK Explosive Safety Ohmmeter Operator Manual



AMPTEC 620UK EXPLOSIVE SAFETY OHMMETER



MAINTENANCE and CALIBRATION PROCEDURE

AMPTEC 620UK EXPLOSIVE SAFETY OHMMETER - SPECIFICATIONS



620UK Resistance Range/Resolution Nominal Test Current/Fail-Safe Current

2.0 Ω	20.0 Ω	200 Ω	2.0 K Ω	20.0 K Ω	200 K Ω	2.0 M Ω
100 $\mu\Omega$	1.0 m Ω	10 m Ω	100 m Ω	1.0 Ω	10 Ω	100 Ω
5mA	5mA	0.5mA	50 μ A	5 μ A	0.5 μ A	50nA
8mA	8mA	1.5mA	150 μ A	15 μ A	1.5 μ A	15nA

* 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°C)

2.0 ohm range $\pm 0.02\%$ of reading $\pm 0.05\%$ of range
 20 ohm range thru 20K ohm ranges $\pm 0.02\%$ of reading $\pm 0.02\%$ of range
 200 Kohm range $\pm 0.05\%$ of reading $\pm 0.05\%$ of range
 2.0 Mohm range $\pm 1.0\%$ of reading $\pm 0.2\%$ of range

Temperature Range - Operating ... -20°C to +40°C, Storage -10°C to 70°C

Temperature Coefficient

2.0 ohm through 20 K ohm ranges $\pm 0.002\%$ per °C (from 0°C-15°C and 35°C-50°C)
 2.0 M ohm range $\pm 0.02\%$ per °C (from 0°C-15°C and 35°C-50°C)

Instrument Display . . (20,000 counts) 4½ digit Liquid Crystal Display (LCD) with a back light for viewing the 620UK display in dim ambient light conditions.

Low Battery Indication . . The 620UK LCD Displays shows “**LOW BAT**”

Over-Range Indication . . . “**i** and **blank digits**” in the 620UK LCD display

Measurement Update Rate. Approximately 3 readings per second

Open Circuit Current Source Compliance Voltage . diode clamped at <1.4 volts

Power Battery Pack inside separate metal box houses (4 ea "AA") 1.5V Alkaline batteries, requires tamper-proof security screwdriver: **use only Duracell Plus Type MN1500, or** Eveready Silver Seal type R65 or Eveready Ultras Plus, Silver Seal type R6F4UP, Varta Type 3006, or GP Type GP15

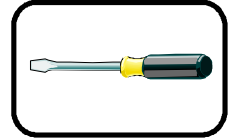
Dimensions 7.0" W x 8 " D x 2.5" H

Weight 13 lbs net; 16 lbs shipping

Calibration Access requires tamper-proof security screwdriver



MAINTENANCE , REPAIR AND CALIBRATION



A-1. General

The AMPTEC RESEARCH 620UK Ohmmeter is shown in PCB block diagram form on page 17.

The AMPTEC 620 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 **620UK spare PCB inventory** and its customer service department can also provide additional assistance in the trouble shooting process.

A-2. Troubleshooting Only by Authorised Personnel

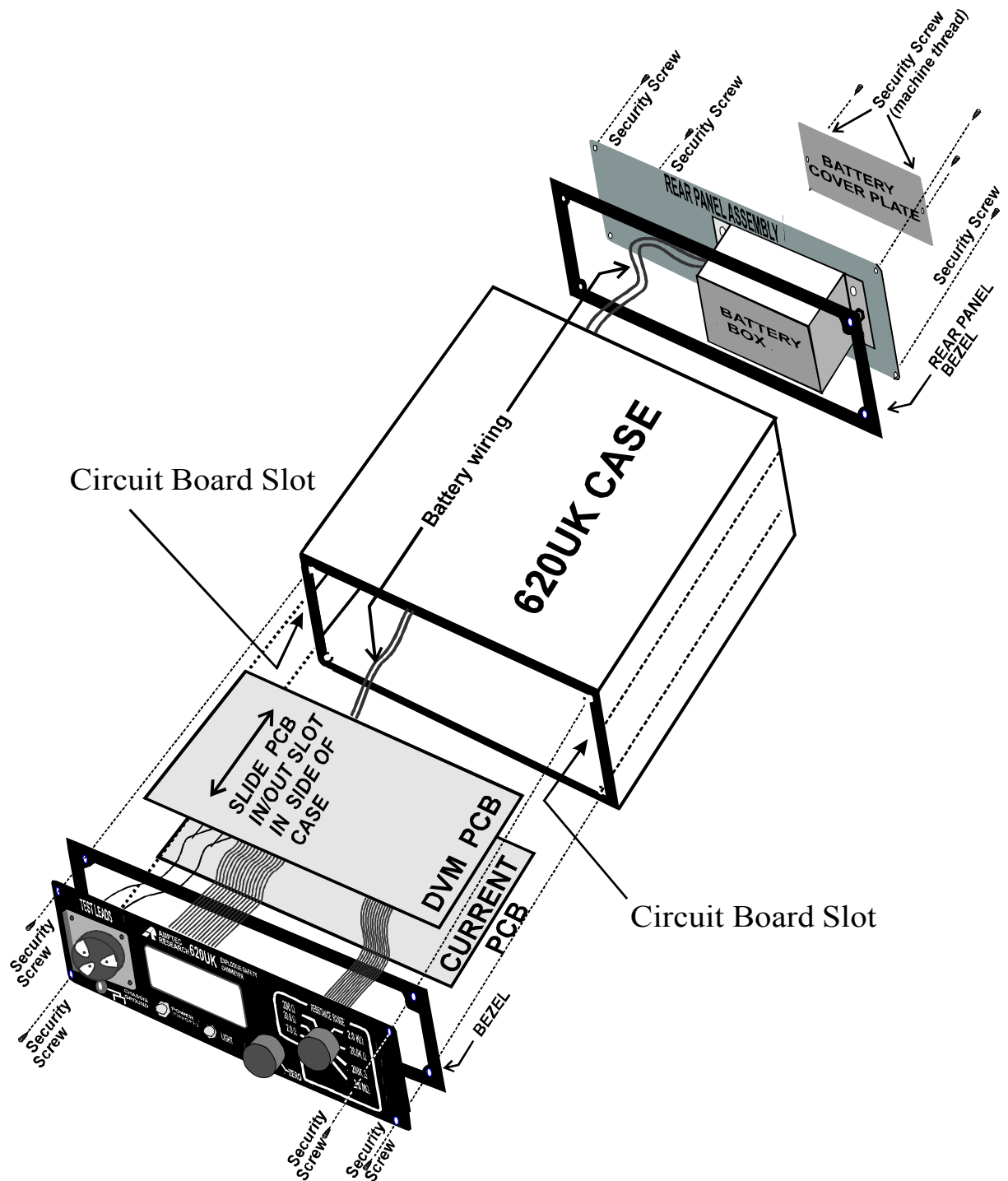
Since the 620 Ohmmeter is used to test potential deadly explosive force detonators and warheads of missiles etc., ***personnel that are not qualified to make such electrical repairs on the 620UK Tester should not even attempt to remove the calibration access screws or open the main panel or effect any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

Apparent 620 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 620 series igniter tester .

If you turn on the AMPTEC 620UK, ***and the display does not come on***, it may indicate the batteries need replacing. If the 620UK exhibits problems that cannot be eliminated by reviewing Chapters B and D, the following guidelines have been established to help solve the problem.

A-3. CIRCUIT BOARD OPERATION OVERVIEW

There are two main internal printed circuit boards that perform the AMPTEC 620UK “Digital Ohmmeter” resistance measurement. The AMPTEC 620UK Explosive Safety Ohmmeter uses an ***independently certified “intrinsically safe”*** constant current source (current source PCB). When the intrinsically safe current constant source is combined with the ohmmeter's digital voltmeter PCB electronics a stable DC resistance measurement for 0.0001 Ohms to 2.0 Megohms is provided. The digital voltmeter electronics (DVM PCB) uses a high input impedance sense circuit. The digital voltmeter circuit draws very little current when it measures the DC voltage drop across the “resistance under test”. The worst case test current (<8mA or less) for each range is indicated on the AMPTEC 620UK Explosive Safety Ohmmeter/ Igniter Circuit Tester specification page of this manual (Section B). The AMPTEC 620UK DVM PCB slides in (slot) ***above*** the Failsafe Current Source PCB. ***The 620UK Ohmmeter's front panel security screws must be removed to access either the DVM PCB (upper slot) or the Constant Current Source PCB (lower slot).***

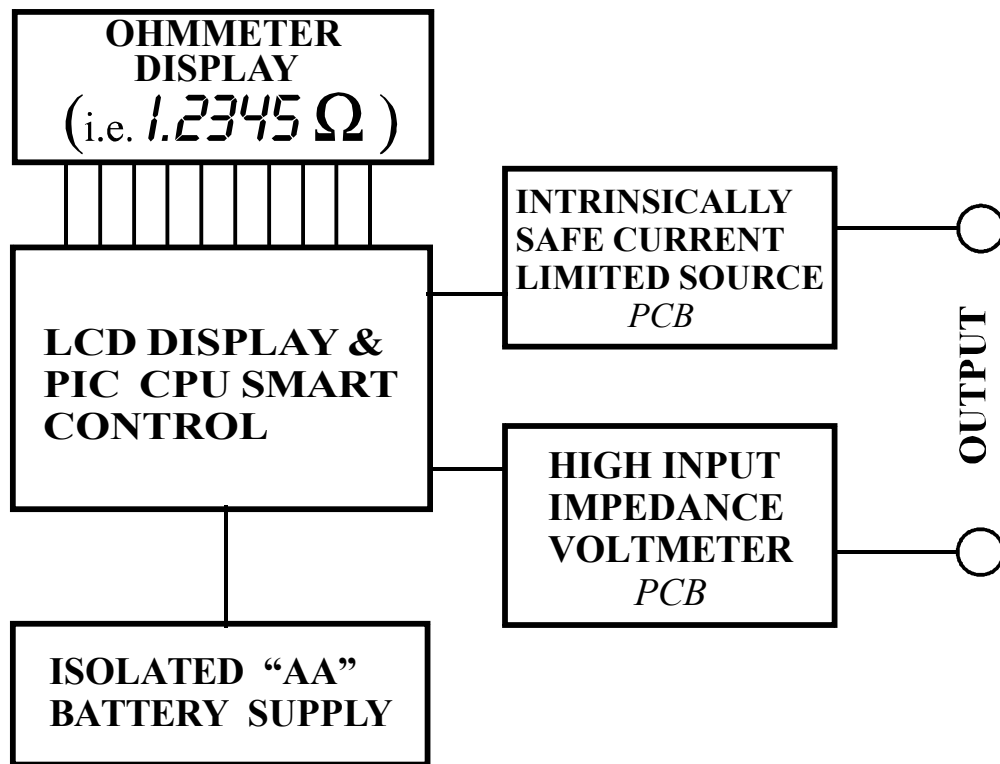


A-4 AMPTEC 620UK Ohmmeter Assembly/Disassembly Diagram

The AMPTEC 620UK Ohmmeter Current Source PCB and DVM PCB are epoxy **conformal coat** encapsulated, both the top and bottom side of each PCB. This PCB encapsulation **provides** excellent **humidity resistance**, moisture **condensation resistance**, **dust and dirt PCB contamination resistance**. In addition, it provides PCB **electrical insulation preventing virtually** any kind of mechanical circuit damage (loose or broken wire(s), loose washer, accidental component substitution or component lead damage that can happen while servicing, etc.) and helps **prevent virtually all compromise of the AMPTEC 620UK Ohmmeter's EEx-ib IIC-T4 Intrinsically Safe circuitry**. **In the past, some safety ohmmeters (i.e. ALINCO 101 series) have a history of faulty service related (i.e. wrong component or electrical current limit fault) failures which have had catastrophic and deadly result when connected to an explosive device . (Vital Jet engines fail when serviced wrong)**

A-5 BLOCK DIAGRAM AND CIRCUIT DESCRIPTION

The AMPTEC 620UK Explosive Safety Igniter Tester is a portable digital milli-ohmmeter specifically designed for ultra-safe resistance testing on explosive devices (i.e. squibs, igniters, flares, explosive bridge wire and detonators). With 4 1/2-digit resolution and a low Ohm range of 2.0 Ohms full-scale, the AMPTEC 620UK Ohmmeter provides ordnance safe resistance measurements and viewing even in direct sunlight. The AMPTEC 620UK Ohmmeter is constructed in a metal EMI enclosure and internally contains 5 VDCt HC-MOSS clock operating at 100 KHz for the display, and an HC-MOSS clock operating at 32.7KHz for the PIC computer chip.



A-5.1 Principle of Operation

The AMPTEC 620UK Safety Ohmmeter **fundamentally measures on the principle of Ohm's Law**. In order to measure, it outputs a constant DC current through a given resistance then measures the voltage drop across it and displays the resistance. The unit's 2.0 Ohm range outputs an *intrinsically safe* 5mA level of test current. When the AMPTEC 620UK outputs 5mA through a 1.0 Ohm resistor you should measure a 5mV drop. When you put that voltage drop into the x10 (times ten) amplifier (only on the 2.0 Ohm range) it becomes 50mV, which inputs into the DVM PCB and ratiometrically displays the measurement as 1.0000 Ohm. The unit's 20 Ohm range outputs the same constant 5mA level (without the x10 amp). When this constant 5.0 mA level is put through a 10.0 ohm resistor, you get a 50mV drop, which inputs into the DVM PCB and is displayed as 10.000 Ohms. The 200 Ohm range outputs a constant 500uA DC current. When this current level (500uA) is routed across a 100 Ohm resistor you get a 50mV drop, which routes into the DVM PCB and is displayed as 100.00 Ohms. As the 620UK selected range resistance goes up by a factor of 10 the constant DC current level goes down by a factor of 10 keeping the voltage at 50mV.

Localizing the Problem to PCB level

The key to successful troubleshooting is to localize the problem to a general electronic parameter (i.e. current source or DVM PCB) as much as possible. Certain questions should be asked such as "Does the problem occur on all ranges or on a specific range only?". If the 620UK Ohmmeter does not come on when powered up, did you check the power switch.

PCB Exchange/Replacement

If the malfunction is a faulty component, the repair of the AMPTEC 620UK Ohmmeter can be maintained by replacing the proper internal PCB (Printed Circuit Board) that the faulty component is located on. AMPTEC 620UK Ohmmeter PCBs use ribbon cables with easy to disconnect connectors. There are no serviceable or faulty component replacements necessary on the 620UK PCBs, it is a case of PCB replacement. AMPTEC provides a "No-Charge" PCB replacement while the 620UK Ohmmeter is under warranty (1 year) and a small charge for "non-warranty" repairs.

Use only the specified component or its exact equivalent. Spare replacement PCBs 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.

A-6 Trouble-shooting or Diagnostic Test Procedure for AMPTEC 620UK Ohmmeter Printed Circuit Board (diagnosis or replacement)

The following steps will facilitate the proper repair personnel to diagnose whether the AMPTEC 620UK Ohmmeter **Current Source PCB** or the **Digital Voltmeter PCB** needs replacement.

A-6.1 Current Source PCB Diagnostic Routine (bottom internal PCB)

- * Place the AMPTEC 620UK Ohmmeter in the 20 Ohm range.
- * Put output leads across a 10 Ohm resistance standard (0.005% or better).
- * Measure the voltage drop with a DC Voltmeter, it should be 0.05V .
- * Place the AMPTEC 620UK Ohmmeter in the 200 Ohm range.
- * Measure the voltage drop with a DC Voltmeter, it should be 0.005V.

If any of these tests are not true then the Current Source PCB is faulty and needs replacing. See the PCB replacement procedure described below.

A-6.2 Digital Voltmeter PCB (DVM) Routine (top internal PCB)

- * Place the AMPTEC 620UK Ohmmeter in the 20 Ohm range.
- * Short the output test leads.
- * Adjust the Zero pot for a reading of 0.000
- * Put the output leads across a 10 ohm resistor
- * The display should read 10.000 +/-100 counts depending upon the resistors accuracy.
- * Place the AMPTEC 620UK Ohmmeter in the 200 Ohm range.
- * The AMPTEC 620UK Ohmmeter LCD display should read 10.00

If any of these tests routines are not true then the DVM PCB is faulty and needs replacing. (see next page)

A-7 PCB replacement Procedure -

Use caution when pulling the PCB from the aluminum case, as there is umbilical wiring and ribbon cabling that connects the front panel electronics to circuitry mounted inside the 620UK case. Slide boards out to gain access to the main PCB.

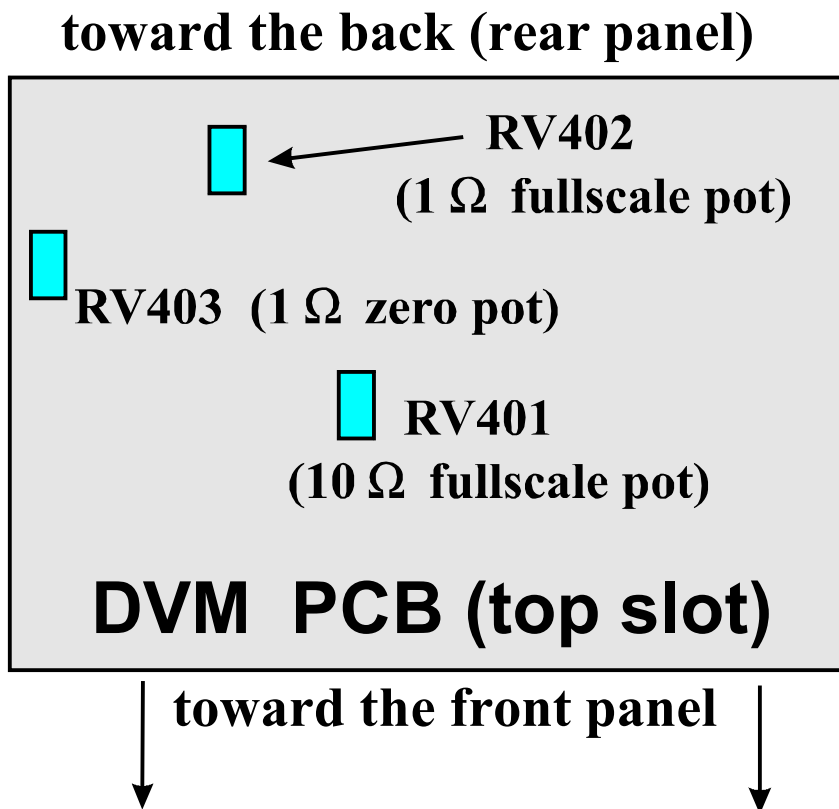
Use the snake eye screwdriver (option “620UK-201”) to remove the Ohmmeter’s 4 front panel screws. located in the corners.

- * Pull the front panel forward and carefully slide out the two PCB's.
- * Disconnect all wires and cables that go to the bad PCB.
- * Reinstall all wires and cables on to the new PCB.
- * Follow the calibration procedure (*below*).
- * Slide the two PCB's back in and replace the front panel and screws.

A-8 620UK Calibration Adjustment Procedure.

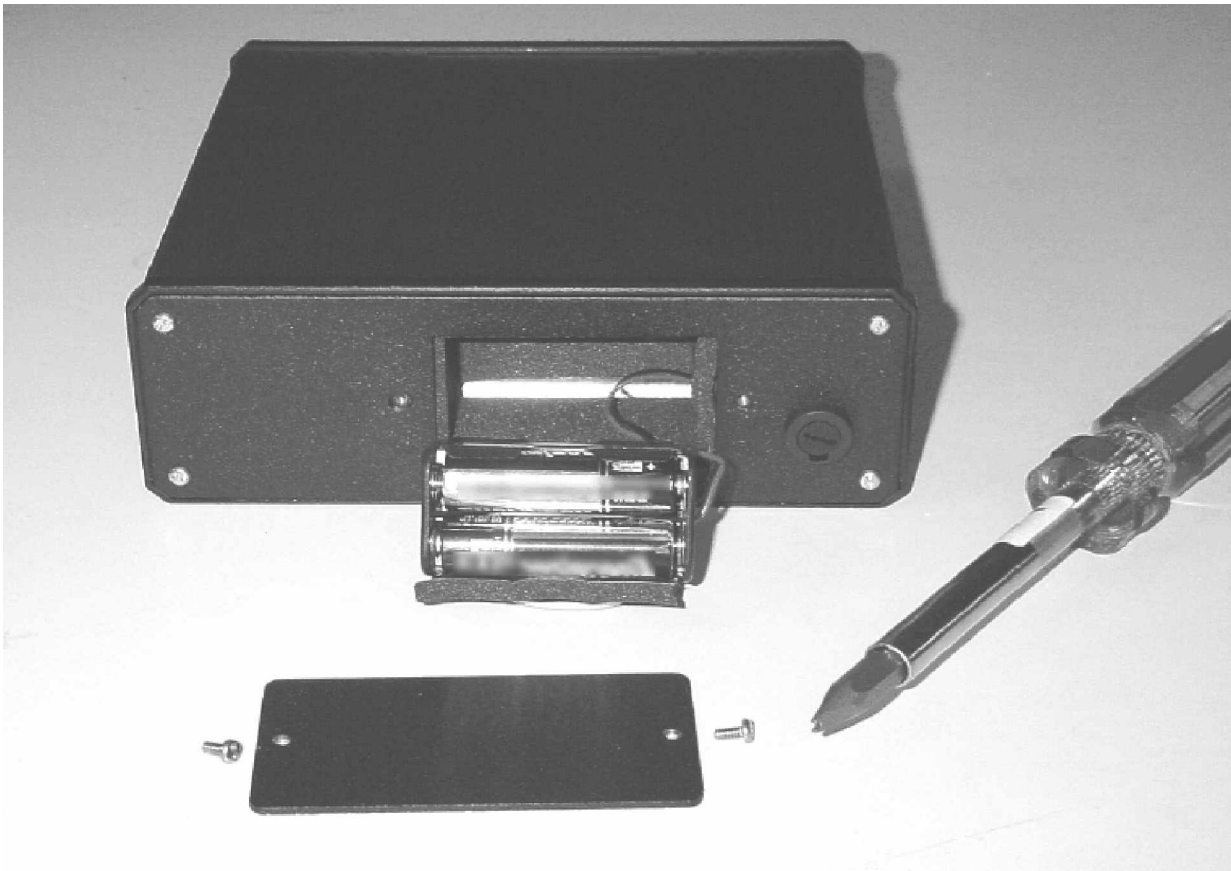
All the 620UK Ohmmeter calibration adjustments (trimpots) are located on the DVM PCB (top slot - see diagram below). The calibration adjustments must take place with the 620UK Ohmmeter Front panel and all PCBs assemblies must be out of the 620UK chassis.

- * Place the 620UK in the 20 Ohm range and short the measurement test leads together.
- * Adjust the unit’s front panel “Zero” knob for a reading of 0.000 Ohms on the LCD display.
- * Put the measurement test leads across a known 10.0 Ohm resistance standard. (i.e 0.005% or better)
- * Adjust RV401 so the display is the value of the 10 ohm resistance standard.
- * Next short the measurement test leads together.
- * Place the 620UK Ohmmeter in the 2 Ohm range (front panel range select knob).
- * Adjust RV403 (see diagram below) for a reading of .0000 on the display.
- * Put the output leads across a known 1.0 Ohm resistance standard (0.005%).
- * Adjust RV402 so the ohmmeter displays the same value of the 1.0 Ohm resistance standard.
- * Reassemble and verify the other ranges (there are no other adjustments needed)



A-9 Battery Compartment Design and Description

The battery compartment of the 620UK Ohmmeter has been designed in accordance with **British Defence Standard 66-31** and is **separate to the main electronics**. The battery compartment houses four AA-size batteries and holder. The supply wires connect the batteries to the Printed Circuit Boards inside the Ohmmeter passes through a small hole in the side of the battery compartment. This hole is sealed to prevent any fluid leakage or other failure of the batteries causing damage to the main electronics of the ohmmeter and thus ensuring that the ohmmeter remains safe at all times. The battery compartment can be secured with standard screws (makes it easier for filed install new AA batterries) or can be optionally fitted with security screws. Tamper-resistant battery compartment lid screws make it extremely difficult for field personnel to install new batteries. ***Option “620UK-201” Security Screwdriver (snake-eye type) is available for calibration maintenance personnel to have access to the unit's battery compartment and internal electronics. The secure the batteries via a plastic cable tie in the holder to prevent dislodging from the spring contacts of battery holder.***



BATTERY HOLDER LABEL
(4 each Type AA)

Only fit the following battery types:
Duracell Battery Type MN1500, Varta Battery Type 3006,
GP Battery Type GP15G-S4, Ever Ready Silver Seal Type R65,
Every Ready Ultra Plus Type R6F4UP

All batteries fitted must be of the same type.
Authorised service personnel only are to replace batteries.
Batteries must only be replaced in non-hazardous areas.