



AMPTEC RESEARCH MODEL 620LK-HR OPERATION AND MAINTENANCE MANUAL



TABLE OF CONTENTS

SECTION A: RECEIVING AND INITIAL INSPECTION

- A-1 Introduction - AMPTEC 620LK Bond Milliohmmeter (p.3)
- A-2 Unpacking and Inspection (p. 3)
- A-3 DC Battery Power Requirements (type AA) (p. 4)
- A-4 Setup and Preparation for Use (p. 4)



SECTION B: 620LK EXPLOSIVE SAFETY BONDING OHMMETER SPECIFICATIONS

- Table B-2. Specifications (p. 5)



SECTION C: REPLACEMENT & ACCESSORY ITEMS

- C-1 Available Accessories and Test Leads (p. 6)



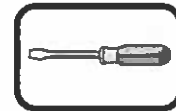
SECTION D: OPERATION, FUNCTION AND USE

- D-1 General Use (p. 7)
- D-2 Front Panel (p.7)
 - D-2.1 Test Leads and Chassis Ground Connector (p. 7)
 - D-2.2 Connections (p. 7)
 - D-2.3 Main Power Switch (p. 8)
 - D-2.4 Light (p. 8)
 - D-2.5 Resistance Range (p. 8)
 - D-2.6 Test Lead Connection Pin/Socket detail (p.8)
- D-3 Photo of 620LK Bonding Milliohmmeter *with* carrying case (p.9)
- D-4 620LK Metal Chassis Description (p. 10)



SECTION E: MAINTENANCE, REPAIR, & CALIBRATION

- E-1 General (p. 11)
- E-2 Circuit Board Operation Overview (p. 11)
- E-3 Ohmmeter Assembly/Disassembly (p.12)
- E-4 Block Diagram and Circuit Description (p. 13)
- E-5 Principle of Operation (p. 13)
- E-6.0 Trouble-shooting and Diagnostic Testing (p.13)
 - E-6.1 Current Source PCB Diagnostic Test Routine (p. 14)
 - E-6.2 DVM PCB Diagnostic Test Routine (p. 14)
 - E-6.3 620LK Calibration Adjustment Procedure (p.14)
- E-7.0 PCB removal from case
- E-8 Battery Compartment Design and Description (p.15)
- E-9 Manual Updates and Safety Approvals



SECTION A - RECEIVING AND INITIAL INSPECTION



A-1. Introduction - AMPTEC 620LK (*Approvals -See tech library section of website*)

The AMPTEC 620 Series Failsafe Ohmmeters have become the standard in the Safety Ohmmeter Test industry. The High Resolution AMPTEC 620LK Safety Bonding Milli-Ohmmeter (white front panel) is derived from both the AMPTEC 620UK Intrinsically Safe Ohmmeter and the earlier developed standard version AMPTEC 620LK Bonding Milli-Ohmmeter. It is essentially a “smart” and safe milli-ohmmeter that simplifies the process of safely checking the quality of metal component to the metal chassis connection/interface (often called “bond”). The better the metal to metal connection, the lower the resistance (ohms and milliohms) the better the bond is. With the AMPTEC 620LK Bond Meter, the operator simply makes contact, using any of a variety of the 4-Wire Kelvin probes onto the appropriate conductive chassis and bond test piece. The AMPTEC 620LK does the rest of the work, safely and automatically.

The meter will require initial charging for several hours prior to the first use. The smart charger supplied should not be substituted. The internal battery pack (uses intrinsically safe rechargeable batteries) requires proper conditioning and charging.

There are typically 2 different probe packages available with the meter. The “Commercial Air” package includes the meter with a padded carrying case, a 5’ long (10’ span) set of heavy duty spear point Kelvin probes (OP630-406S), spare spiked tips, and a US N.I.S.T. Traceable Calibration Certificate. The “LM” package additionally includes a 10’ long (20’ span) set of heavy duty spear point Kelvin probes (OP630-405S). Refer to the accessory section of this manual for more details.

Featuring an all metal case now with a separate F.O.D. (foreign object damage) resistant battery compartment (no loose parts), the AMPTEC 620LK Explosive Safety Bonding Ohmmeter provides a safe and easy method of measuring electrical connection or bonding quality (using a low level DC resistance) in explosive and volatile atmospheres (aviation air fuel areas).

The AMPTEC 620LK is a 4-wire Kelvin based failsafe digital milli-ohmmeter which reliably uses very stable DC test current for its low resistance measurement. The constant DC current flows in a loop out - when the probes make contact with the “bond under test” - one probe tip (*i.e.* red probe) through the “bond” and back into one of the other probe tips (black probe). The other two tips measure the voltage drop across the low resistance bond. The meter then performs a series on reverse polarity and averaging sample resistance measurements. This process provides excellent stability, accuracy and eliminates test lead resistance and probe tip contact resistance. This makes the 620LK ideal for accurate stable bond measurements and ideal for safe use in “volatile” environments. The voltage and current limiting prevents arcing (**will not make a spark**) associated with the use of the meter and *is certified as MIL STD 810 method 511 compliant for explosive and volatile (fuel-air) atmospheric use.*

A-2. Unpacking and Inspection

Should the AMPTEC shipping box appear damaged upon arrival, notify the carrier immediately. If the 620LK appears damaged, the carrier's agent should authorize repairs before the unit is returned to the factory.

If the unit fails to operate or fails to meet the performance specifications of Section B, notify the carrier's agent and AMPTEC RESEARCH (*i.e.* see our website at <http://www.amptec.com> for contact info). Retain the shipping carton for the carrier's inspection. **DO NOT** blindly 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 (return shipping address, billing info, etc. in order to properly *coordinate the return of the repaired instrument*).

AMPTEC RESEARCH doesn't charge a fee to evaluate a meter that may be having problems even if out of warranty. The item must be shipped prepaid, however No Collect shipments will be accepted. Please include your company name, person to contact, address, telephone and e-mail address with the instrument being returned.



A-3. DC Battery Power Requirements

The High Resolution AMPTEC 620LK Explosive Safety Bonding Ohmmeter is completely powered by an internal "Intrinsically Safe" rechargeable battery pack. The unit's battery pack is housed inside the instrument case. There is a spring loaded cover over the charging jack. The meter comes with a "Smart Charger" that is specially selected for properly conditioning, charging and later trickle charging the internal battery pack.

Low Battery Display Indicator - Time to "Re-charge" the Internal Battery Pack

Located in upper left hand portion on the front panel LCD display is a low battery indicator area. The absence of the "LO BAT" LCD display indication signifies the internal battery pack have acceptable power levels. Anyone in the field may connect the meter to it's "smart charger" whenever the unit's LCD display indicates "LO BAT" (*meaning "low battery"*). see *Rear Panel Charging Jack*

Main Power ON/OFF Switch (hold down for 2 seconds - to turn the unit "ON")

The main power switch has two separate modes, **on and off**. **Press and hold** the power button **down for about 2 seconds**, then **release** to first turn the unit **on**. If you try to turn on the AMPTEC 620LK Ohmmeter several times, and the LCD display does not come on, it may indicate the batteries are completely dead and may need replacement. The full 2 second momentary "press and hold" time for the power switch is to **prevent** accidentally bumping the switch while closed in the case, turning the unit **on and draining the batteries**. The units automatically turn off after 15 minutes of non-use to conserve battery power.

A-4. Setup and Preparation for Use

The AMPTEC 620LK Explosive Safety Bonding Ohmmeter may be setup to operate as soon as power is turned on (*requires pressing and holding down power switch for 1 to 2 seconds*). A quick check for no sign of the "low battery indicator" and a test lead integrity check and the AMPTEC 620LK Bonding Ohmmeter is ready to use.

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

One should become familiar with the basic test lead use and the "AUTO-LOCK" automatic bond measurement (sample and hold and re-sample) routine described in detail in this manual if you plan to use the instrument.



**SECTION B - High Resolution AMPTEC 620LK Explosive Safety Bonding
Milli-Ohmmeter - SPECIFICATIONS**



Standard 620LK				
<i>Range</i>	20mΩ	200 mΩ	2.0 Ω	20 Ω
<i>Display</i>	19.999 mΩ	199.99 mΩ	1,999.9 mΩ	19.999 Ω
<i>Resolution</i>	0.001 mΩ	0.01 mΩ	0.1 mΩ	1.0 mΩ
	1.0 amp	100 ma		10mA
High Resolution Model 620LK (White Front Panel)				

The High Accuracy/High Resolution 620LK Version (white front panel) has all the ranges of the standard version 620LK plus it has both the lower 20 milli-ohm range and higher 20 ohm range(s).

Table B-2. Specifications (High Resolution AMPTEC 620LK)

Accuracy: (for 1 year from 0°C to 40°C) when stabilized at ambient temp. after a 3 minute warm-up -

Hi-Res AMPTEC 620LK (White Front Panel) - A 4 Wire Kelvin, Bipolar Current source Milli-Ohmmeter.

Up to 20 milliohms . . . ± 0.005 milliohms (± 5 counts or 5 micro-ohms) or % example on a 1.0 milli-ohm standard, its within 0.1% of reading ± 3 micro-ohms ± 1 display count or ± 0.005 milliohms (again ± 5 counts on the 20 milliohm range) . *Example calculation* - the uncertainty on a 1.0 milliohm resistance standard is 0.1% of reading (0.001 milliohms or 1 count) plus 3 micro-ohms (3 counts) plus 1 count for a total of ± 5 counts (5 micro-ohms). The HI-RES 620LK has a **20,000 count display**.

From 20 milliohms to 200 milliohms . . . ± .05 milliohms (± 5 counts for 200 milliohm range readings)

From 200 milliohms to 2.0 ohms . . . ± .5 milliohms (± 5 counts for 2.0 ohm range readings)

From 2.0 ohms to 20.0 ohms . . . ± 5 milliohms (± 5 counts on the 20.000 ohm range)

Temperature Range - Operating. . 0°C to +40°C at rated accuracy, add +4 counts more for use to +50 °C,

Storage -30°C to 70°C

Instrument Display .. (20,000 counts) 4½ digit Liquid Crystal Display (LCD) with a backlight that indicates "Autolock", plus sounds a series of beeps. The 620LK measurement has sensed continuity and automatically samples readings, locks on the lowest (remains on to free up hands of operator) reading automatically.

Low Battery Indication . . . 620LK LCD display shows "LO BAT".

Over-Range Indication . . . ">>>OR & blank digits" in the 620LK LCD display

Measurement Update Rate. Approximately 3 readings per second

Open Circuit Current Source Compliance Voltage . typically ~3.0 VDC is standard, diode clamp modification to 1.0 VDC is available - contact the sales dept. at AMPTEC .

Power .. Internal "Intrinsically Safe" rechargeable battery pack comes with a "power conditioning" smart charger no substitutes allowed.

Dimensions 7.0" W x 8 " D x 2.75" H

Weight 2 lbs net; 10 lbs shipping

Calibration Access . . . "Performed with All Panels and Covers ON" (adjustments are one "zero" adjustment and "fullscale" has 4 range adjustments) performed from the rear panel with trimpot access via removal of calibration seal over the calibration / adjustment holes. (normally sealed with a tamper resistant sticker)

Note: Calibration must be performed using 4 wire Kelvin Test Lead connections to the resistance standard (i.e. Option 630-304 4 Wire Kelvin Banana Jack Test Lead Set are recommended)



SECTION C: REPLACEMENT & ACCESSORY ITEMS



The AMPTEC 620LK Explosive Safety Bonding Ohmmeter Commercial Air package and the "LM" package described below includes the padded carrying (OP620LK-101) with shoulder strap (see photo and see full description below).



The padded carrying case is included with the AMPTEC 620LK Safety Bonding Milli-Ohmmeter and all the 4-Wire Kelvin Heavy Duty Spring loaded probe leads, either the "LM" pkg or "Commercial Air" Pkg. Both packages offer heavy duty probes. There's room (back pocket of the padded case) for the operator manual and the meter's U.S. N.I.S.T Traceable Calibration Certificate. The AMPTEC 620LK operator can measure bonds while the meter is still in the padded case using the "AUTOLOCK" measurement feature.



For the Calib. Lab Option "630-304" Kelvin Banana Jack Test Leads for precision connection to Lab Standard Resistors, as probes tips don't connect well to most standards.



Lab Standard Resistor

Option "45662T" Calibration Kit - includes 620LK Kelvin Leads see above (4 terminal banana jacks), and US N.I.S.T. Traceable precision 1.0 ohm, 0.100 ohm, and 0.001 Ohm Lab Standard Resistors.

The "Commercial Air" probe package includes 5' long (10' span - OP630-406S see photo below) handheld Kelvin heavy duty probes (spear point) and spare spiked tips (use pliers to swap tips) and padded case. see photo on the left with the padded case

The AMPTEC 620LK is often supplied with the "LM" Heavy Duty Probe package. Includes 10' long (20' span) two single spear point heavy duty spring loaded Kelvin probes, a 5' long Spear point heavy duty spring loaded Kelvin probes, and a spare set of spiked tips (all tips can be swapped using a pair of pliers - see photo below OP630-405S or K). The spear tips for the "LM" probe package are single sharp spear tips but rounded tips are available - contact the AMPTEC sales. It also includes the padded transit carrying case, U.S. N.I.S.T. Traceable Calibration Certificate and manual.



Option "630-405K" is for a replacement set of 10 foot long (each probe wire set) heavy duty spring loaded handheld Kelvin spiked tip probes (total span 20 feet).



Option "630-406S" is for a set of the of spear tipped heavy duty spring loaded Kelvin Probes (5' long - 10' span) two tips per probe. (included with "Commercial Air" & "LM" package.)

Need Rounded Tips?



USAF NSN
Rounded Tips
Close up

Option 630-403R is a 4-wire Kelvin Handheld Probe Lead set terminated with two handheld probes (2 spring loaded round tipped gold plated tips per probe) included with the NSN pkg.

AMPTEC 620LK Bonding Milli-ohmmeter test leads are also manufactured 48" long. The 620LK uses the water-resistant ITT Cannon Trident™ connector on its front panel. Virtually all AMPTEC 620LK, 620UKB and AMPTEC 630 series Ohmmeter test lead compatible.



Option "630-403P" is a 4-wire Kelvin Handheld Mini-Probe Lead set terminated with two handheld probes (2 sharp pointed gold plated spring loaded tips per probe), only supplied when ordered by part number OP630-40P. Not part of the Commercial Air or "LM" package.

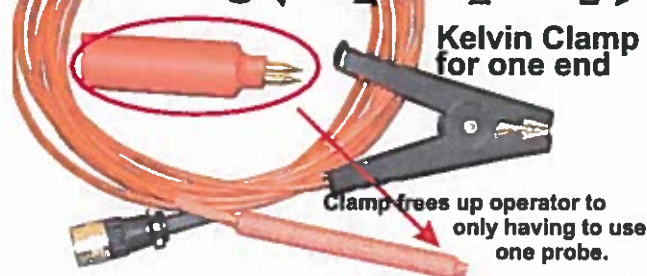


Option "630-401" Gold 4-Wire Kelvin Single Point Mini-Probe Lead Set are 4 wire Kelvin to the base of each gold plated tip and have a fixed tip not spring loaded. Good for probing into sockets and recessed areas that may be difficult to access.



Option "PG-401" 4 Wire Kelvin Pistol Grip Probes (48' long lead wiring) - Tips are round but pointed replacement tips are available - contact the AMPTEC's sales dept. for any custom requirement, we welcome any custom requirement.

Option "630-408J" Heavy Duty Kelvin Clamp (one end) and single Kelvin Probe 10' long (20' span - spear tips)



Kelvin Clamp for one end

Clamp frees up operator to only having to use one probe.

Option "630-408J" is both a single Large Kelvin Clip at one end (10' long) and single handheld Kelvin probe. This frees up an operator to simply clamp one lead (jaws) to chassis and Kelvin probe any metal item (bond test) of interest (up to a 20' span).



Option "KCS" Kelvin Clips accept banana jacks in back.

works with

Option "630-304" Kelvin Calib. Banana Jack Lead Set

Need a test lead or custom set of probes that you don't see pictured here? Please don't hesitate to contact the Sales Dept. at AMPTEC RESEARCH Tel +1-512-858-4045 or via e-mail info@amptec.com for support.



SECTION D : OPERATION , FUNCTION, AND USE



D-1 Introduction to Operation and General Use

The AMPTEC 620LK is a battery powered, portable, milli-ohmmeter designed to safely measure low level DC resistance (from 0.001 milli-ohms to 19.999 ohms). It 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). If you flip the carrying case lid completely open (almost inside out) and use carrying case straps (*Item F* in photo section D-3) it can be carried hands free. Simply use the padded straps (placed around head / neck) to carry the meter in front. Your hands are now free to use the meter's Kelvin probes to measure a bond, not carry or hold the bond meter. You can focus on the bond resistance measurement and probe placement, not the display (see **Autolock** below).

Signaling "Auto-Lock" mode the meter's backlight comes ON (audible beeper will also sound briefly) and the reading is frozen only if the probes are lifted or removed from the test piece (if lifted while the display is lit). When the AUTO MEASURE RESET switch is pressed or the probes are sensed as still making continuity contact (then it starts measuring over again).



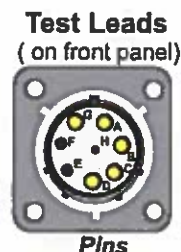
"A breeze to Operate" - You can simply focus on steady placement of the Kelvin Probe(s) onto the bond material area and you do not have to look at the meter while also pressing the probes. It's "Auto-Lock" measurement feature, signaled by a short audible series of "beeps", and the milli-ohmmeter's display backlight comes "ON". It takes care of the bond measurement for you.

Automatic Measurement Continued - It will reset and measure again automatically (backlight is OFF while measuring), whenever the probes still make continuity, or when the front panel measurement "reset" switch is pressed. The measurement is actually a short series of bi-polar (auto reverse polarity) resistance measurements.

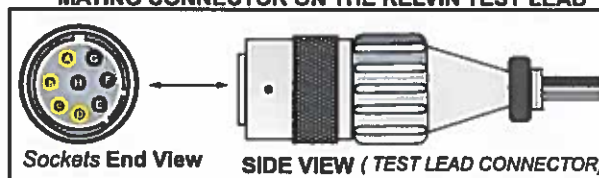
The result is displayed as the average of the two opposite polarity readings. This prevents thermal EMF and related offset errors.

Test Lead Connection Pin / Socket detail

A= I High E= unused
B= V High F= unused
C= V Low G= Chassis Grd
D= I Low H= unused



MATING CONNECTOR ON THE KELVIN TEST LEAD



D-2 Test Leads & Chassis Ground Connections

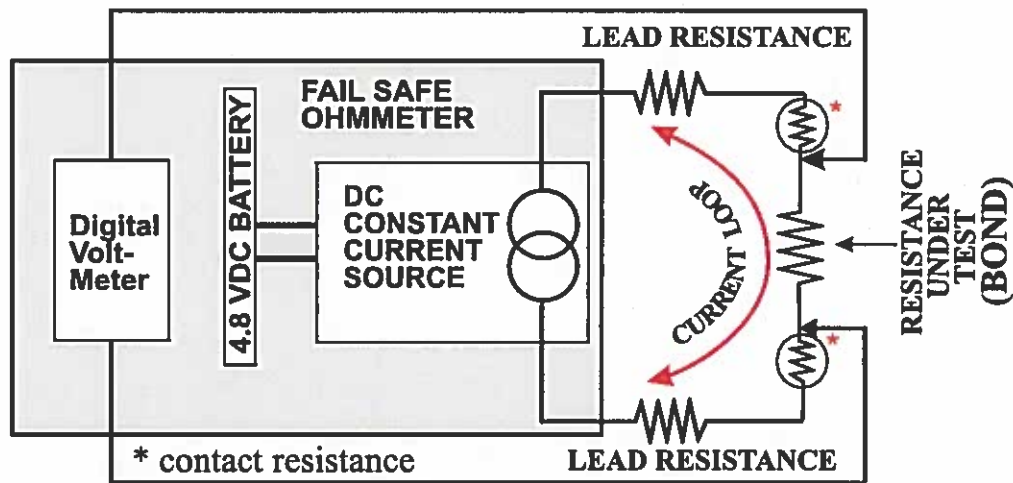
The AMPTEC 620LK Safety Bonding Milli-Ohmmeter front panel test lead connector uses a militarized 4 terminal Kelvin type connector (ITT Cannon Trident). (see above diagram label "TEST LEADS"). To prevent damaging the gold pins and sockets, only use AMPTEC test leads that are 620LK Bond Meter compatible. When using AMPTEC test leads (probes etc.), the notched connector (12 O'clock position) end plugs directly into the single access notched main connector. Turn the connector collar clockwise until you feel the click of the mating connector. Its as simple as align, rotate and "click".

Occasionally, the user may want to connect the unit's chassis ground on the transit case to a local earth/ground connection. The unit's front panel chassis ground panel jack (accepts an external banana jack) is connected to its all-metal case, metal front panel, rear panel, battery compartment and also Pin "G" of the test lead jack. 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 (if desired).

D-2.3 Main Power Switch

This required momentary "hold down" routine (~ 2 seconds) helps avoid accidental power on while the milli-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 pressed again it will turn off. The main power switch is covered with a silicon rubber boot to provide added water/dust resistance in harsh environments. *There is a rubber o-ring under switch boot cover. This compression provides water and dust resistance.* The meter is set to "automatically turn off" after a preset 15 minute time period to preserve battery life. This "automatic power off" capacity can be deactivated contact AMPTEC for details.

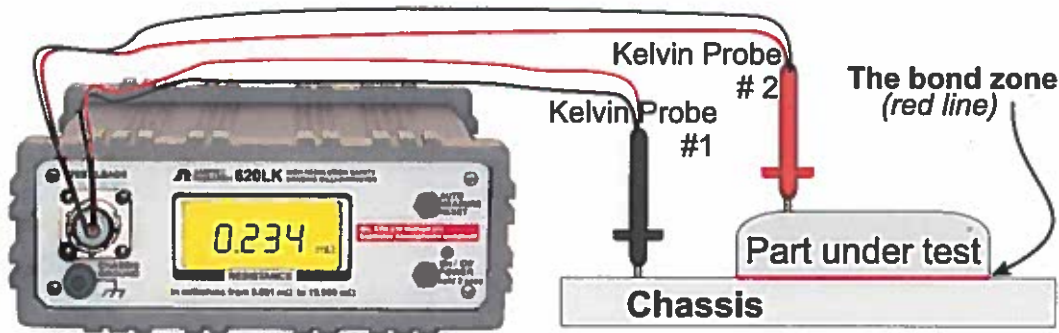
The other 2 wires (Voltage high V_{high} and Voltage low $-V_{low}$) sense the voltage drop across the "unknown resistance". This measurement is high impedance and virtually no current is drawn in either voltage sense lead wire. With "virtually no current drawn, in the V_{sense} wires means "No voltage drop error in the voltage sense wires". **Conclusion** – With 4 Wire Kelvin, long distance, test leads aren't a measurement error source if you have enough compliance voltage (V_{drive}) remaining in the current loop. If the unknown resistance is too high the meter display flashes ">>>OR or Overrange" as the unknown resistance is greater than the unit's resistance range (constant current source loop is out of compliance voltage).



4 Wire KELVIN CIRCUIT DIAGRAM for the 620LK Bonding Ohmmeter

The AMPTEC 620LK measures DC resistance with a Bipolar 4 Wire Kelvin or 4 Terminal Ohms technique. Fundamentally a 4 Wire Kelvin resistance method avoids the measurement errors induced from the resistance of the test leads and the resistance associated with the connection (contact resistance) of the leads to the device under test. Two of the wires Current high (I_{high}) and Current Low (I_{low}) pass through the unknown bond resistance under test in a current loop - as part of a constant current source. It doesn't matter if the current path (test leads) is shorter or longer with more in-series lead resistance or even if there is some contact resistance with the connection to the resistance under test. As the constant current source's compliance voltage works to maintain a constant current flowing in the loop.

As stated earlier - The displayed result measurement is actually a short series of 4 Wire Kelvin bipolar (auto reverse polarity) resistance measurements. The result is displayed as the average of the two bi-polar (opposite polarity) resistance readings with the current path automatically reversed. This corrects for any directional thermal EMF and related dissimilar metal contact offset errors that might be present.



Bond measurements are typically a "PASS" or "FAIL" inspection to determine if the bond is better than (or lower than) a given resistance level (ie 20 mΩ , 5 mΩ , 2.5 mΩ , 1.0 mΩ)

Intro - What is a bond measurement and why is it (i.e. on aircraft) important?

Many electrical systems, subsystems and components (e.g. on aircraft) receive a voltage supply and/or signal wiring input **but** rely on a physical electromechanical (e.g. bolted down) "metal to metal" connection to the aircraft's chassis as the return path to complete many circuits. The better the devices bolted connection (a "bond") to it's (*aircraft*) chassis the lower the bond's electrical resistance. With a good bond to chassis ground, you're less likely to encounter electrical performance problems with the given component. Think of a *bond measurement* as the "*quality of connection to chassis ground*". The lower the bond's resistance, the better the devices connection to chassis ground.

Why does each probe have 2 tips?

With "Bonds" you are making very low level resistance measurements. Often at the sub-milliohm level. An accurate method must be used that prevent measurement errors such as the effect of the test lead resistance (often 0.10 ohms) and probe contact resistance. Both test lead resistance and probe contact resistance can be many times greater than the bond your trying to measure. With a 4 Wire Kelvin probe resistance measurement like the AMPTEC 620LK Safety Milli-Ohmmeter uses both the test lead wiring "in-series" resistance and the probe contact resistance touching the device and the chassis are automatically eliminated. There are many technical diagrams / explanations available to explain "4 Wire Kelvin" resistance in more detail if needed, *refer to page 9 of this manual.*

See our website at <http://www.amptec.com>

What's the best method to make a AMPTEC 620LK bond measurement?

Starting out, "Power up" the milli-ohmmeter and connect the test probes to the test lead connector on the meter's front panel. *Simply align probe lead collar connector with the front panel connector, turn it clockwise and you should feel it "click-in".* Initially, the Kelvin probe tips aren't touching a conductive surface, so the meter is "open circuit" and the display indicates ">>>OR". Find a clean area on **both** the part you need to test (no paint or coating) and the metal chassis of your test item. Pointed probes work best on some aluminum parts as this type of material often has a thin coating (aluminum oxide) that is a non-conductor. Press and hold each probe with a steady hand (be still, avoid any shaky hand movements). It is only necessary to push the probe tip springs in about half way. Do not move the probes for 5 seconds (*you will know when - see below*). The meter has several resistance ranges (a very low 19.999 milliohm range, higher ranges up to 19.999 ohm range) and needs a little settling time to determine which range is optimal and then display the calculated bond value.

When the display backlight (light yellow) comes "ON" and a series of audible beeps (short burst is heard) that signals the meter has made a bond measurement. You can remove the probes while the unit's backlight is "ON" (Auto-Lock) and the reading is "frozen". The backlit "frozen measurement" stays frozen (allows you to climb down a ladder and then take a look at the reading) until you either press the "Auto-Measure Reset" button or press the test probes against a conductor (continuity is sensed). If you want to measure again simply place the probes back again on the test item. The meter automatically starts another measurement.



**END VIEW
TEST LEAD PLUG**
(remove dust cap from the bond meter) To plug in test leads, align and turn connector collar until you feel the "click".



D-3 AMPTEC 620LK Front Panel - Buttons/Features Diagram (in padded Carrying Case)

The AMPTEC 620LK Bonding Milliohmmeter & padded carrying case shown with the following:

A) ITT Cannon / Trident MIL STD Kelvin Test Lead Connector with water tight dust cap. The front panel gold plated pin contacts (inside the connector) mate with the gold plated socket contacts of the test lead connector. Twist dust cap off the front panel connector labeled "Test Leads" align and connect the mating test lead plug onto the connector (twist and click).

B) Chassis Ground Connector - is wired to the entire all aluminum case body, including front/rear panels, and aluminum battery housing/box. The input jack accepts standard DMM banana jacks. For floating resistance measurements (made at the same potential as the "device under test") leave this jack unplugged or connect it to the device under test (i.e. airframe "chassis") first.

C) 4½ Digit LCD Displays "Low Battery" Indicator and Over-Range Indicator (examples). Meter measures down to 0.001 milliohm. If the display indicates ">>>OR" (Over-Range) then the meter senses either "open circuit" or the level of resistance is higher than measurement range. (20 ohms max.)

D) Auto Measure Reset - Automatically detects continuity and then "Locks-On" & holds bond measurement. This is signaled to the operator by both the display backlight coming "on" and an "audible series/short burst of beeps".

- continued next column -

This free's the operator up to focus on proper Kelvin probe placement without having to press buttons or select ranges while measuring, no zeroing of the leads. Press and hold it again to reset and start measurement again.

E) Power On/Off switch with LED (hold down for ~ 2 seconds for "Power on" - this "timing" prevents inadvertent power on in the case if the power switch is accidentally bumped (Auto Turn Off after 5 minutes of use). Front Panel LED indicates when the unit power in "ON".

Padded Carrying Case Neck Strap frees up hands to use probes - The 620LK Bonding Ohmmeter can be carried and operated *easily* hands free. Simply place the padded carrying case neck straps attached to both sides of the 620LK case over head and neck to carry the meter in front. Your hands are now free to use the meter's Kelvin probes to measure a bond. With "Auto-Lock" you can look at the measured bond resistance value after you disconnect the probes, (frozen reading when backlight is ON). You can also flip the carrying case lid completely open (almost inside out) and connect the lid buckle near the bottom of the carrying case to the unit's front buckle.

The "Auto-Lock" display feature frees the operator up to focus on clean steady Kelvin probe placement without having to manually change ranges, no buttons to press while measuring, no zeroing of the leads. The display backlight is "OFF" while it is measuring and comes "ON" (and meter "beeps") to signal or indicate when it has a bond resistance value to display and "lock" onto. Continuing to hold down the probes on a conductive surface will restart the AMPTEC 620LK's active bond measuring (backlight "OFF") process, and measured (backlight "ON") bond resistance routine. You can use the unit's soft carrying case with padded straps to securely hold the bond meter around your neck while your hands hold the Kelvin probes and make bond measurements.

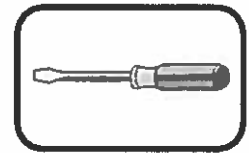
Repetitive measurements assure a good bond measurement - You may want to hold the probes down for 2 consecutive display "ON" (AUTO-LOCK) then "OFF" then "ON" cycles to avoid any timing issue of probe placement in the unit's measurement cycle and also the first initial settling in on the proper range. The bond measurement is almost always a "PASS" or "FAIL" to determine if the bond (metal electrical connection is lower resistance than) some resistance level (5 milliohms, 2.5 milliohms etc). When the AMPTEC 620LK bond meter gives a repetitive reading, then the user can be assured the bond value is valid.

Bond Measurement Fundamentals: *The lower the measured bond resistance, the better the integrity of the metal to metal connection (bond).* If you are measuring bond resistance on aluminum parts or any metal to metal connections that may have a non-conductive (aluminum oxide) coating then pointed probe tips with a little applied probe grip pressure should be used to break through the oxide coating to get to the conductive (unoxidized) material underneath.

You do not want to press too hard with the pointed probe tips as they could be damaged. With a little experience (practice) you will get a feel for the just enough applied force with the Kelvin probes to break through any non-conductive coating that may be present on the "bond measurement" metal under test.



SECTION E : MAINTENANCE , REPAIR AND CALIBRATION



E-1 General - Battery Pack Replacement

The High Resolution version (white face) AMPTEC 620LK uses an rechargeable intrinsically safe LiFePO4 battery pack. It's housed in an aluminum clam shell battery box. The battery pack is expected to last for years and has no serviceable parts. Replacement should only be performed by qualified personnel (a trained electronic technician). The replacement battery pack is part # **620LKHR-BAT**. The front panel must first be removed (corner screws). **Make note of the slot location of both 1) the Main PCB and 2) the battery (clam shell) holder . This makes putting it back together easier.** Carefully slide the battery holder out of the case slots that support it along with the main PCB. Open up (remove the screws) on the battery clam shell and carefully remove the dead battery pack. **Note the battery wiring (red wire and black wire) routed to the main PCB. The red (+ positive) and black (-neg.) wires are routed through a hole in the PCB up and around to a terminal block. Pay careful attention as to the exact location of each battery wire as to which terminal block its secured to.** Unscrew the appropriate terminal block screws, removing the old battery pack wire (red and black). Reroute the new battery pack wiring into the same location as the original wire path. Screw tight the new battery pack wire (red for red etc.) into the terminal block. Reassemble the new battery pack into the clam shell housing. Replace the clam shell screws holding the battery pack inside it. Carefully return the battery clam shell and Main PCB into their original slots. Be careful not to pinch any wires or ribbon cabling while putting everything back. Replace the front panel and secure the front panel corner screws.

Plug in the battery charger to the rear panel charging jack and allow the battery pack to charge for several hours. The final confirmation, once charged, is to **Power up** the meter and verify that the display comes on and operates normally.

The AMPTEC 620LK Bonding Ohmmeter uses modern solid-state semiconductors to minimize power requirements and make battery operation useful and practical. AMPTEC often maintains a **620LK spare PCB inventory** and our customer service depart. can assist in the trouble shooting process (via phone).

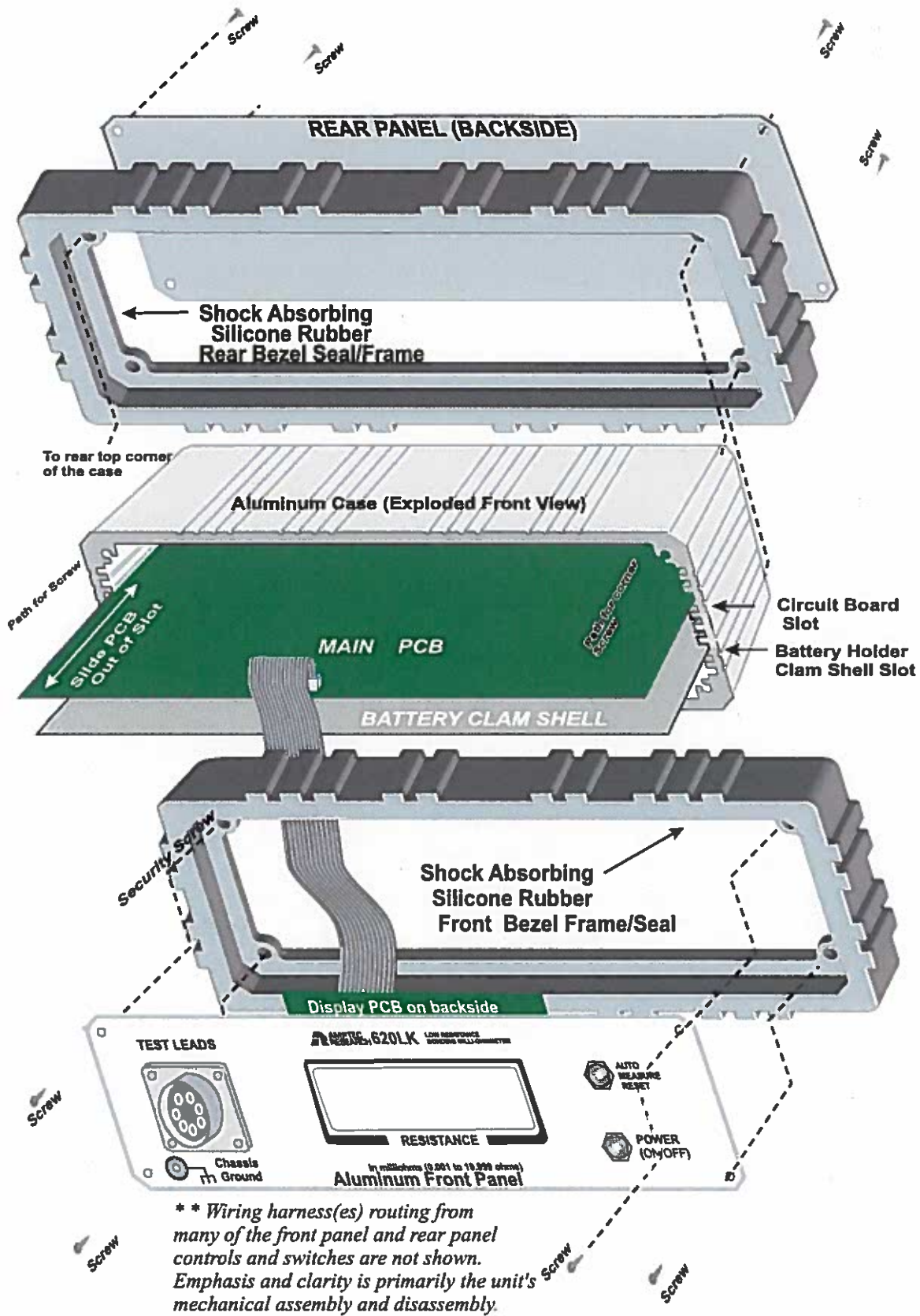
Troubleshooting Only by Authorized Personnel - Since the 620LK Ohmmeter is used to make bonding measurements in potentially explosive fuel air atmospheres, *personnel that aren't qualified to make such electrical repairs on the 620LK Tester should not even attempt to remove the calibration sticker and make adjustments (except PMEL) or open the main panel or effect any repair whatsoever.*

Apparent 620LK meter 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 safety ohmmeter .

If you turn on the AMPTEC 620LK, and the display does not come on, it may indicate the batteries need replacing, also check both ends of the unit's display ribbon cable connector. If the 620LK exhibits problems that cannot be eliminated by reviewing sections B and D, the following guidelines have been established to help solve the problem.

E-2. PCB OPERATION OVERVIEW

There is one internal printed circuit board (PCB) that perform the "Digital Ohmmeter" resistance measurement. The AMPTEC 620LK uses a bi-polar constant current source circuit and DVM circuitry all on one PCB. When the constant current source is combined with the digital voltmeter circuit the result is an accurate stable DC resistance measurement. The DVM PCB's electronics uses a high input impedance voltage sense circuit. This circuit draws very little current while measuring the DC voltage drop across the "resistance under test". The AMPTEC 620LK Main PCB slides in (a slot or groove) the sides of the aluminum case (see assembly / disassembly diagram next page).



E-3 AMPTEC 620LK Bond Meter Assembly/Disassembly Diagram

E-4 BLOCK DIAGRAM AND CIRCUIT DESCRIPTION

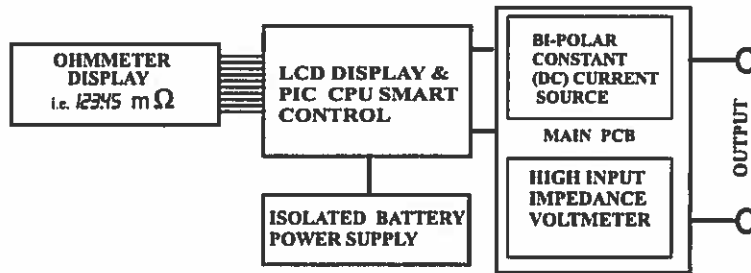


Figure E-5.1

AMPTEC 620LK Block Diagram

		Standard 620LK		
Range	20mΩ	200 mΩ	2.0 Ω	20 Ω
Display	19.999 mΩ	199.99 mΩ	1,999.9 mΩ	19.999 W
Resolution	0.001 mΩ	0.01 mΩ	0.1 mΩ	1.0 mΩ
	1.0 amp	100 ma		10mA
High Resolution Model 620LK (White Front Panel)				

E-5.0 Principle of Operation

Keeping the principle of Ohm's Law in mind ($V / I = R$), the AMPTEC 620LK Bonding Ohmmeter outputs constant DC current (first in one direction then the opposite) through the “unknown resistance” and measures the **voltage drop** across it. The initial measurement is stored, the polarity reversed and another DVM measurement is made. Taking into account the meter's range information and with scaling (e.g. decimal point) the meter displays the average of both polarities as the measured resistance. The 2.0 Ohm and 200 milli-ohm ranges output a 100 mA DC level of test current. On a 1.0 ohm resistor the meter outputs 100mA, you should see a 100mV drop ($.10V / .10A$). On the 200 milliohm range for **DVM IC scaling**, we scale the voltage drop using a x10 (times ten) amplifier (for range scaling). Therefore a 10 mV drop becomes 100mV, which inputs into the DVM circuit and ratiometrically displays the measurement as 100.00 milliohms on a 0.100 Ohm standard. The 20 milliohm range uses a 1.0 ampere level of test current. So 1.0 ampere into a 1.0 milliohm resistance standard sees a 1.0 millivolt drop. We scale /amplify the voltage drop using the x10 amplifier same as above, causing a 10 mV drop.

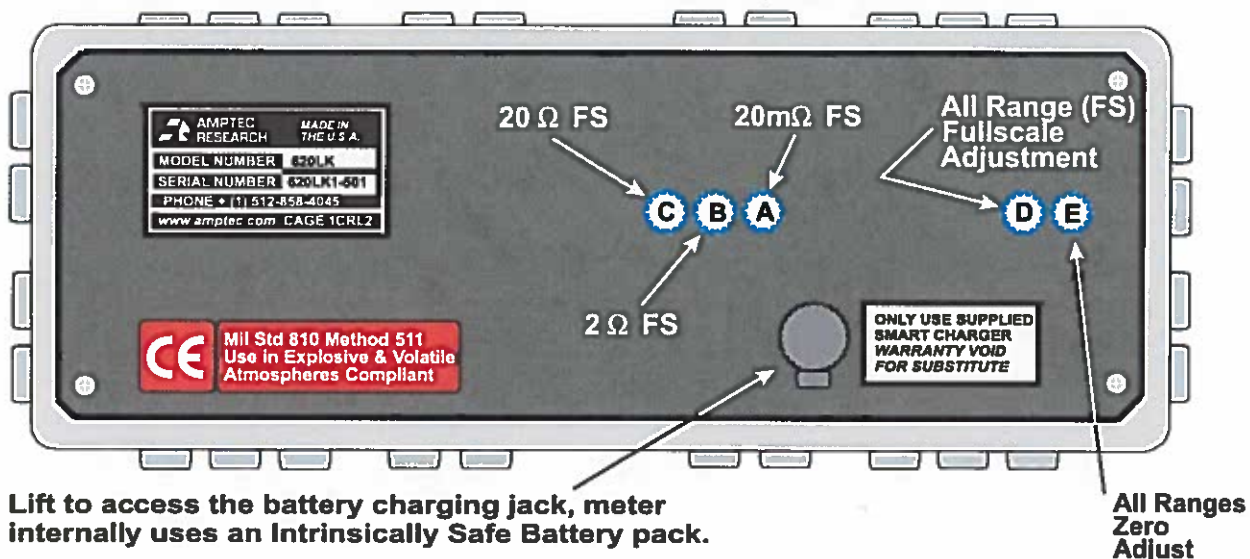
The meter also changes the polarity of the current source, re-samples and actually displays the average of both polarities for optimal accuracy purposes.

E-6.0 PCB Trouble shooting / Diagnostic Testing

There is “**NO FEE**” for AMPTEC RESEARCH to evaluate **any problem** associated with the AMPTEC 620LK Milli-ohmmeter, irregardless of warranty status.

If the malfunction is a faulty component, the repair of the AMPTEC 620LK Milli-ohmmeter can be maintained by replacing the proper internal PCB (Printed Circuit Board) that the faulty component is located on. There are no serviceable or faulty component on the 620LK PCBs, it is a case of PCB replacement. AMPTEC provides a “No-Charge” PCB replacement while the 620LK Ohmmeter is under warranty (2 year) and a small charge for “non-warranty” repairs. AMPTEC RESEARCH customer service dept. should be contacted if it is determined that the unit needs repair. There is no fee for AMPTEC RESEARCH to evaluate any problem associated with the AMPTEC 620LK Ohmmeter, regardless of warranty status. **Contact AMPTEC RESEARCH customer service if you have any technical problems with the unit.**

Remove calibration sticker to perform the zero and (FS) Fullscale adjustments



Keep in mind the AMPTEC 620LK is an automatic bi-polar measuring milli-ohmmeter. It first makes an initial positive + polarity measurement (temporarily displayed, no back light). It's followed shortly by another, no backlight, opposite (negative) polarity measurement in the same fashion. Finally the average of the two polarities is "indicated" when the meter's backlit comes "on" (the beeper emits a short audible burst of beeps) and holds the reading for a few seconds. The averaging bipolar measurement cycle begins again automatically after that, only if continuity is sensed.

ZERO ADJUSTMENT - Connect to a precision 0.001 Ohm (1.0 milliohm) resistance standard (0.005% or better) using 4 Wire Kelvin connections (option 630-304) test jacks from the AMPTEC 620LK Bonding Milli-ohmmeter. Remove any rear panel calibration stickers covering the calibration access / adjustment holes. Through the panel hole labeled **E** above, zero adjustments are made (using a trim-pot). If correctly adjusted, the readings typically should be as follows: First) the reading (no backlight) should be 1.000 m Ohm (milliohm). The next reading (no backlight) should also be 1.000 m Ohms, and the last reading should be 1.000 m Ohms (with back light illuminated) Then the cycle will be repeated. If the adjustment is off, then you will get the first reading high, 1.005 m Ohms and the second reading low, 0.995 m Ohms and the third reading 1.000 m Ohms (illuminated). Another example is the first reading low 0.995 m Ohms, the second reading high 1.005 m Ohms and the third reading 1.000 m Ohms (illuminated). Adjust the "zero" trim-pot so all three readings are the same as the nominal value of the resistance standard.

FULL SCALE ADJUSTMENT (10.000 milliohm range) - Connect to a precision 0.010 Ohm (10.0 milliohm) resistance standard (0.005% or better) using 4 Wire Kelvin (option 630-304) test jacks to the AMPTEC 620LK Bonding Milli-Ohmmeter. Adjust the resistive trim-pot inside rear panel hole **A** (diagramed above) until the reading is 10.000 m Ohm (illuminated).

FULL SCALE ADJUSTMENT (1.0000 Ohm range)

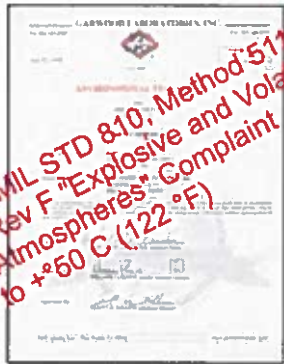
Connect to a precision 1.0 Ohm (1.000 Ohm) resistance standard (0.005% or better) using 4 Wire Kelvin (option 630-304) test jacks to the AMPTEC 620LK Bonding Milli-Ohmmeter. Adjust the resistive trim-pot inside rear panel hole **B** (diagramed above) until the reading is 1.0000 Ohm (illuminated).

FULL SCALE ADJUSTMENT (10.000 Ohm range)

Connect to a 10 Ohm (10.00 Ohm) Standard (0.005% or better) using 4 Wire Kelvin (option 630-304) test jacks to the AMPTEC 620LK Bond Meter. Adjust the resistive trim-pot inside rear panel hole **C** (diagramed above) until the reading is 10.000 Ohm (illuminated).

Normally the resistive trim-pot behind rear panel hole-**D** does not have to ever be adjusted. It should only be adjusted when the trim-pots behind rear panel holes -**A**, **B**, and **C** cannot be brought into an acceptable range of adjustability.

E-8 Manual Updates and Safety Approvals
 For future updates to this 620LK Bond Ohmmeter "COTS" manual, see (www.amptec.com) AMPTEC's website. A full 16 page copy of MIL STD 810, Method 511(rev F) Explosive and Volatile Atmosphere Test compliance at +50 C is available. (www.amptec.com/tech.htm - call for document access password)



MIL STD 810, Method 511 Rev F "Explosive and Volatile Atmospheres" Complaint to +50 C (122 °F)



STARTING IN 2006 AWARDED 8 YEAR USAF BONDING OHMMETER CONTRACT (100+ UNITS)

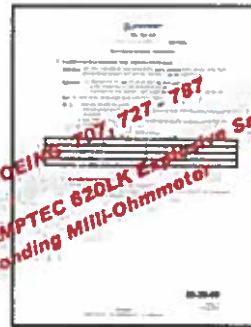
*** Certified MIL STD 810, Method 511 Explosive and Volatile (Safe Use in Fuel-Air) Atmospheres compliant**

The Explosive and Volatile Atmosphere Certification MIL STD 810, Method 511 involved placing the AMPTEC 620LK bonding ohmmeter in a heated (+ 50°C, +122°F) air chamber also filled with highly explosive n-hexane (~ 130 octane). The chamber's air fuel concentration was optimal for ignition/explosion should any "spark" occur. The AMPTEC 620LK Safety Bonding Milli-ohmmeter with test lead contacts were remotely made to "short" and "open" over 400 times without an ignition. Every 100 contacts, a small sample of the chamber's atmosphere was separately ignited to verify its explosive potential. The US Air Force has recognizes and accepts the AMPTEC RESEARCH's Mil Std 810, Method 511 Explosive and Volatile Atmospheres certification on its bonding milli-ohmmeters. The US Air Force awarded AMPTEC RESEARCH with an 8 year multi-unit contract for onding milli-ohmmeters. At this point in time the USAF has over 250 units in the USAF inventory since 2006.

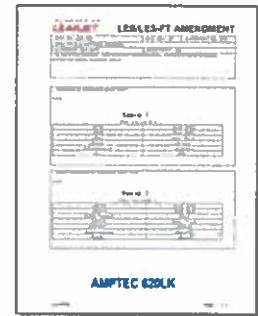
NSN 6625-01-542-7487 Bond Milliohmmeter

The AMPTEC 620LK Safety Bonding Milli-Ohmmeter has an NSN listed version available. Its physically/electrically identical to the standard version AMPTEC 620LK. It's called the AMPTEC 620UK-B Safety Bonding Milliohmmeter and is NSN listed as NSN 6625-01-542-7487.

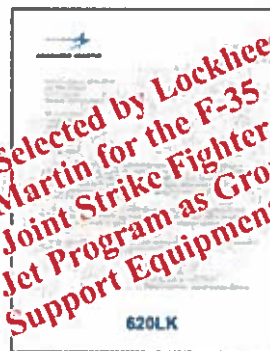
Listed for BOEING 707,727-787 AIRCRAFT MAINTENANCE MANUAL ELECTRICAL BONDING PROCESSES



BOEING 707, 727 - 787 AMPTEC 620LK Explosive Safety Bonding Milli-Ohmmeter



Bombardier Lear Jet, Embraer - Approved



Selected by Lockheed Martin for the F-35 Joint Strike Fighter Jet Program as Ground Support Equipment

Lockheed Martin Ft. Worth F-35 Production Ground Support Engineering has over 100 AMPTEC 620LK Safety Bond Meters in active duty service.

Ideal for Flight Deck Use - No Worries about loose F.O.D - The battery cover is attached by a chain, & captive thumbscrews prevent any loose parts.

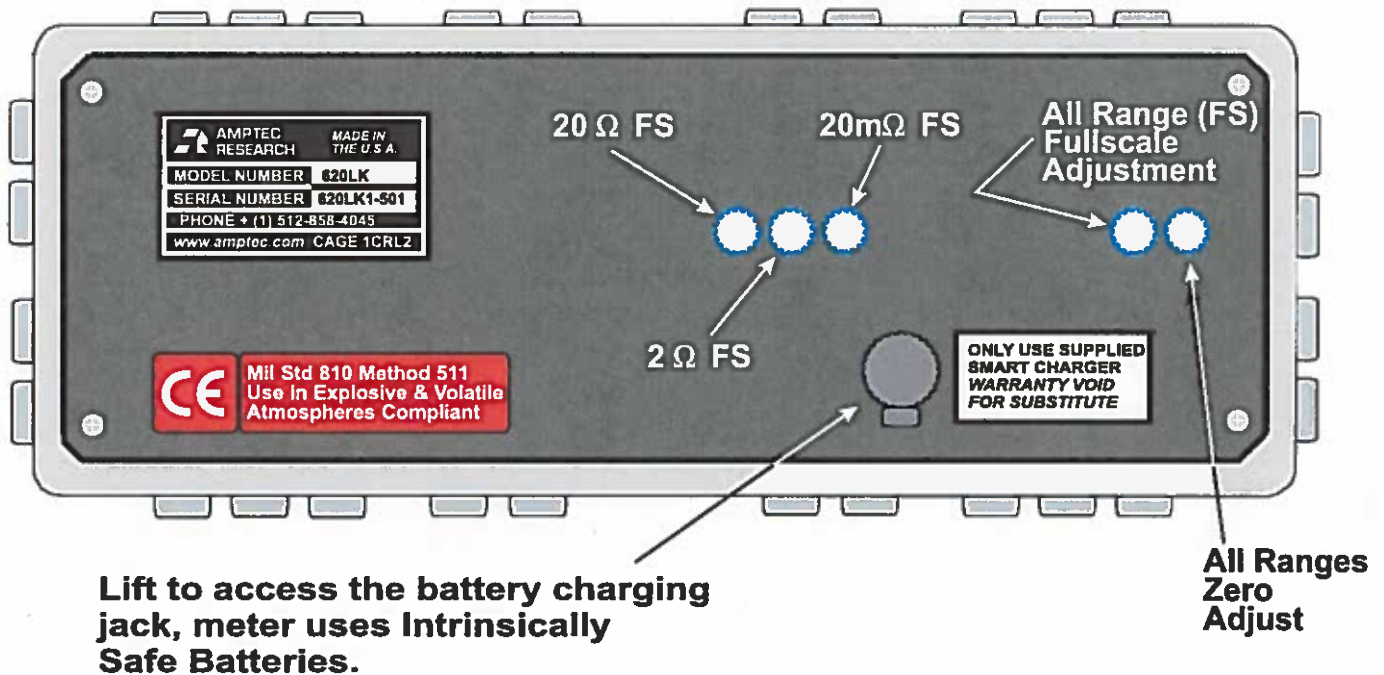
Lockheed Martin F-35 Lightning II Listed and Approved 2ZZP00010 Electrical Bonding - Appendix A (26MARCH2012)



Latest document Update at www.amptec.com/tech.htm

High Resolution 620LK Rear Panel

Remove calibration sticker to perform the zero and fullscale adjustments



REAR COVER of MANUAL