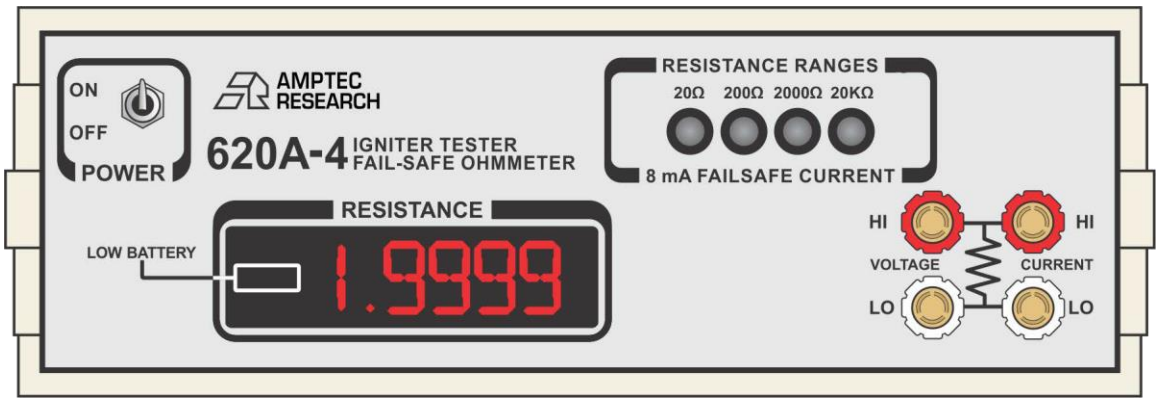
MODEL 620A-4 OPERATION/ MAINTENANCE MANUAL



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REV. I, APRIL 2022

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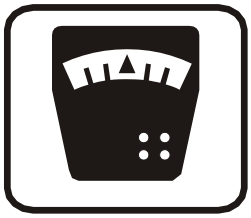
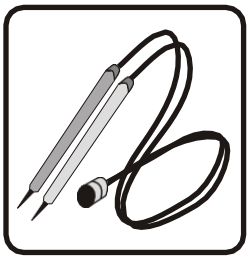
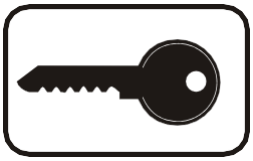
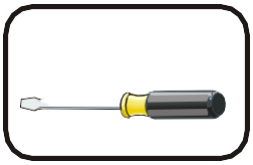


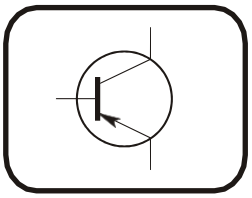


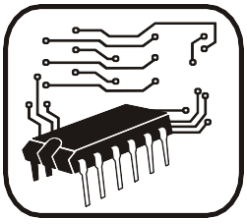


SECTION E: THEORY OF OPERATION

SECTION F: ROUTINE MAINTENANCE







SECTION A - RECEIVING AND INITIAL INSPECTION

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

The AMPTEC 620A and the 630 Series Igniter Testers/Failsafe Ohmmeters have become the standard in the Safety Igniter Circuit Test industry, and are designed to provide extremely safe and reliable resistance testing of electrically explosive devices (EEDs) or “current sensitive” blasting devices. Approvals from various Safety Boards include, the U.S. Air Force (620A-4) for use on Non-Nuclear munitions provided the appropriate T.O. is available. In addition the US NAVAL ORDNANCE CENTER has approved the AMPTEC 630AN, 630BN and 640N Igniter Testers and other versions are pending. Some of the devices the 620A-4 Failsafe Ohmmeter may be used on include: fuses, squibs, igniters, warheads, explosive bolts, rocket motor squibs, drone parachute squibs, automobile air-bag initiators and many others.

The AMPTEC 620A-4 is a 4-wire Kelvin (i.e. eliminates contact resistance errors) failsafe digital ohmmeter which has been designed to use safe levels of DC current for its DC resistance measurement. Failsafe Output Circuitry proprietary to AMPTEC RESEARCH ensures that test current levels do not exceed the specified "failsafe current" in a worst-case component failure situation. The failsafe feature is tested in every instrument before shipment. The AMPTEC 620A-4 represents the latest in ultra-safe Igniter Tester measurements. The 620A-4 (serial numbers 620A4-800 and higher) Igniter Testers all use the same main printed circuit board (PCB) referred to as Revision D.

Please check the Appendix of this manual for any addendums that may apply to any differences between the newer (rev D.) version 620A-4s and older (rev C.) 620A-4 Igniter Testers with serial numbers less than 620A4-800 (i.e. 620A4- 525).

Should the rechargeable batteries reach a low charge level, a minus sign will appear on the display. The 620A-4 has a **battery monitoring** circuit that indicates when to charge the batteries.

A-2. Receiving, Unpacking, and Initial Inspection

Should the AMPTEC shipping box appear damaged upon arrival, request that the carrier's agent (i.e. UPS) be present when the unit is unpacked. If the 620A-4 appears damaged, the carrier's agent should authorize repairs before the unit is returned to the factory. Even if the instrument appears undamaged, it may have suffered internal damage in transit that may not be evident until the unit is operated or tested.

If the unit fails to operate or fails to meet the performance specifications of Section B, notify the carrier's agent and the nearest AMPTEC Sales Office. Retain the shipping carton for the carrier's inspection.

DO NOT return equipment to AMPTEC RESEARCH or any of its sales offices ***without first obtaining*** an RMA number (Return Material Authorization). 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. After getting an RMA # from AMPTEC, ***as an added precaution*** against loss, be sure to also affix an ID label (contact info) on the lid of the 620 Igniter Tester with your phone number, name, address and FAX number, and email address. **By calling AMPTEC RESEARCH, prior to returning the 620A-4,** we can often troubleshoot and identify the problem (i.e. battery loose in the battery holder), over the phone.

A-3. AC/DC Battery Charger - Power Requirements

The AMPTEC 620A-4 uses an internal rechargeable heavy-duty nickel-cadmium battery pack (4 D cells - 5.0 AHr). Replacement batteries may be purchased, contact the sale department at AMPTEC RESEARCH.

The battery charger is an external AC/DC converter that **plugs into a standard 115VAC receptacle**. The battery charger outputs 6.0 VDC @ 100 mA. The battery charger circuitry is configured such that the 620A-4 main power switch must also be in the "OFF" position.

The 620A-4 main power "On/Off" switch design makes it impossible to be powered (in operating - measurement mode) directly from the AC/DC Battery Charger. When the620A-4 main power switch is in the "On" position the rear panel charging jack is electrically disconnected from all 620A-4 circuitry.

A fully charged battery pack typically powers the 620A-4 for approximately 8 hours before requiring a recharge. AMPTEC installs a quality set of 4 each Heavy Duty (5000 mAHr) Ni-Cad batteries (option 620-BAT) set of 4 each. The 620A 4 will also operate on a 4000 mAHr D cell Ni-Cads with a shortened operating time between charges. Recharge time is typically twice the "Power On" time. An "Overnight" charge usually restores the 620A-4 to a "Fully Charged" ready to use state.

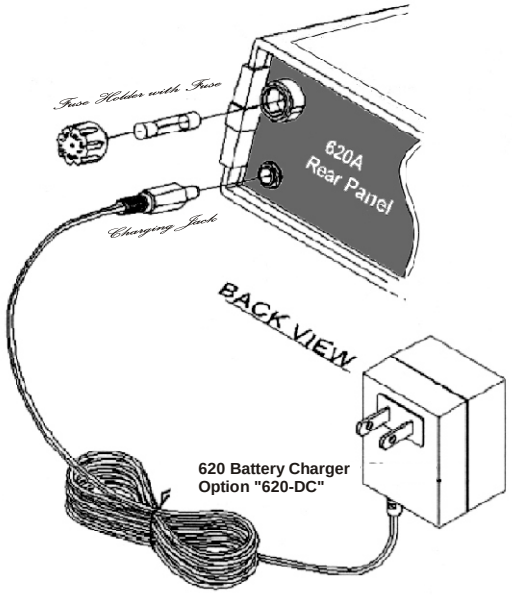
If you turn on the 620A-4, and the display does not come on, it may indicate the batteries need charging.

The diagram on the right shows a rear panel view of the 620A-4 Igniter Tester. To check the fuse, remove the cap from the fuse holder. The 620A-4 uses a 2-ampere fast blow (3AG size). Only replace with an identical rated fuse.

A spare or replacement battery charger (option "620-DC") or replacement set of 4 heavy duty NICAD batteries (option "620-BAT") may be purchased if needed, contact the sales department at AMPTEC RESEARCH.

The "OFF/ CHARGING" power switch position is for use when the batteries need charging or the 620A-4 is not in use. As mentioned earlier the Battery Charger (115 VAC 60 Hz powered) must be plugged into the 620A-4's rear panel charging jack to facilitate charging the batteries.

Although the batteries are fully charged prior to shipment, it may be desirable to refresh the charge for 24 hours before use. As a rule of thumb, the 620A-4 requires twice as much time to fully recharge as the amount of discharge time. For example, if the instrument was used continuously for 2 hours, the AC adapter must be connected for 4 hours to fully restore the charge.



Additional note - Main switch Power "On" When the 620A-4 Igniter Tester is first turned on, the unit briefly draws more internal power then cuts back to less than 100 mA, after a few seconds. The initial Power "On" battery drain is to heat up the unit's ovenized zener voltage reference. If the "Low Battery" Indicator only comes on (i.e. 10 to 15 seconds) for a few seconds (i.e. when the 620A-4 is first turned on), then goes out, the battery levels are starting to indicate the charge level is starting to get low

A-4. Setup and Use

Once the AMPTEC 620A-4 has had its batteries charged for 12 to 24 hours it is ready for use. The 620A-4 only draws a little electrical power (internal battery based) and generates virtually no heat. Consequently, it may be used in any area where the environment does not exceed the specifications of Table B-2.

You may also have a test procedure or technical order (T.O.) that has you inspect the calibration sticker on the AMPTEC 620A-4 Igniter Tester to determine that it is still valid, or within its calibration interval. Avoid exposing the 620A-4 to extreme temperatures, hot or cold which will affect accuracy and shorten battery lifespan.

A-5 Serial Number, Revision and Safety Board Approvals

The AMPTEC 620A-4 Igniter Tester represents the latest in ultra-safe Igniter Tester resistance measurements. The AMPTEC 620A-4 (serial numbers 620A4-800 and higher) Igniter Testers use the same main printed circuit board (PCB) referred to as "Revision D". This manual is specific for the "Rev D" versions of the 620A-4.

The AMPTEC 620A-4 Igniter Tester is Mil Std 810 Method 511 Compliant for use in Explosive Atmospheres Use to +50 degrees C.

This product is also
certified for Use in Explosive Fuel Air Mixtures per Mil Standard 810 Method 511.

SECTION B – 620A-4 IGNITER TESTER SPECIFICATIONS

The below specifications apply to units that are purchased as a part of our 620A-4 Commercial Package with no additional options. For information on the specifications of units with additional options, please refer to the specific section per your unit's modification(s).

AMPTEC 620A-4 Range, Resolution, Accuracy, & Current Levels

Range	20 Ω	200 Ω	2000 Ω	20 KΩ
Nominal Current	5 mA	.5 mA	50 uA	5 uA
Failsafe Current	8 mA	8 mA	8 mA	8 mA
Resolution	1 mΩ	10 mΩ	100 mΩ	1 Ω
Accuracy	± .02% of reading & range	± .02% of reading & range	± .02% of reading & range	± .02% of reading & range

AMPTEC 620A-4 General Specifications

Display ……. 4 ½ digit LED display

Input Voltage ……..….. 250 VDC maximum

Low Battery ….…….……. Display reads"—"

Overload/Overrange ……...… Display flashes

Temperature Coefficient ….. ± 0.002% per 1º C

Temperature Limit (Storage) .….. -20º to 70º C

Weight (Standard Version) ……..…….. 3.5 lbs.

Dimensions …….…….…..... 9.75" x 10" x 3.25"

Internal Voltage ….…..... 4.8 VDC maximum

Open Circuit ……..…….... 1.6 VDC

Terminal ….....… Banana jack binding posts

Temperature Limit (Operating) ….. 0º to 50º C

Update Rate …….……. 3 readings per second

AMPTEC 620A-4 Power Specifications

Batteries ……..... 4ea 5000 mAh NICAD batteries

Battery Charger ……..…..... AMPTEC 620-DC

Battery Charger Input ……... 90 – 264 VAC

Battery Charger Output …….…….…… 5.9V

Battery Charge Time …..... ~8 hrs. til full charge

Battery Charger Charging Current ..... 2A max

Battery Life ……..……. 1000 cycles or 3 years

OP-247 Optically Isolated Power Specifications

This option enables your unit to be ran via AC power, allowing for uninterrupted use. Unless otherwise noted in the table below, all other specifications match those listed in the general specifications section.

AC/DC adaptor …..……..… AMPTEC 247-DC

Adaptor output ……..……...…..…… 24 VDC

Adaptor input ……..…….…..…..……. 120VAC

Unit Weight ……....…..……..… 2.3 lbs

OP-232 RS232C Interface Specifications

This option enables your unit to connect to a computer and receive commands via RS232C.

Connection ……..….....….... DE-9 connector

Rear terminal block .….. 4 Gold-Plated terminals

OP-519 Rack Mount Specifications

This option, OP-519S (for single units) and OP-519D (for dual units), allows your unit to be rack mounted. Unless otherwise noted in the table below, all other specifications match those listed in the general specifications section.

OP-519S (Single Unit)

Dimensions ……..….. 19" x 3.5" x 10"

Materials ……. ABS plastic face, aluminum

Weight ……..…… 2.3 lbs (plus unit weight)

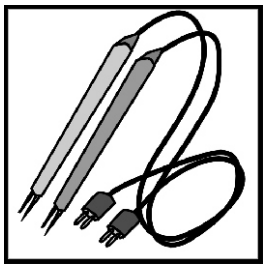
OP-519D (Dual Units)

Dimensions …….. 19" x 3.5" x 10"

Materials …….. ABS plastic face, aluminum

Weight ……..…. 2.1 lbs (plus unit weights)

SECTION C OPTIONAL ITEMS AND ACCESSORIES



C-1. Available Accessories and Options

Listed below are the options available for use with the AMPTEC 620A-4 Series FailSafe Ohmmeters.

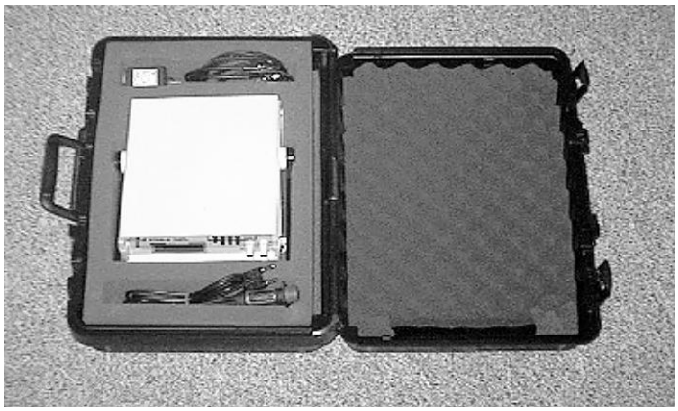
Option 620-DC: Battery Charger

Option "DC" is an AC/DC converter that converts 115VAC line voltage to 6VDC at 300mA. One charger is provided as a standard accessory with every 620A-4. A 220 VAC 50 Hz powered Battery Charger adapter is also available.

Replacement Batteries (Option 620-BAT)

The rechargeable Nicad batteries installed in the 620A should provide years of trouble-free operation. Replacement, however, will eventually be necessary. The 620A-4 uses four 1.2V cells (Heavy Duty) installed in the unit's battery box. The batteries are held in place by reusable tie-wraps. When ordering replacement batteries, please specify AMPTEC option "**620-BAT**" (a new set of 4 each NiCAD **D** cells will be supplied).

Option 100: Carrying Case



Option "100" is a hardshell (impact resistant plastic) shock absorbing foam lined meter and accessory carrying case for the 620A-4 Ohmmeter with extra room for test leads, battery charger, Kelvin Clip Test Leads, Connector Adapters, single pointed probes and operator manual etc.

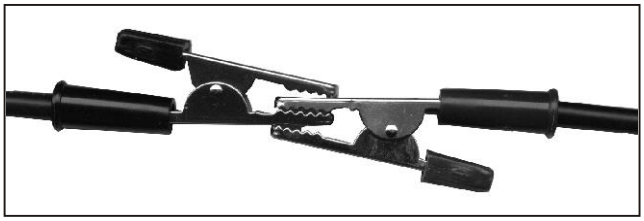
Test Leads and Probes - ***All AMPTEC Igniter Tester Leads and Probe sets are a minimum 48" length, (call the Sales Department for any custom requirement).***

Option "620RACK": Rack Mount Adapter

Option "620RACK" includes an adapter tray that allows any single AMPTEC 620 series tester to be flush panel mount installed in a standard 19" equipment rack.

C-2. Test Lead Sets and Probes

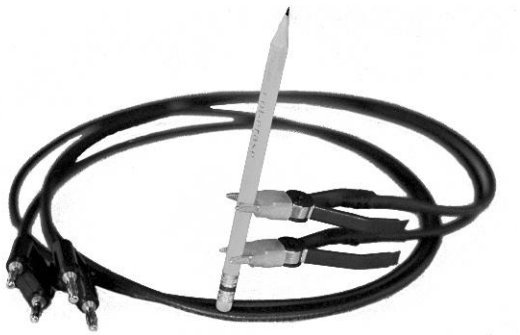
Option "290" Alligator Clip Lead Set



Option "290" is the recommended general purpose Alligator Clip test lead set (red and black) ***for models not having a 2.0 Ohm range*** (due to a small resistance "offset" at the tips - OK for 20 Ohm and higher range units) . Option "290" is supplied as a standard item with all 620A-4 (USAF version) ohmmeters as part of the accessory package. Option "290" is a 48" long cable set with dual banana plugs at one end. The other end is terminated with an alligator clip (red and black). Some "Squib Resistance" test panel jacks have a plastic exterior with a conductive socket center. These alligator clips will measure (2 wire method) properly with either upper or lower jaw connected to the conductive socket center of plastic test panel jacks. Kelvin Clips see Option "300" (using the 4-wire method) *may have difficulty only if* both jaws (both upper and lower) do not make electrical contact with the conductive "resistance under test" center.

See next page for Kelvin Clips and other accessories.

Option 300: 4-Wire Gold Plated Kelvin Lead Set



Option "300" is a general-purpose Gold-Plated Kelvin four wire Leads for all AMPTEC 620 series Testers. Kelvin clips provide a ***4 wire Kelvin*** Gold plated low thermal EMF connection (minimizes the thermocouple effect) with most connections. ***The Option "300" is the recommended test lead set for any AMPTEC 620 Series Igniter Tester for calibration or precision measurements*** (i.e AMPTEC 620ES and 620RK). The 4 wire Kelvin connection is ***important when measuring less than 1.0 ohm***, and also automatically ***eliminates test lead length offset*** and ***test lead contact resistance errors***. Option "300" is a shielded 48" lead set terminated in ½" opening gold-plated Kelvin clips. The option "300" can clip easily to wires, pins, and medium size (up to ½" diameter conductors). The dual banana plug ends connect directly to the 620 tester's front panel input terminals. (see Option "320" for replacement Kelvin clip ends only)

Option 305: Banana-to-Banana Cable

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

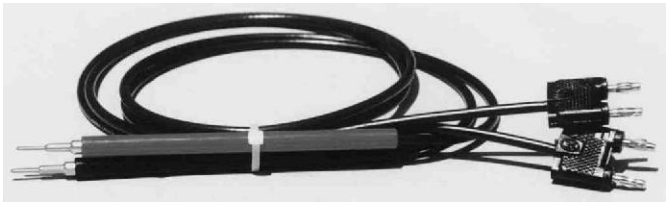
Option 320: Kelvin Clips

Option "320" are the gold-plated kelvin clips used on the Option "300" cable set. These clips may be used when making custom cables or when repairing Option "300".

Option 360: Heavy-Duty Clips

Option "360" are Gold-plated jumper cable (large jaws) type clips used on the Option "350" cable. They are still Kelvin Clips because the insulated upper and lower jaw (jumper cable appearance) integrity is maintained. These may be used when making custom heavy-duty cables that open to 1 1/2 " wide (i.e bolt heads).

Option 401: Handheld Single Probe Leads



Option "401" is a ***gold plated*** 620 series compatible handheld probe (one black probe & one red probe) lead set terminated in ***single points***. The OP401 handheld probes allow for easy access to connector socket wiring (i.e. drone parachute squib sockets), recessed surfaces, and parts (i.e. flares) that alligator clip can't reach.

Option 430 4000-ITS Mating Connector

AMPTEC offers an adapter connector that provides equivalent circular socket connections **(J9 Connector)** found on SIMPSON 4000 ITStm, and Alinco 101 series Circuit Igniter Testers. ***In some applications*** (i.e. AIM-7 Missile harnesses) ***regular alligator clip leads cannot properly connect to*** (screw on ring collar type connectors) ***the small recessed electrical sockets inside a connector harness*** that normally mates with the ***J9 style connector***. ***This item is included in the AMPTEC 620A-4 NSN 6625-01-460-1499NM package.*** The "OP430" has the AMPTEC 620A-4 Ohmmeter act as a 2-wire ohmmeter from the OP430 connector out to the resistance under test.

Option "247" - Isolated Continuous Operating Power - Allows the AMPTEC 620A-4 series tester safely operate continuously 24 hours a day 7 days a week. It includes an isolated AC/DC wall adapter. This option uses a 3.0 KV AC and DC isolated circuitry (i.e. medical grade DC to DC convertor) to safely supply the 5.0 VDC needed to operate the unit's main measurement electronics normally supply by batteries. This 3 KV medical grade electrical isolation is the same safety isolation that cardiac monitors use. They are AC line powered (i.e. 120 VAC) while electrodes are connected to a human patients' chest. *The unit's Safety Board Approved failsafe ohmmeter current source is still running independent of the meter's 3.0 KV DC supply isolation circuitry. UL 61010 AC Line Isolation Test Report confirms Isolation to 3 KV AC input protection.*

Option "500" Optically Isolated Analog Output

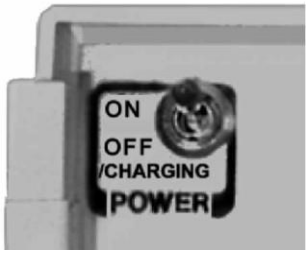
This rear panel mounted isolated analog DC Voltage output signal is directly proportional to the 620 tester's ohm display measurement. (i.e. 1.2345 VDC for 12.345 ohms). It is used to track 620 tester measurements for datalogging purposes with an external device (i.e chart recorder, system DMM with GPIB). Isolation protection is rated @2000 volts peak to ensure any instrument connected to "Option 500" has virtually no impact on the 620 series tester's safety.

SECTION D - OPERATION AND USE

D-1. General Operation

This section contains operating instructions for the AMPTEC 620A-4 Explosive Safety Igniter Tester. A description of the front panel controls, connection instructions and theory behind 4-wire Kelvin resistance measurement is discussed in this section.

D-2. Front Panel Features and Operation



When the front panel power switch is in the "**OFF**" or charging position, all power is removed from the (output terminals) ohmmeter measurement circuitry and the unit's internal battery pack is connected to the rear panel charging jack *(see diagram on next page)*.

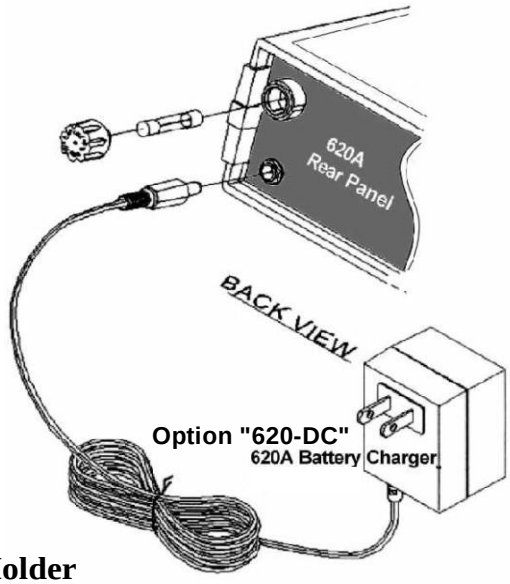
When the AMPTEC 620A-4 main power switch (single throw double pole) is placed in the "**ON**" or up position, the battery pack is disconnected from the rear panel charging jack. The possibility of a voltage between the device under test and a AC/DC Voltage from the rear panel AC/DC Charging jack is therefore eliminated. The operator need not be concerned if the battery charger is plugged in while making resistance measurements.

Range Switch

AMPTEC 620A-4 Range Switches shown

The AMPTEC 620A-4 ohms ranges are manually selected by pressing the desired range switch on the front panel. The range select pushbutton for the lowest resistance range 20 Ohms (left-most resistance range button) indicated above the range select buttons. When a given range is selected (pushed in) the other range switches "pop-out" and inform the user. It is obvious to the 620A-4 user which resistance range has been selected, as it is pushed in. Also note that a resistance range should be selected after powering up the 620A-4 to place it in an operational mode. After turn "ON", a range should be selected. If the resistance being measured (including "Open Circuit/ Disconnected states") is a higher value than the selected range, the instrument's display will flash (blink), which indicates "overrange". If the front terminals are disconnected, the display may even wander around; this is normal for the disconnected 4 Wire Kelvin "Open Circuit" mode.

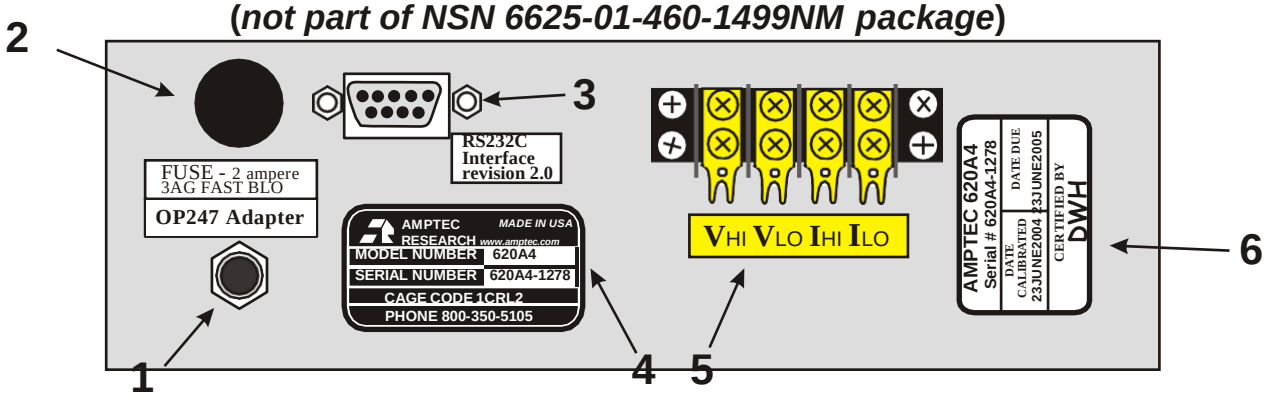
D-3 Rear Panel



Fuse Holder

The fuse holder is mounted on the rear panel of the unit. The fuse for the AMPTEC 620A-4 is a 2-ampere fast blow 3 AG type (1 ¼" long).
This fuse is designed to protect the battery pack from excessive currents. On some AMPTEC 620A-4 versions a fuse holder is mounted on

AMPTEC 620A-4 REAR PANEL configured with Option "232", "247"
(*not part of NSN 6625-01-460-1499NM package*)



620A-4 Rear Panel with options RS232C I/O
The AMPTEC 620A-4 rear panel (shown above) may contain many optional jacks, terminals, labels, and stickers. Only the option "247" Continuous Isolated Operating Power DC Adapter (item #1) plugs in the rear panel jack for isolation and to continuously operate the unit.

Item 2 is the fuse holder - replace with a 2 ampere 3 AG type fast blow fuse (rarely needs replacing).

RS232C Serial Interface - Item # 3 is the safety isolated RS232C serial I/O (9 pin D type Sub-min connector). This RS232C Interface provides the meter's resistance measurements to a PLC fitted with a serial port. The **RS232C protocol settings should be 9600 Baud, 8 Bits, No parity, 1 Stop Bit,** *9 pin D Sub-min connection***.**

RS232C Command Set (Option 232)
(NOTE: All front panel range buttons must be de-selected (press in halfway) **with all range pushbuttons out** to disable with local lockout and enable RS232C control. ***Note commands are case sensitive***.

C **Continuous Read Mode** - *RS232C I/O* outputs a data string every A to D conversion cycle, approx**.** 2.5 times per second.

S **Single Read Mode** - *RS232C I/O* outputs a single data string upon reception of a "R" command.

R **Read** - Commands *RS232C I/O* to output a single data string (1 resistance reading).

r0 De-Selects all Ranges
r1 Selects the 20 Ohm Range
r2 Selects the 200 Ohm Range
r3 Selects the 2K Ohm Range
r4 Selects the 20K Ohm Range
V Version **c**ommands board to output the firmware version string.

Data Format - The *RS232C I/O* outputs a data string with the following format:

1.2345E+3 The measurement is always in Ohms *(where E+3 = 10^{+3}scientific notation style)* . The Exponent is defined below. ***1.2345E+3 = 1.2345 KOhms*** (where $E^{+3}=10^{+3}$). ***1.3700E+1 = 13.700 Ohms*** (where $E^{+1}=10^{+1}$)

Range		**Exponent**
20.0	Ohm	E+1
200.0	Ohm	E+2
2.0 K	Ohm	E+3
20 K	Ohm	E+4

An overrange condition is indicated by 9.9999E*nn*..Where nn is the selected resistance range exponent. A Range Error is indicated by x.xxxxERR.

Item # 4 is the unit's serial number sticker.

Item # 5 is the gold plated 4 terminal rear terminal strip (they are wired in parallel with the front terminals). If a "2 wire ohms" connection is made then the **V** high and **I** high terminals should be shorted together, and the **V** low and **I** low terminals should be shorted. The AMPTEC 620A-4 Voltage High, Voltage low, Current high and Current low wires are permanently connected to the gold plated rear terminal strip (seel labeled gold plated terminal strip on rear panel).

Item #6 Calibration Sticker - If the calibration due date has expired (1 year) AMPTEC or a Cal. Lab can contact to re-certify the AMPTEC 620A-4 Explosive Safety Ohmmeter/Igniter Tester. contact AMPTEC customer service 001-512-858- 4045.

Charging Jack

The battery charging jack is a barrel type and is located on the 620A-4 rear panel. The center pin of the connector is positive. The charging requirements of the internal battery pack are 6VDC @300mA. The correct charging voltage is supplied by the adapter included with the instrument. Additional AC/DC Battery Chargers are available as Option "620-DC". *with the AMPTEC 620A-5, the charging jack is mounted on the unit's front panel.*

D-4. 4-Wire Resistance Measurement

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

The 620A-4 avoids this potential error source by providing two terminals of constant current and an additional two terminals for high impedance voltage measurement. The constant current can be thought of as a ***current loop*** that overcomes lead length resistance and contact resistance encountered (all series resistance) along its loop path. The result is a fast, accurate resistance measurement of the load, independent of the resistance of the current carrying leads.

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

The internal high-impedance DVM senses the voltage drop across the load. There is negligible contact and lead resistance error created by the voltage measurement because the high input impedance of the DVM limits current flow in the voltage leads.

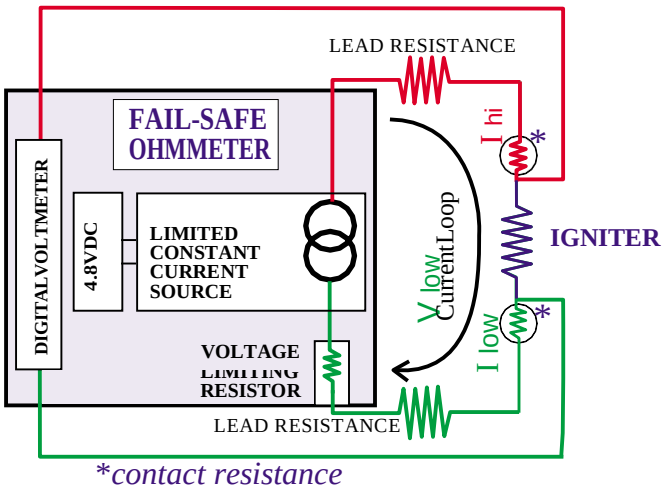
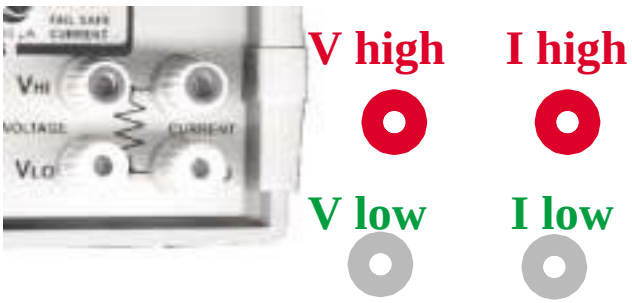


Figure D-1. Error Sources in Resistance Measurements eliminated with Four Wire Kelvin Connections

D-5. Connections

Connections are made to the front panel terminals using a 4-wire configuration as described in section 4-4. When using AMPTEC test leads, the tabbed or ***negative (-) side of the banana jack is plugged into the current terminals of the 620A-4***. This ensures that the current is carried in the largest conductor and that the voltage input is shielded. The 620A-4 features five-way gold plated input jacks. The gold plating on the input jacks helps minimize thermal EMFs. Wire connections often generate a DC offset voltage with the contact between two dissimilar metals (also called the thermo-couple effect).

In addition, the 620A-4 five-way input jacks allow for clean, simple connections to bare wires, cables terminated with spade lugs, and banana jacks.



620A-4 CLOSEUP - *INPUT JACKS (4 wire connection)*

All AMPTEC ohmmeters use a high impedance voltmeter as part of the resistance measurement process. This voltmeter is a highly accurate and stable 4½ digit analog-to-digital converter (A to D). Unless it is receiving a definite input signal, the output reading of this A to D is ambiguous. The display may indicate a randomly wandering number, or it may indicate an overrange condition. This unpredictable display may make it seem to appear that the instrument is experiencing some sort of malfunction. It is, in fact, just a characteristic of the voltmeter circuit and should not be mistaken for a fault in the instrument.

The display indications should be ignored unless there is a definite measurement being taken. If this wandering display is not acceptable, the ohmmeter can be made to indicate an overrange condition whenever the terminals are open by using a 4-wire Kelvin type lead set or by shorting the V_{HI} and I_{HI} terminals together.

The display should indicate a stable reading when the test leads are securely attached to the device under test. If the display appears to be erroneous when connected to a load, recheck the test leads for integrity and cleanliness. If all external items appear to be functioning properly, the problem may be the ohmmeter. In this case, please contact your local AMPTEC RESEARCH Sales Office.

D-6. Failsafe Operation

The AMPTEC 620A-4 Series Igniter Tester/Ohmmeter incorporate a proprietary current source design that renders them incapable of delivering excessive voltage or current to the device under test. The *typical* fail-safe current for each range is indicated under the corresponding range switch on the 620A-4 front panel. Please refer to section 5-6 for a technical description of the failsafe circuitry.

Every 620A-4 Series Failsafe Ohmmeter is thoroughly tested before it leaves the factory. Every resistance range is tested and calibrated (a U.S. N.I.S.T. Certificate of Calibration accompanies every 620A-4).

As a further precaution the 620A-4 is isolated from the AC line whenever the POWER switch is in the ON position.

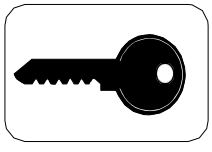
The 620A-4 receives its power from an internal rechargeable battery pack. The 620A-4 must be in the OFF/CHARGING position to charge the batteries.

D-7. Battery Monitoring Circuitry

If the low battery indicator LED is continuously illuminated, readings should not be trusted. An overnight recharge should be performed before using the 620A-4 for critical testing.

It is possible for the user to receive a low battery indication on a single range only (particularly the 20 ohm range), while the 620A-4 remains well within operating limits
on other ranges. **Unless the user observes a <u>continuous</u> low battery indication during measurement, readings are still valid.**

Notice for Cal Lab: The variable potentiometer - trimpot RV3 is factory adjusted to have the low battery indicator come on at 4.50 VDC. To make this adjustment, **refer to Section F** Routine Maintenance for further details.

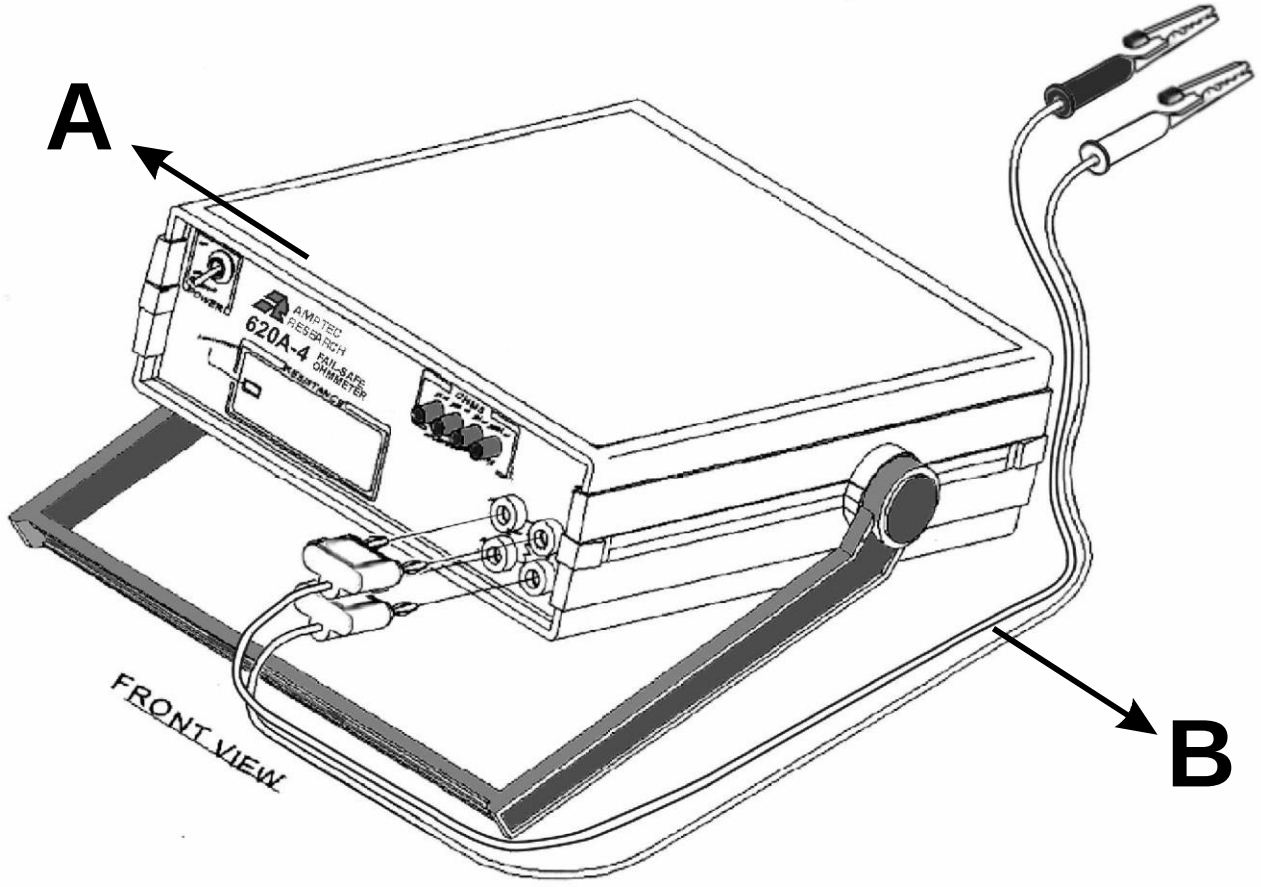


Replacing the AMPTEC 620A-4 Handles

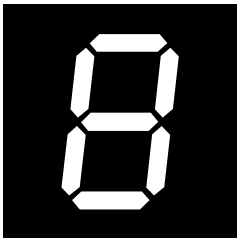
The AMPTEC 620A-4 handle access screws are located **behind the black circular end caps** (see points A and B in the diagram below) at the joint where the handles meet the case. Once the recessed circular end caps have been removed (i.e. pop out with screwdriver), you should be able to locate the spring-loaded assembly with the access screws. Care should be taken when unscrewing the handle access screws as they hold back the spring-loaded lock-notch assembly. Once the screws have been removed the spring-loaded handle lock assembly will come apart (take note of the parts and sequence of disassembly). Remove the broken handle and replace with the new handle. Return the spring-loaded lock-notch assembly to the center of the rotating joint (points A and B below). Replace the retaining screws back into the center of the spring-loaded lock-notch assembly. Replace the black end caps. The repair is complete.

Rotating the AMPTEC 620A-4 Instrument Case and Handle Position

The AMPTEC 620A-4 handles position can be easily adjusted or rotated with the simple maneuver described below. There is a lock notch rotating joint at points A and B below, where the handles meet the case. Never force the handles to rotate as this will damage the lock notch rotating joint and break the handle. By pulling outward firmly but not too hard, you can release the lock rotating notch mechanism inside the handle pivot assembly. While pulling out at points A and B, rotate the handle position to the desired location. If the handles do not freely pivot/rotate, then slightly more pulling force at points A and B may be required (to unlock the notch mechanism). Once you have rotated the handles to the desired angle simply release the outward pull at points A and B. You should then feel or hear a "click" as the handle locks/notches into the new position.



SECTION E - GENERAL OPERATION AND DESIGN



E-1. General

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

The AMPTEC 620A-4 series Igniter Tester uses modern solid-state semiconductors exclusively and digital CMOS circuits extensively to minimize power requirements and make battery operation useful and practical. AMPTEC also maintains a spare parts inventory of all components found in the 620A-4 Tester and its customer service department can also provide additional assistance in the trouble shooting process.

E-2. Troubleshooting

Since the 620A-4 Tester is used to test potential deadly explosive force detonators and warheads of missiles etc., ***personnel that are not qualified to make such electrical repairs on the 620A-4 Tester should not even attempt to remove the calibration access screws or open the main panel or effect any repair whatsoever***.

Apparent 620A-4 Tester malfunctions can sometimes be the result of bad test lead/connection wiring, wrong connections, misinterpretation of specifications, low battery levels, and in rare cases due to an incomplete understanding of the instrument and how to use it. A thorough review of the operating instructions for this instrument is recommended prior to any component replacement. Check to be sure that cables and other test equipment are in good working order before attempting to troubleshoot the 620A-4 series igniter tester.

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

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

E-2-1. Localizing the Problem

Chapter D-2 discusses how to use the ***Functional Test Section*** of the 620A-4 Tester to help localize the problem. The key to successful troubleshooting is to localize the problem to a general electronic parameter as much as possible before trying to pin the problem down to a specific component. Certain questions should be asked such as "Does the problem occur on all ranges or on a specific range only?". If the 620A-4 Tester does not come on when powered up, did you check the front panel fuse. The power supplies for both the current source and the digital voltmeter electronics are also one of the first things that should be tested.

As it is not possible to anticipate all failure modes of the 620A-4 series igniter tester, servicing personnel should become familiar with this section to gain a complete understanding of the internal workings of the ohmmeter.

E-2-2. Component Replacement

If the malfunction is a faulty component, the accuracy of the 620A-4 series igniter tester can be maintained only if the 620A-4 is re-calibrated following the component replacement and the following precautions are taken:

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

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

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

Use the chassis ground (connect to the common terminal of the functional test section) connection - i.e. connect to an earth ground to avoid a static discharge to a static sensitive component. Handle all 620A-4 internal components as if they are static sensitive if you are not sure.

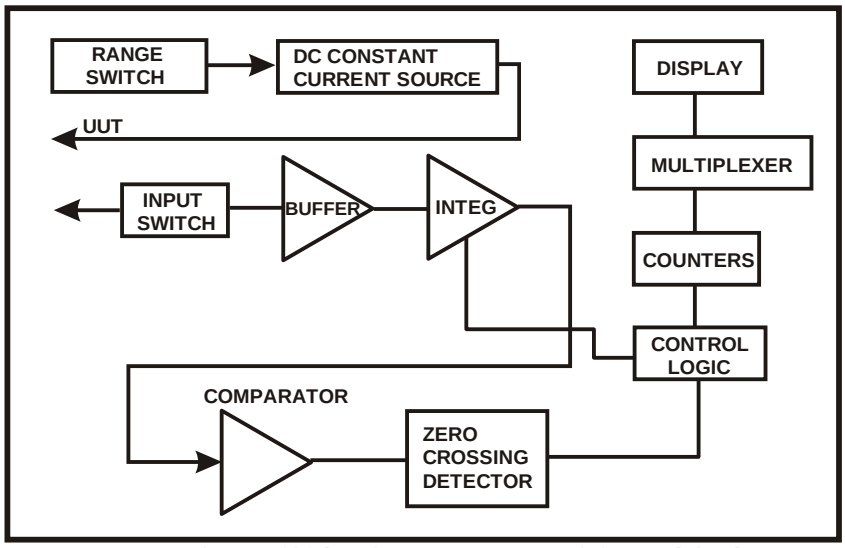
See Next Page for Start of 620 Circuit Descriptions and Functional Diagrams

E-3. Circuit Descriptions

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

E-4. Analog to Digital Conversion

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



MODEL 620A-4 OHMMETER BLOCK DIAGRAM

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

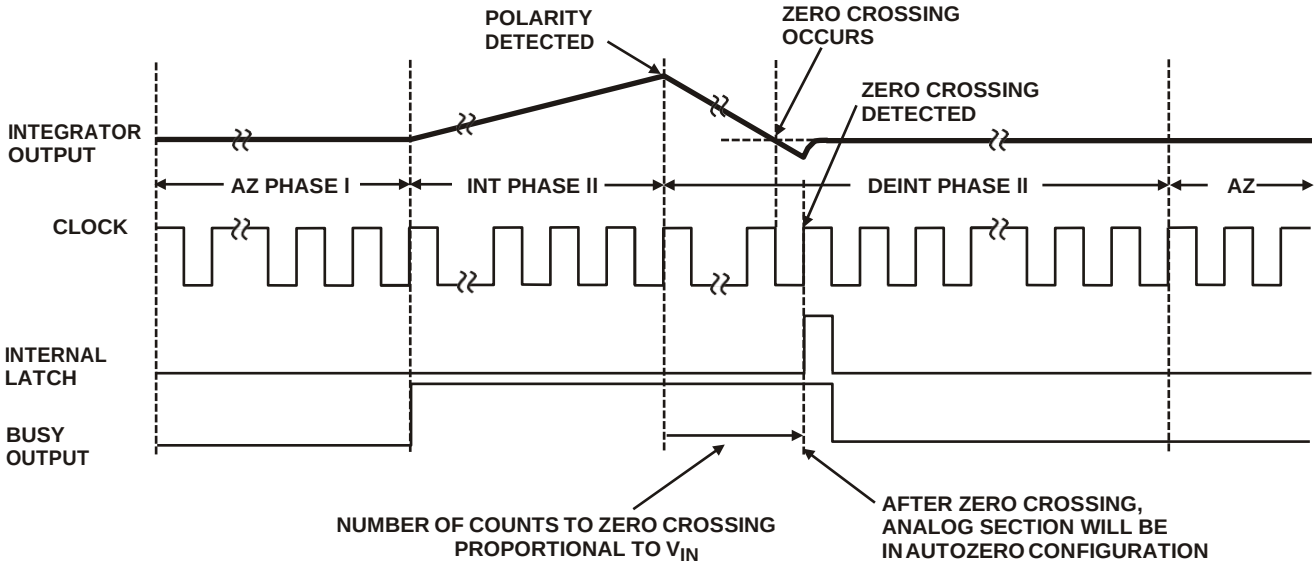


Figure E1 - 620 Conversion Timing Diagram

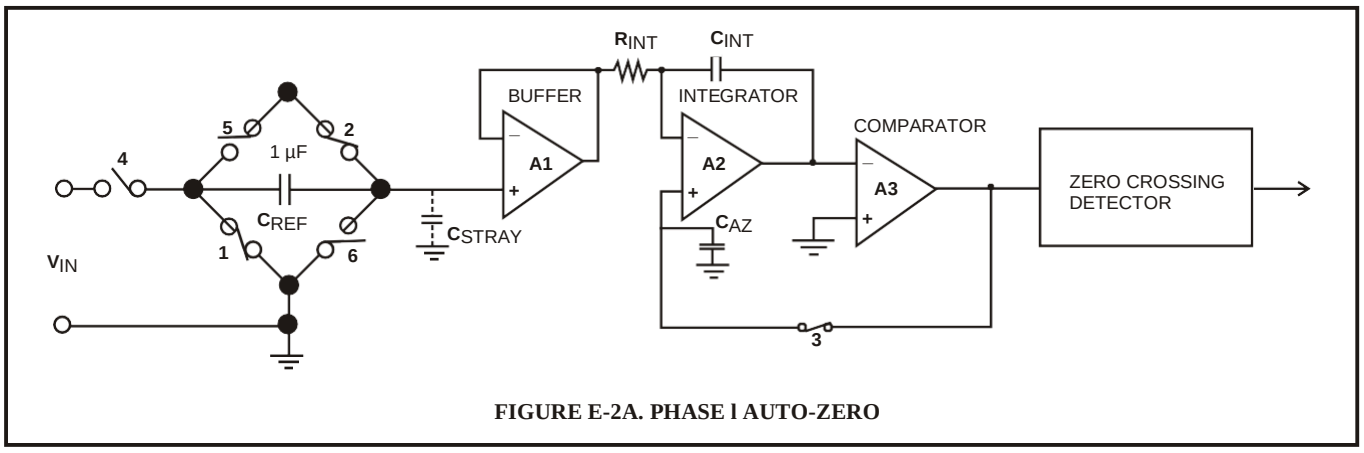


FIGURE E-2A. PHASE l AUTO-ZERO

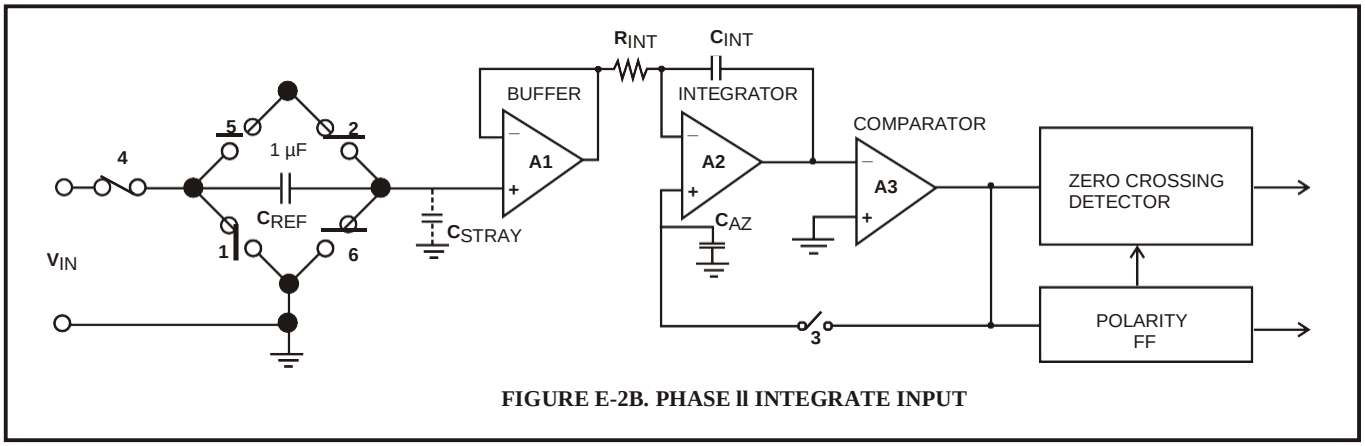


FIGURE E-2B. PHASE ll INTEGRATE INPUT

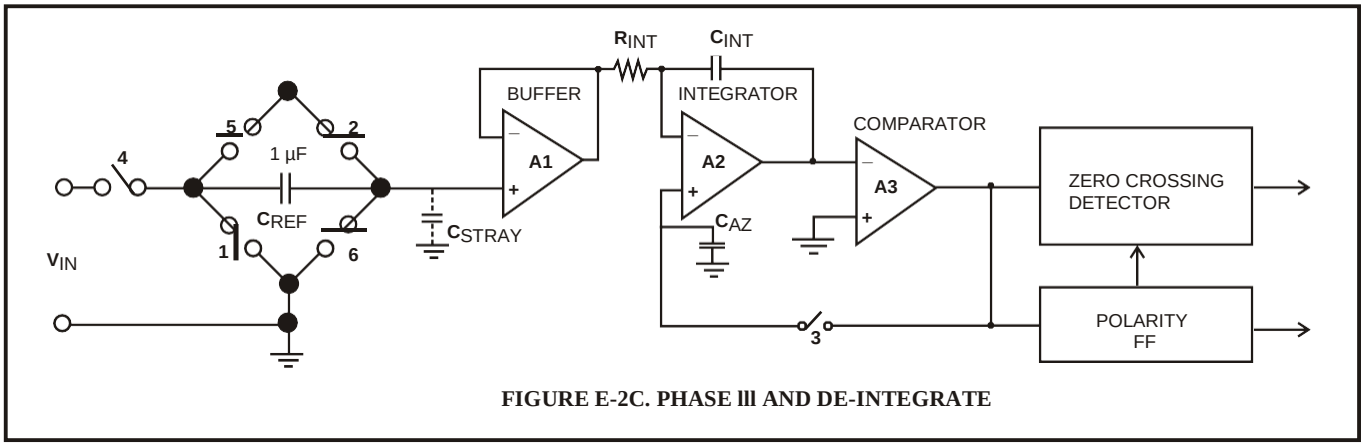


FIGURE E-2C. PHASE lll AND DE-INTEGRATE

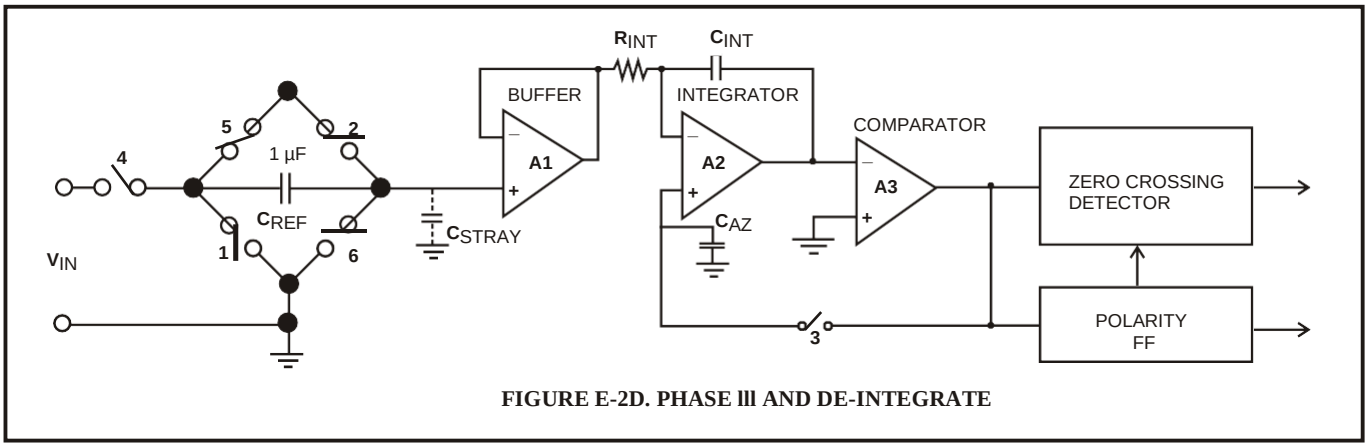


FIGURE E-2D. PHASE lll AND DE-INTEGRATE

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

Detailed Description

Analog Section

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

Auto-Zero Phase I (Figure E2A)

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

Input Integrate Phase II (Figure E2B)

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

Deintegrate Phase II (Figures E2C and Figures E2D)

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

E-4-1. Reference Voltage

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

E-4-2. LED Display

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

E-5. Ohms-To-DC Converter

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

E-5-1. Constant Current Source

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

E-5-2 Constant Current Circuit Operation

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

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

E-6. Failsafe Design

Reference to the AMPTEC 620A-4 Tester Igniter Tester schematic will show that the output of IC202-6 is applied to the base of transistor Q202, ***which acts as a current limiter***. ***The worst-case component failure that could occur in this circuit would be a Q202 short***, which would effectively connect the -5 volt supply directly across R218, D202, the range resistor and R_L.

D203, however, acts as a 1.6 volt zener diode, limiting the voltage that can appear across these components. Even if every component in the amplifier circuit shorted, the current through the igniter could not exceed safe limits, because the -5 volt and +5V supplies includes inherent current limiting. Because of the design of both supply isolation transformers T101 and T102, the ±5 volt supplies can only deliver 20 to 25 milliamperes before the DC/DC converter disengages, dropping the -5 volt output to zero. See Section D-7.

The AMPTEC 620A-4 Tester is powered by a rechargeable internal battery pack and cannot be operated directly from the battery charging adapter. This is to ***eliminate the possibility*** of an electrical short to/from the AC line. ***Only when*** the 620 POWER switch is in the "***OFF/ CHARGING***" position are the batteries connected to front panel charging jack. ***When the POWER switch is in the ON position***, the batteries are disconnected from the battery charger and connected to the internal circuits of the AMPTEC 620 Igniter Tester.

The 620A-4 Tester measurement circuitry is also failsafe current limited, even under worst case component failure. **A simple startup test procedure which also has the 620A-4 Tester user perform a functional check using a milliammeter would also detect any current level even getting close to the Failsafe level.**

For the 620A-4 Tester the normal or typical operating current level is less than 5 mA, and <8mA on most 20 ohm range versions as a Failsafe Level**.**

E-7. Ultra-Safe Power Supply Scheme

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

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

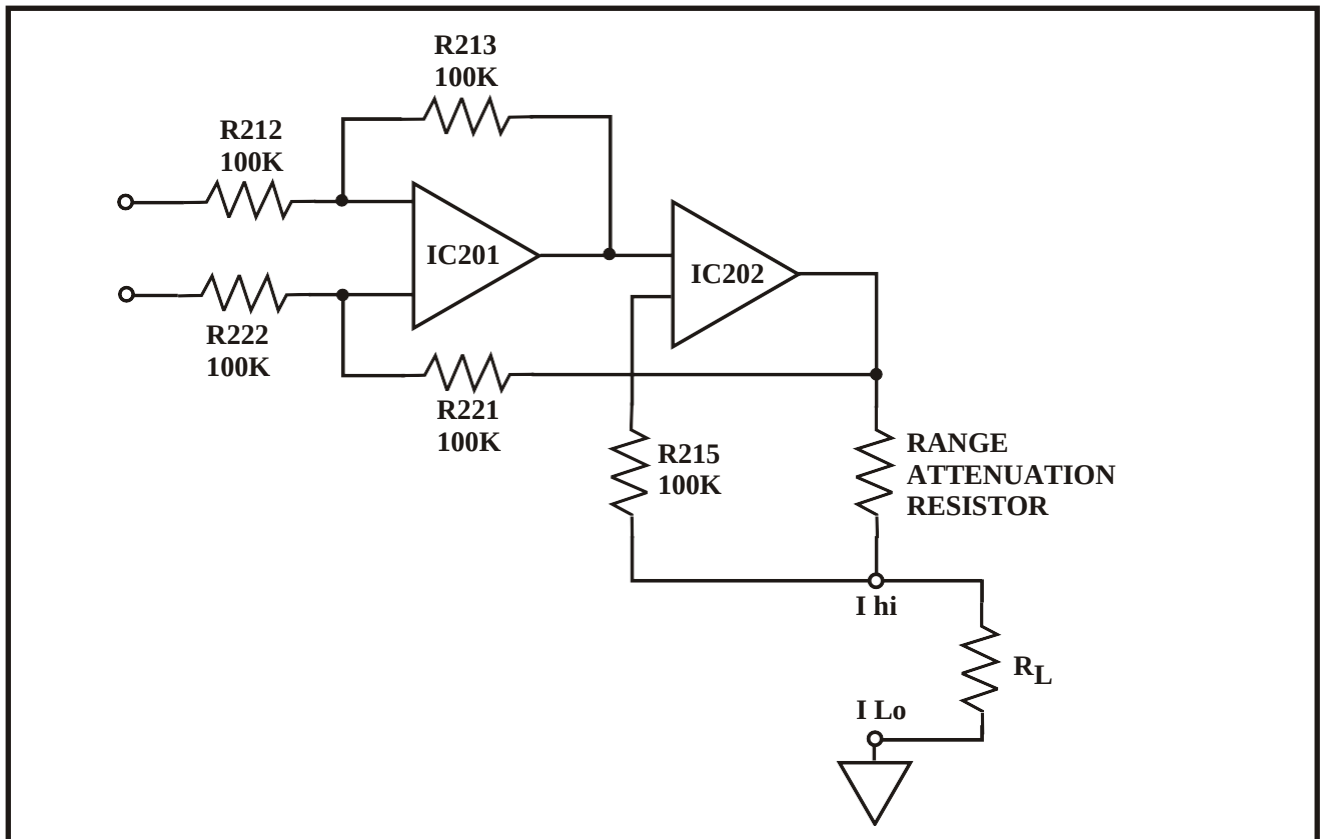


Figure E-3 Constant Current Circuit

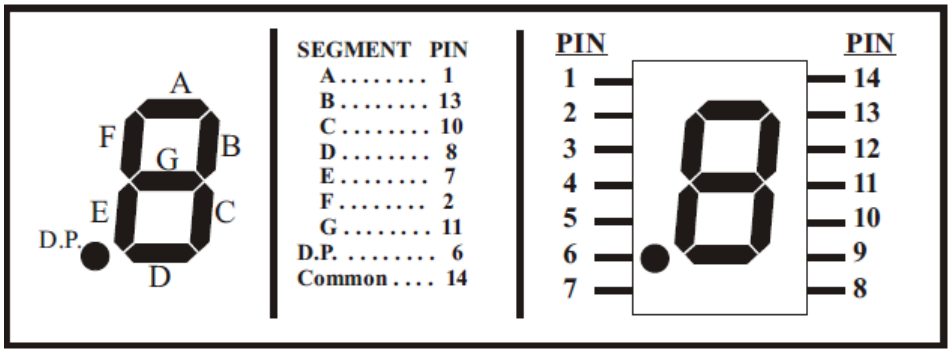
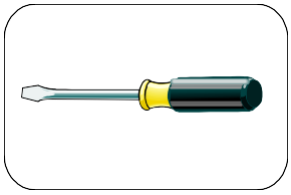


Figure E-4. LED Display Pin Functions

E-8. Relay Board General Operation
(*Not for NSN 6625-01-460-1499NM meters*)

For products such as the ruggedized water-proof version AMPTEC 620A-4R Igniter Tester and remote controlled versions via the RS232C Interface option, the internal 620A-4(R) PCB labeled “620-relay board” replaces the range switch S1 on the main board. IC-1 is a ribbon cable header that goes to the top panel and connects to the range push buttons (covered by silicone rubber boots) and their corresponding panel mount LEDS. IC-2 is a latch that will latch its output to the corresponding range push button input. Its output turns on the front panel LED (acts as a range mode indicator LED) and a corresponding relay that connects to the main PCB to select the range. RL1 is for the 20-Ohm range, RL2 is for the 200-Ohm range, RL3 is for the 2K Ohm range, and RL4 is for the 20K Ohm range.

SECTION F: ROUTINE MAINTENANCE



F-1. General

This section of the manual contains routine maintenance information regarding the AMPTEC RESEARCH Model 620A-4 Fail Safe Ohmmeters. Calibration should be performed on a regular basis to ensure continued instrument accuracy. The recommended calibration interval is **1 year**.

The AMPTEC 620A-4 is a four wire Kelvin ohmmeter. ***The 620A-4 must be calibrated using four wire Kelvin connections to the resistance standard*** in order to eliminate lead resistance and contact resistance errors. The alligator lead set (option "290") that is supplied with the 620A-4 accessory package is a 2 wire lead set and should not be used for the 620A-4 calibration. (All U.S.A.F. Tech Order's that involve the 620A-4 with the 2 wire alligator lead set require the user to record the zero offset and manually correct for in-series lead or connection resistance errors when measuring squib resistance).

F-2. Required Test Equipment

The following list of the standard resistors required to calibrate the AMPTEC 620A-4. Calibration of versions other than the AMPTEC 620A-4 use the same basic procedure, however different standard resistor values may apply for different resistance ranges.

Precision Resistors:

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

Test Leads:

4-wire lead set
(AMPTEC Option "300" or "301C")

F-3. Calibration Procedure

The 620A-4 should be calibrated with fully charged batteries and should be allowed to warmup for a minimum of 15 minutes before beginning the procedure. The adjustments are accessed by removing the four feet screws, then lifting off the top cover only. The locations of the adjustments are shown on drawing number 620A-600 at the back of this manual. **Note: RV201 is factory set and should never be adjusted in the field.**

F-3-1. Zero Offset Adjustment

1. Select the 20 ohm range. Connect the Kelvin clips to the 0.1 ohm standard resistor.

2. Adjust potentiometer RV2 for a display indication of 0.100.

F-3-2. Full Scale Adjustment

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

2. Adjust RV1 for a display indication of 100.00**.**

3. Check all remaining ranges with the appropriate standard resistors. All ranges must be within the specifications outlined in Section B.

F-4. Battery Replacement Instructions

The rechargeable Nicad batteries (D cell 5.0 AHr each) used in the 620A-4 are very durable and should provide years of trouble-free operation. As with all batteries, replacement will eventually be necessary. Batteries may be ordered from AMPTEC RESEARCH as Option "**620-BAT**" for a set of 4 **D** cells (NiCAD). Battery Replacement Procedure (see steps below):

1) Remove the four feet screws and the bottom cover.
2) Undo the reusable tie-wraps by pushing down on the locking pin.
3) Remove the old batteries and replace. **Observe polarity!**
4) Secure the new batteries in place by re-tightening the tie-wraps.
5) Replace the cover and feet screws, taking care not to pinch any wires.

Low Battery Indicator:
The variable potentiometer - trimpot RV3 is factory adjusted to have the low battery indicator come on at 4.50 VDC. To make this adjustment, remove the fuse from the fuse holder. With an adjustable DC power supply, set the power supply output to be 4.50 VDC. Be sure to observe power supply polarity. Connect the power supply to the test points labeled "MAIN" + pos. and - neg. located in the rear section of the 620A MAIN PCB. (i.e. positive + power supply output to the anode side). Adjust trimpot RV3 until the low battery indicator just comes on (negative sign on display). An increase in power supply voltage to 4.52 VDC should cause the low battery indicator to go out. Finally, disconnect the power supply, and return the fuse (2 ampere, fast blow type, size 3AG) to the fuse holder in the rear panel.