



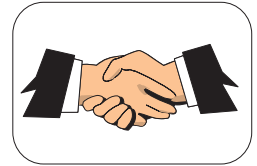
**AMPTEC 620VN
Explosive Safety Igniter Tester
OPERATION/MAINTENANCE MANUAL**

Preliminary Manual Revision A 10APR2013

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A MESSAGE FROM THE PRESIDENT



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

Kerry Clark - President AMPTEC RESEARCH

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



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

620VN SERIES IGNITER TESTER WARRANTY



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

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

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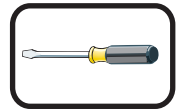


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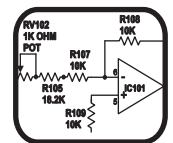
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SECTION A - RECEIVING AND INITIAL INSPECTION



A-1. Introduction to the AMPTEC 620VN

Some of the devices the 620VN Igniter Tester may be used on include: fuses, squibs, igniters, explosive bolts, rocket motor squibs, automobile air-bag initiators and many others.

The AMPTEC 620VN is a 4-wire failsafe digital ohmmeter which has been designed to reliably use very low test currents for its resistance measurement. Failsafe Output Circuitry proprietary to AMPTEC RESEARCH ensures that test current levels do not exceed the specified "failsafe current" even in a worst-case component failure situation. The failsafe feature is tested in every instrument before shipment. The 620VN uses the same main printed circuit board (PCB) as all of the AMPTEC 620A Igniter Testers. The 620VN has many features (no resistance range gaps from 20 ohms to 2.0 megohms) which make it useful in a variety of applications. Please check the last chapter of this manual for addendums that may apply to the AMPTEC 620VN .

For added safety the AMPTEC 620VN Igniter Tester is always electrically isolated or electrically "floating". It normally comes configured with the 2 stage option "247" Isolated Continuous Operating power. The first stage of isolation with op "247" is the ACV wall adapter (ie 120 VAC input to 24 VDC output). This provides the first stage of initial high frequency and high voltage (transient) suppression.

(OP 247) The second stage of isolation uses, converts, isolates and conditions the +24 VDC coming into the meters rear panel. The rear panel input voltage (+24 VDC) is converted (via several circuits) using a Medical Grade DC to DC convertor into the +5.0 VDC that provides the meters main operating power. The high quality Medical grade DC to DC Convertor uses essentially transformer isolation and voltage step down principals to provide the meters main power as a "floating" +5VDC. A 3000 VAC Isolation (Hipot) Test Report is available from AMPTEC's engineering department that has established the isolation of the 2 stage "OP247" as being at least Isolated to the 3 KV level.

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 620VN appears damaged, the carrier's agent should authorize repairs before the unit is returned to the factory. Even if the instrument appears undamaged, it may have suffered internal damage in transit that may not be evident until the unit is operated or tested to verify conformance with its specifications.

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



Call AMPTEC RESEARCH first, prior to just returning the 620VN . We can often troubleshoot (based on the symptoms you describe) and identify the problem. We may possibly be able to fix the problem over the phone and prevent you from having to return the unit to AMPTEC for repair.

A-3. Setup and Use

The AMPTEC 620VN Igniter Tester may be setup to operate within minute(s) of power "turn on" (unless your in an extremely cold temperature - allow more time for warm-up - 15 minutes). A quick test lead integrity check and it should be ready to use. The front panel will display a negative or minus sign Avoid exposing the AMPTEC 620VN Igniter Tester to extremes of temperature which will affect accuracy.



AMPTEC 620VN EXPLOSIVE SAFETY IGNITER TESTER - SPECIFICATIONS



Continuous Decade Resistance Ranges (No Gaps) from 20.0 Ohms to 2.0 Megohms Fullscale

20W	200W	2000 W	20 KW	200KW	2 MW	Resistance Range
5 mA	500 uA	50 uA	5 uA	0.5 uA	0.5 uA	Test Current
8 mA	8 mA	8 mA	8 mA	8 mA	8 mA	Fail Safe Current
1 mW	10 mW	0.1 W	1 W	10 W	100 W	Ohms Resolution

**620VN Resistance Range / Nominal Current/Failsafe Current
and Display Resolution Table**

Table B-1 Specifications

Accuracy: (for 1 year @25°C ± 10°C)

20 Ohm range - 20K Ohm ranges ±0.02% of reading ±0.02% of range
 200K Ohm ranges ±0.02% of reading ±0.05% of range
 2.0 MOhm ranges. ± 1.0 % of reading ± 0.2% of range

Temperature Range

Operating 0°C to 50°C
 Storage -10°C to 70°C

Temperature Coefficient

20 ohm through 200 ohm ranges ±0.002% per °C (from 0°C-15EC and 35°C-50°C)
 2.0 Megohm range ±0.01% per °C (from 0°C-15EC and 35°C-50°C)

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

Over-Range Indication (select next higher range) 620VN Display flashes

Measurement Update Rate Approximately 300ms

Open Circuit Current Source Compliance Voltage clamped at ~1.6 volts

DC Power - The AMPTEC 620VN safety meter is normally configured with (2 Stage Isolation) OP247 Isolated Continuous Operating Power .

Remote Control Interface - The AMPTEC 620VN safety meter is normally configured with the option “232” an optically Isolated Serial Interface. It that allows computer/controller to remotely send I/O commands that make the 620VN change ranges to the desired range and give back resistance readings via a rear panel RS232C interface/connector. See section in this manual for available I/O commands and format detail.

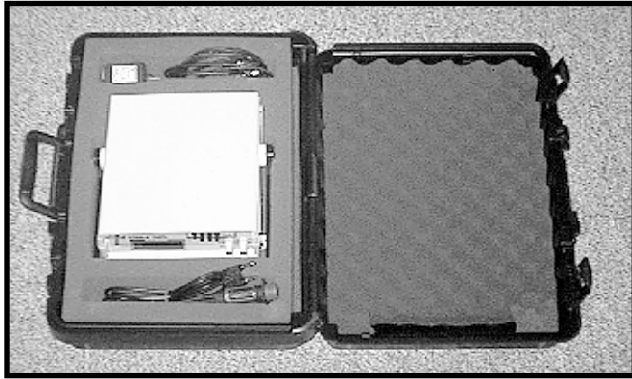
Dimensions 9.0" (23cm) W x 9.0" (23cm) D x 3.0" (8cm) H

Weight 4 lbs net; 10 lbs shipping (without transit case)





620A-4, 620BH, 620VL, 620VN etc. compatible



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

Option "519S and D" Rack Mount Adapter

Option "519S or D" - "S" for a single unit, "D" for dual/side by side two unit install. The AMPTEC 620VN Igniter Tester (this option comes with a flush panel mount faceplate cutout and support tray) can be installed/secured into a standard 19" NEMA equipment rack support tray (provided). The meters feet screws (~ 3" long #6-32 machine screws) are routed through the support tray holes back through the meter's (bottom) feet holes into its lid.

All AMPTEC 620 series test lead and probe sets are a minimum 48" length, dual banana termination at the ohmmeter end (call the Sales Department at AMPTEC RESEARCH for any custom requirement).

Option "110" Test Lead Pouch (Mounted on the 620A4 top lid) with enough storage room to hold a variety of test leads and accessories (see photo above).

Option "300" Gold Plated Four Terminal Kelvin Clip Test Lead Set open to 1/2" for connection to wires, lugs, etc.

Option "302" Gold Plated Banana Jack Backed Four Terminal Kelvin Clips open to 1/2" for connection to wires, lugs, etc.

Option "401" Single Pointed Handheld Probe Set - ideal for probing into recessed squib wire sockets, and onto larger metal surfaces (flat or round) such as flares, rounds and shells, that do not easily accept test lead clip attachment.

Option "403" 4 Terminal Kelvin Mini-probes - (photo shown above) *Each probe has two spring loaded, gold plated, steel tips* with 0.18" separation. (one red and one black handheld probe). Excellent general purpose Mini-Probe, and along with the Option "300" Kelvin Clip Leads easily fit inside the AMPTEC 620ES Test Lead Pouch (OP110).

Option "620-ISO" Isolated Analog Output provides an isolated DC Voltage output directly proportional to the measured resistance (1.2345 VDC =1.2345 ohms). A datalogger or system DVM can safely measure the isolated voltage as being representative of the actual resistance of the device under test.

Option "247" for continuous operation 24Hr/7day. Dual stage isolation provides safe power for 620 series Igniter Tester *to safely run continuous 24 Hrs/day* without batteries. It's proven "Medical Safety 3 KV Isolation" technology is used in monitoring human patients wired to electrical instrumentation. This field tested option is presently running in over 50 AMPTEC 620 series igniter testers in U.S. Anti-Ballistic Missile systems (24Hrs/7).



Kelvin Leads, Probes Accessories and Options

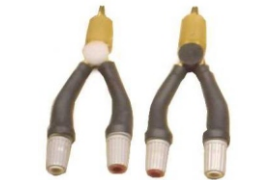


Option "401" Test Probe Lead Set



Option "403" Kelvin Mini-probe Test Lead Set

Magnified Tip Close-up



Option "302" Banana Jack Backed Kelvin Clips

FEDEX SWIFT delivery program



Option "300" Kelvin Clip Test Leads

Option "290" Alligator Test Lead Set



NO BATTERIES NEEDED

See **Option "247" Continuous Isolated Operating Power capability** description on the bottom left column. Recommended for customers that plan to automate the AMPTEC 620 series Explosive Safety Igniter Tester using the RS232C interface.



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SECTION D - OPERATION, FUNCTIONAL SELF - TEST AND USE



D-1. General Operation

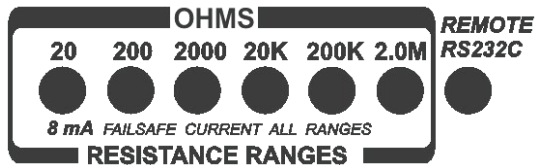
This section contains operating instructions for the AMPTEC 620VN Explosive Safety Igniter Tester.

D-2. Front Panel Features and Operation

When the front panel power switch is in the “OFF” position, all power is removed from the unit’s main PCB and the unit’s RS232C interface. When the 620VN main power switch is placed in the power “ON” position, the unit powers up all ohms and related measurement circuitry and allows the optically RS232C interface located on the unit’s rear panel to also operate remotely.



Resistance Range Switches



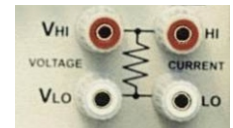
The 4 ½ digit display can display up to 19.999 ohms on the 20 ohm range and 199.99 ohms on the 200 ohm range. The 2.0 Megohm range can display resistance readings up to 1.9999 Megohms. The meter can display from readings 0000 to 19,999 (decimal point position varies with the selected range). That is referred to as 20,000 counts, which is common for 4 ½ digit meters. The user can depress (feel a “click”) one of the meter’s range latching switches to select the desired resistance range. The prior range switch button will “pop out” when a new range is selected.

The far right front panel switch labeled “REMOTE RS232C” must be selected (clicked in) to get the meter to accept remote commands via the RS232C (rear panel) serial interface. When the “REMOTE RS232C” mode is selected all the meters manually selected resistance range switches should “pop out” or be de-selected. In this way, There is no manual selected range and meter is ready to accept remote RS232C computer commands for range and reading control.

The AMPTEC 620VN ohms ranges can be computer controller selected via the RS232C interface (see rear panel).

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" . which is also available via the **automated control** RS232C Interface.

Gold Plated Five way Input Jacks

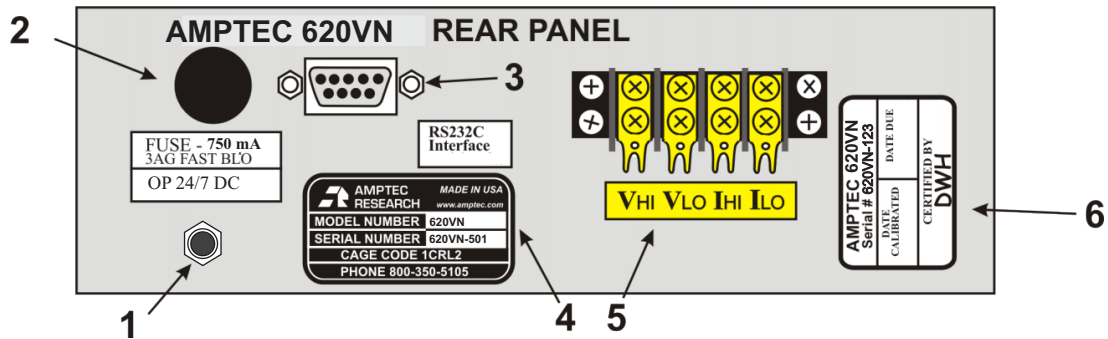


The AMPTEC 620 front panel input jacks are a gold plated variety that readily accept a number of user connection modalities. The unit's banana post input jacks may be unscrewed several turns to exposed a horizontal hole thru the gold plated post. The AMPTEC 620 user can directly connect a bare wire thru the banana post (horizontal hole). The AMPTEC 620 front panel input posts also accept wires with spade lugs, and or banana jacks. The front panel or rear panel terminal strip inputs are wire for Voltage High and Voltage low , and Current high and Current low (resistance measurements). The spacing of the front panel jacks only allow horizontal connection of the dual banana jack test leads to prevent mis-connection (i.e. during calibration) .

Calibration Access Screws

Recessed in the feet on the bottom side of the AMPTEC 620VN meter there are 4 screws (phillips type). When removed you can "remove the lid" and access the main internal electronics /PCB and calibration “adjustment potentiometers. They (*feet screws*) are normally meant to remain intact and to be removed by authorized Repair and Calibration Lab staff.

D-3 RS232C Computer Control and Command Set



620VN Rear Panel with options RS232C I/O

The rear panel (shown above) may contain optional jacks, terminals, labels, and stickers.

Item 1 -The option "247" Continuous Isolated Operating Power DC Adapter (item #1) must be left in the rear panel jack in order to continuously operate the unit. *For Safety Reasons - Only the AMPTEC supplied AC/DC adapter, in conjunction with the meter's OP 247 internal DC/DC circuitry has been tested and approved for its 3 KV isolation.*

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 half way) **with all range pushbuttons out** in order 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 2000 Ohm Range
r4 Selects the 20 K Ohm Range
r5 Selects the 200 K Ohm Range
r6 Selects the 2 Meg Ohm Range
V Version commands 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
2000 Ohm	E+3
20 KOhm	E+4
200 KOhm	E+5
2.0 M Ohm	E+6

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 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 620VN Voltage High, Voltage low, Current high and Current low wires are permanently connected to the gold plated rear terminal strip (see labeled terminal strip on rear panel).

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

AMPTEC 620A series Explosive Safety Igniter Tester RS232C Operation

These instructions should provide a step-by-step how to operate a AMPTEC 620A series (620ES, 620BH, 620EH, 620VL, 620VN etc.) Explosive Safety Igniter Tester via the optically Isolated RS232C interface. An important note - all **manual selected push button front panel ranges must first be de-selected** (popped out) prior to any RS232C remote operation. The RS232C operation example(s) shown below is for an AMPTEC 620VL Igniter Tester. For the AMPTEC 620VN press the meter's front panel remote RS232 button to pop out any previous selected resistance ranges. The RS232 remote control process is essentially the same for all 620A series meter. Newer PC controllers (i.e. Windows 7 etc.) may not come with an RS232C serial port but do offer a USB port. There are many low cost USB to serial converter cables available (see below - item 1 and 2).

1. Plug USB-to-serial interface cable into computer (if direct serial-to-serial connection is not available).
2. Plug serial end of USB-to-serial cable into the AMPTEC 620VN Igniter Tester unit.
3. Open serial communication software and select the correct communication channel.
4. Ensure that communication specifications are as follows:
 - 9600 bits per second.
 - 8 data bits.
 - No parity bit.
 - One (1) stop bit.
 - No flow control.
5. Start testing each range of the unit via the RS232C interface by typing in the following commands (commands are case sensitive):
 - S
 - i. Should receive prompt "Single Read Mode Selected".
 - ii. To have a reading displayed on the screen from Single Read Mode, type "R".
 - r0
 - I. All resistance ranges are "De-selected".
 - r1
 - i. Should receive prompt "20 Ohm Range Selected".
 - ii. This resistance range is valid for any resistance being measured that is less than 19.999 Ohm.
 - r2
 - i. Should receive prompt "200 Ohm Range Selected".
 - ii. This resistance range is valid for any resistance being measured that is less than 199.99 Ohm.
 - r3
 - i. Should receive prompt "2000 Ohm Range Selected".
 - ii. This resistance range is valid for any resistance being measured that is less than 1999.9 Ohm.
 - r4
 - i. Should receive prompt "20 K Ohm Range Selected".
 - ii. This resistance range is valid for any resistance being measured that is less than 19.999 K Ohm.
 - r5
 - i. Should receive prompt "200 K Ohm Range Selected".
 - ii. This resistance range is valid for any resistance being measured that is less than 199.99 K Ohm.
 - r6
 - i. Should receive prompt "2 M Ohm Range Selected".
 - ii. This resistance range is valid for any resistance being measured that is less than 1.9999 M Ohm.

continued next page

6. If the commands above were entered and the correct prompt was not received, then type “V”. The correct prompt from typing “V” is “620VN version 1.0 (C)opyright Amptec Research 3/16/2013”. If this prompt was not received, then the firmware of the unit is out of date and must be updated. If the correct prompt was received, but the commands in bullet 5 did not yield the correct prompt, then there is a defect in the unit.
7. If every command up to this point has yielded the correct prompt, then the unit is operating correctly. Other commands available for this unit are:
 - R
 - i. Should receive resistance reading displayed on screen corresponding to the range that the unit is currently operating in.
 - ii. Must be in Single Read Mode to receive this command properly.
 - C
 - i. Should receive prompt “Continuous Read Mode Selected”.
 - ii. This command continuously displays the resistance being measured. The only way to exit Continuous Read Mode is to type “S” to enter into Single Read Mode.

If every command entered yielded the correct prompt(s) that were detailed above, then the unit is operating correctly. If incorrect prompts were received, try repeating the command, or repeating the process listed in bullet 6.

For further information regarding the *AMPTEC 620VN* Explosive Safety Igniter Tester or any other AMPTEC product, please contact us at:

Phone: (512) 858-4045

Email: info@amptec.com

Website: www.amptec.com

D-4. 4-Wire Resistance Measurement

In many resistance measurement applications the contact resistance and can exceed the value of the test resistance by several orders of magnitude. The AMPTEC 620VN overcomes this potential error source by providing two terminals of constant current (**I** high and **I** low) and an additional two terminals for high impedance voltage measurement. The constant current source uses a variable compliance voltage circuit to overcome lead and contact resistance until the current loop is a constant level. The result is a fast, accurate resistance measurement of the test resistance, independent of the resistance of the current carrying leads.

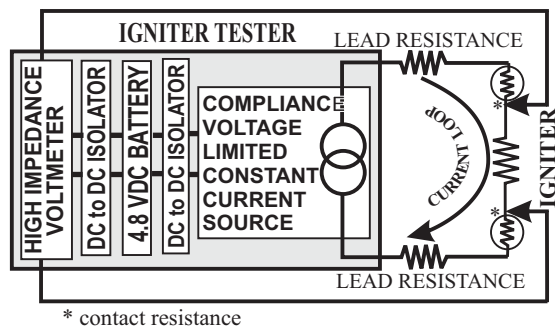


Figure D1 - Igniter Tester Kelvin Block Diagram

Figure D-1 above illustrates the 4-wire principle eliminates lead, wire and contact resistances as potential error sources. The internal constant current source inherently overcomes all series resistance (within compliance voltage limits) and delivers a precise constant current. **Separate DC to DC isolation circuitry provides independent circuit voltage supplies for both polarities of the constant current source circuit.** The internal high-impedance Digital Voltmeter (DVM) senses the voltage drop across the test resistance (i.e. squib or detonator). There is negligible contact and lead resistance error created by the voltage measurement because the high input impedance of the DVM limits current flow in the voltage (V_{hi} and V_{lo}) leads.

D-5. Connections

Connections should be made to the front and rear panel terminals using a 4-wire configuration as described in section D-3. Next connect the 4 wire Kelvin (Option "300") Clip Test Leads into the AMPTEC 620 Igniter Tester. The AMPTEC 620 front panel input jacks are spaced to only allow horizontal access (i.e. **V** high and **I** high) if using dual banana

Jacks. All AMPTEC 620VN Kelvin leads have the 4 wire current high, current low as well as the voltage sense high and voltage sense low routed to the end of the leads. The 4 wire Kelvin wires then terminate in a pair of gold plated clip jaws (upper and lower jaws). One Kelvin Clip for current and voltage high, and another Kelvin Clip for current and voltage low.

For 620 series test leads other than those terminated with banana plugs, RG-58 Shielded Coax Cabling is recommended. Customer built test wiring should maintaining the four wire Kelvin measurement if possible. Make the current conductor the largest conductor and keep the voltage sense input shielded or inside the current shield. The AMPTEC 620 series Igniter Tester's five way input jacks allow for customized wire connections, extended kelvin wiring (beyond 100 feet depending upon conductor gauge), cables terminated with spade lugs, and special banana jacks can all be used with the AMPTEC 620 Tester.

All AMPTEC ohmmeters use a high impedance voltmeter as part of the resistance measurement process. This voltmeter is a highly accurate and stable $4\frac{1}{2}$ digit analog-to-digital converter (A to D). The high impedance DVM must receive a voltage drop in order to display the proper value. When the DVM is not receiving a definite input signal, the output reading from the Analog to Digital Converter can appear random and wandering. The display may indicate a randomly wandering number or it may indicate an overrange (flashing) condition. This unpredictable display (No input to the DVM) condition is not a malfunction, in fact, just a characteristic of the high impedance voltmeter circuit and *should not be mistaken for a fault in the instrument* - As this condition is simply a state of an "open circuit" or "nothing connected" to the DVM circuitry. A flashing display (on and off usually all zeros) indicates an over-range condition whenever the test lead terminals are open, or the resistance under test is a higher value than the range selected on the AMPTEC 620 tester. **Connecting V_{HI} to I_{HI} and V_{LO} to I_{LO} eliminates the wandering (open circuit) display condition.**

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By using a 4-wire Kelvin type lead set or by shorting the V_{HI} and I_{HI} terminals together and V_{LOW} and I_{LOW} terminals together the instrument is in the 2 wire resistance mode.

Resistance Offset in 2 Wire mode

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

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



CHAPTER E - GENERAL OPERATION AND DESIGN



E-1. General

The AMPTEC RESEARCH 620VN Explosive Safety Igniter Tester is shown in the block diagram (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 620 Series Igniter Tester uses modern solid-state semiconductors exclusively and digital CMOS circuits extensively to minimize power requirements and make battery operation useful and practical. AMPTEC also maintains a spare parts inventory of all components found in the 620VNTester and its customer service department can also provide additional assistance in the trouble shooting process.

E-2. Troubleshooting

Since the 620VN 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 620VNTester should not even attempt to remove the calibration access screws or open the main panel or effect any repair whatsoever.***

Apparent 620VN 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 620VNseries igniter tester .

If you turn on the AMPTEC 620VN Igniter Tester and the display does not come on it usually means the AC to DC Adapter isn't supplying power or fuse needs replacing.

If the 620VN 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

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 620VN Tester does not come on when powered up, did you check the rear 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 620VN Explosive Safety 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 620 Series Igniter Tester can be maintained only if it is re-calibrated after a 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.

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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 620VN 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.

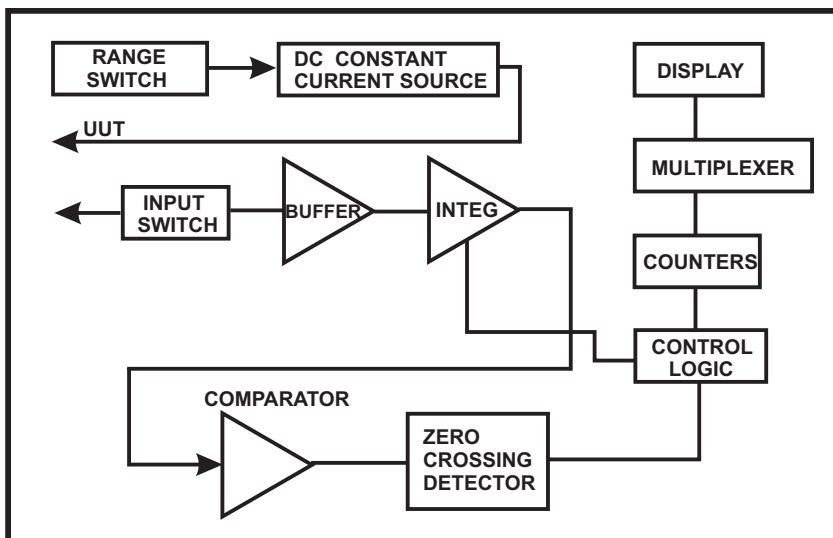


Figure E1 - AMPTEC 620VL FUNCTIONAL BLOCK DIAGRAM

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

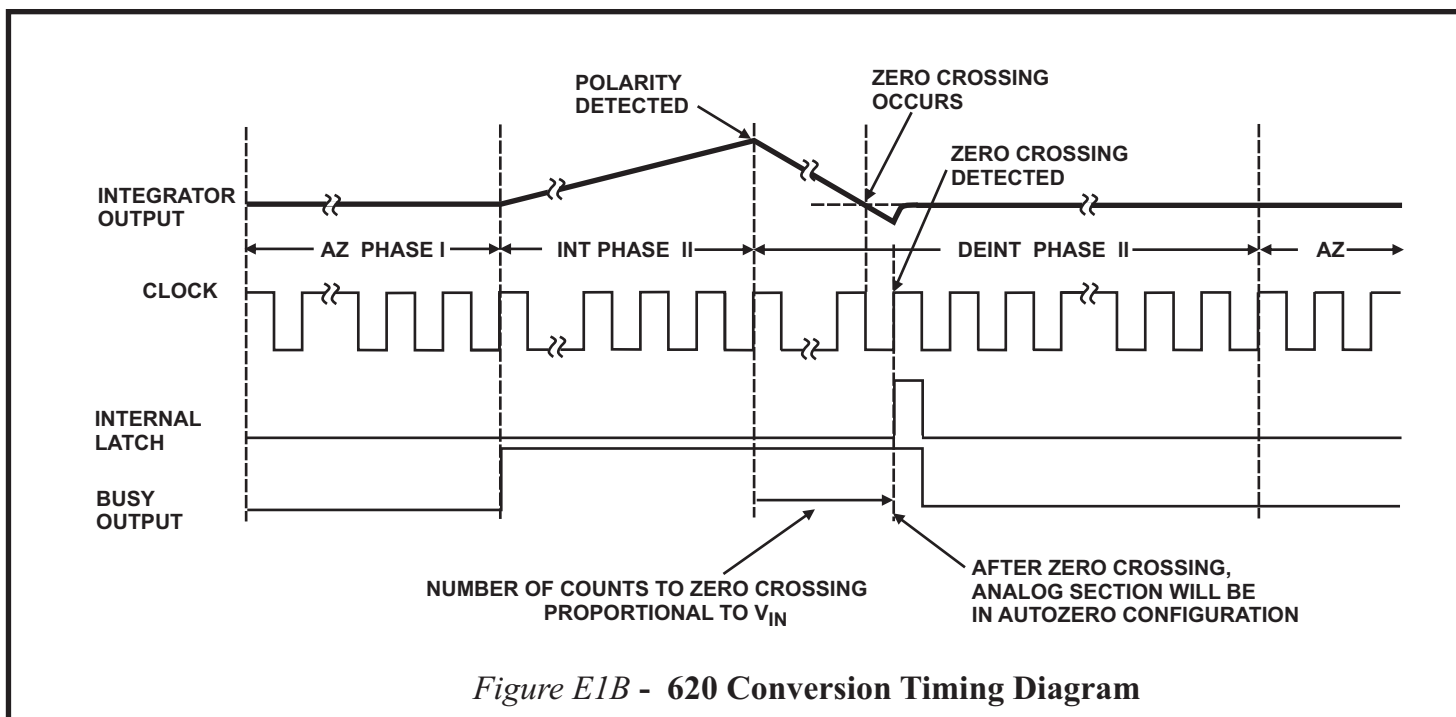
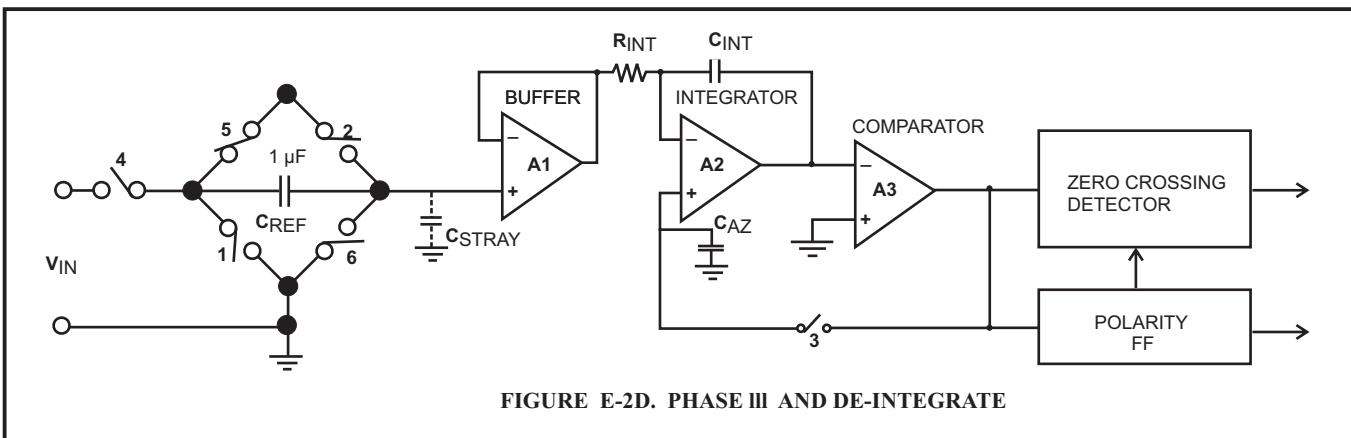
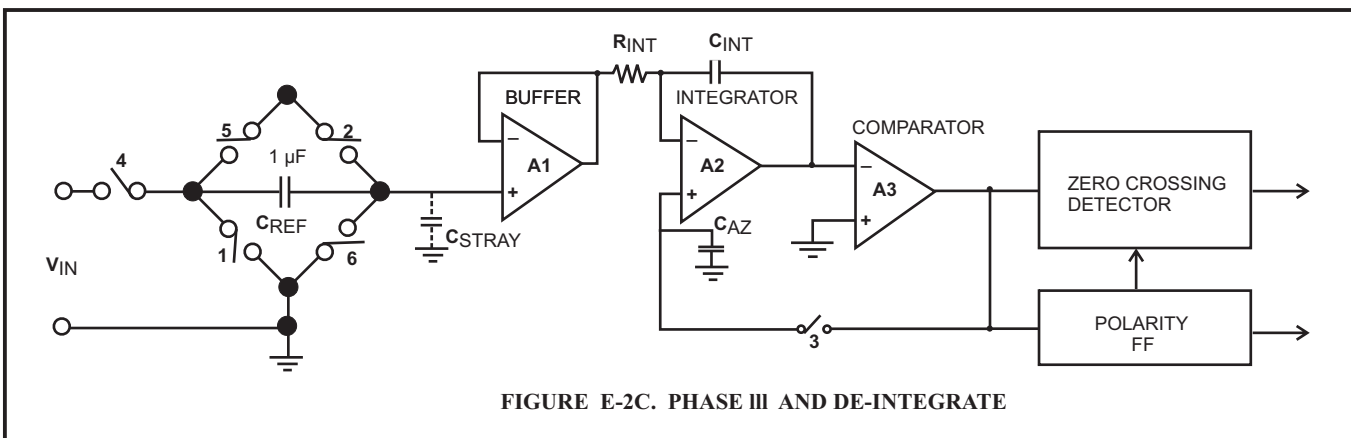
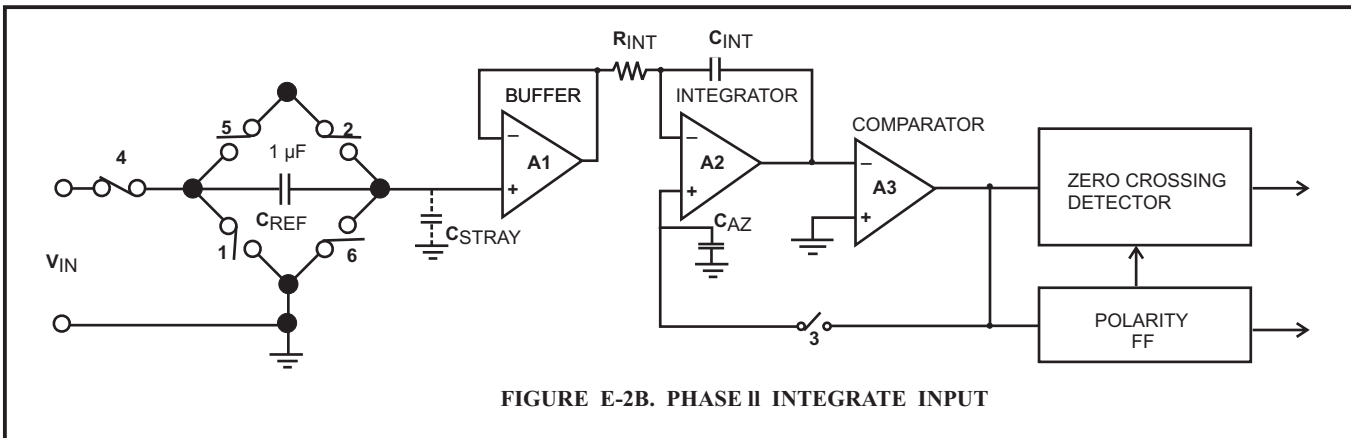
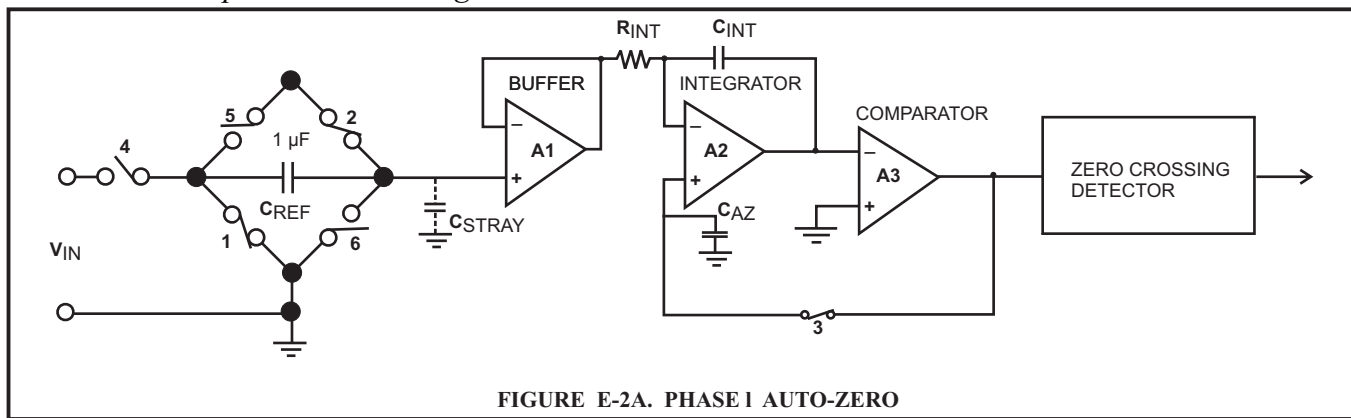


Figure E1B - 620 Conversion Timing Diagram

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

Detailed Description

Analog Section

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

Auto-Zero Phase I (Figure E2A)

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

Input Integrate Phase II (Figure E2B)

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

Deintegrate Phase II (Figures E2C and Figures E2D)

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

E-4-1. Reference Voltage

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

E-4-2. LED Display

The output format from IC2 is in Binary Coded Decimal (BCD) format. Each digit is scanned for 10 clock pulses. The scan sequence is D5 D4 D3 D2 D1. This drives Q1 thru Q5, which in turn drives the seven segment displays. The BCD data is converted to seven segment format by IC4. When the 620VL 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.

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E-5-2 Constant Current Circuit Operation

Assume that terminals I_{hi} and I_{lo} of Figure E-3 are shorted, and 0.5 volt is applied to E_{in} so that I_{hi} is positive. To equalize the 0.5 volt applied to E_{in} , the inputs of IC202, IC201 must be driven to zero. This condition occurs only when the voltage drops across R212 and R222 are equal to the drops across R213 and R221. For these voltage drops to be equal, the output of IC202 must be at +0.5 volt. Since the output of IC201-8 must be zero, the drop across R213 is 0.25 volts, making the inverting input 0.25 volts. The drops across R212, R221 and R222 will also be 0.25 volts. Since the inputs to IC201 are essentially equal, its output is zero (offset by the few microvolts required to drive IC202 to +0.5 volt). Under these conditions the sum of the voltages across R212, R213, R221 and R222 equals the sum of E_{in} plus the output of IC202.

Consider now that the short is removed from the I_{hi} and I_{lo} terminals and a 100-ohm resistor (R_L) is connected in its place. The current through R_L increases the voltage at the input to IC201. A balanced condition will be reached when the output of IC201 is equal to the non-inverting input of IC202. Again, this condition occurs when the voltage drops across R212 and R222 are equal to the voltage drops across R213 and R221. At this time the output of IC202 is 0.5 volts. The voltage drop across the range resistor is 0.5 volt, just as it was when the output terminals were shorted. The current through R_L is 5 milliamperes, just as it was through the jumper when the output terminals were shorted.

E-6. Failsafe Design

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

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

Igniter could not exceed safe limits, because the -5 volt and +5V supplies includes inherent current limiting. Because of the design of both supply isolation transformers T101 and T102, the ± 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.

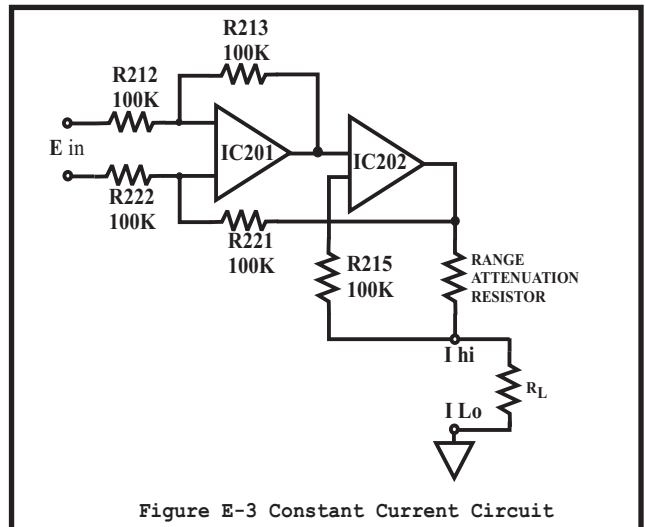


Figure E-3 Constant Current Circuit

620VN Failsafe Current Calculation - Worst Case Component Failure

Voltage limiting diode, D203, provides a 1.6 volts maximum across R227 (100W) and R223 (100W), which are 200 Ohms across the Igniter Testers output terminals.

(I_{max}) Current Maximum Calculation

$$1.6V/200 \text{ ohms} = 0.008 \text{ Amperes} \\ (8mA) \text{ max}$$

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The 620VN Tester measurement circuitry is also failsafe current limited, even under worst case component failure.

For the 620VN Tester the normal or typical operating current level is less than 5 mA, and <8mA on as a Failsafe Level .

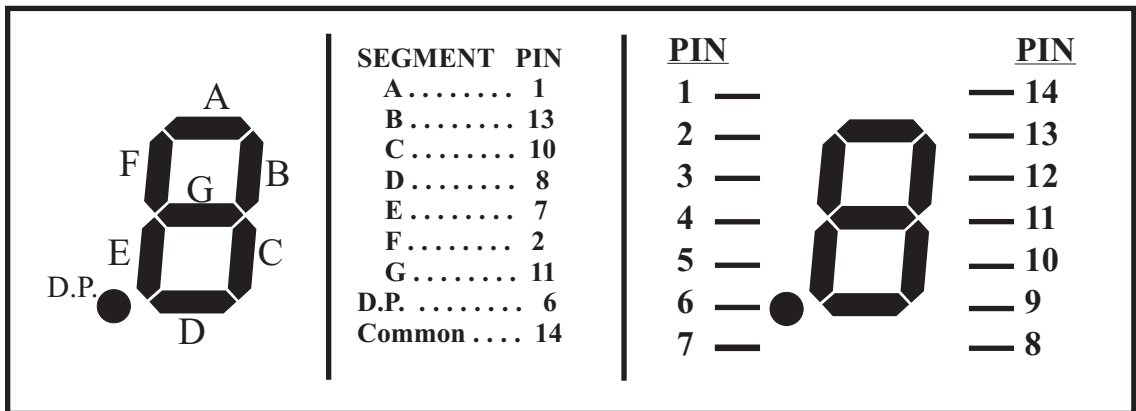
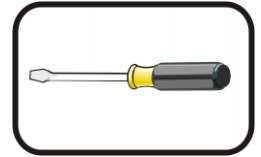


Figure E4 - 620 series LED Display Pin Out Detail/Functions





F-1. General

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

All AMPTEC 620 series Igniter Testers are four wire Kelvin compensated ohmmeters. *The 620VN Igniter Tester must be calibrated using four wire Kelvin connections to the resistance standard* in order to eliminate lead resistance and contact resistance errors. The Option "290" has 48" long coax test cabling terminated with twin single alligator clip jacks will not work properly for calibrating the 620VN.

Note: *Only for 620 versions with a 2 Ohm range:* Option "300" is a 48" long Gold Plated Kelvin Clip Lead set optionally supplied as part of the AMPTEC 620 accessories is recommended for the actual calibration of 620 Igniter Testers versions fitted with a low 2.0 Ohm range.

F-2. Required Test Equipment

Following standard resistors are required to calibrate the 620VN Igniter Tester.

Precision Resistance Standards:

- .01 ohm \pm 0.01% or better accuracy
- 10 ohm \pm 0.005% or better accuracy
- 100 ohm \pm 0.005% or better accuracy
- 1.0 Kohm \pm 0.005% or better accuracy
- 10.0 Kohm \pm 0.005% or better accuracy
- 100 Kohm \pm 0.005% or better accuracy
- 1.0 Mohm \pm 0.1% or better accuracy

Test Leads:

AMPTEC "Option 300" Kelvin Clip Lead Set

F-3. Calibration Procedure

The 620VN Igniter Tester must be calibrated with a fully charged battery pack and should be

allowed to **warm-up** for a minimum of **15 minutes** before beginning the procedure. The calibration adjustments are accessed by removing the screws in the feet on the bottom of the unit, then lifting off the lid. The locations of the adjustments are shown on drawing number 620VN -600 at the back of this manual.

F-3-1. Zero Offset Adjustment

1. Select the 20 ohm range. Connect the Kelvin clips to the 0.010 ohm standard resistor.
2. Adjust potentiometer RV2 for a display indication of 0.010 Ohms. **Do not over adjust RV2 past a 0.00 reading.** A false or negative polarity 0.010 display reading offset error can be created. This calibration error has the display appearing normal (even though a negative 0.010 offset has been created) - the display doesn't indicate a negative sign).

F-3-2. Full Scale Adjustment

1. Select the 2000 ohm range. Connect the Kelvin clips to the 1.0 Kohm standard resistor.
2. Adjust RV1 for a display reading of 1000.0 ohms.
3. Check the 20 Ohm range with a 10 Ohm resistance standard (std). Check the 200 Ohm range with a 100 Ohm resistance standard (std). Check the 20 KOhm range with 10 KOhm resistance std. Check the 200 Kohm with a 100 Kohm resistance std. Check the 2.0 MegOhm range with the 1.0 MegOhm resistance std. All ranges should be within the specifications outlined in Chapter B. *There are no individual adjustments necessary for the 20ohm, 200 ohm, 20K, 200K and 2.0 MegOhm ranges.* Contact AMPTEC's customer service department if further technical support is necessary.

F-4. Battery Monitoring Circuitry

The following does not apply to AMPTEC 620VN Meters fitted with "OPT 247" Optically Isolated Continuous operating power.

The 620VN Igniter Tester display has a LOW BATTERY LED indicator (dot) just to the left of the meter's main 4 ½ digit numeric display. The LED dot when lit is used as a Low Battery indicator. This status is also available over the meter's optically isolated RS232C serial interface. If the low battery LED is illuminated, 620VN Series Igniter Tester readings should not be trusted.

The AMPTEC 620VN is powered by an external battery, if the meter indicates "LOW BATTERY" then a freshly charged external battery should be supplied or exchanged for the LOW or nearly drained battery.

Notice for Cal Lab: The variable trimpot RV3 is factory adjusted to have the *low battery indicator* come on at approximately 4.00 VDC.

