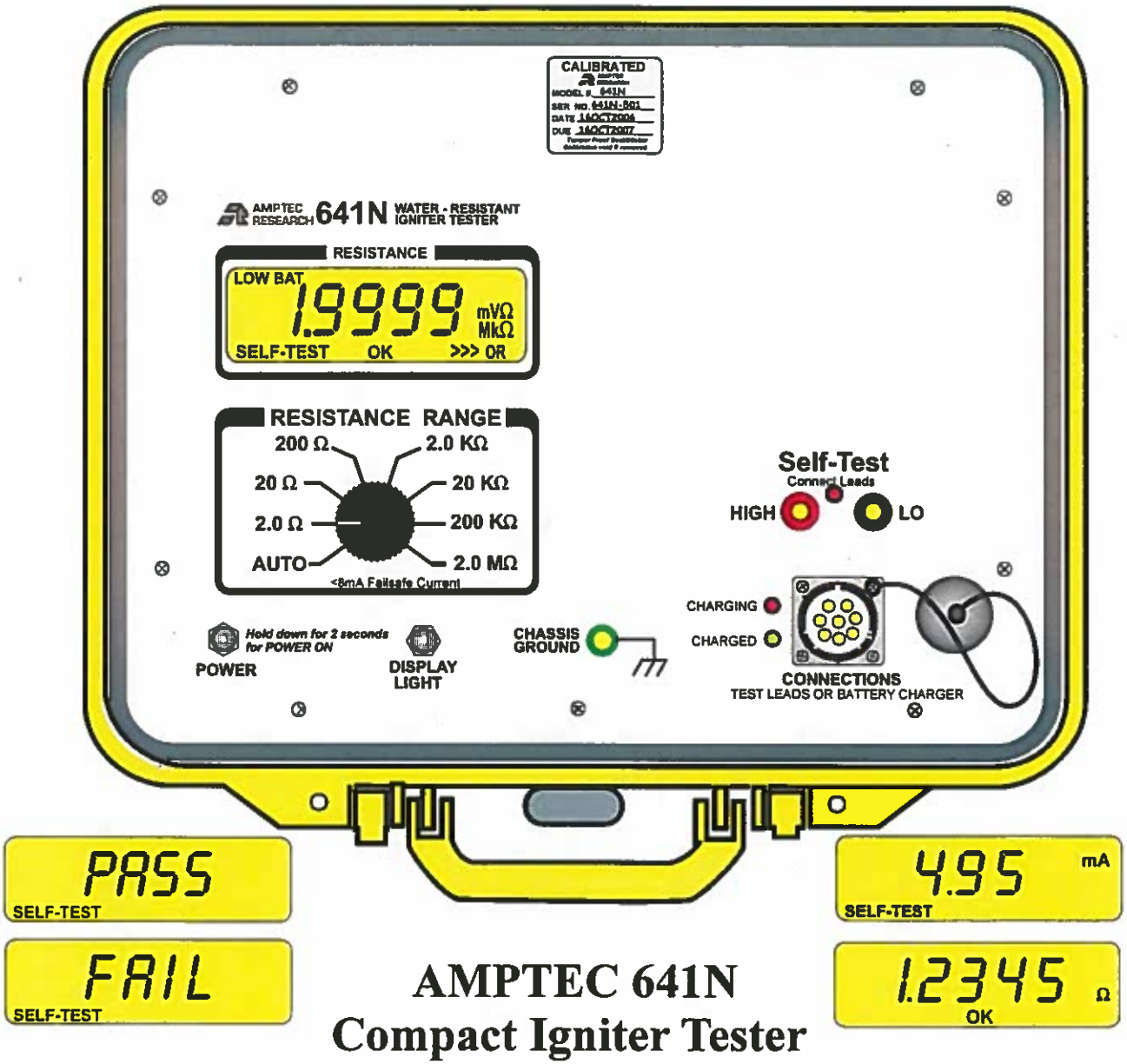
AMPTEC RESEARCH



AMPTEC 641N Compact Igniter Tester

OPERATION/MAINTENANCE MANUAL

Revision C

AUSTIN, TEXAS USA DEFENSE LOGISTICS **CAGE CODE 1CRL2**
PHONE (512) 858-4045 or 1-800-350-5105 (from the USA)
FAX (512) 858-4340 or 1-800-430-5440 (from the USA) website http://www.amptec.com

A MESSAGE FROM THE PRESIDENT

Over the past 20 years our experienced engineering staff have designed, manufactured and supplied earlier versions similar to the AMPTEC 641N Water Resistant Igniter Tester to the U.S. NAVY for submarine launched "TOMAHAWK CRUISE MISSILE", and the "Evolved Sea Sparrow Missile (ESSM). In addition the U.S.A.F. for the AIM-9 "SIDEWINDER", AIM-7 "SPARROW" and AIM-120 "AMRAAM" just to name just a few.
Throughout this manual the AMPTEC 641N Water Resistant Igniter Tester is referred to occasionally in abbreviated form as "641N ICT" (Igniter Circuit Tester), in fact we are referring to the same instrument. We value the trust our customers have placed with us, and are looking forward to supporting any new requirement you may have.

Kerry W. Clark - President AMPTEC RESEARCH

U.S. N.I.ST. CALIBRATION CERTIFICATE

AMPTEC RESEARCH, Inc. certifies that this instrument has been completely tested, inspected and was 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.

AMPTEC 641N IGNITERTESTER 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, where to). The warranty period for this instrument is 1 year from the unit's ship date. 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 have their design frozen, and no changes will be made without prior notice to the proper approving authority. Through out this manual, there may be reference(s) made to the generic model 641N series Igniter Testers. There may be versions of the AMPTEC 641N Igniter Tester specifically developed to meet our customers ever changing requirements in the future. The specification, operation, drawing and schematic sections of this manual contain the unique detail that define the 641N with a revision XX. 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.

AMPTEC RESEARCH also maintains a website at **http://www.amptec.com**. We maintain safety board approvals, product revisions-updates, schematics and this operator manual in the tech directory located at **http://www.amptec.com/tech.htm**.

Contact AMPTEC RESEARCH for the proper passwords and user I.D.'s to access the latest information for the AMPTEC 641N Explosive Safety Igniter Tester.

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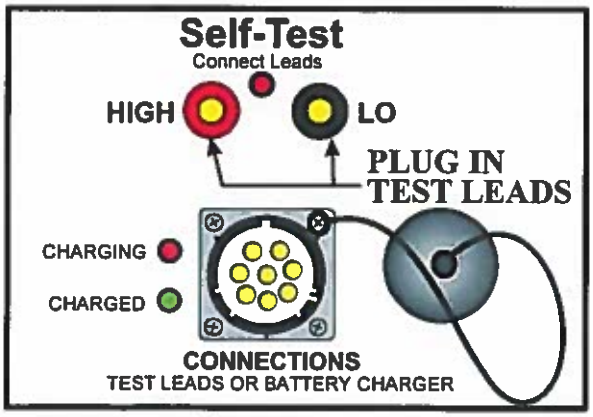
SECTION F: Routine Maintenance

SECTION A - RECEIVING AND INITIAL INSPECTION

A-1. Introduction to the AMPTEC 641N Explosive Safety Igniter Tester

The AMPTEC 620A, 630, 640 series have all been Munition Safety Board Approved and widely accepted by the US Military Forces over the years. Now the AMPTEC 641N Explosive Safety ICT) Igniter Circuit Tester) is setting a new "***Standard in the Explosive Safety Igniter Circuit Test industry***" as the first to initiate an automatic "Self-Test" to determine its own measurement integrity in a streamline fashion. It provides extremely safe and reliable resistance measurements on electrically initiated explosive devices. Safety Approvals from various Safety Boards include the US NAVAL ORDNANCE CENTER (630BN, 640N, 620UK and other versions). The AMPTEC 641N (Failsafe) milliampere constant current source is very similar analog circuit that is used in previous safety board approved units (like the AMPTEC 620UK). The primary improvements being made on the AMPTEC 641N electronics were with newer DVM circuitry and on-board microprocessor control, display control, diagnostics & charging circuitry. Some of the devices the 641N Explosive Safety ICT (Igniter Circuit Tester) Meter may be used on include: fuses, squibs, igniters, EBW, explosive bolts, rocket motor squibs, to name a few.



** note: If you don't:*
***1) plug in** the test leads **into the SELF-TEST jacks and** let it perform the multi-step sequence of tests and then*
***2) PASS** the "SELF-TEST" **the unit will not even operate** (AUTO SHUT DOWN) - displays "OK" when finished (passes) with "SELF-TEST"*

Power On - The AMPTEC 641N ICT Explosive Safety Meter main "Power" switch ***must be held down approx. 2 seconds*** to turn the meter "ON". This feature helps prevent the unwanted effect of bumping of the power switch and accidentally turning the meter "ON". Press again to turn"OFF". Low or near dead batteries are the primary reasons for the unit not powering up. If the batteries reach a low energy level, a "LO BAT" indication appears on the display.

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 641N Safety Igniter Tester 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.
The AMPTEC 641N Igniter Tester comes with its own battery charger and test leads. They are stored inside the lid compartment. Although the unit's test leads are compatible with the AMPTEC 630BN and AMPTEC 640N Igniter Testers, the battery charger for the 641N is **not** compatible. The intelligent charging / charged battery load level indicator circuitry (voltage level) isn't compatible with the AMPTEC 630BN style battery chargers. Only the 641N battery charger should be used with the AMPTEC 641N Igniter Tester.

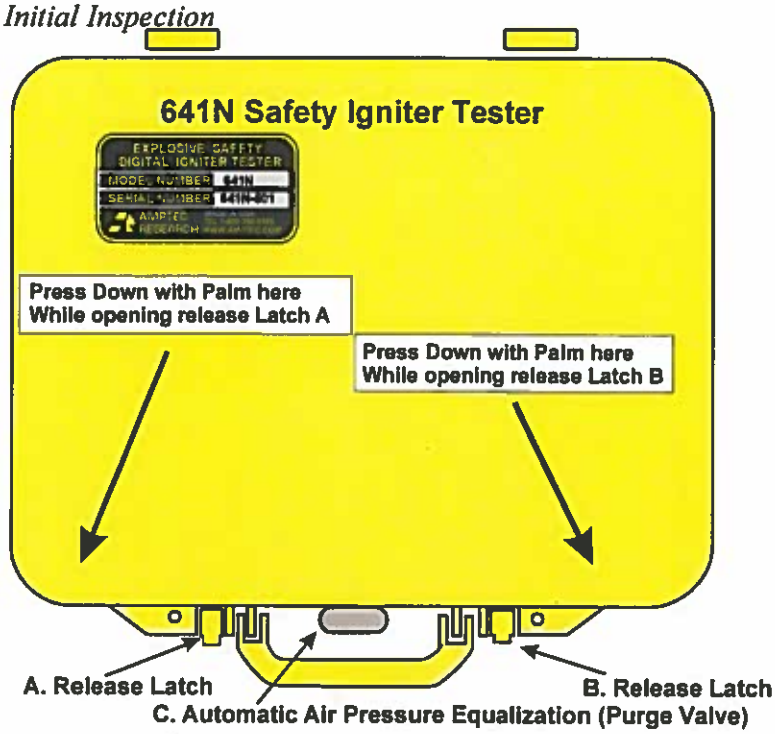


FIG. A-3

conformance with its specifications. You may refer to the ***Trouble-Shooting section of Chapter D of this manual to help identify the problem.***

If the unit fails to operate or fails to meet the performance specifications of section B, notify the carrier's agent and AMPTEC RESEARCH. 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 all of your contact information (i.e. phone and FAX numbers) in order to properly coordinate the return once repaired. **Calling AMPTECRESEARCH first, often saves having to ship us the unit. We can trouble-shoot (based on the symptoms you describe) and identify minor problems over the phone (broken test leads will also fail a self-test etc).** We may possibly be able to fix the problem over the phone, and prevent you from having to return the unit to AMPTEC's factory for repair.

A-3. Opening the 641N Explosive Safety Igniter Tester

When closed, the 641N has two large O-rings (that compress) in the lid perimeter and also under the top-plate that provide a water resistant seal. The 641N has an automatic purge valve, that should make it easy to open after a pressure or altitude change.

A-4. Battery Replacement / Power Requirements

The AMPTEC 641N Explosive Safety Igniter Tester is powered internally by rechargeable batteries. You may use a set of 4 "AA" rechargeable NiMH (Nickle Metal Hydride) batteries preferably or **only** as a second choice rechargeable NICAD batteries. Never mix types, use all of the same type of rechargeable.

Be sure to charge the Nickel Metal Hydride batteries when taken out of their original packaging for the full charge cycle after installing them in the 641N Explosive Safety Igniter Tester.

If you try to use any type of Alkaline batteries, they could explode, when a new user plugs the battery charger in (not knowing the batteries aren't re-chargeable) causing a void in the warranty. To prevent this, the battery compartment in the 641N Explosive Safety Igniter Tester is designed to sit internally within the unit. Only authorized technicians may remove the calibration sticker which covers a top plate access screw. This provides access to the internal battery compartment located on the underside of the unit's top panel. The unit will have to be re-calibrated following replacement of the re-chargeble batteries. We recommend replacing the batteries once a year during the unit's annual calibration.

"Low Battery level" is indicated by a "LO BAT" display. The unit's rechargeable batteries are charged via the unit's (one use at as time) TRIDENT connector. **When charging you can't connect any test leads to measure anything** and if measuring you can't connect the charger.

To recharge the 641N Portable Igniter Tester, simply place the Charger's mating connection into the TRIDENT connector, and then plug the opposite end into an AC/DC outlet (220VAC or 120 VAC compatible).

If 'LO BAT" is on the LCD display screen, this indicates that the unit's readings cannot be trusted because of the decreasing battery level. The 641N may be charged while on, however because the 641N only has one connector, (the TRIDENT connecter) the unit cannot be charging and take reading at the same time. Although you may charge the unit while on, the 641N will charge faster if it is off. You should **primarily** use NiMH (Nickle Metal Hydride preferred) or re-chargeable NICAD (Nickel Cadium) batteries. The NiMH batteries (4 ea. "AA") are better than NICADs, as they do not have a memory discharge problem and **store typically twice the capacity** (2900 mAHr vs . 1600 mAHr)

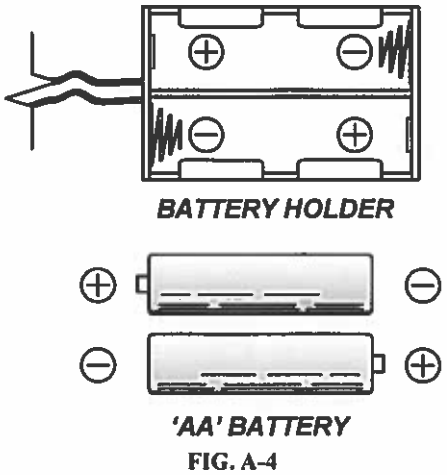


FIG. A-4

NOTE: For Authorized Personnel Only

When replacing batteries in the 641N Explosive Safety Igniter Tester, you may *preferably* use NiMH (Nickle Metal Hydride) or NICAD batteries as a 2nd choice. **Do not use any type of Alkaline battery in the 641N! !**

In order to remove or replace any battery in the 641N, you must remove the calibration sticker and take out all perimeter screws securing the top panel. The battery box is mounted on the underside of the unit's front panel. Undoing the machine screws that secure the metal battery box gives you access to the battery compartment. When you replace batteries in the 641N, make sure you secure the batteries with a cable tie of some sort to the holder. Using a plastic tie wrap in the battery compartment, wrap the plastic around the battery holder and secure. Cut excess plastic. Following a new calibration, lastly replace the lid and screw in the top plate screws to secure. See Fig. A-4 above.

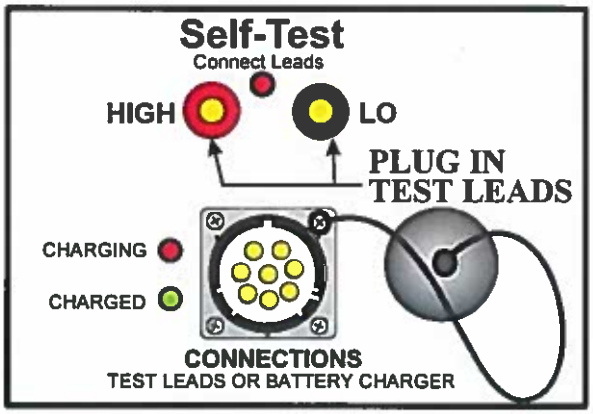
A-5. Setup and Use

The 641N Explosive Safety Igniter Tester consumes little power and generates virtually

no heat. Consequently, it may be used in any area where the environment does not exceed the specifications of Table B-1.

Avoid exposing the 641N Explosive Safety Igniter Tester to extremes of temperature which will affect accuracy and shorten battery pack lifespan.

Become familiar with the **"Self-Test"** routine that occurs automatically at power-on (*see section D for a full description of all the steps*). As stated below the 641N will not even operate if it doesn't first PASS the "Self-Test" routine.



** note: If you don't:*
***1) plug in** the test leads **into the SELF-TEST jacks and** let it perform the multi-step sequence of tests and then*
***2) PASS** the "SELF-TEST" **the unit will not even operate** (AUTO SHUT DOWN) - displays "OK" when finished (passes) with "SELF-TEST"*

SECTION B - RANGES, LEVELS & SPECIFICATIONS
AMPTEC 641N PORTABLE IGNITER TESTER

641N Resistance Range/Resolution Nominal Test Current/ Failsafe Test Current

2.0 ohm	20 ohm	200 ohm	2.0 Kohm	20 Kohm	200 Kohm	2.0 Mohm
100 µohm	1 milliohm	10 milliohm	100 milliohm	1 ohm	10 ohm	100 ohm
5 mA	5 mA	0.5 mA	50µA	5µA	0.5µA	50nA
8mA	8mA	1.5 mA	150µA	15µA	1.5µA	15nA

Table B-2. Specifications

Accuracy: (for 1 year @ **20°C ± 10°C**)

2.0 ohm range . . . . . ± 0.03% of reading ± 0.03% of range

20 ohm range thru 200Kohm ranges . . . . . ± 0.03% of reading ± 0.03% of range

2.0M ohm range . . . . . ± 1 % of reading ± 0.2% of range

Temperature Range - Operating . . 0°C to +40°C, Storage . . . . . -10°C to 60°C

Temperature Coefficient : Additional 5 counts (from 0°C-10°C and 30°C-40°C)

Instrument Display . . (20,000 counts) 4½ digit Liquid Crystal Display (LCD) with a back light for viewing the 641N display in dim ambient light conditions.

Self Test diagnostics performed at "Power Up" . . . . . LCD displays "SELF TEST during the process and "OK" after successful self test, the instrument is inoperable if the instrument does not pass self test.

Low Battery Indication . . The AMPTEC 641N LCD Displays shows "LO BAT"

Over-Range Indication . . . " **>>OR** " in the 641N LCD display

DC Resistance Method . . . . . Four Terminal Kelvin configured

Measurement Update Rate. . . . . .Approximately 3 readings per second, Auto-range may require a few extra seconds (meter may need to make several range changes) to get to final reading.

Open Circuit Current Source Compliance Voltage . diode clamped at <1.6 volts

Power . . . Re-chargeable Battery Pack is inside a separate battery compartment (box) from the units main electronics, located under the AMPTEC 641N Top Plate (no user access). Only Authorized (calibration) personnel have access (remove calibration seal) to internal electronics and the battery compartment. The battery type is primarily rechargeable NiMH (2900 MAHr or greater) or NICADs can be used - 4 each type "AA".

Dimensions . . . . . 10"W x 9" D x 5"H

Weight . . . . . ~ 6.5 lbs net; 8 lbs shipping

Case - Waterproof to a depth of 3 feet with the case lid closed

Test Leads - For NAVY customers it includes one set of 641N compatible test leads (Eichmann Technologies locking copper tellurium banana plugs - twin single banana plug terminated)

Compatible Test Leads, Probes, Accessories and Spares

All the AMPTEC 641N series test leads are normally 48"long unless a custom length is ordered. These test leads **all** use the water-resistant **ITT Cannon Trident**tm (test lead mate) compatible connector which mates with the unit's front panel **"CONNECTIONS** or **TEST LEAD"** jack (shown here). The majority of these test leads are normally 4-**Wire Kelvin** unless twin single banana jack terminated (OP630-305) ordered. Not all 630 and 640 series test leads will easily store in the unit's lid compartment (contact AMPTEC for details).

Kelvin Leads, Probes Accessories and Options

Option 630-300: Gold Plated 4-Terminal Kelvin Clip Leads

The option "630-300" is a shielded 48" lead set terminating in ½" opening Gold Plated 4-Terminal Kelvin clips. The option "630-300" can clip easily to wires, pins, and medium size (up to ½" diameter) conductors. Option "630-300" is the recommended 4- wire Kelvin Clip lead set for all **ITT Trident** connector based AMPTEC instrumentation. The notched connector end plugs directly into the unit's **J1** main front panel connector (commonly labeled "test leads or connections").

Option 630-304
4-Wire Kelvin Banana Jacks

Option 630-305
Twin Single Banana Jacks

Option 630-304: 4-Wire Kelvin Banana Jack Leads

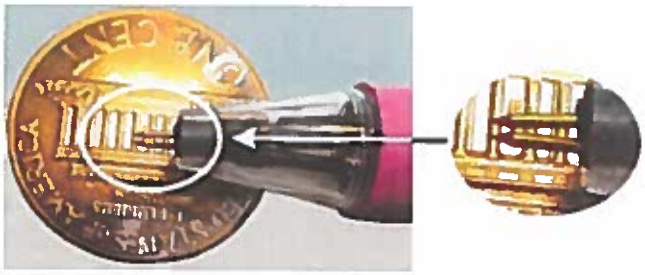
Option "630-304" is the recommended 4-wire Kelvin banana jack test lead set for **ITT Cannon Trident**tm (test lead mate) compatible connector which mates with the unit's front panel. The option "630-304" is ***terminated with four individual gold plated banana jacks*** (*Vhigh*, *Vlow*, *Ihigh* and *Ilow*). The notched connector end plugs directly into the 630ES's J1 main front panel connector labeled for "test leads". **Option "630-305"** is a Twin Single Banana Jack Lead Set for 2 wire resistance method applications. It has two single gold plated banana plugs (meter and common) terminated with the **ITT Trident** compatible style notched connector (J1 mating)

One banana plug is **red** (Voltage high and Current High) and the other banana plug lead end is **black** (Voltage low and Current low). The back of each banana jack is open to accept any other banana post when "piggybacked" into it. ***The 4-wire configuration is maintained up to the point of the banana plug, eliminating most cable resistance effects.***

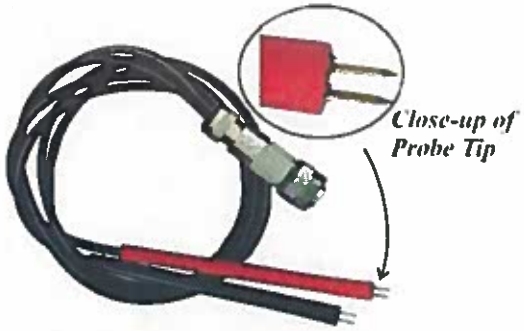
Option "PG-401" ***Round Tipped*** **4 Wire Kelvin Pistol Grip Probe Set** - ***often used for low resistance bond measurements*** (< 2.5 milliohms) (*620UK-B Bonding Ohmmeter* **ITT Trident connector compatible**). Ideal for use on metal *or* conductive surfaces (flat or round), chassis', cable bulkheads or grounded blocks, that don't readily accept lead clip(s) attachment.

Option "630-401" Gold Plated Single Pointed Probes

It is a partial 4-wire Kelvin l lead set. (up to the base of the gold plated probe tip, 2 and 2 style) with each hand-held probe. 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. It's **ITT Trident**tm compatible mating notched test lead connector plug compatible. The partial 4-wire configuration is maintained up to the base of the tip (~ 1.0 milliohm). This eliminates 98% of most "in-series cable resistance effects". They can be used where a single probe tip is a must (i.e probing into connector sockets or difficult to connect to conductive test points). The small resistance offset can easily be characterized and then subtracted from the measurement.



Option "630-402" 4-Terminal Kelvin Micro-probes
Similar to Option 630-401 shown above except each probe has two gold plated fine steel tips that are spring loaded. The two spring loaded tips on each micro-probe maintain the 4-Wire Kelvin Ohmmeter test lead connection (a set of OP630-402 probes is 2 probes - 4 points). The micro spacing of 0.05" is the separation of the two spring loaded tips. The delicate tips are not recommended for rough handling use (see OP630-403).



Option "630-403" ***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 Kelvin Mini-Probe.** Normally supplied with sharp tips. round tips available.

Option "641-DC" is the slimline 641N **ITT Canon**tm **Trident** compatible connector battery charger. This AC/DC battery charger supplies the 12.0 VDC needed to charge the AMPTEC 641N and drive the intelligent LED indicating charging and charged circuitry.

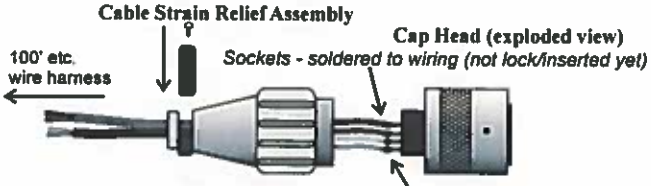
You can also make your own custom **ITT Cannon Trident** connector compatible test lead wire harness. The option **"630-PLUG"** or option **"630-SGBELL"** is available. Gold sockets, heat shrink tubing, an insertion/extraction tool and a mating Trident J1 connector (used to tighten cap when assembly is near completion) along with instructions is available from AMPTEC RESEARCH.

Completed Assembly Cap Head and Plug
Option **"630-PLUG"**

Backside of Cap Head
(accepts locking socket wires)

The backside of the caphead has a threaded collar that accepts the plug collar assembly. *Notice the hole identification is opposite the front side.*

Plug (exploded view)



Plug - screws into back of cap (use Locktite) when assembly is finished tighten the strain relief back end assembly.

Thin insulating heat shrink tubing should be installed around any exposed/stripped wiring that attached to the sockets to prevent shorting to any other wiring.

SECTION D - UNIT OPERATION, FUNCTION AND USE

D-1. General Operation

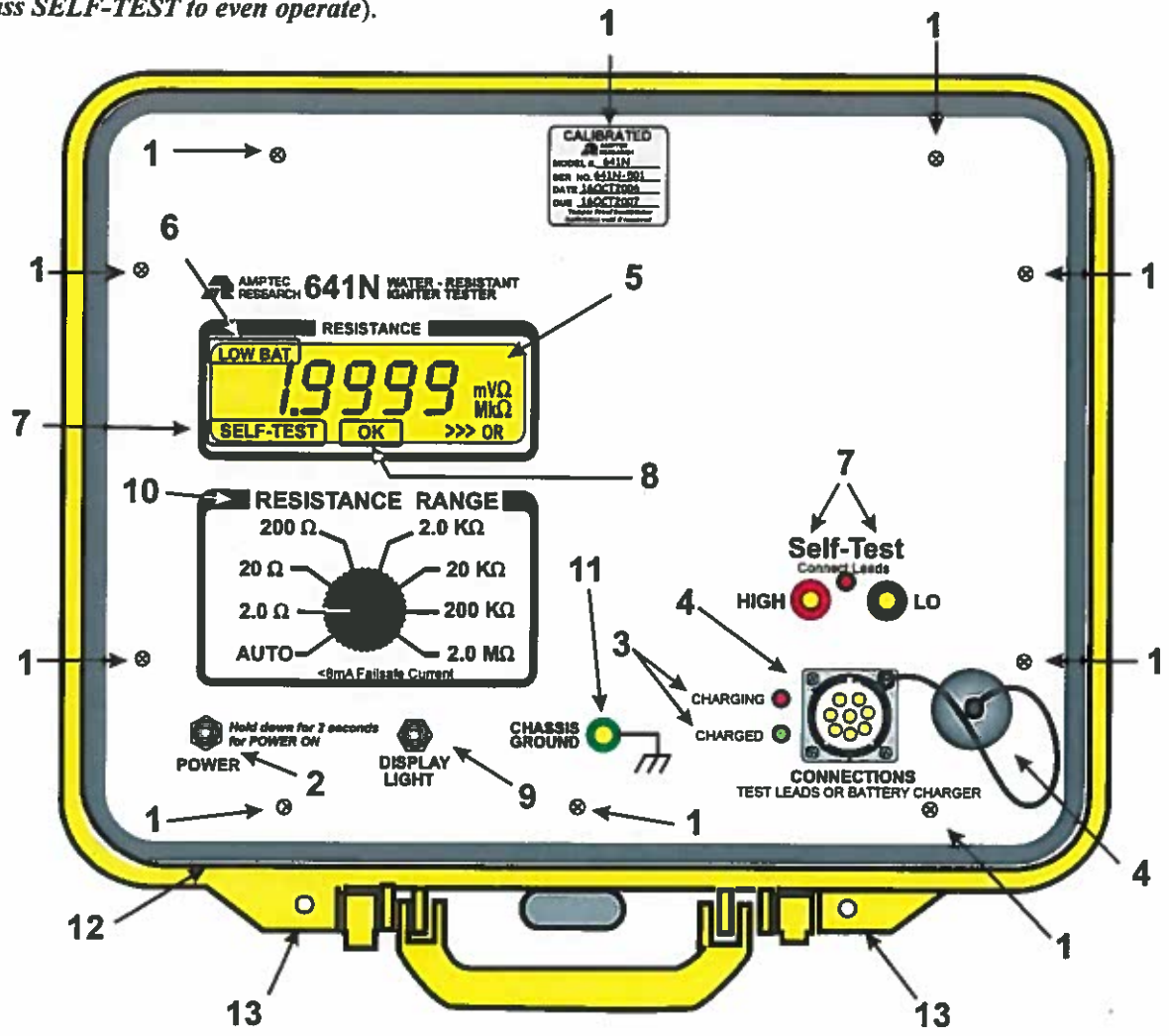
A diagram and description of the front panel controls, connection instructions, and the theory behind resistance measurement is discussed in this section.

D-2. Front Panel Features and Operation

1. Calibration / Maintenance access screws, also can be easily protected with a tamper resistant calibration sticker. After removal of the perimeter screws (item #1) use a flatblade screwdriver and carefully lift up the top plate. Use caution when lifting, as umbilical and ribbon cabling is attached to the unit's top plate .

2. Power On requires user to **press and hold** the button down for approx. 2 seconds in order to power up. The SELF-TEST routine (**item #7**) will begin automatically at turn on, so the user should become familiar with the entire SELF-TEST process in order to operate the instrument properly (***the unit must pass SELF-TEST to even operate***).

3. CHARGING & CHARGED indicator LEDs provide AMPTEC 641N Igniter Tester battery energy level information to the user. The AMPTEC 641N may be used anytime there is no "LO BAT" (item #6) displayed after passing SELF-TEST (item #7). Connecting the universal input AC powered battery charger to the unit's Trident "CONNEC-TION" port" (item #4) starts the microprocessor based battery charging process. Initially both red (**charging**) and green (**charged**) LEDs flash for 2 times, then go out. The red (charging) LED comes on (constant) while it's charging. Next the green (charged) LED will flash indicating a trickle charge mode (until batteries are completely charged).Last the green LED (charged) indicator comes on con-stant to signal it's fully charged. This sequence will repeat the steps above in an expeditious process if the charger is re-connected to an already charged 641N. ***Quick Charge note***: The 641N charges about 3 to 4 times faster than the AMPTEC 630BN or 640N. That means you could charge it up for 1 to 2 hours and get 4 to 6 hours of operation.



Sect. D - Operation, Functional Self-Test and Use

4. Single Access Notched Water Resistant Trident Connector - for test lead hookup and is ***compatible with existing AMPTEC 630BN and 640N Test Leads.*** Includes a connected twist snap lock seal cap for added environmental protection. User can **either** connect the test leads **or** connect the unit's battery charger to the **"CONNECTIONS"** port (see item #3 for additional description). *Note: The AMPTEC 641N battery charger is unique and AMPTEC 630BN and 640N battery chargers are not compatible with this unit and should not be used with the AMPTEC 641N Igniter Tester.*

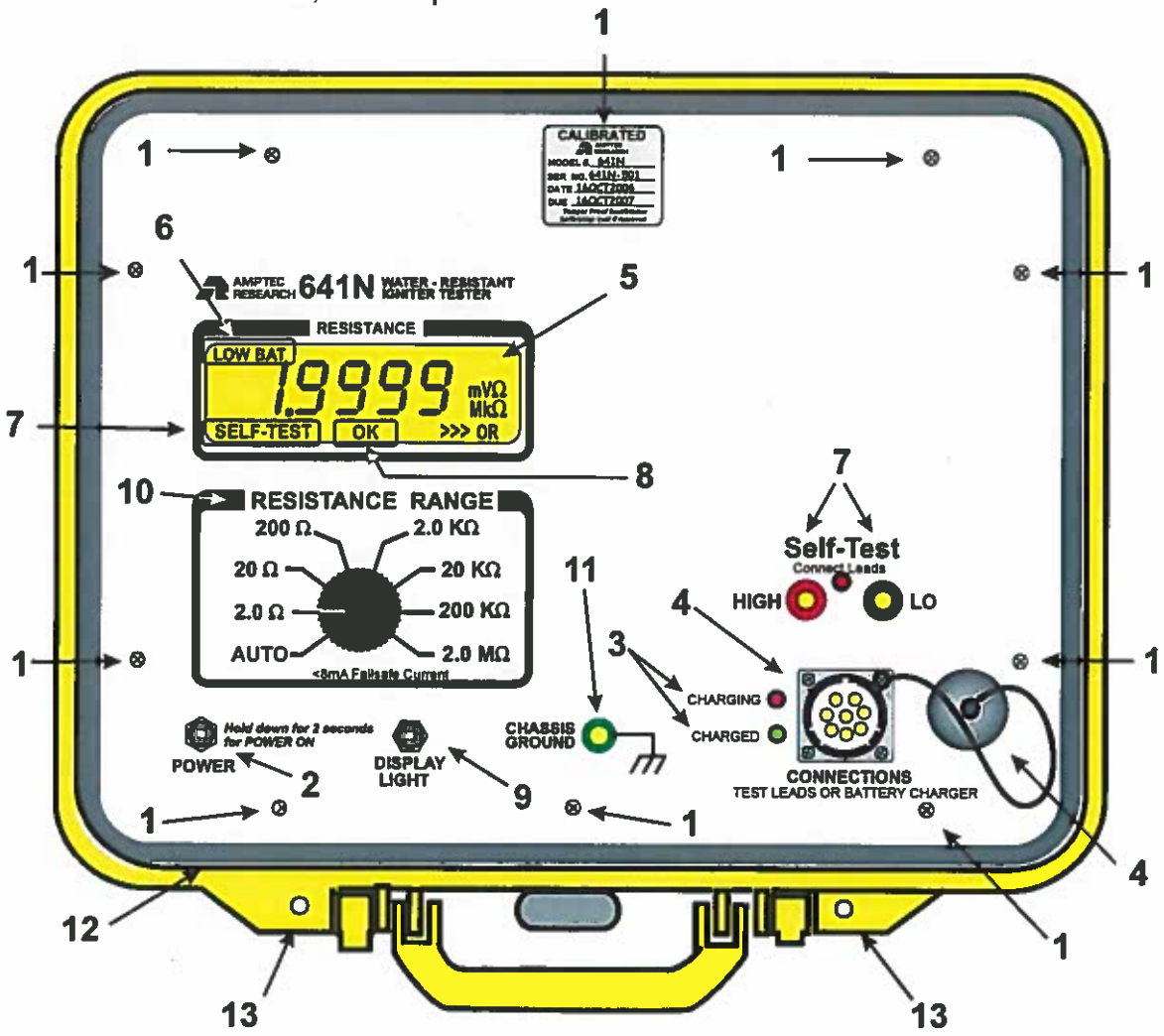
5. Liquid Crystal Display (with many TEST parameter annunciators) uses 1/10 the battery power of a red 7 segment L.E.D. Digital Display. LCD display shows **mA** and Ω , KΩ , and MΩ ohm related symbols.

6. "Low Battery level" is indicated by a **"LO BAT"** display. Recharging the four 4 each "rechargeable" batteries can be done by the 641N operator. *Note: the only access to the batteries is to not only break the calib. sticker but requires unscrewing/lifting the units top plate.* **Re-chargeable Energizer 2500 mAHr** "AA" type batteries are **not recommended** (high internal self discharge rate). You charge them up, put them on the shelf after a few days they are nearly dead. We recommend Duracell 2650 mAHr NIMH, and Accupower 2900 mAHr.

We recommend any NiMH **AA battery** that is 2650 mAHr or greater primarily because they tend to also have a much lower self discharge rate.

7. SELF-TEST -The operator **must** have the **test leads connected** to the unit's connection port (item #4) and also to the **self-test** input jacks in order to PASS the self-test (***prompted by a red flashing LED***). At Power **"On"**, the AMPTEC 641N first begins it's automatic **self test.** The LCD display (#5) flashes **"SELF-TEST"** while each resistance range is automatically connected to a precision test resistor. Stepping through the **"SELF-TEST"** sequence, first the test current level is measured. The unit's test current is measured and **actual output test current level is breifly displayed (i.e. 4.95 mA)** using an internal shunt resistor (< 5 mA or less to **PASS**).

If the test current is less than 5 mA then **PASS** is momentarily displayed in large letters. (*above*)



If a faulty level is measured then "**FAIL**" is displayed for a few seconds then the unit automatically turns "OFF". You must repeat the **Self-Test** any time you power up. Each resistance range is tested against an internal reference resistor of proper magnitude. The AMPTEC 641N displays the actual measured test value (i.e. **1.0009 Ohm** on the **2.0 ohm range** etc.) of the internal Self-Test resistor for the 2.0 ohm range. The unit's **Self Test** mode is **only** a functional test to make sure the instrument is operational on each range and safe to use (less than 5 mA). **It can also help you detect broken test leads.** It is **not** an internal calibration. The self-test has pre-stored limits set by the micro-processor that expect to see a certain range of readings. Any "Self-Test" measurement that is **too high or too low** will invoke the **FAIL** routine. The range that fails is momentarily displayed. ***(see below)***

Following this display, "PASS" or "FAIL" will be displayed again for just a few seconds.

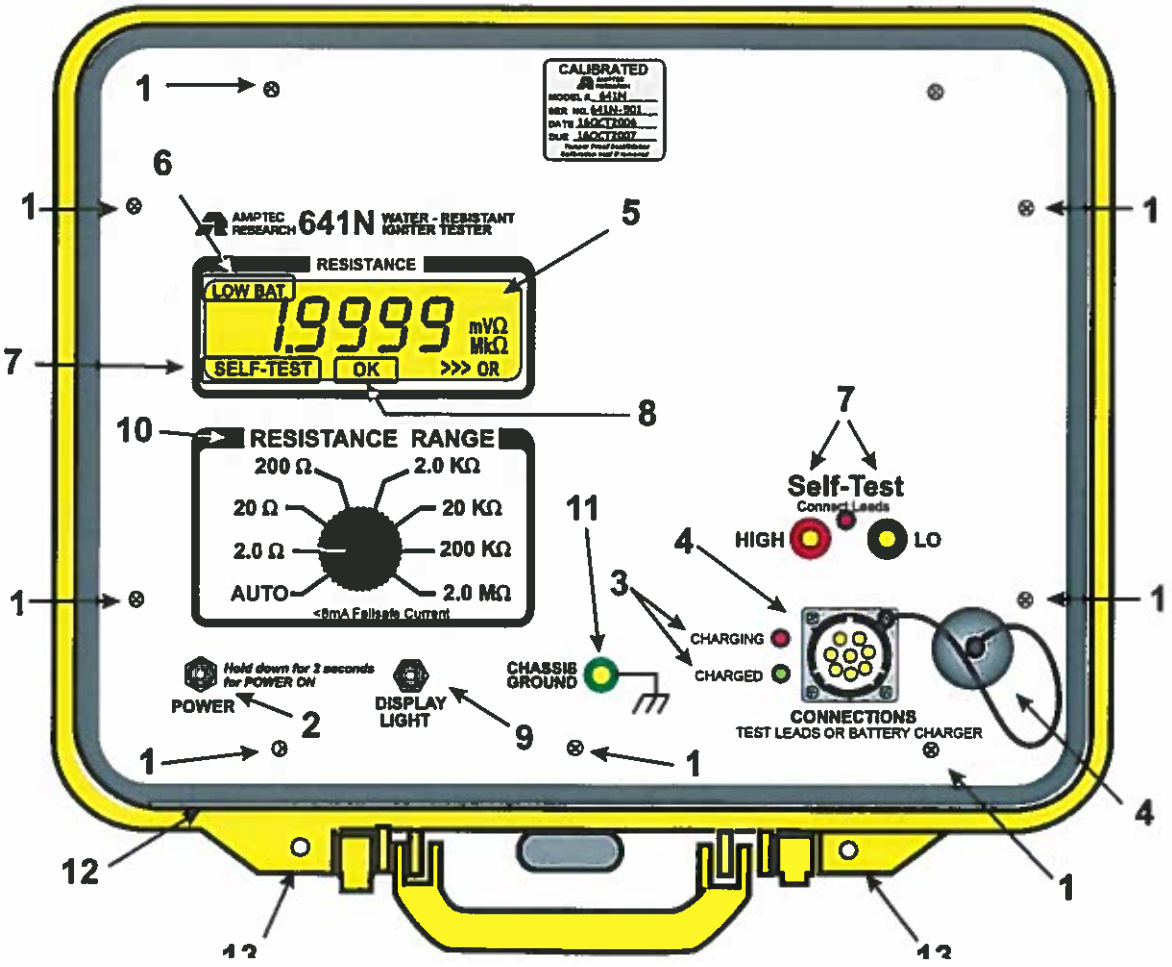
The self test feature reduces human error (older model ICTs often require a full manual check out procedure to be performed using **a** milliammeter and test resistors often taking ½ hour or more. The **641N** "**Self Test**" routine streamlines previous manual check out routines that were tediuosly performed on igniter testers, which were also more subject to human error.

The ***last step*** in the self-test routine is the 2.0 Megohm range. An internal reference resistor of approx. 1.0 Megohm is switched into the **Self-Test** jacks at this point. If the expected 1.0 Megohm measurement is within the unit's (microprocessor acceptable) limit then "**PASS**" is displayed for about a second, then "**OK**" is indicated. This "**OK**" indication ***will continue to be displayed*** as long as the instrument power is left on.

8. The constant display of "OK" is visual proof or confirmation the **AMPTEC 641N passed** "SELF-TEST". It's ready to connect to live ordnance when "**OK**" is ***continually*** shown on the display.

9. LCD Display Backlight - Press this momentary switch (silicone rubber boot protected) to back light the LCD Display (for use in dim ambient light situations)

10. Decade resistance ranges from 2.0 ohms, 20 ohms, 200 ohms, 2.0 Kohms, 20 Kohms, 200 Kohms and 2.0 Megohms.



Note: **Whatever resistance range is manually selected,** the unit's **self-test jacks** (see item # 7) have the **corresponding** internal cardinal point functional test resistance present. ***This can come in very handy when trouble shooting connections etc.*** The 2.0 Ohm range position has a ~1.0 ohm test resistor at the self-test jacks (the 20 ohm range has ~10 ohm reference resistance, the 200 ohm range has a approx. 100 ohm resistor present, the 2.0 Kohm range has a 1.0 Kohm test resistor etc. at the self-test jacks. **Auto-Range** allows the user to let the AMPTEC 641N Igniter Tester determine the optimal range for the "resistance under test".

11. Chassis Ground Jack - Gold plated binding post that is connected to the unit's internal Faraday cage, metal bottom plate and top plate that can be used for earth grounding the 641N or floating it at the same potential as the device under test. It accepts a standard plug-in banana jack (DMM style) test lead wires.

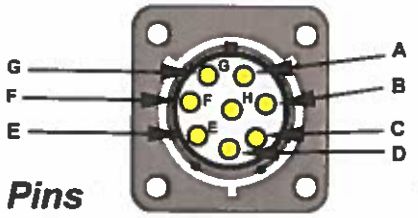
12. Twin Water Tight O-ring Seals - Both the **AMPTEC 641N Lid** and top plate are pressed against compression rubber O-rings to provide excellent weatherizing for use around wet environment.

13. Padlock Holes - The AMPTEC 641N Igniter Tester can be locked (i.e. during transit) to help prevent tampering and provide added security.

AMPTEC 641N Test Leads - The AMPTEC 641N test leads (641N-305) are normally stored along with the battery charger (641N-DC) inside the hinged test lead compartment in the unit's lid area.

The AMPTEC 641N Explosive Safety Igniter Tester Front Panel Test Lead Connection uses an 8 pin connector on it's front panel, labeled "**Connections**" . For all resistance measurements **only** pins **A, B, C, and D** are accessed with the test leads (plug). Pin **A** of the connector is the **Current High** Test Lead connection. Pin **B** of the Test Lead connector is **Voltage High**. Pin **C** of the Test Leads is the **Voltage Low** and Pin **D** is **Current Low. Pin E** is the **+5VDC** for the battery charger. The **Pin F** is Volts common (return line for the battery charger). Pin **H** is unused. **Pin G** being **chassis ground** is connected to the meter's internal metallic Faraday cage (side walls), metal bottom plate , metal top plate (under side of front panel), and the front panel binding post labeled "**Chassis Ground**". The AMPTEC 620UK-B 4-Wire Kelvin test leads have sockets that mate with the pins in the front panel main connector, ***see diagram on previous column (for pins) and below*** for socket detail.

Connections
Test Leads or Battery Charger
(on front panel)

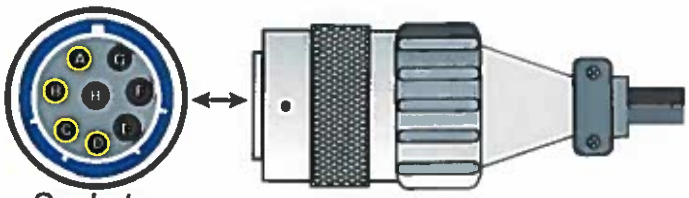


Pins

A= I High	***E= +5 VDC for Battery Charger***
B= V High	***F= Volts common - charger only***
C= V Low	***G= Chassis Ground***
D= I Low	***H= unused (center pin)***

Test Lead Connection Pin/Socket detail

KELVIN TEST LEAD MATING CONNECTOR

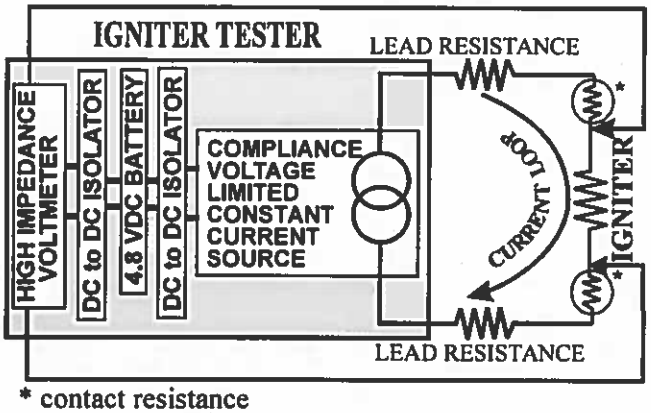


Sockets
End View

SIDE VIEW

D-4. 4-Wire Kelvin Resistance Measurement
The AMPTEC 641N Igniter Tester can be either 2 wire method resistance meter or a 4 Wire Kelvin also called 4 terminal resistance) ohmmeter. With 2 wire resistance method meters, all **test lead wiring resistance and** test lead connection **contact resistance** is in series with the "resistance under test" and as a result a resistance error or offset may be generated. If the wiring (2 wire method) is shorted at the end and measured this "in-series resistance" offset can be subtracted from the combined resistance of lead wiring plus the unit under test resistance to determine the unit under test resistance. In 2 wire applications where the test wiring (i.e. harness length) is several ohms it is a common way to correct for this error.

Fig. D-4 illustrates how the 4-wire principle is used to eliminate lead, wire and contact resistances as potential error sources. The internal failsafe constant current source inherently overcomes all series resistance (within compliance voltage limits) and delivers a precise constant current. The compliance voltage of the AMPTEC **641N Igniter Tester** constant failsafe current source will drop (1.6 VDC) as the resistance under test increases to maintain constant current (i.e. 5 mA on the 2.0 ohm and 20 ohm ranges). The failsafe constant current may be thought of as a current loop from IHIGH out to the "UUT" and back to the AMPTEC 641N Safety Igniter Tester through the ILOW jack. The constant current loop is maintained at a constant current level by the compliance voltage which automatically compensates for "path resistance". That is the compliance voltage automatically increases or decreases as the in-series path resistance changes.



* contact resistance

If the AMPTEC 641 Igniter Tester completely runs out of compliance voltage (in trying to maintain the constant current loop) then the path resistance is too high (exceeds the range) a level, it must be in "overrange" (displayed as **>>>OR**).

The four-terminal kelvin configuration of the AMPTEC 641N Safety Igniter Tester eliminates errors normally caused by in series test lead resistance and contact resistance(s). In many applications the contact resistance and can exceed the value of the test resistance by several orders of magnitude. The AMPTEC 641N Safety Igniter Tester overcomes this potential error source by providing two terminals of (*continued next column*) constant current and an additional two terminals for high impedance voltage measurement. Separate DC to DC isolation circuitry provides independent circuit voltage supplies for both the constant current source circuit and the voltmeter circuit. The internal high-impedance DC Digital Voltmeter (DVM) senses the voltage drop across the test resistance (i.e. igniter/squib or detonator). There is negligible contact or lead resistance error seen by the voltage measurement as the high input impedance of the DVM limits current flow in the voltage (VHi and VLow) leads. Since there is virtually no current drawn (high impedance) by the voltmeter there is virtually no voltage drop associated with test lead resistance (length) or connection / contact resistance. The only voltage drop of significance is the "unit under test" (i.e. squib resistance) generated by the failsafe constant current loop.

D-5. Connections

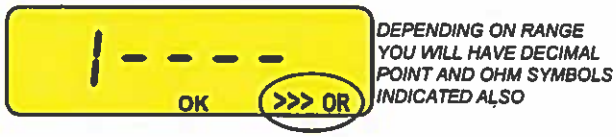
From the **front panel "Connections port"** - When in 4 Wire Kelvin (Ohms) mode, the four pins used (pins A, B, C, and D) are current high (IHIGH), voltage sense high (VHIGH), current low (ILOW) and voltage sense low (VLOW). Even 2 wire test lead sets like Option 630-305 Twin Single Banana Jack test leads are 4 Wire Kelvin most of the 48" length of lead cabling right up to the base of the twin single banana jacks.

With a 2 wire resistance measurement method, all **test lead wiring resistance and** test lead connection **contact resistance** is in series with the "resistance under test" and as a result a resistance measurement error or offset may be generated if not compensated for. If the test lead wiring (2 wire method) harness is shorted at the end and measured with the AMPTEC 641N Safety Ohmmeter/Igniter Tester this "in-series resistance" offset can be subtracted from a second measurement of the combined resistance of lead wiring **plus** the unit under test resistance (i.e. missile squib) - in order to determine the unit under test resistance.

In 2 wire applications where the test wiring (i.e. harness length) is several ohms this is a common way to correct for this error.

Troubleshooting Connections -
If you have fairly short test leads (i.e. 48" long) then you can plug them into the "**Self-Test**" jacks on the unit's front panel and perform a self test (reset the power). If the test leads are broken or have a bad solder joint then the AMPTEC 641N Safety Tester will FAIL the "**Self-Test**" due to faulty test leads. A good set of short length 2 wire test leads or 4 Wire Kelvin leads (piggyback Vhi with Ihi and Vlow with Ilow) will show the AMPTEC 641N will "**PASS**" Self-Test when working properly.

There are **cardinal point functional test resistors** for each range of AMPTEC 641N. The benefit of having on-board ***cardinal point reference resistors*** is if there is a doubt about connection or measurement integrity, you can always double check the range being used against a known mid-scale reference resistance. On the 20 ohm range for example there is a 10.0 Ohm reference resistor (hence ***Cardinal Point***) present at the Self-Test terminals (1.0 ohm on the 2.0 ohm range, 100 ohms on the 200 ohm range, etc.).



OVERRANGE INDICATION ON THE LCD DISPLAY

OVERANGE MODE -
The AMPTEC 641N Safety Igniter Tester is a failsafe 4-Wire Kelvin resistance ohmmeter that may occasionally have ***Voltage high*** and ***Voltage low sense*** leads **open circuited** (disconnected) from everything. Over-Range mode is then invoked as indicated on the lower portion of the display (see diagram above).
When nothing is connected in four wire mode and/or if the leads aren't shorted together the display will indicate over-range by showing and group of symbols **>>>OR** on the LCD display.

Make sure the test leads are connected to the "UUT". "**Overrange Mode**" can occur whenever the measurement terminals are open circuit (not connected to anything) **or** the measurement under test is "higher" than the selected range. The most common way to correct for an "overrange" condition is to select the next higher range. Of course if your already at the highest resistance range, (for example 2.0 MegOhm) then the instrument is informing you that the ***resistance under test*** is a higher level than 2.0 Megohms, possibly an "open circuit".

The AMPTEC 641N Safety Igniter Tester Series of Safety Meters all incorporate a constant current source design that renders them incapable of delivering excessive voltage or current to the device under test. The fail-safe current limit for a single worst case component failure (**<8** mA) for **AMPTEC 641N** is indicated section B of this manual. Please refer to section **E-5** for a technical description of the failsafe circuitry specifics.

D-6. Fatigued Adapters and Loose Connections - Common Sources of Measurement Error
It is important to avoid too many 2 wire adapters and connections in series with the "resistance under test" if possible. A ***fatigued*** test wire harness ***adapter*** or ***wire/plug*** or a ***wire splice*** (i.e. twisted pair) that is ***loose*** can become a real intermittent resistance measurement error problem. A fatigued adapter or loose connector, plug, or wire splice will often times changes their contact resistance characteristics as the connection wiring is handled. Loose adapters, connections, and plugs, are potentially one of the largest source of resistance measurement errors and should be recognized and avoided. As a general rule, when it comes to measuring electrical resistance, ***the fewer the spliced/plugged connections*** you can make getting to the "device under test" ***the fewer the problems.***

D-7. Battery Monitoring Circuitry - The LCD display will indicate **"LO BAT"** when it is time to replace the batteries. If the **"LO BAT"** indicator is displayed, the 641N Igniter Tester readings should not be trusted. **Charging the AMPTEC 641N**

batteries the night before it is to be used is the **best way** to avoid a "LO BAT" indication when you go to use it. **Note:** all re-chargeable batteries (NIMH and NICADs) have an internal self discharge rate that limits the shelf life of a "charged up" 641N. You can't expect a fully charged 641N, if placed on a shelf to be fully charged 3 weeks later when you turn it on. When fully charged (overnite) and used the next day you should be able to operate the 641N typically **6 to 8 hours** before the "LO BAT" indication comes on the display. We recommend Powerex 2650 mAHr NIMH, and Accupower 2900 mAHr. We recommend any NiMH AA that is 2650 or greater primarily because they tend to also have a much lower self discharge rate.

The **"LO BAT"** will typically come on the display when the AMPTEC 641N Safety Igniter Tester internal batteries (4 ea. 1.2 VDC NIMH 2650 mAHr or better) reach approx. 3.6 VDC.

Cal Lab Note: To change the batteries
a) remove all the calibration access perimeter screws (flathead #6-32 type) on the unit's top panel and remove the calibration sticker covering one of the perimeter screws to get to it.
b) use the aluminum top plate handles on the front panel to carefully lift the top plate up and rest it in the lid.
c) from the underside of the top panel remove the machine nuts that secures the metal battery box/compartment housing the four "AA" batteries. Carefully pull the battery holder out and remove the cable-tie securing the batteries. Observe battery polarity when replacing the "AA" **re-chargeable NIMH batteries**. Re-secure the **four new batteries** in the holder with a new cable tie, then return it to the battery compartment and re-secure the compartment box to the underside of the top plate. See Section A-4 for diagram.

D-8. Failsafe Operation Overview
The AMPTEC 641N Safety Igniter Tester Series of Safety Meters all incorporate a constant current source design that renders them incapable of delivering excessive voltage or current to the device under test. The fail-safe current (<10mA) for each range is indicated section B of this manual. Please refer to the next few pages for a technical description of the failsafe circuitry specifics - There is a **Failure Mode and Effects Analysis & Fault Tree Analysis (FTA) starting on** the next page of this manual.

It should also be pointed out that an automatic **"SELF-TEST"** at 1st power-up **before** it can ever be used **always occurs**. This routine requires **<5mA** of test current be present (must see <5 mV drop across an internal 1.0 ohm resistor). The 641N automatically turns "OFF" and makes the 641N completely inoperable should it see any level $\geqq$ 5 mA.

AMPTEC 641N PORTABLE IGNITER TESTER / FAILSAFE OHMMETER - FAILURE MODE AND EFFECTS ANALYSIS AND FAULT TREE ANALYSIS (FTA)

This analysis was conducted on the AMPTEC 641N Portable Igniter Tester under normal and single fault conditions. The failsafe constant current source is limited to an EMF of <1.6V and incorporates a non-removable resistance to limit its **maximum output current to 8 mA into any resistive load.**"

The AMPTEC 641N Portable Igniter Tester Safety Ohmmeter has two sections : **1)** the Digital Voltmeter (DVM) branch which measures the voltage drop and the **2)** Failsafe CURRENT source branch that outputs a low level constant current. The constant current source branch is primarily the branch that would remotely have a chance of exceeding 1.6V or >10mA output. As it will be demonstrated it would take more than one fault in order for this to occur. We have taken every precaution to insure that even one fault is highly unlikely.

Normal Operating Mode Analysis - Constant Current Source Circuit Description

The reference voltage for the current source is supplied by reference zener diode D201 (see schematic 641-706). The operating current for D201 is supplied by the JFET current regulator comprised of Q201 and R208. The zener diode current is regulated to reduce the effects of the power supply voltage on the reference zener voltage.

The reference voltage is applied to the differential amplifier stage comprised of resistors R204, R205, R206, R207, and operational amplifier IC201 section 1 (pins 1, 2, and 3). The voltage gain of the differential amplifier stage is set to 1.00 by the ratios of R205:R204 and R207:R206. The voltage at pin 1 of IC201 is about -1.2 volts.

The -1.2 volt reference from IC201 section 1is applied to a unity gain inverting amplifier stage comprised of resistors R201, R202, R203, and operational amplifier IC201 section 2 (pins 5, 6, and 7). Very little current flows in the amplifier's inputs so that pin 5 sits at approximately current source ground, IGND. R202 provides negative feedback, closing the loop around IC201 section 2 which drives the voltage difference between the amplifier's inputs very close to zero volts. Feedback action causes pin 6 to also sit at current source ground, a virtual ground potential. This means that the -1.2 volt reference is dropped across R203. As very little current flows into the amplifier input the current in R203 also flows through R202. With R202 and R203 being equal pin 7 of IC201 sits at about +1.2 volts.

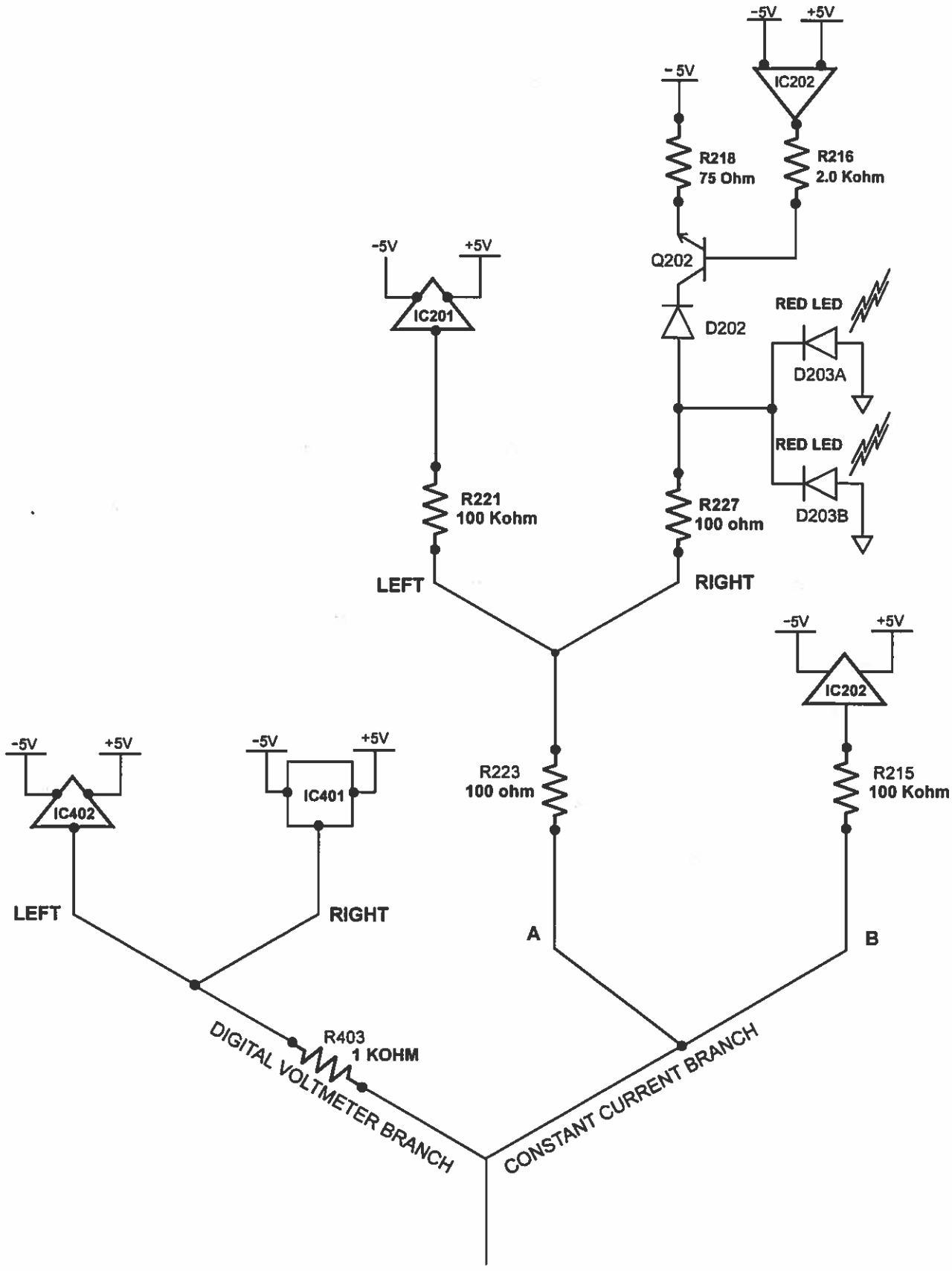
IC201's input bias current is about 100 nA and is temperature dependent. This bias current working into the parallel combination of R202 and R203 causes the reference voltage to slightly shift with temperature. Resistor R201 equalizes the impedances seen by IC201's inputs which reduces the temperature dependent reference voltage shift.

The +1.2 volt reference from IC201 section 2 is applied to a variable gain inverting amplifier stage comprised of resistors R209, R210, R211, R214, RV201, and IC201 section 3 (pins 12, 13, and 14).

The operation of this amplifier stage is similar to that of the unity gain inverting amplifier stage. IC201 pin 13 sits at a virtual ground potential causing the +1.2 volt reference to be dropped across the series combination of R209 and R210. The current in R209 and R210 also flows through R211 and RV201. The ratios of the values of R211 + RV201 : R209 + R210 cause IC201 pin 14 to sit at about -0.500 volts. Variable resistor RV201 provides a means of compensating for the initial accuracies of the reference zener diode, the resistors in the reference amplifier stages and the current source range attenuation resistors.

IC201's input bias current is about 100 nA and is temperature dependent. This bias current working into the parallel combination of R209-R210 and R211-RV201 causes the reference voltage to slightly shift with temperature. Resistor R214 equalizes the impedances seen by IC201's inputs which reduces the temperature dependent reference voltage shift.

- - *continued* - -



(Figure 1)

AMPTEC 641N Portable Igniter Tester Fault Analysis Tree Diagram

The -0.500 volt reference is applied to the voltage to current converter's differential amplifier stage comprised of R212, R213, R222, R221, and IC201 section 4 (pins 8, 9, and 10). The differential amplifier stage causes pin 3 of IC202 to sit at +0.500 volts with respect to the voltage at the left hand end of the range attenuation resistor, R223.

The value of the range attenuation resistor determines the current source output current. The range attenuation resistor is comprised of the series connected resistor string R223, R224, R225, R226, R227 and R228. The range switch, SW101, selects one of seven resistance values, 100 Ohm (R223), 1.00 Kohm (R223 + R224), 10 Kohm (R223 + R224 + R225), 100 Kohm (R223 + R224 + R225 + R226), 1 Mohm (R223 + R224 + R225 + R226 + R227), 10 Mohm (R223 + R224 + R225 + R226 + R227 + R228).

IC202 pin 2 senses the voltage at the right hand end of the range attenuation resistor string, which is also the I HI terminal. Feedback around IC202 drives the inputs of IC202 to equal voltages. IC202, via current limiter Q202 and it's associated components, adjusts the current in the selected range attenuation resistor so that the voltage drop across the range attenuation resistor is the same as the applied -0.500 volt reference.

IC202, an op-amp, has extremely low input bias currents. Therefore very little current flows in R215 which makes the current in the selected range attenuation resistor equal to the current in the DUT.

IC202 operates with both positive and negative feedback. When the Output J100 pins A, pins D are open circuited, a large amount of positive feedback is applied to IC202 which could then oscillate. C201 in concert with R215 provide local negative feedback around IC202 to stop oscillations.

This analysis was conducted on the AMPTEC 641N Portable Igniter Tester Safety Ohmmeter under normal and single fault conditions.

Under normal conditions the output current is regulated to <5mA into a resistive load. Its output compliance voltage is limited to 1.6 Volts into an open circuit (by twin protection clamping diodes D203A and D203B *only 1 diode is actually needed to keep the 641N voltage clamped - see discussion below*).

There are 4 internal separate non-removable resisters to go through. They limit the current to <10mA. In (fig. 1) On the right constant current branch we have the precision feedback resister R223 for the current source. This resistor is a wire wound (thin wire spun onto a bobbin spool) and similar to how a fuse fails, if it fails, it virtually always would fail "open" if at all. If it were to "open" the output would be 0V@0A. The way this current source circuit works is that the value of R223 determines the output current level. At the value of 100 Ohms the output current level would be 5mA.

The next branch to the right consists of resistor R227. We for it to be a carbon composition resistor because the normal failure mode of that type of resistor is to "open". If this resistor "opens" the output goes to zero. If it fails a "short", it shorts the output current, the current level will not change from its normal 5mA because the feed back loop is working.

The next branch, transistor Q202 would first have to short. This would then put the –5V rail closer to the output. It would first have to go through the 75-Ohm resistor R218 then through the shorted Q202. Through D202, **It will at this point find the clamping LED diodes D203A & D203B. Either diode D203A or D203B will clamp to limit <1.6VDC**. The AMPTEC 641N uses two clamping diodes just in-case one diode should fail.

To get any output its path now has to go through R227, and R223. The total resistance of these two resistors is 200 Ohms. So using Ohms Law -1.6V (either D203A or D203B clamping voltage) divided by 200 Ohms equals only 8mA, still <10 mA the 641N failsafe current limit specification.

The next branch if R216 were to open then Q202 would turn **off** and the output would go to 0V@0A. ***If*** R216 **shorts *then*** Q202 will turn **off** harder so the output would be 0V@0A.

The next component that could fail is IC202. ***If*** +5V were to **short** internally to this branch ***then*** it would have to go through R216 (2.0 Kohm), Q202 would turn on and –5V would go through D202 and D203A or D203B would clamp it to <–1.6V. So - 1.6V divided by 200 ohms from R227 and R223 equals - 8 mA. ***If*** -5V were to short internally of IC202 to this branch ***then*** it would have to go through R216, Q202, D202 then ***either*** D203A or D203B would clamp it to –1.6V divided by 200 Ohms (R227 and R223) equals - 8 mA, back down the branch to R223 then the next branch to the left. ***If*** R221 were to fail ***open, then*** IC201 would output what its other input is at which is 0.5V. This would drive IC202's output to +5V ***then*** it would have to go through R216 (2.0 Kohm), Q202 would turn **on** and –5V would go through D202 and D203A or D203B would clamp it to –1.6V. So -1.6V divided by 200 ohms from R227 and R223 equals -8 mA. ***If*** R221 were to fail ***short, then*** it would drive the input of IC201 close to 0V so its output would go to 0V, which would make IC202, go to 0V. This would turn off transistor Q202 so the output current would go down to about –2mA.

If IC201 **failed** and either +/-5V **shorted** to this branch then R221 (100Kohm) would drop the voltage before it got to the output. **5V divided by 100K (R221) + 100 ohm (R223) equals ~ 5 µA (the output).**

Back down the branch through R223 (100 ohms) and to the right. ***If*** R215 were to fail ***open, then*** IC202's output would go close to 0V. This would turn off Q202 so the output current would go down to about –2mA. ***If*** R215 were to ***fail short then*** there is no current flow through it any way so there would be voltage change so the output current would remain 5mA. ***If*** IC202 failed and either +/-5V shorted to this branch ***then*** R215 would drop the voltage before it got to the output.

The 5V supply divided by 100K *(*R215*)* equals 50 *µ*A (the output). Back down the branch and go up the DVM left side. **If** R403 were to fail **open or short then** there would be no change in the output current because IC401 has a high input resistance and 0V output.

If IC401 failed and either +/-5V shorted to this branch ***then*** R404 would drop the voltage before it got to the output. 5V divided by 1K R403 equals about 5 mA added or subtracted to the output. Back down the branch through RL401 to the left branch. ***If*** IC402 failed and either +/-5V shorted to this branch ***then*** +/- 5 VDC divided by (R403 - 1Kohm) = 5 mA

This concludes the fail safe circuit analysis and has explored every path of any and all single point failure modes. None of which at any time exceeded either 1.6 Volts or 8 mA to appear on the output terminals. It should also be pointed out that an automatic **"SELF-TEST"** at 1st power-up **before** it can ever be used always occurs. This routine requires **<5mA** of test current be present (must see <5 mV drop across an internal 1.0 ohm resistor). The 641N automatically turns "OFF" and makes the 641N completely inoperable should it see any level ≧ 5 mA.

Additional comments: *Our experience is when resistor failures occur, it's almost always because the resistor was overloaded beyond its capacity to carry the power (current supply and driving voltage) forced upon it. The 641N is a relatively low current, low voltage and low power device with resistors (i.e. 1/4 watt) that can potentially carry **much more current (10X) without failing than they will ever see in the 641N circuitry. Resistors that aren't stressed / over powered tend to not fail much, if at all.** This is due to its current limiting and voltage clamping (double diode protected) design. In certain PCB circuit locations, carbon composition resistors vs. wire wound resistors have specific safety advantages. **They would also have to fail in a completely opposite fashion** from their historically predicted modes (i.e. wirewound resistors **virtually always fail as an "open" not a short)** to even approach the <10 mA current limit which has be shown to be an acceptable level (AMPTEC 630BN and AMPTEC620UK) when testing EEDs such as rocket motor squibs. The AMPTEC 641N Igniter Tester was derived from the AMPTEC 620UK Explosive Safety (Intrinsically Safe) Ohmmeter which also has U.S. NAVY Indianhead Safety board approval for use on specific EEDs.*

CHAPTER E - GENERAL OPERATION AND DESIGN

E-1. General

The AMPTEC 641N Safety 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 641N Safety 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 RESEARCH also maintains a spare parts inventory of all components found in the AMPTEC 641N Safety Igniter Tester and it's customer service department can also provide additional assistance in the trouble shooting process.

E-2. Troubleshooting

Since the AMPTEC 641N Safety Igniter 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*** AMPTEC 641N Safety Igniter Tester ***should not even attempt to remove the calibration access screws or open the main panel or effect any repair whatsoever.***

Apparent AMPTEC 641N Safety Igniter Testermalfunctions 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 AMPTEC 641N Safety Igniter Tester series.

If you turn on the AMPTEC 641N Safety Igniter Tester ***and the display does not come on***, it may indicate the re-chargeable batteries need charging.

AMPTEC 641N Safety Igniter Tester exhibits problems that cannot be eliminated by reviewing Chapters B and D, the following guidelines have been established to help solve the problem.

E-3. Localizing the Problem

The AMPTEC 641N "Self-Test" will help localize a particular problem rather fast. Remember faulty test leads will cause a "Self-Test" failure. ***See section F-4 to by-pass "Self-Test" and prevent the automatic shutoff of the unit in order to assist with trouble-shooting.***

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?" AMPTEC 641N Safety Igniter Tester does not come "on" when powered up, did you check the obvious items such as dead batteries?

E-4. Component Replacement

If the malfunction is a faulty component, the accuracy of the AMPTEC 641N Safety Igniter Tester ***can be maintained only if the AMPTEC 641N is re-calibrated following a component replacement (repair)*** and the following precautions are taken:

Use only the specified component or its exact equivalent. Spare parts can be ordered from AMPTEC RESEARCH 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 unit's chassis ground connection - i.e. connect to an earth ground to avoid a static discharge to a static sensitive component. Handle all AMPTEC 641N Safety Igniter Tester internal components as if they are static sensitive if you are not sure.

E-5. Circuit Descriptions

E-5.1 Digital Voltmeter (DVM) IC 401 - DVM IC MAX1494 - Description

The Maxim IC part # MAX1494 is a uniquely designed single chip A/D converter. This vital component is a surface mount IC that unfortunately cannot be easily replaced on the main PCB . The good news is AMPTEC RESARCH has never seen a single Maxim DVM IC Chip failure in over 150 failsafe ohmmeters (AMPTEC 620UKs, AMPTEC 601ES DMMs, and AMPTEC 620UK-B Bonding Ohmmeters) that are presently still operational in the field in.
AMPTEC RESEARCH also has the expertise to replace a surface mount DVM IC (under warranty or otherwise) should it ever become necessary.

VOLTMETER Discussion -Diode, D402 is the reference voltage zener diode used on all the voltmeter circuits (both the low 2.0 ohm circuit and all the unamplified higher range circuits. IC401 is an X 10 Amplifier (times ten) used for the 2 Ohm range (this amplifies the 2.0 ohm range voltage drop times ten and routes it to the unit's 20 ohm range electronics). RL401 is used to switch the amplifier in and out. RV401 is used to set the zener (D402) reference voltage to 500 millivolts for the 2.0 ohm X 10 amplifier circuit. In the 100 mV measurement mode 50 mV input will display 10000.

RV402 is used to adjust the voltage reference circuit used (D402) for all the other ranges (20 ohms and up).

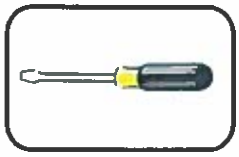
E-5.2 Resistance

The AMPTEC 641N Safety Igniter Tester resistance measurement function works using the principle of OHM'S LAW (V/I=R). It outputs a constant DC current through the unknown resistance then measures the voltage drop across the resistance. The 641N ohms measurement circuit then scales magnitude and displays the V/I ratio as resistance. For example, the 2 Ohm range outputs a constant 5.0 mA DC. When 5.0 mA passes through a 1.0 Ohm resistor the result is a 5.0 mV drop. We then route the measured voltage drop (i.e. 5.0 mV) into the **x10 Amplifier circuit** and get 50.0 mV, which is routed into the DVM chip (MAX1494) which drives the LCD display as 1.0000 Ohm. The 20 Ohm range also outputs 5mA of constant failsafe current. When 5 mA is routed through a 10 ohm resister, you get 50mV. which is also routed into the DVM chip (MAX1494) which drives the LCD display as 10.000 Ohms. The 200 Ohm range outputs 500uA. Put that across a 100 Ohm resister and you get 50mV which put into the DVM chip (MAX1494) displays it as 100.00 Ohms. As the range resistance goes up by a factor of 10. The DC current goes down by a factor of 10 keeping the voltage at 50mV.

E-5.3 POWER SUPPLY

IC101 is a 5 volt regulator with an enable pin 4. Pin 4 normally sits at +5V through RN101:3 and RN101:1. When the Power switch is pressed SW101 pin 4 is pulled to ground through D101, and +5 is turned on which then goes to IC102 a 5 volt regulator. Once the power is turned on the microprocessor wakes up and turns on TR101, which then holds pin 4 low keeping the power on. Even when the momentary power switch is released. When the power switch is pressed again to turn the unit off TR102 is turned on and a signal is sent to the micro processor and it turns off TR101 which allows pin 4 to go high and turns the power off.

CHAPTER F - CALIBRATION AND MAINTENANCE



F-1 Troubleshooting Only by Authorised Personnel

Since the AMPTEC 641N Igniter 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 641N Igniter Tester should not even attempt to remove the calibration access screws or open the main panel or effect any repair whatsoever.***

This section of the manual contains routine maintenance information regarding the AMPTEC 641N Safety 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.

AMPTEC 641N Igniter Tester ***Calibration note: The resistance function of the*** AMPTEC 641N 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 "630-304" is a gold plated 4 Wire Banana Plug Test Lead set that is available for the AMPTEC 641N Igniter Tester calibration.

F-2. Required Test Equipment

Following standard resistors are required to calibrate the 641N Explosive Safety Meter Igniter Tester .

Precision Resistance Satandards:

1 ohm ± 0.01% Accuracy
10 ohms ± 0.005% Accuracy
1000 ohms ± 0.005% Accuracy
10 Kohms ± 0.01% Accuracy
100 Kohms ± 0.01% Accuracy
1.0 Megohms ± 0.05% Accuracy

F-3. Calibration Procedure

The AMPTEC 641N Safety Igniter Tester tester should be calibrated with fully charged batteries and should be allowed to **warm-up** for a minimum of **15 minutes** before beginning the calibration procedure. The calibration adjustments are accessed by removing the 10 calibration access screws around the perimeter of the 641N Failsafe Ohmmeter front panel, then ***carefully lifting*** off the top plate by the handles.

Use caution when lifting the 641N top panel up by the handles, as there is delicate umbilical wiring and ribbon cabling that connects the top panel electronics (display, battery pack wiring and chassis/case ground wiring) to the all the proper main PCB electronics mounted on the bottom plate. Set the top panel on end resting on the unit's bezel. The AMPTEC 641N must normally pass "Self-Test" and display "OK" to even operate ***(see F-4 below to bypass "Self-Test" Mode to get a failing unit to operate enough to help determine the nature of the repair needed).***

F-3-1. Zero Offset Adjustment not necessary

1. The AMPTEC 641N DVM section design has "NO" zero adjustment, as the internal DVM chip (IC401 - MAX 1494) performs an "Auto-Zero" itself and stores its internal offset automatically.

F-3-2. Full Scale Adjustment

1. Select the 20 Kohm range. Connect the Test leads to a 10 Kohm standard resistor.
2. Adjust RV402 for a display indication of 10.00 Kohms.

F-3-3. 2.0 Ohm Range Adjustments

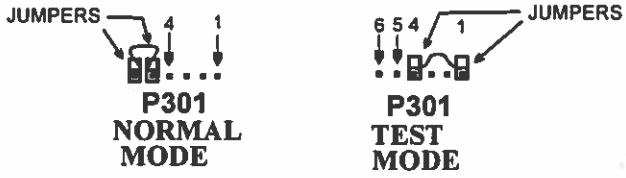
1. Select the 2.0 Ohm range. Connect Kelvin test leads to a 1.0 Laboratory Standard resistor.
2. Adjust RV401 for a display indication of 1.0000 Ohms.

The following steps will facilitate the proper repair personnel to diagnose whether the AMPTEC 641N Ohmmeter **Current Source Electronics** or the **Digital Voltmeter Electronics** need repair.

F-4. By Passing the "Self-Test" turn-on routine -

Note: If the AMPTEC 641N "Self-Test" at power up fails do not forget to **first check the test leads** as a broken lead wire or loose jack (open) can also cause an AMPTEC 641N "Self-Test" failure. For diagnostic

repair purposes the unit's **"Self-Test" routine may be bypassed** just to get the AMPTEC 641N operational enough as an ohmmeter to determine the nature of the needed repair. (requires cal sticker removal etc. and access to the main PCB inside the unit - see calib. procedure *previous page* for lifting up the top plate)



1. On the Main PCB move the shorting jumpers located on **pins 5 & 6 at plug header P301** to be across pins 4 & 1 then **reset power** on the AMPTEC 641N .
2. AMPTEC 641N Igniter Tester will be in **"TEST MODE"** . In test mode the 641N is simply operational as failsafe ohmmeter. The "OK" message is **not** indicated on the LCD display. The **TEST MODE** will allow calibration test personnel to perform a few simple tests to help diagnose a possible component failure. When the jumpers are returned to their original position across **pins 5 & 6 on the P301 programing port,** the meter will be returned to the **normal mode** -automatic self test once the unit's power is reset.
Helpful Hint: Assuming good test leads - If the Self-Test fails noting where (at what step) it fails is a good indicator of the type of component failure. If it passes the 5.0 mA test then the current source electronics are operational. If a resistance step fails, the suspected failure tells which range fails (corresponding range resistor or relay etc.).

F-5. Battery Replacement Instructions
The battery replacement process is:

a) remove all the calibration access perimeter screws (flathead #6-32 type) on the unit's top panel and remove the calibration sticker covering one of the perimeter screws to get to it.
b) use the aluminum top plate handles on the front panel to **carefully** lift the top plate up and rest it in the lid. There is **delicate umbilical wiring and ribbon** cabling attached to the unit's top plate so be careful in the top plate lifting/handling process.
c) from the underside of the top panel remove the machine nuts that secures the metal battery box/compartment housing the four rechargeable "AA" batteries. Carefully pull the battery holder out of the metal battery box and remove the cable-tie securing the batteries. Observe battery polarity when replacing the "AA" **re-chargeable NIMH batteries (Duracell 2650 mAHr NIMH or better are recommended).**

Re-secure the **four new rechargeable "AA" batteries** in the metal battery holder with a new cable tie, then return it to the battery compartment after cutting any excess cable tie ends. Re-secure the compartment box to the underside of the top plate.
Be careful not to pinch any cabling when returning the top panel to its original position. You can also perform a brief power up test to check for battery functionality ***before returning the perimeter screws*** and replacing calibration sticker. You may have to briefly charge the new 641N batteries in order to see if the unit powers up "OK". Once the batteries are fully charged and it "PASSES" SELF-TEST you can also perform a full calibration and or verification if necessary.

Energizer 2500 mAHr NiMH rechargeable batteries are not recommended for use with the AMPTEC 641N as they have a rather high internal self discharge rate. They don't hold a charge very well (poor shelf life) over time. The next time (say a few days go by) you go to use the unit with Energizer 2500's inside it may have dead batteries. There are many other brands commercially available, presently the Duracell 2650 and AccuPower 2900 work well to name a few.
You can also check our website at **www.amptec.com/tech** for AMPTEC 641N related docs and updates.
The amptec website tech directory requires:
a) **user I.D.= 2004**
b) **password= safety**