Heathkit® Manual

for the

VLF CONVERTER

Model HD-1420

595-3468-01

HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

TABLE OF CONTENTS

INTRODUCTION

The Heathkit Model HD-1420 VLF Converter lets you listen to the frequencies below the standard AM broadcast band between 10 and 500 kHz. Among the many interesting signals in this VLF range are long range navigation signals, radioteletype, European high-power broadcasts, radio beacons, etc. You can tune in the output signal from this Converter on any receiver that will tune from 3510 to 4000 kHz (3.51 to 4.0 MHz).

Most of these signals are ground waves, and frequently travel over relatively great distances. But you do not have to cut a long-wire antenna to a specific length to receive them. (If you wanted a quarter-wave antenna for a 100 kHz signal, for example, you would need a wire 750 meters [2461 ft.] long!) Any wire length, horizontal or vertical, will usually provide you with reasonably good reception; but you should make it as long as you can.

Your VLF Converter is small enough that you can easily place it in almost any small corner near your receiver. When it is not in use, the Converter directly bypasses all the incoming signals to the receiver.

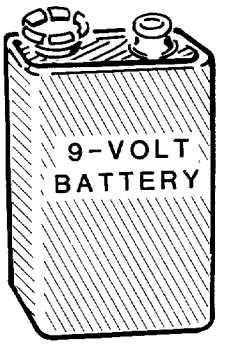
POWER SOURCE

You will need to obtain a suitable source of power for your Converter. You may use a 9-volt battery; a Heathkit Power Supply cube with a miniature microphone plug, Model PS-2350; or any source of DC power from 6.0 to 14 volts that is rated at a minimum of 20 milliamperes.

If you intend to use a battery, purchase a 9-volt alkaline transistor battery, NEDA #1604 (or 1604A). You may want to buy this battery now so you will have it available when you finish the assembly. Representative manufacturers and their type numbers are shown below.

WARNING: If you use this VLF Converter with a transceiver of any kind, be sure to disconnect the Converter before you apply transmitting power to your transceiver output. You will damage the Converter if you do not.

Eveready #216, PP3
Burgess #2U6
Mallory #TR-146X (long life)
RCA #VS323



INITIAL TESTS

NOTE: Do not install the battery or otherwise apply power to your VLF Converter until you are directed to do so in a step.

Refer to Pictorial 3-1 for the following steps.

You will need a high input impedance volt-ohmmeter for the following tests.

( ) Position your Converter as shown in the Pictorial.

( ) Set your ohmmeter to its R × 100 range.

( ) Connect the ohmmeter ground (common) lead to SL1 on the Converter rear panel.

( ) Push the POWER switch to OFF.

NOTE: In the following steps, if you do not get the correct results, do not proceed. Refer to the "In Case of Difficulty" section of this Manual. After you have found and corrected the problem, you may proceed with these tests.

( ) Touch the positive ohmmeter probe to rear panel jack J101, lug 2 (+ battery clip lead). Check for an infinity ohmmeter reading.

( ) Push the POWER switch to ON.

( ) Touch the ohmmeter probe to jack J101 lug 2 again. The ohmmeter reading should be greater than 400 Ω.

( ) Turn OFF the POWER switch.

( ) Connect your 9-volt NEDA Type 1604 battery to the battery clip; then push the battery down into the circuit board battery holder.

OR

If you have purchased a power supply cube or have another source of external power, connect this power to rear panel power jack J101.

( ) Set your voltmeter to read (up to) +15 volts DC.

( ) Connect the voltmeter ground (common) lead to rear panel solder lug SL1.

( ) Touch the positive voltmeter probe to switch SW1 lug 1. The voltage at this point should be greater than 6.0 volts DC.

( ) Push the POWER switch to ON.

( ) Check and make sure the voltage on SW1 lug 1 is approximately the same as the previous step. Also check and make sure LED D101 is lit.

( ) Disconnect and turn off the voltmeter.

( ) Turn OFF the Converter POWER switch.

( ) If you are using an external source of power, disconnect the power plug from J101.

This completes the "Initial Tests"; proceed to "Final Assembly."

FINAL ASSEMBLY

Refer to Pictorial 4-1 for the following steps.

( ) Position the chassis as shown.

( ) Place the top cover on the chassis assembly and secure it in place with four #6 × 3/8" screws as shown.

This completes the "Final Assembly" of your kit.

INSTALLATION AND OPERATION

INSTALLATION

Refer to Pictorial 5-1 for the following steps.

As we said on Page 3, you will need a suitable source of power. Install either a 9-volt NEDA Type 1604 (1604A) internal battery, or connect an external source of from 6 to 14 volts DC that is rated at at least 20 mA.

Connect a long-wire antenna to ANTENNA jack J102 on the Converter rear panel. You may use a long horizontal wire antenna with its end connected to the center pin of ANTENNA jack J102, or you may also use a vertical antenna with its downlead connected to the same point. We suggest that you use a PL-239 connector with its outer shell grounded at some convenient point near your radio. You may also use a loop antenna for VLF reception, as these are effective in nulling out interference.

The exact length of a long-wire antenna is relatively unimportant; a resonant antenna is not required for good signal pickup. Any practical antenna will be short when compared to the wavelength. However, the longer you make your antenna, the better your reception.

Connect the OUTPUT of the Converter at J103 to your receiver. You can use any type of radio capable of receiving from 3.500 to 4.010 MHz: A ham radio, or an SWL receiver which has AM, selectable sideband, or BFO capability.

OPERATION

As most VLF signals are not amplitude modulated, set your receiver for CW or SSB reception.

Tune your receiver up from a frequency of 3.500 MHz. The VLF signals that you hear will be at the frequency shown on the dial minus 3500. For example, if your receiver is tuned to 3560 (kHz) and you are listening to a VLF transmission, the actual transmitted signal will be 3560 minus 3500 (in kilohertz), or 60 kHz. At a dial reading of 3700 (or 3.700 MHz), you will be listening to a VLF transmission at 200 kHz, etc.

The VLF band from 10 to 160 kHz contains standard frequency long-range navigation, radioteletype, and other signals. The band from 160 to 190 kHz is a license-free band with transmission power limited to one watt and antenna lengths of up to 50 feet.

European broadcasters use the band from 150 to 280 kHz with high power. 410-500 kHz is used by coastal shipping. From 190 to 410 kHz, you will hear a large number of radio beacons, most of which identify themselves with call letters sent in code. Some also have AM modulation with weather reports and other information. Some examples follow:

Frequency (In kHz)	Call	Location
192	SFI	Petaluma, CA
233	LG	Long Beach, CA
236	GNI	Grand Isle, LA
263	MFR	Medford, OR
280	IPA	Easter Island
344	ZIY	Grand Cayman, BWI
365	LEO	Leon, Mexico
397	ZBB	Bimini, Bahamas

Interference

Your VLF Converter was designed to minimize feedthrough of 80-meter signals and cross-modulation from standard broadcast signals. However, if your receiver or its interconnecting cable is not well shielded, you may hear 80-meter signals. To check for this, turn off the Converter power; the VLF signal will disappear but any 80-meter interference will remain.

If you hear a standard broadcast station in the VLF band, cross-modulation is present. You may eliminate this by using a shorter antenna, an attenuator between the antenna and the Converter, a series-tuned trap at the station's frequency, or a tuned circuit at the VLF frequency.

IN CASE OF DIFFICULTY

The following "Visual Checks" tell you what to do about any difficulties that occur right after your unit is assembled. If the "Visual Checks" fail to clear up the problems, or if difficulties occur after your unit has been in use for some time, refer to the "Troubleshooting Chart."

NOTE: Refer to the "Circuit Board X-Ray View" for the physical location of parts.

VISUAL CHECKS

1. Recheck the wiring. Trace each lead with a colored pencil on the Pictorial as you check it. It is frequently helpful to have a friend check your work. Someone who is not familiar with the unit may notice something you have consistently overlooked.

2. About 90% of the kits that are returned to the Heath Company for service do not function properly due to poor connections and soldering. Therefore, you can eliminate many troubles by reheating all connections to make sure they are soldered as described in the "Soldering" instructions on Illustration Booklet, Page 2.

3. Closely examine the circuit board foil in a good light to see that no solder bridges exist between adjacent connections. Remove any solder bridges by holding a clean, hot soldering iron tip between the two points that are bridged until the excess solder flows down onto the tip. Compare your foil patterns with the "Circuit Board X-Ray View."

4. Check to be sure each transistor is in the proper location (correct part number and/or type number). Make sure each transistor lead is connected to the proper point.

5. Check to be sure the LED is correctly connected.

6. Check the electrolytic capacitor to be sure its positive (+) and negative leads are at the correct positions.

7. Check each resistor value carefully. Be sure in each step that the proper part has been wired into the circuit as shown in the Pictorial diagrams. It would be easy, for example, to install a 22 kΩ (red-red-org) resistor where a 3300 Ω (org-org-red) resistor should have been installed.

8. Be sure all the wires and leads connected to the circuit boards have been trimmed as close as possible to the circuit board foils.

9. Check for bits of solder, wire ends, or other foreign matter which may be lodged in the wiring.

If you still have not located the trouble after the "Visual Checks" are completed and a voltmeter is available, check the voltage readings at the locations indicated on the Schematic diagram. NOTE: All voltage readings were taken with a high input impedance voltmeter. Voltages may vary slightly, up to ± 10%.

NOTE: In an extreme case where you are unable to resolve a difficulty, refer to the "Customer Service" information inside the rear cover of this Manual. Your Warranty is located inside the front cover.

Troubleshooting Chart

The following chart lists problems and possible cause of some troubles you might encounter. If a particular part is mentioned (Q102 for example) as a possible cause, check that part and any other components connected to it to see that they are installed and/or wired correctly. Also check for solder bridges and poor connections in the surrounding area. It is also possible, on rare occasions, for a part to be faulty and require replacement.

PROBLEM	POSSIBLE CAUSE
LED does not light.	1. Weak battery. 2. Switch SW1A. 3. Jack J101. 4. LED D101.
Signal does not bypass Converter when Power switch is off.	1. Jacks J102, J103. 2. Switch SW1B, SW1C.
No output signal.	1. Transistors Q102, Q103. 2. IC U101. 3. Crystal Y101.
Poor sensitivity.	1. Weak battery. 2. Inductors L101-L103. 3. Transistors Q102, Q103. 4. Capacitors C106-C109.

SPECIFICATIONS

Input Frequencies	10 to 500 kHz.
Output Frequencies	3.510 to 4.000 MHz.
Sensitivity	1 to 5 μV, typical.
Power Requirements	6 to 14 VDC, Type 1604 9-volt battery; or external power supply, at 20 mA typical.
Dimensions	5-1/8" × 5-1/8" × 2-1/4" (13 × 13 × 5.7 cm).
Net Weight	1 lb. (.45 kg).

The Heath Company reserves the right to discontinue products and change specifications at any time without incurring any obligation to incorporate new features in products previously sold.

CIRCUIT DESCRIPTION

Refer to the Schematic Diagram in the Illustration Booklet as you read the following Circuit Description.

The incoming 10-500 kHz signals are routed from J102 through the contacts of switch SW1C to the base of isolation RF amplifier transistor Q102. The signal from the collector of Q102 is then passed through a filter network consisting of inductors L101 through L103 and capacitors C106 through C109. This filter eliminates all higher frequency broadcast and 3.5 MHz signals. The signal is then fed to mixer IC U101 pin 1 to be combined with the local oscillator signal at pin 7.

The local oscillator consists of the 3.5 MHz crystal, oscillator transistor Q103, and its associated components. The 3.5 MHz signal output from this circuit is routed to pin 7 of U101 to be mixed with the incoming signal at pin 1.

Internally, the signals from pins 1 and 7 are mixed and the added signals, ranging in frequency from 3.510 to 4.000 MHz, are routed from U101 pin 6 through the contacts of switch SW1B to the output of the Converter at J103 for reception on the input of your receiver.

Power for the VLF converter consists of either an internal 9-volt Type 1604 (1604A) battery, or an external power supply of from 6 to 14-volts DC, typically at 20 mA. A Heath Power cube, Model PS-2350, is recommended for this unit.

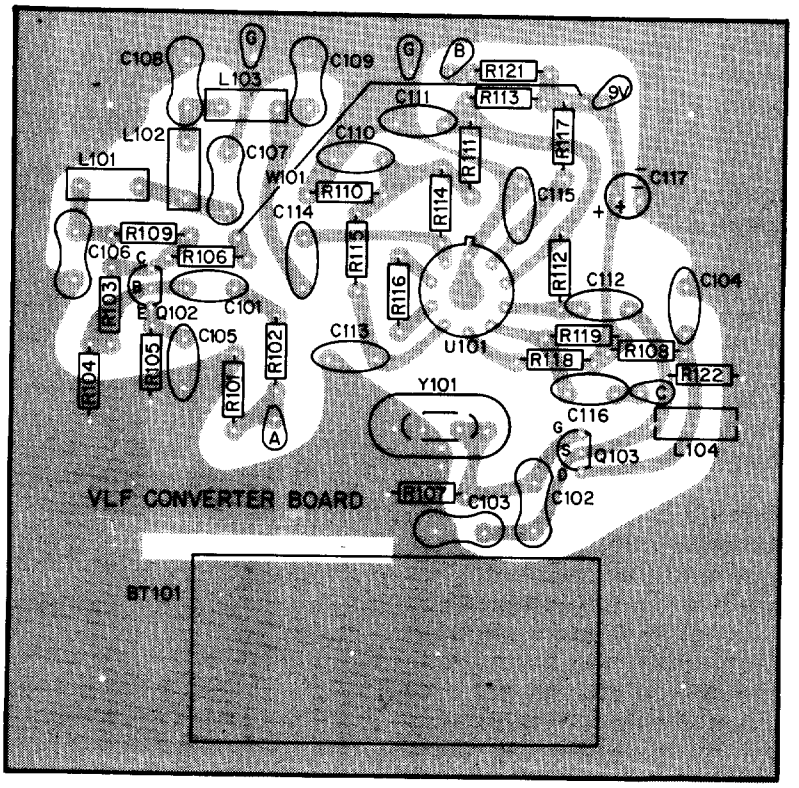
CIRCUIT BOARD X-RAY VIEW

To find the PART NUMBER of a component for the purpose of ordering a replacement part:

A. Find the circuit component part number (R102, C106, D101, etc.)on the X-Ray view.

B. Locate the same number in the "Circuit Component Number" column of the "Parts List" in the front of the Manual.

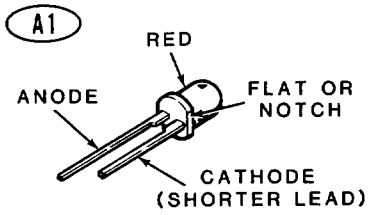
C. Adjacent to the circuit component number, you will find the PART NUMBER and DESCRIPTION which must be supplied when you order a replacement part.

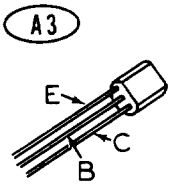


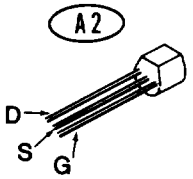
(Shown from the component side.)

SEMICONDUCTOR IDENTIFICATION

COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	KEY NUMBER
DIODE			
D101	412-633	5082-4484	A1
TRANSISTORS			
Q102	417-169	MPF105	A2
Q103	417-875	2N3904	A3
INTEGRATED CIRCUIT			
U101	442-96	MC1496G	A4







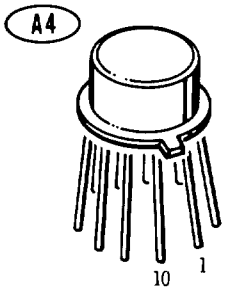


ILLUSTRATION BOOKLET

Part of 595-3468-01

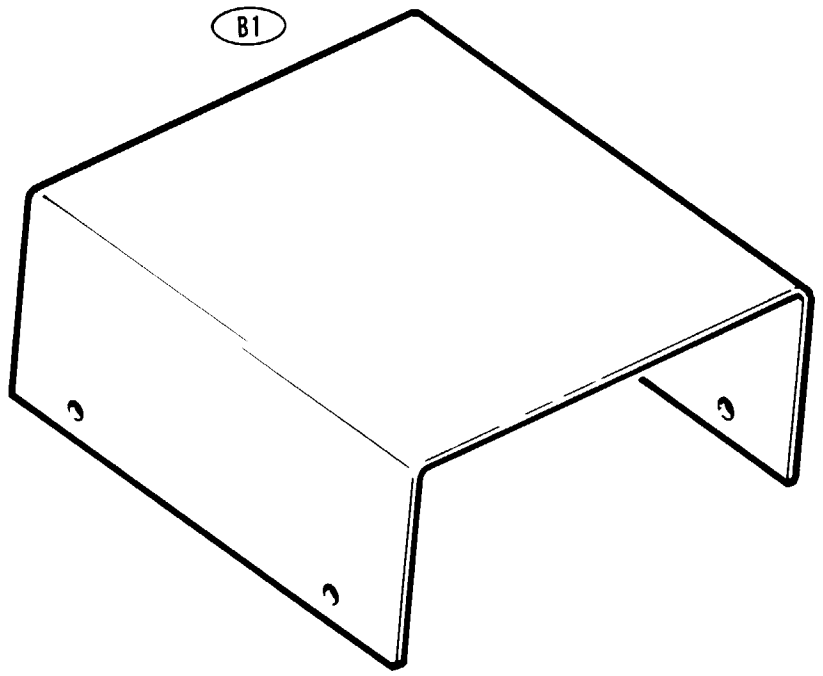
Parts Pictorial

A1

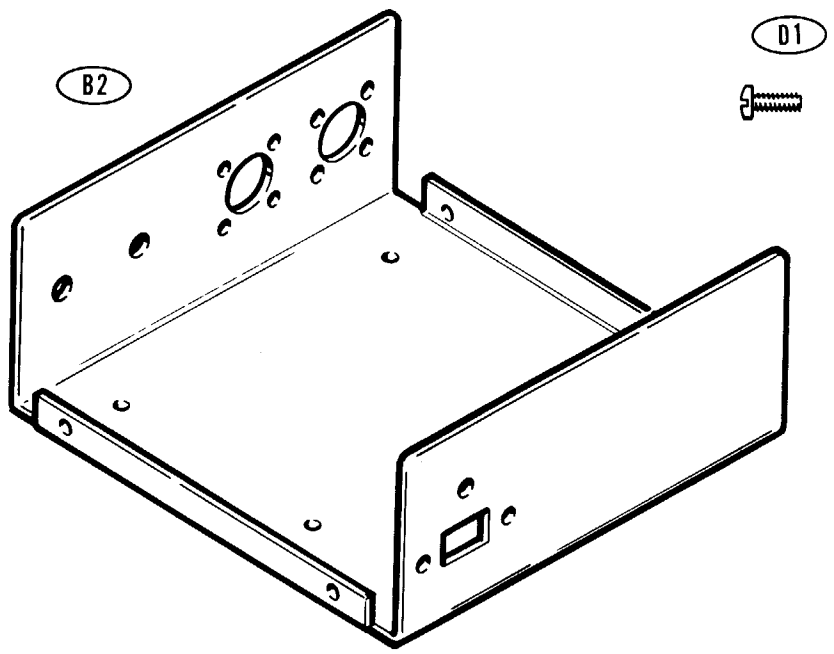
A2

A3

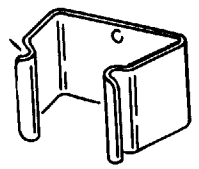
B1



B2



B3



C1

C2

C3

C4

C5

D1

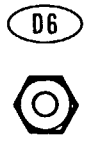
D2

D3

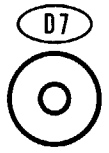
D4

D5

D6



D7



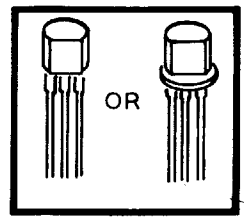
D8

D9

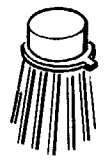
D10

D11

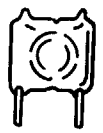
E1



E2



F1



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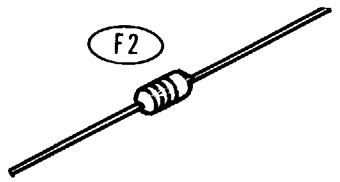

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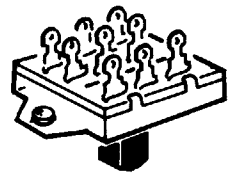
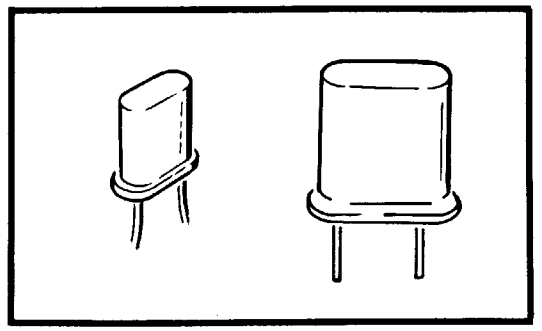
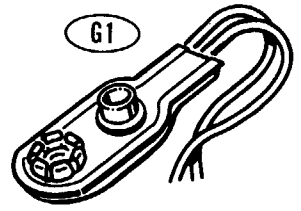


F4



F5

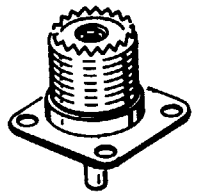
G1



G2

G3

G4



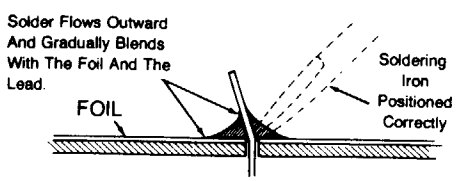
G5

H1

H2

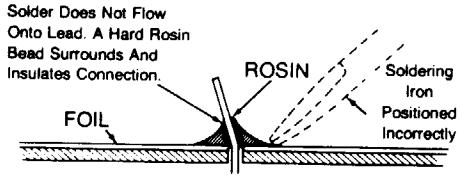
Model HD-1420

A GOOD SOLDER CONNECTION

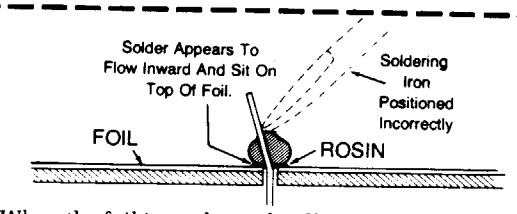


When you heat the lead and the circuit board foil at the same time, the solder will flow evenly onto the lead and the foil. The solder will make a good electrical connection between the lead and the foil.

POOR SOLDER CONNECTIONS



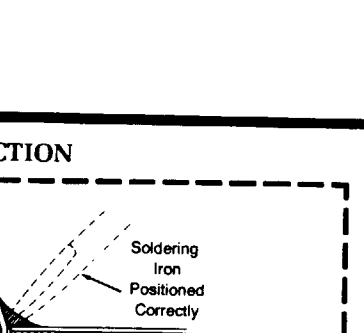
When the lead is not heated sufficiently, the solder will not flow onto the lead as shown above. To correct, reheat the connection and, if necessary, apply a small amount of additional solder to obtain a good connection.



When the foil is not heated sufficiently the solder will blob on the circuit board as shown above. To correct, reheat the connection and, if necessary, apply a small amount of additional solder to obtain a good connection.

SOLDER BRIDGES

A solder bridge between two adjacent foils is shown in photograph **A**. Photograph **B** shows how the connection should appear. A solder bridge may occur if you accidentally touch an adjacent previously soldered connection, if you use too much solder, or if you "drag" the soldering iron across other foils as you remove it from the connection. A good rule to follow is: always take a good look at the foil area around each lead before you solder it. Then, when you solder the connection, make sure the solder remains in this area and does not bridge to another foil. This is especially important when the foils are small and close together. NOTE: It is alright for solder to bridge two connections on the same foil.



Use only enough solder to make a good connection, and lift the soldering iron straight up from the circuit board. If a solder bridge should develop, turn the circuit board foil-side-down and heat the solder between connections. The excess solder will run onto the tip of the soldering iron, and this will remove the solder bridge. NOTE: The foil side of most circuit boards has a coating on it called "solder resist." This is a protective insulation to help prevent solder bridges.

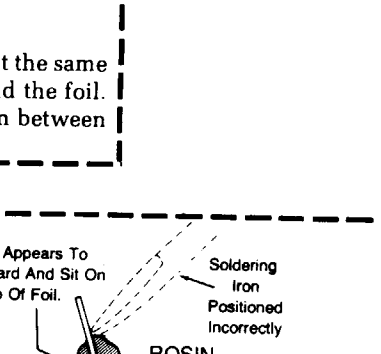
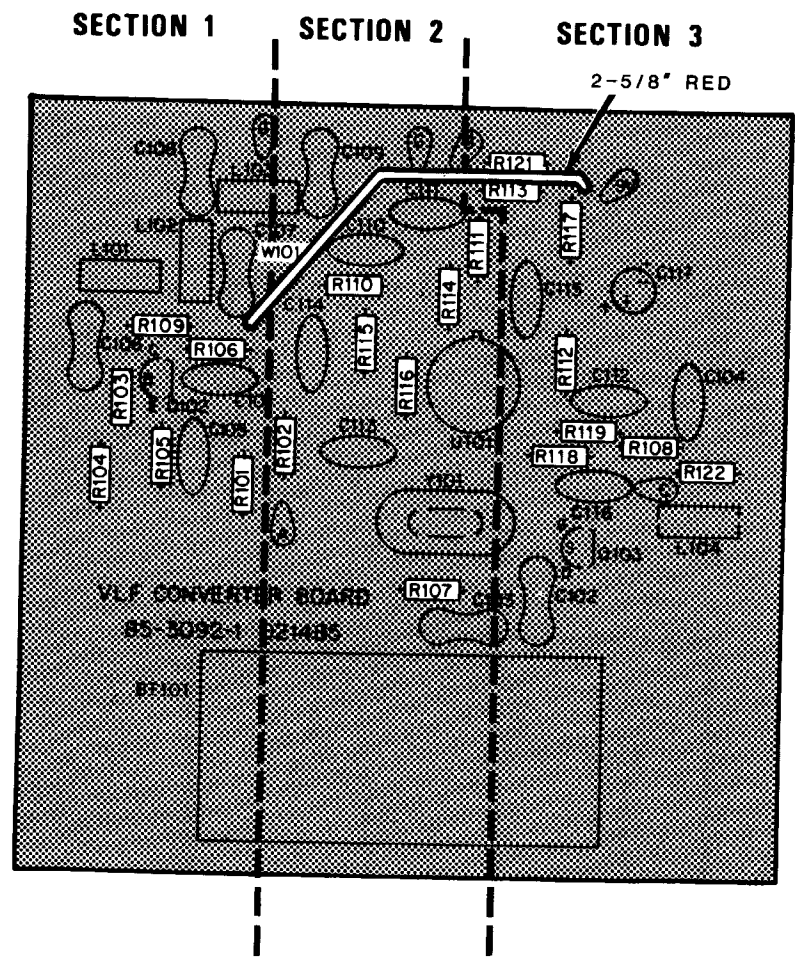
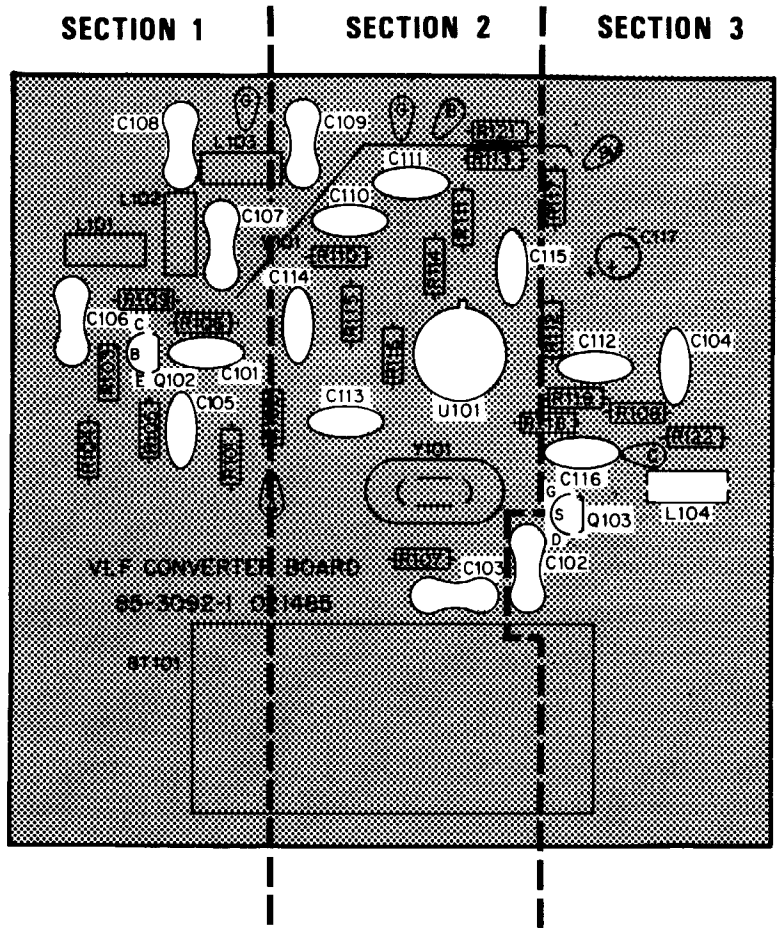


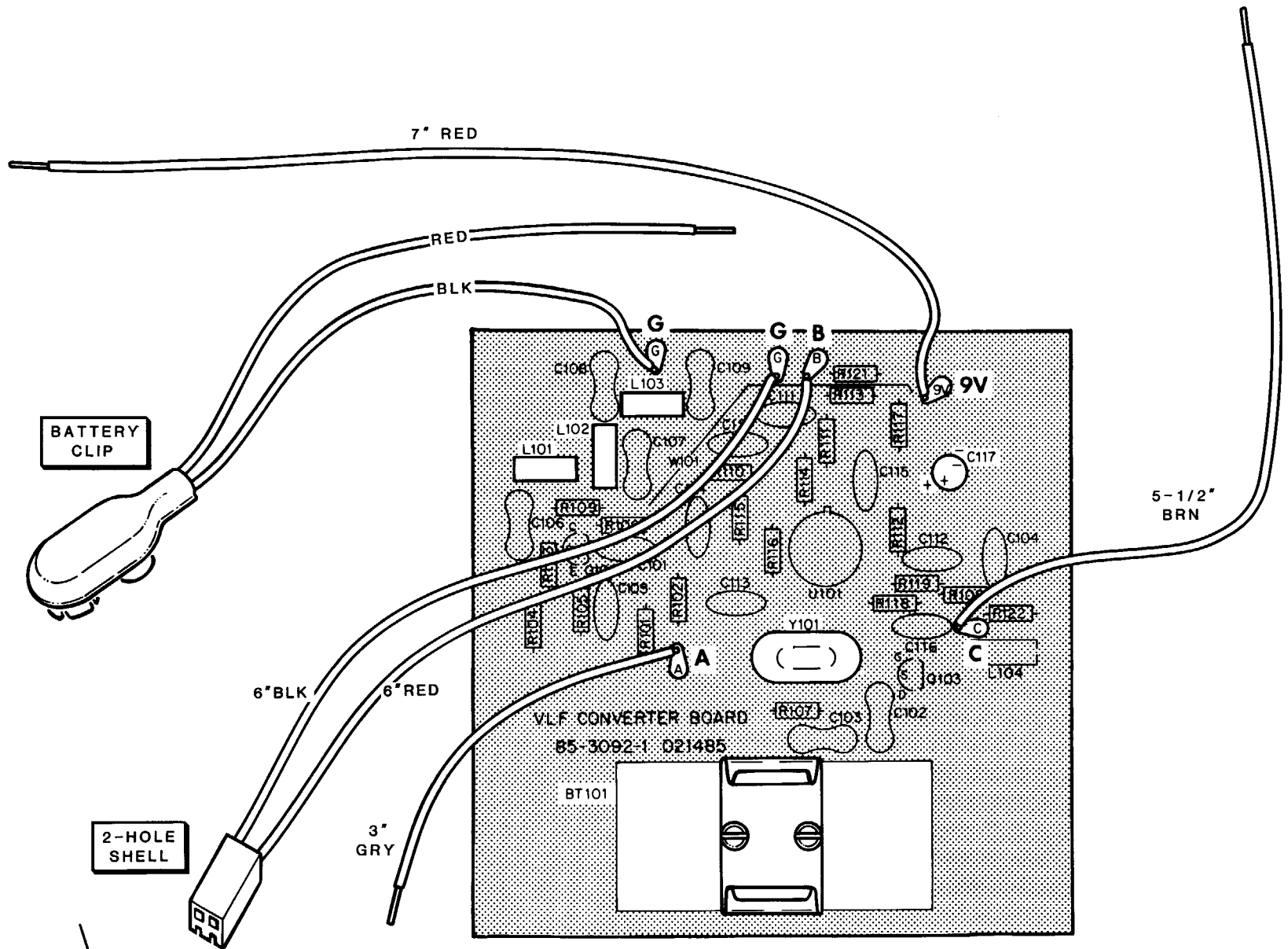
Figure 1



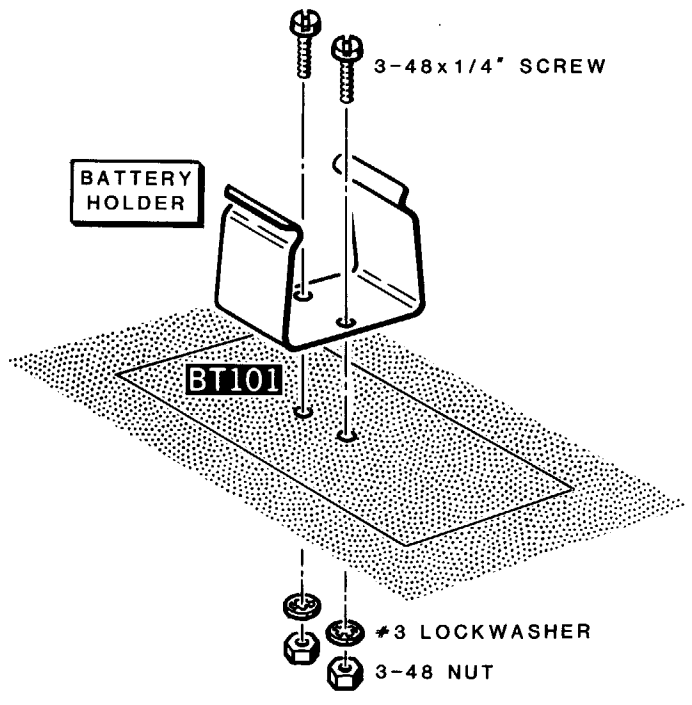
PICTORIAL 1-1



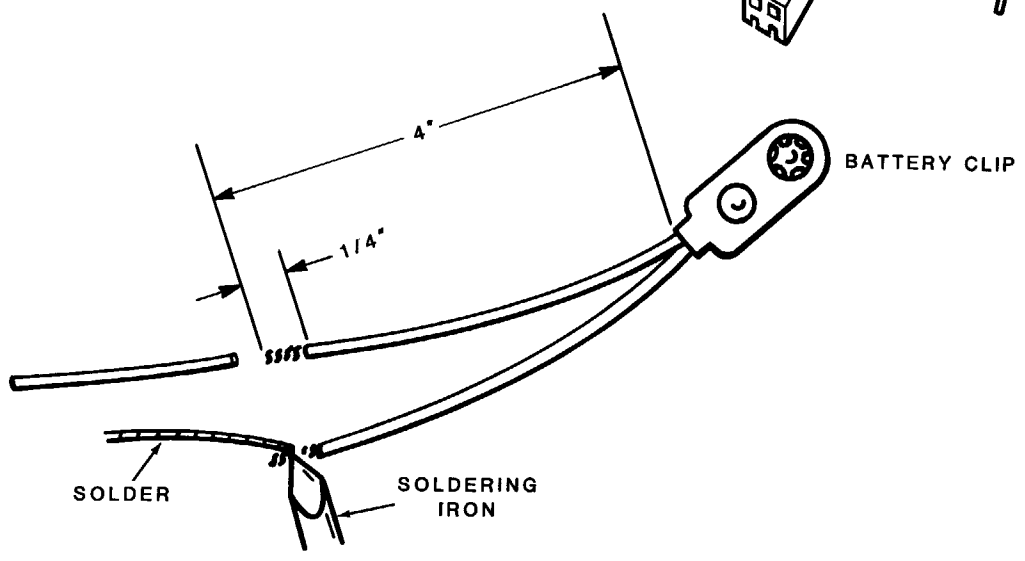
PICTORIAL 1-2



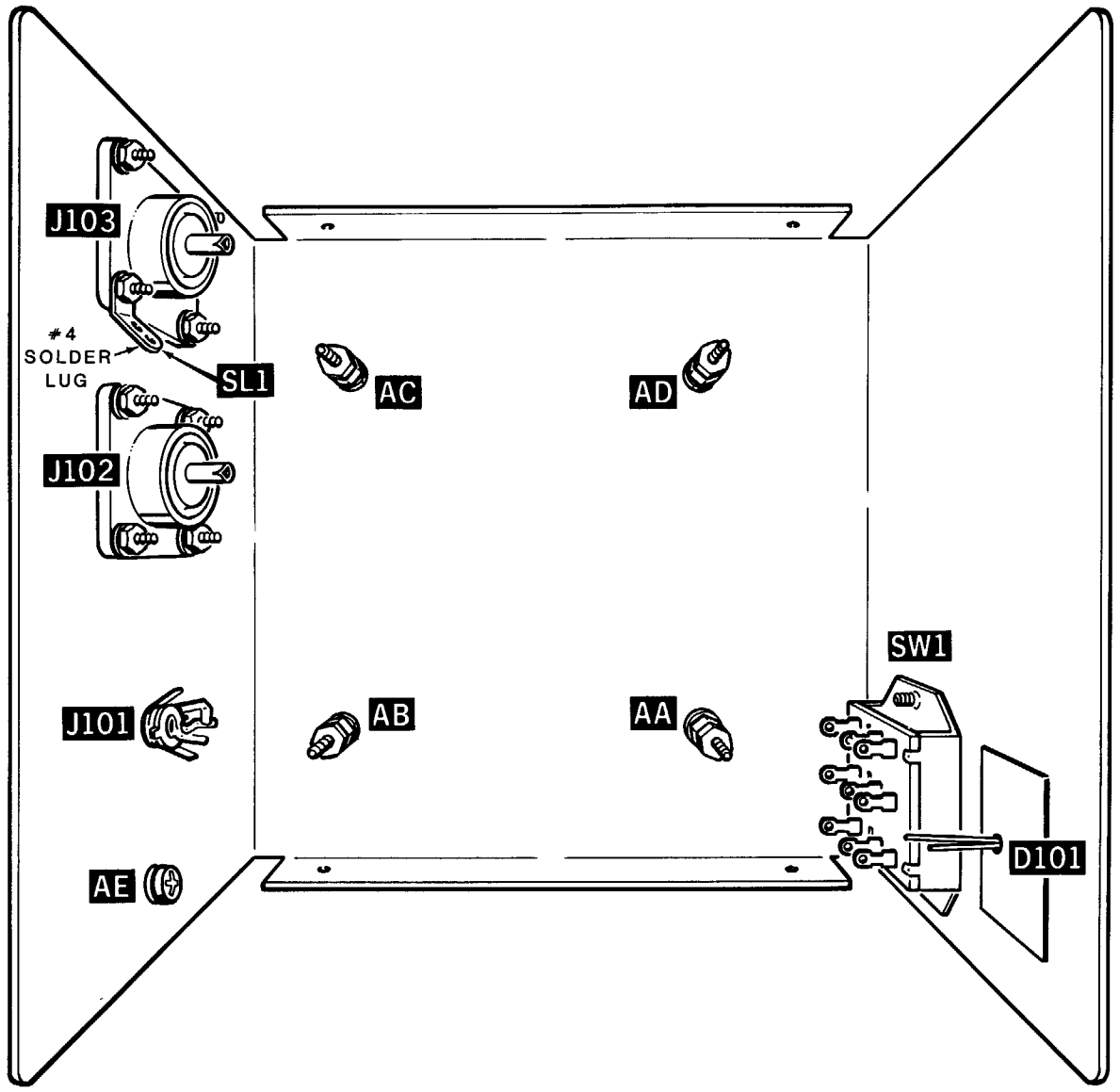
PICTORIAL 1-3



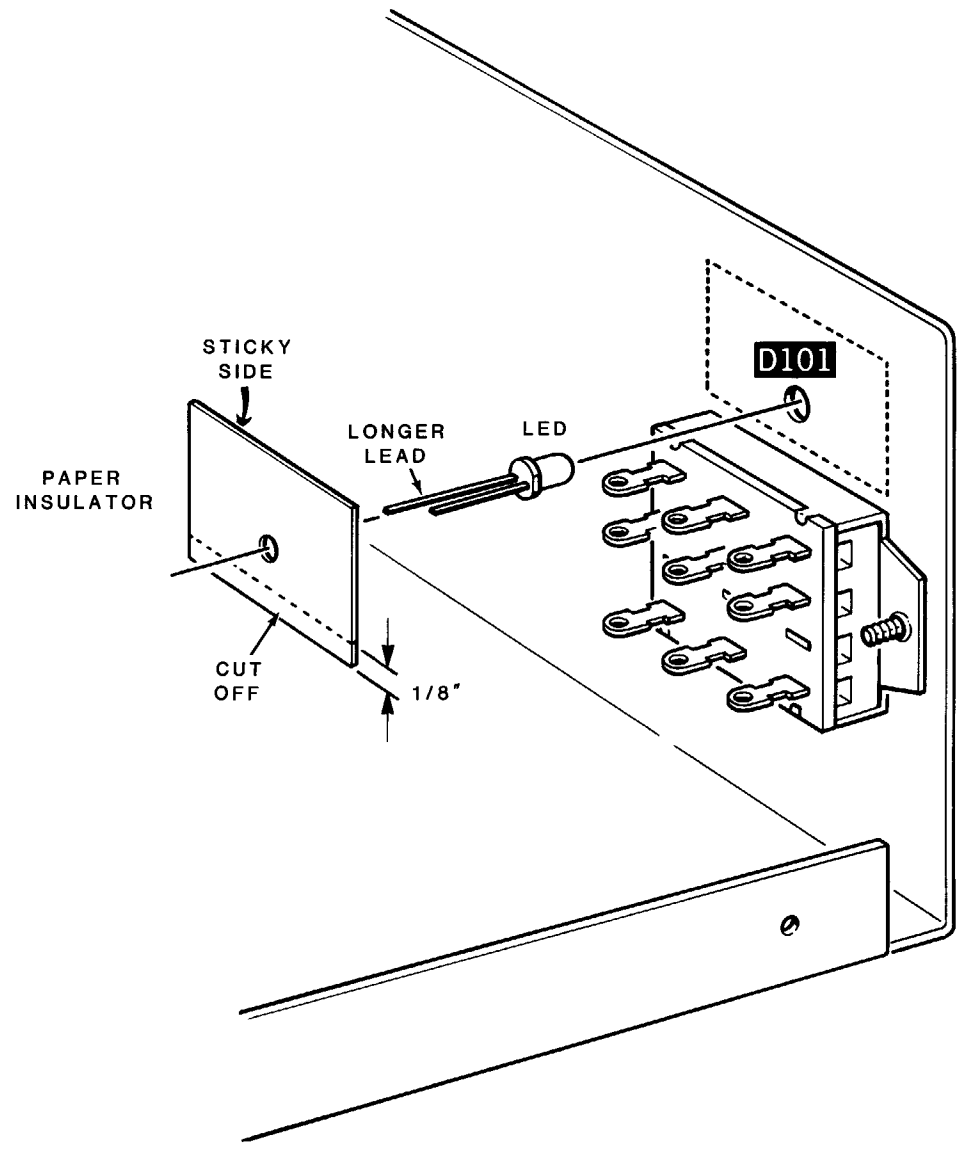
Detail 1-3A



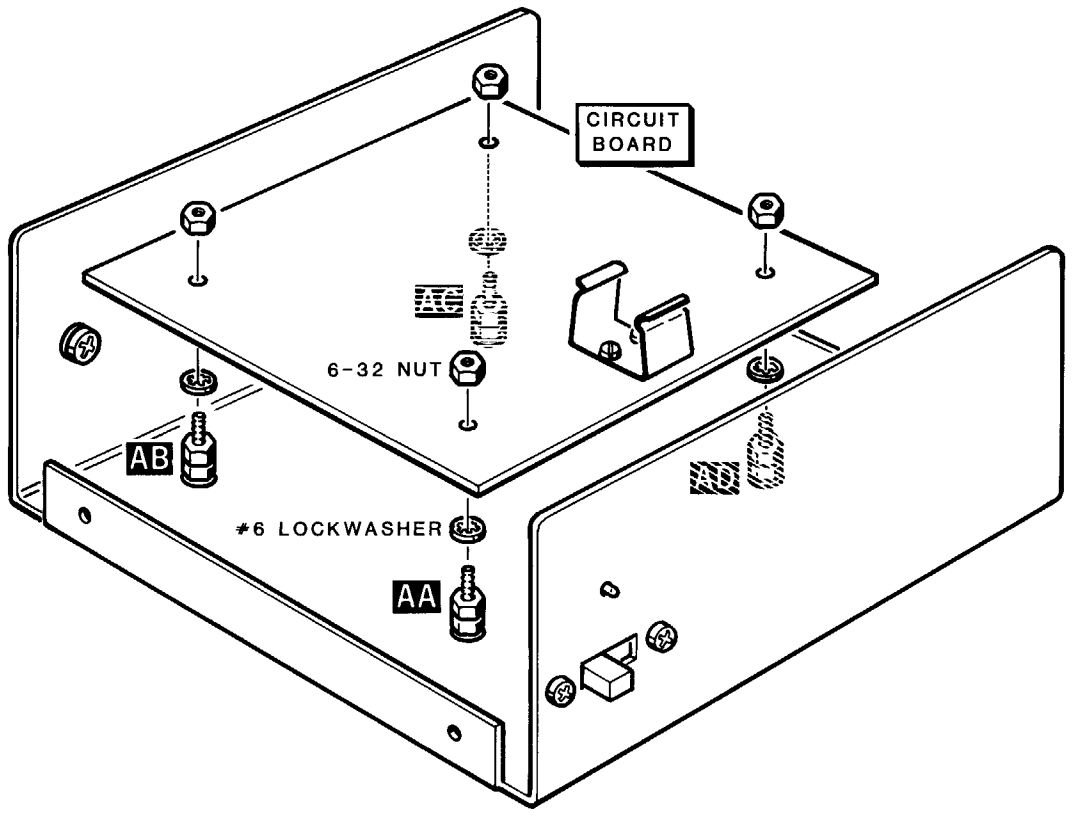
Detail 1-3B



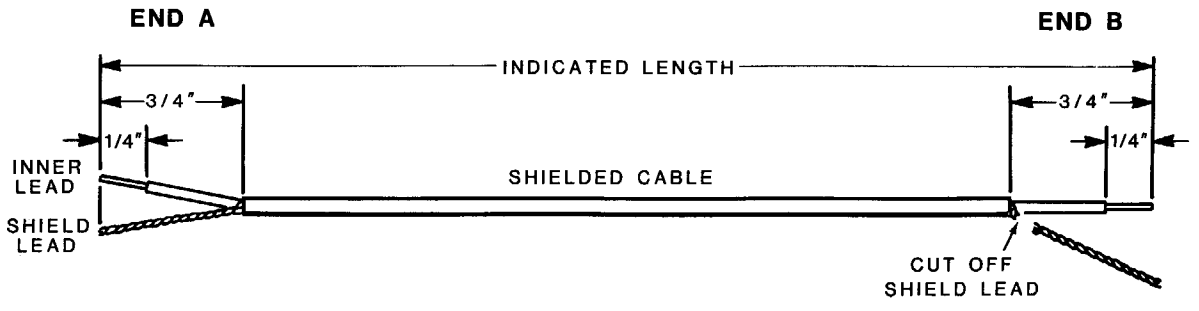
PICTORIAL 2–1



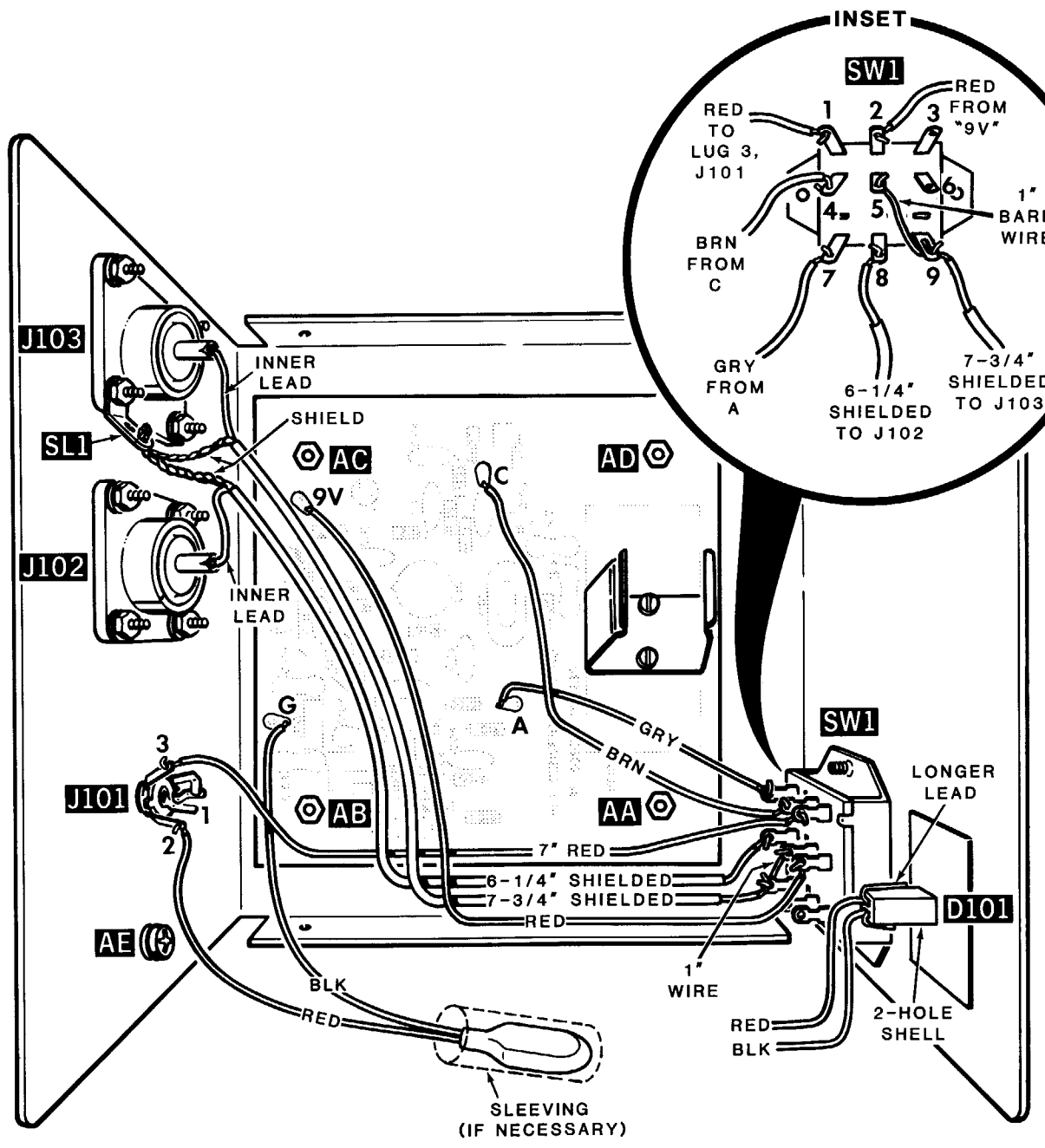
Detail 2-1A



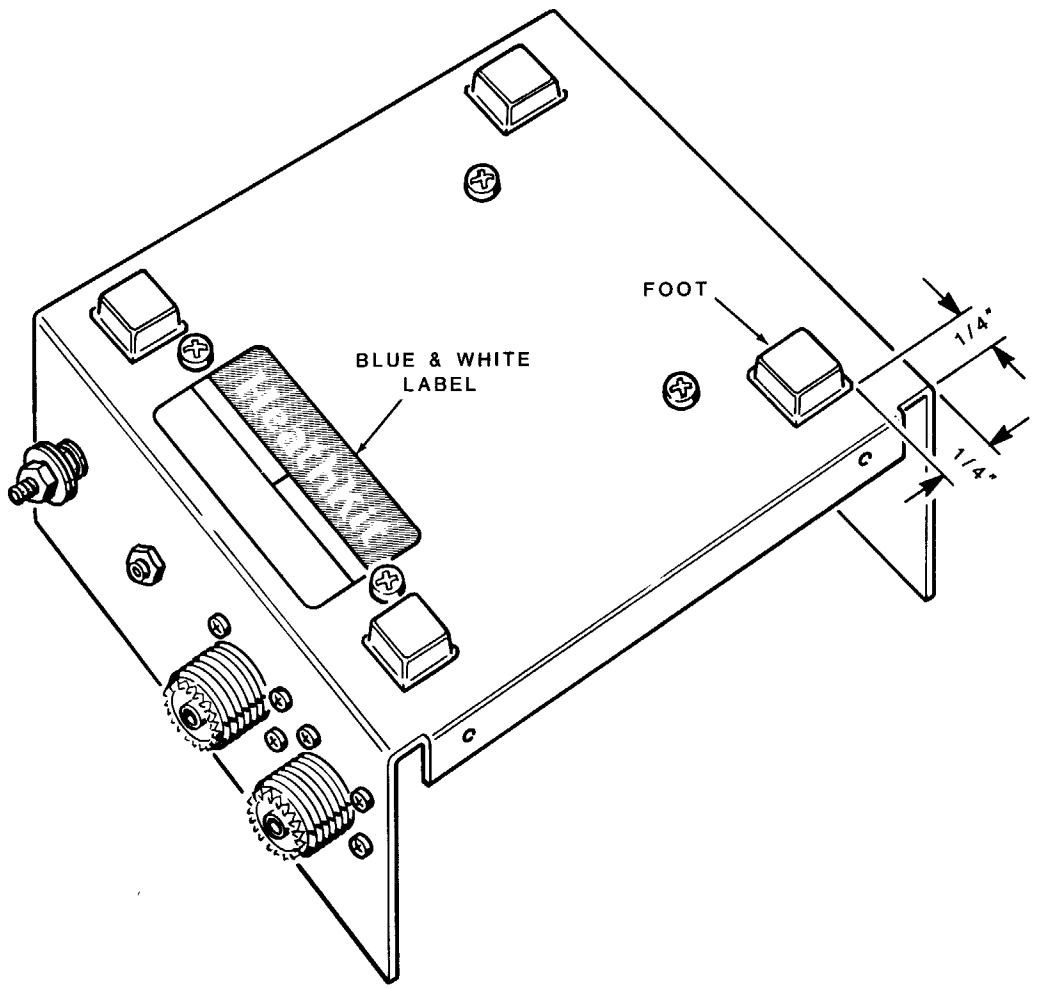
Detail 2–2A



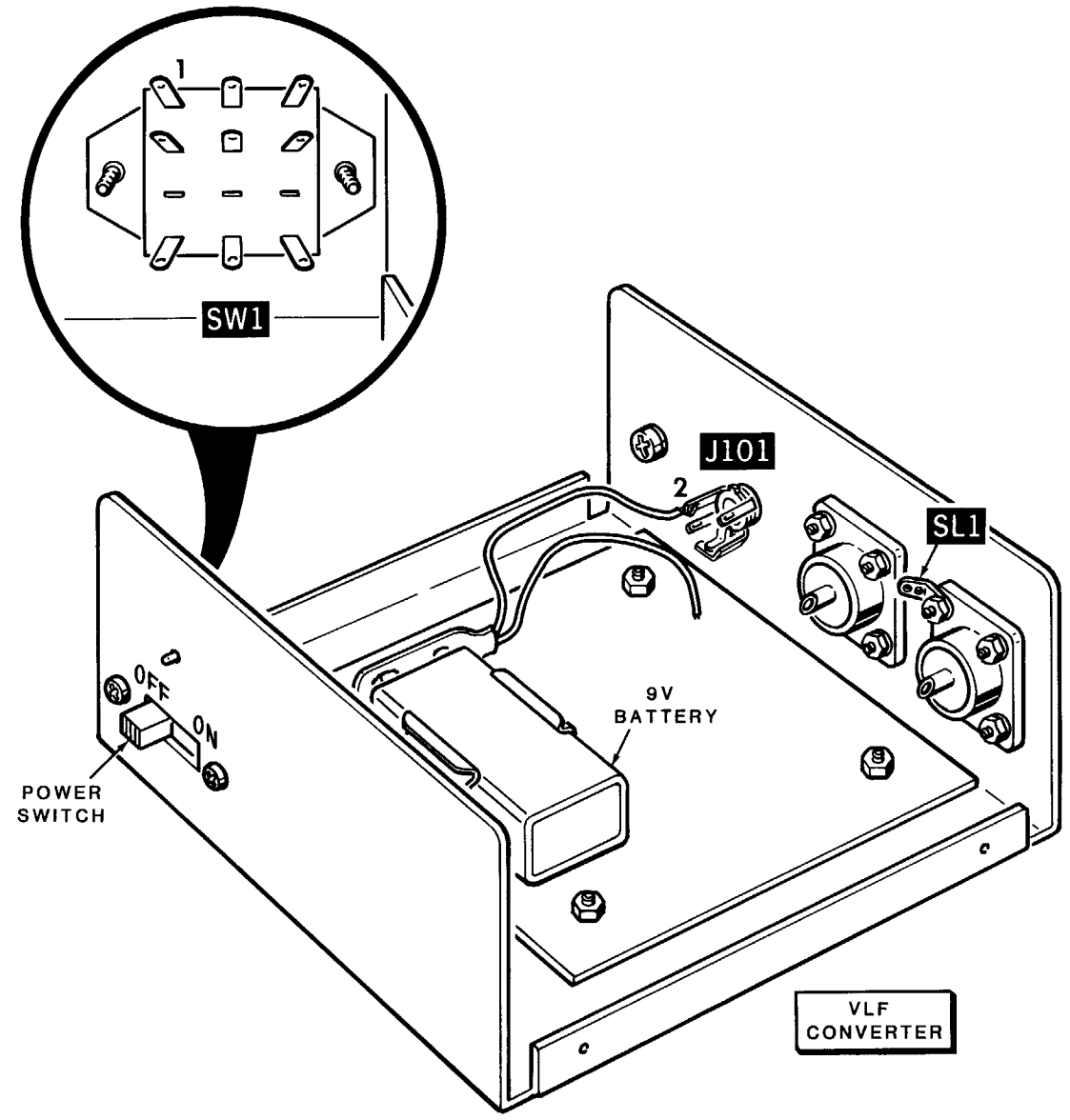
Detail 2-2B



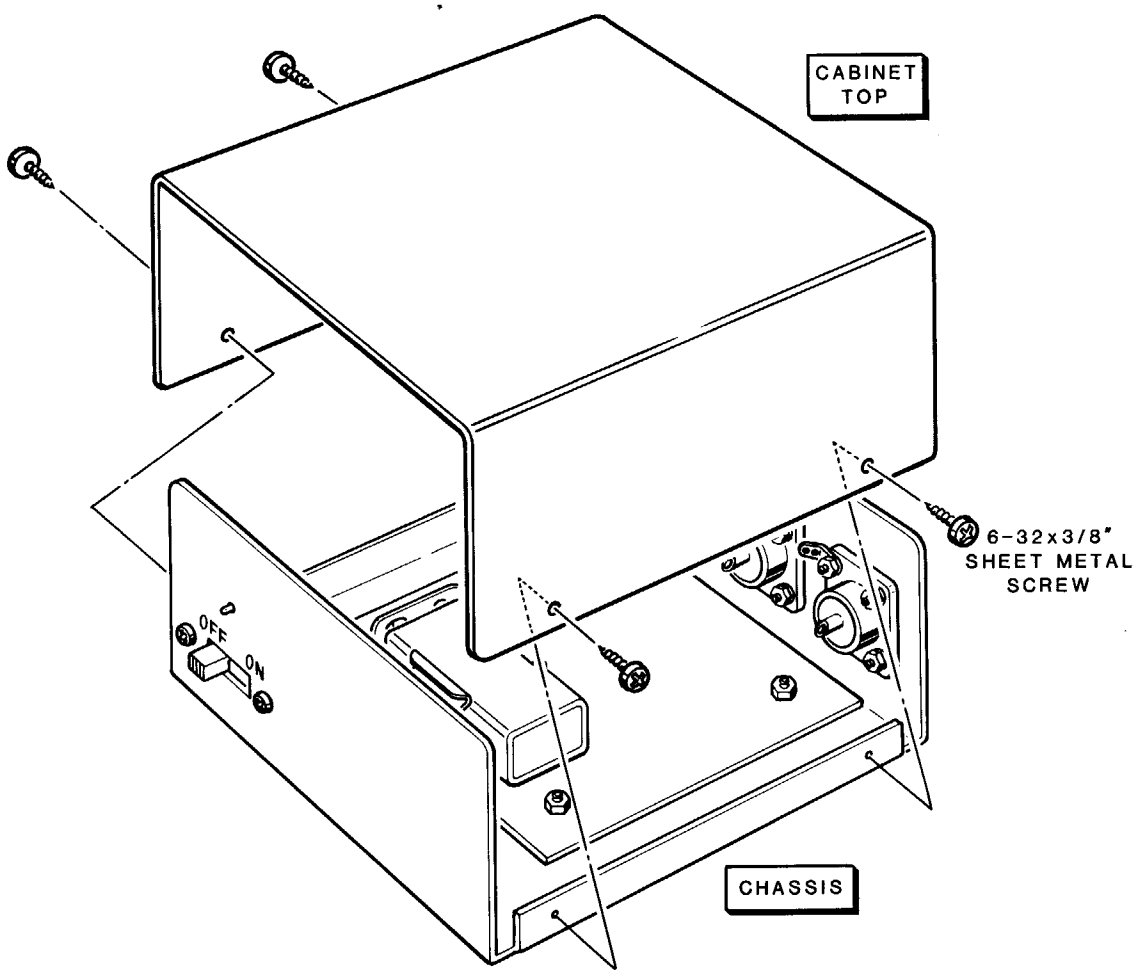
PICTORIAL 2-2



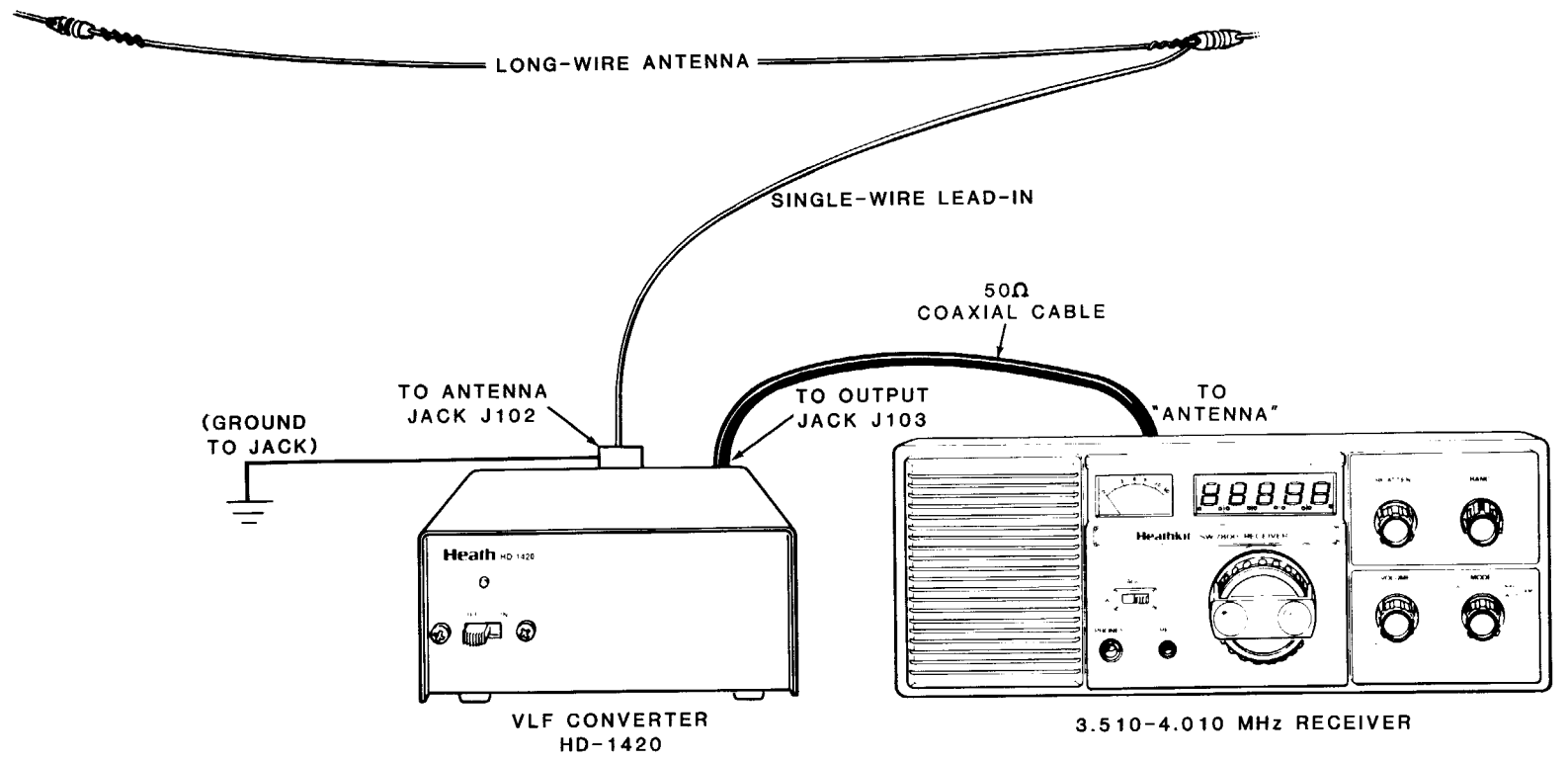
PICTORIAL 2-3



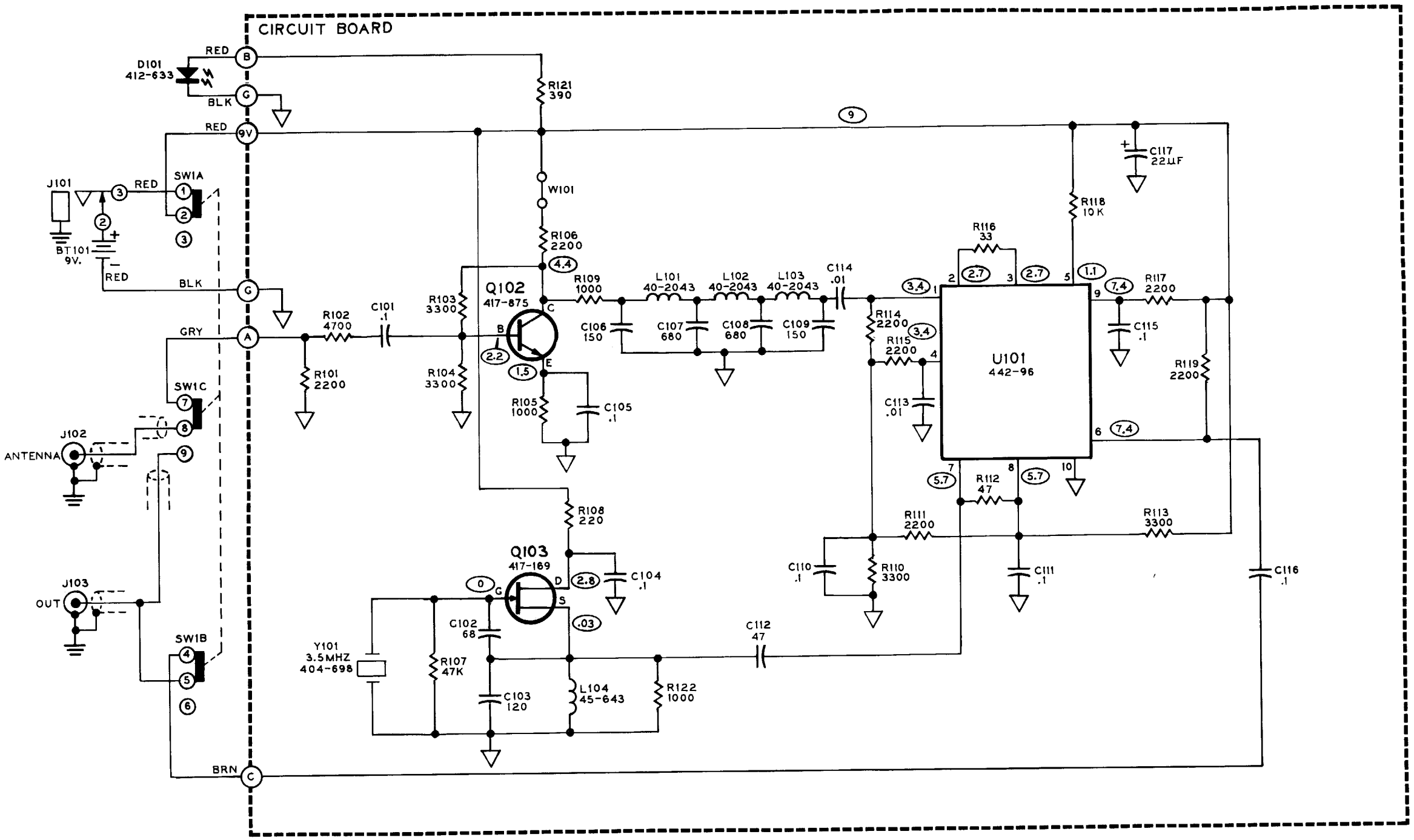
PICTORIAL 3–1



PICTORIAL 4-1



PICTORIAL 5-1



SCHEMATIC OF THE HEATHKIT VLF CONVERTER MODEL HD-1420

NOTES:

1. All resistors are rated at 1/4-watt, and have a 5% tolerance unless otherwise noted (K = 1000).
2. Capacitor values less than 1 are in µF (microfarads); those 1 or greater are in pF (picofarads), unless otherwise noted.
3. The following symbols are used on this schematic diagram:

Circuit board ground.

Chassis ground.

Circuit board wire connection.

DC voltage reading taken with a high input impedance voltmeter from the point indicated to chassis ground. Voltages may vary ± 10%.

4. Switch SW1 is shown in the "on" position.
5. Refer to the "Circuit Board X-Ray View" on Manual Page 23 for the physical locations of parts.