IMPORTANT WARRANTY INFORMATION! PLEASE READ

Return Policy on Kits When *Not* Purchased Directly From Vectronics: Before continuing any further with your VEC kit check with your Dealer about their return policy. If your Dealer allows returns, your kit must be returned *before* you begin construction.

Return Policy on Kits When Purchased Directly From Vectronics: Your VEC kit may be returned to the factory *in its pre-assembled condition only*. The reason for this stipulation is, once you begin installing and soldering parts, you essentially take over the role of the device's manufacturer. From this point on, neither Vectronics nor its dealers can reasonably be held accountable for the quality or the outcome of your work. Because of this, Vectronics cannot accept return of any kit-in-progress or completed work as a warranty item for any reason whatsoever. If you are a new or inexperienced kit builder, we urge you to read the manual carefully and determine whether or not you're ready to take on the job. If you wish to change your mind and return your kit, you may--but you must do it *before* you begin construction, and within ten (10) working days of the time it arrives.

Vectronics Warrants: Your kit contains each item specified in the parts list.

Missing Parts: If you determine, during your pre-construction inventory, that any part is missing, please contact Vectronics and we'll send the missing item to you free of charge. However, *before* you contact Vectronics, *please look carefully* to confirm you haven't misread the marking on one of the other items provided with the kit. Also, make certain an alternative part hasn't been substituted for the item you're missing. If a specific part is no longer available, or if Engineering has determined that an alternative component is more suitable, Vectronics reserves the right to make substitutions at any time. In most cases, these changes will be clearly noted in an addendum to the manual.

Defective Parts: Today's electronic parts are physically and electrically resilient, and defective components are rare. However, if you discover an item during your pre-construction inventory that's obviously broken or unserviceable, we'll replace it. Just return the part to Vectronics at the address below accompanied with an explanation. Upon receipt, we'll test it. If it's defective and appears unused, we'll ship you a new one right away at no charge.

Missing or Defective Parts After You Begin Assembly: Parts and materials lost or damaged *after construction begins* are not covered under the terms of this warranty. However, most parts supplied with VEC kits are relatively inexpensive and Vectronics can replace them for a reasonable charge. Simply contact the factory with a complete description. We'll process your order quickly and get you back on track.

Factory Repair After You Begin Assembly: *Kits-in progress and completed kits are specifically excluded from coverage by the Vectronics warranty*. However, as a service to customers, technicians are available to evaluate and repair malfunctioning kits for a minimum service fee of $18.00 (½ hour rate) plus $7.00 shipping and handling (prices subject to change). To qualify for repair service, your kit must be fully completed, unmodified, and the printed circuit board assembled using rosin-core solder. In the event your repair will require more than an hour to fix (or $36.00, subject to change), our technicians will contact you in advance by telephone before performing the work. Defective units should be shipped prepaid to:

Vectronics
1007 HWY 25 South
Starkville, MS 39759

When shipping, pack your kit well and include the minimum payment plus shipping and handling charges ($25.00 total). No work can be performed without pre-payment. Also, provide a valid UPS return address and a day time phone number where you may be reached.

INTRODUCTION

Enjoy world-wide shortwave radio listening. The Vectronics VEC-101K turns your AM or AM/FM radio into a world-band shortwave receiver at the push of a button. Hear late-breaking news from the BBC, a concert from Vienna or a soccer game from Brazil. Learn the culture of other nations, or brush up on your foreign language skills. Many interesting and informative programs from all over the world are available for your enjoyment. You can choose any two 1-MHz bands between 3 and 22 MHz and select either at the push of a button. Coverage includes the popular 13, 16, 19, 25, 31, 41, 49 and 60-meter international shortwave bands, plus much, much more. Select a night-time band and daytime band so you'll always have shortwave stations to listen too! Enjoy good sensitivity and selectivity when used with a car radio; tuning is done on the radio's AM dial. This kit features a professional quality glass epoxy PC board with solder mask and screen printed component legends making assembly a breeze! Circuit features the NE602 active doubly-balanced mixer IC, and operates from a long-life and economical 9-volt transistor battery. The VEC-101K automatically bypasses when not in use, normal AM or AM/FM is not affected.

TOOLS AND SUPPLIES

Construction Area: Kit construction requires a clean, smooth, and well-lighted area where you can easily organize and handle small parts without losing them. An inexpensive sheet of white poster board makes an excellent construction surface and provides protection for the underlying table or desk. Well-diffused overhead lighting is a plus, and a supplemental high-intensity desk lamp is especially helpful for close-up work. Safety is always important! Be sure to use a suitable high-temperature stand for your soldering iron, and keep the work area free of combustible clutter.

Universal Kit-building Tools: Although your particular kit may require additional items for completion, virtually all construction projects require a work area outfitted with the following tools and supplies:

- ☐ 30 to 60 Watt Soldering Iron
- ☐ High-temperature Iron Holder with Cleaning Sponge
- ☐ Rosin-core Solder (thin wire size preferred, .031")
- ☐ Needle Nose Pliers or Surgical Hemostats
- ☐ Diagonal Cutters or "Nippy Cutters"
- ☐ Solder Sucker (squeeze bulb or vacuum pump type), or Desoldering Braid

- ☐ Bright Desk Lamp
- ☐ Magnifying Glass

Special Tools for This Kit:

- ☐ "Blade" type tuning tool or jeweler's screwdriver.

BEFORE YOU START BUILDING

Experience shows there are *four common mistakes* builders commonly make. Avoid these, and your kit will probably work on the first try!

1. **Installing the Wrong Part:** It always pays to double-check each step. A 1K and a 10K resistor may look *almost* the same, but may act very differently in an electronic circuit! The same is true for capacitors—a device marked 102 (or .001 uF) may have very different operating characteristics from one marked 103 (or .01 uF).
2. **Installing Parts Backwards:** Always check the polarity of electrolytic capacitors to make sure the positive (+) lead goes in the (+) hole on the circuit board. Transistors have a flat side or emitter tab to help you identify the correct mounting position. ICs have a notch or dot at one end indicating the correct direction of insertion. Diodes have a banded end indicating correct polarity.
3. **Faulty Solder Connections:** Inspect for cold-solder joints and solder bridges. Cold solder joints occur when you don't fully heat the connection or when metallic corrosion and oxide contaminate a component lead or pad. Solder bridges form when a trail of excess solder shorts pads or tracks together (see Solder Tips below).
4. **Omitting or Misreading a Part:** This is easier to do than you might think! Always double-check to make sure you completed each step in an assembly sequence.

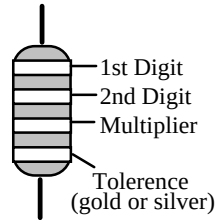
Soldering Tips: *Cleanliness* and good *heat distribution* are the two secrets of professional soldering. Before you install and solder each part, inspect leads or pins for oxidation. If the metal surface is dull, sand with fine emery paper until shiny. Allow the tip of your iron to contact both the lead and pad for about one second (count "one-thousand-one") before feeding solder to the connection. Surfaces must become hot enough for solder to *flow smoothly*. Feed solder to the opposite side of the lead from your iron tip. Solder will wick around the lead toward the tip, wetting all exposed surfaces.

Desoldering Tips: If you make a mistake and need to remove a part, follow these instructions carefully! First, grasp the component with hemostats or needle-nose pliers. Heat the pad beneath the lead you intend to extract, and pull gently. The lead should come out. Repeat for the other lead. Solder may fill in behind the lead as you extract it—especially if you are working on a double-sided board with plate-through holes. Should this happen, try heating the pad again and inserting a common pin into the hole. Solder won't stick to the pin's chromium plating. When the pad cools, remove the pin and insert the correct component. For ICs or multiple-pin parts, use desoldering braid to remove excess solder before attempting to extract the part. Alternatively, a low-cost vacuum-bulb or spring-loaded solder sucker may be used. Parts damaged or severely overheated during extraction should be replaced rather than reinstalled.

Work Habits: Kit construction requires the ability to follow detailed instructions and, in many cases, to perform new and unfamiliar tasks. To avoid making needless mistakes, work for short periods when you're fresh and alert. Recreational construction projects are more informative and more fun when you take your time. Enjoy!

Sorting and Reading Resistors: The electrical value of resistors is indicated by a color code (shown below). You don't have to memorize this code to work with resistors, but you do need to understand how it works:

Resistor Color Code



Black = 0 (tens)	Blue = 6
Brown = 1 (hundreds)	Violet = 7
Red = 2 (K)	Gray = 8
Orange = 3 (10K)	White = 9
Yellow = 4 (100K)	Silver = 10%
Green = 5 (1Meg)	Gold = 5%

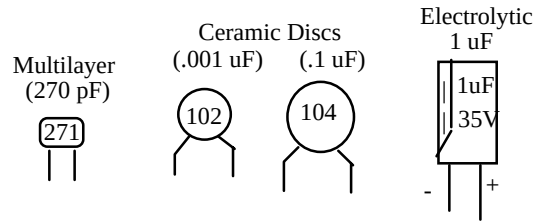
When you look at a resistor, check its multiplier code first. Any resistor with a black multiplier band falls between 10 and 99 ohms in value. Brown designates a value between 100 and 999 ohms. Red indicates a value from 1000 to 9999 ohms, which is also expressed as 1.0K to 9.9K. An orange multiplier band designates 10K to 99K, etc. To inventory resistors, first separate them into groups by multiplier band (make a pile of 10s, 100s, Ks, 10Ks, etc.). Next, sort each group by specific value (1K, 2.2K, 4.7K, etc.). This procedure makes the inventory easier, and also makes locating specific parts more convenient later on during construction. Some builders find it especially helpful to arrange resistors in ascending order along a strip of double-sided tape.

This VEC kit contains molded chokes which appear, at first glance, similar to resistors in both shape and band marking. However, a closer look will enable

you to differentiate between the two—chokes are generally larger in diameter and fatter at the ends than resistors. When doing your inventory, separate out any chokes and consult the parts list for specific color-code information.

Reading Capacitors: Unlike resistors, capacitors no longer use a color code for value identification. Instead, the value, or a 3-number code, is printed on the body.

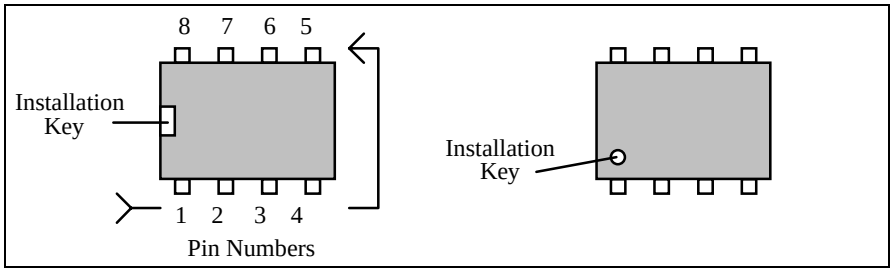
Value		Code
10 pF	=	100
100 pF	=	101
1000 pF	=	102
.001 uF	=	102*
.01 uF	=	103
.1 uF	=	104



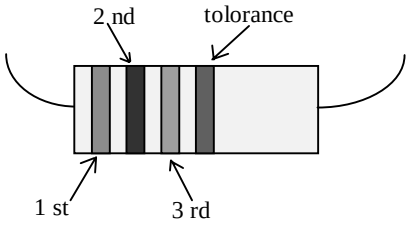
As with resistors, it's helpful to sort capacitors by type, and then to arrange them in ascending order of value. Small-value capacitors are characterized in pF (or pico-Farads), while larger values are labeled in uF (or micro-Farads). The transition from pF to uF occurs at 1000 pF (or .001 uF)*. Today, while *most* monolithic (multilayer) and disc-ceramic capacitors are marked with a three-number code, you may still find a .1 uF capacitor marked either "104" or ".1". For three digit codes, the first two digits indicate a numerical value, while the last digit indicates a multiplier (same as resistors). The value is in pF; thus a capacitor marked "104" is 100,000 pF, or .1 uF.

Electrolytic capacitors are always marked in uF. Electrolytics are polarized devices and must be oriented correctly during installation. If you become confused by markings on the case, remember the uncut negative lead is slightly shorter than the positive lead.

Integrated Circuits: Proper IC positioning is indicated by a dot or square marking located on one end of the device. A corresponding mark is silk-screened on the PC board and printed on the kit's parts-placement diagram. To identify specific IC pin numbers for testing purposes, see the following diagram. Pin numbers always start at the keyed end of the case and progress counterclockwise around the device, as shown:



This VEC kit contains molded chokes which appear, at first glance, similar to resistors in both shape and band marking. When doing your inventory, separate out any chokes and consult the parts list for specific color-code information.



Important Note: The fourth color band indicates the tolerance. We are interested in the value, and the parts lists and assembly directions will only specify the colors of the first three color bands.

PARTS LIST

Your kit should contain all of the parts listed. Please identify and inventory each item on the checklist before you start building. If any parts are missing or damaged, refer to the manual's warranty section for replacement instructions. If you can't positively identify an unfamiliar item on the basis of the information given, set it aside until all other items are checked off. You may then be able to identify it by process of elimination. Finally, your kit will go together more smoothly if parts are organized by type and arranged by value ahead of time. Use this inventory as an opportunity to sort and arrange parts so you can identify and find them quickly.

CAPACITORS:

☑	Qty	Part Description	Designation
☐	2	12 pF monolithic (12 or 120)	C1,C2
☐	1	47 pF disc ceramic (47 or 470)	C3
☐	2	47 pF monolithic (47 or 470)	C9,C9
☐	2	.1 uF monolithic (.1 or 104)	C6,C7
☐	2	.1 uF disc ceramic (104)	C4,C5
☐	4	100 pF ceramic trimmer	C10,C11,C12,C13

SEMICONDUCTORS:

☑	Qty	Part Description	Designation
☐	1	NE602, SA602 or NE612 linear IC	U1

INDUCTORS:

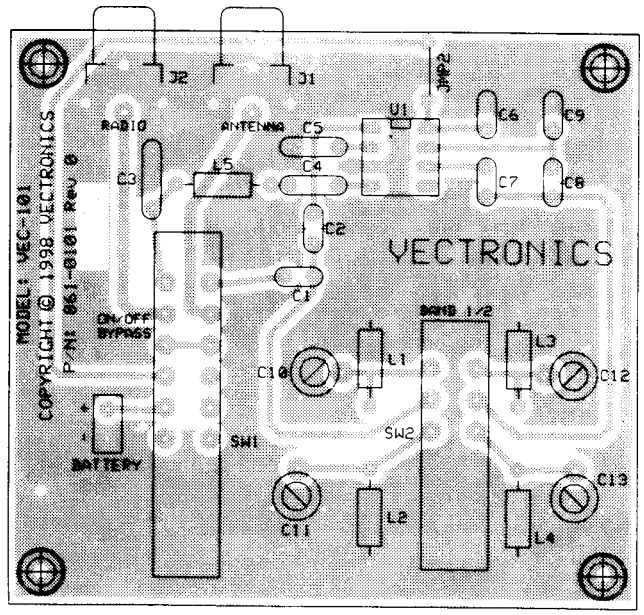
☑	Qty	Part Description	Designation
☐	1	180 uH molded inductor (brown-gray-brown)	L5
☐	2	33 uH molded inductor (orange-orange-black)	L2,L4
☐	2	10 uH molded inductor (brown-black-black)	L2,L4
☐	2	3.9 uH molded inductor (orange-white-gold)	L1,L3
☐	2	1.2 uH molded inductor* (brown-red-gold)	L1,L3

* Your kit may include a different looking 1.2 uH inductor. The full color band is silver-brown-gold-red-silver.

MISCELLANEOUS:

☑	Qty	Part Description	Designation
☐	1	DPDT push action switch	SW2
☐	1	4PDT push action switch	SW1
☐	1	9-volt battery snap with leads	BT1
☐	1	4" nylon tie wrap	
☐	1	8 pin DIP low profile IC socket	
☐	1	VEC-101 printed circuit board	
☐	2	RCA phono jacks, pc board mount	

PARTS PLACEMENT DIAGRAM



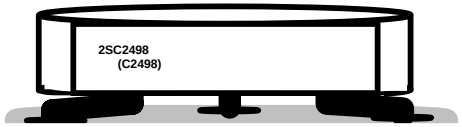
STEP-BY-STEP ASSEMBLY INSTRUCTIONS

Before assembling your kit, please take time to read and understand the VEC kit warranty printed on the inside cover of this manual. Read through the assembly instructions to make sure the kit does not exceed your skill level. Once construction is started, the kit is non-returnable. Finally, if you haven't already done so, please verify that all parts listed in the inventory are included. If anything is missing or broken, refer to the warranty instructions for replacing missing or damaged parts.

First, a few notes and comments to help you along. Part designators for components such as L1, C3, etc., appear on the silk-screened legend on the component-mounting side of the printed circuit board. These correspond to the drawing shown in the "Part Placement Diagram" section of this manual. The parts are inserted on the silk-screen side of the board. All capacitors should be installed with their bodies as close to the PC board as possible; this is very important in RF circuits.

If you have last-minute questions concerning what tools or materials are needed to assembly this kit, please refer back to the section entitled "Before You Begin".

"Install" When you are directed to *install* a part, this means to locate, identify, and insert the part into its mounting holes on the PC board. This includes pre-bending or straightening leads as needed so force is not required to seat the part. Once a component is mounted, bend each lead over to hold it in place. Make sure trimmed leads don't touch other pads and tracks, or a short circuit may result:



"Solder" When you are directed to *solder*, this means to solder the part's leads in place, and to inspect both (or all) solder connections for flaws or solder bridges. If no soldering problems are noted, nip off the excess protruding leads with a sharp pair of side cutters.

We'll begin with the molded chokes

Phase 1: Molded Chokes

Important Note: only the first three color bands are specified in the following directions. The fourth band is for tolerance and may be disregarded.

Locate the 180-uH molded choke (brown-gray-brown).

☐ ☐ 1. *Install* and *solder* the 180-uH choke (brown-gray-brown) at location L5 on the PC board.

Important Note: You need to determine the two SW bands the VEC101 will cover. Chokes L1 and L3 are used for the lowest frequency band, chokes L2 and L4 are selected for the higher frequency band. Band selection is via switch SW2. Push button is in for lowest frequency band, push button is out for highest frequency band.

The choke values for the following steps are determined by the following:

Desired coverage	L1, L3 low range	L2, L4 high range
3.0 to 5.8 MHz	33 uH, 33 uH	use low range
5.0 to 9.0 MHz	10 uH, 10 uH	10 uH, 10 uH
8.0 to 14.5 MHz	3.9 uH, 3.9 uH	3.9 uH, 3.9 uH
13.9 to 23 MHz	use high range	1.2 uH, 1.2 uH

Table 1

Example:

Your favorite SW bands are 31 Meters and 49 Meters. 49 Meters is from 5.95 MHz to 6.20 MHz. 31 Meters spans from 9.50 MHz to 9.90 MHz.

According to the data in Table 1, 10-uH chokes should be used for the 49-Meter band (5.95 to 6.20 MHz). Because this is the lowest frequency band of the two we are selecting, the 10-uH chokes will be used at locations L1 and L3.

Referring to Table 1 again shows for 30 Meters (9.5 to 9.9 MHz) coverage 3.9-uH chokes should be used at locations L2 and L4.

☐ ☐ 2. Determine the two shortwave frequency ranges or SW bands you wish to monitor. Refer to Table 1 for the proper choke values. *Note:* Some bands, such as 16 and 13 Meters, share the same choke value. Only one of those two bands may be covered.

☐ ☐ 3. Select the two chokes to be used for the *lowest frequency* Short Wave band. Install and solder at the following locations (both chokes must be identical values):

☐ ☐ 4. L2, *selected choke value*

☐ ☐ 5. L4, s*elected choke value*

☐ ☐ 6. Select the two chokes to be used for the *highest frequency* Short Wave band. Install and solder at the following locations (both chokes must be identical values):

☐ ☐ 7. L1, *selected choke value*

☐ ☐ 8. L3 *selected choke value*

Phase 2: Capacitors

Locate the four 100-pF ceramic trimmer capacitors. Install and solder at the following locations:

☐ ☐ 1. C10 100-pF ceramic trimmer

☐ ☐ 2. C11 100-pF ceramic trimmer

☐ ☐ 3. C12 100-pF ceramic trimmer

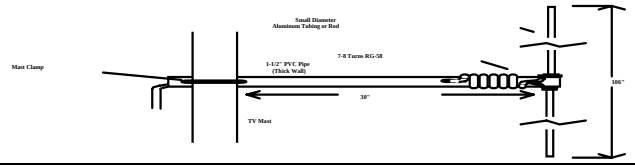
☐ ☐ 4. C13 100-pF ceramic trimmer

Locate the two .1-uF ceramic disc capacitors (.1 or 104). *Do not* confuse the two .1 ceramic disc capacitors with the two .1 monolithic capacitors! Install and solder at the following locations:

☐ ☐ 5. C4 .1-uF ceramic disk (.1 or 104)

☐ ☐ 6. C5 .1-uF ceramic disk (.1 or 104)

Important Note: *never use force to seat a monolithic cap* into the PC board. If the spacing isn't right, pre-form the leads to the correct spacing before installation!



Locate the two .1-uF monolithic capacitors (.1 or 104). Install and solder at the following locations:

☐ ☐ 7. C6 .1-uF monolithic (.1 or 104)

☐ ☐ 8. C7 .1-uF monolithic (.1 or 104)

Locate the two 47-pF monolithic capacitors (47 or 470). *Do not* use the 47-pF disc ceramic at this point! Install and solder at the following locations:

☐ ☐ 9. C8 47-pF monolithic (47 or 470)

☐ ☐ 10. C9 47-pF monolithic (47 or 470)

☐ ☐ 11. Locate the 47-pF (47 or 470) ceramic disc capacitor. Install and solder at location C3.

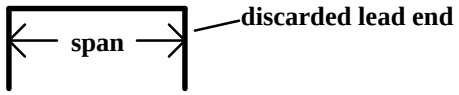
Locate the two 12-pF monolithic capacitors (12 or 120). Install and solder at the following locations:

☐ ☐ 12. C1 12-pF monolithic (12 or 120)

☐ ☐ 13. C2 12-pF monolithic (12 or 120)

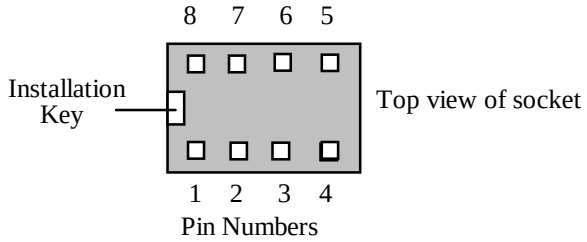
Phase 3: Jumpers/IC Sockets and Chips

Select a scrap capacitor lead end for use as a jumper wire, as shown below. Use needle-nose pliers to form to fit, making sure the jumper lies flat on the PC board when installed:



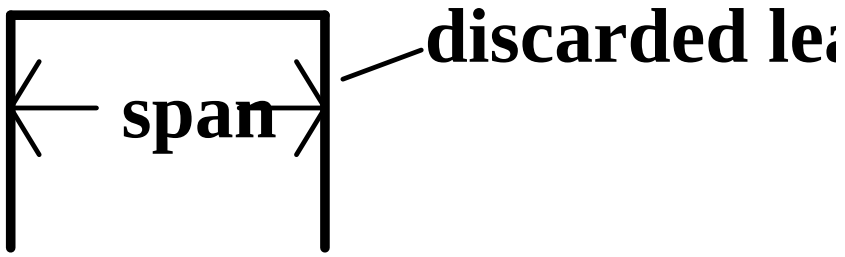
☐ ☐ 1. Prepare, install, and solder a jumper wire at JMP2.

Locate the 8-pin DIP integrated IC socket. Note that the socket is "keyed", and should be installed with its key aligned to the silk-screened outline on the PC board.



☐ ☐ 2. Install and solder the 8-pin IC socket at location U1. Observe proper orientation!

The IC body has a small notch, or *key*, molded at one end, indicating pins 1 and 8. A small dimple-like body-molding is often found adjacent to pin 1. Some IC packages may include both key indicators.

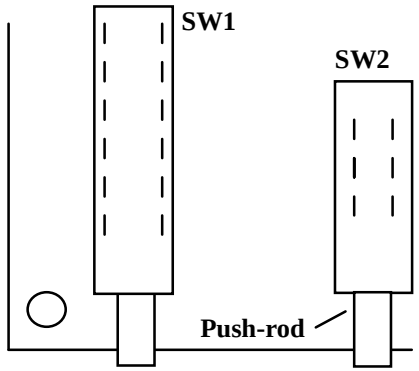


Locate the 8-pin NE602 (may be marked as NE602, SA602, or NE612).

☐ ☐ 3. Align the body of the NE602 to correspond with the key of socket U1. Loosely insert the NE602 pins into socket U1. All 8 pins should fit freely into the socket openings. If not, straighten the IC pins until they do. Using firm and steady pressure, fully seat the IC into the socket.

☐ ☐ 4. Locate the push-action DPDT band switch. Install and solder at SW2. The push shaft should extend over the front of the board. Be sure the switch is fully seated and level before soldering.

☐ ☐ 5. Locate the push-action 4PDT power/bypass switch. Install and solder at location SW1. The push shaft should extend over the front of the board. Be sure the switch is fully seated and level before soldering.



Phase 4: Phone Jacks/Battery Clip/Tie Wrap

Locate the two RCA phono jacks. Install and solder at the following locations (be sure the leads are fully seated before soldering):

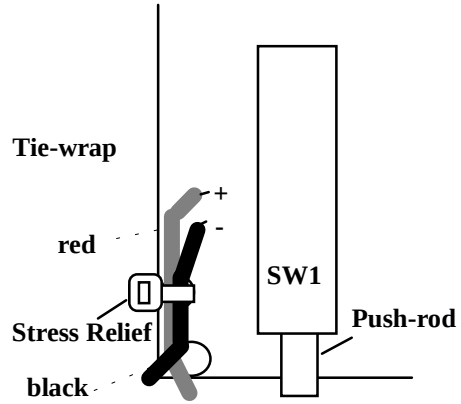
☐ ☐ 1. J1 -- install and solder a RCA phono jack.

☐ ☐ 2. J2 -- install and solder a RCA phono jack.

Locate the 9-volt battery snap.

☐ ☐ 3. Solder the RED positive lead to the positive (+) termination shown on the silk-screened legend.

☐ ☐ 4. Solder the BLACK negative lead to the negative (-) termination shown on the silk-screened legend.



☐ ☐ 5. Locate the nylon wire tie wrap. Loop the nylon tie through the stress relief hole (see above) and around the battery lead wires.

☐ ☐ 6. Run the nylon tail through the locking head of the tie, and pull until snug. Trim excess nylon tail.

This concludes the construction phase of your receiver. You deserve a break! When you come back, be ready to give your work a thorough "QC" quality control check before moving on to the testing and alignment section.

☐ ☐ Please go over the board and verify that all parts are properly installed. Check all solder connections, and redo those that look suspect.

TESTING AND ALIGNMENT

Understanding alignment: This converter is intended to be used with a tunable communications receiver that covers from 540 to 1600 (or 1710) kHz. For

alignment, a communications receiver or car radio will be needed. The receiver must be shielded, and one that requires an external antenna for reception.

Alignment consists of adjusting capacitors C10 and C12 for the highest frequency band, and capacitors C11 and C13 for the lowest frequency band. Capacitors C10 and C11 are part of the input tuning, and are set for best sensitivity. Capacitors C12 and C13 set the Local Oscillator frequency for the shortwave converter mixer.

Because we are using a tunable IF (a receiver covering 540 to 1600 kHz), the Local Oscillator should be set for *Low Side injection.* Using high side injection would result in the bands being tuned "backwards" across the dial. Let's look at an example and see what needs to be done.

Let's assume we want the converter to cover the 41-Meter and 25-Meter Shortwave broadcast bands. 41 Meters spans 7.100 to 7.300 MHz. We'll begin with the 41-Meter band alignment. Since this is the lowest frequency band, we will be adjusting capacitors C11 and C13. (L2 and L4 both should be 10-uH molded chokes.)

The tunable receiver starts at 540 kHz. If we have the 41-Meter band start at this point, a dial reading of 540 kHz would equate to a receive frequency of 7.100 MHz. This is confusing, as there is no relationship between the two frequencies. Instead, let's set the Local Oscillator so dial reading of 1100 kHz (1.100 MHz) corresponds to the beginning of the 41 Meter band at 7.100 MHz. A dial read of 1300 kHz would correspond to 7300 kHz (7.300 MHz), the upper frequency of the 41-Meter band. . The correlation between the radio dial and the actual receive frequency is easily understood. Except for 31 and 13 Meters, most of the bands can be set to align with the AM broadcast band dial scale readings. 31-Meters begins at 9.500 MHz. This could equate to an IF. at 500 kHz (below the tuning range of the radio) or 1500 kHz. Using 1500 kHz would require that the radio tune to 1900 kHz, again out of range. Using 500 kHz would lose coverage of the lower 40 kHz of the 31-Meter band, not too bad of a compromise if dial correlation is important.

Worldwide Shortwave AM broadcast bands

Band	Frequencies	Tuning range	LO setting
75 Meters	3.900 to 4.000 MHz	900kHz to 1000kHz	3.000 MHz
49 Meters	5.950 to 6.200 MHz	950kHz to 1200kHz	5.000 MHz

41 Meters	7.100 to 7.300 MHz	1000kHz to 1300kHz	6.000 MHz
31 Meters	9.500 to 9.900 MHz	no recommendations	
25 Meters	11.650 to 12.050 MHz	650kHz to 1250kHz	11.00 MHz
19 Meters	15.100 to 15.600 MHz	1100kHz to 1600kHz	14.00 MHz
16 Meters	17.550 to 17.900 MHz	550kHz to 900kHz	17.00 MHz
13 Meters	21.450 to 21.850 MHz	no recommendations	

The table shows the optimum LO settings for our example converter operating on 41 and 25 Meters would be 6.00 MHz and 11.00 MHz, respectively.

Calculating the Local Oscillator Frequency:

When used with a receiver that covers from 540 to 1600 kHz, the converter can cover any two 1060 kHz wide segments between 3 and 22 MHz. The Local Oscillator frequency is the ***difference*** between the shortwave frequency and its corresponding AM broadcast band frequency.

Examples of good and poor correlation between the receiver and shortwave frequencies :

Desired coverage	**Actual Coverage**	**Receiver Tuning**	**Local Oscillator**
8.54 to 9.54 MHz good correlation	**8540 to 9600 kHz**	**540 to 1600 kHz**	8000 kHz (8.00 MHz)
8.00 to 9.00 MHz poor correlation	**8000 to 9060 kHz**	**540 to 1600 kHz**	7460 kHz (7.46 MHz)

Performing Local Oscillator Alignment:

Using a shortwave receiver: If you own a good shortwave receiver that covers to at least 22 MHz, it may be used for the Local Oscillator alignment.

1. Set up the shortwave receiver on your workbench. It should be equipped with a short wire antenna that is run near the VEC-101K circuit board.
2. The low-frequency band Local Oscillator is aligned first.
3. Set the receiver to monitor the frequency the Local Oscillator is going to be set to. If the receiver has a BFO, turn it on.
4. The push-button for the SW2 bandswitch should be in the “depressed” or “in” position, selecting the low-frequency shortwave band.
5. Attach a fresh 9-volt battery to the VEC-101K battery clip.
6. Set SW1 power switch button to on, the “in” position.

7. Using a blade type alignment tool or small jeweler's screwdriver, carefully adjust ceramic trimmer capacitor C13 until the oscillator signal is heard sweeping through the shortwave receiver.
8. Slowly adjust the trimmer C13 so the Local Oscillator signal falls exactly on frequency (if the BFO is on, adjust for "zero beat").
9. Set the receiver to the highest Local Oscillator frequency to be set.
10. Activate bandswitch SW2 so the shaft returns to the fully extended position (high frequency band).
11. Adjust ceramic trimmer capacitor C12 until the Local Oscillator signal is head sweeping across the receiver.
12. Carefully peak C12 so the Local Oscillator frequency falls exactly on the receiver frequency (if the BFO is on, adjust for "zero beat").
13. This completes the Local Oscillator alignment.

Using a frequency counter: A sensitive frequency counter is needed. Make up a small "gimmick capacitor" using two or three inches of insulated wire twisted together. The gimmick capacitor is used to couple the Local Oscillator signal from pin 7 of the NE602 to the counter input. RF cables must be *very* short to prevent signal attenuation. If more signal amplitude is needed, use an in line broadband RF preamplifier. Many Tektronix scopes (465) have a vertical amplifier output which may be used to drive a counter. Use the scope vertical amplifier to amplify the level. Note that the gimmick capacitor will load the oscillator, and pull its frequency to some extent.

Using off-air signals: Shortwave broadcasters operate on known schedules, and often announce their frequencies throughout the broadcast or on the hour. Popular Communications Magazine includes a monthly guide listing shortwave broadcast times and frequency. Adjusting the Local Oscillator trimmers to find areas of shortwave broadcast activity will get your converter into the "ballpark". Use the frequency announcements to *fine tune* the calibration.

Using a signal generator:

1. Set the signal generator to the lowest shortwave frequency (i.e.: 3900kHz for 75 Meters).

The generator output should be set to about 20 uV, modulation should be AM (1000-Hz tone) at 30% modulation.

2. Connect the signal generator output to RCA jack J1 on the VEC-201. Use coaxial cable with suitable connectors or adapters.
3. .Connect the receiver antenna connector to RCA jack J2 on the VEC201. Use coaxial cable with suitable connectors or adapters.
4. Set the converter bandswitch to the "in" position (low frequency band).
5. Set the receiver to the frequency corresponding to the lowest portion of the Shortwave band being calibrated (i.e.: 900kHz for 3900kHz on the 75-Meter band).
6. Attach a battery and turn on the converter.
7. Carefully adjust capacitor C13 until the signal generator signal is heard on the receiver.
8. Increase the signal generator frequency slightly (20 or 30 kHz) and note in which direction the receiver has to be retuned to find it. If the receiver has to be set lower in frequency to find the signal generator, the Local Oscillator has been set for high-side injection. Continue with the alignment until the proper low-side injection Local Oscillator setting is found.
9. Repeat the above steps to adjust the Local Oscillator on the higher frequency band. Remember to set the bandswitch to the extended position. Capacitor C12 is used to set the high-frequency band Local Oscillator frequency. Set the receiver dial to correspond to the new band's lower edge. Set the signal generator to the new frequency.

Performing Antenna Trimmer Alignment:

The objective is to peak ceramic trimmer C10 for best signal reception on the high- frequency band, and ceramic trimmer C11 for best signal reception on the low-frequency band. The trimmers are peaked for best reception at the approximate center of the band of interest. For example, for 41 Meters (7.10 to 7.30 MHz) the antenna trimmer would be tuned for maximum response at 7.165 MHz.

Using off-air signals: Once the Local Oscillators are set to frequency, antenna trimmers C10 and C11 may be peaked for best reception. Tune into a weak shortwave broadcaster, and peak the associated antenna trimmer for best volume. On the lower shortwave bands, the trimmers can often be peaked for maximum noise. It is possible to tune the trimmers to an image response, so be sure the signal you're peaking to is operating in the desired band!

Using a signal generator: Use the same basic setup suggested for the Local Oscillator alignment with a signal generator. The signal generator is set to the center of the desired shortwave band, and the receiver is tuned to the generator

signal. Decrease the signal generator output level until the signal is barely audible. Adjust the appropriate antenna trimmer capacitor (C10 or C11, depending on which band is being aligned) for the loudest signal. As the trimmer is brought into tune, you may have to continuously lower the generator output to notice further improvements. Repeat for the second shortwave band.

OPERATING INSTRUCTIONS

Power requirements: The VEC-101K requires a 9-volt transistor battery for operation. Alkaline batteries are recommended—they cost more initially, but are more economical to use over the long run.

Enclosure: The VEC-101K should be mounted in an enclosure to protect it from damage. Vectronics can supply enclosures for most of the Vectronics kit line. The Vectronics enclosures have all needed buttons and knobs, and have decaled front panels. If you chose to supply your own enclosure, it should be roomy enough to house the battery.

Operating the unit: When power switch SW1 is set to "off" (push-button extended) the 9-volt power is removed from the converter, and the antenna is automatically connected directly to the receiver. Activating the power switch places the converter in line between the antenna and receiver. Bandswitch SW2 is used to select the desired shortwave band. Depressing SW2 (button in) selects the lower frequency shortwave band, releasing SW2 (button out) selects the higher frequency shortwave band.

The car radio tuning control is used for tuning across the shortwave bands, just as it would be used to tune across the AM broadcast band. The radio volume and tone control are set for the best listening level. Turn the converter off when not in use to conserve battery power.

Understanding Shortwave Broadcasting: Getting the most from your shortwave converter requires a basic knowledge of radio propagation, and where SW broadcasts take place.

Where to listen:

Worldwide Shortwave AM Broadcast Bands	
75 Meters	3.900 to 4.000 MHz
49 Meters	5.950 to 6.200 MHz
41 Meters	7.100 to 7.300 MHz

31 Meters	9.500 to 9.900 MHz
25 Meters	11.650 to 12.050 MHz
19 Meters	15.100 to 15.600 MHz
16 Meters	17.550 to 17.900 MHz
13 Meters	21.450 to 21.850 MHz
Time standards	2.5, 5.0, 7.335, 10.0, 15, 20 MHz

When to listen:

75 Meters: very local daytime coverage; very good evening and nighttime band, especially in winter months. Shared with Amateur Radio.

49 Meters and 41 Meters: Late afternoon, early evenings and nighttime band. These are very active and popular bands.

31 Meters and 25 Meters: Good daytime and nighttime reception.

19 Meters: Excellent daytime listening. Good nighttime during summer months and periods of high sunspot activity.

16 Meters: Excellent daytime listening. Activity best during periods of high sunspot activity.

13 Meters and 15 Meters: Excellent daytime listening. Activity best during peak of 11 year sunspot cycle. Excellent evening and nighttime propagation possible during sunspot maximum.

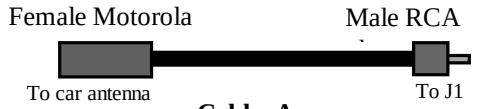
Shortwave broadcasters are very dynamic. Frequencies are often changed several times a day, even hourly, and different bands are more favored as the changing seasons affect propagation. An even bigger influence is the 11 year sunspot cycle. During the years of maximum sunspots activity flourishes across the spectrum. During the years of low activity the 13 and 11 Meter bands may appear to be totally inactive, and broadcasters crowd the 31, 41 and 49 Meter bands. We are entering a new sunspot cycle, for the next several years shortwave broadcasting will grow and new adventures will await you each day. If your main interest is in shortwave English broadcasts aimed the United States, remember that broadcasters chose time and frequencies that will reach the largest targeted audience. Very few shortwave stations are interested in reaching New York City at 3:00AM when most folks are in bed.

Popular Communications Magazine publishes a monthly list of active shortwave stations, noting the language, frequency and times of broadcast.

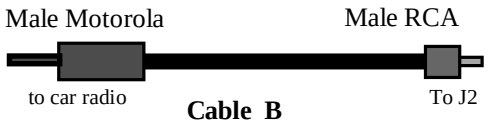
Connecting to your car's AM receiver:

Receiver requirements: The output of the converter is designed for receivers covering the standard AM broadcast band—540 kHz to 1600 kHz. Since the receiver is being used a *"tunable IF."* (the shortwave stations are tuned across the receiver's dial) it must meet certain requirements. *The receiver must be well shielded, and require an external antenna to hear signals on the broadcast band.* This is because we don't want AM band broadcast signals competing with the shortwave signals. The ideal receiver is a car radio. They are well-shielded (to keep out ignition noise) and will only receive signals when an external antenna is attached.

Connecting the converter to the car receiver and antenna: Auto receivers use very short antennas that are very reactive (offer a poor match) at the broadcast band frequencies. The antenna cable is a special very-high impedance coax. Using standard 50 or 75-ohm cables would severely attenuate the received signals. Connecting cables between the VEC-101K and auto receiver can made from sections of automotive antenna extension cables. Radio Shack carries these in different lengths. Most automotive radios use Motorola™ style antenna jacks and plugs. (Some newer vehicles use a new miniaturized style.) You will need to make up interconnecting cables to mate with the RCA fittings on the VEC-101K. The cables must be long enough to permit the antenna lead to reach the converter's location, and for the converter output to reach the receiver antenna input connector.



Cable A



Cable B

Cable A: Cable A is used to extend the existing automotive antenna lead to reach the converter enclosure. One end is a Motorola female connector to mate with the male connector on the antenna cable. The other end of the cable is terminated with a solder-on RCA male connector to mate with jack J1 (antenna) on the VEC-101K. The cable can be made by cutting the male connector off of

an extension cable from Radio Shack, and soldering a RCA phono connector in its place.

Cable B: Cable B is used to connect the converter to the automotive receiver antenna jack. On one end is a Motorola male connector to mate with the automotive receiver antenna jack. The other end is terminated with a solder-on RCA male connector to mate with jack J2 (radio) on the VEC-101K. The cable can be made by cutting the female connector off of an extension cable from Radio Shack, and replacing it with a solder-on RCA phono connector.

Using other antennas:

The converter is designed to work with short antennas, using a long wire antenna may overload the converter. Try using an active antenna if more sensitivity is needed.

Use with home receivers:

Many higher quality AM or AM/FM receivers have provisions for connecting an external AM antenna. The output of the VEC-101K converter may be feed to a receiver that has provisions for an external AM antenna. This includes many HI-FI tuners that include AM broadcast band coverage. A short wire antenna will be needed for the converter. 10 or 20 feet of wire will do in most wooden-framed structures. If the building construction overly attenuates shortwave signals, you may need to run a short outdoor antenna. Small active antennas are ideal for this purpose.

IN CASE OF DIFFICULTY

Only high-quality components and proven circuit designs are used in Vectronics kits. In very rare instances is a defective component the source of a problem. Replacement of defective parts is covered in the **Warranty** section. Ninety-five percent of the kits returned for factory repair are due to soldering problems or parts in the wrong locations. We advise repeating the assembly instructions step-by-step, looking for mistakes or soldering problems. Be especially wary of electrolytic capacitors and semiconductors. Kit builders often miss obvious mistakes. What is needed is a “fresh” set of eyes. Enlist a friend to go over your work.

Always check the obvious! Has the battery worn down? Is the power switch on?

Check all cables and connectors.

Receiver overloads: Under certain conditions shortwave signals may be extremely strong--strong enough to overload the converter. Try using a smaller

antenna. If the signals are coming from out-of-band stations using a preselector in line with the antenna will help to reduce the level of the interfering signal.

Image problems: This problem will be more pronounced on the higher shortwave bands. The best solution is using a preselector in line with the antenna to reduce the level of the interfering signal.

Signals drift out of tune: This could be caused by a failing battery. Also, the converter should be located away from heater or air-conditioning ducts! Rapid temperature changes will cause drifting.

AM Broadcast stations are heard across the dial: The balance mixer design and input tuning give good rejection of AM broadcast signals; but, it is possible for very strong signals to leak around the converter. This is the nature of the design. A preselector may help reduce the problem to an acceptable level. If the offending station prevents reception of a favorite shortwave station, adjust the local oscillator trimmer so the shortwave station falls on a quiet channel.

If all else fails, refer to the **Warranty** for factory repair options.

THEORY OF OPERATION AND SPECIFICATIONS

Technical Circuit Description:

Input selectivity is provided by LC combinations L1/C10 and L2/C11. A single tuned stage is used to achieve the needed 1.06 MHz tunable IF bandwidth. Coupling capacitors C1 and C2 are used for the impedance transformation needed between the antenna and tuned band-pass circuit, and to the 2000-ohm input impedance of the NE602 mixer. The NE602 is an active doubly-balance Gilbert cell mixer. The doubly-balanced mixer enhances attentuation of IF band signals.

A broadband L-type matching circuit (L5, C3) is used between the 2000-ohm mixer output and the receiver IF. output jack J2.

The NE602 also contains the local oscillator. All fixed capacitors in the oscillator section are monolithic types for good stability. LC combinations L3/C12 and L3/C13 form the oscillator tank circuits.

Specifications:

I.F. Range: ..... 530 to 1710 kHz (limited by receiver)
Coverage: ..... two 1 MHz wide bands between 3 and 22 MHz
Bypassing: ..... unit bypassed when power is off
Antenna: ..... 60 mW into 8-ohm load
Impedance: ..... matched for hi Z automotive antenna systems

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I.F. Range:.....530 to 1710 kHz (limited by receiver)
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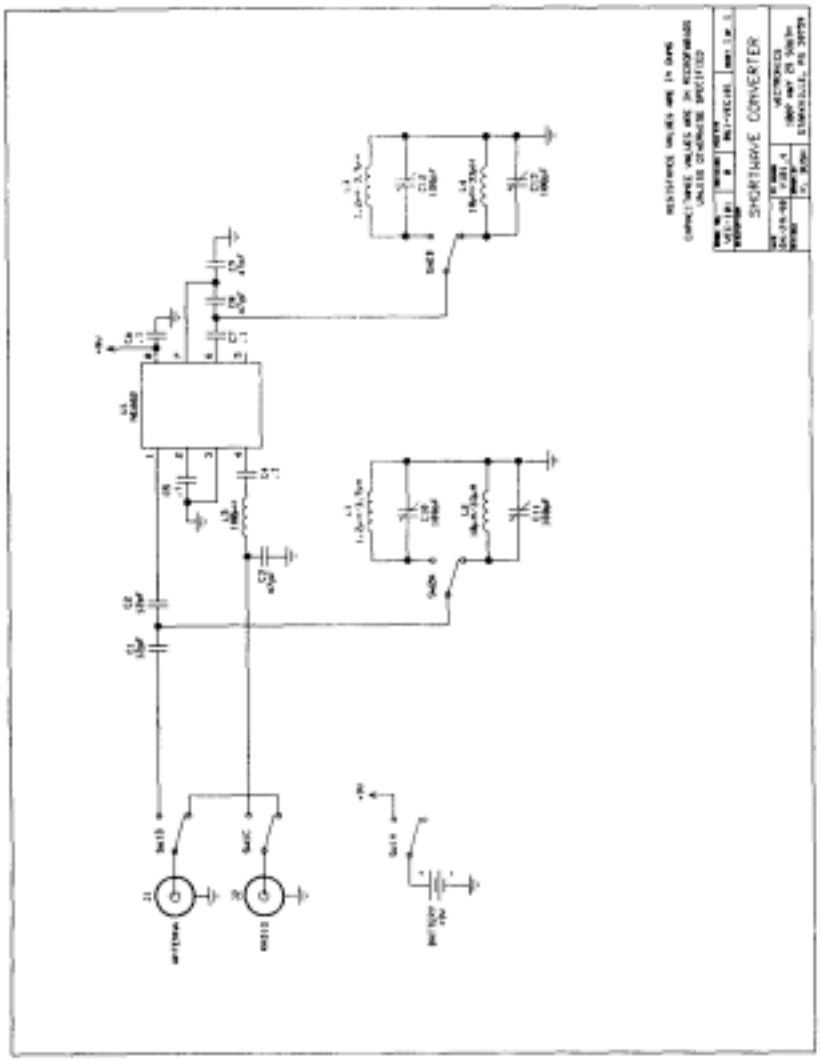
SCHEMATIC



ENCLOSURE

Vectronics has designed a matching enclosure just for your VEC-101K Shortwave Converter Kit. The matching enclosure is an all metal box which includes push-button caps, hardware, decals, and rubber feet.
Model: VEC-101KC.

To install your converter in the VEC-101KC matching enclosure follow these instructions *(read all instructions before beginning ... take your time)*:

1. Find the front panel decal and rear panel decal; separate using scissors. Be sure to leave excess decal material around the edges. Put the rear panel decal on first. This is done by: **a.)** Remove all debris and oil from the chassis. This should be done using a piece of cloth and alcohol. **b.)** Remove the crack and peel to expose the adhesive. **c.)** Place the decal on the rear panel without securing it completely. **d.)** Gently rub the alignment circles with your finger--if the circles are centered in the enclosure holes (also check the corner alignment marks) secure the decal by rubbing and removing all air bubbles. **e.)** If the alignment circles are not centered, adjust the decal accordingly then secure. **f.)** Use a penknife, or small Exacto™ knife, to cut away the unused edges *(cut from the adhesive side)* and cut out the component holes *(cut from the description side)*. **g.)** Repeat this procedure for the front panel.
2. Next, install the two L-brackets on the chassis using two of the 3/16" screws. The longer side of the L-bracket *must be* connected to the chassis using the two holes centered on each edge of the enclosure. Refer to the diagram on the next page for location and orientation.
3. Install the four 1/2" mounting screws next. Insert the screws, from the bottom, through the four holes relatively close to each corner of the chassis.
4. Place the four 3/16" round spacers on the mounting screws.
5. Now insert the PC board. This must be done by: **a.)** Insert the front of the PC board at an angle so the switches enter their respective holes. **b.)** Push down on the rear of the board. Make sure the mounting screws align with the mounting holes in the PC board before pushing.
6. Use the four hex nuts to secure the PC board. Be certain all appropriate components are centered with the enclosure holes before tightening.
7. Find the two switch caps. Align a switch cap with SW1 and push it on. If it is difficult to push on, then rotate it 90° and try again. Repeat for SW2.
8. Locate the piece of double-sided tape. This is to be used for holding the 9-volt battery clip in place. Locate a place on the underside of the top cover where the battery will not interfere with any components. Peel off the backing of the tape and stick it to the chosen location.
8. The top should be installed next. Use the two remaining 3/16" screws for securing the top to the L-brackets. Make sure the L-brackets are aligned properly.
9. Place the four rubber feet on the bottom of the enclosure at the corners.