

Super CW Filter Kit

with 1 Watt audio amplifier

model VEC-821K
shown with optional cabinet

Incredibly narrow 80 Hz bandwidth lets you pull Morse code signals out of heavy interference on any ham radio band. Powerful one watt audio amplifier drives external speaker. Eight poles of active IC filtering gives super steep CW skirts for performance that few tunable filters can match—interference is up to 60 dB down one octave away.



- Razor sharp selectivity dramatically snatches out your desired CW signal from a mass of interference.
- Select from 3 bandwidth: 80, 110, 180 Hz. Center frequency is a pleasant 750 Hz.
- 15 dB noise reduction relieves fatigue. Automatic noise limiter knocks down static crashes and other impulse noises. Plugs into your transceiver's phone jack. Drives external speaker to one watt.
- Requires 9 to 18VDC, 300 mA

Skill Level 1

Simple: Calls for a few basic tools—a soldering iron, cutters, pliers, wire strippers, and a small screw driver. Does not require test equipment for final adjustment or tuning.

Turn your
VECTRONICS electronic kit
into a fabulous show piece!
Add our custom cabinet and knob
set to complete your kit!

VECTRONICS®

High-performance electronic kits... fun to build and use!

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.

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INTRODUCTION

Thank you for purchasing the VEC-821K CW Filter kit. The VEC-821K consists of a four stage, switch selectable band pass CW filter, using selected components that will make “cleaning up” CW signals effortless and easy. Featuring razor sharp selectivity and extremely steep sided skirts, even the weakest signal stands out. Also, the VEC-821K has a 1 watt audio amplifier built in that will easily drive headphones or an external speaker. With the VEC-821K you bring up any hard to hear signal out of a “band pile up” for easy listening or get rid of unwanted, annoying signals. The VEC-821K also features a headphone output that will allow the use of standard monoral headphones. Although physically small in size, the VEC-821K is high on performance and reliability. The VEC-821K is powered from a 9-volt transistor radio battery, or any 9-18 volt DC power supply.

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, while providing protection for the underlying table or desk. Well-diffused overhead lighting is a plus, and a supplemental high-intensity desk lamp will prove especially helpful for close-up work. Safety is an important consideration. 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 to complete, virtually all construction projects require a work area outfitted with the following tools and supplies:

- 30-60 watt Soldering Iron
- High-temperature Iron Holder with a Moist Cleaning Sponge
- Rosin-core Solder (thin wire-size preferred)
- Needle Nose Pliers or Surgical Hemostats
- Diagonal Cutters or "Nippy Cutters"
- Wire Strippers
- Solder Sucker, Vacuum Pump, or Desoldering Braid
- Bright Desk Lamp
- Magnifying Glass

BEFORE YOU START BUILDING

Experience shows there are *four common mistakes* builders make. Avoid these, and your kit will probably work on the first try! Here's what they are:

- 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 they may act very differently in an electronic circuit! Same for capacitors--a device marked 102 (or .001 uF) may have very different operating characteristics from one marked 103 (or .01uF).
- 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. Always double-check--especially before applying power to the circuit!
- 3. Faulty Solder Connections:** Inspect for cold-solder joints and solder bridges. Cold solder joints happen 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 Soldering 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. Also, clean the oxidation and excess solder from the soldering iron tip to ensure maximum heat transfer. 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. Apply solder sparingly, and do not touch solder directly to the hot iron tip to promote rapid melting. If you are using Lead free solder it has a higher melting point than the older Tin-Lead solder. Make sure you allow the lead and pad to get hot enough for the solder to flow properly. **DO NOT USE ACID CORE SOLDER.**

When cutting and bending leads make sure they do not short between adjacent pads on the board.



Desoldering Tips:

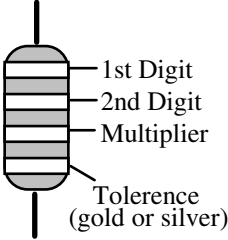
If you make a mistake and need to remove a part, follow these instructions carefully! First, grasp the component with a pair of hemostats or needle-nose pliers. Heat the pad beneath the lead you intend to extract, and pull gently. The lead should come out. Repeat for the other lead. Solder may fill in 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 multi-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:


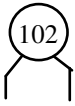
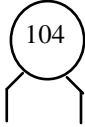
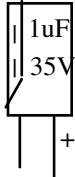
Resistor Color Code		
	Black = 0 (tens)	Blue = 6
	Brown = 1 (hundreds)	Violet = 7
	Red = 2 (K)	Gray = 8
	Orange = 3 (10K)	White = 9
	Yellow = 4 (100K)	Silver = 10%
	Green = 5 (1Meg)	Gold = 5%

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 sort and 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.

Some VEC kits may contain 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.

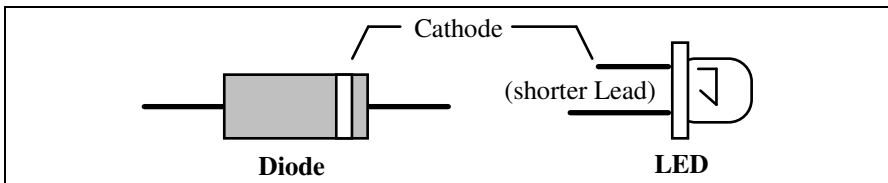
Value	Code					
10 pF	= 100	Multilayer (270 pF)	Ceramic Discs		Electrolytic 1 uF	
100 pF	= 101		(.001 uF)	(.1 uF)		
1000 pF	= 102					
.001 uF	= 102*					
.01 uF	= 103					
.1 uF	= 104					

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, most monolithic and disc-ceramic capacitors are marked with a three-number code. The first two digits indicate a numerical value, while the last digit indicates a multiplier (same as resistors).

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.

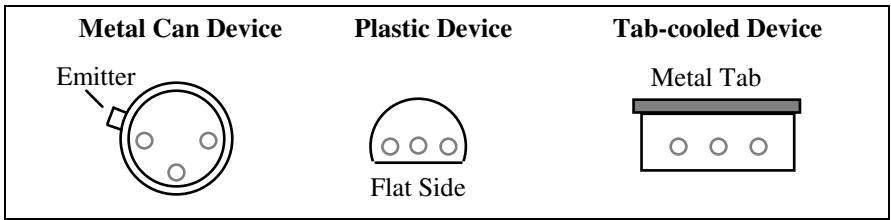
Diodes:

Diodes are also polarized devices that must be installed correctly. Always look for the banded or cathode end when installing, and follow instructions carefully.



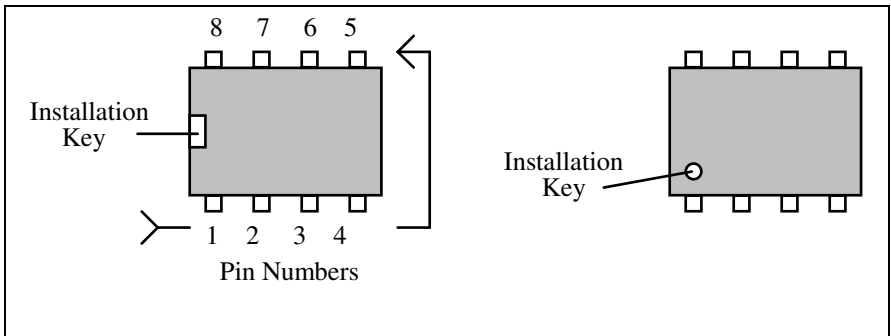
Transistors:

If transistors are installed incorrectly, damage may result when power is applied. Transistors in metal cases have a small tab near the emitter lead to identify correct positioning. Semiconductors housed in small plastic cases (TO-92) have an easily-identified flat side to identify mounting orientation. Many specialized diodes and low-current voltage regulators also use this type packaging. Larger plastic transistors and voltage regulators use a case backed with a prominent metal tab to dissipate heat (T-220). Here orientation is indicated by the positioning of the cooling tab.



Integrated Circuits:

Proper IC positioning is indicated by a dot or square marking located on one end of the device. A corresponding mark will be 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 diagram below. Pin numbers always start at the keyed end of the case and progress counter-clockwise around the device, as shown:



PARTS LIST

Your kit should contain all of the parts listed below. Please go through the parts bag to identify and inventory each item on the checklist before you start building. If any parts are missing or damaged, refer to the warranty section of this manual for replacement instructions. If you can't positively identify an unfamiliar item in the bag 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.

<input checked="" type="checkbox"/>	Qty	Part Description	Designation
<input type="checkbox"/>	1	2.7 ohm resistor (red-violet-gold)	R17
<input type="checkbox"/>	1	5.6 ohm, 1/2 watt resistor (green-blue-gold)	R19
<input type="checkbox"/>	1	1K ohm resistor (brown-black-red)	R2
<input type="checkbox"/>	1	1.8K ohm resistor (brown-gray-red)	R1
<input type="checkbox"/>	6	24.3K* ohm resistor (red-yellow-orange-red)	R5,R8,R10,R13, R14,R15
<input type="checkbox"/>	1	91K ohm resistor (white-brown-orange)	R3
<input type="checkbox"/>	4	681K* resistor (blue-gray-brown-orange)	R4,R7,R11,R18
<input type="checkbox"/>	4	1.82M* ohm resistor (brown-gray-red-yellow)	R6,R9,R12,R16
<input type="checkbox"/>	6	.1uF disc ceramic capacitor (104 or 104Z)	C2,C3,C4,C5, C6,C7
<input type="checkbox"/>	1	.01uF disc ceramic capacitor (103Z)	C8
<input type="checkbox"/>	8	1000 pF poly capacitor (1000J)	C12,C13,C14, C1,C5,C16,C17, C1,C8,C19
<input type="checkbox"/>	2	470uF electrolytic capacitor (470uF)	C1,C9
<input type="checkbox"/>	2	10uF electrolytic capacitor radial (10uf)	C10,C11
<input type="checkbox"/>	2	CDHS270 diode (CDHS270)	D1,D2
<input type="checkbox"/>	2	LM747 Op Amp IC	U1,U2
<input type="checkbox"/>	1	LM380 Audio Amplifier (LM380)	U3
<input type="checkbox"/>	3	14 pin IC sockets	For U1,U2,U3
<input type="checkbox"/>	1	Rotary Switch	SW1
<input type="checkbox"/>	1	Switch PCB (861-1565)	For SW1
<input type="checkbox"/>	2	8 pin right angle headers	For SW1
<input type="checkbox"/>	1	3/8-32 Hex Nut	For SW1
<input type="checkbox"/>	1	Thin Flat Steel Washer	For SW1
<input type="checkbox"/>	4	6" insulated wires	For circuit wiring
<input type="checkbox"/>	1	9-volt battery snap	
<input type="checkbox"/>	1	PC board VEC-821K	
<input type="checkbox"/>	1	Owner's Manual	

* These parts have a 1% tolerance. The fifth color band on these components will be **BROWN**,

specifying a 1% tolerance.

PARTS PLACEMENT DIAGRAM

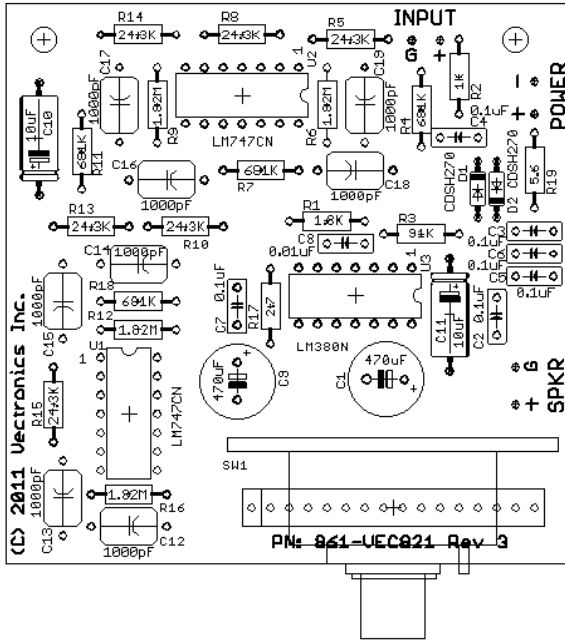


Figure 1

STEP-BY-STEP ASSEMBLY

Before assembling your kit, please take time to read and understand the VEC kit warranty printed on the inside cover of this manual. Also, read through the assembly instructions to make sure the kit does not exceed your skill level. Once you begin construction, your kit will be 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.

Note that part designators, such as R1, C3, etc., appear on a silk-screened legend on the component-mounting side of the printed circuit board. This corresponds with the parts placement page in the manual. All parts will be inserted on the silk-screen side of the board.

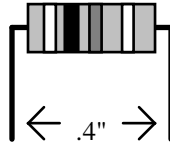
If you have last-minute questions about what you need to build your kit, please refer back to the section titled "Tools and Supplies". If you're ready to begin now, here we go!

The directions use two sets of check boxes. Check one when a step is complete and use the other for double-checking your work before operation.

Phase 1:

- □ 1. Locate resistor R1. This is 1.8K resistor (brown-gray-red).

Carefully bend the leads close to the resistor body to form right-angles (see following diagram).



- □ 2. Insert R1 into its mounting holes so the resistor body rests against the board. Solder in place and trim the leads.
- □ 3. Locate resistor R2. This is 1K resistor (brown-black-red). Carefully bend the leads close to the resistor body as in Step #1.
- □ 4. Insert R2 into its mounting holes so the resistor body rests against the board. Solder in place and trim the leads.
- □ 5. Locate resistor R3. This is 91K resistor (white-brown-orange). Carefully bend the leads close to the resistor body as in Step #1.
- □ 6. Insert R3 into its mounting holes so the resistor body rests against the board. Solder in place and trim the leads.
- □ 7. Locate resistor R4. This is 681K resistor (blue-gray-brown-orange). Carefully bend the leads close to the resistor body as in Step #1.
- □ 8. Insert R4 into its mounting holes so the resistor body rests against the board. Solder in place and trim the leads.
- □ 9. Locate resistor R7. This is 681K resistor (blue-gray-brown-orange). Carefully bend the leads close to the resistor body as in Step #1.
- □ 10. Insert R7 into its mounting holes so the resistor body rests against the board. Solder in place and trim the leads.
- □ 11. Locate resistor R11. This is 681K resistor (blue-gray-brown-orange). Carefully bend the leads close to the resistor body as in Step #1.
- □ 12. Insert R11 into its mounting holes so the resistor body rests against the board. Solder in place and trim the leads.
- □ 13. Locate resistor R18. This is 681K resistor (blue-gray-brown-orange). Carefully bend the leads close to the resistor body as in Step #1.
- □ 14. Insert R18 into its mounting holes so the resistor body rests against the board. Solder in place and trim the leads.
- □ 17. Locate resistor R5. This is 24.3K resistor (red-yellow-orange-red). Carefully bend the leads close to the resistor body as in Step #1.

- 18. Insert R5 into its mounting holes so the resistor body rests against the board. Solder in place and trim the leads.
- 19. Locate resistor R8. This is 24.3K resistor (red-yellow-orange-red). Carefully bend the leads close to the resistor body as in Step #1.
- 20. Insert R8 into its mounting holes so the resistor body rests against the board. Solder in place and trim the leads.
- 21. Locate resistor R10. This is 24.3K resistor (red-yellow-orange-red). Carefully bend the leads close to the resistor body as in Step #1.
- 22. Insert R10 into its mounting holes so the resistor body rests against the board. Solder in place and trim the leads.
- 23. Locate resistor R13. This is 24.3K resistor (red-yellow-orange-red). Carefully bend the leads close to the resistor body as in Step #1.
- 24. Insert R13 into its mounting holes so the resistor body rests against the board. Solder in place and trim the leads.
- 25. Locate resistor R14. This is 24.3K resistor (red-yellow-orange-red). Carefully bend the leads close to the resistor body as in Step #1.
- 26. Insert R14 into its mounting holes so the resistor body rests against the board. Solder in place and trim the leads.
- 27. Locate resistor R15. This is 24.3K resistor (red-yellow-orange-red). Carefully bend the leads close to the resistor body as in Step #1.
- 28. Insert R15 into its mounting holes so the resistor body rests against the board. Solder in place and trim the leads.
- 29. Locate resistor R6. This is 1.82M resistor (brown-gray-red-yellow). Carefully bend the leads close to the resistor body as in Step #1.
- 30. Insert R6 into its mounting holes so the resistor body rests against the board. Solder in place and trim the leads.
- 31. Locate resistor R9. This is 1.82M resistor (brown-gray-red-yellow). Carefully bend the leads close to the resistor body as in Step #1.
- 32. Insert R9 into its mounting holes so the resistor body rests against the board. Solder in place and trim the leads.
- 33. Locate resistor R12. This is 1.82M resistor (brown-gray-red-yellow). Carefully bend the leads close to the resistor body as in Step #1.
- 34. Insert R12 into its mounting holes so the resistor body rests against the board. Solder in place and trim the leads.
- 35. Locate resistor R16. This is 1.82M resistor (brown-gray-red-yellow). Carefully bend the leads close to the resistor body as in Step #1.
- 36. Insert R16 into its mounting holes so the resistor body rests

- against the board. Solder in place and trim the leads.
- 37. Locate resistor R17. This is 2.7 ohm resistor (red-violet-gold). Carefully bend the leads close to the resistor body as in Step #1.
 - 38. Insert R17 into its mounting holes so the resistor body rests against the board. Solder in place and trim the leads.
 - 39. Locate resistor R19. This is 5.6 ohm resistor (green-blue-gold). Carefully bend the leads close to the resistor body as in Step #1.
 - 40. Insert R19 into its mounting holes so the resistor body rests against the board. Solder in place and trim the leads.

Now that you have finished Phase 1, you may want to take a few minutes to double check your work. There are two additional phases to go and quite a few additional parts to be installed; making the board more crowded and hard to find the different components.

Now that you have finished your double check it is time to move on.

Phase 2:

Important Note: Capacitors C12-C19 are made of a polystyrene type material. Avoid overheating these components when soldering to prevent melting the capacitor body.

- 1. Locate capacitor C12 (1000pF). The is a polystyrene capacitor and will be marked with a "1000J" on the body. (actual value in pF).
- 2. Mount C12 and solder both leads in place, making sure the capacitor remains seated. Remove excess leads on the bottom side of the board with diagonal cutters.
- 3. Locate capacitor C13 (1000pF). The is a polystyrene capacitor and will be marked with a "1000J" on the body. (actual value in pF).
- 4. Mount C13 and solder both leads in place, making sure the capacitor remains seated. Remove excess leads on the bottom side of the board with diagonal cutters.
- 5. Locate capacitor C14 (1000pF). The is a polystyrene capacitor and will be marked with a "1000J" on the body. (actual value in pF).
- 6. Mount C14 and solder both leads in place, making sure the capacitor remains seated. Remove excess leads on the bottom side of the board with diagonal cutters.
- 7. Locate capacitor C15 (1000pF). The is a polystyrene capacitor and will be marked with a "1000J" on the body. (actual value in pF).
- 8. Mount C15 and solder both leads in place, making sure the

capacitor remains seated. Remove excess leads on the bottom side of the board with diagonal cutters.

- 9. Locate capacitor C16 (1000pF). This is a polystyrene capacitor and will be marked with a "1000J" on the body. (actual value in pF).
- 10. Mount C16 and solder both leads in place, making sure the capacitor remains seated. Remove excess leads on the bottom side of the board with diagonal cutters.
- 11. Locate capacitor C17 (1000pF). This is a polystyrene capacitor and will be marked with a "1000J" on the body. (actual value in pF).
- 12. Mount C17 and solder both leads in place, making sure the capacitor remains seated. Remove excess leads on the bottom side of the board with diagonal cutters.
- 13. Locate capacitor C18 (1000pF). This is a polystyrene capacitor and will be marked with a "1000J" on the body. (actual value in pF).
- 14. Mount C18 and solder both leads in place, making sure the capacitor remains seated. Remove excess leads on the bottom side of the board with diagonal cutters.
- 15. Locate capacitor C19 (1000pF). This is a polystyrene capacitor and will be marked with a "1000J" on the body. (actual value in pF).
- 16. Mount C19 and solder both leads in place, making sure the capacitor remains seated. Remove excess leads on the bottom side of the board with diagonal cutters.
- 17. Locate capacitor C2 (.1uF). This is a disc ceramic type capacitor and will be marked "104" or "104Z" (actual value in uF). Carefully install C2, be sure not to chip the ceramic material. Once installed, then solder in place and trim the leads.
- 18. Locate capacitor C7 (.1uF). This is a disc ceramic type capacitor and will be marked "104" or "104Z" (actual value in uF). Carefully install C7, be sure not to chip the ceramic material. Once installed, then solder in place and trim the leads.
- 19. Locate capacitor C3 (.1uF). This is a disc ceramic type capacitor and will be marked "104" or "104Z" (actual value in uF). Carefully install C3, be sure not to chip the ceramic material. Once installed, then solder in place and trim the leads.
- 20. Locate capacitor C4 (.1uF). This is a disc ceramic type capacitor and will be marked "104" or "104Z" (actual value in uF). Carefully install C4, be sure not to chip the ceramic material. Once installed, then solder in place and trim the leads.
- 21. Locate capacitor C6 (.1uF). This is a disc ceramic type capacitor and will be marked "104" or "104Z" (actual value in uF). Carefully install C6, be sure not to chip the ceramic material. Once installed, then solder in place and trim the leads.

- 22. Locate capacitor C5 (.1uF). This is a disc ceramic type capacitor and will be marked "104" or "104Z" (actual value in uF). Carefully install C5, be sure not to chip the ceramic material. Once installed, then solder in place and trim the leads.
- 23. Locate capacitor C8 (.01uF). This is a disc ceramic type capacitor and will be marked "103" or "103Z" (actual value in uF). Carefully install C8, be sure not to chip the ceramic material. Once installed, then solder in place and trim the leads.
- 24. Locate diode D1 (CDHS270). This is a Schottky diode similar to the 1N34 and is made from a clear glass type material. This part will have a band on one end indicating the cathode end of the diode.

Remember diodes are polarity sensitive devices that must be installed correctly. Always look for the banded or cathode end when installing, and follow instructions carefully.

- 25. Insert D1 into its mounting holes so the diode body rests against the board. Be sure to observe the circuit marking indicating the cathode. Solder in place and trim the leads.
- 26. Locate diode D2 (1N34). This is a germanium diode and is made from a clear glass type material. This part will have a band on one end indicating the cathode end of the diode.
- 27. Insert D2 into its mounting holes so the diode body rests against the board. Be sure to observe the circuit marking indicating the cathode. Solder in place and trim the leads.

Now that you have finished Phase 2, you may want to take a few minutes to double check your work. There is still one more phase to go.

Now that you have finished your double check it is time to move on.

Phase 3:

- 1. Locate capacitor C10 (10uF). This is an electrolytic type capacitor and will be marked "10uF" (actual value in uF). Carefully install C10, be sure to orient the negative end of the capacitor properly. Please refer to the section titled, "Parts Placement", Figure 1 for correct orientation of C10. Once installed, then solder in place and trim the excess leads.
- 2. Locate capacitor C11 (10uF). This is an electrolytic type capacitor and will be marked "10uF" (actual value in uF). Carefully install C11, be sure to orient the negative end of the capacitor properly. Please refer to the section titled, "Parts Placement", Figure 1 for correct orientation of C11. Once installed, then solder in place and trim the excess leads.
- 3. Locate (1) 14 pin IC socket.
- 4. Install the IC socket at the U1 location on the circuit board. Be careful to orient the socket correctly according to the "Parts

Placement" section Figure 1.

- □ 5. Carefully bend over the four corner pins of the socket against the solder pads on the solder side of the board. Solder in place.
- □ 6. Locate another 14 pin IC socket.
- □ 7. Install the IC socket at the U2 location on the circuit board. Be careful to orient the socket correctly according to the "Parts Placement" section Figure 1.
- □ 8. Carefully bend over the four corner pins of the socket against the solder pads on the solder side of the board. Solder in place.
- □ 9. Locate the remaining 14 pin IC socket.
- □ 10. Install the IC socket at the U3 location on the circuit board. Be careful to orient the socket correctly according to the "Parts Placement" section Figure 1.
- □ 11. Carefully bend over the four corner pins of the socket against the solder pads on the solder side of the board. Solder in place.
- □ 12. Locate capacitor C1 (470uF). This is an electrolytic type capacitor and will be marked "470uF" (actual value in uF). Carefully install C1, be sure to orient the negative side of the capacitor properly. Please refer to the section titled, "Parts Placement", Figure 1 for correct orientation of C1. Once installed, then solder in place and trim the excess leads.
- □ 13. Locate capacitor C9 (470uF). This is an electrolytic type capacitor and will be marked "470uF" (actual value in uF). Carefully install C9, be sure to orient the negative end of the capacitor properly. Please refer to the section titled, "Parts Placement", Figure 1 for correct orientation of C9. Once installed, then solder in place and trim the excess leads.
- □ 14. Locate the rotary switch, SW1 and the switch PCB. Insert the switch into the PCB. Be careful and make sure the pin on the switch marked **1** goes into the hole on the PCB marked **1**. Do not remove the nut on the switch. It holds the stop tab in the right hole for this particular switch configuration.

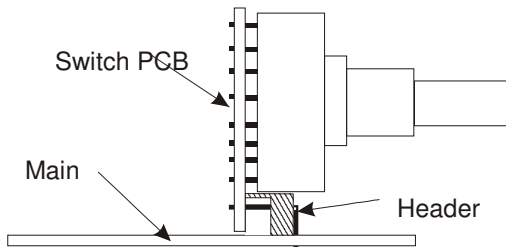


Figure 2

- □ 15. Insert the Headers into the PCB side by side. The header has a plastic square body with pins along the back facing down and a plastic lip that runs above the longer horizontal pins. The long pins are pushed through the main PCB till the plastic contacts

the main board. The lip and horizontal pins point toward the back of the board. Make sure the two headers horizontal pins are in line. Solder the pins on the main board.

- 16. Push the Switch PCB onto the horizontal pins till the PCB is in contact with the plastic lip. All the pins should be coming out of the holes on the Switch PCB and not beside the board on either side. Carefully solder the pins making sure that the components on the main board are not damaged by the soldering iron body.
- 17. Prepare eight (8) 3" wires, by cutting all four (4) 6" wires provided in the kit.
- 18. Using the wire strippers, remove a 1/4" piece of insulation from each of the 8 pieces of insulated wire.
- 19. Take one 3" piece of insulated wire and insert one end into the hole silk-screened **INPUT +** on the circuit board. Solder in place and trim the excess lead.
- 20. Take another 3" piece of insulated wire and insert one end into the hole silk-screened **G** on the circuit board. Solder in place and trim the excess lead.
- 21. Take another 3" piece of insulated wire and insert one end into the hole silk-screened **SPKR +** on the circuit board. Solder in place and trim the excess lead.
- 22. Take another 3" piece of insulated wire and insert one end into the hole silk-screened **G** on the circuit board. Solder in place and trim the excess lead.
- 23. Locate the battery snap.
- 24. Insert the **RED** wire of the battery snap into the hole on the circuit board labeled, **POWER +**. Solder in place and trim the lead.
- 25. Insert the **BLACK** wire of the battery snap into the hole on the circuit board labeled -. Solder in place and trim the lead.
- 26. Locate both LM747 op amp integrated circuits. Insert them into ic sockets for U1 and U2. Please refer to the "Parts Placement" section, Figure 1 for proper orientation. Be sure not to bend any of the pins underneath the ic body, and that all pins are inserted into the socket.
- 27. Locate the LM380 audio amplifier integrated circuit. Insert it into ic socket for U3. Please refer to the "Parts Placement" section, Figure 1 for proper orientation. Be sure not to bend any of the pins underneath the ic body, and that all pins are inserted into the socket.

At this point, your kit assembly is finished and it's time to take a well-earned break! You should have one washer and nut left. These parts are to be used when the circuit is installed in an enclosure, so do not discard them. When you come back, be sure to give your work a close

"quality control" inspection.

PC Board Inspection:

Before applying power to your kit, give it a thorough QC (quality control) inspection. This will help you find inadvertent assembly errors that might prevent the filter from working or cause damage to sensitive parts. Follow this procedure:

- Compare parts locations against the parts-placement diagram. Was each part installed where it is supposed to be? Was the correct value used? Start at one side of the board and work your way across in an organized pattern.
- Inspect the solder side of the board for cold-solder joints and solder bridges between tracks or pads. Use a magnifying glass to obtain a clear view of the track area. If you suspect a solder bridge, hold the board in front of a bright light for a better view. All joints should be smooth and shiny, indicating good solder wetting and flow. Resolder any beaded or dull-appearing connections. Lead Free solder will not be as shiny as the lead-tin solder.

If you find a construction error and need to remove a part or two, it will be easier if you have the right tools. One very convenient item for freeing soldered-in parts is a "solder sucker". This consists of a suction bulb or a spring loaded vacuum pump that draws molten solder away from the pad and lead. Alternatively, you may use a special copper braid called "solder wick" (solder suckers and solder wick are both available at your local Radio Shack or electronics supply house). If you suspect you've damaged a component during removal, better to replace it than risk reusing it!

Finally, rosin flux can absorb moisture, which may cause a problem for some electronic equipment. To remove flux, use isopropyl alcohol (or 95% grain alcohol) and an old toothbrush. Apply a generous amount of alcohol with the toothbrush and scrub gently. Once the flux has fully dissolved, blot the bottom of the board dry with an untreated tissue. Give it a final alcohol wash, and allow to dry thoroughly.

Caution: alcohol is highly flammable and must be used with adequate ventilation! Use safety goggles, and avoid prolonged skin contact. It's also best to do this outdoors.

Now that assembly and inspection is completed, you're ready to begin the testing and alignment phase of construction.

TESTING AND ALIGNMENT

The best way to test the VEC-821K is with a calibrated audio signal

generator and oscilloscope. However, VEC-821K does not require any alignment. If all components are installed correctly and in the proper places, the center frequency of the filter will be between 750-800 hertz. The filter has three switch selectable selectivity cutoff points, 80, 110, and 180 hertz. The switch positions on SW1 from left to right are BYPASS, 180, 110, and 80. The 80 hertz cutoff is the fourth switch position from the left and is the narrowest filter cutoff, while the 180 hertz cutoff is the second position from the left and is the widest filter cutoff.

Probably the best method of seeing if the VEC-821K is working, or not, is to listen to some "on the air" CW signals. Then using SW1, select the filter cutoff position that best cleans up the signal being received.

If you are trying to pick out one signal out of a very tight band pile up, then try using the 80 hertz cutoff. The 80 hertz cutoff provides the highest selectivity and will greatly help you in "pulling out" those hard to get signals.

If the CW signal you are receiving is noisy with some static, then try either the 110 or 180 filter cutoffs. However, in these positions the filter will let slightly more noise through, but in some cases this may be desirable. The best way to see which position works the best is to try it. This way you can really hear what the filter is doing for the received signal, and which switch position works the best in different band conditions.

OPERATING INSTRUCTIONS

You may use the VEC-821K with any communications receiver or scanner with a BFO, (Beat Frequency Oscillator). You can also use the VEC-821K with a ham-radio transceiver in either LSB or CW mode. The VEC-821K requires a 9-volt battery power source, or any 9-18 volt DC source.

There are a few items that you will need to operate the VEC-821K. We have provided a list of these items below for your convenience.

- Communications Receiver, scanner, or Ham Radio transceiver with proper cables.
- 9-Volt transistor radio battery
- External speaker with clip leads

Receiver or Scanner Operation

As previously mentioned you can use the VEC-821K with a communications receiver or scanner. A BFO, or Beat Frequency Oscillator, or a Fine Tuning control will assist you in fine tuning the received CW signal to the VEC-821K center frequency. The center frequency of the filter being 750-800 hertz.

The filter requires audio from the external speaker or headphones output of the receiver or scanner. Apply the positive side of the audio signal to

the insulated wire connected to the location on the circuit labeled **INPUT**. Apply the negative side of the audio signal to the insulated wire connected to the location on the circuit board labeled **GND**. Please refer to the "Parts Placement" section, Figure 1 for the location of both points on the circuit board.

Next, connect the **POSITIVE** lead of the external speaker to the end of the insulated wire connected to the location on the circuit board labeled **SPKR**. Connect the **NEGATIVE** lead of the external speaker to the point labeled **GND** on the circuit board. Again please refer to the "Parts Placement" section Figure 1 for the location of the point labeled **GND** on the circuit board.

Next, turn the receiver volume all the way down, then clip the 9-volt battery to battery snap. Set SW1 to the far left position. Now turn the receiver up slightly so you can hear the received signals on the external speaker. The signal you are listening to is the "raw" or "unfiltered" signal. Using the tuning knob on the radio, find a CW signal. A good place to find CW signals is in the Amateur Radio bands. Once you find a CW signal, switch SW1 to the 110 filter cutoff. The 110 position is the third from the left. When you switch to the 110 cutoff, you will notice that the signal sounds cleaner than before. You can now fine tune the radio tuning knob for the best received signal. If using a communications receiver or scanner with a BFO control, use this control to fine tune the received CW signal. If the receiver or scanner you are using does not have a BFO control, it will be very difficult trying to tune the signal in properly. If the signal you are trying to receive is in a "pile up", then try the 80 hertz filter cutoff. Then fine tune the receiver to "pull out" the desired signal.

Operation with an Amateur Radio transceiver is basically the same, but you would use either LSB, (Lower Side Band) or CW mode. All other connections are the same.

IN CASE OF DIFFICULTY

No Signal Filtering:

A newly constructed filter that fails to work upon initial power up, generally requires a very close and careful inspection of all work. Please go back through all steps of assembly and inspection, referring to the "Parts Placement" Figure 1. Most of the time there will be a part that is not installed or not installed properly, a wrong value part in place of another, or a broken part. A close inspection at this point may reveal some accidental mistake(s).

Intermittent Filter Operation:

A filter that operates intermittently may have poor solder connections, a problem with broken wires, or a low voltage power source. Self-

oscillation may be caused by a defective U1, U2, or U3. Also, check for dirty or intermittent switch operation.

Filter Stops Filtering:

A working filter that fails "in-service" generally indicates a failure of one or more of the integrated circuits U1, U2, or U3. If you suspect a bad integrated circuit then **do not touch** the part with your fingers. If the part is bad, it could be **HOT** and could cause a serious burn. The supply voltage (9-volt battery) and/or broken wires could cause this problem.

No Speaker Audio:

No speaker audio can be a symptom of a bad SW1, a broken wire or a bad C9. Check the voltage from the 9-volt battery. A broken wire at the audio input to the filter could attribute to no speaker audio. The audio amplifier chip (U3) could also be defective.

If technical assistance or factory repair is desired, please refer to the warranty instructions on the inside front cover.

THEORY OF OPERATION AND SPECIFICATIONS

Circuit Description:

The VEC-821K uses two LM747 operational amplifier integrated circuits to form four low Q cascaded stages with no insertion loss. This results in a very narrow bandwidth and extremely high skirt rejection with minimal audible ringing, making good signal copying possible. The center frequency is between 750-800 hertz. The filter also has an LM380 Audio Amplifier which can drive an 8 ohm speaker or headphones.

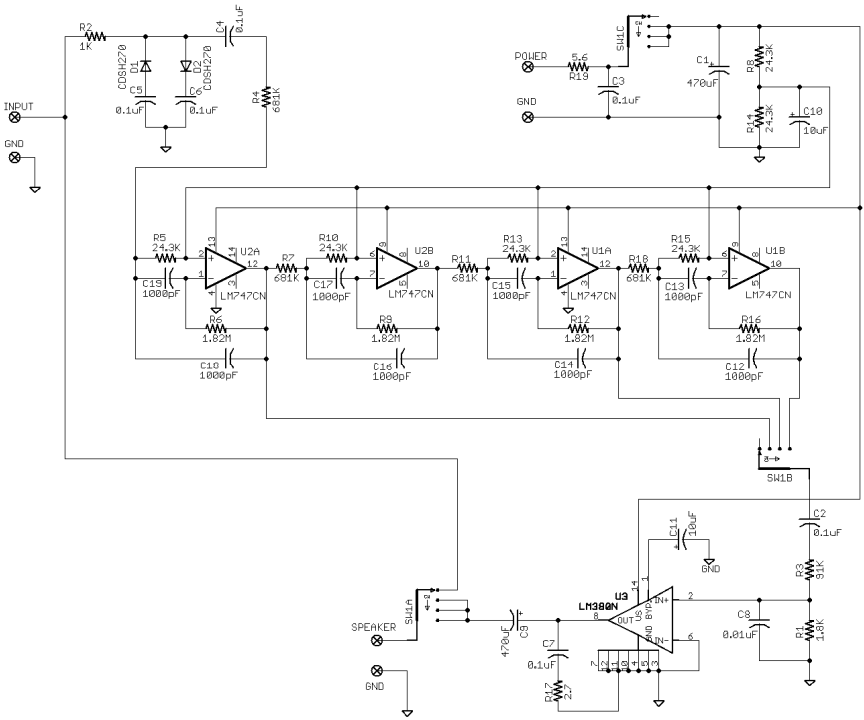
Specifications:

Bandwidth:	80Hz, 110Hz, 180Hz (switch selectable)
Skirt Rejection:	At least 60dB down 1 octave from center frequency for 80Hz. bandwidth.
Center Frequency:	750-800Hz
Insertion Loss:	None
Power Required:	9-volts DC; 9-volt battery
PCB Dimensions:	3" x 3"

ENCLOSURE

Vectronics has designed a matching enclosure just for your VEC-821K Super CW Filter Kit. The matching enclosure is an all metal box which includes knobs, hardware, decals, and rubber feet. The Vectronics model number for the matching enclosure is VEC-821KC.

SCHEMATIC



VEC-821K