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.

Table of Contents

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INTRODUCTION

Welcome to the world of effortless CW. With the VEC-221K, you'll have a professional sounding fist in no time! Whether you're a Novice or seasoned Extra, the VEC-221K CW Memory Keyer Kit has the features you've been waiting for! Novices will appreciate the preset factory defaults for plug-and-play operation. Extra's will enjoy the advanced features: weight control from 25 to 75%, iambic A and B operation, auto or semi-auto operation, full dot-and-dash memories, and immediate front-panel speed control from 3 to 65 WPM. The VEC-221K uses non-volatile memory to store four messages of about 120 characters each. Because the message memories are non-volatile, it does not require battery backup to preserve the recorded messages. The built-in sidetone generator is ideal for CW practice sessions or for radios lacking a CW sidetone. The sidetone is implemented as a sinewave with 5 ms rise and decay times for removing harsh key clicks.

The VEC-221K keyer is compatible with any modern transceiver or QRP transmitter using positive keying. The 50 volt at 100 mA keying permits the use of many early vintage cathode-keyed transmitters. Its small size and battery operation are ideal for QRP or Field Day activities! CW has never been so enjoyable or effortless!

A *state-of-the-art* PIC16C72 microprocessor is the heart of the keyer! Learn the basics behind embedded controllers, and how they are revolutionizing the electronics field. The powerful PIC device permits advanced settings to be entered from the keyer paddles, using Morse characters! The generously-sized quality glass-epoxy PC board with silk-screened component legends and solder-masking make assembly a snap. Powered by a common 9-volt transistor radio battery, the keyer is ready for action whenever you are!

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 to 60 Watt Soldering Iron
- ☐ High-temperature Iron Holder with Moist Cleaning Sponge
- ☐ Rosin-core Solder (thin wire-size preferred)
- ☐ Needle Nose Pliers or Surgical Hemostats
- ☐ Diagonal Cutters or "Nippy Cutters"
- ☐ 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

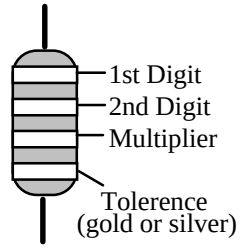
lead and pad for about one second (count "one-thousand-one") before feeding solder to the connection. Surfaces must become hot enough for solder to *flow smoothly*. Feed solder to the opposite side of the lead from your iron tip--solder will wick around the lead toward the tip, wetting all exposed surfaces. Apply solder sparingly, and do not touch solder directly to the hot iron tip to promote rapid melting.

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%

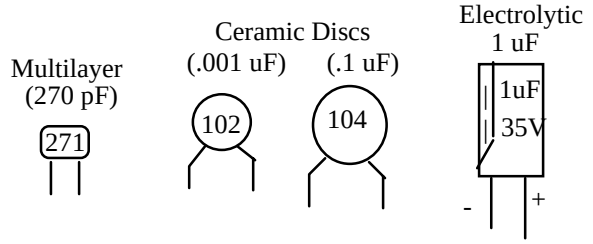
When you look at a resistor, check its multiplier code first. Any resistor with a black multiplier band falls between 10 and 99 ohms in value. Brown designates a value between 100 and 999 ohms. Red indicates a value from 1000 to 9999

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.

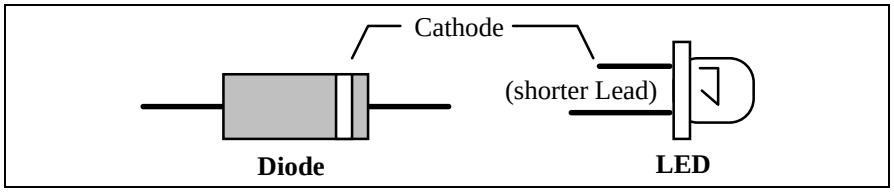
Value	**Code**
10 pF	= 100
100 pF	= 101
1000 pF	= 102
.001 uF	= 102*
.01 uF	= 103
.1 uF	= 104



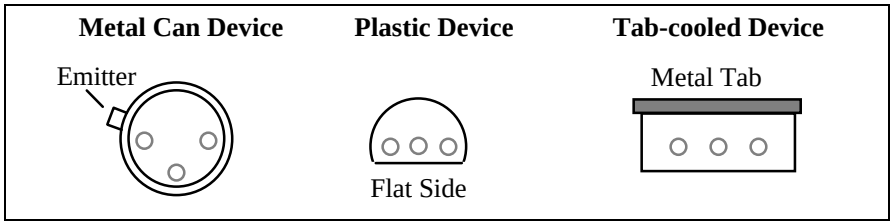
As with resistors, it's helpful to sort capacitors by type, and then to arrange them in ascending order of value. Small-value capacitors are characterized in pF (or pico-Farads), while larger values are labeled in uF (or micro-Farads). The transition from pF to uF occurs at 1000 pF (or .001 uF)*. Today, 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.

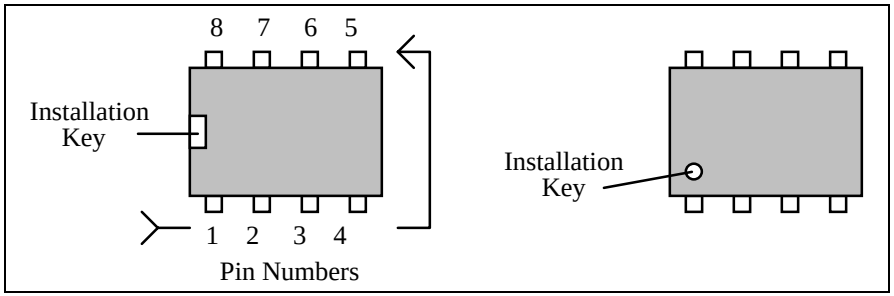
Diodes: Diodes are also polarized devices that must be installed correctly. Always look for the banded or cathode end when installing, and follow instructions carefully.



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

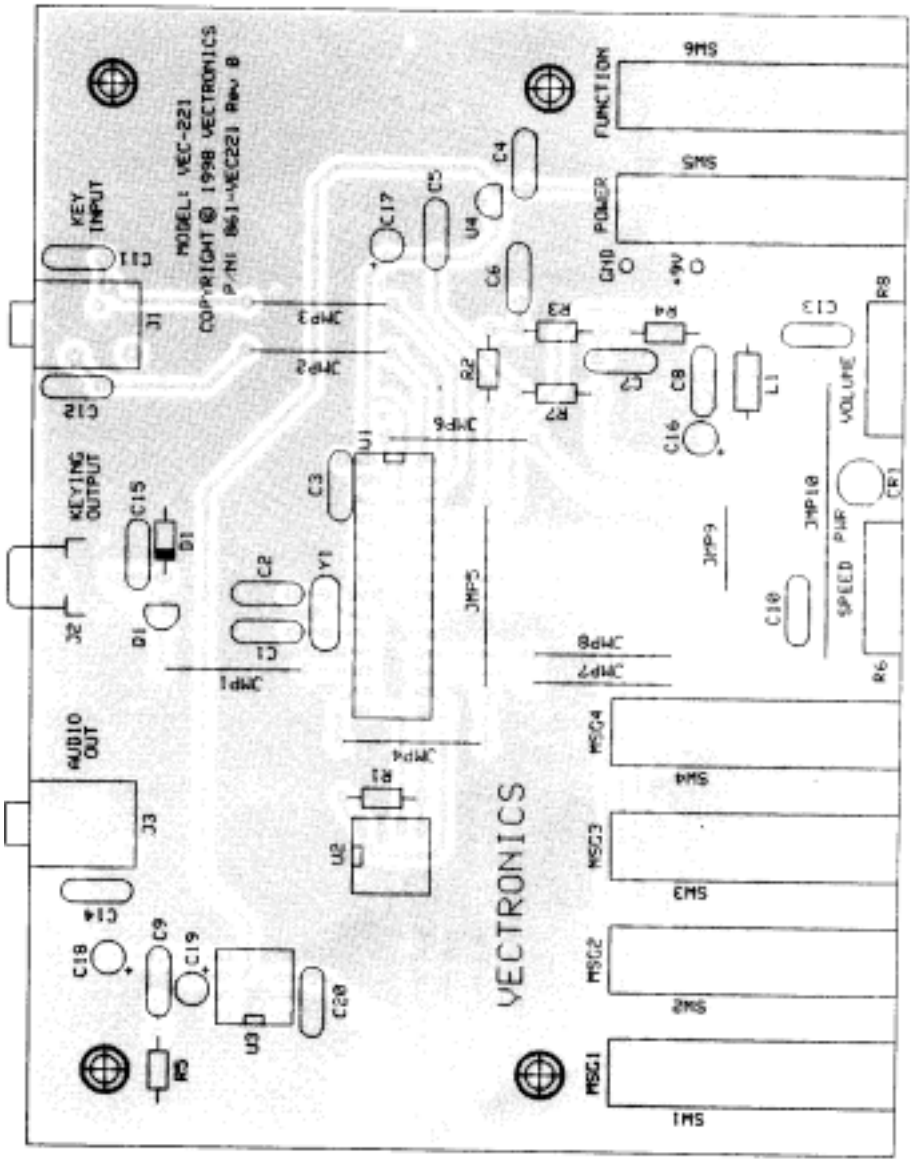
Your package kit should contain all of the parts listed below. Please go through the parts bag to identify and inventory each item on the checklist before you start

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.

☑	Qty	Part Description	Designation
☐	1	10 ohm (brown-black-black)	R5
☐	4	1.5K ohm (brown-green-red)	R2,R3,R4,R7
☐	1	10K ohm (brown-black-orange)	R1
☐	2	10K ohm potentiometer	R6,R8
☐	2	22 pF disc ceramic (22 or 220)	C1,C2
☐	7	0.01 uF disc ceramic (.01 or 103)	C10,C11,C12,C13,C14,C15,C20
☐	7	0.1 uF disc ceramic (.1 or 104)	C3,C4,C5,C6,C7,C8,C9
☐	1	0.47 uF electrolytic	C16
☐	2	10 uF electrolytic	C17,C19
☐	1	100 uF electrolytic	C18
☐	1	Red 5 mm round LED	CR1
☐	1	1N4007 rectifier diode	D1
☐	1	2N7000 field-effect transistor	Q1
☐	1	PIC16C72 microcontroller IC	U1
☐	1	24C04 serial EEPROM IC	U2
☐	1	LM386 audio amplifier IC	U3
☐	1	78L05 +5-volt regulator	U4
☐	1	1000 uH inductor (brown-black-red)	L1
☐	1	4 MHz crystal	Y1
☐	2	3.5 mm stereo jack	J1,J3
☐	1	RCA phono jack	J2
☐	1	12" length of #22 buss wire	For JMP1 - JMP10
☐	6	DPDT push-button switch	SW1 - SW6
☐	2	8-pin IC socket	For U2,U3
☐	1	28-pin IC socket	For U1
☐	1	9-volt battery snap clip	
☐	1	nylon tie wrap	
☐	1	PC board for VEC-221K	
☐	1	VEC-221K Owner's Manual	

PARTS PLACEMENT DIAGRAM

PARTS PLACEMENT DIAGRAM



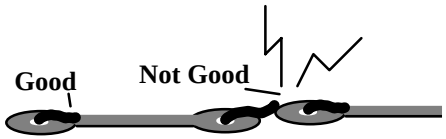
STEP-BY-STEP CONSTRUCTION

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.

Observe correct polarity when mounting components such as the electrolytic capacitors, diode, LED, transistor and voltage regulator. If you orient capacitors so their values face the board edges, you'll be able to read them easily when the kit is finished. Part designators for components such as R1, 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 section titled "Parts Placement Diagram". 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 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, let's get started!

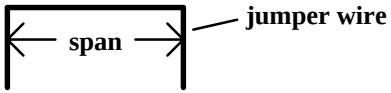
"Install" When you are directed to *install* a part, this means to locate, identify, and insert the part into its mounting holes on the PC board. This includes pre-bending or straightening leads as needed so force is not required to seat the part. Once a component is mounted, bend each lead over to hold 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.

Notice 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.

☐ ☐ 1. Cut the 12 inches wire into ten pieces of appropriate lengths for use as jumper wires. Use needle-nose pliers to form each one, as shown below, making sure each rests flat on the PC board when installed:



☐ ☐ Prepare, install, and solder a jumper wire at JMP1.

☐ ☐ Prepare, install, and solder another jumper wire at JMP2.

☐ ☐ Prepare, install, and solder another jumper wire at JMP3.

☐ ☐ Prepare, install, and solder another jumper wire at JMP4.

☐ ☐ Prepare, install, and solder another jumper wire at JMP5.

☐ ☐ Prepare, install, and solder another jumper wire at JMP6.

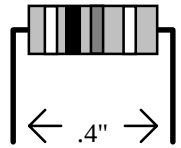
☐ ☐ Prepare, install, and solder another jumper wire at JMP7.

☐ ☐ Prepare, install, and solder another jumper wire at JMP8.

☐ ☐ Prepare, install, and solder another jumper wire at JMP9.

☐ ☐ Prepare, install, and solder another jumper wire at JMP10.

Note: Resistor installation: The resistors packaged in this kit are all 5-percent tolerance ending with a fourth *gold* color band, *only* the first three bands of the color code are needed for the following steps. All resistor leads should be formed as shown below.



☐ ☐ 2. Find the 10 ohm resistor (brown-black-black). Install and solder at location R5.

☐ ☐ 3. Find the four 1.5K ohm resistors (brown-green-red). Install and solder at the following locations:

☐ ☐ R2 1.5K ohm resistor (brown-green-red)

☐ ☐ R3 1.5K ohm resistor (brown-green-red)

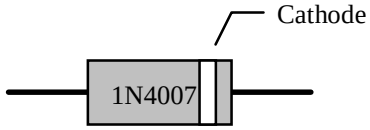
☐ ☐ R4 1.5K ohm resistor (brown-green-red)

☐ ☐ R7 1.5K ohm resistor (brown-green-red)

☐ ☐ 4. Find the 10K ohm resistor (brown-black-orange). Install and solder at location R1.

☐ ☐ 5. Locate the 1000 uH inductor or choke (brown-black-red). Pre-form the leads in a similar manner as done for the resistors. Install and solder at location L1.

☐ ☐ 6. Locate the 1N4007 rectifier diode. Note that the band indicates the cathode lead end of the device. Pre-form the leads in a similar manner as done for the resistors. Install and solder at location D1, be sure to observe the silk-screened marking for the cathode lead orientation!



☐ ☐ 7. Locate the two 22 pF ceramic disc capacitors (marked 22 or 220). Install and solder at the following locations:

☐ ☐ C1 22 pF ceramic disc capacitor (22 or 220)

☐ ☐ C2 22 pF ceramic disc capacitor (22 or 220)

☐ ☐ 8. Locate the seven 0.01 uF ceramic disc capacitors (.01 or 103 marking). Install and solder at the following locations:

☐ ☐ C10 0.01 uF ceramic disc capacitor (.01 or 103)

☐ ☐ C11 0.01 uF ceramic disc capacitor (.01 or 103)

☐ ☐ C12 0.01 uF ceramic disc capacitor (.01 or 103)

☐ ☐ C13 0.01 uF ceramic disc capacitor (.01 or 103)

☐ ☐ C14 0.01 uF ceramic disc capacitor (.01 or 103)

☐ ☐ C15 0.01 uF ceramic disc capacitor (.01 or 103)

☐ ☐ C20 0.01 uF ceramic disc capacitor (.01 or 103)

☐ ☐ 9. Locate the seven 0.1 uF ceramic disc capacitors (.1 or 104 marking). Install and solder at the following locations:

☐ ☐ C3 0.1 uF ceramic disc capacitor (.1 or 104)

☐ ☐ C4 0.1 uF ceramic disc capacitor (.1 or 104)

☐ ☐ C5 0.1 uF ceramic disc capacitor (.1 or 104)

☐ ☐ C6 0.1 uF ceramic disc capacitor (.1 or 104)

☐ ☐ C7 0.1 uF ceramic disc capacitor (.1 or 104)

☐ ☐ C8 0.1 uF ceramic disc capacitor (.1 or 104)

☐ ☐ C9 0.1 uF ceramic disc capacitor (.1 or 104)

☐ ☐ 10. Locate the 0.47 uF electrolytic capacitor. Install and solder at location C16 (observe polarity).

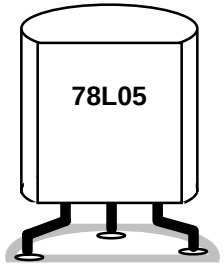
☐ ☐ 11. Locate the two 10 uF electrolytic capacitors. Install and solder at the following locations (observe polarity):

☐ ☐ C17 10 uF (observe polarity)

☐ ☐ C19 10 uF (observe polarity)

☐ ☐ 12. Locate the 100 uF electrolytic capacitor. Install and solder at location C18 (observe polarity).

☐ ☐ 13. Locate the 78L05 +5-Vdc voltage regulator IC. Form the leads as shown below to allow the device to fit at location U4. *Make sure the regulator is properly keyed to the silk-screened outline; if installed incorrectly, damage to the PIC processor is certain when power is applied.* Install and solder.



☐ ☐ 14. Find the 2N7000 field-effect transistor. Position the body outline to correspond the silk-screened legend at Q1. Install and solder.

☐ ☐ 15. Find the red LED. Note that the LED has a flat edge corresponding to the shorter lead. Make sure that the LED is properly keyed to the silk-screened outline at CR1. Install the LED leads until the shouldered stops on the leads are flush to the PC board Bend the leads so the LED is flush with the edge of the PC board. Solder.

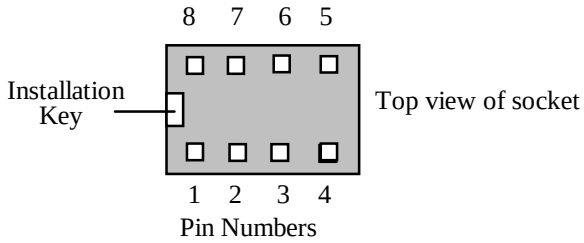
☐ ☐ 16. Find the 4 MHz crystal. Install and solder at location Y1.

☐ ☐ 17. Locate the two 8-pin IC sockets. Note that the socket is “keyed”, and should be installed with its key aligned to the silk-screened outline on

the PC board. Install and solder the sockets at the following locations. Make sure key is orientated with board legend.

☐ ☐ U2 8-pin IC socket (observe key orientation)

☐ ☐ U3 8-pin IC socket (observe key orientation)



☐ ☐ 18. Install and solder the 28-pin IC socket at location U1. Make sure key is orientated with board legend.

☐ ☐ 19. Locate the two 3.5 mm stereo jacks. Install and solder at the following locations:

☐ ☐ J1 3.5 mm stereo jack

☐ ☐ J3 3.5 mm stereo jack

☐ ☐ 20. Find the RCA phono jack. Install and solder at location J2.

☐ ☐ 21. Locate the six push-button switches. The leads should be fully seated, and the switch body level to the board. Install and solder at the following locations:

☐ ☐ SW1 push-button switch

☐ ☐ SW2 push-button switch

☐ ☐ SW3 push-button switch

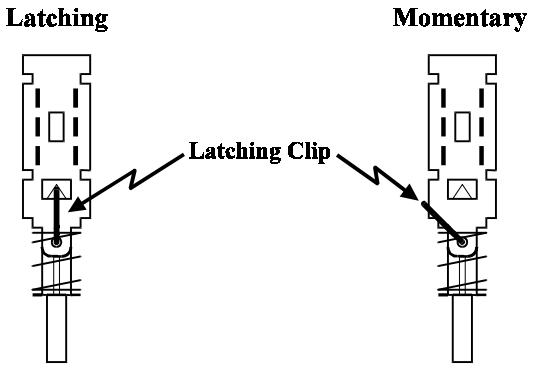
☐ ☐ SW4 push-button switch

☐ ☐ SW5 push-button switch

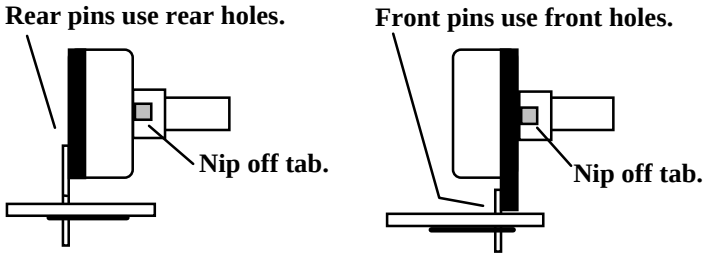
☐ ☐ SW6 push-button switch

☐ ☐ 22. Switches SW1, SW2, SW3, SW4 and SW6 must be changed from latching to momentary operation. *Follow these directions carefully to avoid damaging these switches!* Set switch so shaft is latched in the fully extended position. Using a pair of long-nose pliers, carefully lift the latching clip's end near the switch body (away from the shaft) out

of the switch assembly, and set it to the side of the switch body as shown below. *Be careful not to remove the end under the spring.*



☐ ☐ 23. The front-panel controls are mounted next. Before installing these parts, inspect the potentiometer supplied with your kit. If the pins are located on the *front* side of the pot, use the *front set of mounting holes* on the PC board for installation. If the pins are on the *rear*, use the *rear set of mounting holes* (see below). Also, using side cutters, remove the key tab from the side of each pot prior to installation.



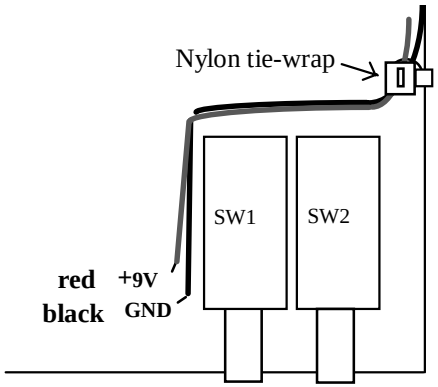
☐ ☐ 24. Install a 10K ohm potentiometer at R6. Insert the potentiometer leads until the shouldered stops on all three leads are flush to the PC board. Solder the three leads.

☐ ☐ 25. Install the other 10K ohm potentiometer at R8, following the procedures used for R6. Solder.

☐ ☐ 26. Locate the 9-volt battery clip. Install and solder the free end of the black lead to the negative (*GND*) termination point on the PC board.

☐ ☐ 27. The remaining red battery clip lead should be installed and soldered to the positive (*+9V*) termination point on the PC board.

☐ ☐ 28. The nylon tie wrap should be used to firmly attach the battery clip wires to the support hole on the PC board. Use the hole located closest to the edge of the PC board. Pull the tie snug and trim excess.

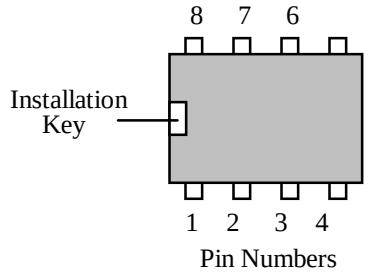


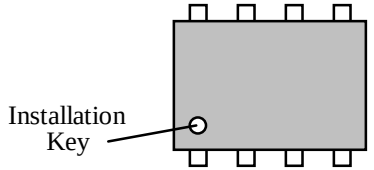
Important Note: U1, U2 and U3 have good immunity to static discharge. However, if you are working in a carpeted area, it's always a good idea to touch a metal ground before handling semiconductors.

☐ ☐ 29. Locate the PIC16C72. Align its key (see below) with the socket key for U1. Be sure that all 28 pins are freely entering the socket holes, and apply firm pressure to fully seat the IC.

☐ ☐ 30. Locate the 24C04 EEPROM. Align its key (see below) with the socket key for U2. Be sure that all 8 pins are freely entering the socket holes, and apply firm pressure to fully seat the IC.

☐ ☐ 31. Locate the LM386 audio amplifier. Align its key (see below) with the socket key for U3. Be sure that all 8 pins are freely entering the socket holes, and apply firm pressure to fully seat the IC.





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

At this point, your kit is finished and it's time to take a well-earned break! When you come back, be prepared to give your work a close "quality control" inspection before moving on to the testing and alignment section.

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 keyer 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.

Important Note: 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 "solder wick". If you suspect you've damaged a component during removal, it's better to replace the part than risk reusing it!

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

TESTING AND ALIGNMENT

The following items will be needed for testing:

- ☐ 9-volt alkaline transistor battery.
- ☐ Keyer paddles (iambic preferred), terminated with 3.5 mm stereo plug. Wired dot-to-tip and dash-to-ring.
- ☐ 4- to 32-ohm headphones or monitor speaker, terminated with 3.5 mm stereo or mono plug.

Actuate push-button switches SW1 to SW6 a few times and note the latching action. The switches will toggle from *off* to *on*; the *on* condition exists when the shaft remains partially recessed; *off* when the shaft is fully extended.

- ☐ Set Power switch SW5 to *off*.
- ☐ Attach the paddle plug to jack J1 (Key Input) on the PC board.
- ☐ Attach a monitor speaker or headphones to jack J3 (Audio Out.)
- ☐ Connect a fresh 9-volt battery to the battery clip.
- ☐ Perform the self-test described below.

Self Test

A self-test routine is used to check the functions of the unit. This routine checks the paddles, the push-button switches, the knob, the non-volatile memory and the audio circuitry. During the self-test, you may stop the test by turning off the unit; however, this should NOT be done during the memory test or the memory could be corrupted. This self-test can be completed in approximately one minute.

Note: Performing the self-test will reset the unit to its factory default settings.

Here is the self-test procedure:

1. Turn off the unit.
2. Turn the Speed control R6 to full clockwise position.
3. Set the Volume control R8 to a comfortable listening level (midrange).
4. Squeeze the paddle while turning the power on by pressing the Power switch SW5. The test begins by sending a copyright message "(c) 199X VECTRONICS VX.XX". This is the test of the audio circuitry. Release the paddles before this message completes.
5. The LED should be off after the copyright message is finished. For the entire test, the LED should *blink once* after each operation. If the LED *blinks continuously*, the unit fails the test and a Morse code message is sent to indicate the nature of the failure.
6. Press and release the dot level (connected to the tip of the plug).
7. Press and release the dash level (connected to the ring of the plug).
8. Press and release the Message 1 switch SW1.
9. Press and release the Message 2 switch SW2.
10. Press and release the Message 3 switch SW3.

11. Press and release the Message 4 switch SW4.
12. Press and release the Function switch SW6.
13. Turn the Speed control R6 to full counter-clockwise position.
14. Turn the Speed control R6 to full clockwise position.
15. The unit then tests its non-volatile memory. This step will reset the unit to its factory default values.
16. If the unit is okay, "PASS" is repetitively sent to the speaker. If there is a problem, a failure message is sent, indicating that you did not follow the correct order or the unit failed the test. These messages are shown below.
17. Once you have confirmed that the audio is okay, turn the unit off.

Failure Message	Meanings
DH FAIL	Dash level is shorted or improperly connected.
DT FAIL	Dot level is shorted or improperly connected.
EE FAIL	Non-volatile memory circuitry is improperly connected.
FN FAIL	Function switch is shorted or improperly connected.
M1 FAIL	Message 1 switch is shorted or improperly connected.
M2 FAIL	Message 2 switch is shorted or improperly connected.
M3 FAIL	Message 3 switch is shorted or improperly connected.
M4 FAIL	Message 4 switch is shorted or improperly connected.
SP FAIL	Speed control is faulty.

Now that the self-test is completed, you're ready to continue the testing and alignment phase of construction.

☐ Preset Volume control R8 to midrange.

☐ Preset Speed control R6 about 30% clockwise from the full counter-clockwise stop.

☐ Turn the keyer *on* using Power switch SW5.

☐ Press and hold the dot paddle—you should hear a stream of *"dits"* from the monitor speaker.

☐ Press and hold the dash paddle—you should hear a stream of *"dahs"* from the monitor speaker.

☐ While generating a continuous stream of *"dits"* or *"dahs"*, verify that adjusting Volume control R8 varies the monitor sidetone level.

☐ While generating a continuous stream of *"dits"* or *"dahs"*, verify that adjusting Speed control R6 varies the sending rate.

- ☐ If your paddle is iambic, squeeze both paddles—this should produce a continuous stream of alternating *"dits"* and *"dahs"*.
- ☐ Activate Function switch SW6. The keyer should verify that the function mode has been entered by sending a Morse character "F" (di-di-dah-dit).
- ☐ Enter the Morse character for the letter "S" (di-di-dit) via the paddles. The keyer should respond with two beeps, indicating an invalid command.
- ☐ Activate Function switch SW6. The keyer should verify that the function mode has been entered by sending a Morse character "F" (di-di-dah-dit).
- ☐ Enter the Morse character for the letter "R" (di-dah-dit) via the paddles. The keyer will respond with a single beep indicating a valid command entry. (This command reverses the action of the dot and dash paddles.)
- ☐ Try your dot and dash paddles—the paddle action should be reversed.
- ☐ Turn the unit off. Note that the reversed paddle orientation will resume when power is reapplied. This indicates the function command is saved into the non-volatile memory and ready to be used the next time without having to set it again.

This completes the testing phase of the VEC-221K keyer. No alignment is needed.

OPERATING INSTRUCTIONS

Dits, dahs, dots and dashes? Beginners often think of CW characters as being composed of strings of dots and dashes, the visual image conveyed when viewing Morse CW characters on the printed page. Experienced CW operators tend to think of CW characters as a *sound*, and hear *dahs* instead of dashes, and *dits* instead of dots when listening to CW characters. Both terms will be used interchangeably in the following text.

Determining keyer speed: Hold the dash lever and count the number of dashes generated in a five-second period. The number of dashes roughly equals your CW sending speed.

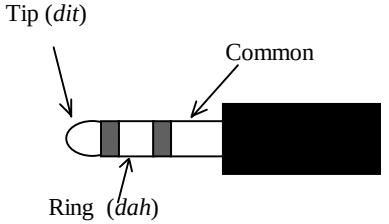
Enclosure: An enclosure will protect the keyer from damage. If you are going to provide your own enclosure, allow room for the battery, and perhaps the sidetone monitor speaker. The optional Vectronics VEC-221KC enclosure is custom made for the VEC-221K keyer, and includes knobs, push-buttons, feet and decals.

Power requirements: The keyer is designed to operate from a 9-volt DC battery source. An alkaline battery will give long service, but always remember to turn the keyer power switch off when the keyer is not being used.

Experienced builders may opt to power the VEC-221K from an external power source. The *absolute maximum* DC supply voltage is limited to 12 Vdc by the LM386 specifications. Keyers damaged by over-voltage conditions will not be honored under the terms of the **Warranty**.

Keyer paddles: Most popular paddles will work well with the VEC-221K. Full enjoyment of the VEC-221K's features requires paddles that are capable of iambic operation. We recommend the Vectronics iambic paddles as being a good value. Iambic paddles can be recognized by the totally independent operation of the *Dit* (or "Dot") and *Dah* (or "Dash") paddles. Some CW operators refer to iambic paddles as "squeeze paddles".

The paddles should be equipped with a three-wire interconnecting cable terminated in a 3.5 mm stereo jack. Miniature shielded and balanced microphone cable is ideal for this. The common return is connected to the longest "ring" (shaft) of the stereo jack. The *Dah* paddle connection is made to the jack terminal for the smaller insulated ring. The *Dit* paddle is connected to the jack tip connection. If your paddles are equipped with a ¼" stereo jack, a suitable stereo adapter is available at most electronic or hi-fi shops. Reversed paddle wiring can be corrected by a function entry, more on this later. The paddles are connected to J1 on the VEC-221K.



3.5mm stereo jack. Refer to the connector packaging for wiring terminal details.

Linear controls: There are two linear controls. Potentiometer R8 sets the sidetone monitoring level. The second control, potentiometer R6, sets the CW speed over a range of 3 wpm (words-per-minute) to 65 wpm. This is for good reason, these are the controls that are most frequently adjusted.

Sidetone operation: The sidetone is tone keyed by the CW keyer. This permits you to monitor your keying and provides the aural "feedback" to assist in sending good CW. Many transceivers already provide for internal CW sidetone monitoring. If your transmitter does not have built-in sidetone monitoring provisions, the VEC-221K will generate a sidetone for you. Either a monitor speaker (4 to 32 ohms) or headphones equipped with a 3.5 mm stereo or mono

jack should be attached to J3 to monitor the CW sidetone. Adjust potentiometer R8 (sidetone level) to a comfortable listening level.

Factory defaults status: As soon as power is supplied and the VEC-221K turned on by depressing Power switch SW5, the unit is ready for operation. A microprocessor program "subroutine" loads several operating parameters into the keyer at power up. These parameters are the same as the last time you turn the unit off, many of them may be changed to suit your preferences—more on this later. Commands entered via the Function switch are stored in non-volatile memory.

At factory default settings, the keyer assumes standard paddle wiring, that is *dit* key to tip and *dah* key to the ring of the 3.5 mm jack. Iambic operation is set to mode "A". The sidetone frequency is set to 701 Hz. The CW weight is set to 50%, the standard 1:3 dit to dah ratio. The keyer is in the automatic mode.

If CW operation is a new experience for you, consider running the keyer in its basic default configuration until you become comfortable with its feel and operation. Feel free to learn the more advanced features at your own pace.

Factory default settings after the self-test:

1. 701 Hz sidetone
2. Standard weight (50%, dot-dash-space ratio of 1:3:1)
3. Iambic A
4. Automatic
5. Standard paddle wiring (dot = tip, dash = ring)
6. Serial number = 0001
7. Leading zeros sent as "O" (dah-dah-dah)
8. Other zeros sent as "0" (dah-dah-dah-dah-dah)
9. Nines sent as "9" (dah-dah-dah-dah-dit)

Transmitter keying: The keyer output is through RCA phono jack J2. You will need a cable to connect between the keyer and the CW keying jack of your radio. The operation instructions for your set should show what sort of connector is needed and its location on your radio. Many modern transceivers use RCA phono jacks for connecting accessories, in those cases ready-made cables for home entertainment devices may be used between the VEC-221K and radio.

Keyer output specs: The keyer is designed for ***positive keying output***. Most modern solid-state transceivers and QRP transmitters meet this requirement. Always check the owner's manual before attaching the keyer to a radio. The VEC-221K will key positive voltages to 50 Vdc maximum. Keying current is limited to 100 mA maximum. Exceeding these limits may damage keying transistor Q1.

Use with vintage sets: Early tube transmitters and hybrid transceivers may not be compatible with the VEC-221K. If the transmitter uses grid-block keying (a negative key voltage), it can not be used with the VEC-221K. An example of a grid-block keyed transmitter is the Heathkit DX60. Check the ARRL handbooks for circuits for adapting keyers to grid-block keying.

Vintage novice transmitters commonly used cathode keying, a combination of high current and high voltage. The Heathkit DX40 used cathode keying, for example. In general, most cathode-keyed transmitters should be compatible with the VEC-221K keying circuit, so long as the 50 Vdc and 100 mA limits are not exceeded.

Dot-and-dash memories and iambic keying: The dot and dash memories making sending CW easier. The memory allows the user to key a dot before the completion of a dash, and vice-versa. This feature maybe checked by setting the keyer to the lowest speed and tapping first the dash lever and then the dot lever before the completion of the dash. The keyer will generate both the dash and the dot with perfect spacing. Test the dash memory in a similar manner. First tap the dot lever and quickly tap the dash lever. The keyer will send the dot followed by the dash, again with perfect character spacing.

Iambic paddles allow both paddles (or levers) to be depressed at the same. Pressing (squeezing) both paddles simultaneously will generate a continuous stream of alternating dots and dashes. The first paddle contacted determines whether a dot or dash occurs first. CW characters such as "C", "K", "Q" and "R" are very easily generated with iambic paddles.

Non-volatile memory: The non-volatile memory is used to store the serial number, the keyer settings, and the four message memories. Because it is non-volatile, it does not require battery backup to preserve the memory.

Special Functions

Note: All programmable special functions are saved in non-volatile memory. These settings are restored at power on.

Automatic mode: Early telegraphers used a mechanical device called a bug to send high-speed code. The bug would automatically send a string of *dits* when the dot paddle was depressed and held. Bugs did not generate strings of dashes, the dash had to be depressed once to generate each individual “dah”. The VEC-221K normally operates in the fully automatic mode. However, it may be set for “semi-automatic” operation, to emulate the sound and feel of a mechanical bug.

Weight: A 3:1 ratio between dit’s and dah’s is considered to be optimum. Some operators prefer slightly different ratios; and the VEC-221K weight is adjustable from 25 to 75% of a dot to suit those preferences. The factory default is 50%, or 3:1 dash-to-dot ratio.

Sidetone frequency: The factory default sidetone is about 701 Hz. The sidetone may be programmed from approximately 300 to 1000 Hz to suit individual tastes. There are two ways of setting the sidetone frequency.

Reverse: Reverses the sense of the left and right paddles. Useful when the paddle is shared by both left and right handed operators.

Iambic modes A and B: Either mode may be selected. Factory default is iambic "A" mode.

Serial number: A four digits serial number can be embedded within a message. Only three digits are sent for numbers less than 1000--use leading zeros when appropriate. The serial number is automatically post-incremented each time it is sent (9999 will increment to 0001, skipping 0000 since it is not used) and is updated in the non-volatile memory when the message is finished. The factory default is 0001.

Zeros and nines: Zeros and nines in the serial number can be sent in different ways. The factory defaults are leading zeros as "O" (dah-dah-dah), other zeros as "0" (dah-dah-dah-dah-dah), and nines as "9" (dah-dah-dah-dah-dit).

Using the Function switch: The Function switch customizes the keyer to your preferences. To set or change a setting, depress the Function switch. The keyer acknowledges by sending the Morse character for the letter "F" (di-di-dah-dit).

Keyer functions are entered via the keyer paddles. If an invalid character is entered, the keyer responds with two beeps. Multiple functions may not be entered at one time. That is, each function must be individually entered and preceded by pressing the Function switch. A valid entry is acknowledged by a single beep. The transmitter key line is disabled during programming. The function mode maybe exited at any time by pressing the Function switch. The keyer confirms the exit with two beeps.

Command Character	Function
A	**A**utomatic–toggles between automatic and semi-automatic (bug) mode.
I#	**I**ambic–sets iambic mode A or B, where # represents A or B.

N####	**N**umber−sets the serial number. You must enter four numbers, most significant digit first. All numbers must be in the proper Morse code format. For example, the number "1" must be "di-dah-dah-dah-dah" and the number "0" must be "dah-dah-dah-dah-dah". The serial number can be set from 0000 to 9999 (0000 will be converted to 0001).
P##	**P**itch−sets the sidetone frequency to approximately ##0 Hz, where ## represents two digits in the range of 30 to 99.
R	**R**everse−reverses the sense of the dot and dash paddles.
T	**T**one−sets the sidetone frequency in the range of approximately 300 to 1000 Hz. Press the dash paddle to raise the sidetone frequency; press the dot paddle lowers. Squeeze both paddles exits. Notice an alternating series of dots and dashes are sent to the sidetone monitor to assist in the setting of the desired sidetone frequency.
W##	**W**eight−sets the code weighting to ## percent, where ## represents two digits in the range of 25 to 75. Weighting is independent of the speed.
X	**X**mit (tune)−gives continuous key-down for adjusting transmitter or antenna tuner. Tapping either paddle exits tune mode and releases the key line.
Z###	**Z**eros and nines−sets the way zeros and nines in the serial number are sent. The first # sets whether to send the leading zeros as "0", "O", "T" or not at all by setting # to the double dash character "=" (dah-di-di-di-dah). The second # sets whether the other zeros are sent as "0", "O" or "T". The last # sets whether the nines are sent as "9" or "N". For example, "ZO09" will send the leading zeros as "O" (dah-dah-dah), the other zeros as "0" (dah-dah-dah-dah-dah), and the nines as "9" (dah-dah-dah-dah-dit).

Message Memory

The Message buttons are used to record and play your message. To record a message, press and hold the corresponding Message button until the keyer plays "GO" (dah-dah-dit dah-dah-dah) in Morse code and the LED flashes. You may now key in the message of your choice. As you pause after every word, the keyer will play a "W" (di-dah-dah) over the sidetone speaker to show that it is

inserting a word break (uses one unit of memory). If you make a mistake entering a word, you can back up over it by briefly pressing and releasing the same Message button. The keyer will erase the last word, then play the word before it (if any) to let you know where you stopped. If deleting the first word of the message, the keyer will play "GO" instead. At the end of your message, press and hold the same Message button until the keyer sends an end of message character "+" (di-dah-di-dah-dit) and the LED stops flashing. If you try to save more characters than you have memory, the keyer will automatically end your message and send you an end of message character. To play a message, momentarily press the corresponding Message button. On-going message can be stopped by tapping either paddle or pressing a Message button to send another message. The speed *cannot* be changed during message sending and message recording. Also, the output keying circuit is disabled during recording.

The messages are stored in non-volatile memory: message 1 has 120 units of memory and the other three messages have 128 units of memory each. Each normal character uses one unit of memory; only the rarely used 7-, 8- and 9-element (dots and dashes) characters require two units of memory. Characters with more than nine elements are ignored. When there are ten or less units of memory in the message remaining, the LED will flash faster to let you know the memory is running low.

Note: A straight key cannot be used to record the message.

Embedded Commands:

While in the message recording mode you may use embedded commands for special features. To use an embedded command simply store the multi-character embedded command code within your message.

Embedded Command	Represents
/D	**D**ecrement–decrements the serial number. Serial number 0001 will decrement to 9999, skipping 0000 since it is not used. This feature allows a serial number to be sent twice in a message. Example: UR RST 559 559 SN /N /D SN /N

/G#	**G**ap−inserts a gap of # standard intra-character spaces into the message, where # is a digit in the range of 1 to 9 (0 can be used but not practical). Invalid numeral code will automatically default to zero. This command is used to exaggerate inter-character and word spacing.
/L	**L**oop−creates a message loop (message repeat). Note that any character recorded after "/L" will not be sent. Example: BEACON AA5CS 5 W /L
/N	**N**umber−inserts a contest serial number, in the range of 001 to 9999, into the message. Only three digits are sent for numbers less than 1000--use leading zeros when appropriate. The serial number is automatically post-incremented each time it is sent (9999 will increment to 0001, skipping 0000 since it is not used) and is updated in the non-volatile memory when the message is finished. The serial number is set to the same one as before when power on. If a different serial number is desired, it must be set using the paddle-entered Number function. Example: YOU ARE CONTACT NR /N
/P*mmss*	**P**ause−inserts a timed pause of *mm* minutes and *ss* seconds into the message. Four numbers must follow "/P". Invalid numeral code will automatically default to zero. Example: TIMEOUT 1 HOUR /P6000 TIMEOUT 1.5 MIN /P0090 TIMEOUT 1 HR 40 MIN 39 SEC /P9999
/S	**S**pace−inserts an extra standard word space into the message. This command yields the same result as "/G7" but uses one less unit of memory.
//	Slash character−stores the slash character "/" into the message.
/#	Message call−inserts message number # into the current message, where # is a digit from 1 to 4.

Morse Code Character Set [1]

A	di-dah	•–	N	dah-dit	–•
B	dah-di-di-dit	–•••	O	dah-dah-dah	–––
C	dah-di-dah-dit	–•–•	P	di-dah-dah-dit	•––•
D	dah-di-dit	–••	Q	dah-dah-di-dah	––•–
E	dit	•	R	di-dah-dit	•–•
F	di-di-dah-dit	••–•	S	di-di-dit	•••
G	dah-dah-dit	––•	T	dah	–

H	di-di-di-dit	●●●●	U	di-di-dah	●●–
I	di-dit	●●	V	di-di-di-dah	●●●–
J	di-dah-dah-dah	●–––	W	di-dah-dah	●––
K	dah-di-dah	–●–	X	dah-di-di-dah	–●●–
L	di-dah-di-dit	●–●●	Y	dah-di-dah-dah	–●––
M	dah-dah	––	Z	dah-dah-di-dit	––●●
1	di-dah-dah-dah-dah	●————	6	dah-di-di-di-dit	–●●●●
2	di-di-dah-dah-dah	●●–––	7	dah-dah-di-di-dit	––●●●
3	di-di-di-dah-dah	●●●––	8	dah-dah-dah-di-dit	–––●●
4	di-di-di-di-dah	●●●●–	9	dah-dah-dah-dah-dit	––––●
5	di-di-di-di-dit	●●●●●	0	dah-dah-dah-dah-dah	–––––

Period	[.]	di-dah-di-dah-di-dah	●–●–●–	$\overline{AAA}$
Comma	[,]	dah-dah-di-di-dah-dah	––●●––	$\overline{MIM}$
Question Mark or Request for Repetition	[?]	di-di-dah-dah-di-dit	●●––●●	$\overline{IMI}$
Fraction Bar	[/]	dah-di-di-dah-dit	–●●–●	$\overline{DN}$
End of Message or Cross	[+]	di-dah-di-dah-dit	●–●–●	$\overline{AR}$
End of Work		di-di-di-dah-di-dah	●●●–●–	$\overline{SK}$
Double Dash, Pause or Break	[=]	dah-di-di-di-dah	–●●●–	$\overline{BT}$
Semicolon	[;]	dah-di-dah-di-dah-dit	–●–●–●	$\overline{KR}$
Colon	[:]	dah-dah-dah-di-di-dit	–––●●●	$\overline{OS}$
Apostrophe	[']	di-dah-dah-dah-dah-dit	●————●	$\overline{WG}$
Quotation Mark	["]	di-dah-di-di-dah-dit	●–●●–●	$\overline{AF}$
Hyphen or Dash	[-]	dah-di-di-di-di-dah	–●●●●–	$\overline{DU}$
Underline	[_]	di-di-dah-dah-di-dah	●●––●–	$\overline{IQ}$
Dollar Sign	[$]	di-di-di-dah-di-di-dah	●●●–●●–	$\overline{SX}$
Left Parenthesis	[(]	dah-di-dah-dah-dit	–●––●	$\overline{KN}$
Right Parenthesis	[)]	dah-di-dah-dah-di-dah	–●––●–	$\overline{KK}$
Wait		di-dah-di-di-dit	●–●●●	$\overline{AS}$
Understood		di-di-di-dah-dit	●●●–●	$\overline{SN}$
Starting Signal		dah-di-dah-di-dah	–●–●–	$\overline{KA}$
Error		di-di-di-di-di-di-di-dit	●●●●●●●●	$\overline{HH}$
Paragraph	[¶]	di-dah-di-dah-di-dit	●–●–●●	$\overline{AL}$
Invitation to Transmit		dah-di-dah	–●–	K

1. FCC test requirement consists the 26 letters, the 10 numerals, the period, the comma, the question mark, $\overline{AR}$, $\overline{SK}$, $\overline{BT}$ and $\overline{DN}$.

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! Is the battery dead or weak? Is the power switch on? Check the keying cable and paddle cable for intermittent or broken wires. Note that the solder connections for the various jacks may fail due to stress from frequent insertion and removal of plugs.

Trouble shooting guide:

Performing the self-test will isolate the problems in most cases.

No sidetone, but keying line actuates: Use a scope to view the sidetone signal from pin 13 of U1. Look for the sidetone signal at R2, R3, R4, C13, pin 3 of U3, pin 5 of U3, and both sides of C18 to isolate problem stage. Set scope for AC coupling, 100 mV (or higher, as needed) per-division. Pin 6 of U3 should show 9 Vdc. Pin 5 of U3 should measure about 4.5 Vdc with no tone (use scope or VOM).

Dot or Dash characters not being generated: Dot lever should produce low-going logic level at pin 28 of U1. Dash level should produce low-going logic level at pin 27 of U1. Check pin 12 of U1 for high-going CW signal. Check for 5 Vdc on pins 1 and 20 of U1. Set scope for DC coupling, 1 volt-per-division.

Sidetone okay, but keyline remains low: Check for high-going logic signal from pin 12 of U1 when paddles are actuated. Set scope for DC coupling, 1 volt-per-division. Presence of signal indicates possible failure of Q1 or D1.

Keyer dead: Check for 9 volts at pin 6 of U3. Check for 5 volts at pin 20 of U1. Loss of 5 volts may indicate failure of U4 voltage regulator.

Sidetone distorted, erratic operation: Weak battery. There is RF getting into keyer; use an enclosure and shielded leads.

Can't enter function mode: Pressing SW6 should put a logic low on pin 25 of U1.

Can't enter message mode: Pressing SW1, SW2, SW3 and SW4 should put a logic low on pins 21, 22, 23 and 24 of U1, respectively.

LED not lit: Check the LED to make sure it is properly keyed to the silk-screened outline. Check for 5 volts at R7 and a logic low on pin 18 of U1.

Keyer gives error beeps on function entry: Code characters must be perfectly formed, with proper timing. Invalid command prefix or suffix.

THEORY OF OPERATION AND SPECIFICATIONS

Circuit Description:

The VEC-221K features the powerful PIC16C72 microcontroller. This integrated circuit contains the programming and basic power of a microprocessor chip. CW speed is set via R6, a 10K-ohm potentiometer, that controls the voltage input to pin 2 of U1 (PIC chip). Pin 2 is an analog-to-digital input for the PIC processor. Programming subroutines scan the digitized setting of R6, and adjust the speed accordingly.

Keyer paddle activation is also sensed by the PIC chip. All dot-and-dash memories, iambic operations, and sidetone generation and sidetone frequency are under the control of the PIC16C72 device.

The message memories and parameter settings are stored in the 24C04 EEPROM, a non-volatile memory IC that does not require battery backup to preserve the recorded messages and settings.

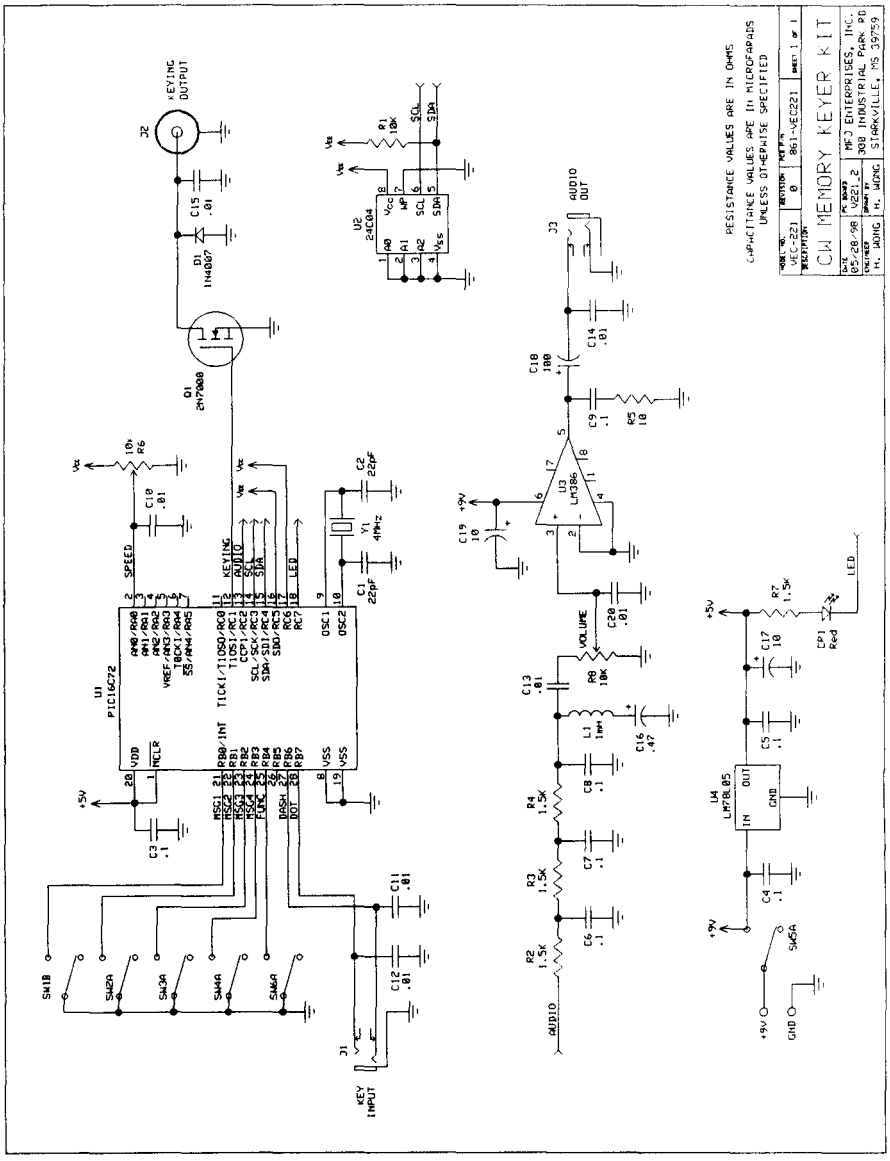
Power to the PIC controller is regulated at 5 volts by 78L05 (U4), a low-power 5-Vdc regulator IC. The sidetone signal from the processor is filtered by R2-C6, R3-C7, R4-C8 and L1-C16 to form a sinewave signal, which is amplified by U3, a linear audio amplifier IC. U3 is powered directly from the 9-volt battery. Transistor Q1 is a silicon-gate TMOS switching FET, and is used to key the transmitter. The maximum FET ratings are 50 Vdc at 100 mA.

Specifications:

Voltage requirement .....Internal 9-volt transistor battery
Keyer speed .....Typically 3 to 65 WPM
Sidetone level .....50 mW max., adjustable
Sidetone frequency .....701 Hz default, adjustable 300 to 1000 Hz.
Keying limit.....Positive keying. 50 volts at 100 mA max.
CW generation.....Iambic A or B, Automatic or Semi-auto
Memory .....Dot-Dash memory
Weight .....50% default, adjustable 25 to 75 percent
Message memories .....4 messages, about 120 characters each

SCHEMATIC

SCHEMATIC


CW MEMORY KEYER KIT
MFJ ENTERPRISES, INC.
300 INDUSTRIAL PARK RD
STARKVILLE, MS 39759
PIC16C72
LM386
LM78L05
24C04
KEYING OUTPUT
KEY INPUT
AUDIO OUT
VOLUME
SPEED
LED

ENCLOSURE

Vectronics has designed a matching enclosure just for your VEC-221K *CW Memory Keyer Kit*. The matching enclosure is an all metal box which includes knobs, hardware, decals, and rubber feet. **Enclosure Model: VEC-221KC.**

To install your receiver in the VEC-221KC matching enclosure follow these instructions *(read **all** instructions before beginning ... take your time)*:

1. Find the front and rear panel decal; separate using scissors. Put the rear panel decal on first. This is done by: **a.)** Remove all debris and oil from the chassis. **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 and cut out the component holes. **g.)** Repeat 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 two holes close to each rear 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.)** Remove the nuts and washers from R6 and R8. **b.)** Insert the front of the PC board at an angle, **c.)** then 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. Put the washers and nuts--removed from R6 and R8--back on and tighten.
7. Find the knobs and switch caps. Align the 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 through SW6. Now put the knobs on R6 and R8. You may need to loosen the set screw. Align appropriately then tighten the set screw.
8. The top should now be installed. Use the two remaining 3/16" screws for securing the top to the L-brackets.
9. Place the four rubber feet on the bottom of the enclosure at the corners.