INTRODUCTION

If you like prowling the airwaves to gather news first-hand, the VEC-1012K is the perfect kit for you! Tune in local fire, police, ambulance, public service, commercial business, and marine traffic as you search for real-life on-air drama. Before you know it, you'll master 2-way radio lingo, special operating procedures, and police 10-codes as you ferret out the "real story" behind the news! You'll also master hands-on electronic construction skills. Detailed step-by-step assembly instructions guide you through each stage, and clearly-presented alignment procedures ensure top performance without need for expensive test equipment. Your receiver is built around a Motorola IC designed especially for narrow-band FM communication radios, so it's guaranteed to pull in weak signals--just like the best commercially-built scanners and two-way transceivers. Electronic tuning lets you scan the band quickly for activity without need for entering complex strings of microprocessor commands. And, once you've found the action, your radio's fully adjustable "tail-free" squelch eliminates annoying background noise between transmissions. The VEC-1012K uses minimal energy, and can run for many hours from its self-contained 9-volt flat-pack alkaline battery. Plug in a 8-ohm speaker or use headphones for loud-and-clear reception. All circuitry is self-contained on a rugged 3" x 3.2" pc board.

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:

- ☐ Soldering Iron (grounded-tip and temperature-controlled preferred)
- ☐ High-temperature Iron Holder with 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

Special Tools for This Kit:

- ☐ 6-32 screw, at least 3/4" long, for winding coils.
- ☐ Insulated hex-head tuning wand.
- ☐ Small flat-blade screwdriver or tuning wand.
- ☐ Voltmeter, digital or analog.
- ☐ VHF "high-band" antenna to receive off-air signals.

BEFORE YOU START BUILDING

Experience shows there are *four common mistakes* builders commonly make. Avoid these, and your kit will probably work on the first try! 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 on 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 solder tips below).
4. **Omitting or Misreading a Part:** This is easier to do than you might think! Always double-check to make sure you completed each step in an assembly sequence.

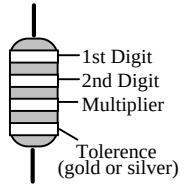
Soldering Tips: *Cleanliness* and good *heat distribution* are the two secrets of professional soldering. Before you install and solder each part, inspect leads or pins for oxidation. If the metal surface is dull, sand with fine emery paper until shiny. Also, clean the oxidation and excess solder from 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 or 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 project 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 in the following chart). You don't have to memorize this code to work with resistors, but you do need to understand how it works:

Resistor Color Code



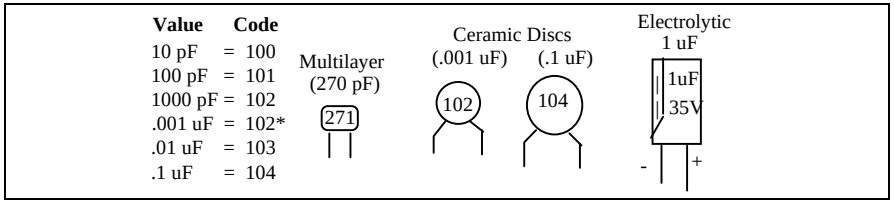
Black	= 0 (tens)	Blue	= 6
Brown	= 1 (hundreds)	Violet	= 7
Red	= 2 (K)	Gray	= 8
Orange	= 3 (10K)	White	= 9
Yellow	= 4 (100K)	Silver	= 10%
Green	= 5 (1Meg)	Gold	= 5%

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.

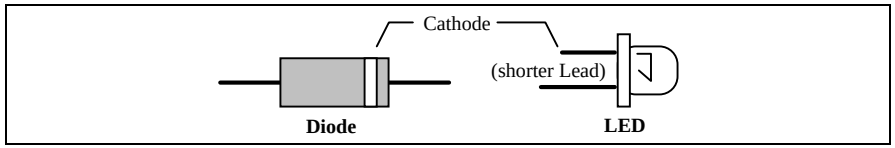
Reading Capacitors: Unlike resistors, capacitors no longer use a color code for value identification. Instead, the value, or a 3-number code, is printed on the body.



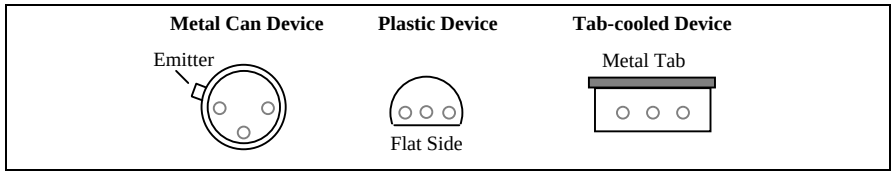
As with resistors, it's helpful to sort capacitors by type, and then to arrange them in ascending order of value. Small-value capacitors are characterized in pF (or pico-Farads), while larger values are labeled in uF (or micro-Farads). The transition from pF to uF occurs at 1000 pF (or .001 uF)*. Today,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

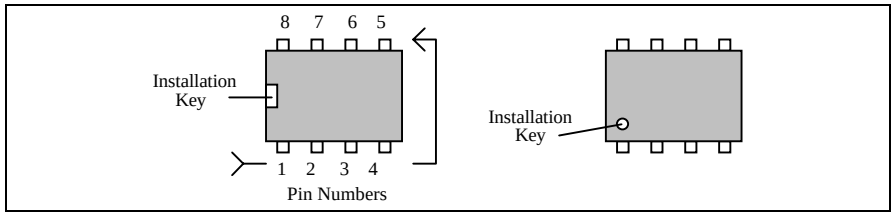
Diodes: Diodes are also polarized devices that must be installed correctly. Always look for the banded or cathode end when installing, and follow instructions carefully.



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

Resistors:

☑	Qty	Part Description	Designation
☐	1	22 ohm (red-red-black)	R3
☐	1	270 ohm (red-violet-brown)	R4
☐	1	470 ohm (yellow-violet-brown)	R2
☐	2	2.2K (red-red-red)	R11,R14
☐	2	4.7K (yellow-violet-red)	R7,R17
☐	2	10K (brown-black-orange)	R5,R18
☐	2	39K (orange-white-orange)	R12,R15
☐	1	47K (yellow-violet-orange)	R8
☐	4	100K (brown-black-yellow)	R1,R9,R13,R19
☐	2	10K potentiometer	R6,R16
☐	1	100K potentiometer	R10

Capacitors:

☑	Qty	Part Description	Designation
☐	1	2.2 pF disc ceramic (2.2C)	C3
☐	8	.1 uF disc ceramic (104)	C10,C11,C12,C21,C22, C24,C26,C29
☐	1	.05 uF disc ceramic (503)	C27
☐	1	6.8 pF disc ceramic (6.8J or 6.8C)	C5
☐	1	4.7 pF disc ceramic (4.7J or 4.7C)	C1
☐	5	.001 uF disc ceramic (102)	C6,C13,C14,C25,C32
☐	2	1 uF electrolytic	C23,C28
☐	2	10 uF electrolytic	C30,C31
☐	2	100 uF electrolytic	C8,C9
☐	2	15 pF multilayer (15 or 150)	C17,C18
☐	1	18 pF multilayer (18 or 180)	C19
☐	2	22 pF multilayer (27 or 270)	C2,C4

Capacitors cont.

☑	Qty	Part Description	Designation
☐	1	56 pF multilayer (56 or 560)	C20
☐	1	100 pF multilayer (101)	C7
☐	2	470 pF multilayer (471)	C15,C16

Semiconductors:

☑	Qty	Part Description	Designation
☐	1	5.1 volt zener diode, 1N751A	D1
☐	1	2SC2498 transistor	Q1
☐	1	MC13135 IC (24 pin)	U1

☐	1	MC34119 IC (8 pin)	U2

Inductors/Filters/Crystals

☑	Qty	Part Description	Designation
☐	1	24" length of #24 coil wire	For L1,L2,L3
☐	1	.074 uH slug-tuned, shielded (red)	L4
☐	1	660 uH adjustable, shielded (black)	L5
☐	1	10.245 crystal	Y1
☐	1	10.7 MHz ceramic filter (SFE10.7J)	FL1
☐	1	455 KHz ceramic filter (55D or 55F)	FL2

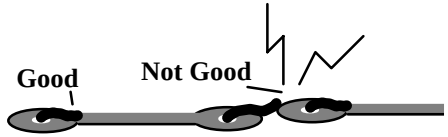
Switches/Jacks/Misc.

☑	Qty	Part Description	Designation
☐	1	DPDT push-button power switch	SW1
☐	1	RCA phono jack, pc-mounted	J1
☐	1	3.5mm stereo jack (mini-jack)	J2
☐	1	8-pin IC socket (for U2)	
☐	1	24-pin IC socket (for U1)	
☐	1	9-volt battery snap clip	
☐	1	plastic cable tie	
☐	1	PC board for VEC-1012K	
☐	1	VEC-1012K Owner's Manual	

PARTS PLACEMENT DIAGRAM

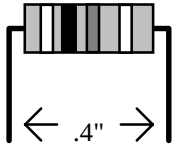
STEP-BY-STEP CONSTRUCTION

In these instructions, when you see the term *install*, 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. Use sharp side-cutters to clip off excess lead length before soldering. Make sure trimmed leads don't touch other pads and tracks, or a short circuit may result:



The term *solder* means to solder the part's leads in place, and to inspect both (or all) solder connections for flaws or solder bridges. Nip off excess protruding leads with a sharp pair of side cutters. Generally, it's easier to install small close-to-the-board parts first, and then mount larger stand-up parts second. Delicate parts, such as air-wound, coils go on the PC board last.

Your kit has 16 fixed-value resistors. We'll begin by mounting these now--starting with the smallest value and moving to the largest. Before mounting each one, carefully bend both leads close to the resistor body to form right-angles, as shown below:



☐ ☐ Find a 22 ohm resistor (red-red-black). Install at R3 and solder.

☐ ☐ Find a 270 ohm resistor (red-violet-brown). Install at R4 and solder.

☐ ☐ Find a 470 ohm resistor (yellow-violet-brown). Install at R2 and solder.

Locate two (2) 2.2K resistors (red-red-red).

☐ ☐ Install a 2.2K at R11 and solder.

☐ ☐ Install a 2.2K at R14 and solder.

Locate two (2) 4.7K resistors (yellow-violet-red).

☐ ☐ Install a 4.7K at R7 and solder.

☐ ☐ Install a 4.7K at R17 and solder.

Locate two (2) 10K resistors (brown-black-orange).

☐ ☐ Install a 10K at R5 and solder.

☐ ☐ Install a 10K at R18 and solder.

Locate two (2) 39K resistors (orange-white-orange).

☐ ☐ Install a 39K at R12 and solder.

☐ ☐ Install a 39K at R15 and solder.

☐ ☐ Find a 47K resistor (yellow-violet-orange). Install at R8 and solder.

Locate four (4) 100K resistors (brown-black-yellow).

☐ ☐ Install a 100K at R1 and solder.

☐ ☐ Install a 100K at R9 and solder.

☐ ☐ Install a 100K at R13 and solder.

☐ ☐ Install a 100K at R19 and solder.

This completes installation of the 16 fixed-value resistors (the three variable resistors will be installed later). Next, we'll install the kit's 17 disc ceramic capacitors. All capacitors should be seated as close to the board as possible.

☐ ☐ Find a 2.2 pF disc ceramic capacitor (2.2). Install at C3 and solder.

☐ ☐ Find a 4.7 pF disc ceramic capacitor (4.7). Install at C1 and solder.

☐ ☐ Find a 6.8 pF disc ceramic capacitor (6.8). Install at C5 and solder.

Locate five (5) .001 uF disc ceramic capacitors (102).

☐ ☐ Install a .001 uF at C6 and solder.

☐ ☐ Install a .001 uF at C13 and solder.

☐ ☐ Install a .001 uF at C14 and solder.

☐ ☐ Install a .001 uF at C25 and solder.

☐ ☐ Install a .001 uF at C32 and solder.

Find a .05 uF disc ceramic capacitor (503). Looking at the pc board, note that two (2) installation holes are provided for the ground-side of C27. Choose the one that most closely matches the lead spacing for the .05 uF capacitor provided in your kit.

☐ ☐ Install .05 uF at C27 and solder.

Locate eight (8) .1 uF disc ceramic capacitors (104).

☐ ☐ Install .1 uF at C10 and solder.

☐ ☐ Install .1 uF at C11 and solder.

☐ ☐ Install .1 uF at C12 and solder.

☐ ☐ Install .1 uF at C21 and solder.

☐ ☐ Install .1 uF at C22 and solder.

☐ ☐ Install .1 uF at C24 and solder.

☐ ☐ Install .1 uF at C26 and solder.

☐ ☐ Install .1 uF at C29 and solder.

There are 9 multilayer capacitors provided with your kit.

A multilayer cap is similar to a surface-mount "chip" capacitor, except that it has a lead spot-welded onto each end of the capacitor body. Multilayers have superior radio-frequency operating characteristics, but the lead welds may fail if the device is over-heated and stressed during installation or removal. For this

reason, never use force to seat a multilayer cap into the PC board. If the spacing isn't right, pre-form the leads to the correct spacing before installation.

Locate two (2) 15 pF multilayer capacitors (marked 15 or 150).

☐ ☐ Install a 15 pF at C17 and solder.

☐ ☐ Install a 15 pF at C18 and solder.

☐ ☐ Find a 18 pF multilayer cap (18 or 180). Install at C19 and solder.

Locate two (2) 22 pF multilayer capacitors (22 or 220).

☐ ☐ Install a 22 pF at C2 and solder.

☐ ☐ Install a 22 pF at C4 and solder.

☐ ☐ Find a 56 pF multilayer capacitor (56 or 560). Install at C20 and solder.

Locate a 100 pF multilayer capacitor (101), then find the location of C7 on the pc board. Note that the mounting holes for C7 are wider than normal for a multilayer cap. This is due to a pc-track running between the mounting pads beneath. To accommodate the wider spacing, carefully spread the 100 pF cap's leads prior to installation.

☐ ☐ Install 100 pF at C7 and solder.

Locate two (2) 470 pF multilayer capacitors (471).

☐ ☐ Install 470 pF at C15, *spreading leads as described above*, and solder.

☐ ☐ Install 470 pF at C16 and solder.

The last six (6) capacitors in your kit are electrolytic. ***Electrolytic caps are polarized and must be installed the correct way in order to work.*** Each capacitor's plus (+) mounting holes are noted on both the circuit board and parts placement diagram. If the markings on the capacitor body are unclear, the plus (+) lead is always the longer of the two.

Locate two (2) 1 uF electrolytic caps.

☐ ☐ Install a 1 uF at C23 and solder.

☐ ☐ Install a 1 uF at C28 and solder.

Locate two (2) 10 uF electrolytic caps.

☐ ☐ Install a 10 uF at C30 and solder.

☐ ☐ Install a 10 uF at C31 and solder.

Locate two (2) 100 uF electrolytic caps.

☐ ☐ Install 100 uF at C8 and solder.

☐ ☐ Install 100 uF at C9 and solder.

This completes installation of all capacitors. Before moving on to the next phase of construction, check the polarity of each electrolytic one more time to confirm all six are installed correctly.

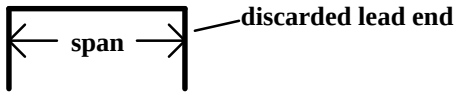
Find 1N751 zener diode--the only diode supplied with your kit. Like electrolytic capacitors, zener diodes are polarized components and must be installed the correct way. Diode polarity is indicated by the black band located at one end of the glass body.

☐ ☐ Install the 1N751 at D1 so the banded end corresponds with the band marked on the PC board (toward U1). Solder.

Locate the 2SC2498 plastic transistor and note its flat side. Position at Q1, as indicated by the outline on the pc board. Gently pre-form the leads so the case is spaced approximately .15" above the pc board surface when leads are fully inserted (see below).

☐ ☐ Install the 2SC2498 at Q1 and solder.

Your kit requires five (5) jumper wires. Each should be pre-formed from a bare length of discarded component lead, as shown below. The approximate distance between mounting holes is given to help you pre-form each one. When installed, each jumper should lay flat against the PC board.



☐ ☐ Make a jumper with a .2" span. Install at JMP1 and solder.

☐ ☐ Make a jumper with a .275" span. Install at JMP2 and solder.

☐ ☐ Make another jumper with a .275" span. Install at JMP3 and solder.

☐ ☐ Make a jumper with a .3" span. Install at JMP4 and solder.

☐ ☐ Make a second jumper with a .3" span. Install at JMP5 and solder.

☐ ☐ Locate the 10.7 MHz ceramic filter. It looks like a square disc-ceramic capacitor with three pins on the bottom, and is marked 10.7J. This component is *not* polarized, and it may be installed either way. Install at FL1 and solder in place.

☐ ☐ Locate the 455 kHz ceramic filter. This is a small black cube with three pins marked 55D or 55F. Note that it will fit only one way on the PC board. Install at FL2 and solder.

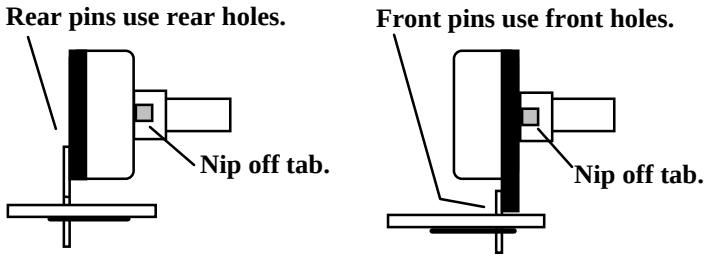
☐ ☐ Find the 3.5 mm stereo mini-headphone jack. Install at J2 and solder all pins.

☐ ☐ Find the RCA phono jack. Install at J1 and solder all tabs.

☐ ☐ Locate push-button power switch SW1. Install and solder all pins.

☐ ☐ Locate the 10.245 MHz crystal (frequency marked on case). Install at Y1 and solder.

The front-panel controls (tuning, squelch, volume) are mounted next. Before installing these parts, inspect the type of 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.



Locate the two (2) 10K potentiometers (B103).

☐ ☐ Install a 10K pot at R6 (tuning) and solder.

☐ ☐ Install a 10K pot at R16 (volume) and solder.

☐ ☐ Find the 100K pot (B104). Install at R10 (squelch) and solder.

Find the radio's oscillator coil (two pins, shielded, red plastic form). Before installing, confirm that the coil's two pins and shield-can tabs are straight and aligned with the mounting holes at L4.

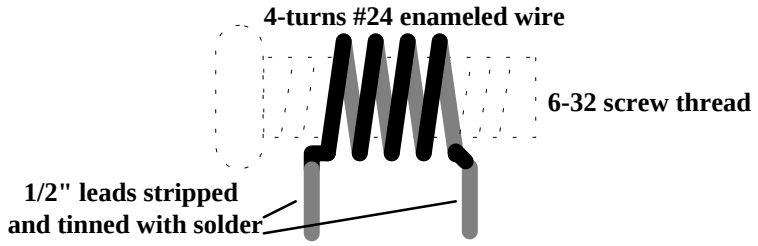
☐ ☐ Install the oscillator coil at L4 and bend shield-can tabs over. Solder in place.

Find the quadrature-detector coil (five pins, shielded, with black coil form). Before installing, make sure all pins and tabs are straight and aligned with mounting holes at L5.

☐ ☐ Install the quad-coil at L5 and bend shield-can tabs over. Solder in place.

The last three coils in your radio are hand-wound from the #24 wire supplied. In addition to the #24 wire, you'll also need a 6-32 screw at least 1/2" long to use as a winding form. Before starting, carefully straighten the coil wire by drawing it over a plastic rounded surface such as a screwdriver handle. Remove any bends or kinks. Cut two (2) lengths about 6" long each.

☐ ☐ Take one length of wire and, while grasping both ends firmly, carefully wind four (4) full turns over the winding form--as shown below. The wire should conform into the thread grooves.



☐ ☐ Remove the coil by unscrewing it from the 6-32 threads. Shape the coil as shown above, with about 1 wire-width spacing between each turn.

Each coil lead must be tinned prior to installation so solder will stick to it. The wire provided with your kit is coated with enamel insulation formulated to melt at high temperatures. This quality should allow you to strip, clean, and "tin" each coil lead in a single operation. To prepare each lead, hold a hot soldering iron tip against it for several seconds while applying a small amount of solder. Eventually, the enamel insulation should begin breaking down, allowing solder to coat and adhere to the wire (it may be easier to perform this operation with the coil threaded onto the screw). If your soldering iron doesn't generate enough heat to start the enamel stripping process, scrape the enamel away with an Exacto™ knife before tinning. Make sure both leads are clean and brightly tinned all the way around before attempting to install.

☐ ☐ When the first 4-turn coil is prepared as shown, install at L1 and solder. Check coil shape and spacing before moving on.

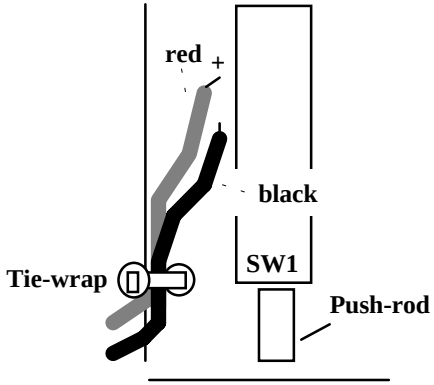
☐ ☐ Repeat this operation--winding, prepping, installing, and soldering a second 4-turn coil at L2.

Using the remaining wire, wind a 10-turn coil. Unlike L1 and L2, the turns of L3 should be compressed together after winding so the overall coil is about .3" in length--about the distance between its mounting holes.

☐ ☐ Wind, prep, and install a 10-turn coil at L3. Solder in place.

☐ ☐ Install the 9-volt battery snap clip. The red lead is installed at (+ 9V), and the black at GND. Solder in place.

☐ ☐ Stress relief is provided to prevent battery leads from flexing and eventually breaking at their connection point. Find a hole part-way back on the left edge of the PC board (not to be confused with the board's mounting holes at the front and back). Use the plastic tie-wrap provided in your kit to secure the battery leads in place, as shown below. Insert the tie-wrap through the hole, close it over the wires, and pull tight. Nip off the excess end.



Finally, install receiver ICs U1 and U2. Before doing this, inspect both devices carefully and straighten any bent or crooked pins. Use extreme care during insertion, and move slowly. It's very easy to miss a pin opening and fold a IC pin underneath the body of the device.

Locate U2, the MC34119 audio-amplifier IC (8 pins). Position its keyed (or notched) end to correspond with the key marked on the pc board at U2. Carefully align the pins with the U2 mounting holes before inserting.

☐ ☐ Install the MC34119 IC at U2, checking carefully that all 8 pins enter their respective mounting holes. Solder each pin in place.

Locate the MC13135 Receiver IC (24 pins). Position the keyed end to correspond with the key marked on the pc board at U1. Carefully align the pins with the U1 mounting holes before inserting.

☐ ☐ Install the MC13135 IC at U1 and solder each pin in place.

☐ ☐ Inspect the pads under both ICs carefully for solder bridges and cold-solder (use a magnifying glass, if available). Correcting any problem before proceeding.

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

TESTING AnD ALIGNMENT

PC Board Inspection: Even the most experienced builders make mistakes! 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 radio from working or cause damage to sensitive parts. Follow this procedure:

1. 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.

2. Inspect the solder side of the board for cold-solder joins 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.

3. Finally, check all electrolytic capacitors and diodes for correct polarity. Does the plus (+) polarity symbol on the part agree with the pictorial and with the silk-screen pattern on the PC board? Is the banded end of each diode positioned correctly? Also, were your ICs installed so the dot or notch on the plastic case corresponds with the white dot or marking on the PC board? Was Q1 installed correctly?

Be sure to correct all errors before moving on. If a careful inspection revealed that everything is OK, you're now ready for the moment of truth!

Initial Checkout:

To check out your kit you'll need a 9-volt flat-pack type alkaline battery and a 8-ohm extension speaker (or monaural headphones) outfitted with a 3.5 mm mini plug. Make sure the radio's power switch is *OFF* (button out) before loading the battery. Plug in speaker or phones and turn all potentiometer controls fully counter-clockwise.

1. Apply power (button in).
2. Turn up *VOLUME* (right-hand pot) clockwise. You should hear a rushing sound, indicating the receiver and audio amplifier are functioning properly.
3. Slowly advance the *SQUELCH* (center pot) clockwise. The rushing sound should stop abruptly around mid-range, indicating the squelch circuit is working.

If your radio passed its turn-on test, congratulations! You're well on your way to success, and ready for pre-alignment.

If your radio *didn't* pass the turn-on test, don't despair. Odds are, you've overlooked something minor that's easy to correct. Take a break, come back fresh, and carefully repeat the QC inspection. If no undiscovered errors turn up during your second inspection, proceed to the "In Case of Difficulty" section of this manual for troubleshooting advice.

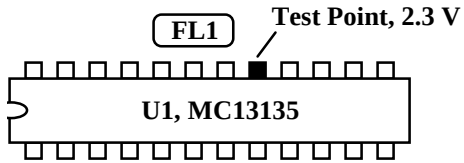
Pre-Alignment:

You'll need the following items to adjust your receiver:

- 6-32 screw, at least 3/4" long, to check the shaping of L1, L2.
- Insulated hex-head tuning wand to adjust L4.
- Small flat-blade screwdriver or tuning wand to adjust L5.
- Voltmeter, digital or analog, to adjust L5.
- Antenna to receive off-air signals.

The instructions below describe how to pre-adjust each of the radio's coils for a ballpark setting. This procedure will make final alignment easier.

1. Locate coils L1 and L2. Thread a 6-32 screw inside the windings of each coil to check for sizing and spacing. If each winding conforms to the 6-32 diameter and thread-pitch, the coil is wound correctly. If not, make any needed adjustments. Spread the turns so they are exactly 1 wire-width apart.
2. Make a small flag from a scrap of tape and install it on the hex-head tuning wand. This will help you count revolutions as you adjust L4.
3. Locate tunable-oscillator coil L4. Insert the tuning wand and rotate the slug counter-clockwise so the top surface is perfectly flush with the top of the metal shield can. Now, watching the tape flag and counting revolutions, rotate the slug *4 turns clockwise* down into the body of the coil.
4. Set your voltmeter range to 10 Volts dc and connect the black (-) lead to a ground point on the PC board. Locate *pin # 17 on U1* (see the following diagram). This is the test point for adjusting L5.



5. Set all front-panel controls on the radio counter clockwise, install a 9-volt battery on the battery snap clip, and apply power via the *OFF/ON* switch. No antenna should be connected during this test. With power applied, touch the

red (+) voltmeter lead to pin #17. Using a small screwdriver, adjust L5 for a reading of 2.3 volts. No further adjustment will be required.

Final Alignment--Oscillator Coil L4:

If possible, your kit should be mounted in its VEC-1012KC metal cabinet (or other enclosure) before adjusting L4. The tuning oscillator frequency coverage may change slightly if you align L4 with the pc board out of the box, then install it later. There are several ways to calibrate L4 for coverage. Choose the method most compatible with the tools you have available:

Option 1: Calibrating with a Signal Generator or FM-Service Monitor.

Set the generator up as follows:

- Frequency:.....154.0 MHz
- Output Level: .....10 uV (-90 dBm)
- Modulation:.....1 kHz tone at 5 kHz FM deviation

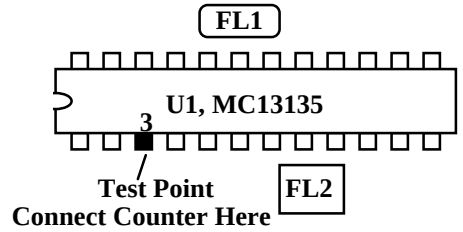
Connect the generator output to your kit's antenna jack using a 50-ohm patch cable. Plug in headphones or external speaker to monitor generator signal.

1. Set *TUNE* to 154.0 MHz (fully counterclockwise).
2. Set *SQUELCH* open (fully counter-clockwise).
3. Power the radio and set *VOLUME* for a comfortable level.
4. *Slowly* tune L4 back and forth with the insulated tuning tool to locate the 154 MHz test signal.

Your receiver's varactor tuning circuit should now cover approximately 4 MHz from bottom to top, providing coverage from 154 to 158 MHz. You may alter the tuning range, if you wish, to cover any 4 MHz segment from 150-154 to 158-162 MHz by readjusting L4 accordingly.

Option 2: Calibrating with a Frequency Counter.

Your kit's NBFM receiver IC features a buffered test point for measuring oscillator frequency with a digital counter. Locate this point on the diagram below:



1. Connect the frequency-counter ground lead to a ground point (case or PC board).
2. Set the *TUNE* to 154 MHz (fully counter-clockwise) and apply power.
3. Touch counter probe to pin-3 and adjust L4 for a counter reading of 143.3 MHz.

Important Note: Some counters may "load down" the oscillator circuit slightly, causing a small change in operating frequency when the counter probe is removed.

Option 3: Calibrating with a Scanner or 2-Meter Amateur Radio Transceiver.

With this method, you use a scanner or 2-meter FM ham transceiver to pick up your receiver's tuning oscillator. The oscillator operates exactly 10.7 MHz *below* the actual receive frequency--which happens to land near the 2-meter ham band. Unlike the counter method, this approach *does not* load down the oscillator circuit and provides more accurate alignment. Install a short antenna on your scanner or 2-M radio to pick up the oscillator signal.

1. Tune your scanner or 2-M radio to 143.3 MHz and position it near the kit.
2. Set *TUNE* to 154 MHz (fully counter-clockwise) and apply power.
3. *Slowly* adjust L4 until the oscillator signal is heard on the scanner at 143.3 MHz.

Option 4: Calibrating with an Off-Air Signal.

If no other option is available, you may calibrate L3 using the signal generated by a local police or public-service base station. To do this, you must know the station's operating frequency (a scanning directory should provide that information). Also, the transmitting station should transmit frequently and be easily identifiable so you can find when tuning. Finally, the radio should be mounted in its case with the tuning knob installed. Begin by connecting a speaker (or phones) and an antenna.

1. Set the *SQUELCH* pot fully counter clockwise (open).

2. Apply power and set the *VOLUME* pot for a comfortable background-noise level.
3. Adjust the *TUNE* knob to correspond with the station's assigned operating frequency.
4. *Slowly* tune L4 until you receive the station's signal at the correct spot on the dial.

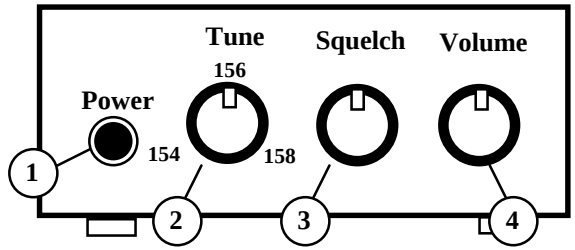
This approach may require some patience, since the slug-tuning in L4 is quite touchy.

Aligning L1, L2 for maximum receiver sensitivity:

If coils L1 and L2 were formed and installed according to instructions, your radio should operate with near-maximum sensitivity and require no further adjustment. However, if you wish, you may "tweak" these two coils to optimize performance on weak distant stations. In order to make this adjustment, you'll need a weak signal source. This could be a 1-uV 156.0 MHz (mid-band) signal produced by a signal generator, or a weak mid-band off-air signal with audible background noise present. To adjust, use the blade of a non-metallic tuning wand or your fingernail to expand or compress the spacing between turns. Note that adjusting L2 may change the radio's operating frequency slightly. To compensate for this interaction, readjust *TUNE* as you make each change to ensure the signal remains tuned in.

Reduced background hiss and lower distortion indicates an improvement in signal strength. As you find the best point for each coil, stretch or compress it permanently into in that position. ***Don't attempt to adjust L1 and L2 while tuned to a strong local signal.*** Use only a weak signal with clearly-audible background hiss. Note that L3 is non-critical, and requires no adjustment. When peaked, your kit should render "solid copy" on FM signals of 1-uV or less.

OPERATING INSTRUCTIONS



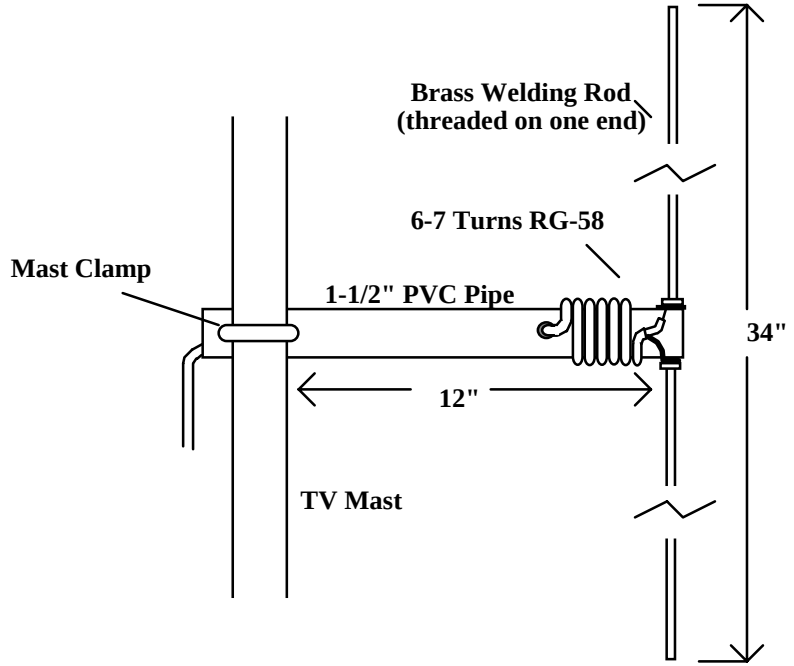
1. **POWER:** Push-on/push-off switch turns unit on and off. The VEC-1012K runs on internal battery power and shouldn't be left *ON* for extended period when not in use.
2. **TUNE:** Electrically tunes receiver oscillator, setting frequency where signals are received. Tuning range may vary slightly from unit to unit, but should be approximately 154 to 158 MHz (the frequencies where most public service and marine activity take place).
3. **SQUELCH:** Adjusts threshold-point for cutting off receiver background noise.
4. **VOLUME:** Adjust audio amplifier gain a comfortable listening level.

Periodically check battery condition:

Operating your radio with a weak battery may lead to unstable tuning (signals drifting off channel rapidly), weak or distorted audio, and motor boating (a low-frequency "putt-putt-putt" noise in your speaker or headphones). Your radio needs a minimum of 7-8 volts in order to work properly.

Antennas:

The VEC-1012K requires an external antenna. For local reception, a 17" length of wire may work reasonably well. However, for longer-range reception, a low-cost ground-plane or VHF scanner antenna mounted out-of-doors and fed with coaxial cable provides much better performance. You may purchase one from Radio Shack or many other sources. Alternatively, you may make your own "side-mount" vertical dipole using the following diagram:



IN CASE OF DIFFICULTY

Your kit's design has been thoroughly field tested, and is known to be both reliable and "forgiving" of construction errors. If you have difficulty with your unit, the cause may be something as simple as a broken cable or a dead battery. In most cases, you will be able to find the cause with some organized troubleshooting. Begin your search with this checklist of symptoms and cures:

Does not turn on: Check battery condition, snap clip, and power leads. Also, make sure lead polarity is correct (red to +, black to GND). Make sure power switch is "on".

Also, squelch may be locked "on" (see following). Check operating voltages.

Turns on, does not receive signals: Check antenna, antenna lead, and plug for shorted or open condition. Also, radio may not pick up signals in metal building without an outdoor antenna.

Drifts off-frequency rapidly, "motorboats", weak audio: Symptoms of a weak battery or insufficient operating voltage. Be sure to check battery voltage "under load" (with the radio turned on).

Squelch won't open when control is fully counter-clockwise: Check the value of the squelch potentiometer. It must be 100K. If a 10K pot is installed at R10, the squelch won't open.

Poor sensitivity: Look for antenna problems. Also, check condition of L1, L2, and L3. If they are improperly shaped or if a lead is broken, sensitivity will be poor.

If these checks fail to uncover the problem, repeat the "QC" check one more time. Service records show that, for most malfunctioning kits, outright component failure is relatively rare. In most cases, the culprit is a misplaced part, reverse-polarized capacitor or diode, or a faulty solder connection!

Voltage Analysis: One effective way to pin-point where a circuit problem might be is to use voltage analysis. To do this, you'll need a voltmeter--preferably a high-impedance DMM type. Set your meter to the 10-volt dc range and clip the black (-) test lead to a ground point on the PC board (the frame of the antenna connector is a good point). Make sure the radio's battery is fresh--the chart readings were made using a 9.0-volt power source. Using the red (+) lead, check the voltage on each IC pin and compare it against the voltage chart below. Readings should be within 10-15% of chart value:

MC13135 (U1)				**MC34119 (U2)**		**2SC2498 (Q1)**		
Pin	**Voltage**	**Pin**	**Voltage**	**Pin**	**Voltage**	**E**	**B**	**C**
1	5.2	13	5.2	1	0.1*		.77	7.1
2	4.5	14	0.1*	2	4.0			
3	4.3	15	0.1*	3	4.0			
4	5.2	16	0	4	4.0			
5	4.7	17	2.3	5	4.0			
6	5.2	18	5.2	6	8.8			
7	3.8	19	5.2	7	0			
8	0	20	4.0	8	4.0			
9	4.4	21	5.2					
10	4.4	22	5.2					
11	4.4	23	1.2-3.0					
12	.2 (no sig)	24	0					

*Squelch open voltage (becomes 3.8 when squelch is "logic-high" or closed)

If you find one or more pins that read radically different from the chart value, it may indicate the device is bad--or it may mean a circuit problem exists in that portion of the radio. If you have technical skills and can read a schematic diagram, this will help you. For example, if you get an unreasonable reading on

pin 23 of U1, the schematic shows that the radio's voltage-tuning circuitry is connected here. You might look for defective or misplaced components on that portion of the circuit board as a potential cause. If, despite your best effort, you cannot solve a problem with your radio, kit repair services are available through Vectronics. See the warranty on the inside front cover for complete instructions.

THEORY OF OPERATION AND SPECIFICATIONS

Technical Circuit Description:

The VEC-1012K FM receiver is a sensitive voltage-tunable dual-conversion NBFM receiver that includes an effective squelch circuit and gated AF-amplifier IC for speaker operation. Incoming signals are filtered through a bandpass filter at L1/L2 to reduce out-of-band interference, then boosted by low-noise preamplifier Q1. Q1 is series-matched to the input of U1. U1 is a Motorola device that perform nearly all receiver functions for the radio. The first LO (local oscillator) is voltage-tuned by a temperature-compensated varactor diode built into the receiver chip. Signals are converted in the receiver's DBM 1st-mixer stage down to 10.7 MHz, the radio's 1st-IF. Here, they are fed through a roofing filter (FL1) to reduce in-band interference. The second LO, crystal-controlled at 10.245 MHz, drives the 2nd mixer for converting signals to 455 kHz. FL2 establishes the radio's message-channel bandwidth prior to 100-dB of signal amplification and limiting in the 2nd IF. Signals are demodulated by quadrature detection, and recovered audio signals are preamplified to line level by U1's output stage. Audio is then sent to the receiver's volume control and to AF amplifier U2.

In addition to processing FM signals, U1 also measures signal strength through log-amp RSSI circuitry. RSSI output is sent to a built-in op-amp comparator, where signal strength is compared to a reference level set by the radio's squelch control. The comparator then generates a logic signal to operate the "mute" pin of audio amplifier U2 for squelch action.

Audio is supplied to U2 via the radio's volume control. Here, audio signals are contoured for frequency response and amplified to speaker-level. The output of U2 is fed to a speaker/phone jack.

Specifications:

Tuning Range ..... 154-158 MHz (may be altered by retuning)

Sensitivity..... .5 uV typical for usable signal

Selectivity..... 20 kHz message-channel bandwidth

AF Output..... 60 mW into 8-ohm load

Current Drain..... 15 mA squelched, 40 mA on voice peaks

Power Source..... 9V flatpack battery

SCHEMATIC

ENCLOSURE