IMPORTANT WARRANTY INFORMATION! PLEASE READ

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

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

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

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

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

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

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

Vectronics
1007 HWY 25 South
Starkville, MS 39759

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

INTRODUCTION

Hidden in many standard FM broadcast signals is a host of very interesting programming—and you can listen in for free! You'll find commercial free background music that the restaurants and hotels subscribe to, all news programs, weather reports, stock quotes, digital data, ethnic programs in different languages, reading services for the blind, and much, much more. This programming is carried by hidden subcarriers on the FM signal, using the VEC-422K *SCA Decoder* allows you to unlock and monitor the subcarrier programming!

The decoder connects to your FM receiver or tuner using one simple connection! Many receivers already have SCA output jacks. If not, we'll give you some simple directions for hooking up your VEC-422K to almost any FM broadcast receiver or tuner! The heart of the VEC-422K is a special FSK decoder chip. No alignment is needed, and construction is quick and simple thanks to the VECTRONICS professional solder masked and screened PC board. The SCA decoder features an on-board audio amplifier to drive headphones or a speaker, or a line-level output to feed your HI-FI system amplifier. The VEC-422K tunes subcarrier frequencies from 50 to 100kHz. Learn how subcarriers work, and how they are decoded.

TOOLS AND SUPPLIES

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

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

- ☐ 30-60 Watt Soldering Iron (temperature-controlled preferred)
- ☐ High-temperature Iron Holder with Moist Cleaning Sponge.
- ☐ Rosin-core Solder (thin wire size preferred, .031")
- ☐ Needle Nose Pliers or Surgical Hemostats
- ☐ Diagonal Cutters or "Nippy Cutters"

- ☐ Solder Sucker (squeeze bulb or vacuum pump type), or Desoldering Braid
- ☐ Bright Desk Lamp
- ☐ Magnifying Glass

BEFORE YOU START BUILDING

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

1. **Installing the Wrong Part:** It always pays to double-check each step. A 1K and a 10K resistor may look *almost* the same, but 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 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.

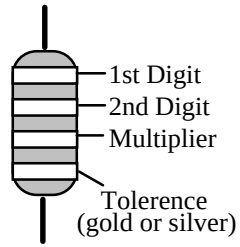
Desoldering Tips: If you make a mistake and need to remove a part, follow these instructions carefully! First, grasp the component with hemostats or

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

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

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

Resistor Color Code



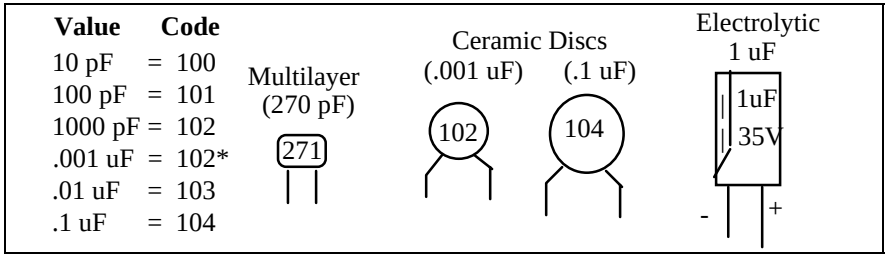
Black = 0 (tens)	Blue = 6
Brown = 1 (hundreds)	Violet = 7
Red = 2 (K)	Gray = 8
Orange = 3 (10K)	White = 9
Yellow = 4 (100K)	Silver = 10%
Green = 5 (1Meg)	Gold = 5%

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

This VEC kit contains molded chokes which appear, at first glance, similar to resistors in both shape and band marking. However, a closer look will enable you to differentiate between the two—chokes are generally larger in diameter

and fatter at the ends than resistors. When doing your inventory, separate out any chokes and consult the parts list for specific color-code information.

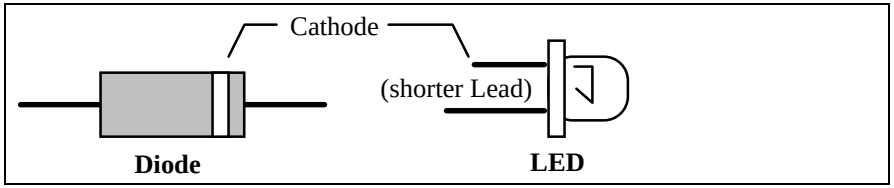
Reading Capacitors: Unlike resistors, capacitors no longer use a color code for value identification. Instead, the value, or a 3-number code, is printed on the body.



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

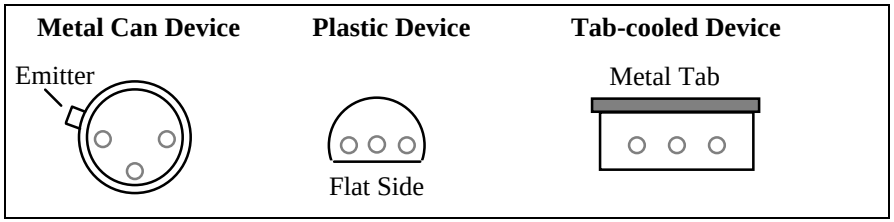
Electrolytic capacitors are always marked in uF. Electrolytic capacitors are polarized devices and must be oriented correctly during installation. If you become confused by markings on the case, remember the uncut negative lead is slightly shorter than the positive lead.

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.

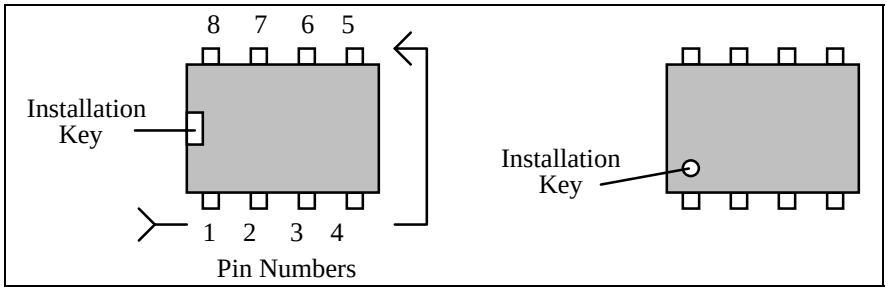


Transistors: If transistors are installed incorrectly, damage may result when power is applied. Transistors in metal cases have a small tab near the emitter lead to identify correct positioning. Semiconductors housed in small plastic cases (TO-92) have an easily-identified flat side to identify mounting 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 is silk-screened on the PC board and printed on the kit's parts-placement diagram. To identify specific IC pin numbers for testing purposes, see the diagram below. Pin numbers always start at the keyed end of the case and progress counterclockwise 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:

Note: The fourth color band (gold) denotes tolerance, only the three bands determining resistance value are listed.

☑	Qty	Part Description	Designation
☐	1	15-ohm ¼-watt resistor (brown-green-black)	R15
☐	3	510-ohm ¼-watt resistor (green-brown-brown)	R1,R3,R5
☐	3	4.7K-ohm ¼-watt resistor (yellow-violet-red)	R6,R10,R13
☐	1	10K-ohm ¼-watt resistor (brown-black-orange)	R4
☐	1	18K-ohm ¼-watt resistor (brown-gray-orange)	R8
☐	3	24K-ohm ¼-watt resistor (red-yellow-orange)	R11,R12,R14
☐	3	100K-ohm ¼-watt resistor (brown-black-yellow)	R2,R7,R9
☐	1	10K-ohm variable resistor	R17
☐	1	50K-ohm variable resistor	R16

Capacitors:

☑	Qty	Part Description	Designation
☐	2	120-pF monolithic (121)	C2,C9
☐	1	470-pF monolithic (471)	C1
☐	3	.001-uF monolithic (102)	C6,C10,C12
☐	1	.0022-uF monolithic (222)	C11
☐	1	.0047-uF monolithic (472)	C4
☐	2	.01-uF monolithic (103 or .01)	C3,C5
☐	3	.1-uF monolithic (104 or .1)	C7,C8,C13
☐	3	1-uF electrolytic	C16,C17,C18
☐	2	470-uF electrolytic	C14,C15

Semiconductors:

☑	Qty	Part Description	Designation
☐	4	2N3904 plastic transistor	Q1,Q2,Q3,Q4
☐	1	LM386 linear audio IC, 8 pin	U2
☐	1	XR2211 FSK demodulator IC, 14 pin	U1

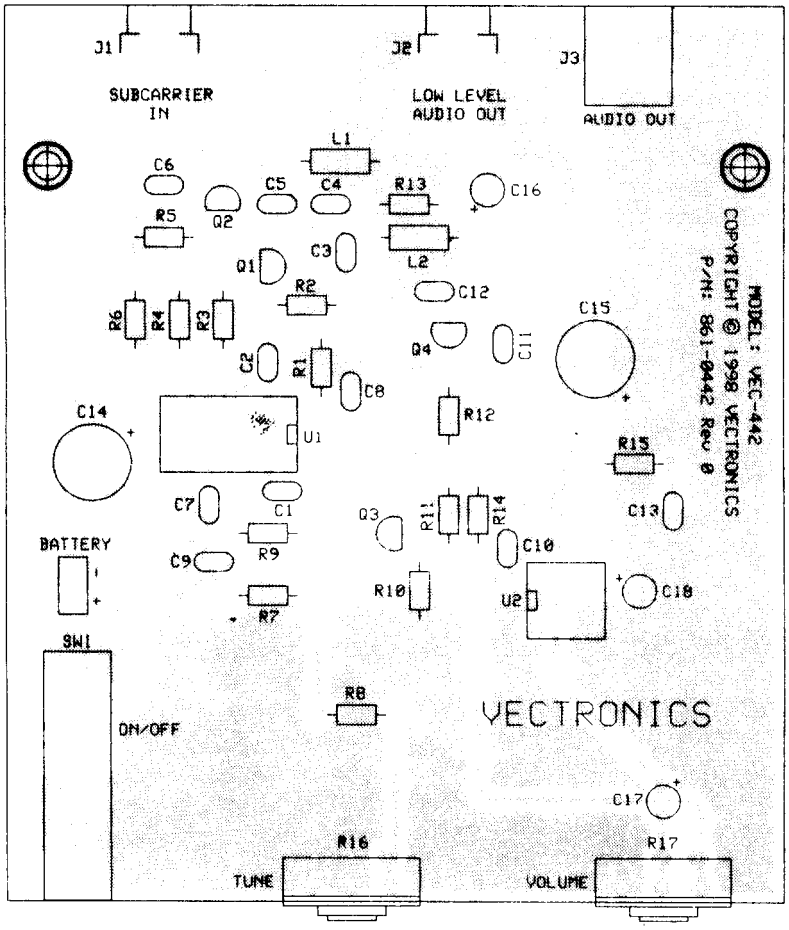
Inductors:

☑	Qty	Part Description	Designation
☐	2	330-uH molded choke (orange-orange-brown)	L1,L2

Miscellaneous:

☑	Qty	Part Description	Designation
☐	1	DPDT push-action switch	SW1
☐	2	RCA phono jacks, PC board mount	J1,J2
☐	1	3.5mm stereo jack, PC board mount	J3
☐	1	8-pin DIP IC socket	U2
☐	1	14-pin DIP IC socket	U1
☐	1	9-volt transistor battery clip	
☐	1	4” nylon wire tie wrap	
☐	1	VEC-442 PC board	
☐	1	3-inch length insulated hookup wire	

PARTS PLACEMENT DIAGRAM



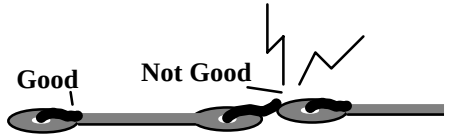
STEP-BY-STEP ASSEMBLY

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

First, a few notes and comments to help you along. Part designators for components such as 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 Parts Placement Diagram found in this manual. The parts are inserted on the silk-screen side of the board. All capacitors should be installed with their bodies as close to the PC board as possible; this is very important in RF circuits.

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

"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:

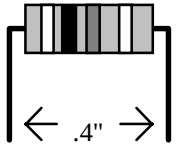


"Solder" When you are directed to *solder*, this means to solder the part's leads in place, and to inspect both (or all) solder connections for flaws or solder bridges. If no soldering problems are noted, nip off the excess protruding leads with a sharp pair of side cutters.

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.

Resistor Installation:

Begin assembly by installing the ¼-watt fixed resistors. Because these are all 5-percent tolerance ending with a fourth *gold* color band, you need only read the first three bands of the color code during the following steps. All resistor leads should be formed as shown below. Install and solder resistors at the following locations:



NOTE: the fourth resistor color band is for tolerance, and is not called out in the following steps.

☐ ☐ 1. Locate the 15-ohm resistor (brown-green-black). *Install* and *solder* at location R15.

Locate the three 510-ohm resistors (green-brown-brown). Install and solder at the following locations:

☐ ☐ 2. R1 510-ohm resistor (green-brown-brown)

☐ ☐ 3. R3 510-ohm resistor (green-brown-brown)

☐ ☐ 4. R5 510-ohm resistor (green-brown-brown)

Locate the three 4.7K-ohm resistors (yellow-violet-red). Install and solder at the following locations:

☐ ☐ 5. R6 4.7K-ohm resistor (yellow-violet-red)

☐ ☐ 6. R10 4.7K-ohm resistor (yellow-violet-red)

☐ ☐ 7. R13 4.7K-ohm resistor (yellow-violet-red)

☐ ☐ 8. Locate the 10K-ohm resistor (brown-black-orange) . Install and solder at location R4.

☐ ☐ 9. Locate the 18K-ohm resistor (brown-gray-orange). Install and solder at location R8.

Locate the three 24K-ohm resistors (red-yellow-orange). Install and solder at the following locations:

☐ ☐ 10. R11 24K-ohm resistor (red-yellow-orange)

☐ ☐ 11. R12 24K-ohm resistor (red-yellow-orange)

☐ ☐ 12. R14 24K-ohm resistor (red-yellow-orange)

Locate the three 100K-ohm resistors (brown-black-yellow). Install and solder at the following locations:

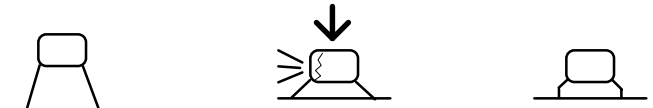
☐ ☐ 13. R2 100K-ohm resistor (brown-black-yellow)

☐ ☐ 14. R7 100K-ohm resistor (brown-black-yellow)

☐ ☐ 15. R9 100K-ohm resistor (brown-black-yellow)

Non-polarized capacitor installation:

Important Note: Monolithic capacitors have superior radio-frequency operating characteristics, but the lead welds *may* fail if the device is over-stressed during installation or removal. For this reason, *never use force to seat a monolithic cap* into the PC board. If the spacing isn't right, pre-form the leads to the correct spacing before inserting into the board.



Incorrect **Ooops!** **Correct**

Locate the two 120-pF monolithic capacitors (121). Install and solder at the following locations:

☐ ☐ 1. C2 120-pF monolithic capacitor (121)

☐ ☐ 2. C9 120-pF monolithic capacitor (121)

☐ ☐ 3. Locate the 470-pF monolithic capacitor (471), install and solder at C1.

Locate the three .001-uF monolithic capacitors (102). Install and solder at the following locations:

☐ ☐ 4. C6 .001-uF monolithic capacitor (102)

☐ ☐ 5. C10 .001-uF monolithic capacitor (102)

☐ ☐ 6. C12 .001-uF monolithic capacitor (102)

☐ ☐ 7. Locate the .0022-uF monolithic capacitor (222). Install and solder at C11.

☐ ☐ 8. Locate the .0047-uF monolithic capacitor (472). Install and solder at C4.

Locate the two .01-uF monolithic capacitors (103 or .01). Install and solder at the following locations:

☐ ☐ 9. C3 .01-uF monolithic capacitor (103 or .01)

☐ ☐ 10. C5 .01-uF monolithic capacitor (103 or .01)

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

☐ ☐ 11. C7 .1-uF monolithic capacitor (104 or .1)

☐ ☐ 12. C8 .1-uF monolithic capacitor (104 or .1)

☐ ☐ 13. C13 .1-uF monolithic capacitor (104 or .1)

Molded choke and inductor installation:

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

Locate the two 330-uH molded chokes (orange-orange-brown). Install and solder at the following locations:

☐ ☐ 1. L1 330-uH molded choke (orange-orange-brown)

☐ ☐ 2. L2 330-uH molded choke (orange-orange-brown)

Polarized capacitor installation:

Electrolytic capacitors are *polarized* devices, and must be inserted with respect to polarity. The style used in the VEC direct conversion receivers have *radial* leads; both leads exit from one end of the device body. Each capacitor's plus (+) mounting holes are noted both on the circuit board and parts placement diagram. If the markings on the capacitor body are unclear, the plus (+) lead is the longer of the two.

Locate the three 1-uF electrolytic capacitors. Install and solder at the following locations:

☐ ☐ 1. C16 1-uF electrolytic capacitor. Observe polarity!

☐ ☐ 2. C17 1-uF electrolytic capacitor. Observe polarity!

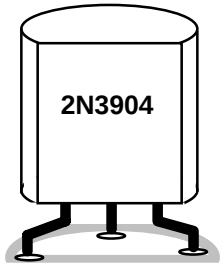
☐ ☐ 3. C18 1-uF electrolytic capacitor. Observe polarity!

Locate the two 470-uF electrolytic capacitors. Install and solder at the following locations:

☐ ☐ 4. C14 470-uF electrolytic. Observe polarity!

☐ ☐ 5. C15 470-uF electrolytic. Observe polarity!

Semiconductors:



Note: The 2N3904 transistor body has a flat and rounded side. The device body outline must correspond to the silk-screened component outline on the PC board.

Locate the four 2N3904 plastic transistors. Install and solder at the following locations:

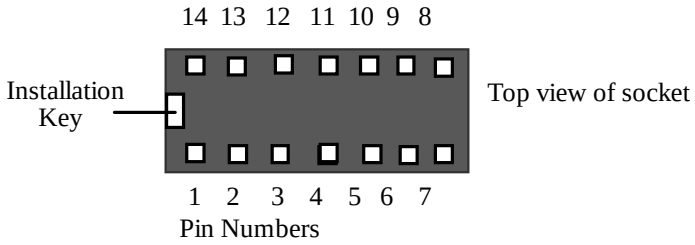
☐ ☐ 1. Q1 2N3904 transistor, observe alignment!

☐ ☐ 2. Q2 2N3904 transistor, observe alignment!

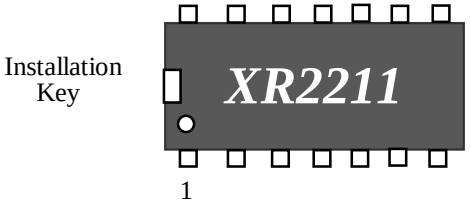
☐ ☐ 3. Q3 2N3904 transistor, observe alignment!

☐ ☐ 4. Q4 2N3904 transistor, observe alignment!

Locate the 14-pin IC socket. Note that the socket is keyed—a small notch shows pin 1 alignment.



☐ ☐ 5. Install and solder the 14-pin IC socket at location U1. Observe that the key aligns with the legend outline on the PC board.



The IC body has a small notch, or *key*, molded at one end, indicating pins 1 and 14. A small dimple-like body-molding is often found adjacent to pin 1. Some IC packages may include both key indicators.

Locate the XR2211 14-pin IC.

☐☐ 6. Align the body of the XR2211 to correspond with the key of socket U1. Loosely insert the pins of the XR2211 into socket U1. All 14 pins should fit freely into the socket openings. If not, straighten the IC pins until they do. Using firm and steady pressure, fully seat the IC into the socket.

☐☐ 7. Locate the 8-pin IC socket. Install and solder at location U2. Observe key alignment!

☐☐ 8. Locate the LM386 audio IC. Align the body of the LM386 to correspond with the key of socket U2. Loosely insert the pins of the LM386 into socket U1. All 8 pins should fit freely into the socket openings. If not, straighten the IC pins until they do. Using firm and steady pressure, fully seat the IC into the socket.

Final steps:

☐☐ 1. Locate the push-action DPDT power switch. Install at SW1. The push shaft should extend over the edge of the board. Be sure the switch is fully seated and level before soldering. Solder.

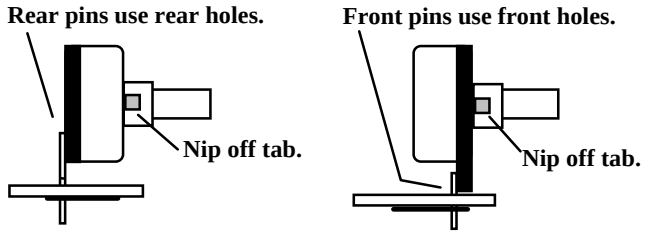
Locate the two RCA jacks. Install and solder at the following locations (note: ensure the leads are fully inserted). Bend the pins over so they contact the copper foil surface. This will improve the mechanical strength of the solder joint.

☐☐ 2. J1 RCA jack.

☐☐ 3. J2 RCA jack.

☐☐ 4. Locate the 3.5mm jack. Install at J3. Be sure the switch is fully seated and level before soldering. Solder.

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). If necessary, use side cutters to remove the key tab from the side of each pot prior to installation.



Note: The resistance value is stamped on the front body for the rear-pin style potentiometers.

☐ ☐ 5. Locate the 10K-ohm variable resistor. Install and solder at location R17 (volume control).

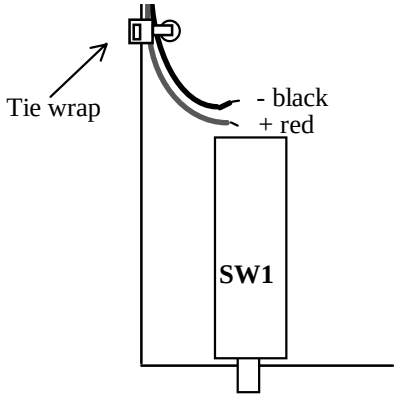
☐ ☐ 6. Locate the 50K-ohm variable resistor. Install and solder at location R16 (tuning control).

Locate the battery clip.

☐ ☐ 7. Solder the red lead (positive) to the (+) location on the PC board.

☐ ☐ 8. Solder the black lead (negative) to the (-) location on the PC board.

☐ ☐ 9. Find the 4” nylon wire tie wrap. Secure the battery leads to the stress relief hole on the PC board using the nylon tie wrap. Trim excess tie length.

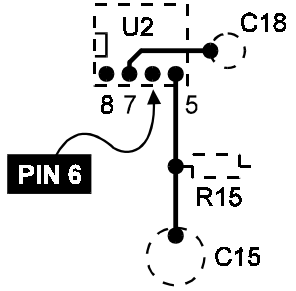


Important Note: The following steps will involve installing a jumper wire on the bottom, or solder side, of the PC board. It is very important that the jumper wire be connected precisely as directed!

Locate the 3" length of hookup wire.

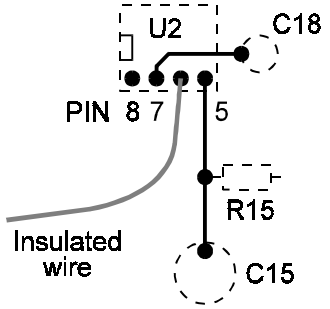
Locate pin 6 of the 8-pin socket for the LM386 chip at location U2.

Location of pin 6 on solder side of board for the LM386 (U2).

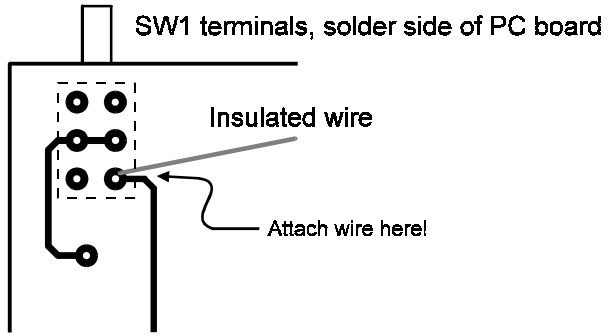


☐ ☐ 10. Trim the exposed wire from one end the insulated jumper wire to about 1/16". Solder this end of the insulated jumper wire to pin 6. ***Be very careful not to bridge adjacent IC socket pins!***

Note: Solder side of PC board!
One end of insulated wire attaches to pin 6.



☐ ☐ 11. Solder the other end of the insulated jumper to the rear set of pins (furthest from the shaft) for power SW1 on the solder side of the board.



The assembly of the VEC-422K SCA decoder is completed.

TESTING AND ALIGNMENT

Testing: The final test is proving the SCA adapter works with your receiver. Here are few simple voltage tests to check out the adapter.

Note: Nine volt battery attached and SW1 on (shaft latched inward).

U2 LM386 9 volts at pin 6. About 4.5 volts at pin 5.

U1 XR2211 9 volts at pin 8.

The following tests need only be performed if you have access to the required test equipment. The advanced test proves that the unit is working flawlessly.

Advanced test: Using a function or audio generator, inject a 60-mV P-P 67-kHz sinewave into jack J1. Monitor pin 11 of the XR2211 with a scope (.1-volt per division, AC coupled, 10uS sweep per division). Observe the scope signal while slowly rotating tuning control R16. The scope pattern should change from a jittery pattern to a stable triangular waveform (about .3-volts P-P) when lock is achieved.

Some function generators will accept a VCG input (such as the Wavetek model III). Apply audio to the VCG input to FM modulate the 67-kHz signal. When tuned for lock, the modulating signal should be audible in the monitor speaker (jack J4 output). Adjust the volume control for best level. Vary the signal generator output from 50kHz to 100kHz in several steps, and tune for lock at each frequency.

Alignment: There is no alignment required for this project. It is ready to enjoy when assembly and testing are completed!

OPERATING INSTRUCTIONS

Tuning in SCA signals: Unless you know which FM broadcasters are carrying SCA programming, you will have to explore each station to find if it has hidden SCA programming. Tune into the FM station; and then carefully tune R16 while listening for SCA signals. If a SCA subcarrier is present, and is strong enough, you should hear the SCA programming when the Phased Locked Loop (PLL) locks onto the subcarrier signal. Volume control R17 is used when an external speaker or headphones are attached to the VEC-422K to set the audio to a comfortable listening level. Don't ignore the Public Broadcasting and college FM stations at the lower end of the FM dial, they are public service oriented and often carry community oriented SCA programs.

What is an SCA signal? SCA (Subsidiary Communications Authorization) programs are auxiliary revenue-producing services provided by many FM stations. The use of the subcarriers is "sold", just as commercial airtime is sold for commercials. SCA subcarriers are located at 67kHz and 92kHz from the main carrier, and transmit with a 7.5kHz deviation maximum. It is not a HI-FI service, as its audio bandwidth is limited to about 5kHz. In theory, each FM station can carry several subcarrier services. ARI, or Automobile Road Services, normally operates on a 57kHz subcarrier. This is a limited bandwidth channel, and requires special equipment for decoding the information. ARI provides constant road advisory updates to motorists who subscribe to the service. Each subcarrier reduces the main channel signal strength by about 1dB. Thus, few stations are willing to lose 2dB of signal strength to carry two subcarrier (SCA) services. Most SCA services will be found using the 67kHz subcarrier. Urban areas with high population densities will generally offer more SCA services than in a rural area. The original 41kHz SCA subcarrier is seldom used, due to its incompatibility with the 38kHz stereo subcarrier.

The SCA signal represents about 10% of the total FM signal, thus it is unusually weak and prone to fading or being noisy. The SCA subcarrier can also suffer from "splatter" from the main audio channel, resulting in occasional noise bursts on the SCA signal. This means even though the main FM signal sounds good, the SCA subcarrier may still be too weak for the VEC-422K to decode properly. Use a good outdoor antenna to capture the most signal level.

What you can hear: SCA programming is used for a variety of purposes. Providing commercial-free background music for restaurants and waiting rooms is just one of many uses. There are also SCA services for physicians giving the latest medical news, reading and news services for the visually handicapped, and second-language programming for ethnic populations.

Power requirements: Power is supplied via an internal 9-volt transistor battery. Alkaline batteries are more expensive initially, but are more economical over the

long run. Remember to turn the SCA Adapter off when not in use to conserve battery power.

Interconnecting cables: The demodulated SCA signal should be connected to the VEC-422K using shielded audio cable (jack J1). Radio Shack and most department stores carry good selections of *A/V hookup cables*. The FM receiver or tuner should be equipped with an RCA phono jack for the SCA output. The line-level output is also an RCA phono jack (J2). Shielded audio cable should be used for interconnecting the line-level output to an external audio amplifier.

Audio: The SCA Adapter has a line-level audio output to feed hi-fi amplifiers directly (RCA phono jack J2). The VEC-422K also includes an on-board audio amplifier to drive a speaker (4 to 32 ohms, 50 mW max.) or headphones at jack J3. The headphones should be equipped with a 3.5mm monaural jack. Stereo phones with a 3.5mm jack may be used, but only one earpiece will be active.

Connecting to the receiver: Some FM receivers or FM tuners come equipped with an SCA adapter jack. If your receiver has a SCA jack, you need only provide the necessary shielded cable from the receiver SCA jack to the SCA input (jack J1) on the VEC-422K. Some older FM receivers featured a "MPX" output jack—this is also an ideal point for connecting to an external SCA Decoder. The MPX signal is taken from the detector, before the SCA filtering and de-emphasis circuits. Newer receivers may have a jack for "four-channel decoders" or "quadrasound decoders"; again, these are also taken directly from the FM detector and can be used to supply SCA subcarrier signals to the VEC-422K. You might notice that the VEC-422K reduces the level of FM audio on some receivers when it is attached; disconnect the VEC-422K when not in use if this is a problem.

Receiver modifications: If your receiver does not have an SCA adapter jack, you will have to provide one. FM receivers can use one of several types of FM detector circuits. The majority use either a Ratio Detector, Discriminator, or Quadrature Detector to recover audio from the FM carrier. Unless you are an experienced technician, you may wish to have the jack installed by a service shop. There is usually room to add an RCA jack on the rear apron of most FM receivers or tuners. The following schematics are representative of typical FM detector circuits, and gives an idea of the proper take-off point for the SCA subcarrier signal. The ratio detector circuit is very similar to the discriminator circuit, which is not shown.

WARNING: Many inexpensive table top stereos or tube-type FM receivers may use a ''hot chassis''. This is commonly found in transformerless sets that are designed to operate from AC/DC voltages. VECTRONICS advises against using these receivers with the VEC-422K to avoid shock hazards!

FCC regulations: The following is what you may and may not do legally. The Communications Act of 1934, Section 605 of the FCC rules, and various other State and Federal laws apply to the interception of private radio transmissions. Many SCA transmissions are subscriber based, that means a fee is charged for commercial use of the program material. An example would be background

music for restaurants or hotels. You may monitor these programs, providing they are for your own or immediate family's enjoyment. Using them in a place of business to provide background music for customers without being a subscriber is theft of service. Stock reports are carried on some SCA systems. Again, monitoring the programs for your own enjoyment is legal, using the information to make investments is a form of personal gain and is illegal. (In most instances stock services require special decoding equipment.) The Communications Act of 1934 also strictly prohibits divulging the contents of any intercepted private radio communications. The laws governing the interception and monitoring of private radio communications are very dynamic and ever changing. Protect your rights as a radio hobbyist by using the VEC-422K in a responsible and legal manner.

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? Is the power switch on?

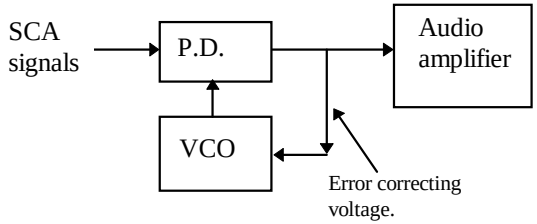
The majority of reception problems can be traced to a few major causes. The FM signal must be strong—if the signal is weak the SCA subcarrier will also be weak, and the XR2211 decoder may not be able to lock to it. The SCA subcarrier modulation is typically 10% of the total FM deviation. The SCA subcarrier must be taken directly from the FM detector stage, before any RC de-emphasis circuits or filters limit bandwidth and reduce the SCA signal. Not all FM stations broadcast SCA signals. Nor, are the SCA subcarriers always present when there is no programming activity. The *advanced test* procedure shown earlier may be used to prove whether there is a problem in the unit, or with the receiver hookup.

THEORY OF OPERATION

Recovered audio from the FM detector is sent directly to the SCA Adapter input. The signal pick-off point must be directly from the detector output before any de-emphasis takes place.

The XR2211 is a Phase Locked Loop (PLL). Tuning control R16 varies the VCO (Voltage Controlled Oscillator) section of the XR2211 over the range of frequencies used by the SCA services. When a subcarrier is detected, the VCO will lock to the subcarrier frequency once the tuning control is in range. Lock is achieved by the Phase Detector generating an error correcting voltage (steering voltage) and feeding it back to the VCO to keep it locked on frequency.

The subcarriers are FM modulated, that is the frequency of the subcarrier varies according to the program material. The phase detector sees these frequency variations, and continually adjusts the steering voltage to keep the VCO in lock. These voltage variations faithfully mimic the program material, and by simply coupling an audio amplifier into the tuning voltage line, the program material may be recovered and monitored.



Specifications:

SCA subcarrier range .....50 to 100kHz

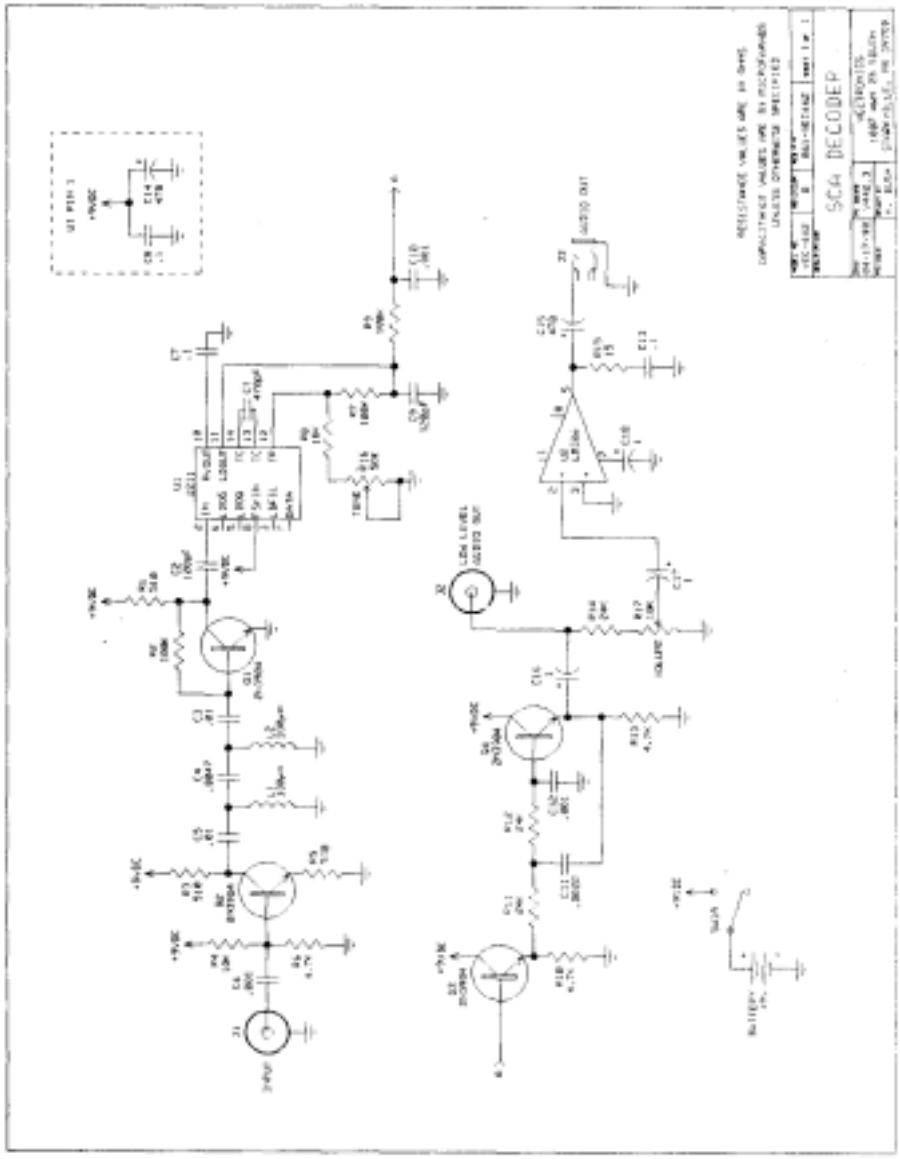
Power requirements.....9-volt transistor battery, alkaline preferred

Audio output J2 .....line level output

Audio output J3 .....4 to 32 ohms, 50mW max.

PC Board.....4.000" x 4.700"

SCHEMATIC



ENCLOSURE

Vectronics has designed a matching enclosure just for your VEC-422K *SCA Decoder Kit*. The matching enclosure is an all metal box which includes knobs, hardware, decals, and rubber feet. **Enclosure Model Number: VEC-422KC.**

To install your decoder in the VEC-422KC matching enclosure follow these instructions ***(read all instructions before beginning ... take your time)***:

1. Find the front panel decal and rear panel decal; separate using scissors. Be sure to leave excess decal material around the edges. Put the rear panel decal on first. This is done by: **a.)** Remove all debris and oil from the chassis. This should be done using a piece of cloth and alcohol. **b.)** Remove the crack and peel to expose the adhesive. **c.)** Place the decal on the rear panel without securing it completely. **d.)** Gently rub the alignment circles with your finger--if the circles are centered in the enclosure holes (also check the corner alignment marks) secure the decal by rubbing and removing all air bubbles. **e.)** If the alignment circles are not centered, adjust the decal accordingly then secure. **f.)** Use a penknife, or small Exacto™ knife, to cut away the unused edges *(cut from the adhesive side)* and cut out the component holes *(cut from the description side)*. **g.)** Repeat this procedure for the front panel.
2. Next, install the two L-brackets on the chassis using two of the 3/16" screws. The longer side of the L-bracket must be connected to the chassis using the two holes centered on each edge of the enclosure. Refer to the diagram on the next page for location and orientation.
3. Install the two 1/2" mounting screws next. Insert the screws, from the bottom, through the four holes relatively close to each corner of the chassis.
4. Place the two 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 R16 and R17. **b.)** Insert the front of the PC board at an angle, so the controls enter their respective holes. **c.)** 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 two 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 R16 and R17--back on and tighten.
7. Find the knobs and switch cap. Align the switch cap with SW1 and push it on. If it is difficult to push on, then rotate it 90° and try again. Now put the knobs on R16 and R17. You may need to loosen the set screw. Align appropriately then tighten the set screw.
8. Locate the piece of double-sided tape. This is to be used for holding the 9-volt battery clip in place. Locate a place on the underside of the top cover where the battery will not interfere with any components. Peel off the backing of the tape and stick it to the chosen location, then install the battery clip.
9. The top should be installed next. Use the two remaining 3/16" screws for securing the top to the L-brackets. Make sure the L-brackets are aligned properly.
10. Finally, place the four rubber feet on the bottom of the enclosure at the corners.