

# TONE DECODER OPTION BOARD

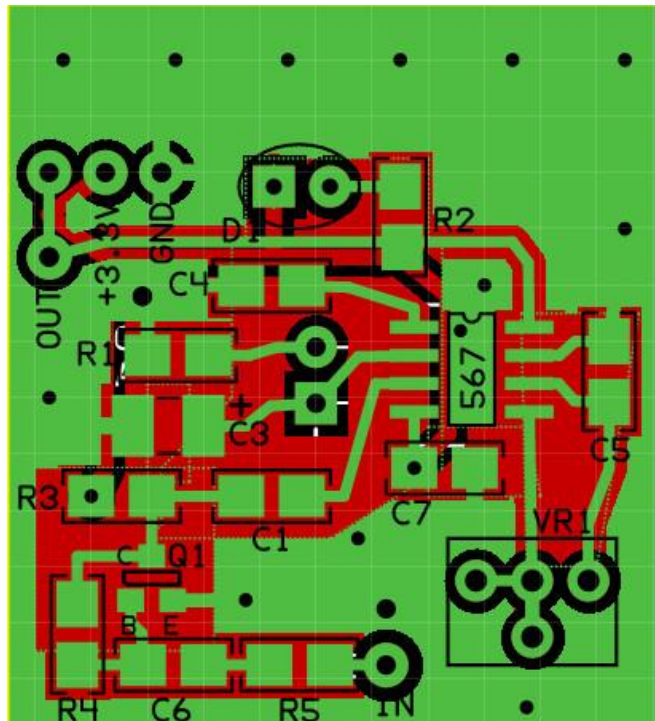
## For the TSW T4.1 Raduino CW Decoder Option

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### Kit Construction Manual Version 1.15, 03/15/2022

This is the construction manual for TSW's tone decoder board as used with the Teensy 4.1 Raduino when the CW decode option has been selected. It is necessary to provide tone to digital pulse conversion in order to decode incoming CW signals and also display CW sent using the CW Practice (CWP) mode.

The board was originally designed to work on 5 volts and as such would have required a modification to the TSW T4.1 Raduino, but it turns out that with the SMD 567's it MAY actually run satisfactorily on the 3.3V provided by the T4.1. (Many of the layout pictures in this manual still indicate 5V on the silkscreen.) The Texas Instruments SMD LM567's will NOT operate on 3.3V so we have changed the instructions to use 5V instead of 3.3 and the supplied P1 plug is modified accordingly.



Top View of the SMD 567 Decoder PC Board

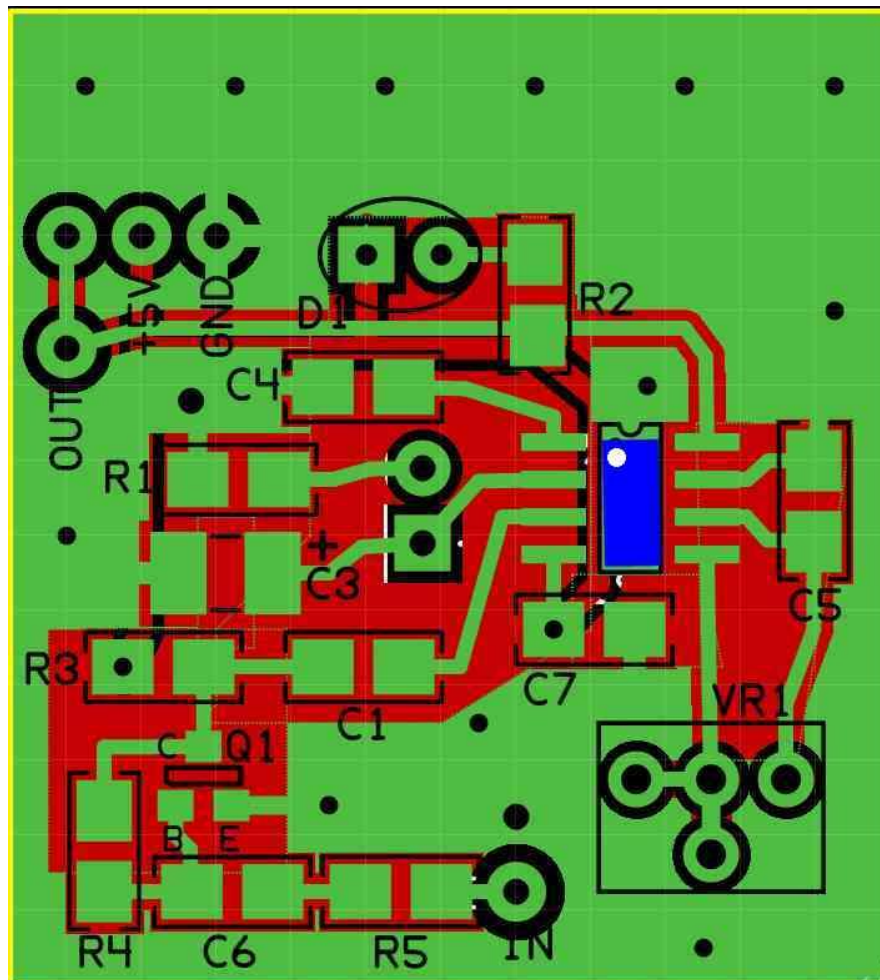
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## Construction:

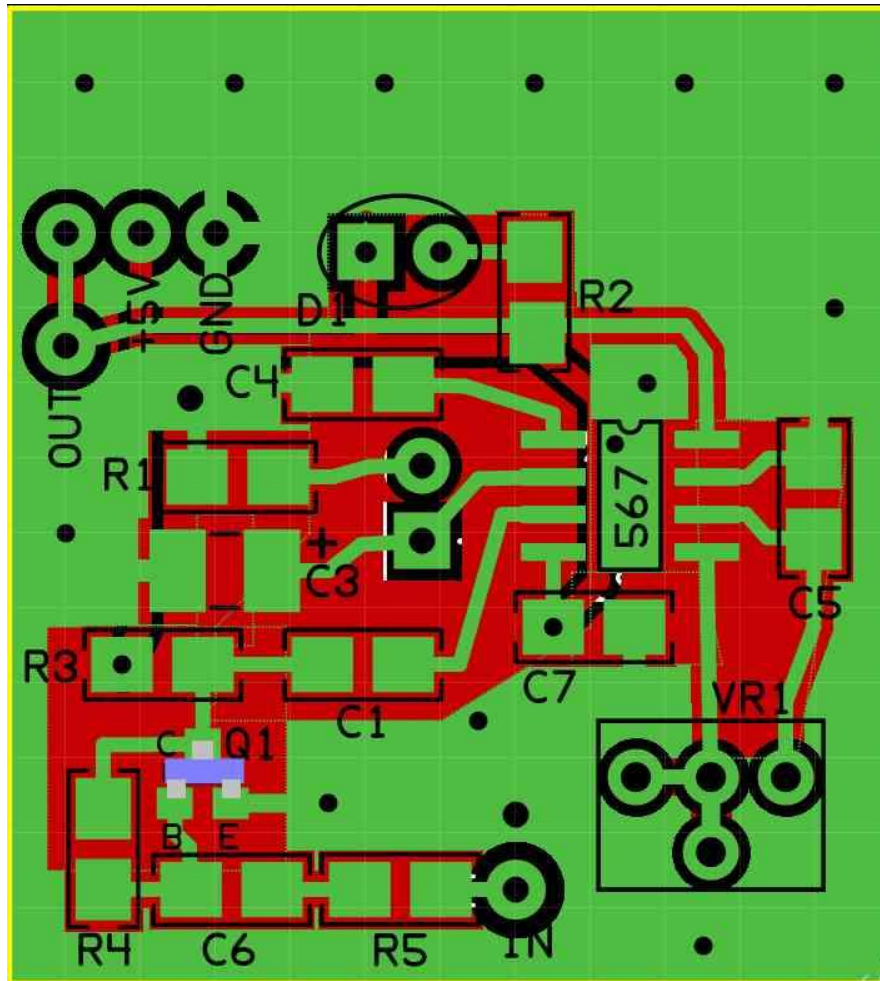
Construction of the board is fairly simple. Check off each step as you complete it.

\_\_\_\_\_ Start off by carefully installing U1, the LM567 decoder Integrated Circuit. Pay Close attention to the location of pin1 and make sure not to short any of the other pins together. If you happen to mess up, some solder wick and a bit of flux should make it easy to clear the short as the pins of U1 are reasonably far apart.

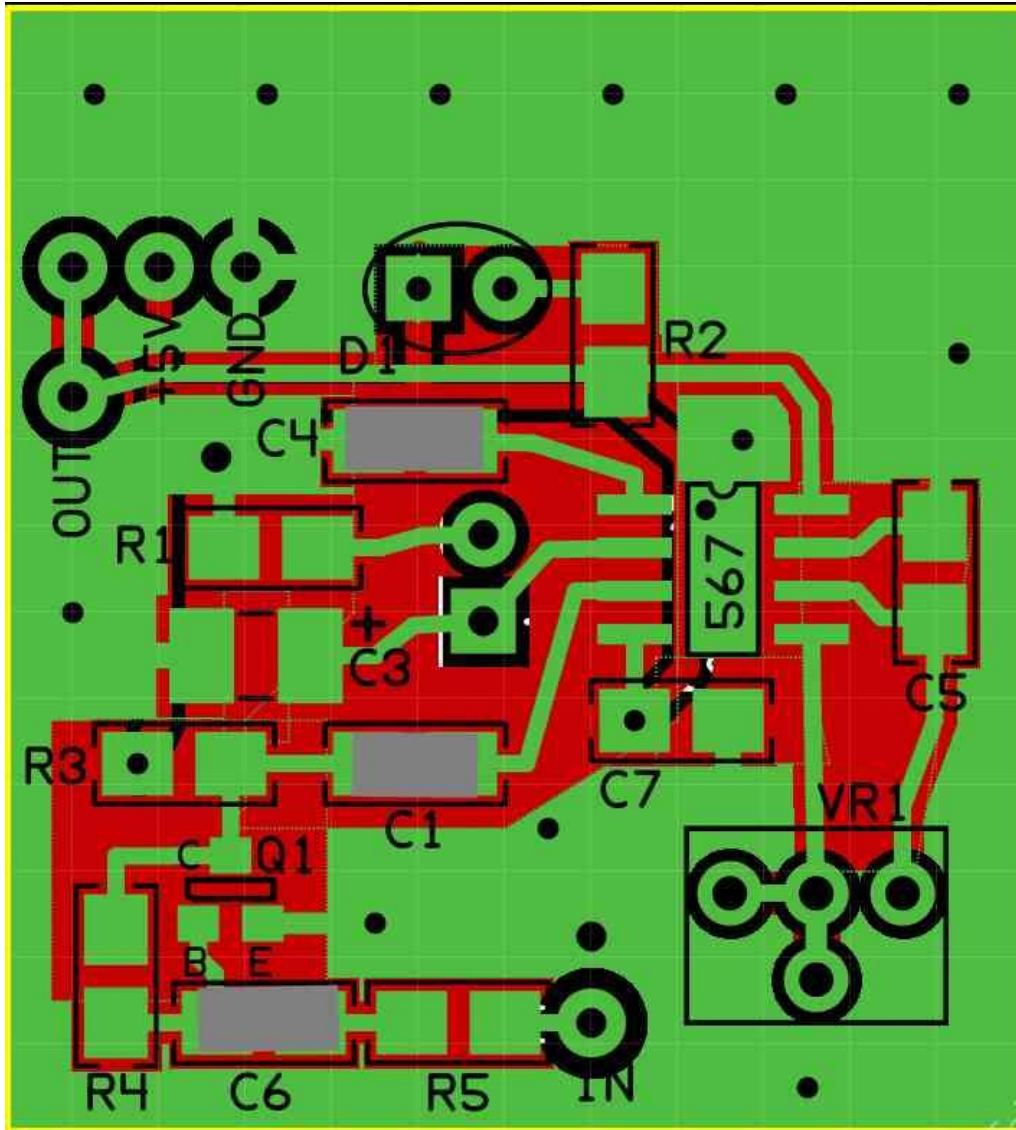


\_\_\_\_\_ Next, install Q1, the MMB53904 transistor. Place a small amount of flux on the collector pad (the pin on top by itself) and Carefully (making sure the transistor is right side up) position it so that the bottom 2 pins are over their

respective pads. Quickly solder the collector, making sure not to disturb your alignment. Finally, carefully solder the other two tabs (emitter & base). If needed, touch up all three solder connections to make sure they are good.



\_\_\_\_\_ Continuing, install the 1206 size capacitors C1, C4, C6 on the top side of the board. (C2 is a 250 uF electrolytic capacitor with leads and it will be installed later on the underside of the board.)



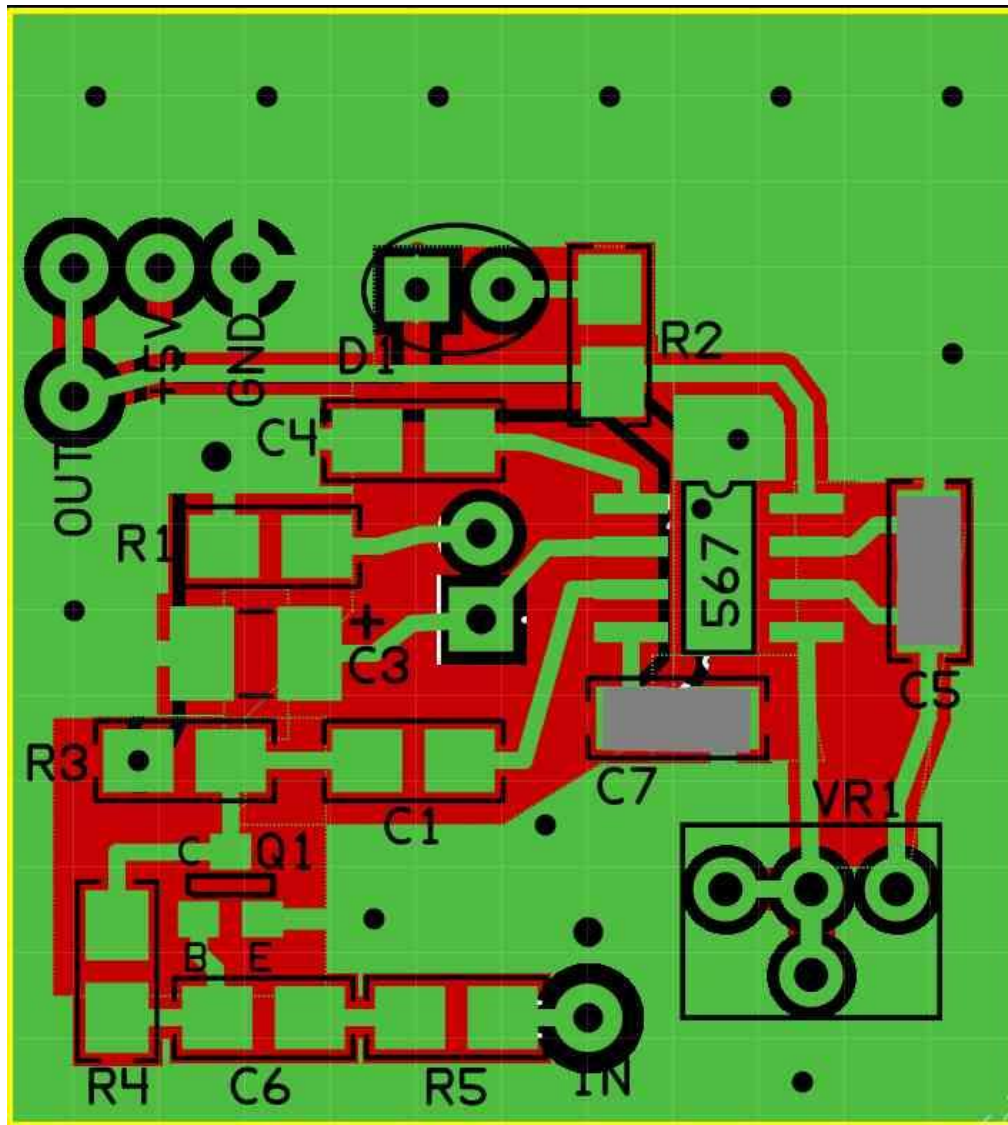
The easiest way to mount SMD capacitors and resistors is to first apply a small amount of solder to one of the pads for the component. Hold the component with a pair of sharply pointed tweezers and while heating the solder on that pad, slide the component into place. Once it's properly seated, solder the other end of the part to its pad.

\_\_\_\_\_ Using the same technique, solder C3, the 1.0  $\mu\text{F}$  1210 size (a size 1206 version may be supplied depending on part availability) tantalum SMD electrolytic capacitor at C3 be sure the + (dark line) marked end of the capacitor is toward U1.

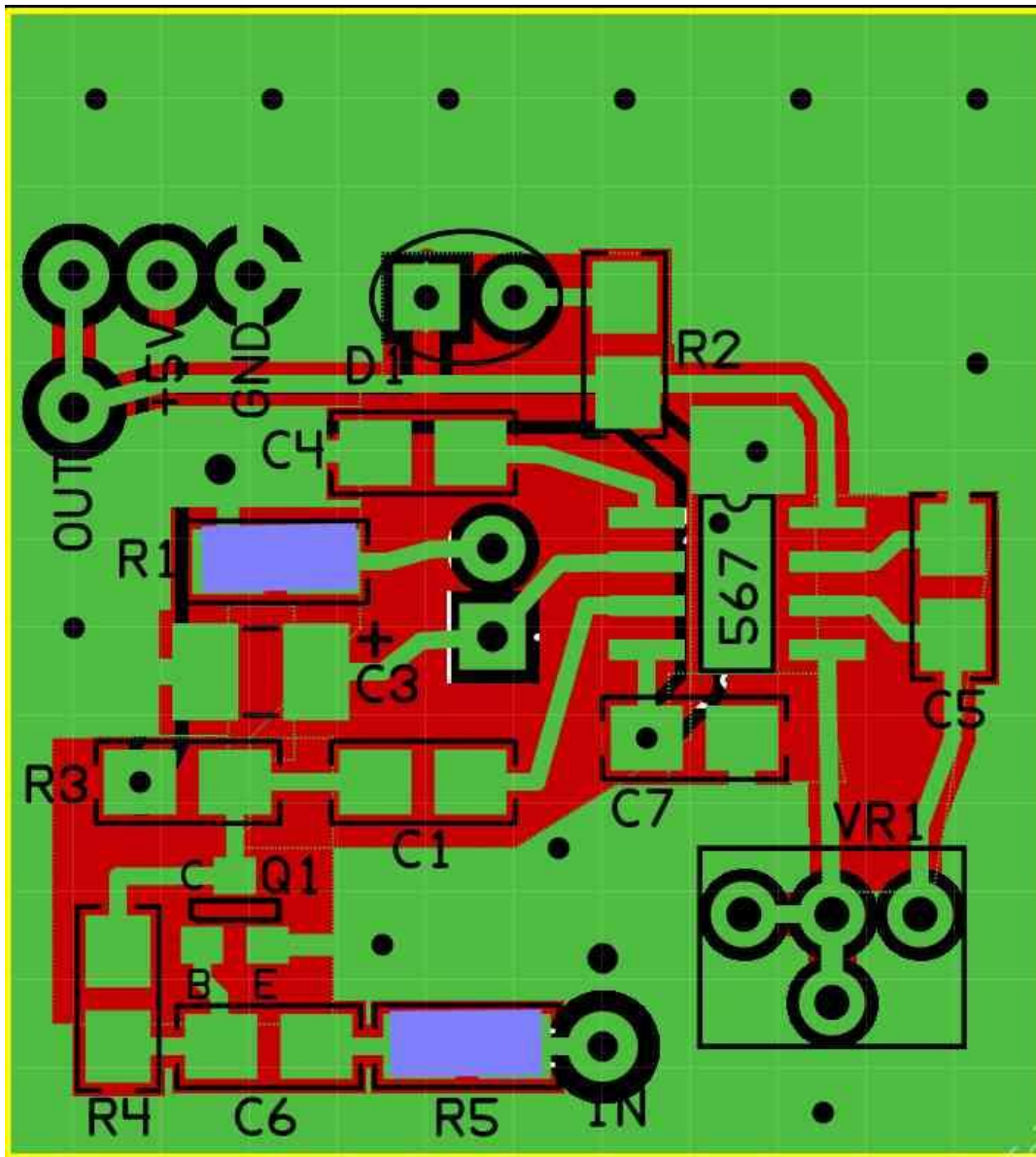




\_\_\_\_\_ Finally, install the 1206 size capacitors C5 and C7 on the top side of the board.

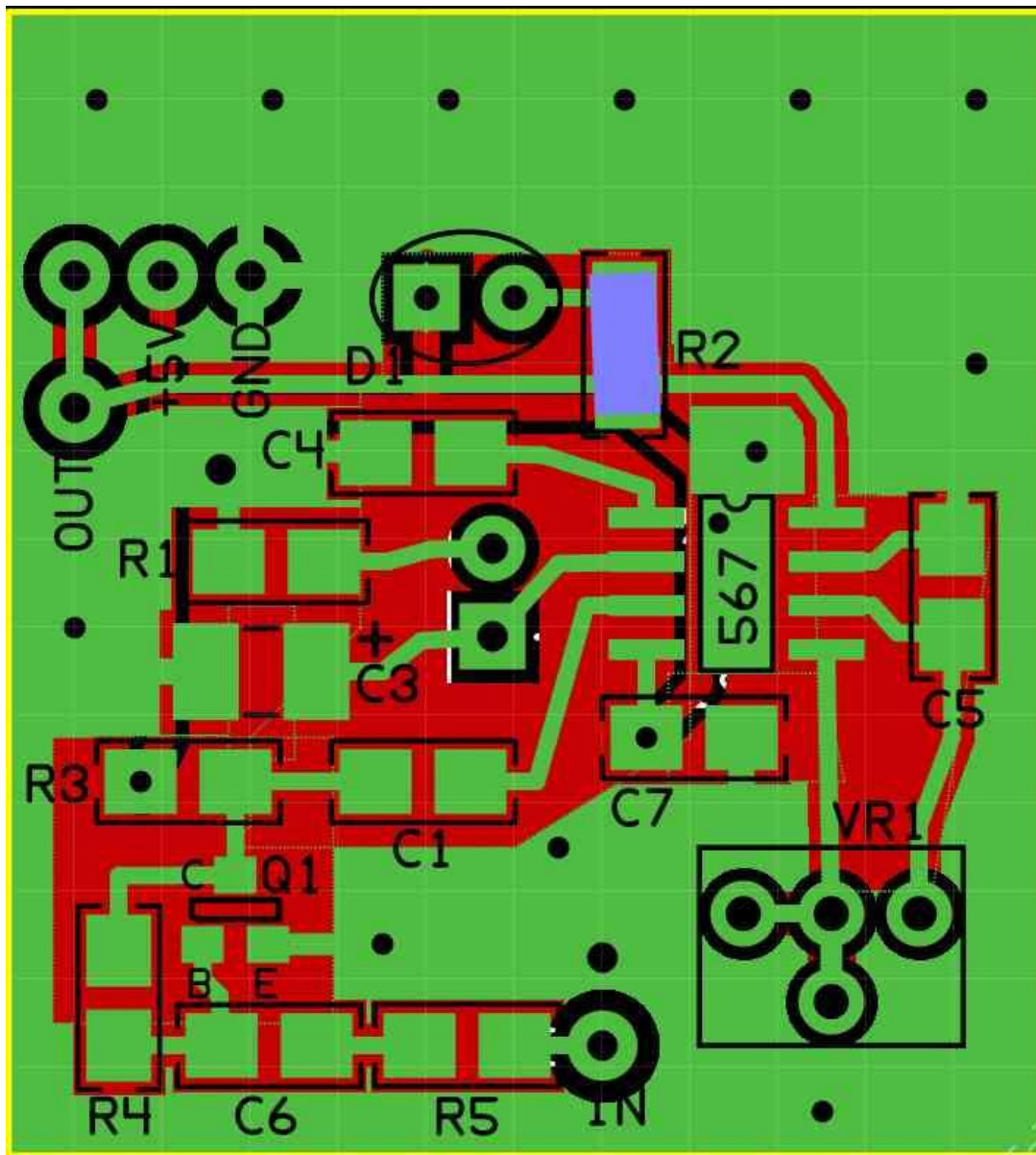


\_\_\_\_ Once the capacitors have been installed, use the same method and install R1 and R5 , the 4.7K 1206 SMD resistors in their respectively marked locations.

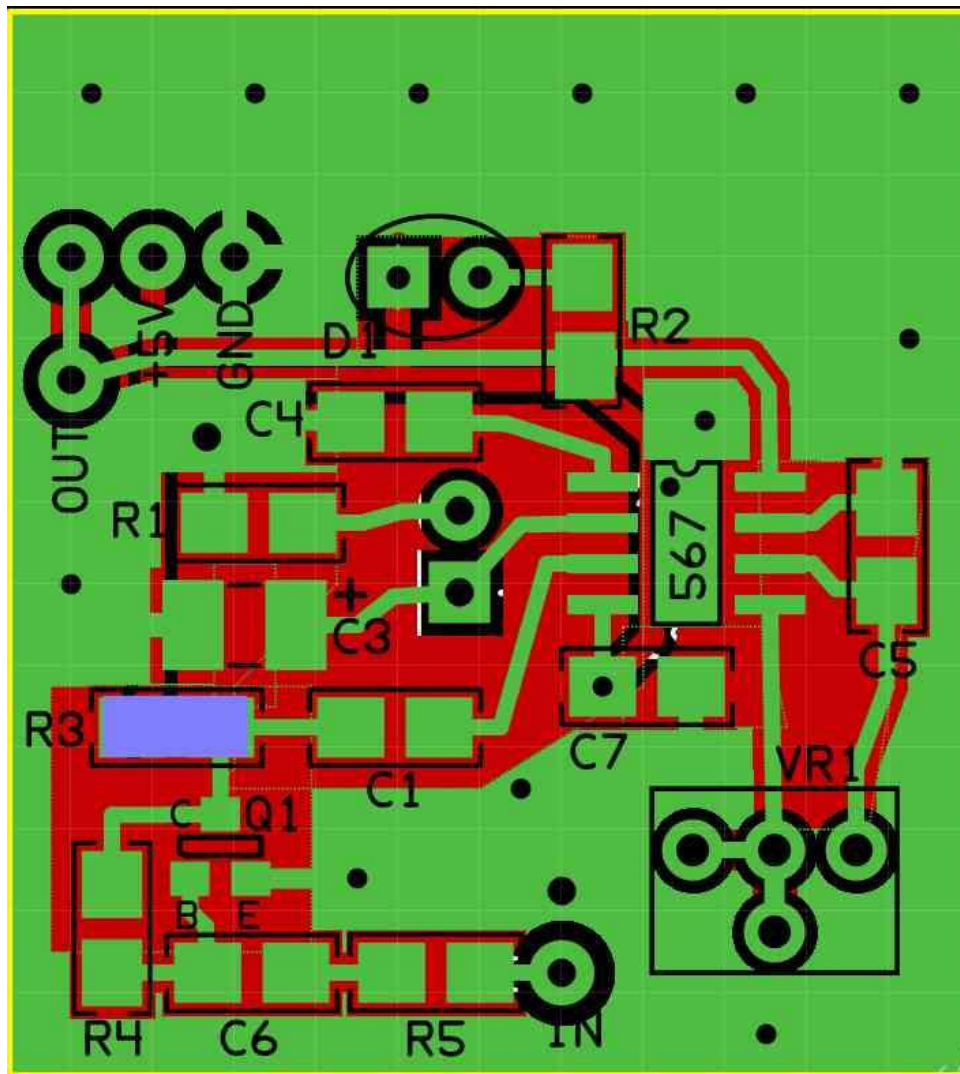




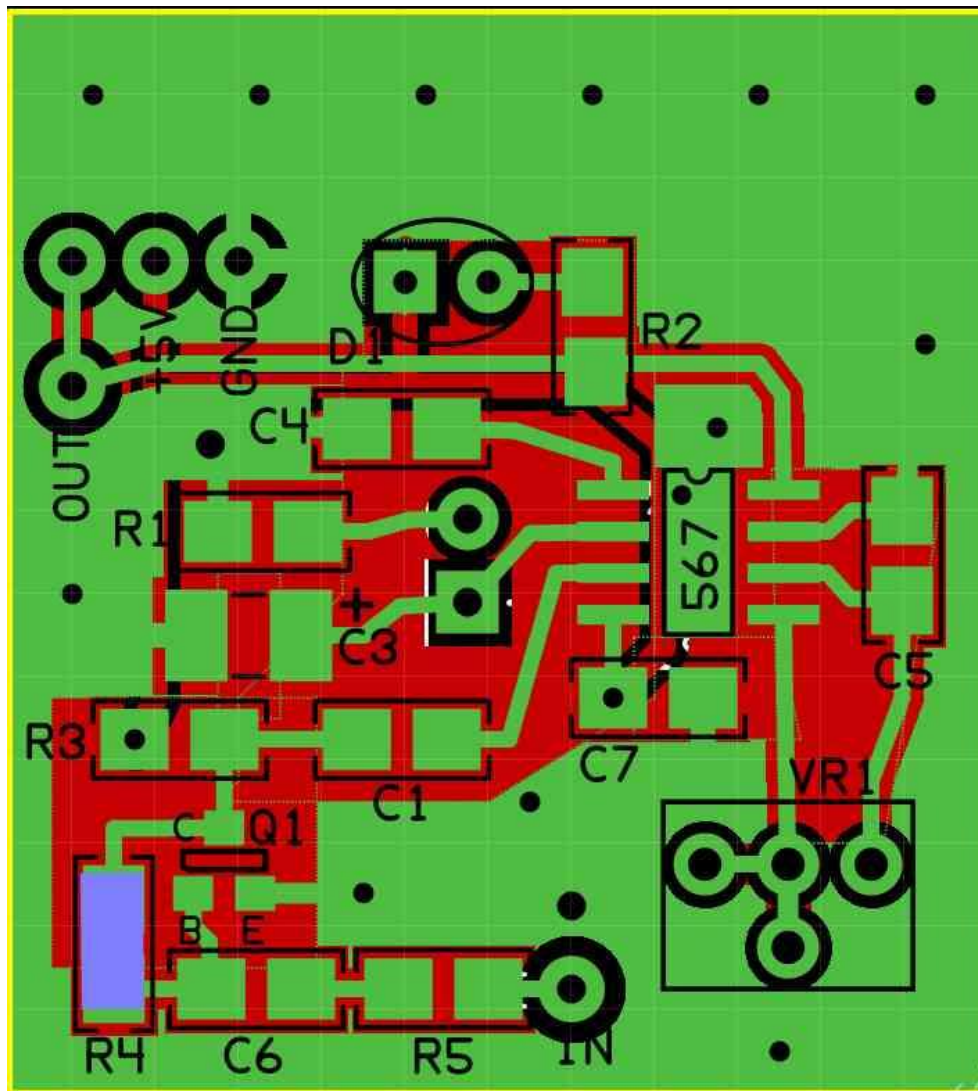
\_\_\_\_\_ Install R2, the 10K 1206 SMD resistor in it's marked position as shown below.



\_\_\_\_\_ Follow with R3, the 2.7K 1206 SMD resistor.

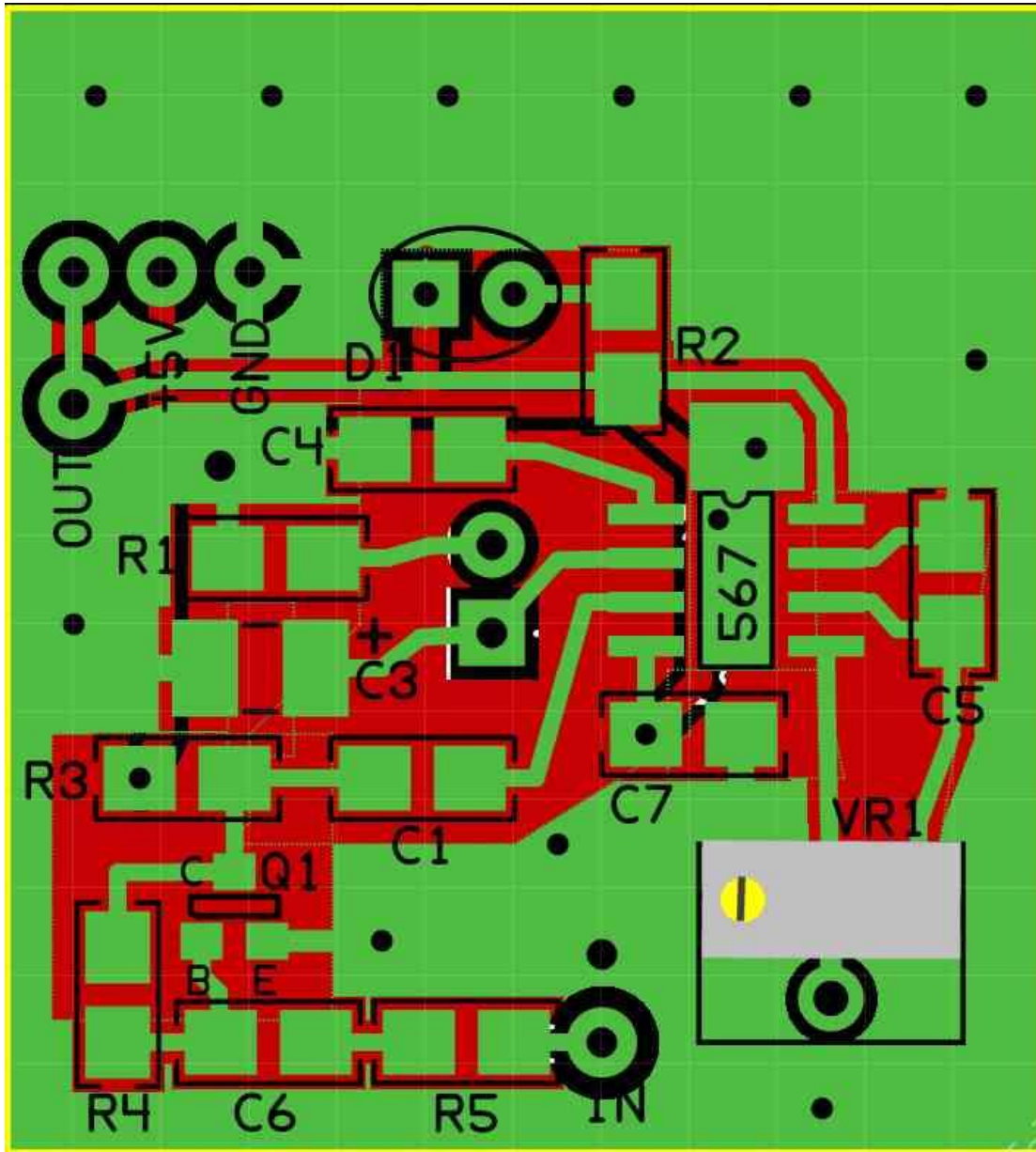


\_\_\_\_\_ The last of the SMD resistors is R4, the 180K 1206 SMD resistor as shown.



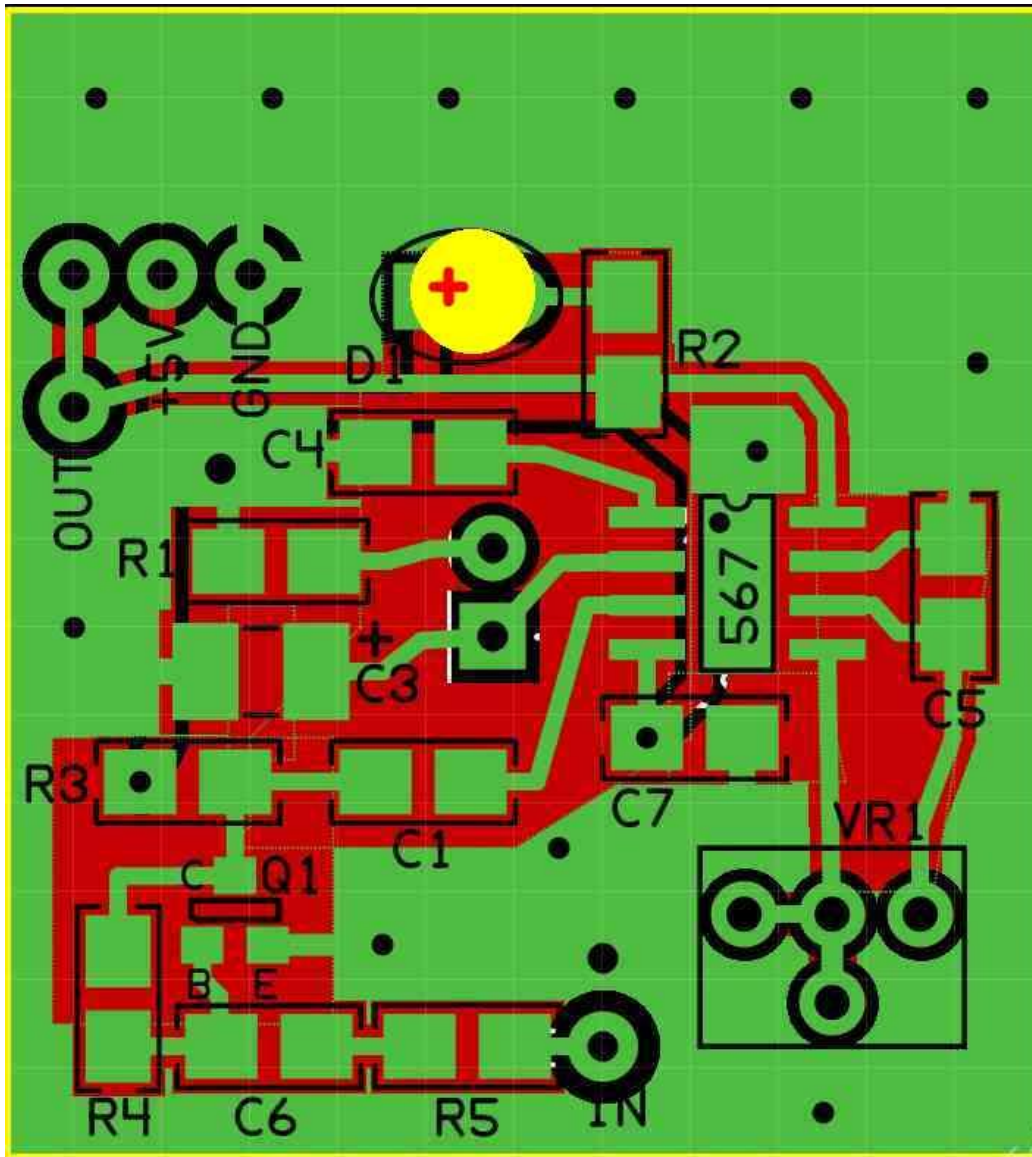
That completes the installation of all the SMD type components. Only a few discrete, through-hole parts remain to be installed before you can begin alignment of the tone decoder.

\_\_\_\_\_ Now, install trimmer resistor VR-1 in its marked location, with the adjustment screw positioned as shown below. Solder and trim the leads on the underside of the PC board.





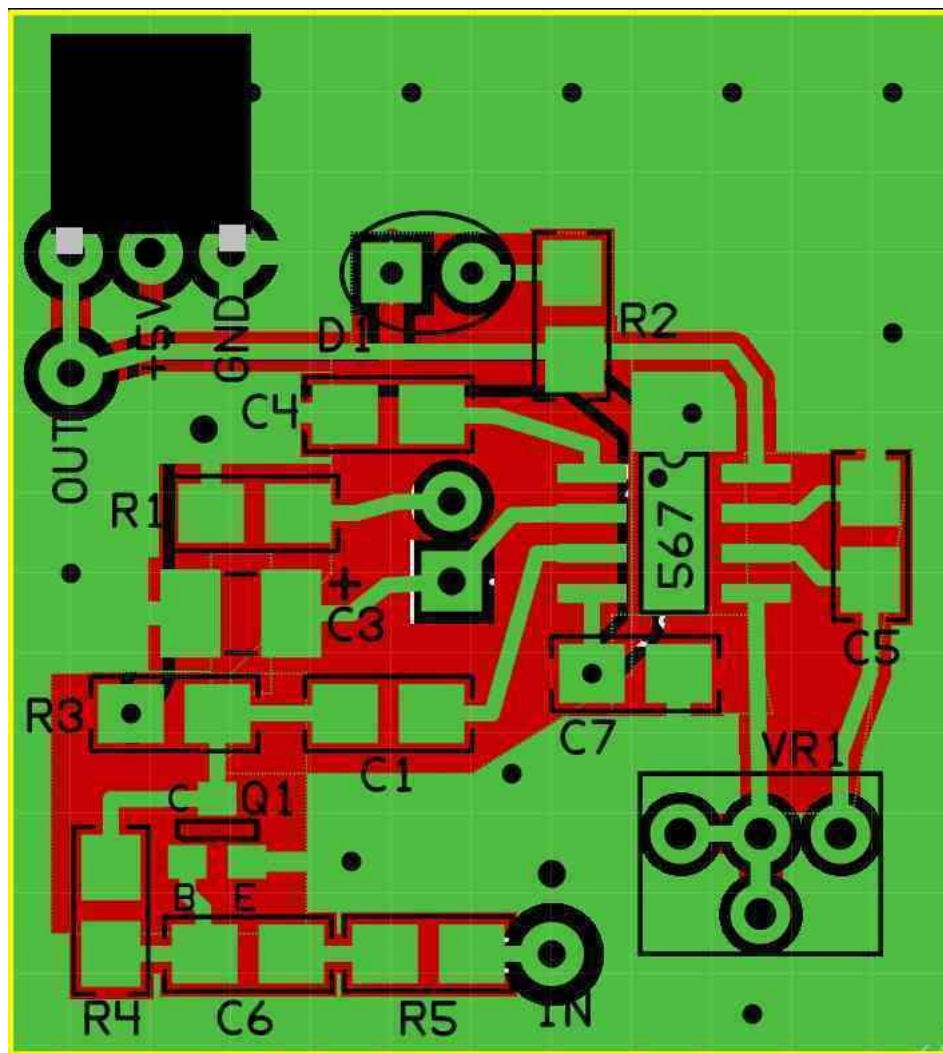
\_\_\_\_\_ Install D1, the LED. Make sure the anode (longer + lead) goes to the square pad.



Solder & trim the LED's leads on the underside of the board as shown on the previous page.

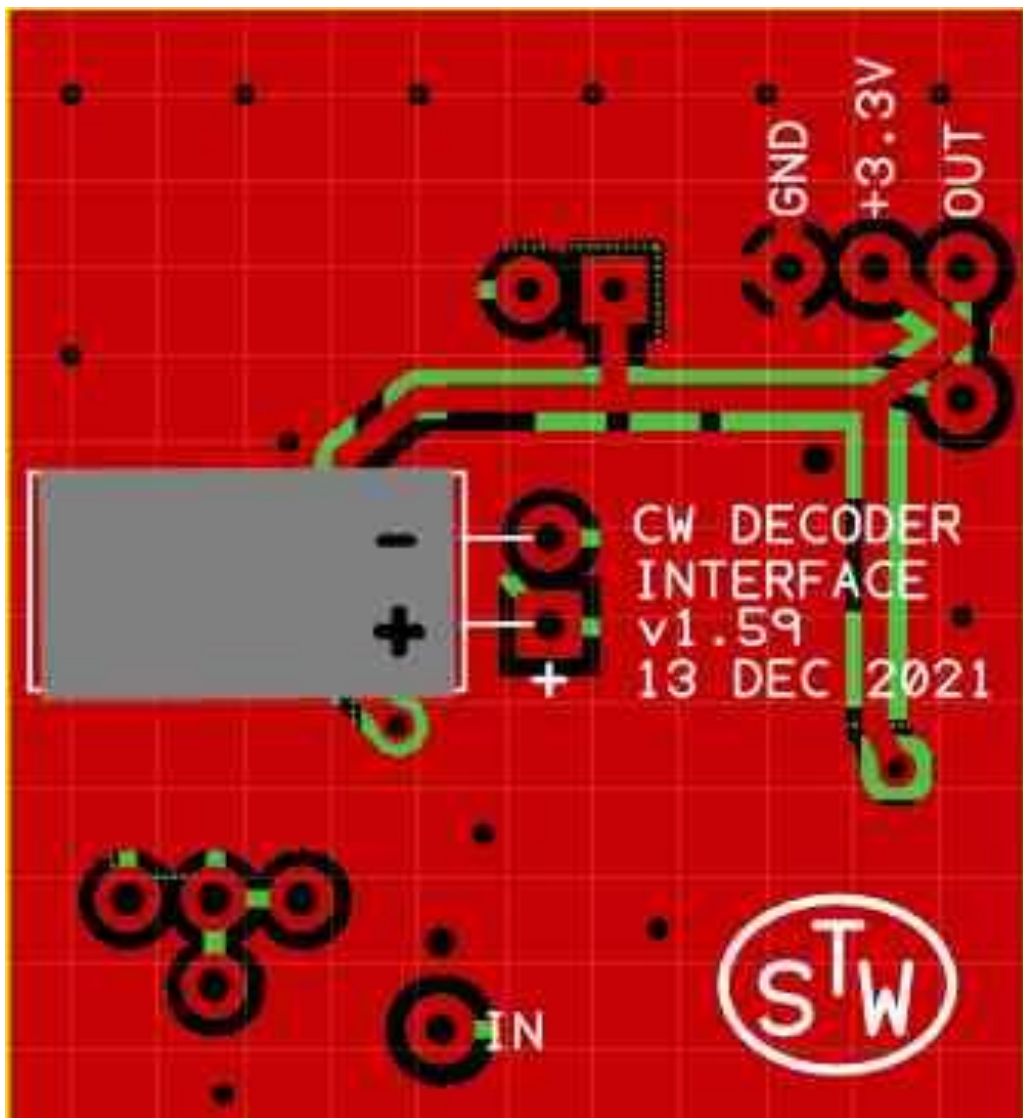


\_\_\_\_\_ Install P1, the 3 pin DuPont female connector(with the center pin removed) on the top side of the board to the 3 pads marked OUT and GND (It can help to use a drop of super glue on the PCB under the connector and carefully press the connector in place before soldering the pins on the underside of the PCB. This will better support the board assembly when plugged into P5 on the uBITX T4.1 Raduino card. There is a second pad marked out just below the “Out” pin of P1. This is available for installing a user supplied, single DuPont male pin as a connection for an oscilloscope to aid alignment.

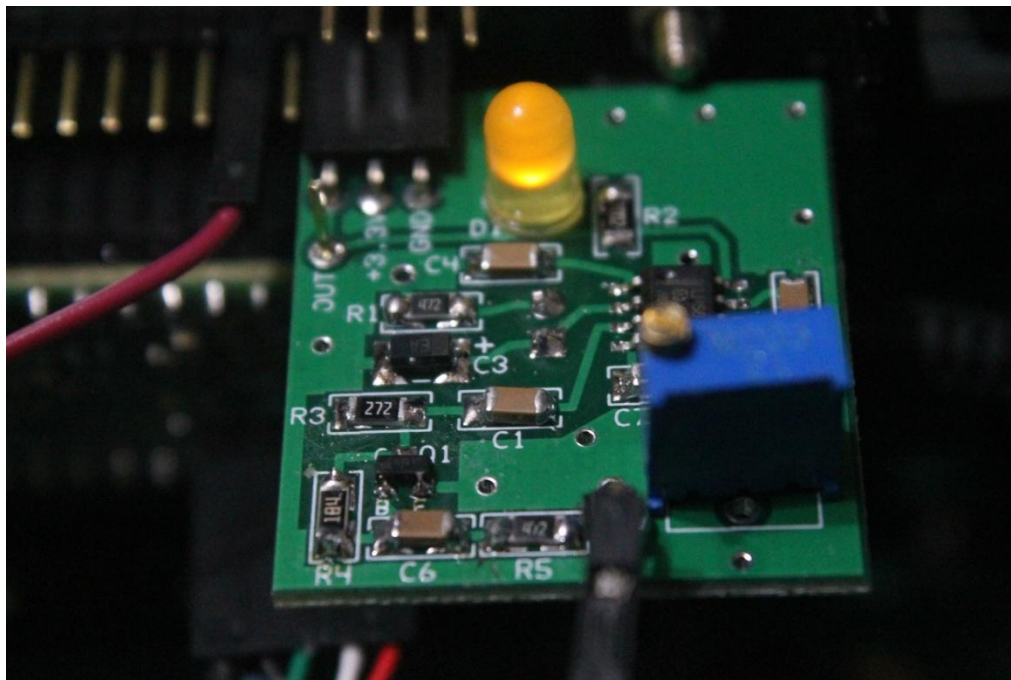


Using a piece of wire soldered (on the bottom side of the board) to the 3.3V hole where the pin was removed from P1, connect the other end to the 5V test point on the Teensy 4.1 Raduino – the 567 does not always run on 3.3V. Use 5V instead.

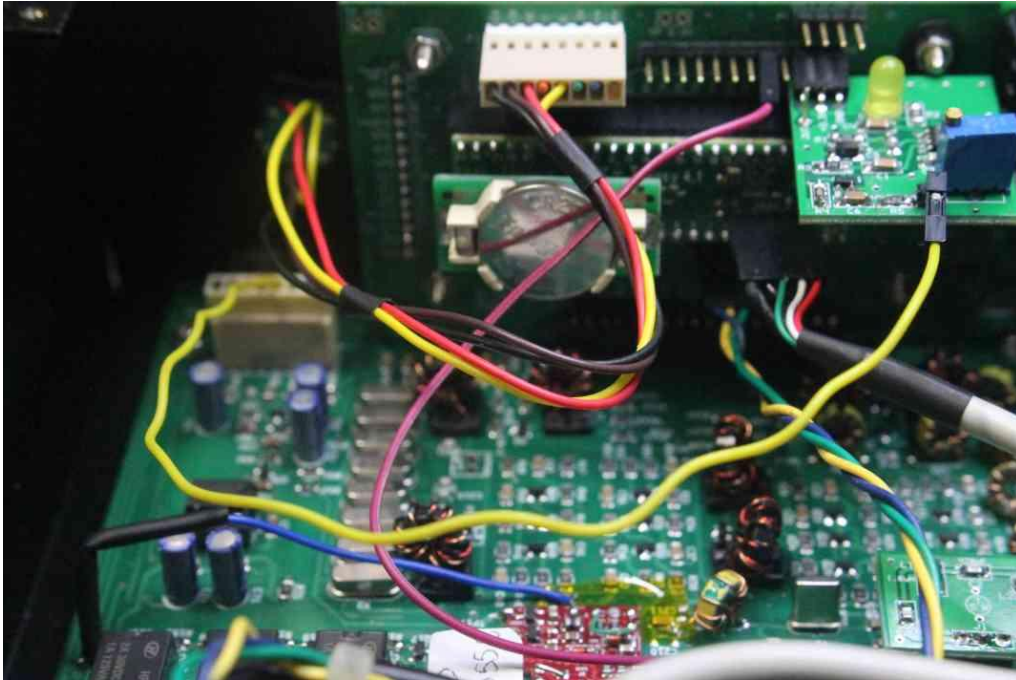
\_\_\_\_\_ Finally, install the 250 uF electrolytic capacitor on the bottom side of the PC board with the + (longer) lead to the square pad marked + on the underside. Before soldering it, bend the capacitor flat toward the the outline silk screened on the underside of the PC board. When you solder the leads on the top side, make sure the capacitor stays in place, folded flat against the underside of the board. Trim the leads once you are satisfied that it's properly in place.



\_\_\_\_\_ The board will plug into P5 on the T4.1 Raduino. As you look at the Raduino from the P5 side, the 3 right most pins will be labeled GND, 3V3 and D23. Out goes to the D23 pin, +3.3V will go to the 3V3 pin (It was originally thought that the Raduino would need to be modified to provide 5V to this pin but it turns out this is not usually necessary, though there may be cases where this is necessary. That will be left up to the user to determine how he/she best wants to modify the Raduino OR the tone detector board to provide this. The input from the board needs to come from the VOL-H pin on the unused audio plug on the uBITX V6 main board. Looking at the front of the radio, that will be the fourth pin from the left usually the yellow wire. None of the other wires on that plug will be used. If you have the tools, you can crimp a 1 pin DuPont female connector on the end of that wire, install a 1 pin right angle DuPont male pin in the pad marked IN on the PCB. Solder that pin on the underside of the board after you are satisfied it's mounted the way you like it. That completes the construction of the board.



TSW Tone Decoder Board plugged in, aligned and receiving a tone.



The yellow wire from the Audio plug on the right (4<sup>th</sup> pin from the right) is connected to the IN port on the decoder. It can be soldered or hooked to a DuPont pin (user supplied).

Not visible in the picture is MT1 which is a 3D printed plastic support for the underside of the tone decoder board when mounted on the TSW Teensy 4.1 Raduino card. It is provided with the kit and mounts under the display standoff mounting screw (or the nut, depending on which standoff was supplied with the Raduino kit originally. Either method will work. This helps support the mounted Tone Decoder and helps keep it from drooping while aligning and during moderately rough handling of the uBITX V6 once the case lid has been closed.

**Alignment:**

\_\_\_\_\_ Alignment is fairly simple. Plug the board into P5 as described above, connect Vol-H (fourth pin from the right on the V6 audio plug) to the IN pad and power up the radio.

The LED should blink briefly if all is constructed and connected properly.

\_\_\_\_\_ Using the SET menu in the T4.1 Raduino firmware, set your sidetone frequency to the tone you like to use when listening to CW signals or sending CW yourself.

\_\_\_\_\_ Set the MODE to CWP (CW Practice) to keep from transmitting an on-the-air signal while doing the alignment.

\_\_\_\_\_ Connect a hand-key to the hand-key jack on the radio and if the key has a shorting switch, short the key closed or set something on it to hold it closed and produce a continuous sidetone. An alternate method would be to go into the "SET" menu, and touch the sidetone frequency to turn it on for setting it. This tone can then be used for alignment if a hand key is not available. Be careful not to change the tone frequency indicated in the SET menu during/after the alignment.

\_\_\_\_\_ Adjust VR-1 on the Tone Decoder board until the LED lights steadily while the key is depressed and goes out when the key is released (no tone being produced). If you have difficulty achieving a steady "ON" state for the LED, you may have to increase the sidetone volume (there is a pot on the backside of the Teensy 4.1 Raduino card that controls this).

There is a second pad (just under the "out" pin for the 3 pin connector P1) that can be used to connect an oscilloscope if desired to watch the output waveform.

Adjust VR-1 in both directions after you find the steady point until it starts flickering or goes out. Set it back to the center of the point where the LED remains on during Key-Down and off when Key-Up.

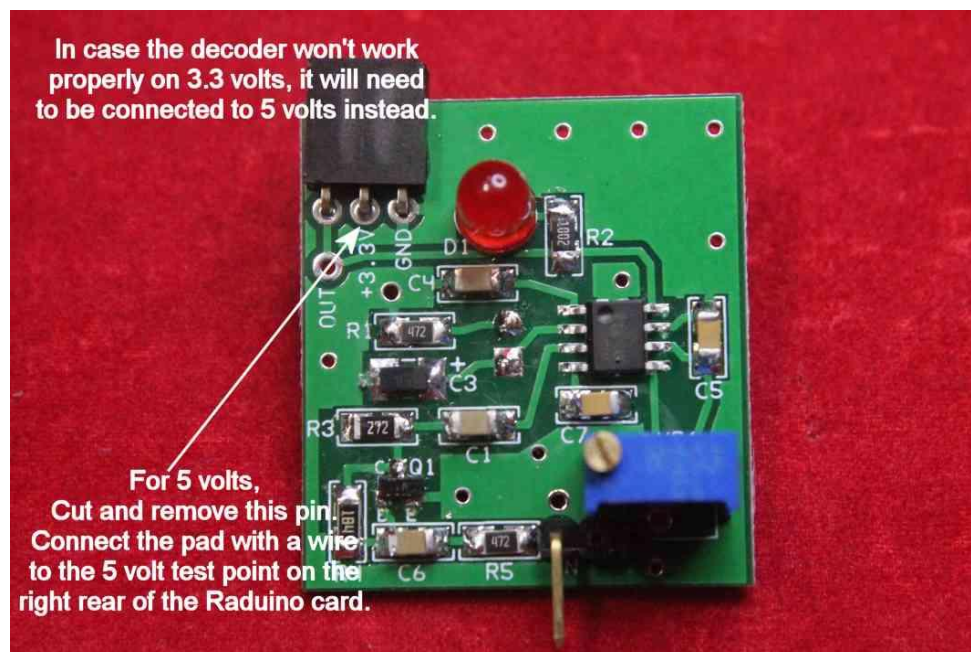
If using an oscilloscope connected to the "out" test point, before alignment the scope input should be set for DC coupling, 1V/division, the sweep set to around



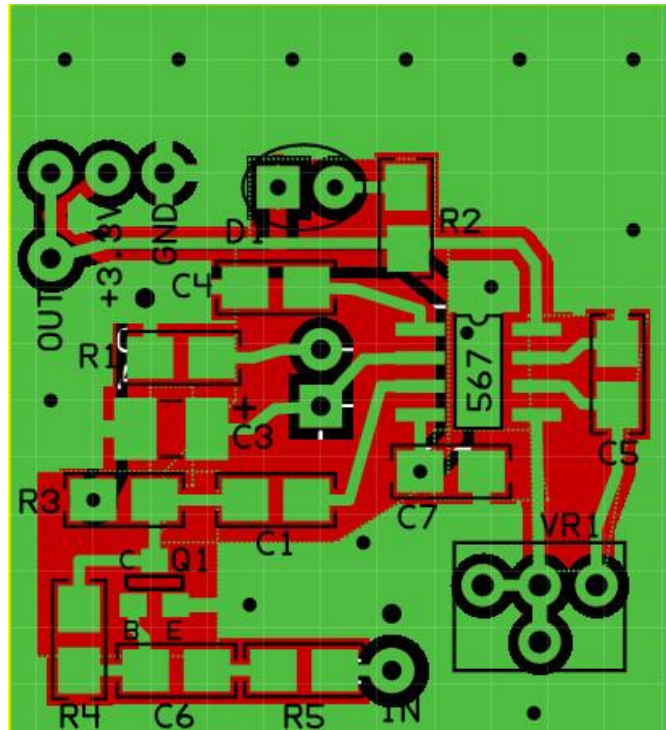
100-200 mSec/division and a X10 probe should be used. Still with a steady tone input, Adjust VR1 until the Oscilloscope traces goes from the “High” level (around 3-3.4 volts DC which it should be if construction is correct) to a steady “Low” level (not oscillating between low & high) and stays there when the tone is applied. It should immediately go back to the “high” level when the tone is removed. Set the trim pot to the center of the range that produces a clean “low” level with steady tone input. That completes the alignment and your decoder is ready to use.

NOTE: If you use the oscilloscope method for alignment, you can use the sidetone frequency set function in the SET menu. Simply turn the tone on and use it to align the decoder board. Be careful not to bump the tuning knob so you don’t accidentally change the frequency of the tone while you are adjusting VR-1 on the decoder.

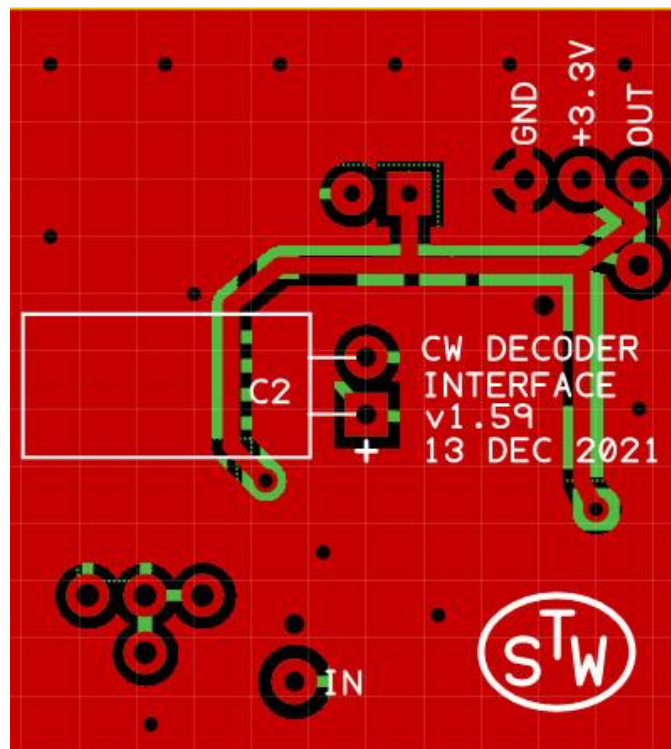
Since the decoder was originally designed, we have found that some of the LM567 decoder chips will not meet spec and will not align properly using the 3.3 volt supply of the Teensy 4.1. The solution is to connect the 3.3 volt input of the Decoder to 5 volts as indicated in the following picture.



## PC Board Layout:

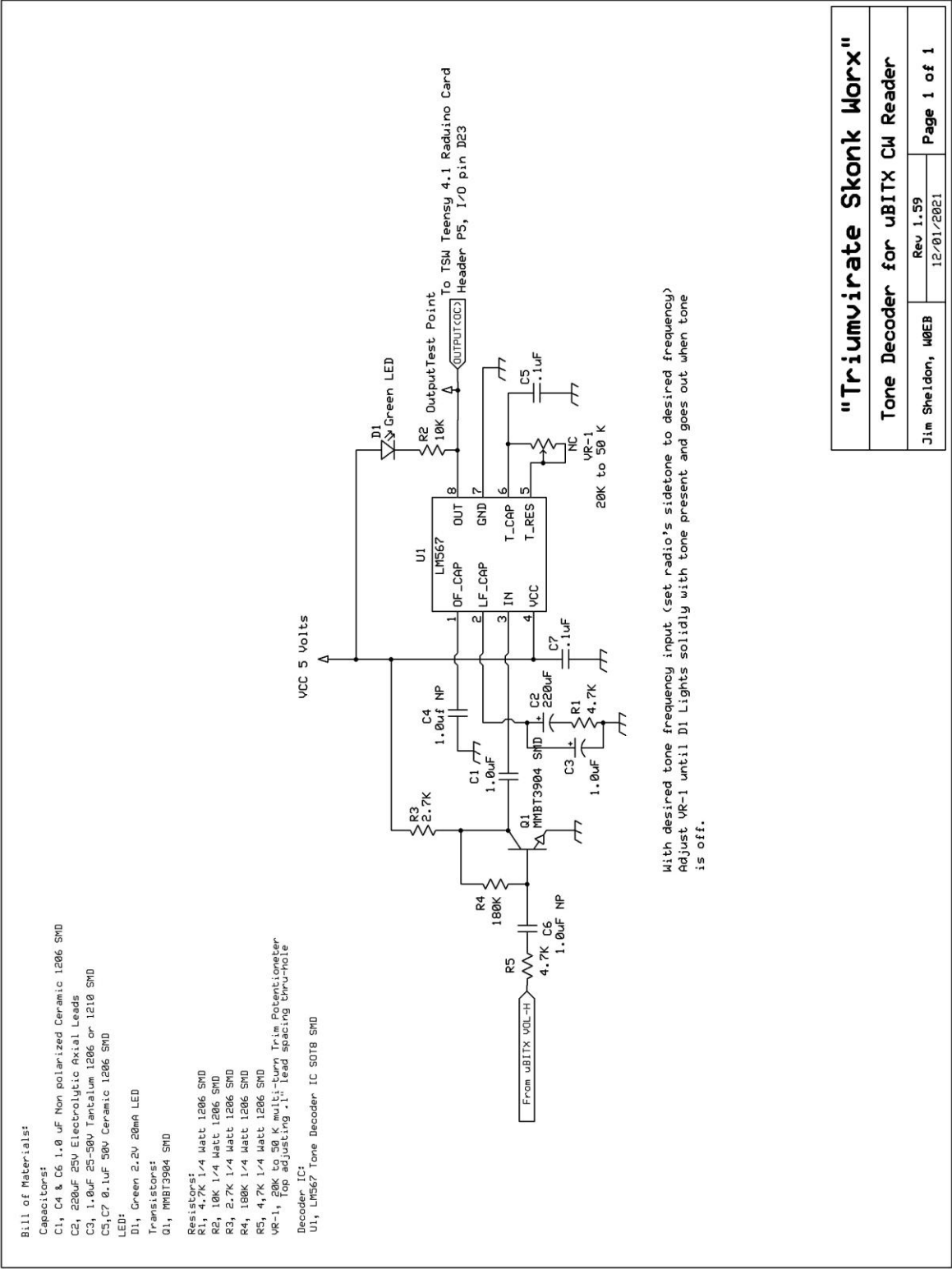


Top View



Bottom View

Schematic:



## TSW Tone Decoder Parts List:

C1, C4, C6	1.0uF 50V Non Polarized 1206 SMD	Mouser 399-8148-1-ND
C2,	220uF 6.3V Electrolytic	Mouser 232-25XYJ220M6.3X11
C3,	1.0uF 50V Tantalum 1210 SMD	Mouser 581-TPSB105K050R3000
C5,C7	0.1uF 50V 1206 SMD	Mouser 80-C1206C104KAREAUTO
D1,	Green LED (or any 3V LED)	User supplied
Q1,	MMBT3904 SMD Transistor	Mouser 726-MMBT3904LT1HTSA1
R1,	4.7K 1/4 watt 1206 SMD	Mouser 279-CRGCQ1206J4K7
R2,	10k 1/4 watt 1206 SMD	Mouser 279-CRGCQ1206J10K
R3,	2.7K 1/4 watt 1206 SMD	Mouser 603-RC1206JR-072K7L
R4,	180K 1/4 watt 1206 SMD	Mouser 652-CR1206JW-184ELF
R5,	4.7K 1/4 watt 1206 SMD	Mouser 279-CRGCQ1206J4K7
U1,	LM567 SOIC8 SMD Decoder IC	Chipmall.com HGSEMI LM567M/TR
VR-1,	20K 25 turn Trim Pot	Tayda Electronics SKU A-592
Misc:		
PCB,	TSW/W0EB	
P1,	3 pin, 1 row Right Angle DuPont Female Center pin removed deliberately (See instructions.)	Tayda Electronics SKU A-1028
MT1	Metal "L" bracket, slightly bent for mounting support. Mounts to the rightmost display mounting screw.	TSW – <a href="mailto:w0eb@cox.net">w0eb@cox.net</a>

## Manual Credits:

Manual Author, Jim Sheldon, W0EB.

Circuit design optimized for the TSW Teensy 4.1 Raduino by W0EB.

PC Board Layout & procurement, Jim Giammanco, N5IB

The TSW Team.

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