*Progress Direct Systems LLC*

# Volt Tattler 2

# *Owner's Manual*

**Version 2.0 Revision 7**

## Disclaimer

Volt Tattler 2 is a device intended to enhance DC power systems that have already been properly designed. Progress Direct Systems LLC, its employees and its representatives are not responsible for any damage to any system or systems either directly or indirectly caused by any Volt Tattler device.

## Introduction

Radio Amateurs, audio enthusiasts, alarm technicians and others commonly use some sort of D.C. voltage supply to power equipment. Often they will connect an expensive piece of electronic equipment to a much less expensive DC power supply. Field and temporary setups are particularly prone to questionable power connections, draining batteries and power supply failures. When power supplies fail the voltage can go up or down depending on the failure mode of the power supply. Equipment can be damaged by high and even by low voltage operation.

> "But my power supply has meters? If the voltage goes high or low I can simply switch off the power supply to avoid damaging my equipment."

During operations, especially contests, concerts, professional photo sessions etc., we are busy doing what needs to be done. Even if you have a meter, how often do you look at your power supply voltage? I believe that a failure is most often noticed because equipment has stopped working or the smell of burning electronics signals that the magic smoke has escaped. If you are not looking at your meter when the problem occurs your equipment can malfunction and even be badly damaged.

VoltTattler monitors your system DC voltage approximately 20 times each second. If your voltage should, for example, rise above a high voltage threshold, VoltTattler will audibly announce the transgression sounding out Morse "H" (. . . .) repeatedly until the condition is fixed. It also will sound a Morse "L" (. - . .) if the voltage should drift low.

 

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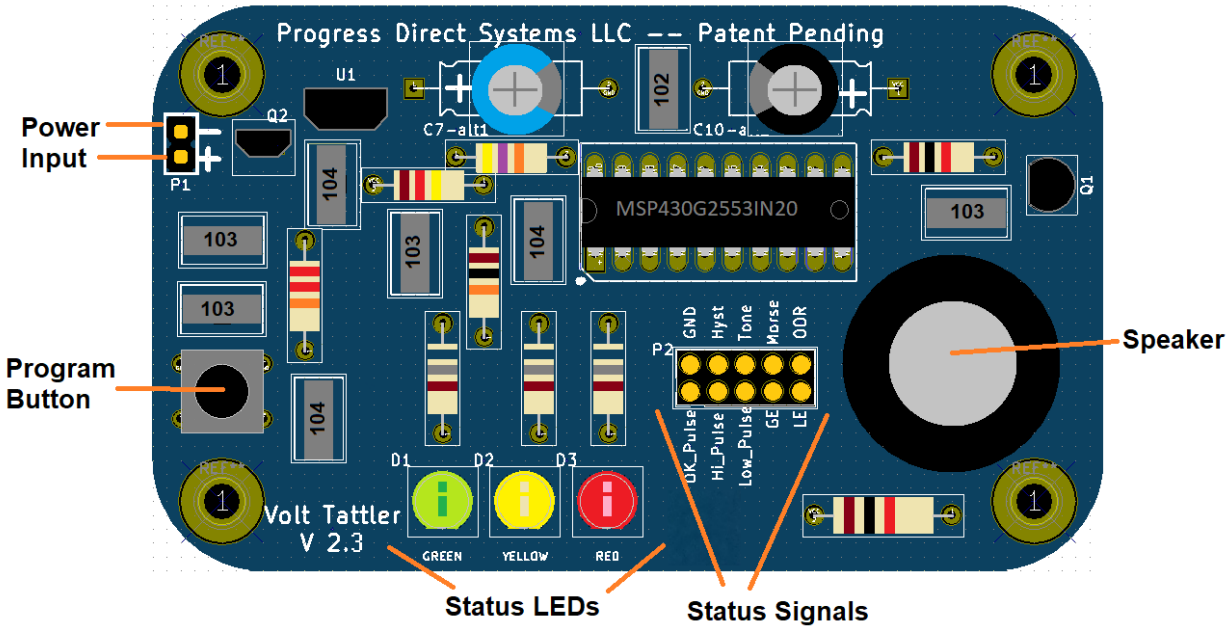
## Volt Tattler 2 Board Details

The Volt Tattler 2 board is depicted below.



## Power Input

Although Volt Tattler 2 is protected against reverse polarity connection, it is not impossible to destroy the unit. Note that the minus connection is nearest the corner of the board.

## Status Lights

If Volt Tattler is connected and watching its supply voltage it will first announce that it is running with an audible Roger signal (Morse 'R' .-.). Then immediately the Green L.E.D. will flash periodically to indicate that it is taking readings and watching them. In normal operation (voltage is not too high or too low) the Volt Tattler operates silently. The Green L.E.D. indicates that it is operating.

The yellow LED applies if Volt Tattler 2 detects that its supply voltage drops to or below the low threshold. A Morse L (.-..) will be heard until the voltage returns to normal. Once a low voltage transgression has occurred, the yellow LED will continue to flash even if the voltage returns back above the low threshold. This indicates a low voltage condition has been detected since power on or the last board reset.

The red LED applies if Volt Tattler 2 detects that its supply voltage rises to or above the high threshold. The Volt Tattler will sound a Morse H (....) while the condition exists. The red LED will continue to flash even if the voltage returns below the high threshold. This indicates a high voltage condition has been detected since power on or the last board reset.

## Program Button

In normal (silent) operation, a quick press and release of this button will cause the Volt Tattler 2 to reset. This clears any indications of previous high or low voltage transgressions (yellow and red LEDs).

A longer press on this button (> 3 seconds) provides the capability of programming the Volt Tattler 2 thresholds within its operational range. Instructions for using the Programming Button to set the thresholds are included in this manual.

## Logic Output Signals

A 10-pin header can be installed here to provide a variety of signals that may be useful for downstream equipment. The signals are described in detail later in this manual.

## Piezoelectric Speaker

This provides the sounds that indicate the status of the Volt Tattler. It announces the startup roger “R”, voltage transgressions and programming states.

## Building

I strongly recommend using a good quality soldering iron and only electronic solder for constructing this project. The soldering iron should be at least 50 Watts and should provide enough heat so that the solder melts quickly. If you have not built a project before I would urge you to watch one of the many YouTube videos on soldering and kit building. Seek help of an experienced solderer if available. Practice if possible.

Recommended tools for building the Volt Tattler 2 should include

- the above mentioned soldering iron
- electronic solder (such as 60/40 or 63/37). If you are new to soldering I suggest staying away from the Lead Free (Pb Free) solders. They can be a bit tricky to solder with
- an inexpensive set of jewelers screw drivers and a small flat blade screwdriver
- a hand magnifier or better a lighted magnifier
- a multimeter that can measure voltages in the range of 3 volts to 30 volts DC and ohms in the range from 500 ohms to 500k ohms
- a solid work surface well lighted
- comfortable seating
- a printout of the parts list so that you can check off what has already been installed
- desoldering braid (like Solder Wick) and a suction desoldering tool

## Parts List

| Check | Quantity | Value | Description | Designators |
|---|---|---|---|---|
| | 3 | 680 ohm | RESISTOR 1/4W Blu-Gry-Brn-Gld | R3, R8, R9 |
| | 1 | 1K ohm | RESISTOR 1/4W Brn-Blk-Red-Gld | R4 |
| | 1 | 1K ohm | RESISTOR 1K 1W Brn-Blk-Red-Gld | R5 |
| | 1 | 10k ohm | RESISTOR 1/4W Brn-Blk-Org-Gld | R2 |
| | 1 | 22K ohm | RESISTOR 1/4W Red-Red-Org-Gld | R6 |
| | 1 | 47K ohm | RESISTOR 1/4W Yel-Pur-Org-Gld | R7 |
| | 1 | 120k ohm | RESISTOR 1/4W Brn-Red-Yel-Gld | R1 |
| | 1 | 0.001uF | BOX FILM CAPACITOR marked 102 | C4 |
| | 4 | 0.01uf | BOX FILM CAPACITOR marked 103 | C5, C2, C6, C3 |
| | 3 | 0.1uf | BOX FILM CAPACITOR marked 104 | C1, C8, C9 |
| | 1 | 1uF | ELECTROLYTIC CAPACITOR marked 1uF** | C10 |
| | 1 | 10uF | ELECTROLYTIC CAPACITOR marked 10uF** | C7 |
| | 1 | 2N3904 | TRANSISTOR TO92, Labeled 2N3904 | Q1 |
| | 1 | ZVP4424A | MOSFET TO92, Labeled ZVP4424* | Q2 |
| | 1 | LP2950-N | REGULATOR TO92 3.3V Labeled KY5033 | U1 |
| | 1 | Microcontroller | IC 20 Pin programmed for VT2* | U2 |
| | 1 | 20 Pin Socket | DIP SOCKET 20-pin | N/A |
| | 1 | Green LED | LED 5mm Green | D1 |
| | 1 | Yellow LED | LED 5mm Yellow | D2 |
| | 1 | Red Led | LED 5mm Red | D3 |
| | 1 | Button | N.O. PCB Mount Pushbutton | PB1 |
| | 1 | Dual Header | HEADER 2 X 5 pin | P2 |
| | 1 | Single Header | HEADER 1 X 2 pin | P1 |
| | 1 | Sounder | Piezo Sounder | SP1 |
| | 1 | Wire | HOOKUP WIRE, 12” each of 2 colors | Wire |
| | 1 | V2.3 | Circuit Board | PCB V2.3 |

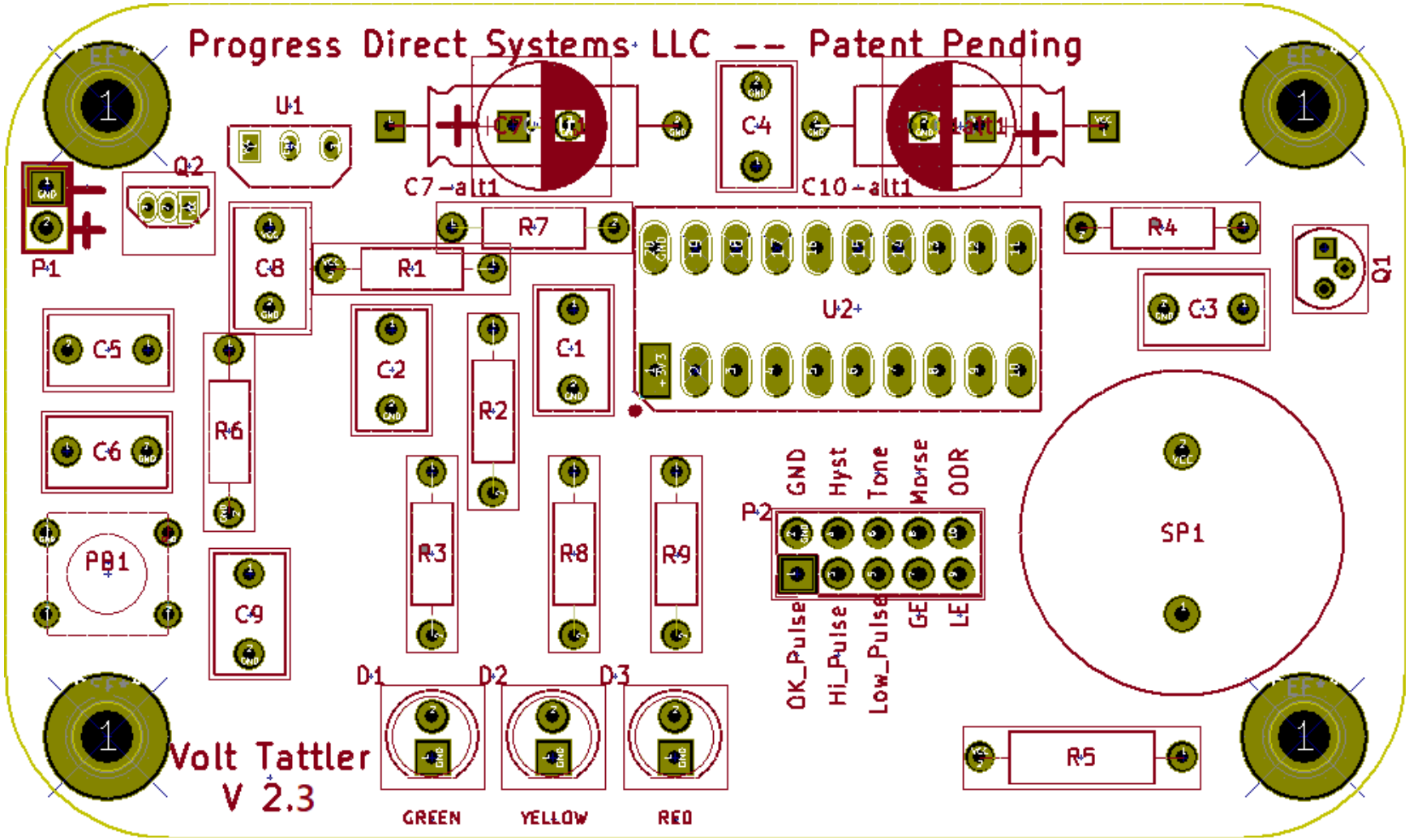
*Static sensitive components

**Radial lead electrolytic capacitors may be used to lower the board profile.

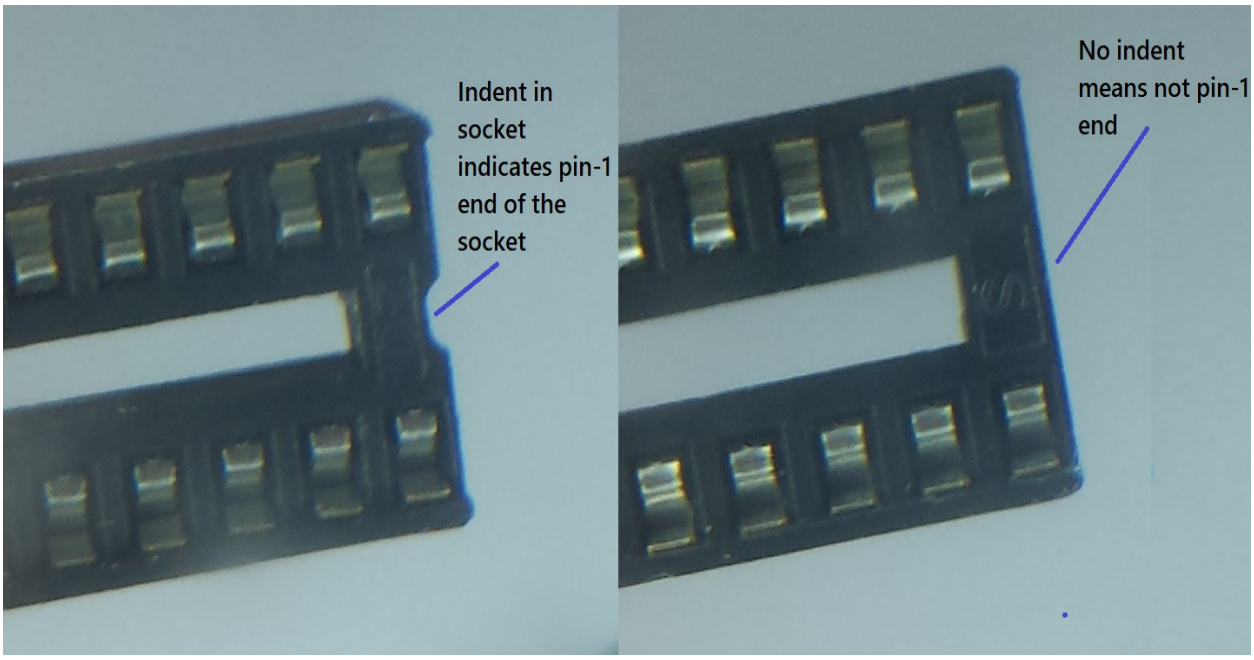
Use provided tables in Appendix B to help identify resistors. It is strongly recommended that you obtain an inexpensive DVM and measure each resistor before placing it into the board.

## Parts Placement






## Construction Phase 1

1. SAVE THE SPEAKER INSTALL FOR NEXT TO NEAR THE END (just before the microcontroller). It is tall and can make other part installations difficult.

2. If you are using the provided 20-pin socket for the microcontroller install it now. A socket will usually have a pin-1 end. That is an end where pin-1 of the chip will be oriented. Sometimes the Pin-1 end of a socket is not very obvious. If you plan to solder the microcontroller directly to the board you can skip to step 8.

3. Check the alignment of the socket over the holes for U2 to see that all of the pins are in place. Most likely many of the pins will not align with their holes. I use a small jeweler's screwdriver to coax each pin into its hole. Frequently one pin will hold the socket away from the board. Using the screwdriver, find each pin that is holding the socket up. Put each lead into its hole until the socket falls onto the board with no pressure. Don't push the socket into the holes. Eventually all of the pins will be aligned and the socket will drop onto the board and bottom out. At this point check that each hole has a pin poking through on the back side of the board. Once a socket is properly seated into its holes, a small piece of cellophane tape can help secure the socket for soldering.

4. Solder one corner pin of the socket to its pad. If there are pins out of place or the socket has moved up on one end while soldering briefly heat the one soldered pin while guiding the socket back onto the board. Use the jewelers screwdriver if necessary to work the pins back i9nto their

holes. Once the pin is soldered and the socket is seated remove the heat immediately. Allow the joint to cool.

5. Once all of the pins have been placed in their proper holes solder the diagonal pin from the corner pin that you just soldered.

6. Finally carefully solder the remaining pins avoiding solder bridges between the pins and adjacent traces.

7. Remove the cellophane tape and inspect the work just completed. Give the board a final once over looking for potential problems, solder shorts, unsoldered or badly soldered connections etc. Solder joints should look smooth and shiny. Joints that appear dull or where the pin does no look whetted with solder should be re-flowed with the hot iron and perhaps a touch more solder.

8. Next install resistors. All resistors are installed on the board laying down with their leads pushed through the end holes and soldered on the back side of the board. R5, the 1K 1W resistor, may be larger than the other resistors. See the Parts Placement diagram.

9. Install the capacitors. Be sure to properly orient the 2 electrolytic capacitors according to their polarity. Radial lead electrolytic capacitors (both leads at the same end of the capacitor) must be installed vertically. The negative leads on the electrolytic capacitors should be mounted facing one another. The 102(0.001uf), 103 (0.01uf) and 104 (0.1uf) capacitors may look very similar. Be sure not to interchange them.

10. Install Q1 the 2N3904, the LEDs and the push button (SW1). Be careful to install the transistor in the proper orientation and the LEDs in the proper direction. Sometimes the transistor pins will need to be reformed to fit properly. The case of the transistor will be shaped to indicate the part orientation. Note that the LEDs in kit may be round (no flat spot). The short lead is cathode (flat spot on silkscreen). The short lead should be oriented near the edge of the board. The longer lead must be nearer the microcontroller socket. **Be sure to install the correct color LEDs in the correct positions.** See the picture regarding LED installation below. **Orientation is very important here. Improperly orienting the 2N3904 transistor can result in its destruction.**

11. Install U1 the LM2950. It may be labeled KY5033. **Orientation is very important here. Improperly orienting the LM2950 integrated circuit can result in its destruction.**

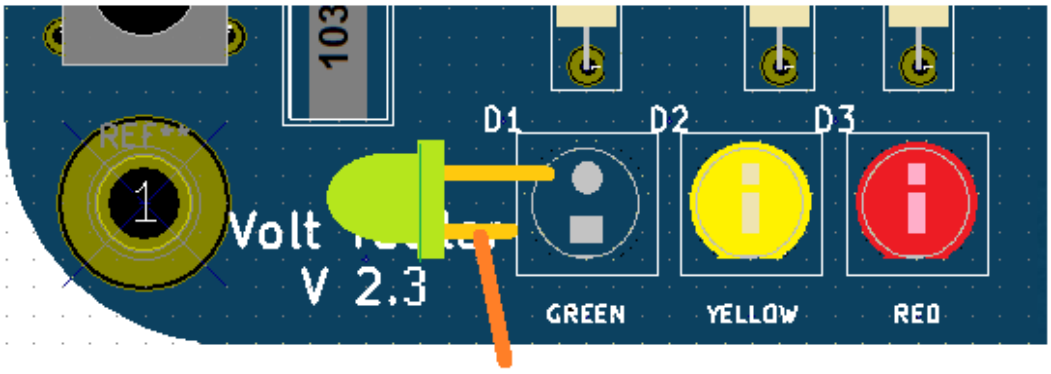
12. Install Q2 the ZVP4424A. **Orientation is very important here. Improperly orienting the ZVP4424A transistor can result in its destruction or reverse polarity protection failure.**

13. Install your included 2 screw terminal power connector and the 10-pin signal connector.

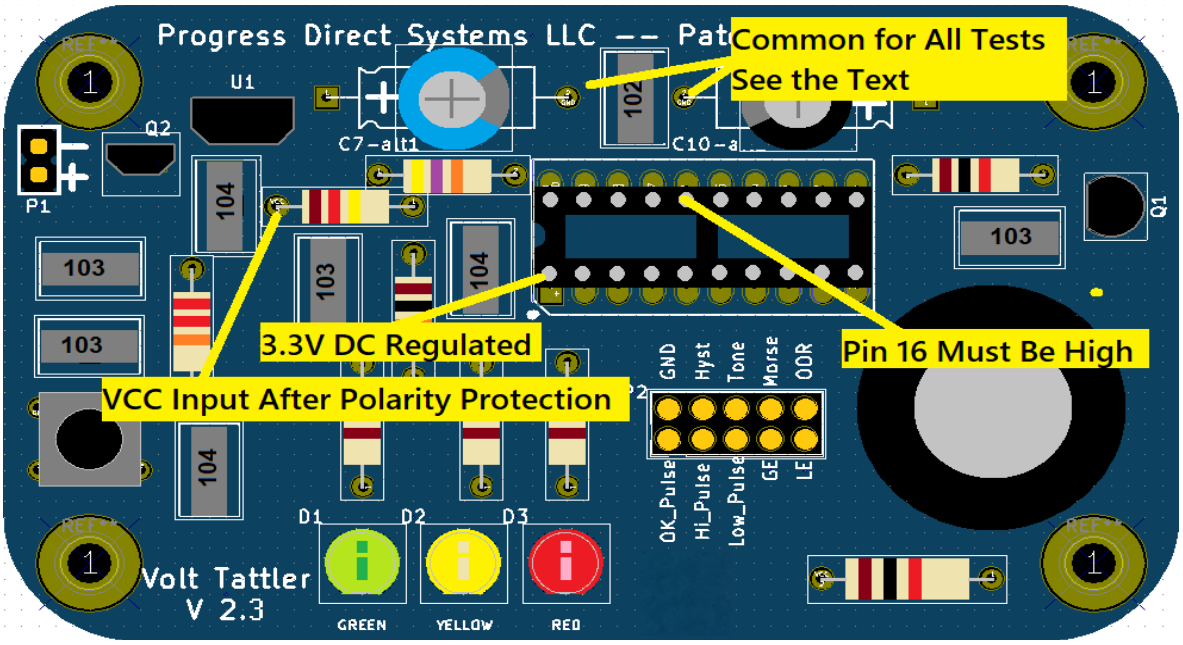
14. Install the speaker.  It is not polarized so either direction will work fine.

15. Look over the board both top and bottom.  Look for missing components, improperly oriented components, cold or dry solder connections, solder blobs and splashes.  Double check the position and orientation of each component.

At this point everything <u>but</u> the microcontroller should be installed.




**Note the short lead and the flat side of the LED must go toward the edge of the board.**




## Testing Phase 1

1. At this point <u>the microcontroller must NOT be installed</u>. These tests are to provide indications that much of what has been done is correct. After these tests the microcontroller will be installed just prior to final testing.

2. Apply around 12V D.C. to the board. Watch the polarity. Protection should be in place but we don't know if everything has been properly constructed yet.

3. If popping, smoke, burning or smell occurs immediately disconnect the voltage and look for a problem in the assembly. Look for shorts between runs, bad solder joints and *improperly oriented components* etc. If you are using a power supply that indicates current it should read very low (less than 1 milliamp) current. Most power supplies with digital meters will register no current as the resolution of the digital meters is usually far larger than 1 milliamp.

4. Assuming everything is stable, set your multimeter to measure DC voltage. If your multimeter is not auto-ranging set your range above the supply voltage.

5. Connect the negative lead of your voltmeter to ground (common). If you have installed axial lead (a wire at each end of the capacitor) electrolytic capacitors at C10 and C7 then connect the negative lead of your multimeter to the negative lead of one of the electrolytic capacitors. If you used radial lead capacitors (leads on one end of the capacitors) you may insert a test wire temporarily into one of the axial lead negative holes. This lead can be clipped off or left for testing in the future.

6. Using the positive lead of your meter, measure the 3.3V supply to pin 1 (pad or socket pin) of U2. The voltage must measure near +3.3V. If it is significantly higher or lower disconnect the power and look for a problem in the assembly.

7. With common lead still attached as in the previous step move the + voltmeter lead to pin 3 of the microcontroller. You should see somewhere near 1 volt (assuming 13V was applied as power). This should read somewhere near 1/13 of the supplied voltage.

8. Move the + voltmeter lead to the pad for pin 16 of the microcontroller. This should read close to +3.3V.

9. If everything above looks good disconnect from power and proceed to installing the microcontroller. If something is not right disconnect power and search for a build error, solder splash, dry solder joint etc. DO NOT install the microcontroller if any of the above measurements are significantly off.

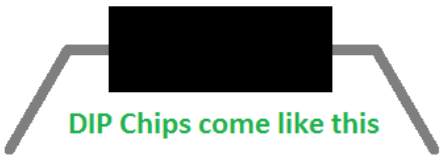
 

## Construction Phase 2

### *Preparing the Microcontroller for Installation*

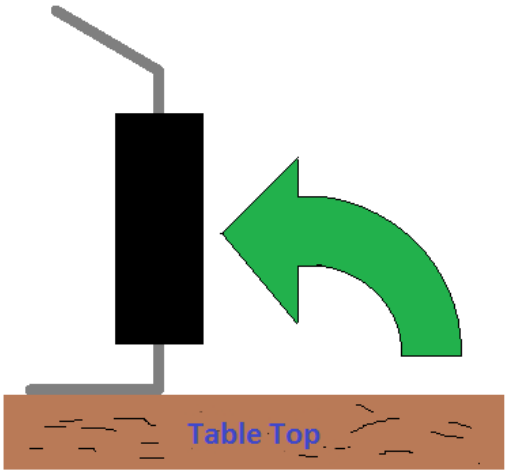
Here we must install the microcontroller. Whether or not we are using a socket, handling 20 pins takes patience. Carefully straighten the pins so that on each side of the chip the pins are perpendicular to the body of the chip. Pins on both sides must be parallel or installing the processor, with or without a socket, will be difficult. Here we see some views of the end of a DIP chip like the microcontroller.

When we get the chips from the supplier the leads are usually splayed out on an angle. This promotes proper tension for automated insertion machines but causes grief trying to manually install the chips into a board or socket.



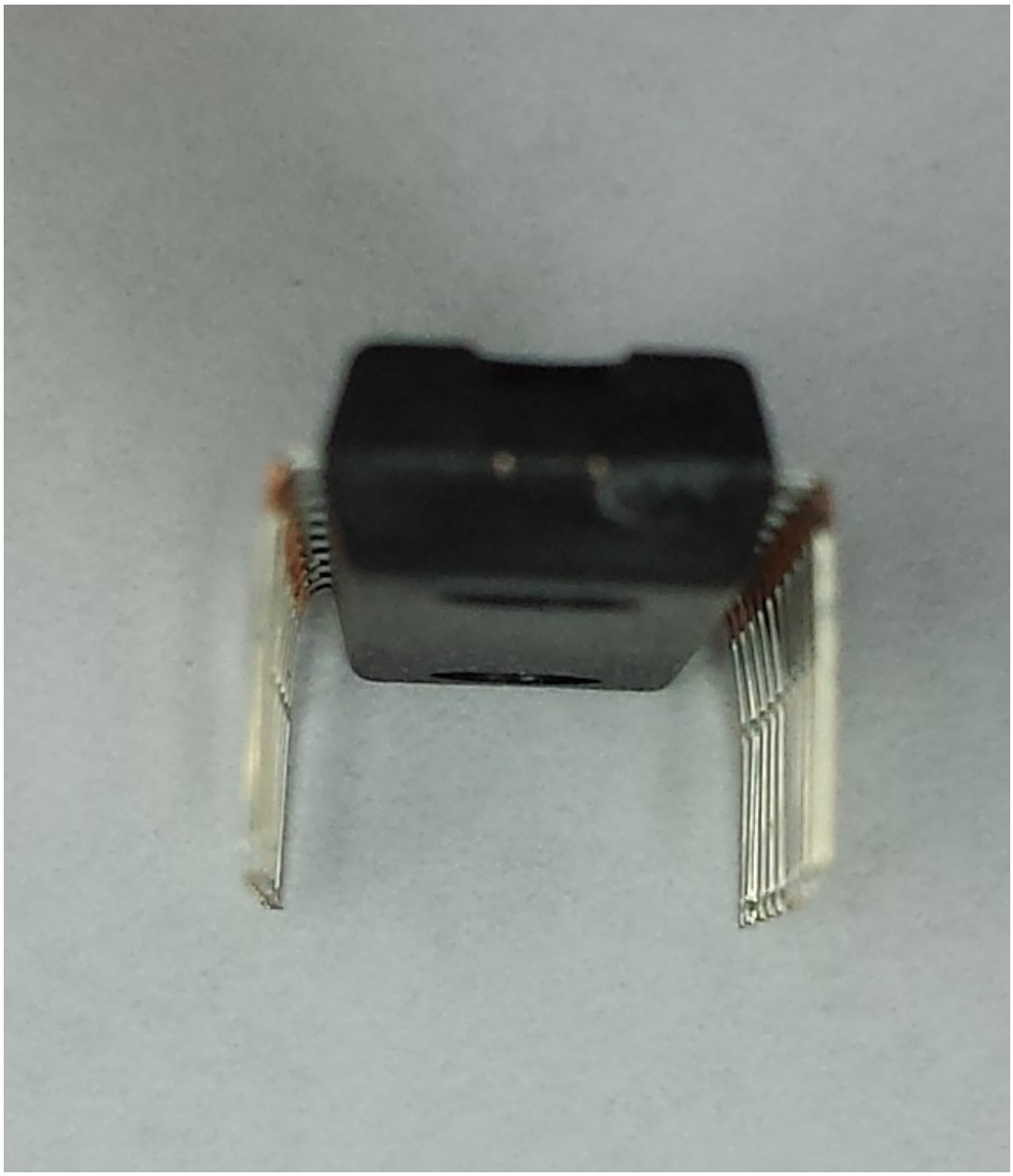

 

Use your work surface to bend all of the pins at the same time while keeping them in line.




We use them like this

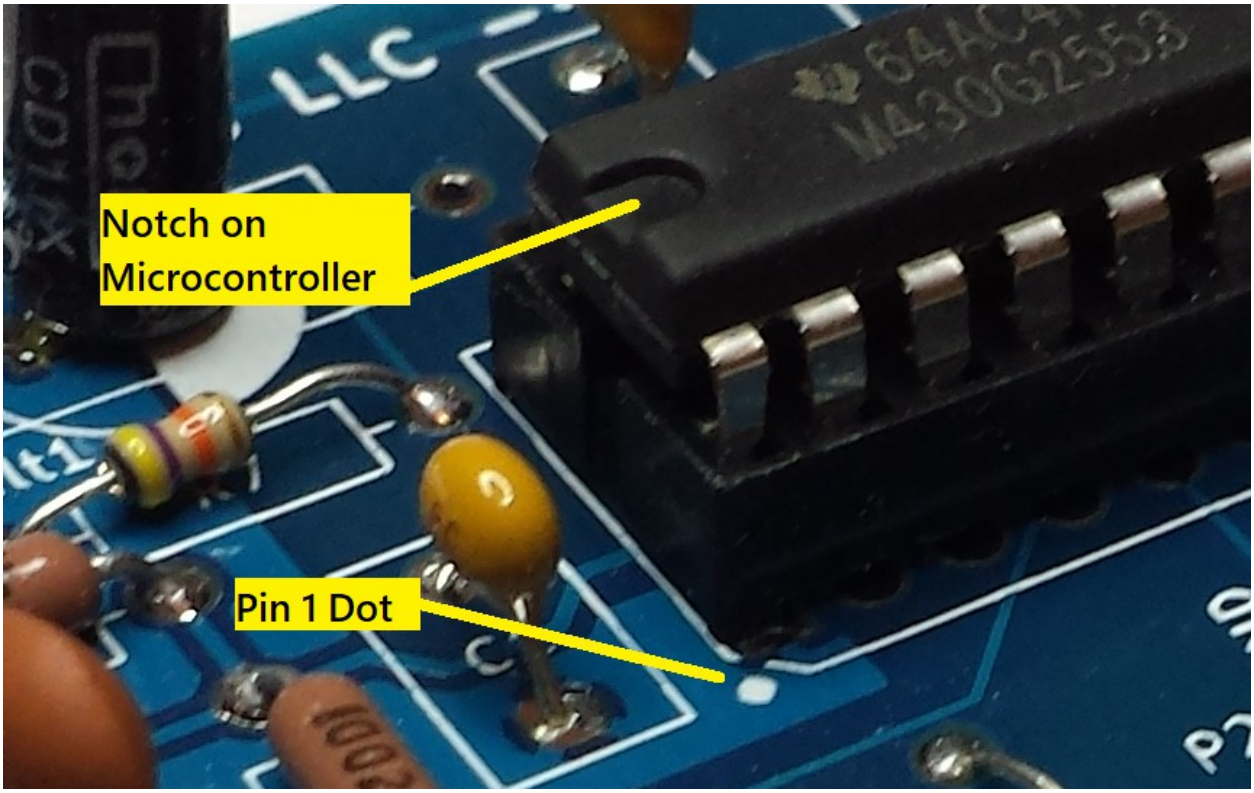
 



### *Soldering the Microcontroller*

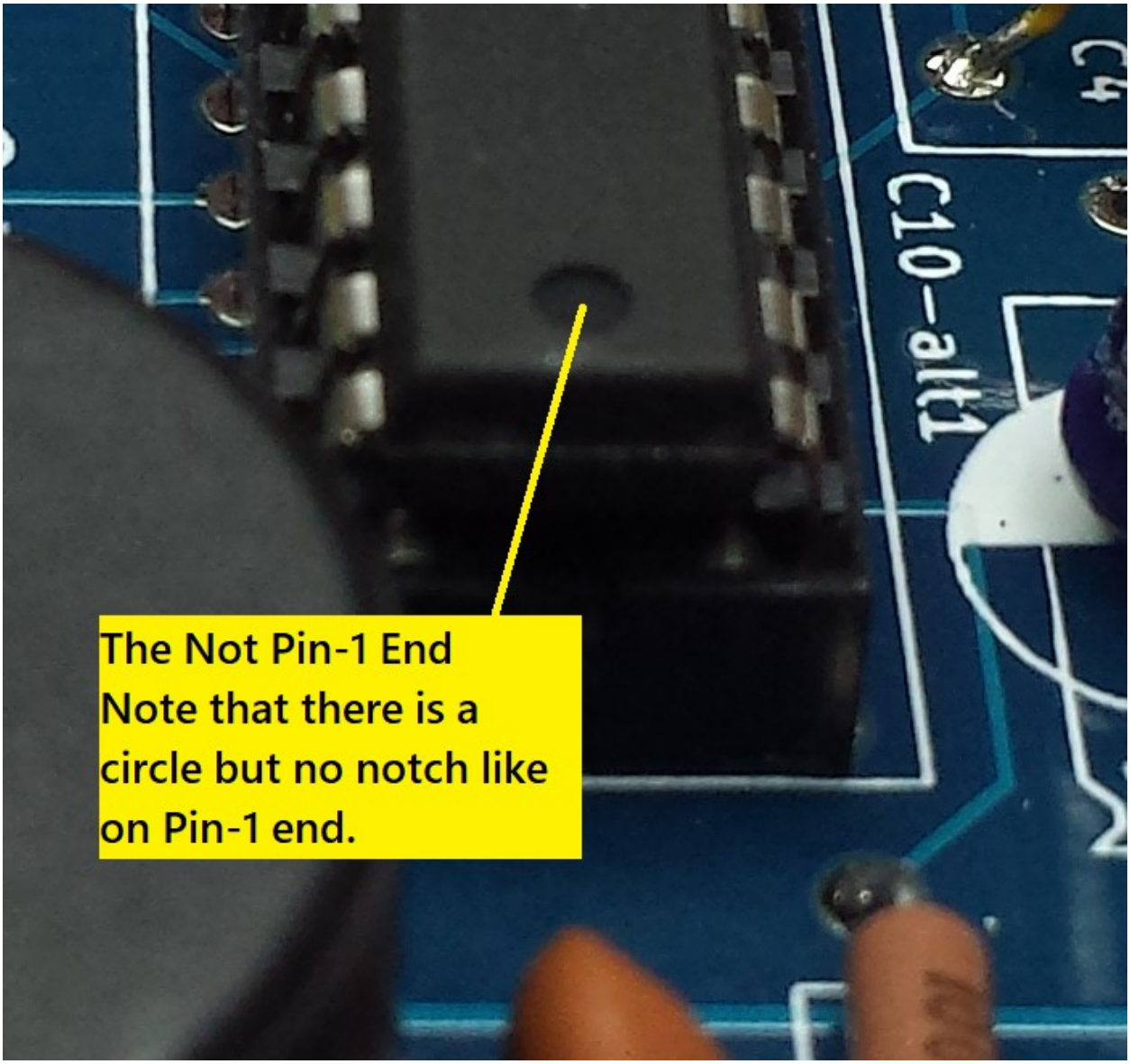
When you insert the chip into the PC board make sure that the pin-1 end is at the proper end of the board, away from the piezoelectric speaker. The pin-1 end of the chip will have a small notch in the chip.




Above is a picture of the Pin 1 end of a microcontroller.

The following picture is NOT of the pin 1 end of the microcontroller. There is a **small circle which is NOT the pin-1 end** of the chip. But **the notch, NOT THE CIRCLE, marks the end with pin 1**.



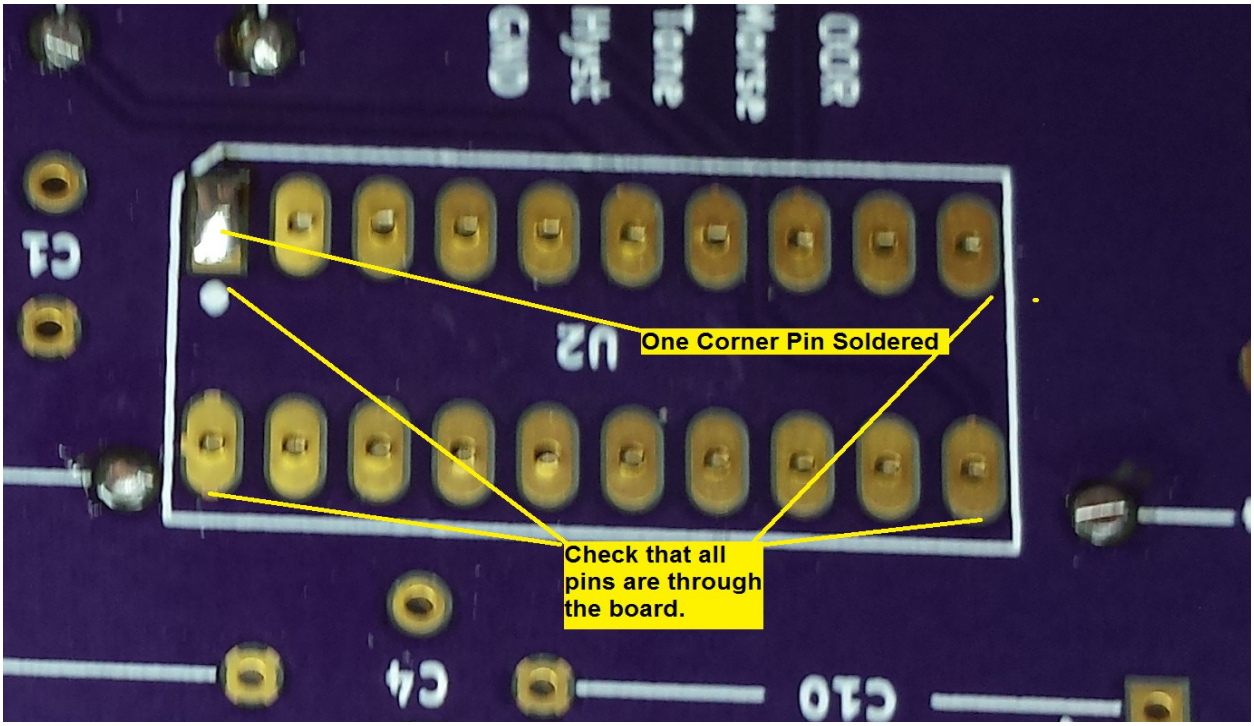

Carefully aligning the pins can prevent bending a pin off to the side or underneath the chip.

If you are using a socket be sure that all of the pins are inserted into the pin sockets and not on the side of the socket or underneath the chip. Proceed to “Seating the Microcontroller into a Socket” section later.

### *Soldering the IC*

If you are soldering the chip in directly be sure that all of the pins are through the board and ready to be soldered to the pads on the back of the board (the non-component side). Once all pins are seen through the PC board, use a piece of cellophane tape to temporarily secure the chip for soldering.

Solder one corner pin of the chip (or socket) to its pad. Check the alignment of the chip to see that all of the other pins are still in place and that the chip is seated flat against the PC board. If there are pins out of place or the chip has moved up on one end, briefly heat the one soldered pin while guiding the chip back onto the board. Remove the heat immediately once the chip is properly seated. Allow the joint to cool.



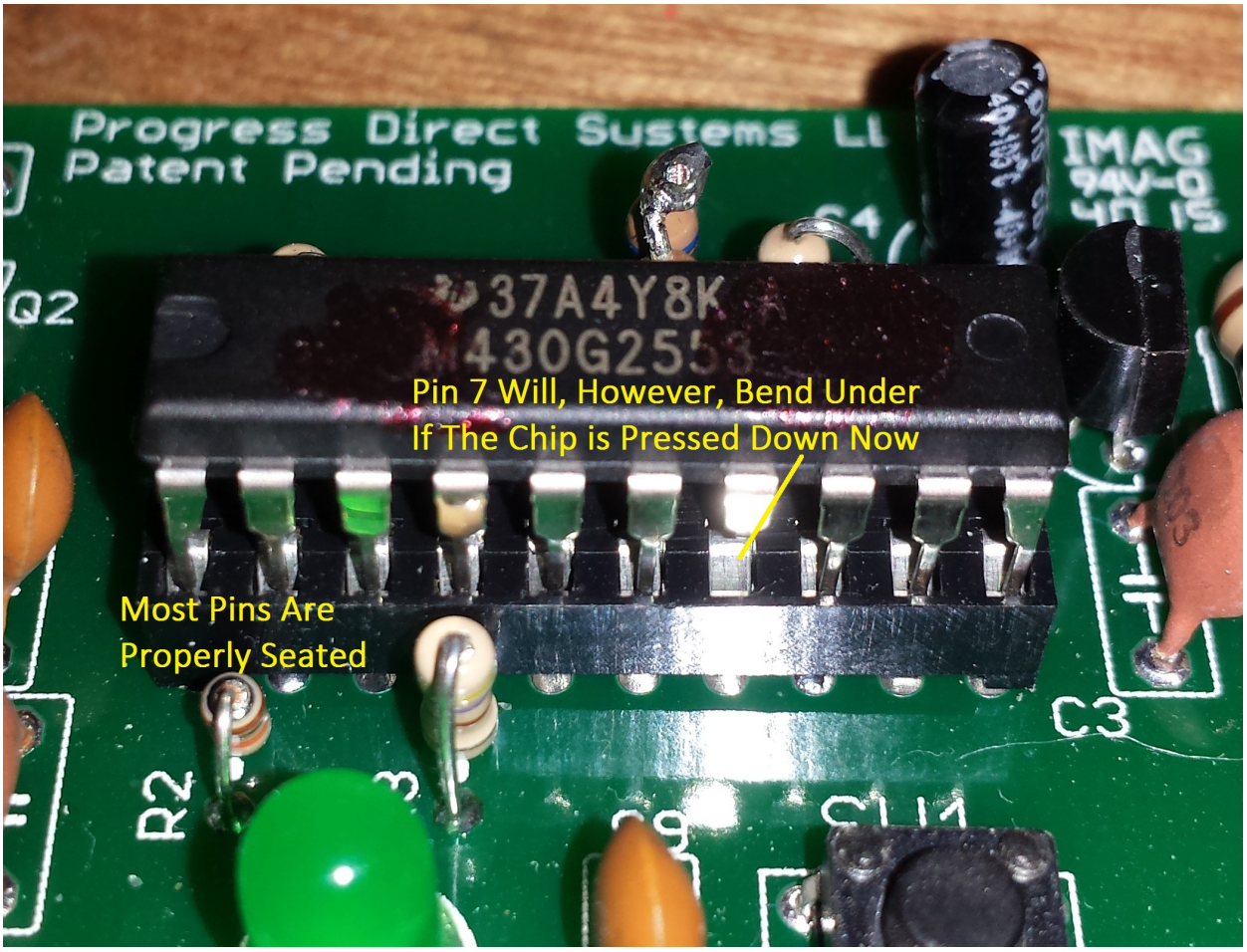

If all of the pins are viewed as through the board as in the above image carefully solder the remaining pins avoiding solder bridges between the pins and adjacent traces.

Remove the cellophane tape and inspect the work just completed. Give the board a final once over looking for potential problems, improper microcontroller installation (Pin 1 end of the chip), solder shorts, unsoldered or badly soldered connections etc.

### *Seating the Microcontroller into a Socket*

If you are using a socket perform the pin straightening exercise previously discussed. Rest the controller in the socket in the proper orientation. Check that all of the pins are properly resting in each of their receptacles in the socket. Any pins outside the socket will not make contract and may cause the Volt Tattler 2 to fail. Pins can also become trapped under the chip. These must be straightened before pressing the chip into the socket. Once all of the pins have been checked and are in the sockets, press down and the chip, slowly increasing pressure until the chip lowers in. It should "bottom out" on the socket.




In the above picture the builder is headed for trouble. Pin 7 of the chip is not pointing down into the socket but tucked a bit back under the chip. When this builder pushes down on the chip to seat it into the socket, pin-7 will fold under the chip and not connect. This may cause issues even though the chip seemed to seat solidly. Check each pin for proper position before attempting to seat the chip into the socket.

## Testing Phase 2

This is the big test. Before applying power check each pin and soldered connection on the microcontroller. It only takes one short, one pin out of place, one improperly oriented part or one improperly soldered connection to cause the Volt Tattler 2 to malfunction.

Apply power as before. Immediately listen for a Morse 'R' (.-.) from the piezo speaker. If you do not hear the 'R' (.-.) or if you hear the Morse question mark '?' (..--..) power down immediately and inspect each solder connection. Look for traces that have been damaged or shorted.

If you heard the Morse 'R' (.-.) then the unit should be up and running. Watch the Green LED to see that it is flashing. If the Green LED is not flashing then remove power, look for a build problem and try again. Check the 680 ohm resistor and for *proper orientation* of the Green LED. The flattened side (if one is flattened) must be toward the edge of the board.

If the Green LED is flashing then the Volt Tattler microcontroller is running. If you heard the Morse 'R' (.-.) then the voltage is being monitored and Volt Tattler will announce when it thinks voltage is outside the thresholds.

## If you have a variable DC power supply

If you do not have access to a variable DC supply jump forward to the section "If you do not have a variable DC power supply". It is best to conduct further testing using an accurate high impedance voltmeter and a variable DC power supply. Adjust the power supply voltage around 12 and connect the new Volt Tattler 2 to the adjustable power supply, watching polarity. You should hear the "roger" R (.-.) and see only the green LED flashing about one time per second. Adjust the supply voltage up above 16V (but below 30 V). The Volt Tattler should begin to repeatedly sound Morse 'H' (....) indicating that the voltage is above the high threshold (around 15 volts for a new Volt Tattler 2). Also notice that the Red LED has begun to flash along with the Green LED.

Next adjust the voltage back around 12 volts. The alarm should stop below about 15 volts but any Morse character that has started will complete before the alarm will stop sounding. The Volt Tattler 2 should become silent but both the Green and Red LEDs should now be flashing. The Red LED indicates that the Volt Tattler voltage has been above the high threshold since power on or board reset.

Next press the Program Button for less than a second. Volt Tattler 2 should restart announcing the Morse 'R'. The Green LED will flash again by itself. Assuming the voltage is still below the high threshold, the Red LED will no longer be flashing.

Next adjust the voltage down to about 9 volts. The Volt Tattler 2 should start to repeatedly sound Morse 'L' (.-..) indicating that the voltage has passed below the low threshold. In addition the Yellow LED will start to flash along with the Green LED.

Returning the voltage in between about 10 and about 15 volts should silence the alarm. The Yellow LED will continue to flash indicating that there was a voltage drop below the low threshold. A short press on the Programming Button will reset the Volt Tattler 2. Once reset only the Green LED should then be flashing. IMPORTANT: These thresholds (10V and 15V) are only valid on a Volt Tattler 2 that has not been reprogrammed. If the unit has been reprogrammed then the thresholds will act according to their newly calibrated values.

**Using the variable voltage setup test each of the output signals as described in the following table.**

| | V Between Thresholds | V Above High Threshold | V Below Low Threshold |
|---|---|---|---|
| **L (LE)** | Low | Low | High |
| **GE (HE)** | Low | High | Low |
| **O (OOR)** | Low | High | High |
| **M (Morse)** | Low | Keying Morse 'H' (….) | Keying Morse 'L' *(.-..) |
| **T (Tone)** | Low | Sounding Morse 'H' (….) | Sounding Morse 'L' (.-..) |
| **OK_Pulse** | High-going pulses if voltage is being sampled | High-going pulses if voltage is being sampled | High-going pulses if voltage is being sampled |
| **Hi_Pulse** | Low unless there has been a previous high voltage since last reset | High-going pulses approximately once per second. | Low unless there has been a previous high voltage since last reset |
| **Low_Pulse** | Low unless there has been a previous low voltage since last reset | Low unless there has been a previous low voltage since last reset | High-going pulses approximately once per second. |
| **Hyst** | High or Low depending on the last threshold crossed. | High or Low depending on the last threshold crossed. | High or Low depending on the last threshold crossed. |

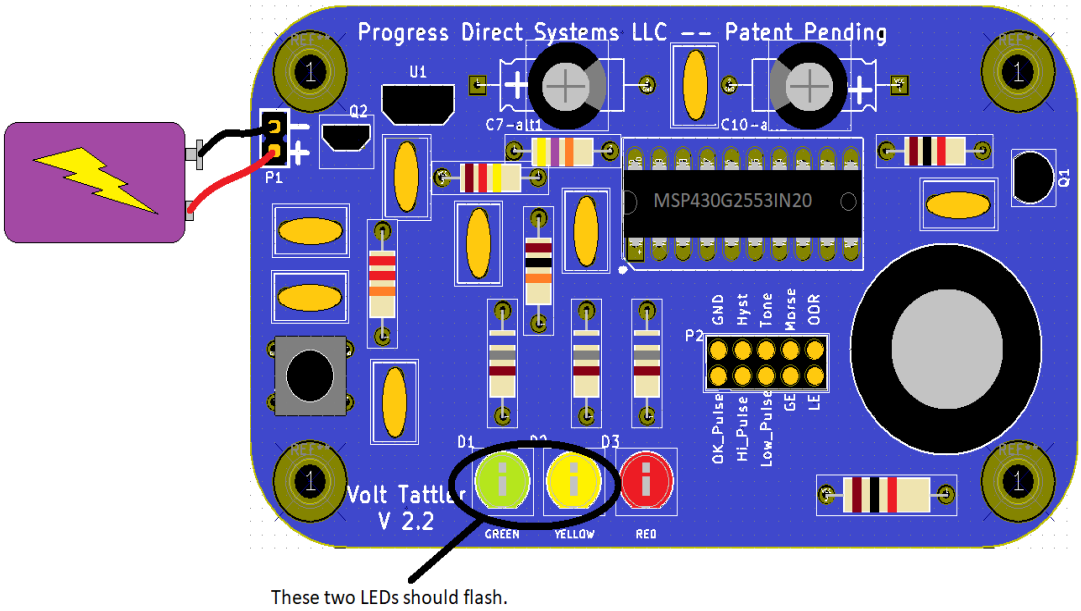
- **T (Tone)** is being generated if the speaker is sounding.
- **Morse** may show up on an analog voltmeter as the needle moving up and down when tones sound.
- **OK_Pulse** indicates that the unit is operating and taking samples.
- **Hi_Pulse** indicates that a high threshold transition has occurred since VT2 was powered on or reset by a momentary press of the Programming Button.
- **Low_Pulse** indicates that a low threshold transition has occurred since VT2 was powered on or reset by a momentary press of the Programming Button.
- **Hyst** goes low at reset or power up. It will go high if a high voltage transition occurs. It will remain high until reset or until a low transition occurs. Hyst takes the state of the last transition crossed since reset or power on.

## If you do not have a variable DC power supply

A better and more thorough testing of the Volt Tattler can be accomplished with a variable supply and meter. However if you don't have a variable DC supply you can still test the functionality of a new Volt Tattler using 2, 9-volt batteries. It is important to note that this will only work for a new Volt Tattler which has not been reprogrammed with new thresholds.

### *Low Voltage Tattling*

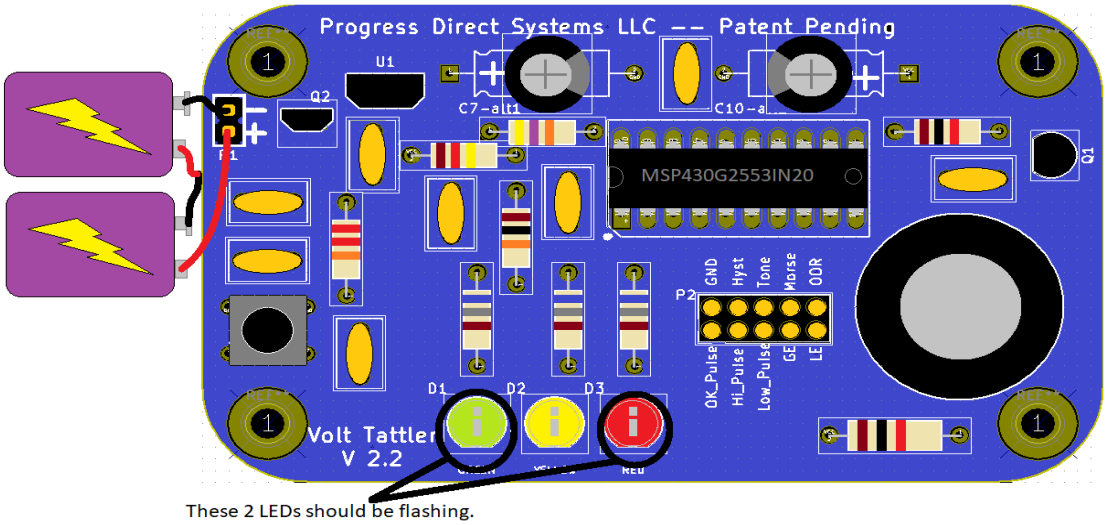



First connect the new Volt Tattler to one of the 9-volt batteries. As always watch polarity. If the battery is relatively alive the Volt Tattler should sound the Morse 'R' (.-.) then repeated Morse 'L' (.-..). In addition the Green and Yellow LEDs should flash periodically.

### *High Voltage Tattling*

Next use both 9 volt batteries together in series to create 18 volts.




In this connection, at power up, a new Volt Tattler 2 should announce the Morse 'R'(.-.) then repeat Morse 'H' (….). The Green and Red LEDs should also be flashing.

## Function

Volt Tattler 2's thresholds are fully programmable with a variable DC supply and a high impedance volt meter of sufficient precision and accuracy. This means that you can adjust Volt Tattler to accommodate your anticipated operating conditions.

Volt Tattler 2 can provide practical protection for any piece of equipment powered by DC voltage from 4 volts up to around 28 volts. It draws less than 1 milliamp[1] of current in normal operating mode making it practical even for Portable and QRP operation.

## An Example

Suppose that you are a ham radio operator running a QRP station for Field Day. You understand that your batteries are going to deplete over the day. You can set the high voltage level to, for example, 15 volts and the low level to 10 volts (or check you manual for high and low limits under which your rig will operate properly). This way you are warned against high voltage levels while adjusting things during setup and then you can be warned again later when your available voltage drops below a level that allows proper operation of your equipment. This can be particularly useful when transmitting on a weakening battery.

[1] Near 13.8V

## Operation

The microcontroller for a new Volt Tattler 2 comes programmed to approximately 15 volts as the high threshold. The low threshold is near 10 volts. This provides a crude announcement of power supply voltages that are significantly out of the proper operating range of many popular devices that run 12V or 13.8V. Using a variable DC supply and a volt meter, these values can be adjusted as desired. The Calibration section later discusses how to adjust Volt Tattler 2 to your desired alarm thresholds.

When Volt Tattler 2 powers up it acknowledges the power up by sounding a Morse 'R' (.-.). This is a kind of "***roger***" letting you know that it has activated. In normal operation Volt Tattler 2 is silent with only the green "heartbeat" LED flashing to indicate that the system is active. Once powered on Volt Tattler 2 immediately begins monitoring the supply voltage.

During normal operation Volt Tattler 2 makes no sound. Its green flashing LED lets you know that it is running. If the Volt Tattler 2 detects that the power supply voltage is at or above the high threshold it will sound Morse "H" (….) indicating the transgression. In addition the red LED will begin to flash indicating that a high voltage transgression has occurred. Should Volt Tattler 2 detect a voltage drop at or below the low threshold Volt Tattler 2 will sound Morse "L" (.-..), indicating that the voltage is low. In addition the yellow LED will flash indicating that a low voltage transgression has happened.

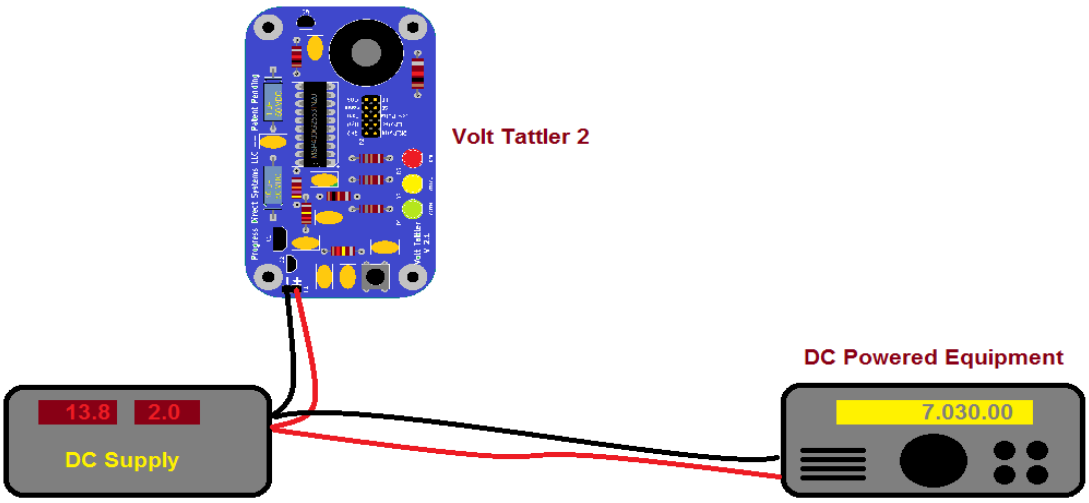
In either case the LED associated with the high or low transgression will continue to flash even after the transgression has passed. They will continue to flash until power off resets the Volt Tattler or the Programming Button is quickly pressed to reset the Volt Tattler. This can show that, for example, the voltage has dropped low during a transmission where the sound during the transgression was not heard.

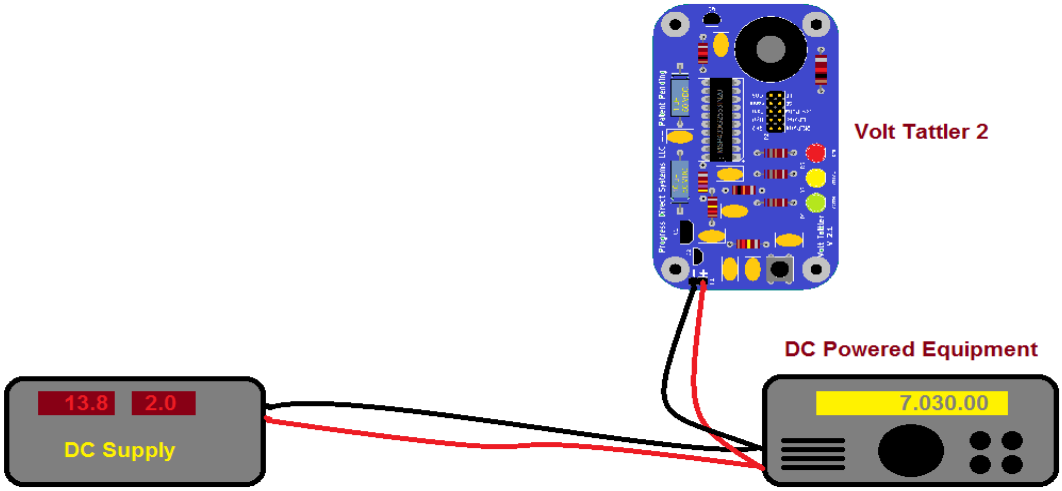
## Wiring Volt Tattler into the System

### At the Source

One way to set up VoltTattler 2 is near the power supply source. At the supply or distribution panel VoltTattler 2 can tell you if the source of voltage goes higher or lower than you like. Adding equipment in a field day situation, for example, can cause voltage drops as the load current increases. Volt Tattler 2 may indicate that another supply or a larger supply is needed.



## At the Equipment




Setting up VoltTattler 2 at the equipment can alert an operator to voltage drops between the power source and your equipment. In addition hearing the "roger" beep (Morse 'R', .-.) can audibly alert you if the power dropped out completely and then came back again (intermittent connection). This can be very useful in troubleshooting a system.

### Another Example

Attaching VoltTattler 2 near a ham radio transceiver can also tell you that your voltage has dropped during high current draining conditions such as a radio transmitting. Insufficiently sized power leads, bad connections and waning batteries can all contribute to voltage droop. Knowing that there is a problem can help you avoid improperly operating equipment. In this way we can avoid transmitting spurious signals that can be generated by improper transmitter voltage.

## Calibration

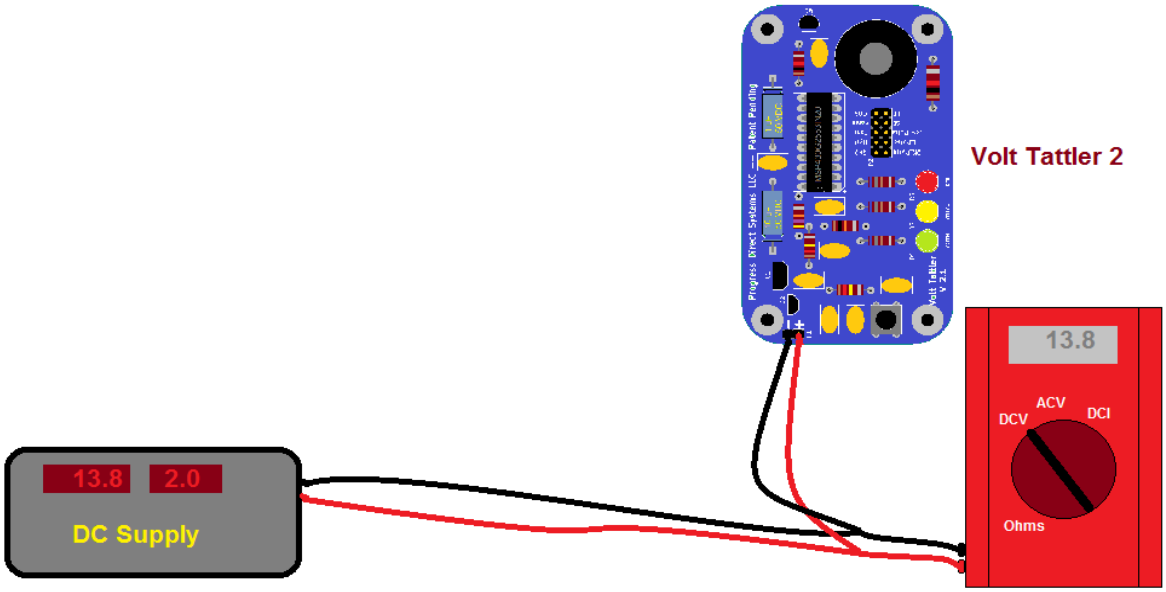
Calibration requires 3 pieces of equipment commonly available to most hams and electronics technicians:

- the VoltTattler 2 module
- a variable DC power supply capable of being adjusted from above the desired high threshold down below the low threshold to be programmed
- a high impedance voltmeter to confirm that the power supply is at the voltages to be programmed*

* Meters that come on power supplies may not give the desired accuracy. In addition there could be some drop between the power supply and VoltTattler 2. Knowing this you can decide to use the power supply meter rather than a separate external voltmeter.

## Calibration Steps

The DC calibration supply must be reasonably clean of hum and noise or significant error may occur in calibration. Power supplies with a fine adjustment can improve the ability to set the voltage more precisely.



1. Connect the variable power supply and the voltmeter to the VoltTattler 2 in parallel as in the accompanying diagram. VoltTattler 2 will begin blinking the Green LED and send a Morse "R" (.-.). That "R" may be followed by other LEDs flashing and continuous "H"s (…. …. ….) or "L"s (.-.. .-.. .-..) depending on the supply voltage and limits currently set in the VoltTattler 2 unit. This is no matter as we plan to calibrate the unit.

2. Press and hold (>3 seconds) the Program Button until VoltTattler 2 beeps once (Morse 'E'). This puts the VoltTattler into the calibration mode for setting the high alarm threshold. Upon releasing the button the VoltTattler 2 will begin repeatedly sending Morse 'H'(…. …. ….) indicating that you are setting the high threshold.

3. **AVOID LOSING POWER DURING THIS STEP. There is a very small possibility that LOSING POWER HERE WILL MAY RESULT IN UNPREDICTABLE CONSEQUENCES ON THE VOLT TATTLER OPERATION.** Adjust the power supply voltage to the desired high alarm threshold as indicated on the voltmeter. Once the voltage has been set to the desired high threshold press and hold the Program Button again for more than 3 seconds. When you hear the single beep (Morse 'E') listen as you release the button. If VoltTattler 2 sends the 'R' (roger, .-.) the new threshold was set properly. If VoltTattler sends a Morse Question Mark '?' (..--..) the high threshold was not set. This is probably because you tried to set the high threshold at or below the low threshold. VoltTattler 2 does not allow that. You will need to move on to finish the low calibration then return here and repeat setting the high threshold.

4. **AVOID LOSING POWER DURING THIS STEP. There is a very small possibility that LOSING POWER HERE WILL MAY RESULT IN UNPREDICTABLE CONSEQUENCES ON THE VOLT TATTLER OPERATION.** Once the high threshold calibration has been completed, successfully or not, the VoltTattler 2 will immediately proceed to setting the low threshold. Now Morse 'L' (.-.. .-.. .-..) will be sent continuously indicating that the low threshold is being calibrated. Adjust the power supply to the desired low voltage threshold as indicated on the voltmeter. Once the voltage is set to the low threshold press and hold the Program Button for more than 3 seconds. After the Morse 'E', listen for the next character as you release the Programming Button. Morse 'R' (.-.) indicates that the new low threshold was taken. Morse '?' (..--..) indicates that the attempted order was incorrect (i.e. low threshold >= high threshold) and that old low threshold will remain in effect.

5. When Morse 'R' (.-.) has been heard for either or both calibrations that new threshold will now be in effect. Once calibrations are completed VoltTattler 2 will frequently sound the last threshold that was adjusted. This is simply because the power supply will be at that threshold. Note that the LEDs will flash according to the last calibration completed. A short press on the Programming Button will clear the Yellow and Red LEDs. Adjust the power supply through the working range, beyond both thresholds and observe the proper functioning of VoltTattler 2 to

your specifications. Note the behavior of the LEDs. If it does not function properly simply go back to step 1 and adjust the offending calibrations.

If you hear Morse question marks (..--.. ..--.. ..--..) or the thresholds do not seem right, simply begin the calibration again. If calibration does not seem to fix the problem you may need to replace the microcontroller. Contact the vendor for parts.

## Calibration Notes

Interrupting the power to the Volt Tattler 2 at any time will cause it to restart, sound a Morse 'R' (.-.) and enter the normal operation mode. Thresholds are saved only during calibration when you hear the Morse "R" beep upon releasing the Programming Button. Each threshold is saved only when the particular calibration (High or Low) is done and the 'R' (.-.) is sounded. If a calibration is aborted (short press on the Programming Button during calibration or power off) *any thresholds that have not generated the 'roger R' (.-.) will keep the original threshold from before calibrations were started*.

No matter how the threshold calibrations end up after programming one can always start over and program each threshold.

## Skipping Calibrations

You may only want to calibrate one threshold. Perhaps Volt Tattler 2 did not accept one of the calibration attempts (Morse '?', ..--..). Maybe you just want that high threshold a bit lower and leave the low threshold alone. You can skip past any calibration that you don't wish to change with a single short press (< 1 second) on the Programming Button. In fact if you get confused as to where you are in the calibration process you can simply short press the Programming Button two or more times to return VoltTattler 2 to the normal monitoring mode. Of course cycling the power will also return the Volt Tattler 2 to its normal monitoring mode. Any calibrations that had been completed successfully (that received the R, .-.) will be saved.

## Losing Power During Programming

As mentioned in the Calibration section, losing power during either the high or low threshold Program Button press may cause the Volt Tattler to store bad results into its thresholds. This can have unpredictable results. It may cause invalid thresholds. These can cause the Volt Tattler to send repeated Morse Question Marks (..--..) and not work properly.

If this does occur it might be possible to get Volt Tattler functioning again by simply running through the calibrations. If you can get both high and low thresholds to take a calibration, Volt Tattler may come back into function. If not the microcontroller will need to be replaced.

## Morse Code Sounds and their Meanings

| Morse Character | Audible Pattern | Meaning |
|---|---|---|
| ***R*** |  | "Roger" indicates that the system is active after power up. It also is used to indicate that a calibration change has been accepted. |
| ***H*** |  | High indicates that the supply voltage is greater than or equal to the high threshold.<br><br>In calibration modes 'H means that VoltTattler 2 is ready to program the high threshold. |
| ***L*** |  | Low indicates that the supply voltage is less than or equal to the low threshold.<br><br>Low in calibration modes 'L' means that VoltTattler 2 is ready to program the low threshold. |
| ***E*** |  | Indicates that a long button press has been recognized. |
| ***?*** |  | A question mark means that a programming attempt has been rejected. Values attempted were not in proper order (the high threshold less than or equal to the low threshold). The attempted threshold is not accepted and the original threshold is maintained.<br><br>A continuous stream of question marks at power up indicates that VoltTattler 2 has detected an error in reading the calibration values at power up. This may indicate a hardware problem. If recalibration fails the microcontroller will need to be replaced. |

## Maximums

- Absolute Maximum DC input voltage ±30
- Maximum operational DC input voltage +30
- Maximum DC threshold voltage @ +27.5
- Minimum Functioning Voltage @+3.9V (with low audio volume)

## Sound Level

Note that the sound level from Volt Tattler is dependent on the source supply. This means that low voltage annunciations will generally be lower volume than high voltage annunciations. The output signals, however, will have proper logic levels (3v, 0v) from 30V down to about 3.9 volts.

## Volt Tattler 2 Cannot/Should not

This is a discussion of some of the things that Volt Tattler 2 cannot or should not do. There are many others yet to be found.

A Volt Tattler 2 should not be used to detect highly transient (i.e. brief) voltage excursions. It may detect them but not every time. Volt Tattler 2 only measures the D.C. voltage around 20 times per second. If the excursions happen in the between times they will be missed.

A Volt Tattler 2 cannot reliably measure highly noisy D.C. voltages. If your D.C. voltage is quite noisy then you have a problem with the voltage source that should be remedied.

A Volt Tattler 2 is not made for extremely hot or cold environments. The microcontroller is rated -40C to +85C. But the rest of the components may not like that. I am sure it would be possible to design something for temperature extremes. But I am not sure of the components that are supplied.

The Volt Tattler 2 has no particular robustness with regards to humidity, wet or corrosive environments. It is a simple PC board with a speaker that needs to breathe air.

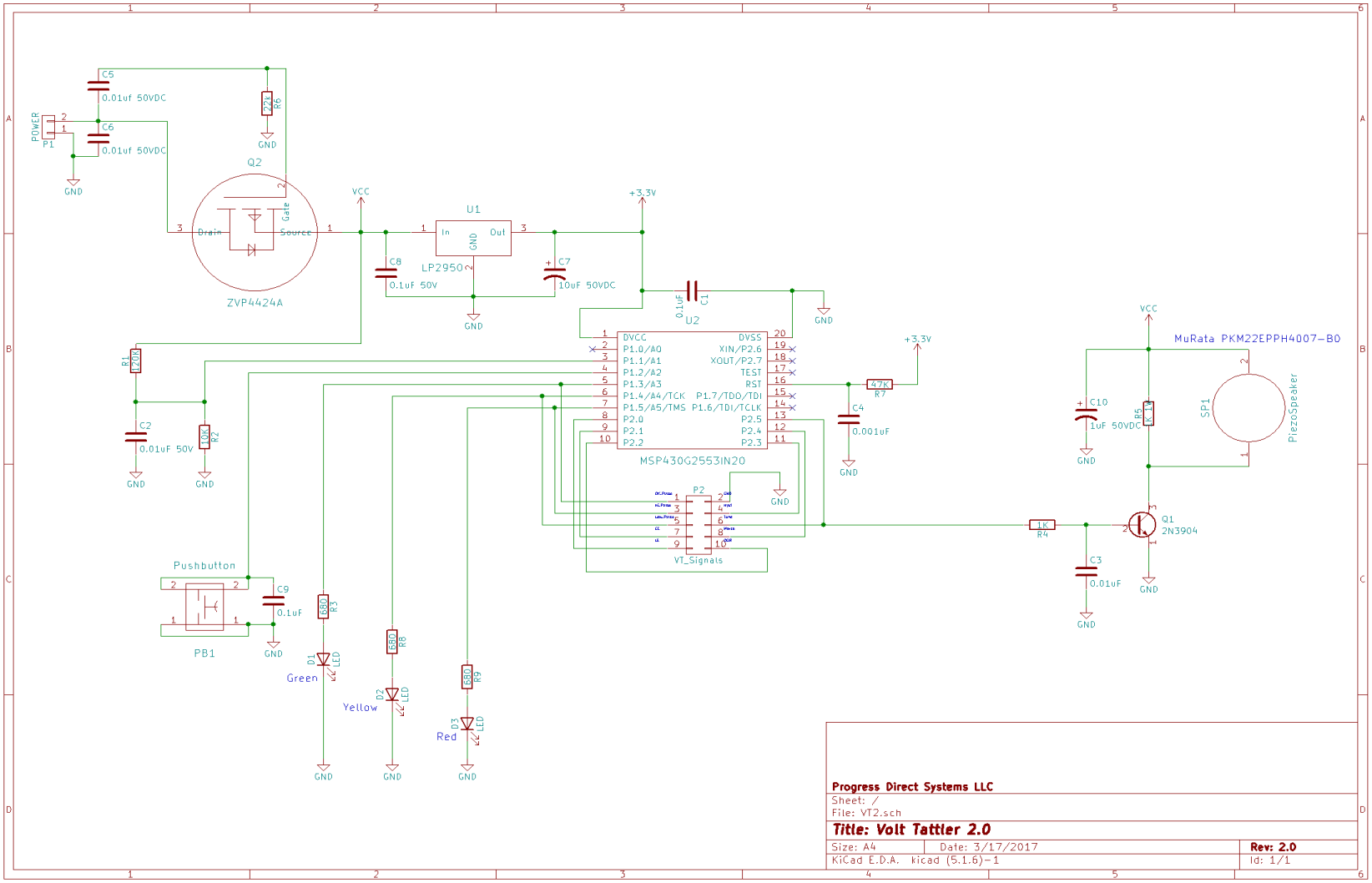
The Volt Tattler 2 cannot compensate for bad or questionable power system design. As mentioned up front it is intended for use as an enhancement of a properly designed system.

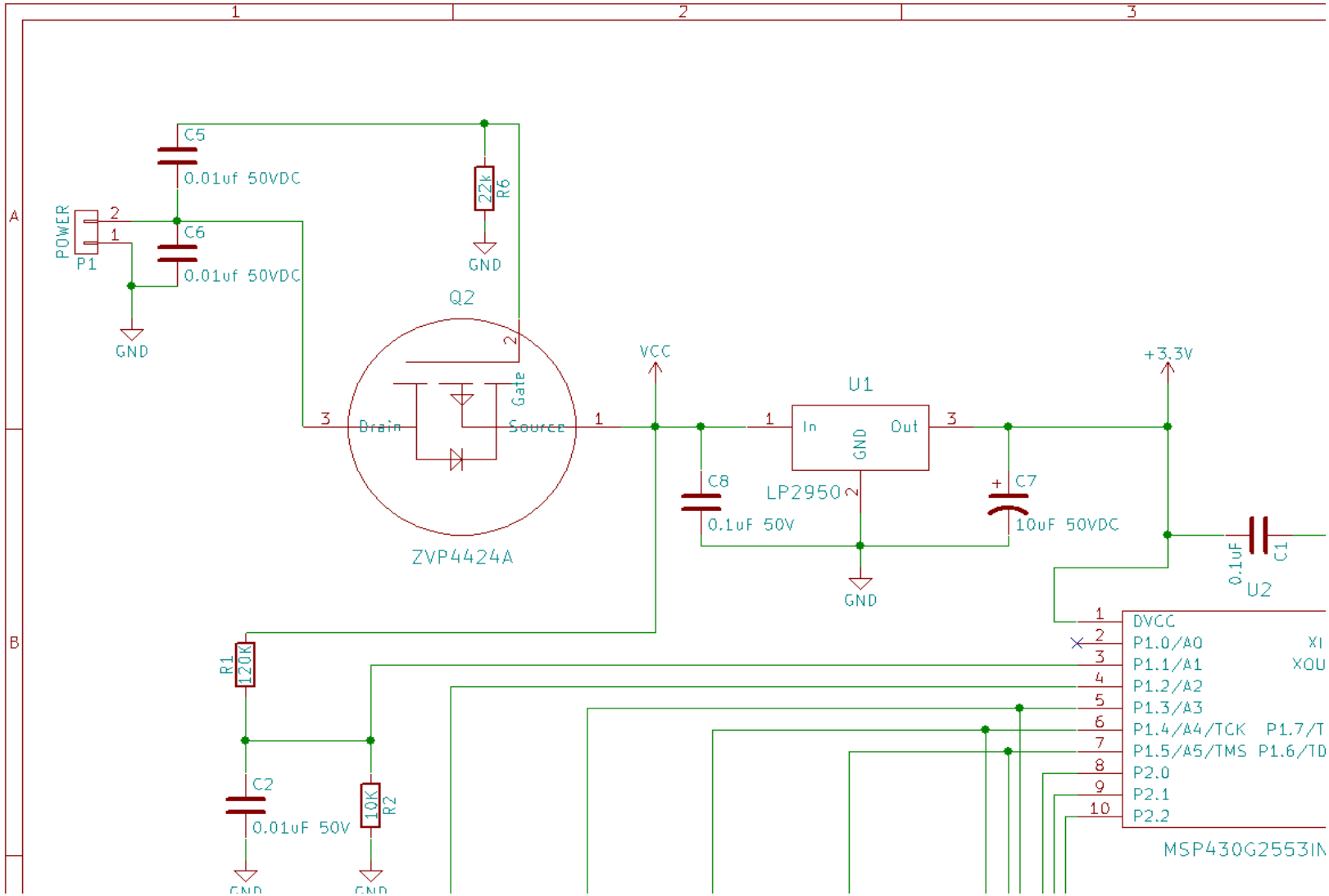
## Schematic

Note that C10 and C7 and C10-alt1 and C7-alt1 are not all installed.  They represent either radial lead or axial lead capacitors.  Only the alt1 or the not alt1 will be installed in either or both cases.

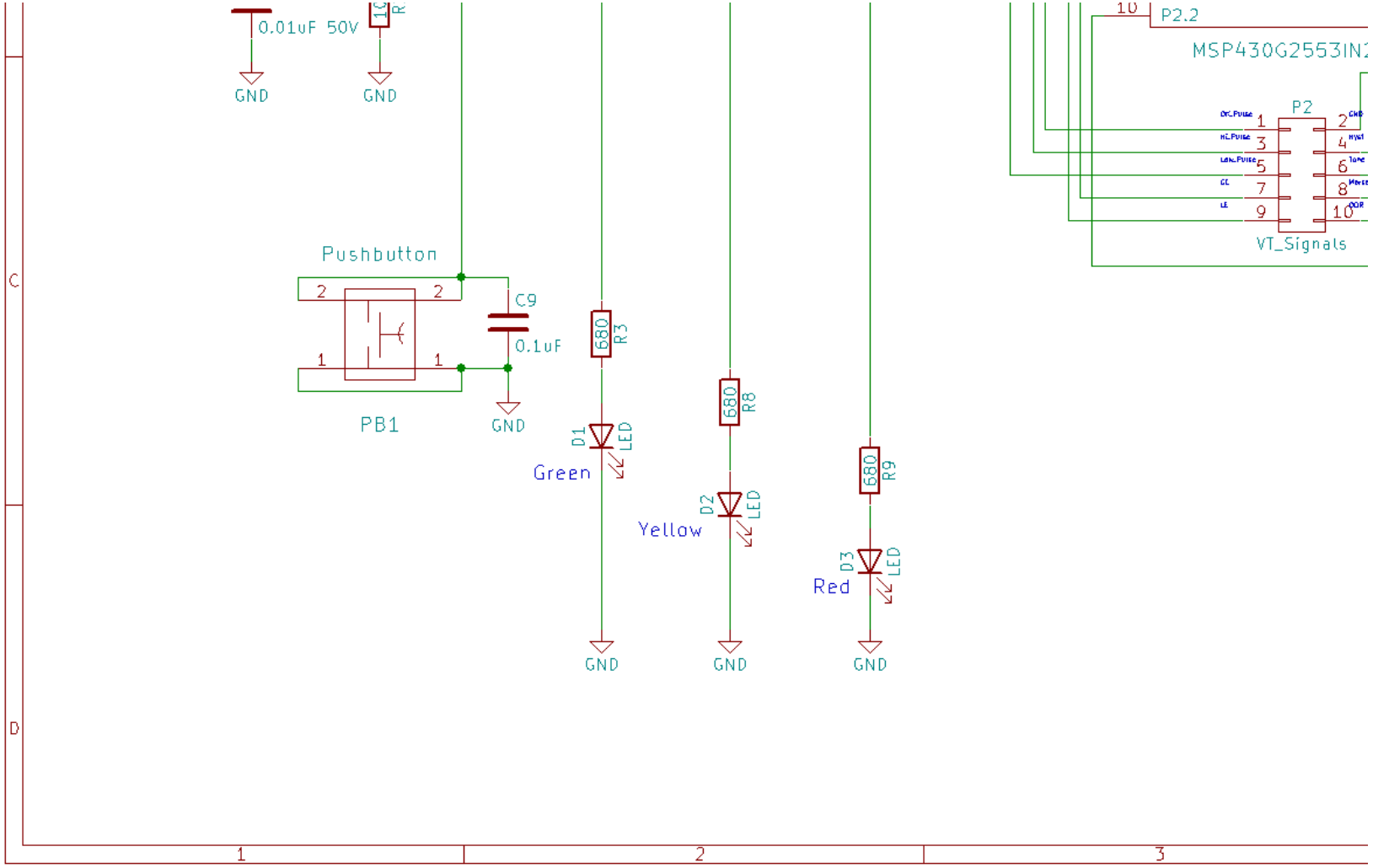
 



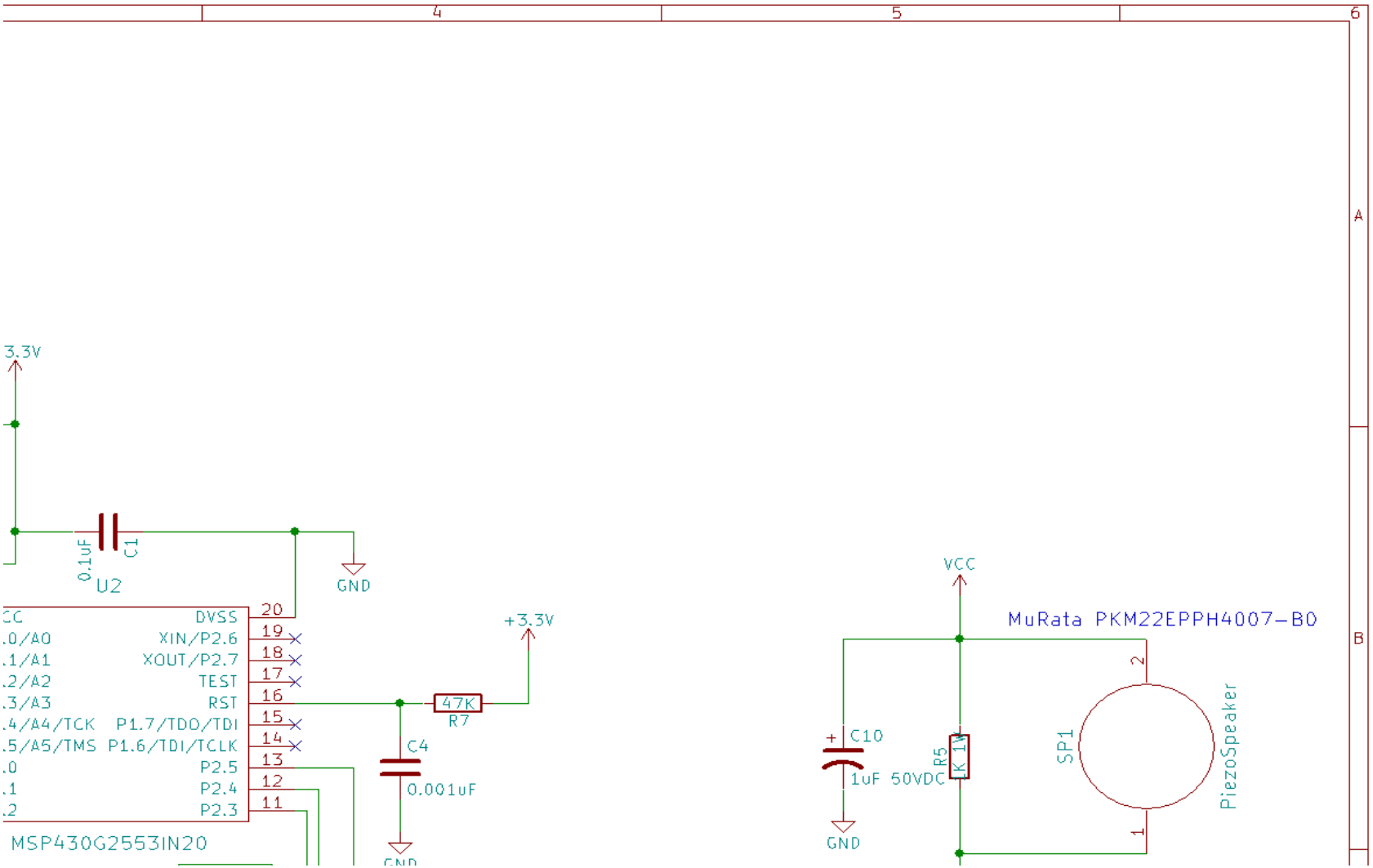

 



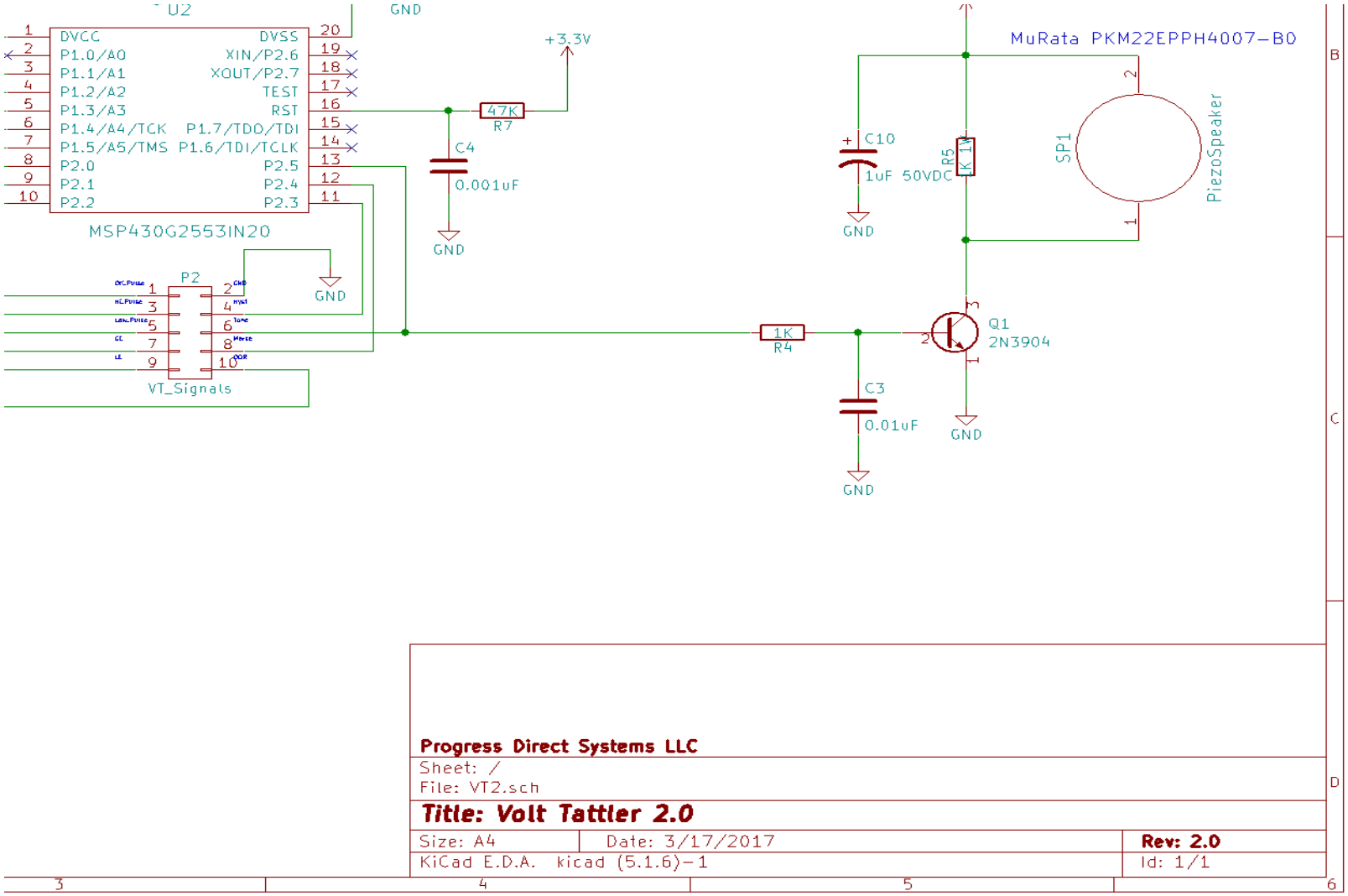

 







# Troubleshooting

***Most Likely Problems***

By far most problems will boil down to one of three things, **bad (cold) solder connections**, **bridged (shorted) solder connections** or **improperly oriented components**. Additionally there may be one or more pins improperly inserted in the socket for the microcontroller. Check these things where a problem is suspected.

Start with a DC voltmeter and the negative lead must be affixed to ground (the minus lead of either of the electrolytic capacitors is fine). The voltmeter should have high input impedance. These are fairly cheap nowadays, sometimes even free.

First look for smoke. Feel the board for heat. Sources of heat or smoke are an indication of something major being wrong. Immediately power down and look for shorted traces and incorrectly oriented components. Make sure that the components are installed in their correct positions *and in their correct orientations*.

Assuming no smoke or heat is observed, power down then up.

Did you hear the "roger" R? No look at ***Power Issues***.

Is the green LED flashing? No look at ***Power Issues***.

***Power Issues***

If the green LED is not flashing check the voltage on pin 1 of the microcontroller. It must be around 3.3V. If so then the microcontroller is powered properly. Check the Low RESET pin (pin 16) for 3.3V. Check C4 and R7, solder and such.

Still voltage issues? Go to ***Regulator Issues***.

***Voltages OK***

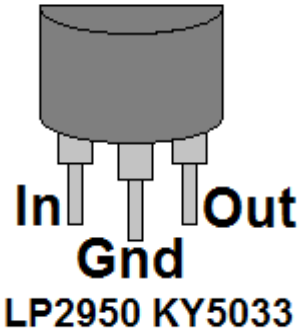
If voltages are present but we are missing the "roger" R we should check the circuitry near Q2 and SP1. Check the orientation of Q2.

If voltages are present and we hear the "roger" but the green LED still does not flash check the orientation of the Green LED and the value of its associated resistor. Look for solder bridges, bad solder joints and incorrect component orientations.

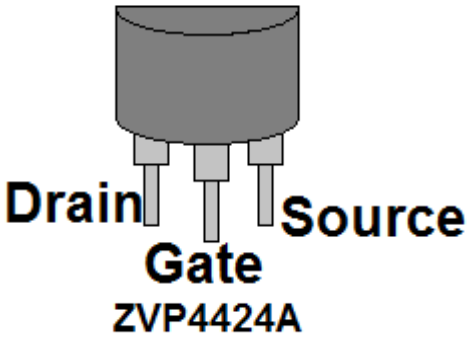
***Regulator Issues***

Test the voltage on the positive lead of C7. It should be 3.3V. Next check the non-ground lead of C8. It should be close to the input voltage. Check the Gnd lead of the regulator (LP2950, KY5033). Any voltage here contributes to the power to the microcontroller. Gnd must be close to 0V. The "In" pin of the regulator must be close to the input voltage. If not check ***Polarity Issues***.




***Polarity Issues***

With the positive lead of the voltmeter check the voltage both at the ***Drain and Source*** of Q1. Both must be very close to the voltage that we are watching. Below is a drawing of Q1 pins.




In normal operation Q1 is turned on so there should be little voltage difference between the Drain and Source. If Q1 is not turned on check its orientation along with R6 and C5 for solder bridges and bad solder joints.

### It's Alive

If the Green LED is flashing then Volt Tattler 2 is taking readings. If the Volt Tattler made no sounds at power up (no Morse 'R', .-.), there must be some problem with the 2N3904 circuitry. Check the orientation of the transistor. Check that the speaker is inserted and properly soldered. The speaker can be installed in either polarity. Look for shorts and bad solder joints in the transistor (Q1) and speaker area components.

### It's Whining

If the Green LED is flashing periodically and we have sounds that are not recognized check the following:

If the programming button is shorted the Volt Tattler 2 will announce its version number in Morse code at power up. It will then go to the high threshold programming mode and stay there. This is quite noisy. Power down and look for a short across the Programming Button.

If at power up we hear the Morse "R" followed by a series of 'H's or 'L's we need to check the incoming voltage to see if it is outside the thresholds. If it is high or low we can adjust the power supply voltage between the thresholds to stop the annunciations. Remember that a new Volt Tattler 2 will have a low threshold of around 10 volts and a high threshold around 15 volts.

### It's Whining Inappropriately

If the Volt Tattler 2 is announcing a bad voltage level, yet we measure one that is fine, there may be a problem with resistors R1 and R2. If either resistor is incorrect the voltage that the microcontroller sees will not be the correct ratio of the power supply voltage. This can cause ether high or low sounds to be inappropriately generated. Using our volt meter we can see if the readings are getting to the proper microcontroller pin. Use the high input impedance voltmeter, such as a digital voltmeter or FET analog voltmeter, to make these measurements. Pin 3 is the analog input that is to be measured to check R1 and R2. The voltage at that pin will be approximately related to the power supply voltage as follows:

$V(Pin3) \approx V(PowerSupply)/13$

This will be approximate as it is governed by the ratio of R2 to (R2+R1).

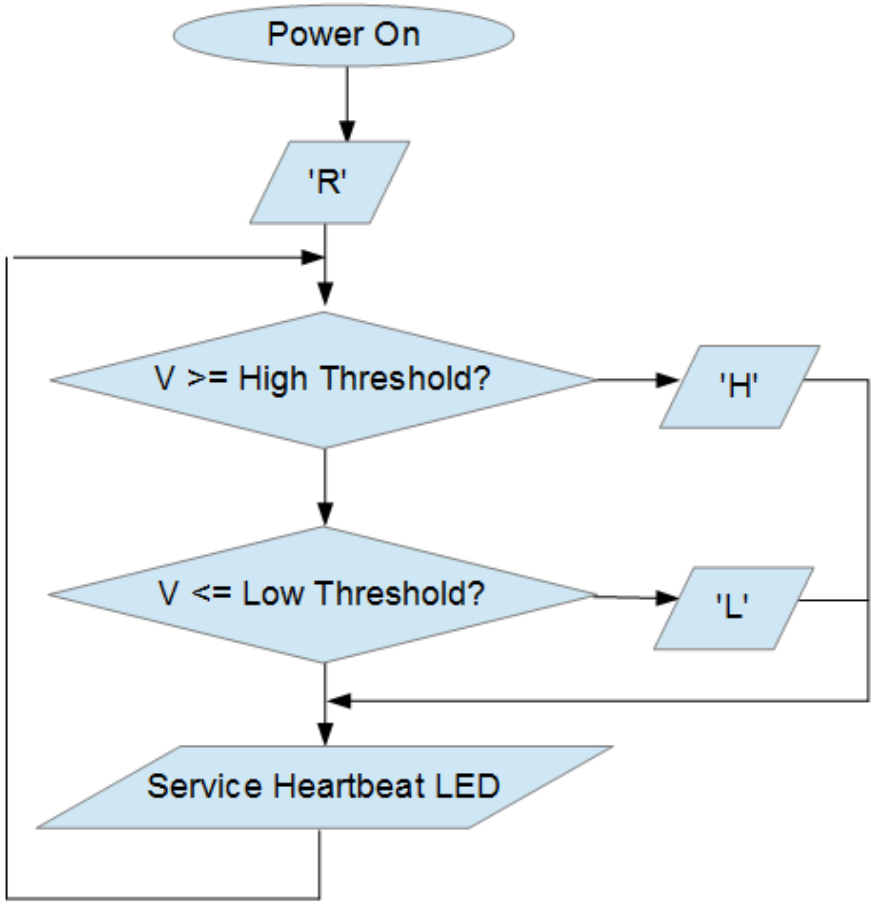
For example if we are feeding the board with 13 volts, the voltage at R2 (Pin 3 of the microcontroller) should be about 1 volt. If the power supply voltage is 26 volts then that voltage should be about 2 volts.

If Volt Tattler 2 sounds repeated Morse question marks '?'attempt to recalibrate the thresholds. If that does not fix the repeated question mark sounds then there is a major problem with the microcontroller and it will need to be replaced.

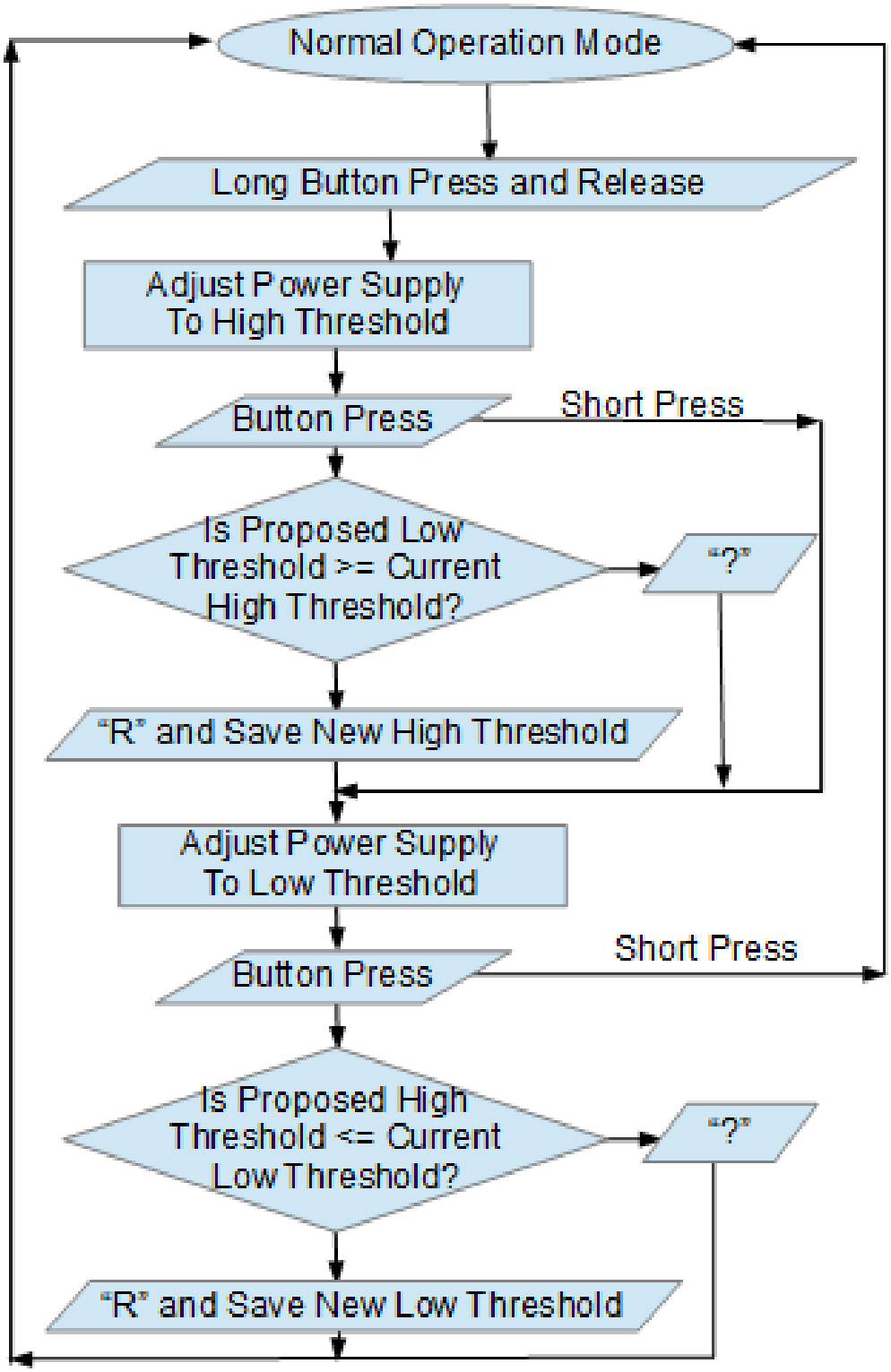
# Appendix A

## Operation Flowchart



## Calibration Flowchart

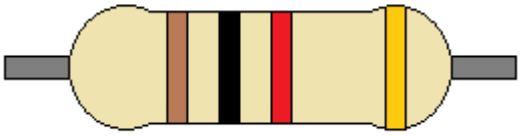


# Appendix B

## 4-Band Resistors

| Band 1 | Band 2 | Band 3 | Tolerance |
|---|---|---|---|
| 0 | 0 | X1 | |
| 1 | 1 | X10 | 1% |
| 2 | 2 | X100 | 2% |
| 3 | 3 | X1K | 3% |
| 4 | 4 | X10K | 4% |
| 5 | 5 | X100K | 0.50% |
| 6 | 6 | X1M | 0.25% |
| 7 | 7 | X10M | 0.10% |
| 8 | 8 | X100M | 0.05% |
| 9 | 9 | X1G | |
| | | | 20% No Band |
| | | /10 | 10% |
| | | /100 | 5% |

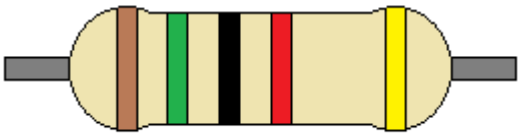


**1K 5%**

## 5-Band Resistors

| Band 1 | Band 2 | Band 3 | Multiplier | Tolerance |
|---|---|---|---|---|
| 0 | 0 | 0 | X1 | |
| 1 | 1 | 1 | X10 | 1% |
| 2 | 2 | 2 | X100 | 2% |
| 3 | 3 | 3 | X1K | 3% |
| 4 | 4 | 4 | X10K | 4% |
| 5 | 5 | 5 | X100K | 0.50% |
| 6 | 6 | 6 | X1M | 0.25% |
| 7 | 7 | 7 | X10M | 0.10% |
| 8 | 8 | 8 | X100M | 0.05% |
| 9 | 9 | 9 | X1G | |
| | | | | 20% No Band |
| | | | /10 | 10% |
| | | | /100 | 5% |



**1.50K 4%**

## 6-Band Resistors

| Band 1 | Band 2 | Band 3 | Multiplier | Tolerance | Tempco |
|---|---|---|---|---|---|
| 0 | 0 | 0 | X1 | | |
| 1 | 1 | 1 | X10 | 1% | 100 |
| 2 | 2 | 2 | X100 | 2% | 50 |
| 3 | 3 | 3 | X1K | 3% | 15 |
| 4 | 4 | 4 | X10K | 4% | 25 |
| 5 | 5 | 5 | X100K | 0.50% | |
| 6 | 6 | 6 | X1M | 0.25% | 10 |
| 7 | 7 | 7 | X10M | 0.10% | 5 |
| 8 | 8 | 8 | X100M | 0.05% | |
| 9 | 9 | 9 | X1G | | |
| | | | | 20% No Band | |
| | | | /10 | 10% | |
| | | | /100 | 5% | |

**1.50K 5% 25ppm/°C**