Progress Direct Systems LLC

Volt Tattler

Owner's Manual

Version 1.01 Revision E

Disclaimer

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

Introduction

Radio Amateurs, audio enthusiasts 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 such questionable power connections. Power supplies fail. 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? If you are not looking at the 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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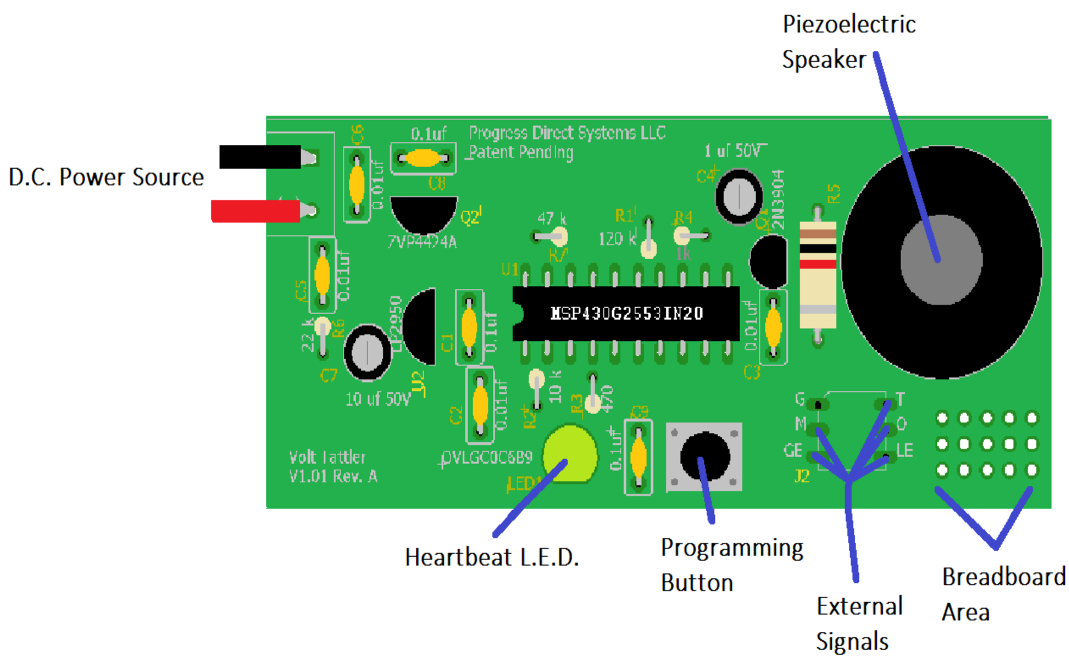
Volt Tattler Board Details

The Volt Tattler board is depicted below.



Power Connections

Although Volt Tattler 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.

Heartbeat L.E.D.

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

Programming Button

This push button provides the capability of programming the Volt Tattler thresholds within its operational range. Instructions for using the Programming Button are included in this manual.

External Signals

A 6-pin socket or 2 3-pin headers 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. (p.21)

Breadboard Area

This area consists of vias and some runs that can be used to construct auxiliary circuitry. This can be useful for adapting the external signals for use outside the board.

Piezoelectric Speaker

This provides the sounds that indicate the status of the Volt Tattler. It announces voltage transgressions and programming states.

Building

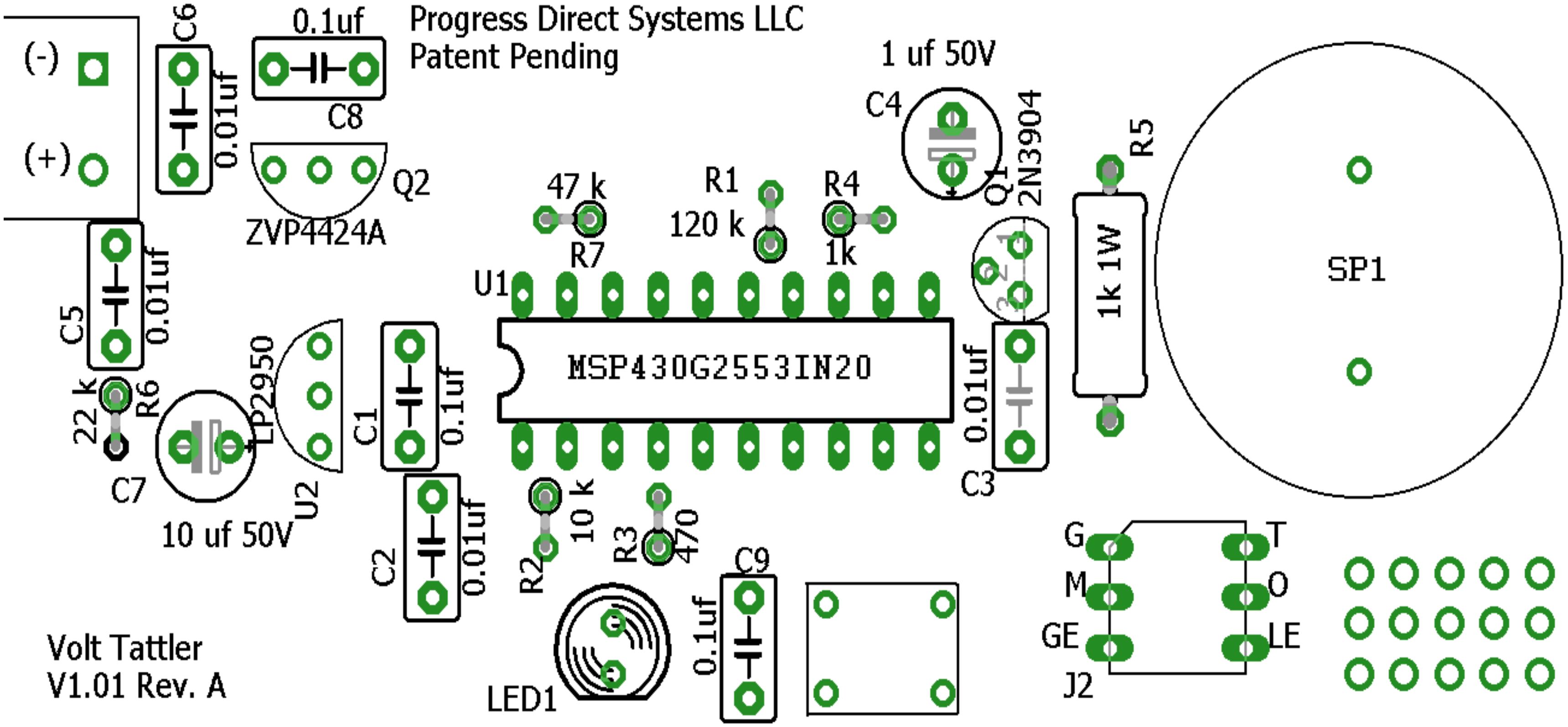
I strongly recommend using a good quality soldering iron and only electronic solder for constructing this project. The soldering iron should be at least 50 Watts and should provide enough heat so that the solder melts quickly. If you have not built a project before I would urge you to watch one of the many YouTube videos on the subject[1]. Practice if possible.

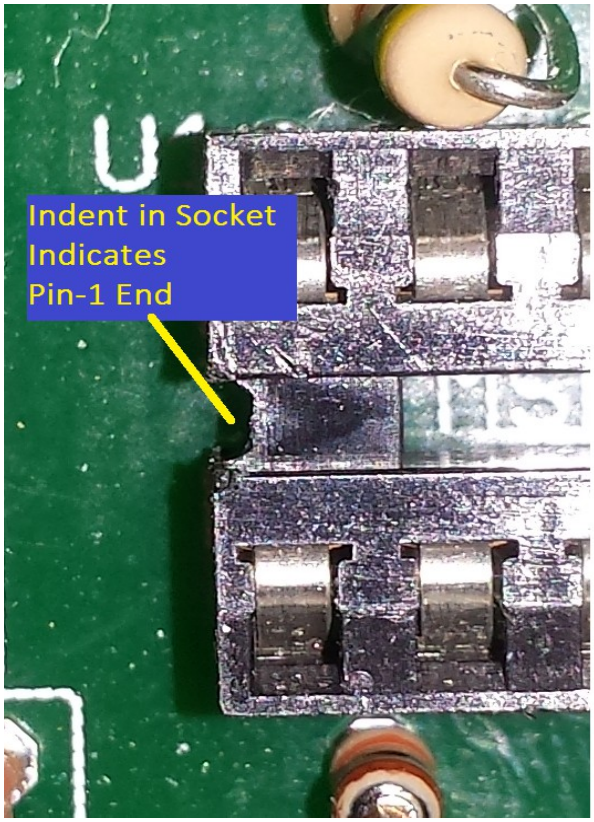
Parts List

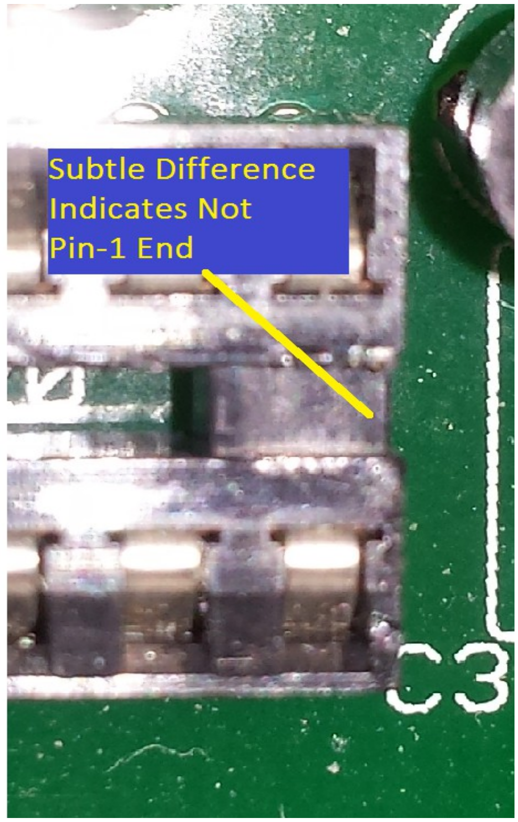
Quantity	Part Number	Description	Designation
1		1K 1W Axial Lead Resistor	R5
1		1K 1/8W Axial Lead Resistors	R4
1		47K 1/8W Axial Lead Resistors	R7
1		10K 1/8W Axial Lead Resistor	R2
1		120K 1/8W Axial Lead Resistor	R1
1		470 ohm 1/8 W axial lead resistor	R3
1		22 K 1/8W axial lead resistor	R6
4		0.01uf 50V disc capacitors (103)	C5, C2, C6, C3
3		0.1uf 50V disc capacitors (104)	C1, C8, C9
1		1uf electrolytic capacitor radial leads	C4
1		10uF 50V Electrolytic Capacitor	C7
1	2N3904	NPN General Purpose Transistor	Q1
1	LP2950-N (KY5033)	TI 3.3V Low Power Voltage Regulator*	U2
1		Clear - Blue/Green T 1 ¾ LED	D1
1		N.O. PCB Mount Pushbutton	PB1
1	ZVP4424A	P channel enhancement mode MOSFET*	Q2
1	PKM22EPPH4007-B0	Piezo Sounder (MuRata)	SP1
1	MSP430G2553IN	TI Low Power Microcontroller with VT firmware*	U1
1		20 pin IC socket	
1		Screw connector block	
1		PCB Rev. 1.01	
* Static Sensitive Component			

[1]A YouTube video by oneTesla I find very straightforward. https://www.youtube.com/watch?v=Qps9woUGkvI

Parts Placement







Construction Phase 1

1. 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 6.

2. Check the alignment of the socket to see that all of the other 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. Generally 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. Don't push the socket into the holes. Eventually all of the pins will be aligned and the socket will bottom out on the board. 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 secure the socket for soldering.

3. 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 briefly heat the one soldered pin while guiding the socket back onto the board. Remove the heat immediately once the socket is properly seated. Allow the joint to cool.

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

5. 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.

6. Next install resistors. The smaller resistors should be installed on one end with the top lead pushed down through the adjacent hole. The Parts Placement diagram for the resistors mounted on end shows a small circle around the side where the resistor is mounted. The other lead will be bent down to go into the other hole for the resistor. Mounting resistors as indicated on the Parts Placement diagram allows test points to be on top of some of the resistors. See the image below to aid in explaining this. R5, the 1K 1W resistor, may be larger than the other resistors. It will lie down rather than stand on one end. See the Parts Placement diagram.

7. Install the capacitors. Be sure to properly orient the 2 electrolytic capacitors according to their polarity. The 103 (0.01uf) and 104 (0.1uf) capacitors may look very similar. Be sure not to interchange them.

8. Install Q1 the 2N3904, the LED and the push button (SW1). Be careful to install the transistor in the proper orientation and the LED in the proper direction. Note that the LED 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 side of the board. The longer lead must be nearer the microcontroller socket. See the picture regarding LED installation below.

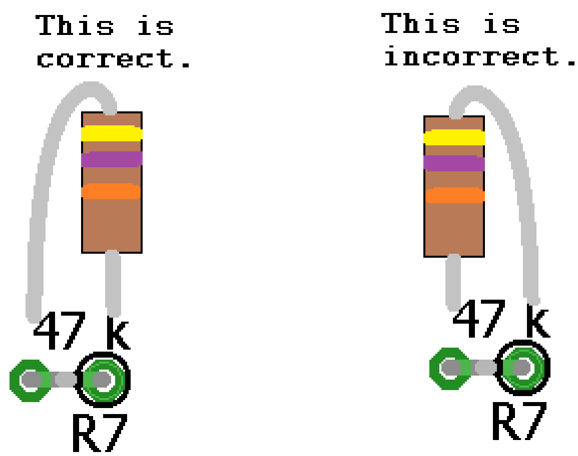
9. Install U2 the LM2950. Again observe orientation of the case.

10. Install Q2 the ZVP4424A. Check the orientation here a well.

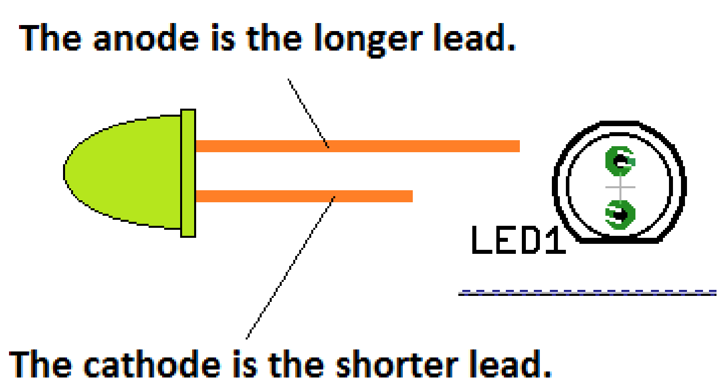
11. Install SP1 the Piezo speaker. The speaker has no polarity.

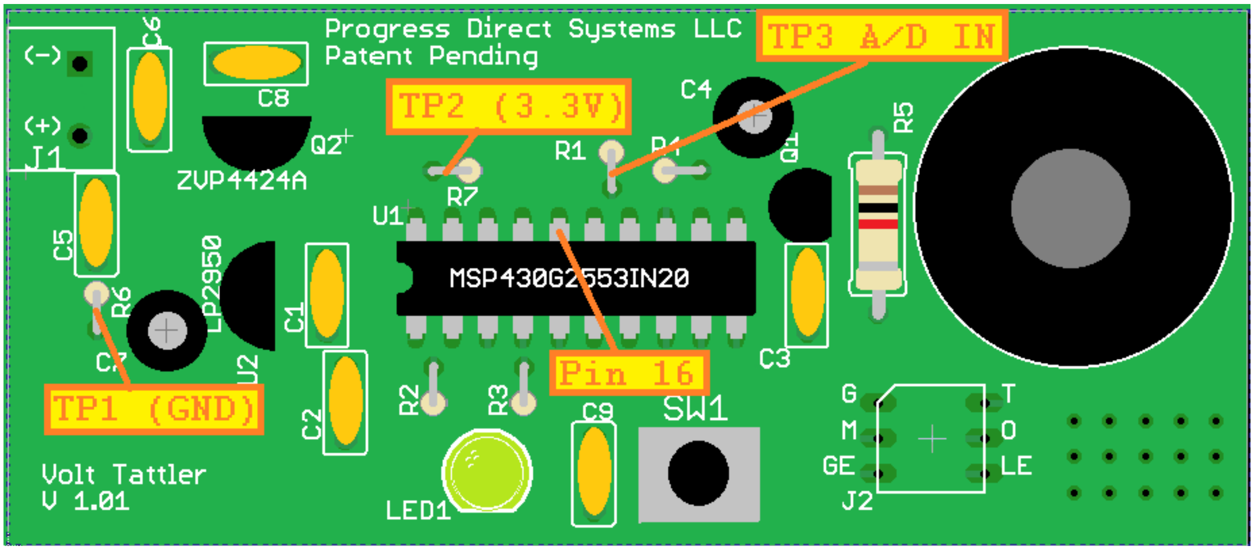
12. Install your included power connector. Not included you may choose to install a 6-pin socket or 2 3-pin headers for the signals.

13. Look over the board both top and bottom. Look for solder blobs and splashes. Look for cold and dry solder joints. Double check the position and orientation of each component.



Note the correct way to install a resistor is to put the resistor on the side of the circle on the Placement Diagram.





Testing Phase 1

If you installed the resistors carefully you will have most of your test points on top of the resistors. Above you see the three test points. Using the positive lead of your high impedance multimeter measure voltages as follows:

1. 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.

2. If 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 a 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.

3. Assuming everything is stable, set your multimeter to measure DC voltage. If your multimeter is not autoranging set your range above the supply voltage. Connect the negative lead of your multimeter to **TP1 (GND)** on the top of R6. Using the positive lead measure the 3.3V supply to the microcontroller at **TP2** (the top or R7). 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.

4. Next move the + voltmeter lead to **TP3** (Pad 3 of the microcontroller). You should see somewhere near 1 volt (assuming 12V was applied as power).

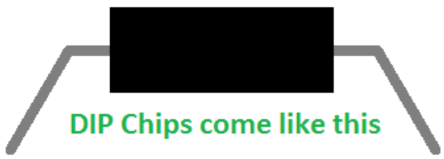
5. Move the + voltmeter lead to the pad for **Pin 16** of the microcontroller. This should read close to +3.3V.

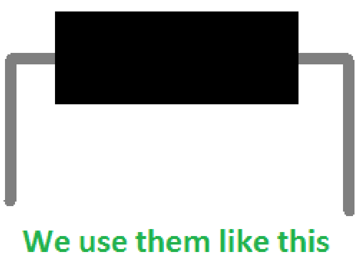
6. If everything above looks good disconnect from power and proceed to installing the microcontroller.

Construction Phase 2

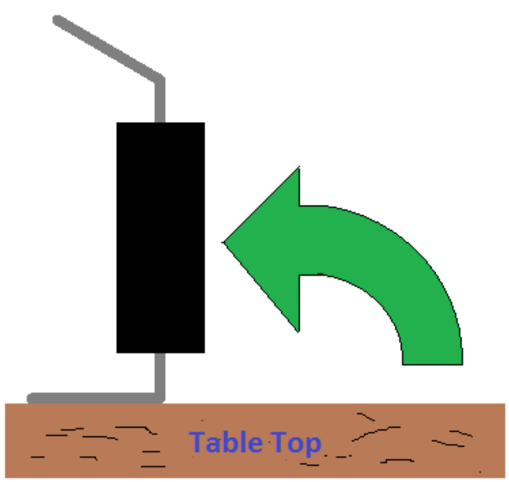
Preparing the Microcontroller for Installation

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 the pins are perpendicular to the body of the chip. Pins on both sides must be parallel. Here we see two views of the end of a DIP chip like the Microcontroller.



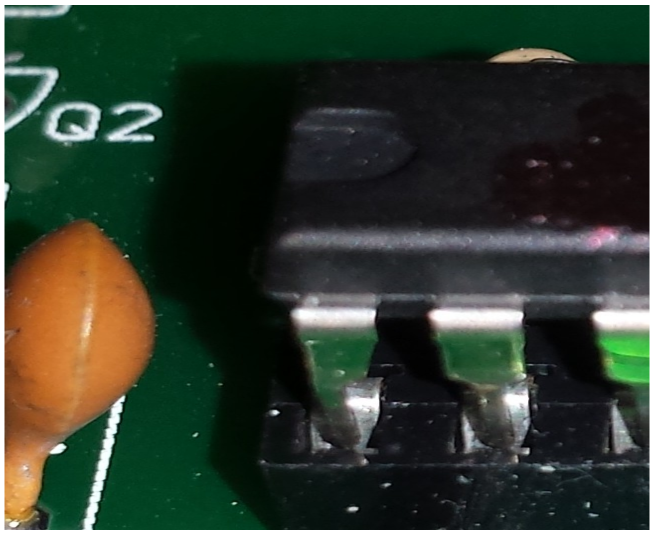


When we get the chips the leads are usually splayed out on an angle. This promotes proper tension for automated insertion machines but causes grief trying to manually install the chips into a board or socket. Use your work surface to bend all of the pins at the same time while keeping them in line.

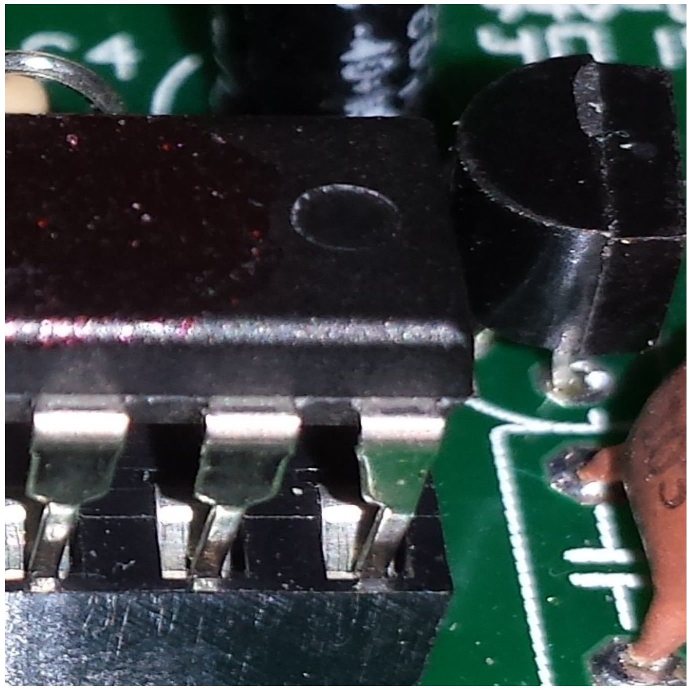


Soldering the Microcontroller

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 the microcontroller. The following picture is NOT of the pin 1 end of the microcontroller. There is a small circle. But the notch marks the end of pin 1.



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

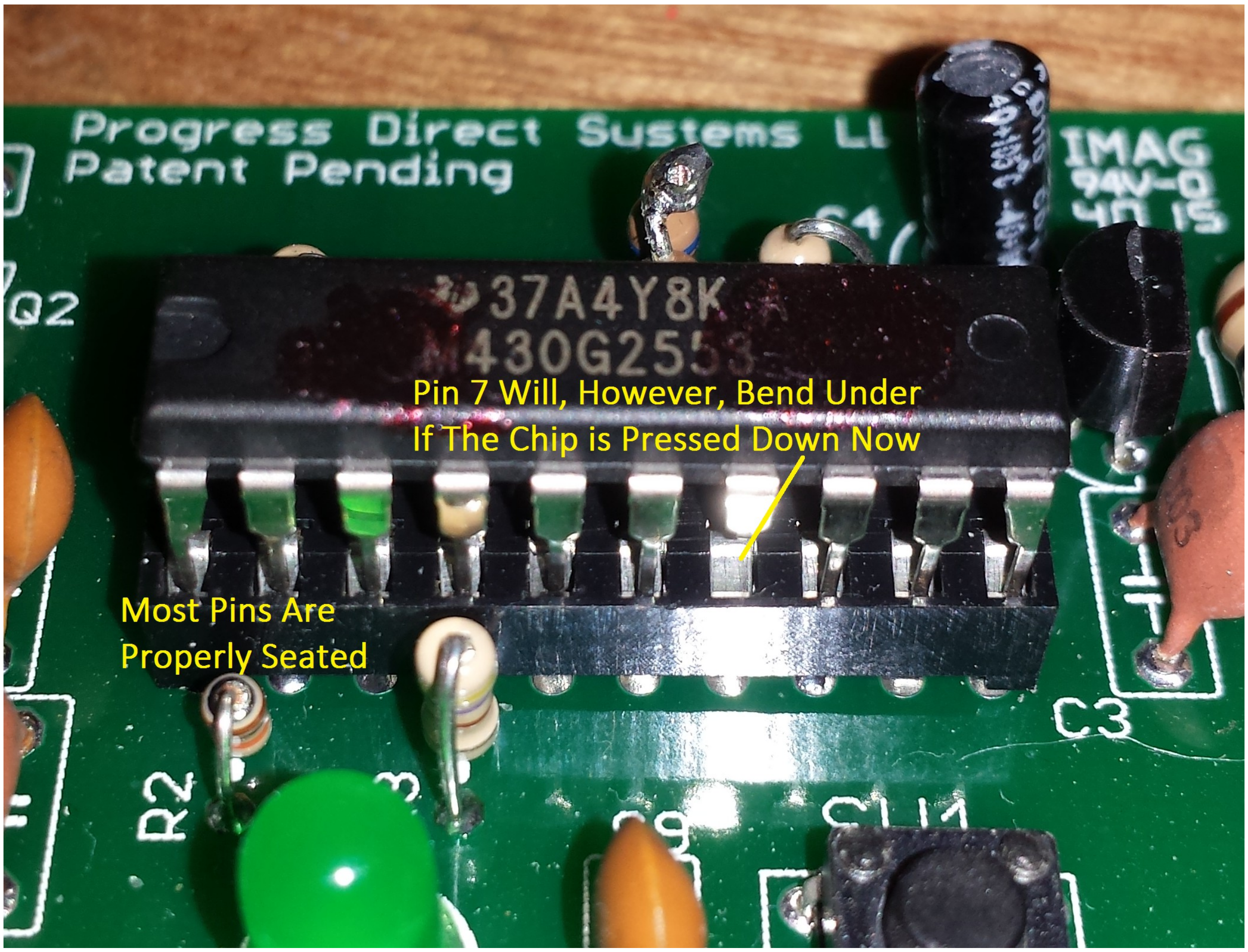
Solder one corner pin of the chip to its pad. Check the alignment of the chip to see that all of the other pins are still in place and that the chip is seated flat against the PC board. If there are pins out of place or the chip as moved up on one end, briefly heat the one soldered pin while guiding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

Finally 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, solder shorts, unsoldered or badly soldered connections etc.

Seating the Microcontroller into a Socket

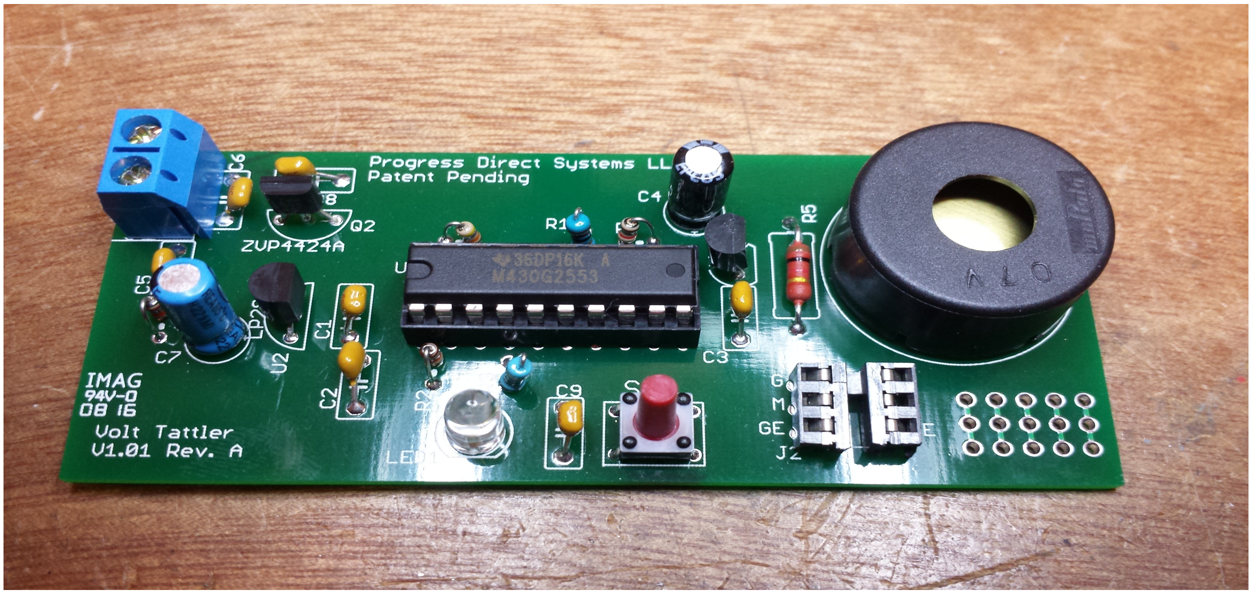
If you are using a socket perform the pin straightening exercise previously discussed. Rest the controller in the socket in the proper orientation. Check that all of the pins are properly resting in each of their receptacles in the socket. Any pins outside the socket will not make contract and may cause the Volt Tattler 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 should "bottom out" on the socket.



Here 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 direction 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 pin out of place or improperly soldered to cause the Volt Tattler to malfunction.



Above is a picture of a fully assembled Volt Tattler. Yours should look like this before this full test.

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 heartbeat LED to see that it is flashing. If the LED is not flashing then remove power, look for a build problem and try again. If you got the sound but the LED is not flashing check the 470 ohm resistor and for proper orientation of the LED. The flattened side (if one is flattened) and the short lead of the LED must be toward the edge of the board.

If the 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. Connect the new Volt Tattler to the adjustable power supply, watching polarity. Adjust the supply voltage up above 16V. 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).

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 the alarm will stop. The Volt Tattler should become silent and the Heartbeat LED should be flashing indicating the Volt Tattler is functioning.

Continue adjusting the voltage down to about 9 volts. The Volt Tattler should start to repeatedly sound Morse ‘L’ (.-..) indicating that the voltage has passed below the low threshold.

Again returning the voltage in between about 10 and about 15 volts should silence the alarm.
<u>IMPORTANT: These thresholds are only valid on a Volt Tattler that has not been reprogrammed. If the unit has been reprogrammed then the thresholds will act according to their newly calibrated values.</u>

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

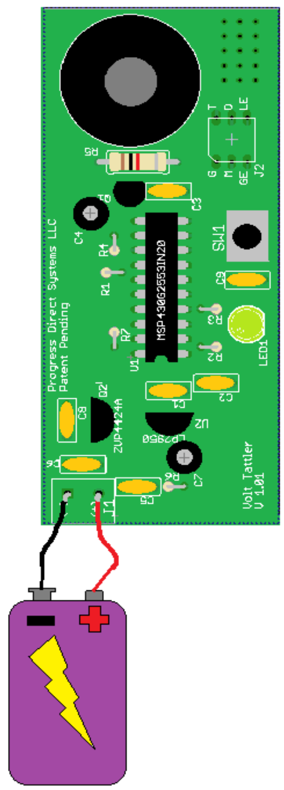
	V Between Thresholds	**V Above High Threshold**	**V Below Low Threshold**
L (LE)	Low	Low	High
GE (HE)	Low	High	Low
O (OOR)	Low	High	High
M (Morse)	Low	Keying Morse ‘H’ (….)	Keying Morse ‘L’ *(.-..)
T (Tone)	Low	Sounding Morse ‘H’ (….)	Sounding Morse ‘L’ (.-..)

The 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.

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.

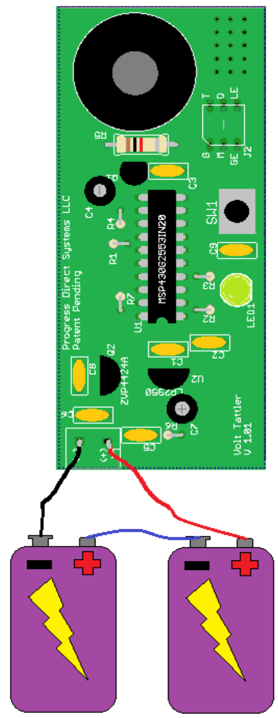
Low Voltage Tattling



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 heartbeat LED 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 should announce the Morse ‘R’(.-.) then repeat Morse ‘H’ (….). The LED should also be flashing.

Function

Volt Tattler'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 can provide practical protection for any piece of equipment powered by DC voltage from 4 volts up to around 27 volts. It draws less than 1 milliamp[2] 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. This way you are warned against high voltage levels while adjusting things during setup. And 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.

2

Near 13.8V

Signals Generated By Volt Tattler

In addition to the audible output, Volt Tattler supplies the following signals[3]:

- The audible tone signal (0V – 3 V)
- A Morse key of the audible warning to key an external oscillator (0V = Key Up, 3V = Key Down)
- A signal that goes high if the voltage is out of range (0V = Normal, 3V = Out of Range)
- A signal that goes high only if the voltage goes above the high threshold (0V = Normal, 3V = V High)
- A signal that goes low only if the voltage is below the low threshold (0V = Normal, 3V = V Low)
- Following is a list of the external signals available from Volt Tattler.

	V Between Thresholds	**V Above High Threshold**	**V Below Low Threshold**	**Max Low Current Sink mA**	**Max High Current Source mA**
L	Low	Low	High	-6	6
GE	Low	High	Low	-6	6
O	Low	High	High	-6	6
M	Low	Keying 'H'	Keying 'L'	-6	6
T	Low	Audio Frequency 'H' (….)	Audio Frequency 'L' (.-..)	-3	3
G	Low	Low	Low	NA	NA

[3] These signals are provided from the microcontroller directly. Their common (GND) connection is also provided.

Operation

The microcontroller for a new Volt Tattler 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 VoltTattler to your desired alarm thresholds.

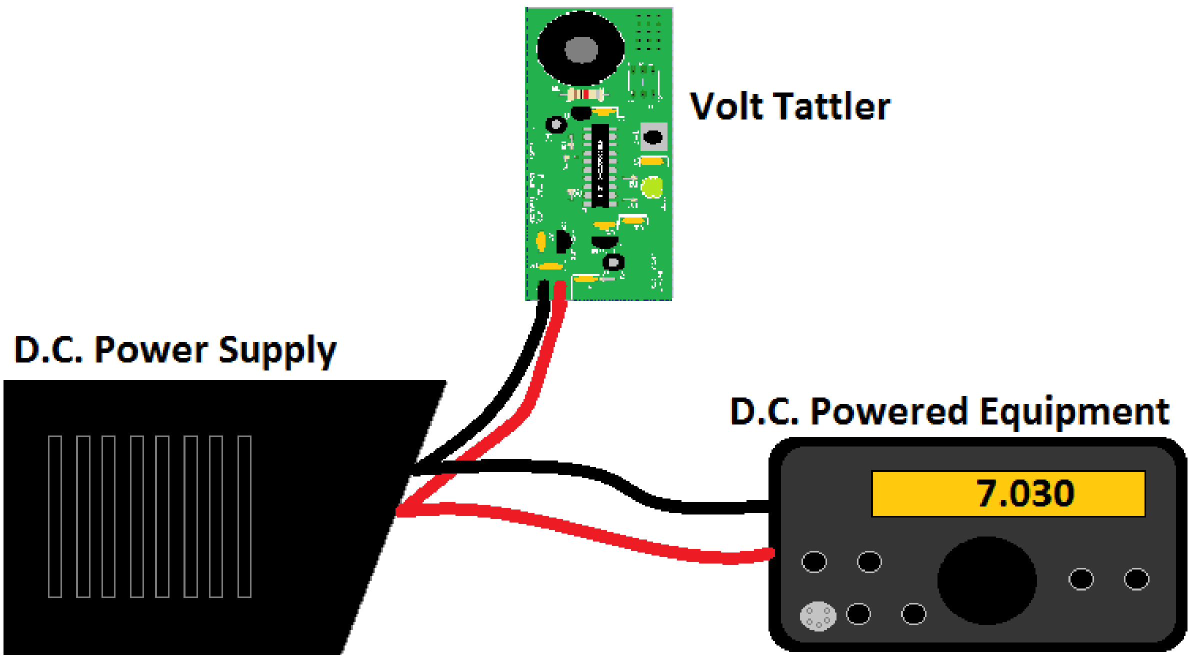
When VoltTattler powers up it acknowledges the power up by sounding a Morse 'R' (.-.). This is a kind of "***roger***" letting you know that it has activated. In normal operation VoltTattler is silent with only the green "heartbeat" LED flashing to indicate that the system is active. Once powered on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

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

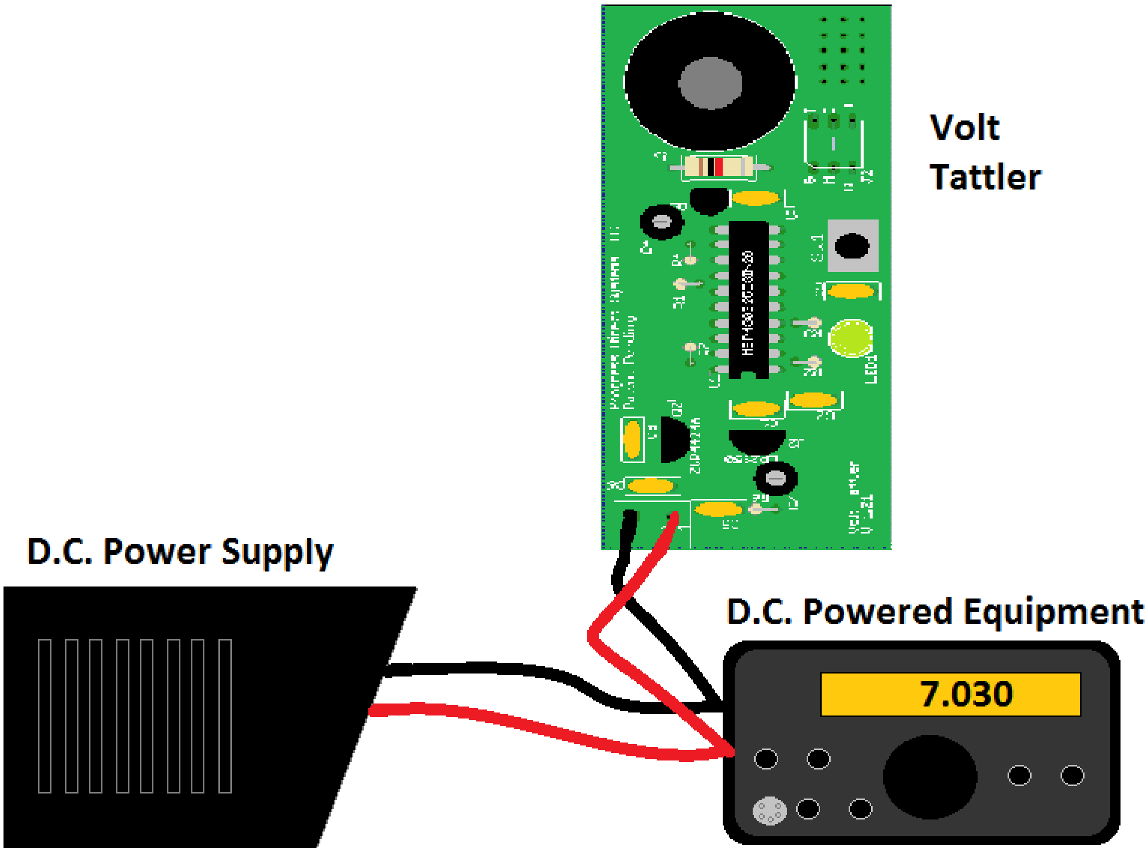
Wiring Volt Tattler into the System

At the Source

One way to set up VoltTattler is near the power supply source. At the supply or distribution panel VoltTattler 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 may indicate that another supply or a larger supply is needed.



At the Equipment



Setting up VoltTattler 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 and then came back again (intermittent connection). This can be very useful in troubleshooting a system.

Another Example

Attaching VoltTattler 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 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

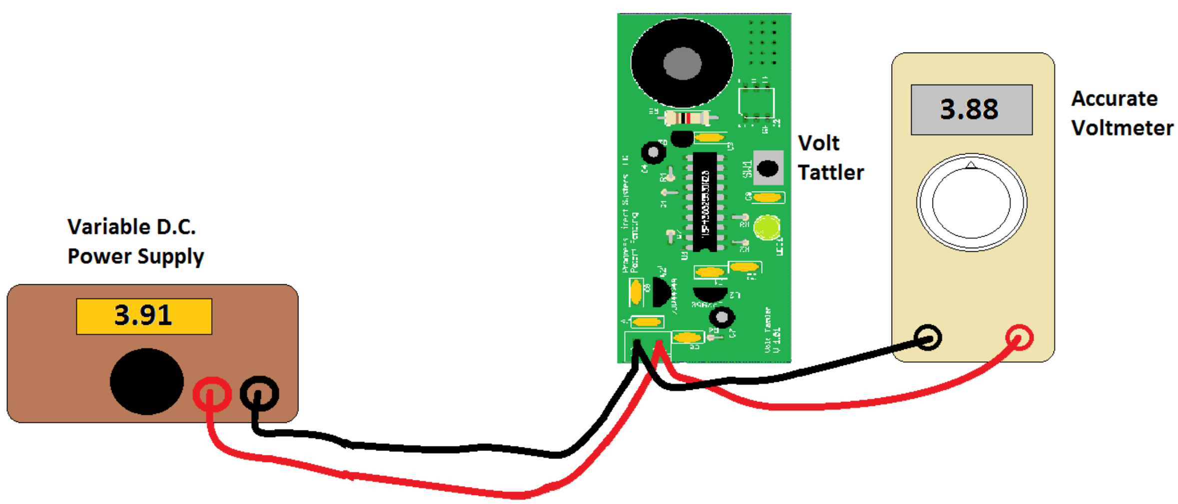
Calibration requires 3 pieces of equipment:

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

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

3. <u>**AVOID LOSING POWER DURING THIS STEP. LOSING POWER HERE WILL HAVE UNPREDICTABLE CONSEQUENCES ON THE VOLT TATTLER OPERATION.**</u> 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') <u>listen as you release the button</u>. If VoltTattler sends the 'R' (roger, .-.) the new threshold was set properly. If VoltTattler sends a Morse Question Mark '?' (..--..) the high threshold was not set. <u>This is probably because you tried to set the high threshold at or below the low threshold. VoltTattler does not allow that</u>. You will need to move on to finish the low calibration then return here and repeat setting the high threshold.

4. <u>**AVOID LOSING POWER DURING THIS STEP. LOSING POWER HERE WILL HAVE UNPREDICTABLE CONSEQUENCES ON THE VOLT TATTLER OPERATION.**</u> Once the high threshold calibration has been completed, successfully or not, the VoltTattler 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', <u>listen for the next character as you release the Programming Button</u>. 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 programming the low threshold will need to be repeated.

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 will frequently sound the last threshold that was adjusted. This is simply because the power supply will be at that threshold. Adjust the power supply through the working range, beyond both thresholds and observe the proper functioning of VoltTattler to your specifications. If it does not function as desired simply go back to step 1 and adjust the offending calibrations.

Calibration Notes

Disconnecting the power at any time will cause VoltTattler 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 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 thresholds end up after programming one can always start over and program each threshold.

Skipping Calibrations

You may only want to calibrate one threshold. Perhaps VoltTattler 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 2 or more times to return VoltTattler to the normal monitoring mode. Of course cycling the power will also return the Volt Tattler 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 button press can 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 Mores 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. In calibration modes means that VoltTattler is ready to program the high threshold.
L	● ▬ ● ●	Low indicates that the supply voltage is less than or equal to the low threshold. Low in calibration modes means that VoltTattler is ready to program the low threshold.
E	●	Indicates that a long button press has been recognized.
?	● ● ▬ ▬ ● ●	A question mark means that a programing 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. A continuous stream of question marks at power up indicates that VoltTattler has detected an error in reading the calibration values at power up. This may indicate a hardware problem. If recalibration fails the unit 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 4 volts.

Volt Tattler Cannot/Should not

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

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

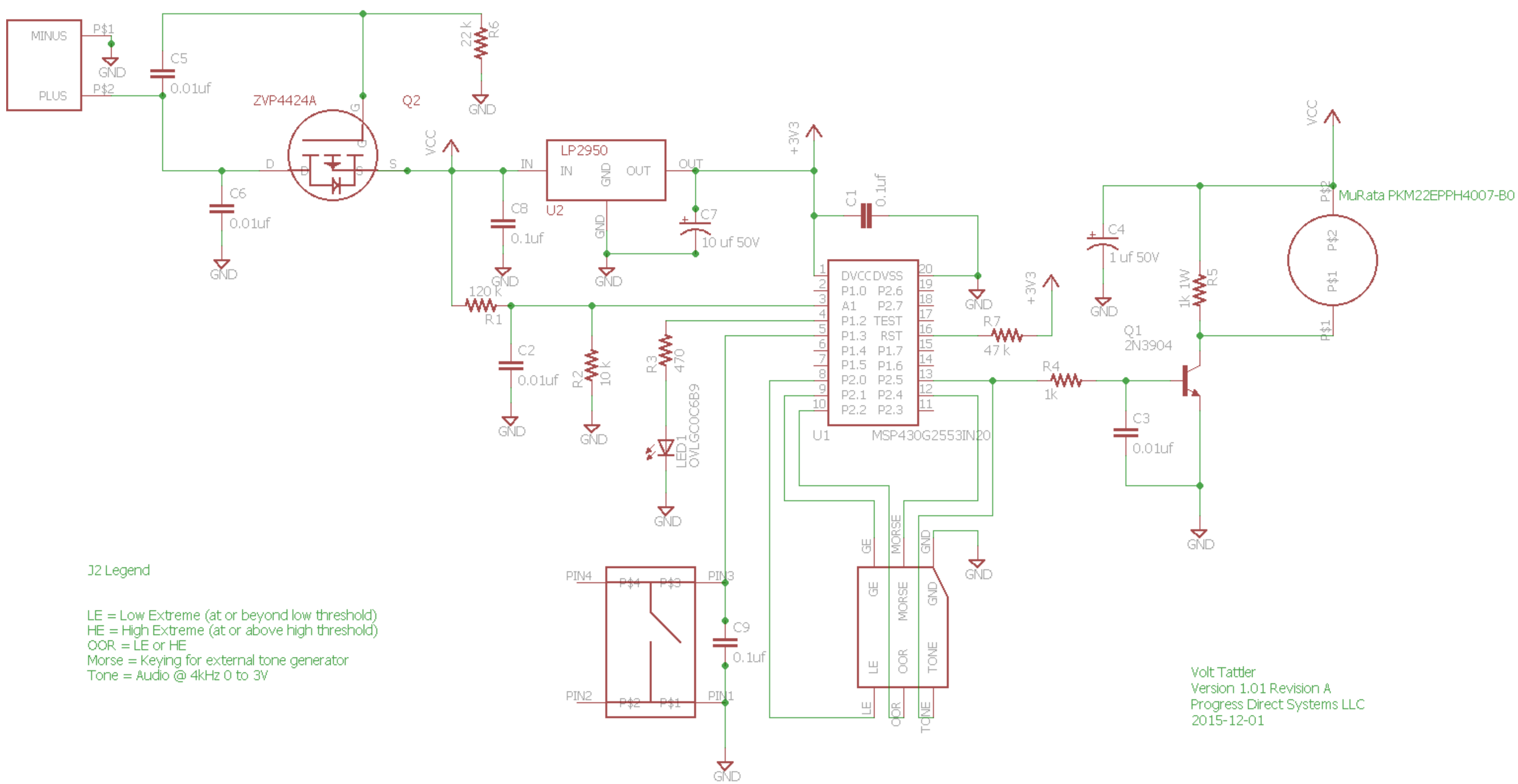
A Volt Tattler cannot reliably measure highly noisy D.C. voltages. If your D.C. voltage is quite noisy then you have a problem with the voltage source that should be remedied.

A Volt Tattler 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 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 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


MINUS
PLUS
P$1
P$2
GND
C5
0.01uf
ZVP4424A
Q2
22 k
R6
C6
0.01uf
VCC
LP2950
IN
GND
OUT
U2
C8
0.1uf
C7
10 uf 50V
+3V3
C1
0.1uf
120 k
R1
C2
0.01uf
R2
10 k
R3
470
LED1
OVLGC0C6B9
DVCC DVSS
P1.0 P2.6
A1 P2.7
P1.2 TEST
P1.3 RST
P1.4 P1.7
P1.5 P1.6
P2.0 P2.5
P2.1 P2.4
P2.2 P2.3
U1
MSP430G2553IN20
R7
47 k
R4
1k
C3
0.01uf
Q1
2N3904
C4
1 uf 50V
1k 1W
R5
MuRata PKM22EPPH4007-B0
PIN4
PIN3
PIN2
PIN1
C9
0.1uf
GE
MORSE
LE
OOR
TONE
J2 Legend
LE = Low Extreme (at or beyond low threshold)
HE = High Extreme (at or above high threshold)
OOR = LE or HE
Morse = Keying for external tone generator
Tone = Audio @ 4kHz 0 to 3V
Volt Tattler
Version 1.01 Revision A
Progress Direct Systems LLC
2015-12-01

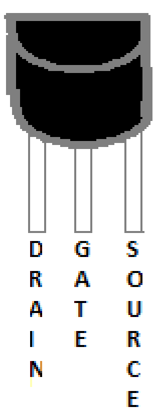
Troubleshooting

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

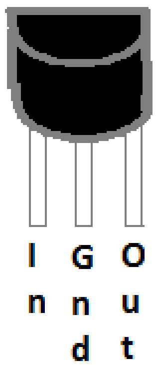
First look for smoke. Feel the board for heat. Sources of heat or smoke are an indication of something major being wrong. Immediately power down and look for shorted traces and incorrectly oriented components.

Assuming no smoke or heat is observed look at the Heartbeat LED. If it is flashing we can skip ahead to ***Its' Alive***.

If the LED is not flashing we must be sure we actually have proper voltage coming into the microcontroller. First check the connection polarity to the Volt Tattler. Although the unit is protected against reverse polarity it cannot function that way. Connect the negative lead of a DC voltmeter to the negative voltage source (**TP1 GND**). With the positive lead of the voltmeter check the voltage at the ***Drain*** of Q2. It must be very close to the voltage that we are watching. Below is a drawing of Q2 and its pins.



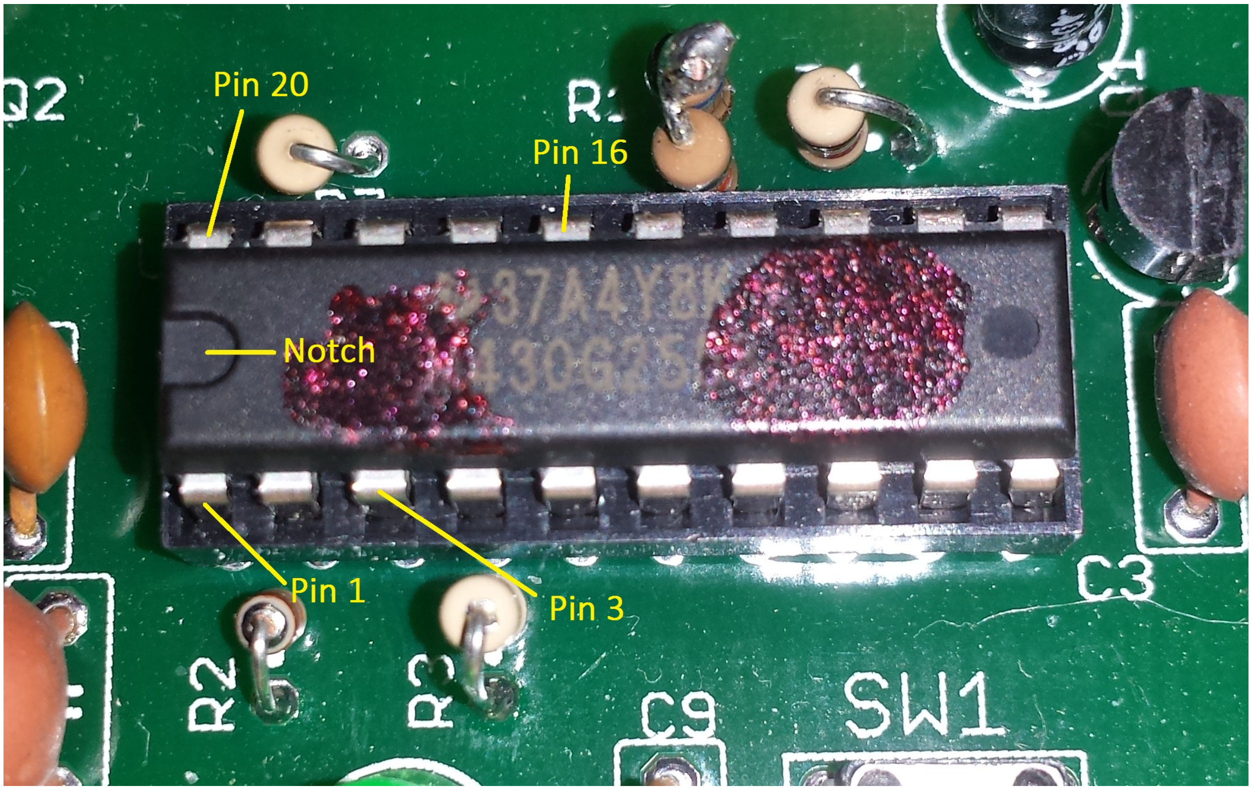
If the voltage is close to what we measure coming in then we want to check the other side of the reverse polarity protection. Move the positive voltmeter probe to the ***Source*** of Q2 then to the ***In*** port of the LP2950. Both of these should be nearly the same as the incoming voltage. If the Drain has voltage but the Source does not then Q2 is not turning on or the rest of the unit is drawing far too much current. Again check for shorts and improper component placement. Check that the ***Gate*** of Q2 is below the ***Drain*** by at least a few volts. If not perhaps C5 has shorted.



If there is 5 volts or more at the ***In*** pin of the LP2950 check that the ***Gnd*** pin is at 0V and that the ***Out*** pin is at about 3.3V. If the ***Out*** voltage is 0 or below 3V there may be a short on the output. Look for traces that have shorted. If it is high (> 3.5V) be sure that the ***Gnd*** terminal is near 0V.

If the output of the LP2950 is near 3.3V check the power to the microcontroller. Pin 1 must be about 3.3V and pin 20 must be 0 V. If not then follow the power chain again from Q2 through U2.

If there is proper 3.3V to the power pins of the microcontroller, be sure that the microcontroller was installed in the proper orientation. Pins 1 and 20 are at the end of the chip that is marked by a notch.



If the microcontroller is installed properly and the voltage to the power pins is proper, check the direction of the installed LED. If it is installed backward it will not flash and may even be damaged.

If the LED is still not flashing check R7 to be sure that pin 16 is near 3.3V. The microcontroller will not run if R7 is not pulling up Pin 16.

It's Alive

If the LED is flashing then Volt Tattler 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 LED is flashing periodically and we have sounds check the following:

If the programming button is shorted the Volt Tattler 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 will have a low threshold of around 10 volts and a high threshold around 15 volts.

It's Whining Inappropriately

If the Volt Tattler 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. We can see if the readings are getting to the proper volt tattler 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 related to the power supply voltage as follows:

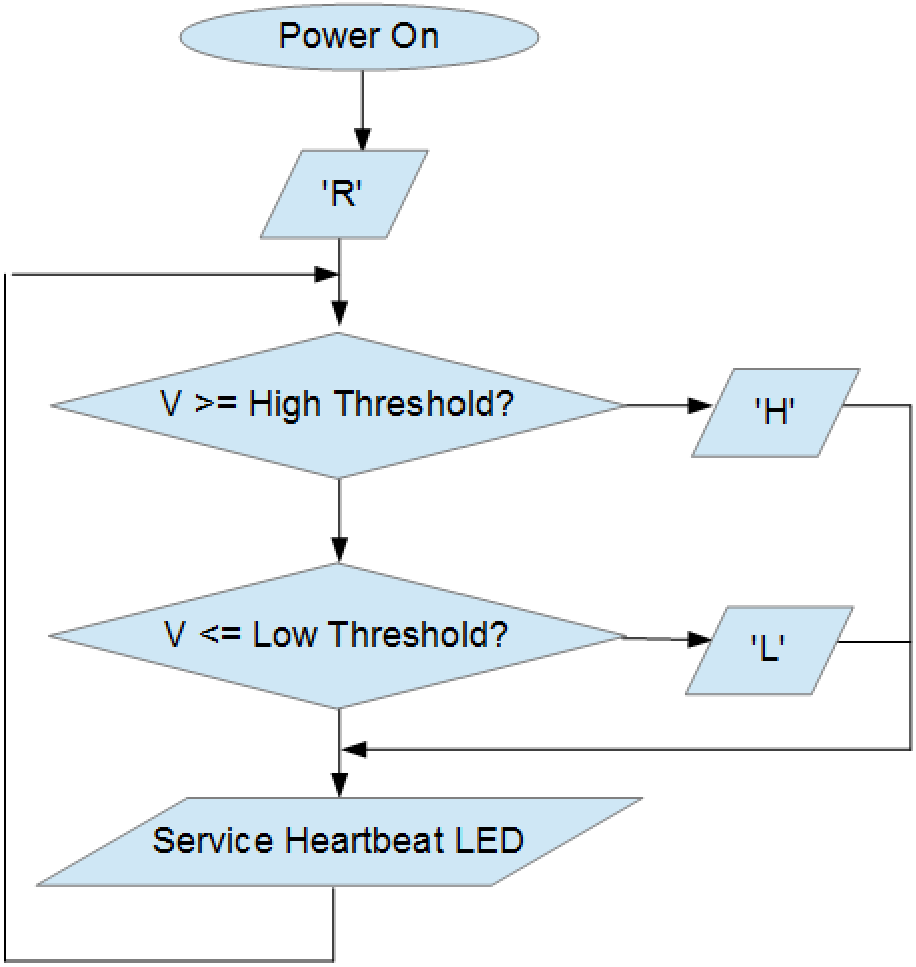
V(Pin3) ≈ V(PowerSupply)/13

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

Operation Flowchart



Calibration Flowchart