VPM-1

Assembly Manual

VOLUME PEDAL MOD

ZEPPELIN DESIGN LABS

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VPM-1
MOD FOR ERNIE BALL VOLUME PEDALS

Assembly Manual

WARNING: THIS IS NOT A BEGINNERS SOLDERING PROJECT. THE COMPACT SIZE AND SMALL FOOT PRINTS OF THE COMPONENTS ON THE VPM-1 CIRCUIT BOARD CAN BE DIFFICULT TO SOLDER. WE HIGHLY RECOMMEND COMPACT CIRCUIT BOARD SOLDERING EXPERIENCE AS A PREREQUISITE FOR THIS KIT. ZEPPELIN DESIGN LABS IS NOT RESPONSIBLE FOR THE SUCCESS OF YOUR KIT AND WE CAN NOT ACCEPT RETURNED KITS FOR REPAIR.

INTRODUCTION

ABOUT THE ERNIE BALL VOLUME PEDAL

The Ernie Ball volume pedal has been around since 1975. The chassis of these early volume pedals was originally made from two pieces of angle iron welded together, which earned them a reputation of being extremely robust. Later, the chassis was replaced with a solid aluminum extrusion that greatly reduced the weight while retaining the structural integrity of the original. A somewhat novel approach was used to alter the value of a volume potentiometer incorporating a string and a set of springs, reminiscent of the tuning wheel on older analog radios. Over the years, some minor mechanical and electrical design changes have been made, but the general concept of how these pedals work has remained the same.

The Ernie Ball volume pedal has a lot of great features. Being made out of solid aluminum, it is nearly indestructible. The string and spring mechanism for turning the potentiometer creates a very smooth response in volume. Also, the placement of the axle on the treadle makes for a very comfortable pedal action. It's no wonder that the Ernie Ball volume pedal is the most popular volume pedal in the world.

But for all its great features, there are a couple of serious down-sides to this pedal. Since the audio signal is sent straight through the potentiometer, any problems with the potentiometer are directly translated to the audio signal. This means that if the potentiometer gets dirty or worn out, the audio signal can sound scratchy. Also, the passive nature of this pedal means that the electrical load of the potentiometer can have drastic tonal effects on the signal. Any stray capacitance in the guitar cable or anywhere else in the system will create a RC (resistance-capacitance) filter when coupled with the given value of the potentiometer. When the potentiometer is turned all the way up, to a higher resistance, this effect is less noticeable; but when the potentiometer is turned to a lower resistance, the high frequencies in the audible range start to become attenuated. This is what causes the "tone suck" effect when adjusting the volume control on a passive guitar. Many musicians have resorted to adding a buffer pedal before their passive volume pedal to help rectify this issue.

Another serious issue with these Ernie Ball volume pedals involves the string and spring mechanism for adjusting the potentiometer. Over time, the string can actually stretch and cause the action of the pedal to be off. This often manifests itself in the potentiometer not getting turned all the way in one direction or the other, which prevents the audio signal from getting as loud or as quiet as it should.

Eventually the string will wear completely out and break. Most long-term Ernie Ball volume pedal users have experienced this, and usually at the most inopportune times. Few things make a guitarist more frustrated than not being able to turn up their volume before a solo.

These limitations of the stock Ernie Ball volume pedal have driven a lot of frustrated guitarists to create their own mods for this pedal. Mostly these mods just incorporate a buffer or boost circuit into the pedal to counteract the "tone suck" effects of the passive potentiometer. Here at Zeppelin Design Labs, we have been fans of the Ernie Ball Volume Pedals for years, and have developed our own mod. Born out of a frustration with its limitations and a passion for its potential, we have created what we think is the "mother of all volume pedal mods." We've improved upon every limitation of these pedals while retaining all the great characteristics that make them the most popular volume pedals of all time.

HOW THE VPM-1 WORKS

Our first goal with this mod was to eliminate the string. We replaced it with a magnetic distance sensor, called a Hall effect sensor. A magnet is affixed to the underside of the treadle and the Hall effect sensor outputs a voltage proportional to the distance to the magnet. See Figure 1, page 5. This voltage is fed into the ADC (analog to digital converter) of a microcontroller. A microcontroller is a tiny computer capable of receiving and sending voltages. This microcontroller manipulates the brightness of the LEDs inside a pair of optocouplers, based on the voltage from the Hall effect sensor. These optocouplers each contain a light-dependent resistor (LDR) which work together to control the volume of the audio signal. The audio path is completely analog, but it is digitally controlled through the LEDs in the optocouplers. Because the audio is digitally controlled, we can easily change many parameters of how the signal is processed. First, we've incorporated five different tapers (or sweeps, or response curves),

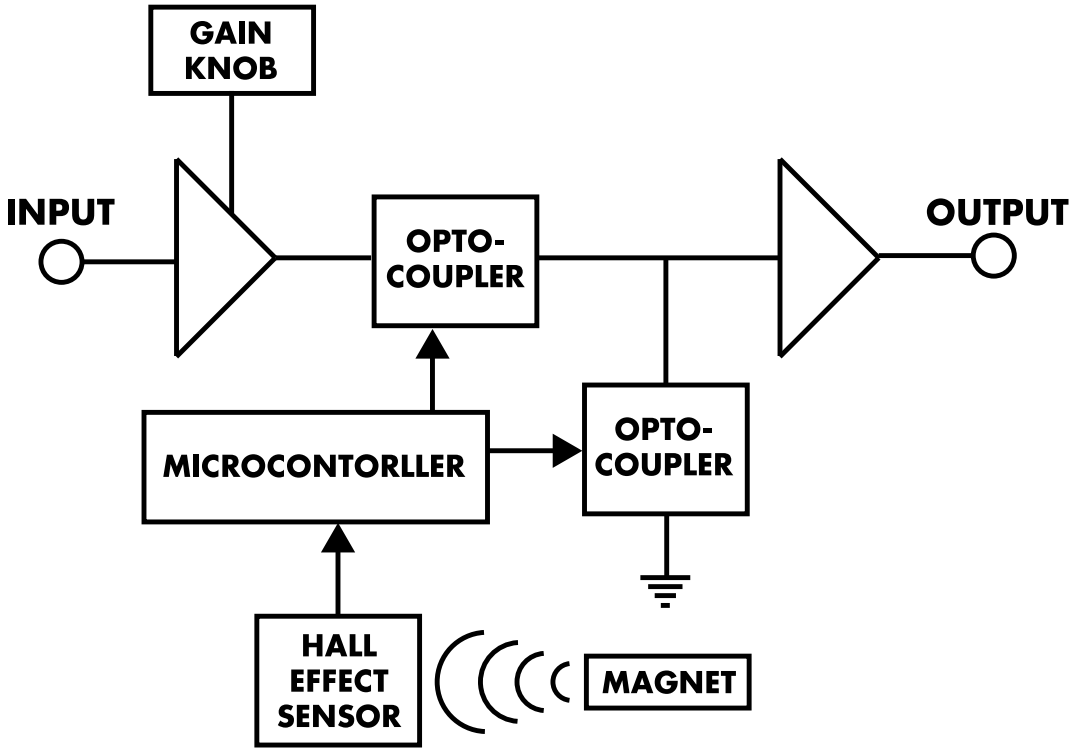
including logarithmic, linear, and reverse logarithmic. Next, we've included a "reverse" feature that allows you to reverse the treadle action. Finally, one of the most useful features of this mod is the ability to program the pedal positions for minimum and maximum volume, which allows you to set the active range of the pedal's sweep.

The VPM-1 comes standard in mono configuration, but stereo configuration is available with a small add-on upgrade board. In the stereo configuration, the VPM-1 can operate as either a traditional stereo volume pedal where both audio channels get louder and quieter together, or it can operate as a "pan" pedal, where one audio channel gets louder as the other gets quieter. Pan mode enables the user to pan between two different signals. Another add-on upgrade board gives the VPM-1 the ability to be used as an expression pedal, with programmable settings to accommodate the different expression jack wiring configurations found on a wide range of effects pedals.

For a complete discussion of the VPM-1's features and controls, please see the VPM-1 Owner's Guide, available from www.zeppelindesignlabs.com.

If you ordered the Stereo upgrade or Expression upgrade with your VPM-1 kit, you will find their parts in their own labeled packages. This assembly manual describes the assembly of these upgrade boards right along side the main board. If you didn't opt for either of these upgrades, just ignore the assembly instructions for these boards.

Figure 1: VPM-1 Block Diagram



WHAT'S IN THE BOX

Table 1: VPM-1 Standard Kit Bill Of Materials (BOM) is a complete parts list of everything that should be present in your kit, followed by photos of each part. Print the BOM and carefully go through the kit, identifying every part. Please read about the proper handling of integrated circuits (ICs) in step 4 on page 22 before removing anything from the silver static-protective bag. Note that some of the components may be difficult to tell apart. Compare them carefully with the photos. Besides verifying that nothing is missing, this will acquaint you with the parts and their names. If ANYTHING is missing, first double-check; we double-checked before sealing the box at our lab! If it's still missing, EMAIL US right away at info@zeppelindesignlabs.com. If we goofed and shorted your kit, we will get replacement parts in the mail to you as soon as possible. If you lose or damage anything, we will be glad to sell you replacements. The unusual or custom components can be ordered directly from us (contact info@zeppelindesignlabs.com). For more common parts, like resistors, capacitors, or screws, you may prefer to go to a local electronics or hardware store.

TIP: Empty the parts of the kit into a bowl, NOT onto the cluttered workbench, or onto the living room carpet! This will protect you from losing tiny parts.

If you ordered either the Stereo or Expression Upgrades with your VPM-1 kit, you will have an extra parts bag or two containing these kits. Throughout this assembly manual, these upgrade components will be installed along side the other components with appropriate notes. If you ordered the Large Format Adapter kit, instructions for its installation are in the "PUTTING IT ALL TOGETHER" section.

Figure 3 is a picture of the Stereo Upgrade kit contents, and Table 2 is its BOM. Figure 4 shows the Expression Upgrade kit and Table 3 is its BOM. Likewise, Figure 5 shows the Large Format Adapter Kit and it's BOM is in Table 4. As with the main board parts, please carefully go through each kit making sure all the parts are present before you start assembling anything.

Figure 2: VPM-1 Standard Kit Contents

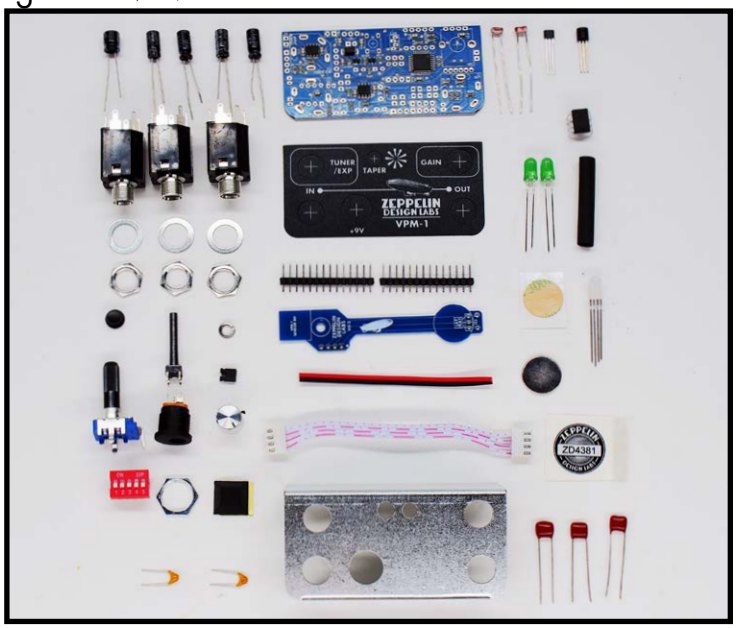


Table 1: VPM-1 Standard Kit Bill Of Materials

ZDL Part #	Description	Notes	Qty
CB-01-42	Hookup Wire, 2.5" (7cm) x 2 wires		1
CB-90-13	Heat Shrink Tube, 3/16" x 1-1/2" (5x40mm)	For Optocouplers	1
CB-06-10	Ribbon Cable, 4 wire x 10cm		1
CH-10-32	Steel Chassis		1
CP-10-08	Electrolytic Capacitor 220uF	C6	1
CP-30-18	Ceramic Capacitor 100nF	C1 on Sensor Board	1
CP-10-01	Electrolytic Cap, Radial 5x11mm 100uF	C19, C20	2
CP-12-10	Electrolytic Cap, Radial 5x11mm 1uF Bipolar	C4A, C5	2
CP-20-16	Film Capacitor 100nF	C1A, C2A, C3A	3
DI-30-51	LED, 5mm RGB		1
DI-30-52	LED, 5mm Green	For Optocouplers	2
FA-93-35	Lock washer, Split Ring 3.5mm		2
FA-12-15	Magnet		1
HD-32-21	Knob, Knurled, Aluminum, 10mm		1
HD-40-01	¼" TRS Audio Jack, Vertical Mount	J1, J2, J3	3
HD-40-12	DC Power Jack, Panel Mount		1
HD-10-11	Rubber Foot, Square		1
HE-60-02	Jumper, Female, 2 pin	For Tuner Jumper	1
HE-20-01	Male Header Pins		16
IC-81-76	Voltage Boost Converter, ICL7660S	U4	1
IC-80-50	Voltage Regulator, 78L05	U5	1
PC-11-01	VPM-1 Main PCB		1
PC-11-02	Sensor PCB		1
PL-10-11	VPM-1 Faceplate Sticker		1
PL-10-90	Serial Number Sticker		1
PT-35-10	Stereo Potentiometer, 100K, PC Vertical Mount	VR1	1
SN-30-10	Light Dependent Resistor (LDR)*	For Optocouplers	2*
SN-50-01	Hall Effect Sensor	Magnet Sensor	1
ST-60-59	LED Standoff, M5 x 19mm		1
SW-30-25	Tact Switch, 6 x 6 x 25mm	S1	1
SW-60-23	Switch Cap, Black		1
SW-45-50	DIP Switch, 5 Position	S2	1
TP-30-21	Tape, Double Sided, 15mm Circle		1
DC-20-21	Calibration Card		1

*NOTE: If you bought the Stereo upgrade kit, you will find a set of 4 matched LDRs packed with the upgrade, and no LDRs packed with the standard kit.

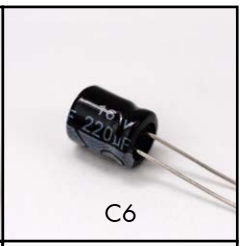
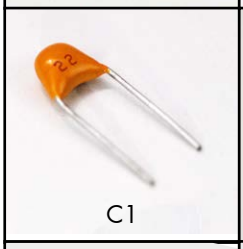
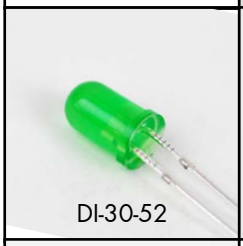
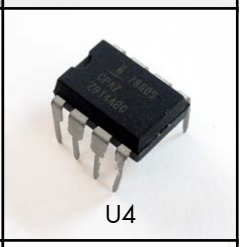
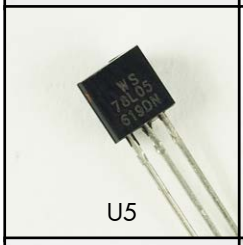
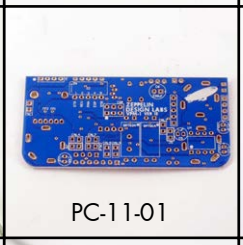
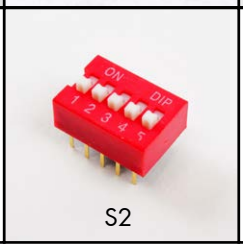
 CB-01-42	 CB-90-13	 CB-06-10	 CH-10-32	 C6
 C1	 C19,C20	 C4A,C5	 C1A,C2A,C3A	 DI-30-51
 DI-30-52	 FA-93-35	 FA-12-15	 HD-32-21	 HD-40-01
 HD-40-12	 HD-10-11	 HE-60-02	 HE-20-01	 U4
 U5	 PC-11-01	 PC-11-02	 PL-10-11	 PL-10-90
 PT-35-10	 SN-30-10	 SN-50-01	 ST-60-59	 SW-30-25
 SW-60-23	 S2	 TP-30-21	 DC-20-21	

Figure 3: VPM-1 Stereo Upgrade Contents

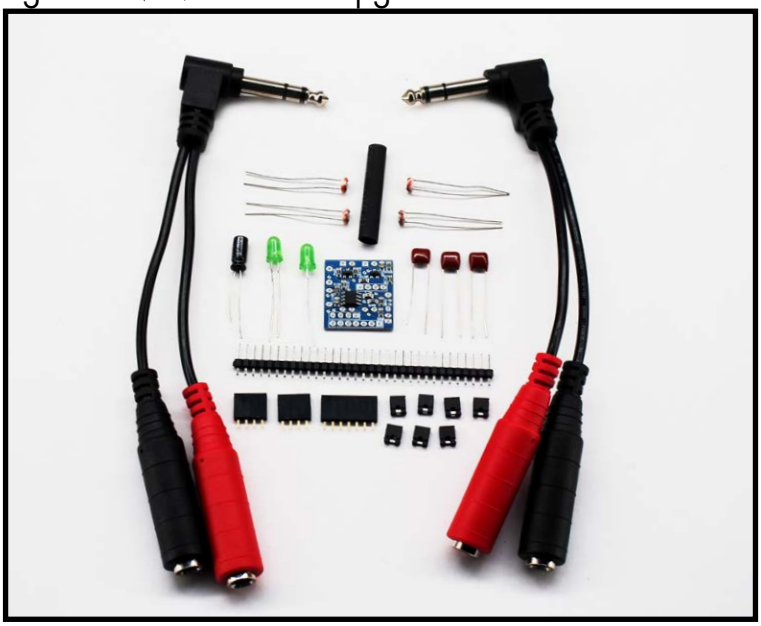


Table 2: VPM-1 Stereo Upgrade Bill of Materials

ZDL Part #	Description	Notes	Qty
CB-90-13	Heat Shrink Tube, 3/16" x 1-1/2" (5x40mm)	For Optocouplers	1
CP-12-10	Electrolytic Cap, Radial 5x11mm 1uF Bipolar	C4B	1
CP-20-16	Film Capacitor 100nF	C1B, C2B, C3B	3
DI-30-52	LED, 5mm Green	For Optocouplers	2
HE-20-01	Male Header Pins		33
HE-20-14	Female Header, 4 Pin		2
HE-20-17	Female Header, 7 Pin		1
HE-60-02	Jumper, Female, 2 pin		7
PC-11-04	Stereo Upgrade PCB		1
SN-30-10	Light Dependent Resistor (ldr)	For Optocouplers	4

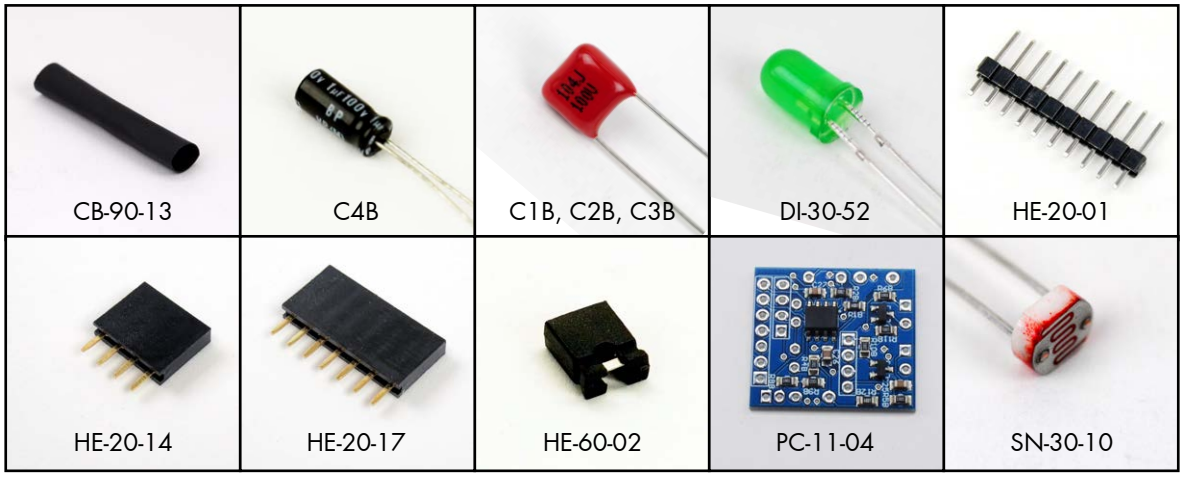


Figure 4: VPM-1 Expression Upgrade Contents

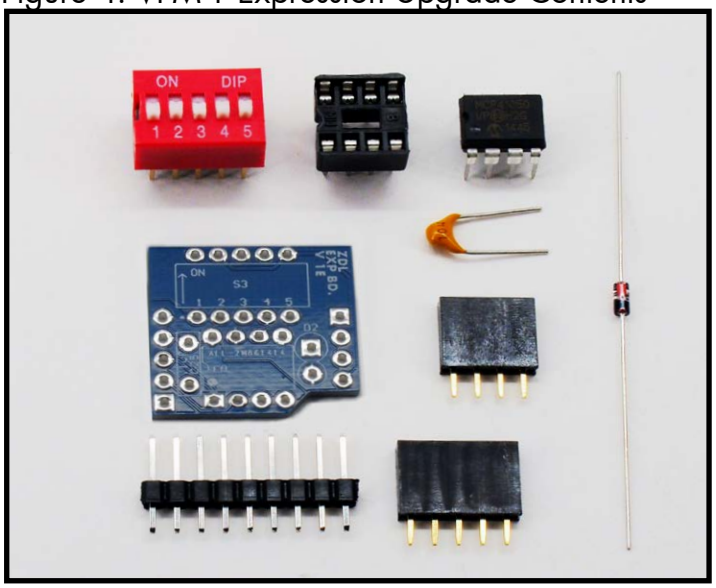


Table 3: VPM-1 Expression Upgrade Bill of Materials

ZDL Part #	Description	Notes	Qty
CP-30-18	Ceramic Capacitor 100nF	C25	1
DI-90-01	Zener Diode, 5.1V	D2	1
HE-20-01	Male Header Pins		9
HE-20-14	Female Header, 4 Pin		1
HE-20-15	Female Header, 5 Pin		1
HE-25-08	IC Socket, Dip 8		1
IC-48-01	IC, Digital Potentiometer, MCP41050	U3, 50K ohms	1
IC-48-02	IC, Digital Potentiometer, MCP41010	U3, 10K ohms	1
PC-11-03	Expression Upgrade PCB		1
SW-45-50	DIP Switch, 5 Position	S2	1

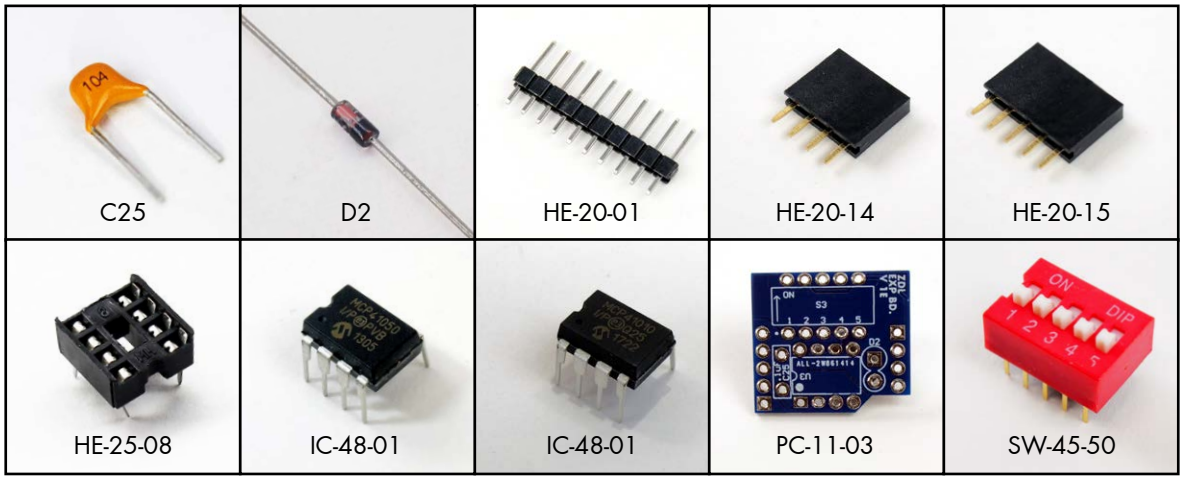


Figure 5: VPM-1 Large Format Pedal Adapter Kit Contents

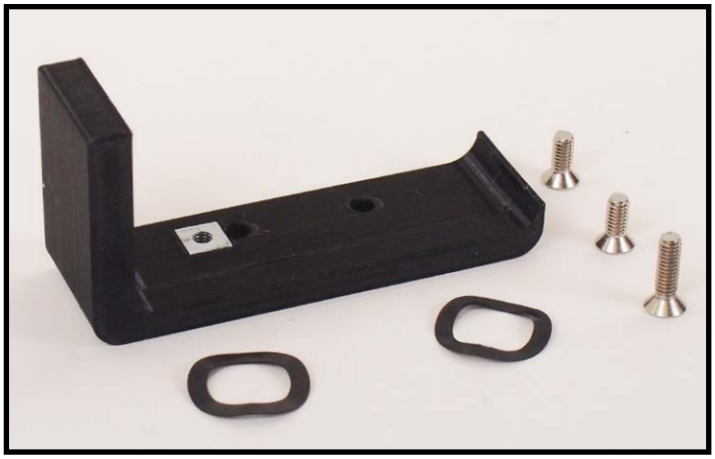
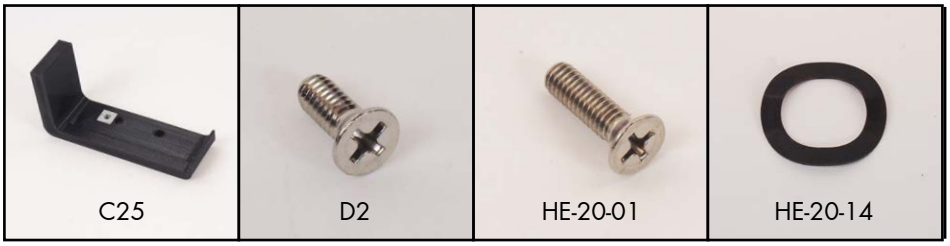


Table 4: VPM-1 Large Format Adapter Kit Bill of Materials

ZDL Part #	Description	Notes	Qty
HE-20-01	VPM-1 Adapter		1
HE-20-14	1/2″ Flat head Screw		2
HE-20-15	3/4″ Flat head Screw		1
HE-25-08	Tension washers		2



WHAT YOU WILL NEED

Here's everything you will need to build the VPM-1 kit.

TOOLS

1. #2 Philips screw driver
2. Flat head screw driver
3. Needle nose pliers
4. 1/2" (12mm) and 9/16" (15mm) sockets and driver (for audio jack nuts and DC jack nuts)
5. Soldering iron* (not a soldering gun, or a "cold heat" iron), good quality, 15-50 watt, with a good small-sized tip, conical or chisel shape. One with a temperature control and a stand* is best.
6. A damp sponge* for cleaning the soldering iron
7. Wire strippers* capable of stripping 22awg wire.
8. Flush cutters* or small diagonal cutters
9. X-Acto® knife or hobby knife
10. Ruler
11. Electronics tweezers*, not entirely necessary, but very helpful for holding small parts.
12. Clamp or vise to hold the printed circuit board while soldering (optional, but handy)
13. Solder sucker* or solder braid (optional, but very handy if you have to remove or repair any components!)
14. Digital multimeter*, not necessary for assembly, but may be handy for troubleshooting.

SUPPLIES

1. Solder*, 60/40 rosin core, the smaller diameter the better (we prefer .032" diameter). Make sure it's good quality; we prefer Kester brand, but most brands will work fine.
2. Isopropyl alcohol and cleaning rag
3. Scotch® or painter's tape
4. Super glue; We prefer the "gel" type because it's easy to control, but any type will work.

*Available from www.zeppelindesignlabs.com.

POPULATING THE PRINTED CIRCUIT BOARDS

Your work space should be well-lit, well-ventilated, and disposable; that is, don't work on the nice dining room table! Work on a utility surface that you can burn, drill and scratch. A piece of ¼" tempered masonite, or a chunk of MDF, makes an excellent surface if you don't have a utility work bench.

> **CAUTION**: Solder fumes are not healthy for you. The fumes consist of vaporized flux, which can irritate your nose, lungs, and even your skin. You MUST work in a space where the air drifts away from you as you work, so fumes do not rise straight into your face.

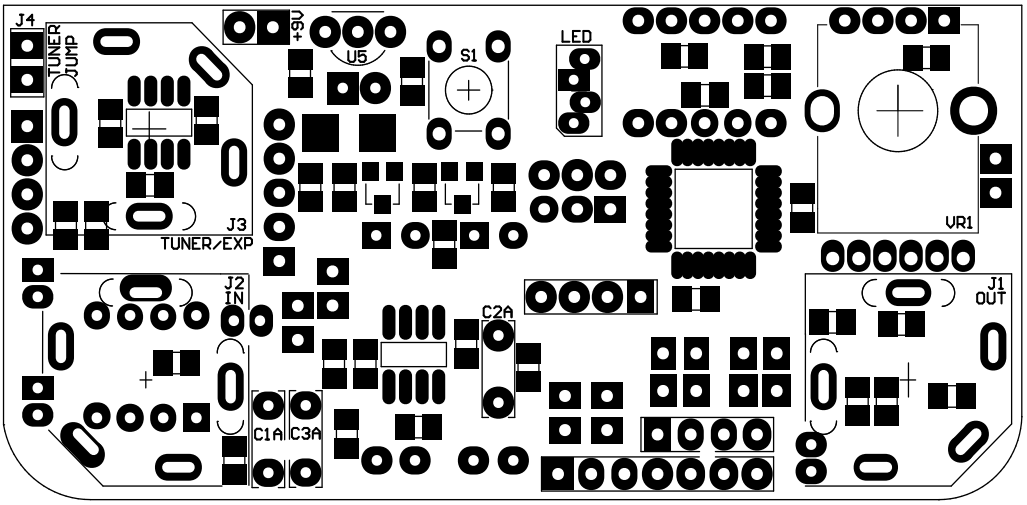
> **CAUTION**: Solder residue usually contains lead, which is poisonous if you ingest it. Do not breathe the fumes, do not eat the supplies, wash your hands after you handle solder, and sweep and wipe up your work space after EVERY USE.

Your VPM-1 standard kit contains two printed circuit boards (PCBs): the main board and the sensor board. The Stereo upgrade and Expression upgrade kits each contain one additional board. We will start with the main board. About half of the components will be installed on each side of the main board. The white silk-screen printing indicates which side of the PCB each component should be inserted through. Each component will then be soldered in place on the other side of the board. Because of the tight spacing on these circuit boards, it's important to not over-apply solder to the joints; otherwise it's easy to create solder bridges between two components that aren't supposed to be connected. Proper technique for installing and soldering components to a circuit board is demonstrated through several great resources on Instructables and YouTube under the search "PCB soldering tutorial." The general procedure consists of the following:

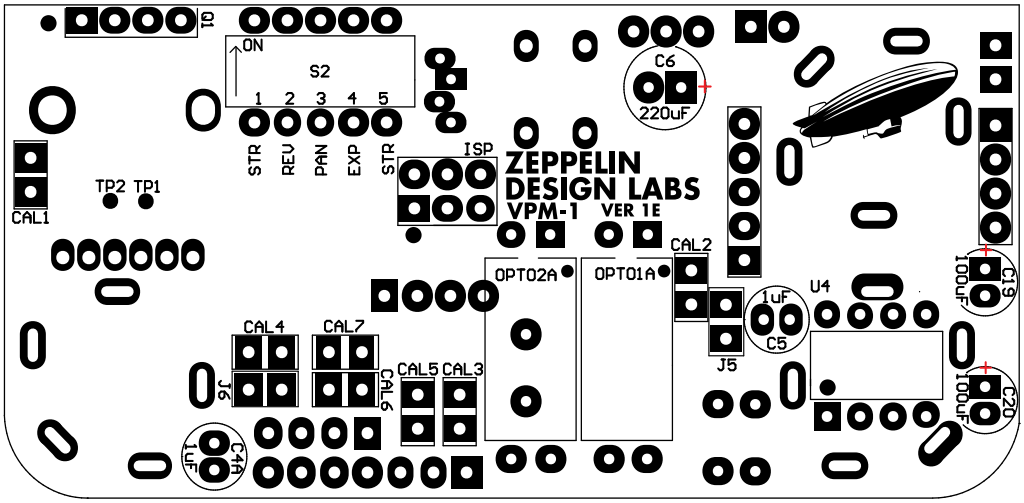
1. Install the part on the component side of the board, by threading the wire leads through the appropriate holes in the board. For your convenience, the board has silk screen outlines indicating where the components should be placed, along with text indicating the part number and the component value.
2. Hold the component in place with your finger and turn the board over.
3. Gently bend the leads out at about 45 degrees to keep the component from falling out.
4. Install all of one type of component, bending each of the leads as they are installed.
5. Flip the board over solder-side-up, and solder all of the components in one pass. In soldering, the key is to place the iron's tip on both the component lead and the pad on the circuit board at the same time in order to heat them both up simultaneously, once they are sufficiently heated, then add solder onto that joint.
6. Clip the leads off with small diagonal cutters, right at the solder joint.

You will notice that we have installed several components on the PCB already. These components are surface mounted, which are a little more difficult to solder. Try to stay away from the surface mounted components as you install the hole-through components.

Figure 5: Main Board Component Values and Locations



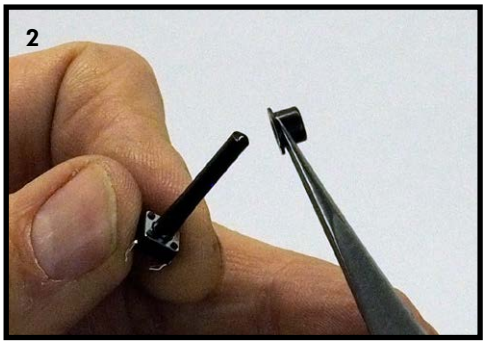
Main Board Top:



Let's begin!

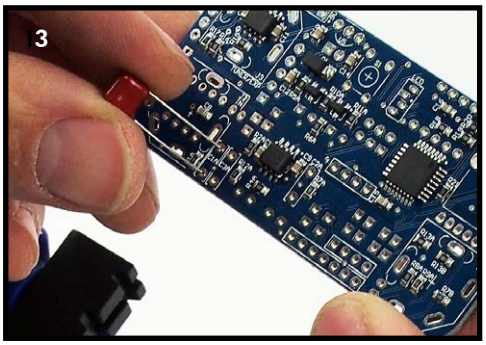
MAIN BOARD

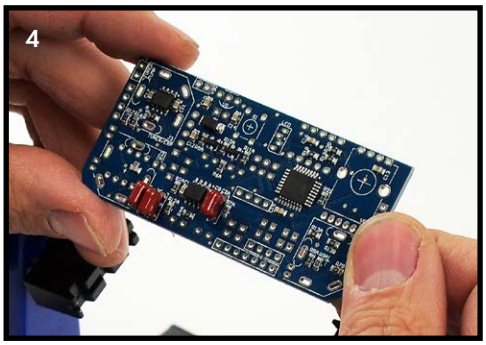
1. Tact Switch (S1): First off, use a tiny half-drop of super glue to attach the little button cap (SW-60-23) to the switch actuator (1,2). Make sure the cap is pressed down tight to the tip of the actuator. Now set the switch aside to allow the glue to fully cure before you install it later.

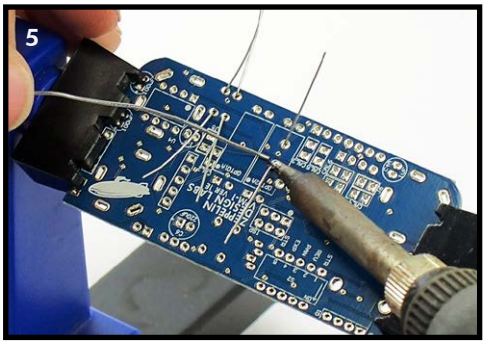


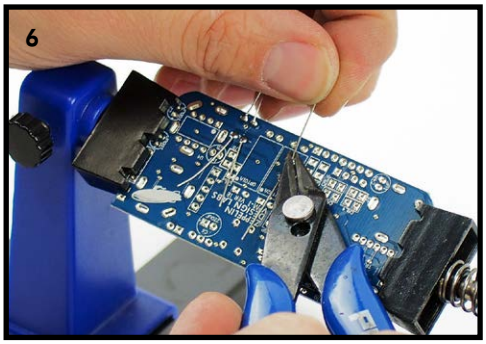
2. Capacitors: This kit contains three types of capacitors (or caps): film, electrolytic, and ceramic. The little yellow ceramic cap will be installed on the sensor board later. For now we will install the red film caps and cylindrical electrolytic caps on the main PCB, one type at a time.

   a. Film Capacitors: There are 3 film capacitors in the VPM-1 (C1A,C2A,C3A). They are100nF (.1uF) in value and labeled "104J". These caps are not polarized, meaning the leads can go into either hole. Install these caps on the front of the board (3,4) and bend the leads on the back so they don't fall out (5). Solder each lead and then clip them off right above the solder joint (6). Save two of these leads to use as jumpers later on in the assembly process.





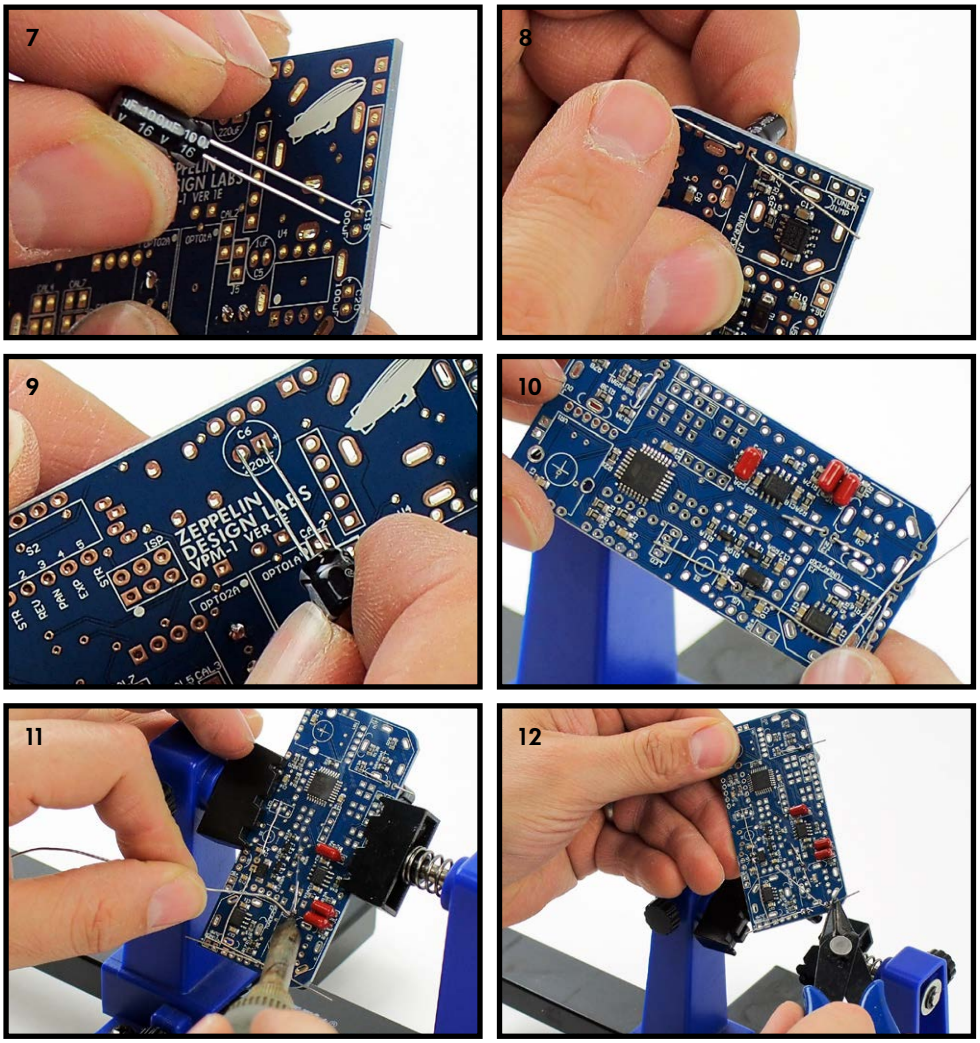




b. Electrolytic Capacitors: We will use 3 different electrolytic caps on the main board. There is one 220uF cap (C6), two 100uF caps (C19, C20), and two non-polarized (bipolar) 1uF caps (C4A, C5). You can read their values on their casings. Caps C6, C19 and C20 ARE POLARIZED: there is a right way and a wrong way to install them. If you get it wrong, your pedal will not work and the capacitor might burst. The white stripe on the case indicates the side of the cap with the shorter, negative lead. The longer lead is positive. The longer, positive lead goes into the hole with a square pad; the shorter, negative, white-stripe lead goes into the hole with the round pad (7).

STRIPE = NEGATIVE = SHORTER LEAD = ROUND PAD
NO STRIPE = POSITIVE = LONGER LEAD = SQUARE PAD

Make sure you orient these caps properly (7, 8)! For reference, "Figure 5: Main Board Component Values and Locations" on page 14 has little red plus signs (+) on the positive pads. C4A and C5 are NOT polarized, which is why there is no white stripe on their casing. You can install these in either direction. Bend the leads out on the back as you install each one (10). Solder (11) and clip each lead (12).



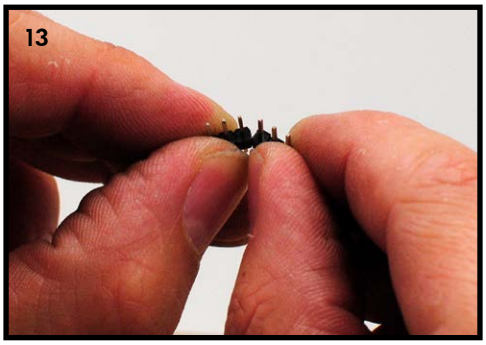
3. Headers: The main board uses male and female headers of various sizes in up to 17 different locations, depending on which upgrade boards you are installing, if any. If you are not installing any upgrade boards, you will install male headers in 3 different locations, and no female headers. The Expression upgrade adds 2 female headers to the main board. Those headers are packaged with the Expression upgrade. The Stereo upgrade adds 3 female headers and 9 male headers to the main board. Those parts are packaged with the Stereo upgrade.

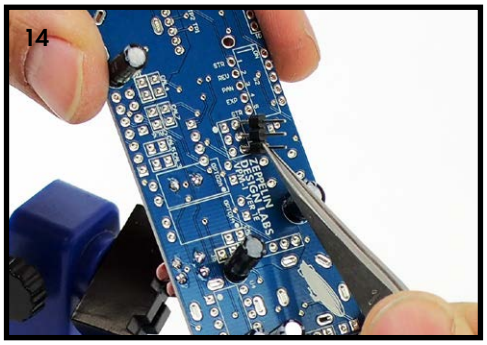
   PLEASE NOTE: Your kit contains the necessary number of header pins in one or more sections. If you have more than one section, be mindful when you break them apart into the individual lengths required for the build. Plan ahead so that you do not end up with a few pieces of one-pin header. This would be annoying.

   We'll start with the 3 male headers that go on the main board, common to all VPM-1 versions.

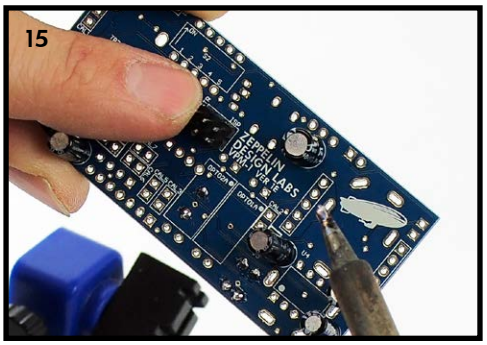
   a. ISP header: By installing a 2x3 header array, you create an ISP (in-system programming) port. This is a little socket that enables you to plug a cable into your VPM-1 and upload (or "flash") new software onto the control chip (aka the microcontroller unit, or MCU). The microcontroller in this kit comes pre-programmed with the software needed to make your VPM-1 work, but you can mod or tweak the software and re-program the chip, if you are into that sort of thing. See the VPM-1 Owner's Guide for more information about this.

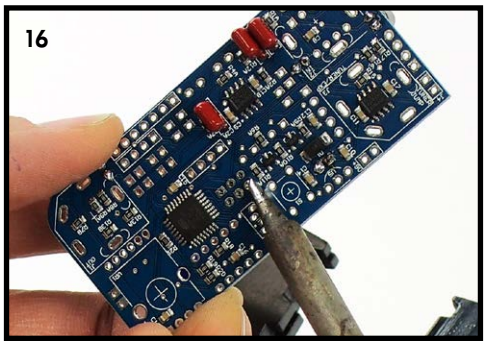
      Carefully break two pieces with three pins each off of the row of header pins. You can use your fingers to do this (13). Insert the two pieces in the pads marked "ISP" (14). The short pins go through the board; the long pins point up. Make sure the bottoms of the headers are flat against the circuit board.

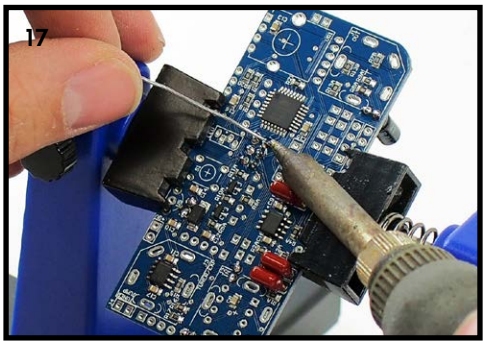

13


14

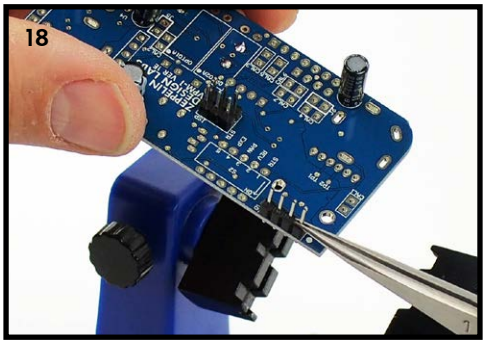
      Tack one pin down with solder while you hold the header in from the top (15,16). Once each row has been tacked on, you can solder the other pins in place (17).

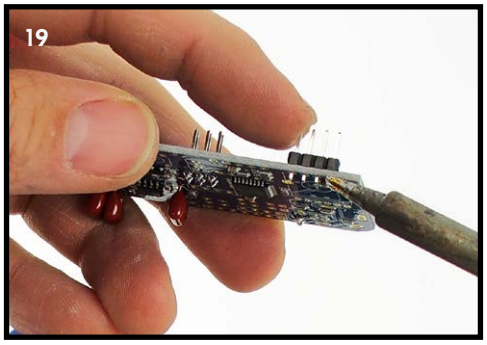


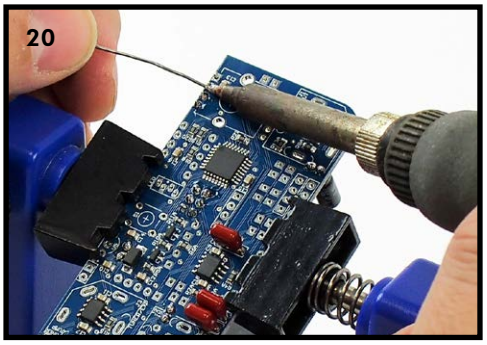




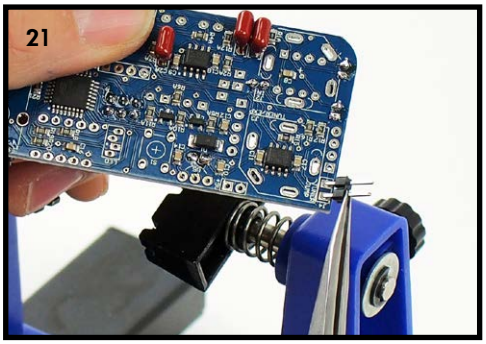
b. Q1 Header: This header uses a 4-pin ribbon cable to connect to the sensor board. Carefully break off 4 pins from the row of header pins. Solder this 4 pin header to the Q1 location (18-20).

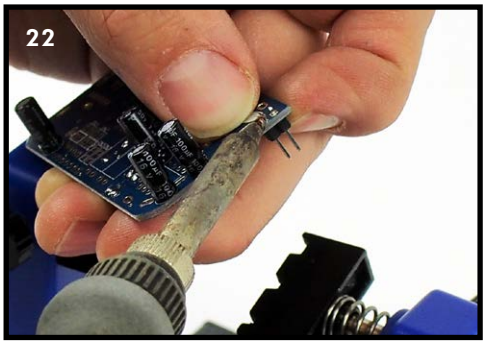


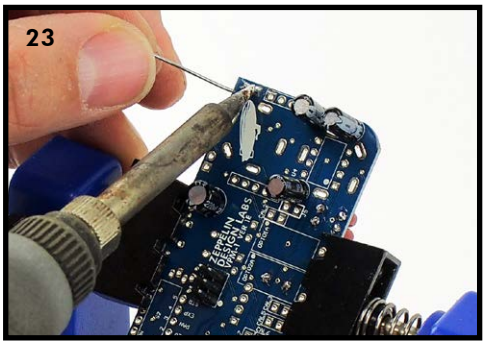




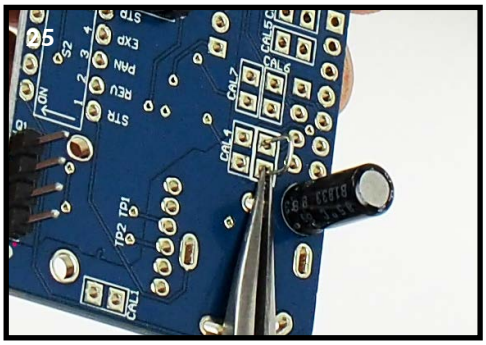
c. J4 (TUNER JMP): This header is used in conjunction with a pin jumper to connect the audio signal to the tuner out jack. Carefully break off 2 pins from the row of header pins and install it in like manner (21-23). If you are NOT installing the Expression upgrade then place the jumper on the header; if you ARE installing the Expression upgrade, leave the jumper off.

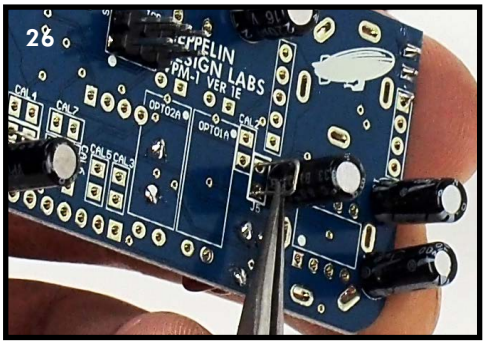


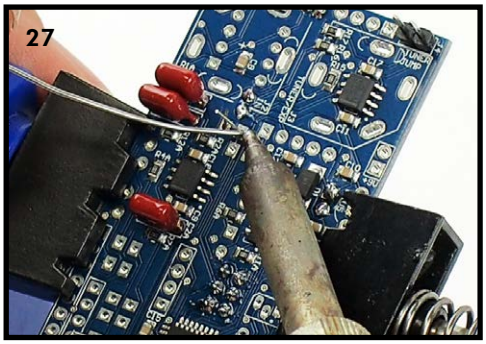




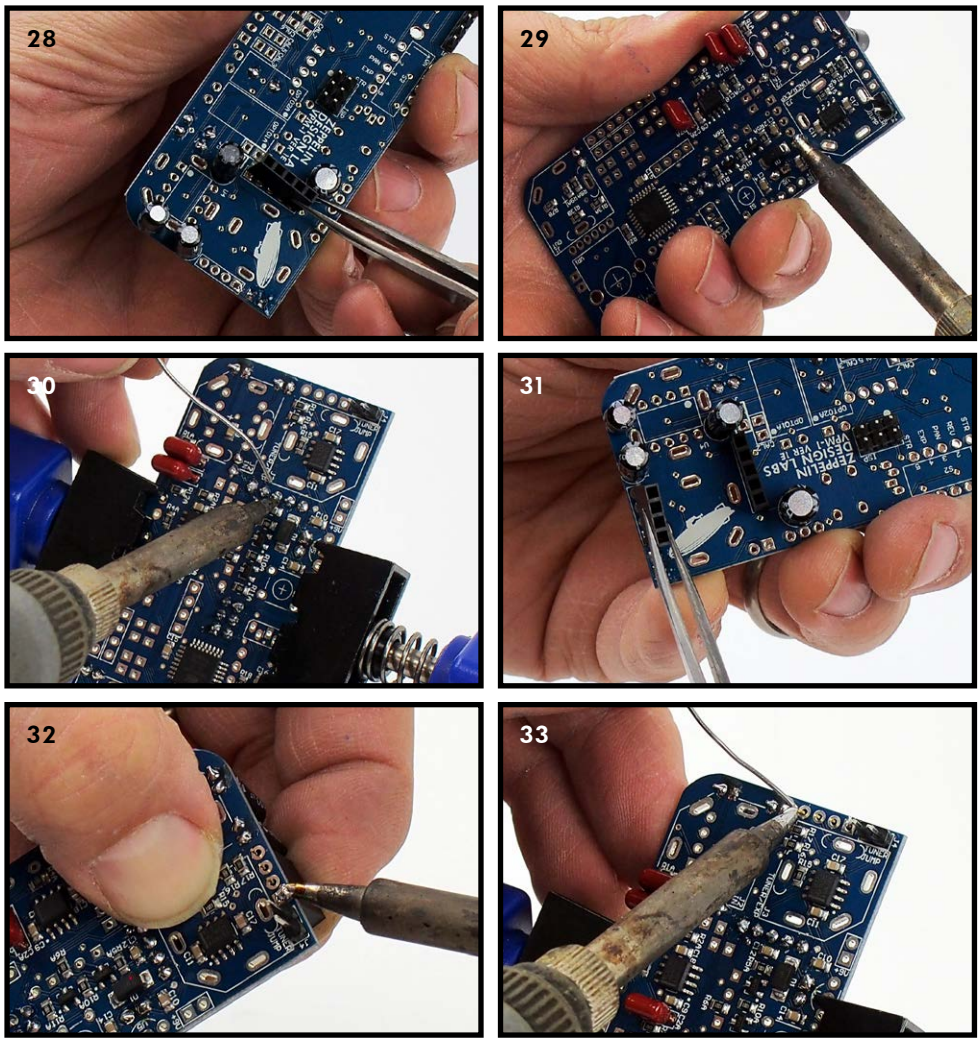
d. If you are NOT installing the Stereo upgrade, then at this time use a couple of your cut-off leads as hard-wired jumpers. Locations J5 and J6 need to be jumped. Use your pliers or tweezers to bend the leads into U-shapes (24) and install them into J5 and J6 (25,26). Solder them on the back side and clip the leads (27).



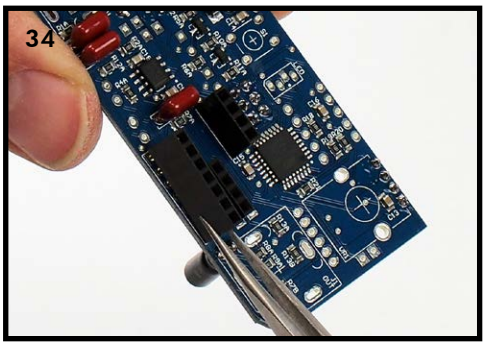


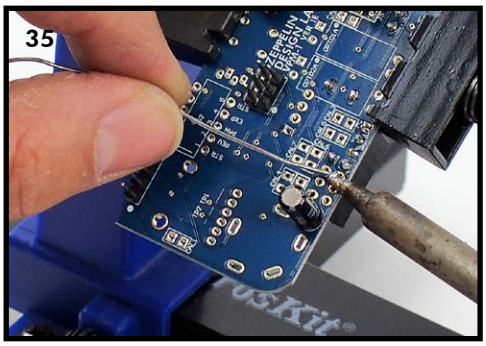


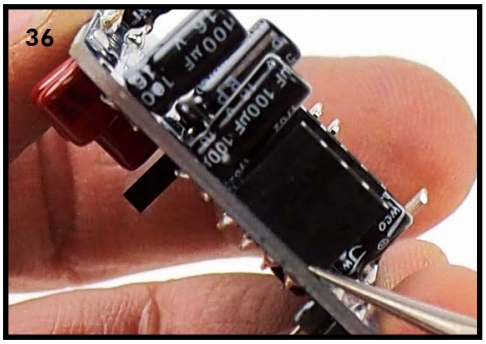
e. Expression upgrade female headers: If you are installing the Expression upgrade, dig out the two female headers from the expression kit bag. One of them will have 4 pins and one will have 5 pins. There are no locations printed on the board for these, so just use the pictures as reference. Make sure the bottom of these headers are flush with the board and are standing straight up as you solder them.



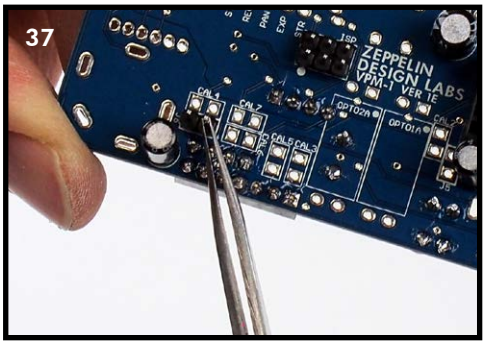
f. Stereo upgrade female headers: If you are installing the Stereo upgrade then dig out the three female headers from the stereo kit bag. There are two 4-pin headers and one 7-pin header. Once again, there are no markings on the board for these parts so use the pictures as reference. As you solder them in make sure they are exactly perpendicular to the PCB. Also make sure the bottom of the headers are flush with the board and are standing straight up as you solder them.

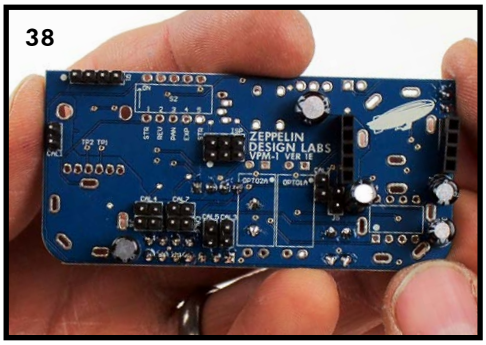


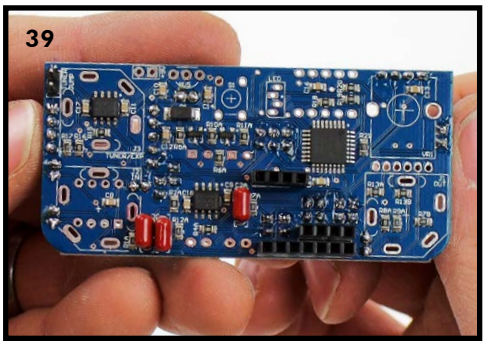




g. Stereo upgrade male headers: If you are installing the Stereo upgrade you need to install nine sets of 2-pin male headers on the main PCB. The Stereo upgrade kit comes with two lengths of male header. Break off 9 sets of 2 pins each, starting with a piece of header that has an even number of pins. (This will ensure you do not end up with a 1-pin header.) Solder them in the locations: CAL1, CAL2, CAL3, CAL4,CAL5,CAL6,CAL7, J5, and J6.





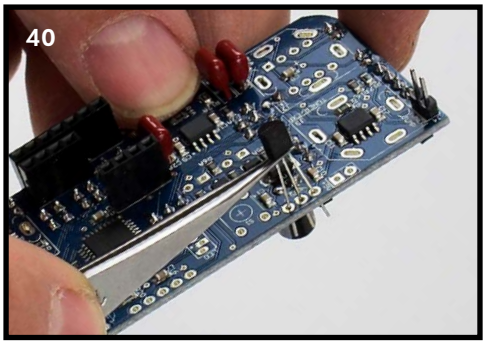


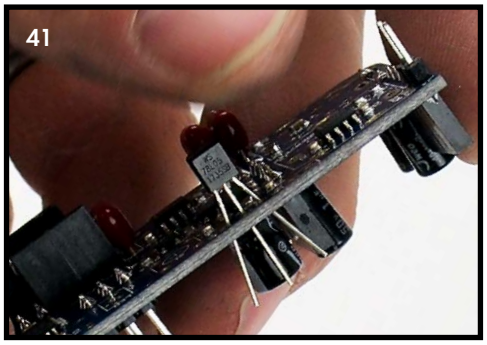
4. Integrated Circuits (ICs): This kit contains three types of IC components: a voltage regulator, the charge pump, and a Hall effect sensor (which will be installed later on the sensor board). These components are packed in a static-protective silver bag along with the PCB (because it also has a few ICs already installed on it). In general, ICs are quite sensitive to static electricity and can easily be damaged. Humans are not sensitive to static electricity at these low, yet damaging levels; in fact, most people can't even feel a static discharge less than 1000 volts! So it is easy to damage these components without even knowing it. Before touching an IC or the PCB, and often while working with them, ground yourself preferably by touching something grounded to the mains like the metal chassis of a plugged-in amplifier, or a refrigerator. At the very least touch a large conductive object like a metal desk or filing cabinet. In our lab, we wear conductive, anti-static bracelets that are connected to the electrical main's ground.

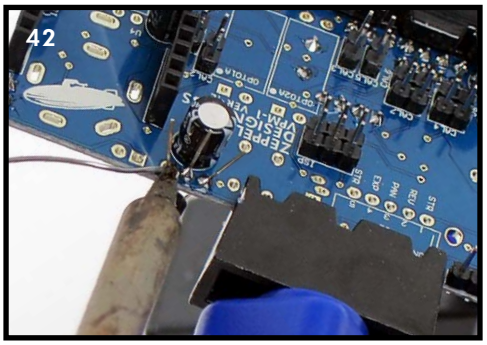
   When soldering ICs, try to prevent the IC from getting too hot. As a rule of thumb don't keep your iron on any leg longer than two seconds, and make sure the chip stays cool enough to touch. Solder one leg at a time and let the chip cool off before proceeding to the next leg.

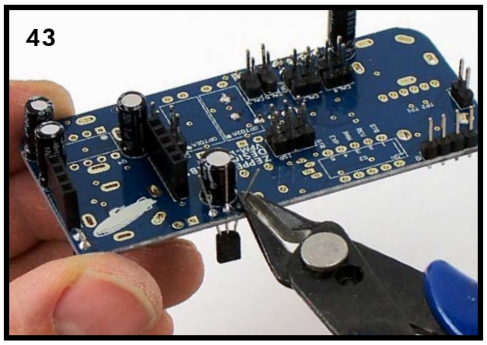
   ICs have a specific orientation. If you install them wrong, your VPM-1 will not work and you could damage or destroy the IC. Please pay close attention to the pictures and instructions so as not to install them backwards. See "Figure 5: Main Board Component Values and Locations" on page 14, and the graphics on the PCB, to help you correctly orient the ICs.

   a. Voltage Regulator, 78L05 (U5): This component takes the 9 volts from the power jack and converts it to 5 volts to run the microcontroller. It is shaped like a three-quarter moon. Install the voltage regulator on the board in the correct orientation (it is polarized) (40). Bend the leads out on the other side of the board (41). Solder and clip the leads (42,43).



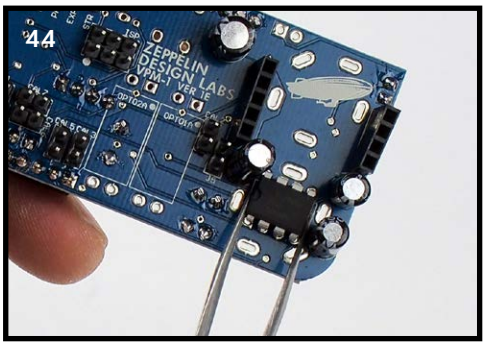


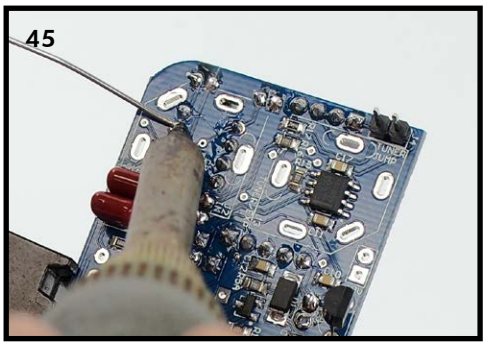


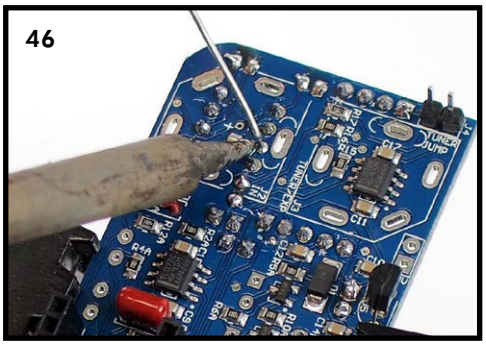


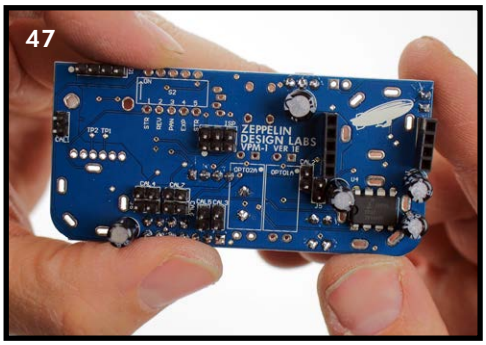
b. Charge Pump (U4): The charge pump (also known as a boost converter) takes the +9 volts from the power supply and turns it into -9 volts. This way, the opamps in the signal path can operate between -9V and +9V, giving the signal a total of 18V to work with.

This IC is labeled 7660S, has 8 pins and is polarized. The little divot on one end of the IC should be placed closest to the white dot silk-screened on the PCB (44). You may have to slightly bend the pins in to get them to seat in the holes on the PCB. The holes for U4 are very close to some of the solder pads of J2; when soldering this IC, it helps to keep the soldering iron away from the pads of J2 by only touching the iron to the inside of the pins of U4 (45).



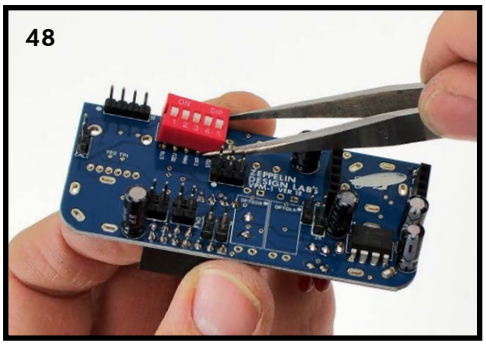


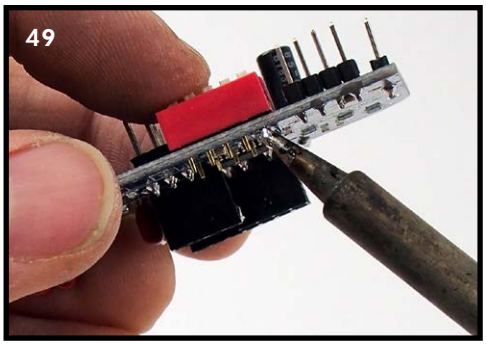




You will install the last IC, the Hall effect sensor, onto the sensor PCB later.

5. DIP Switch (S2): "DIP" stands for "Dual In-line Package," which describes the pin layout on these miniature switches. When installing them, make sure the labels on the switch line up with the markings on the PCB (48). Hold the switch in place with your finger and tack one pin in place (49). Now set down the board or place it in your clamp and solder the rest of the pins properly.

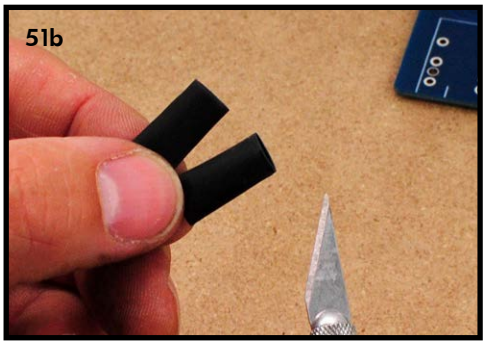




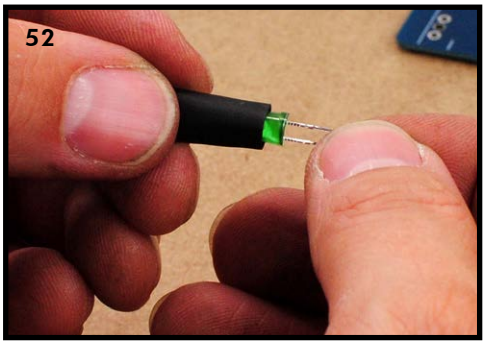
6. Optocouplers: The optocoupler is the link between the digital control side of the circuit and the analog signal path. There are two optocouplers for each signal: the standard kit is a mono device and uses one pair of optocouplers; the stereo upgrade adds an additional pair. Each optocoupler consists of a light dependent resistor (LDR) and a light emitting diode (LED), sealed together inside a piece of heat-shrink tube. The LDRs have been hand tested and performance-matched to each other. This ensures that the volume taper is linear. If you are building the Stereo upgrade, you will find both pairs packaged in the upgrade kit.

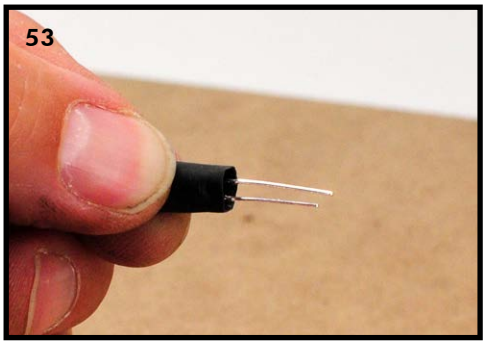
   NOTE: One LDR in each pair has a black mark (50). This LDR goes in OPTO1A. When you seal this LDR inside its tubing, mark the optocoupler so you know where to install it later!
   NOTE: If you are making the Stereo upgrade, do not mix the pairs together!! Make and install the optocouplers one pair at a time, so that you keep the matched pairs together.

a. First cut the heat-shrink tubing into two equal lengths of about 11/16" (18mm) (51a,b).

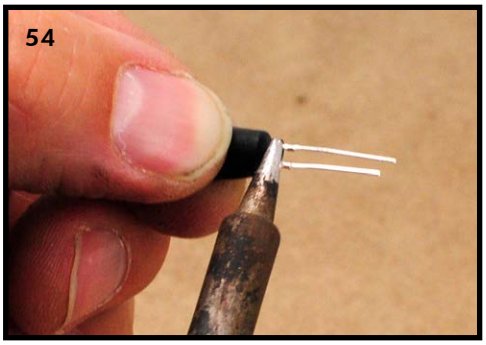


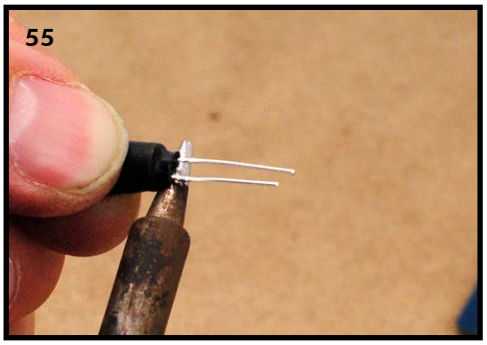
b. Insert a green 5mm LED into the end of a piece of heat-shrink tubing (52). Proper placement of the LED in the tube is important. Slide the LED into the tube until the back of the LED is about 5mm in from the end. The LED just needs to be far enough into the tube so the end can be pinched fully closed around the backside of the LED (53). This will keep as much ambient light out of the tube as possible.

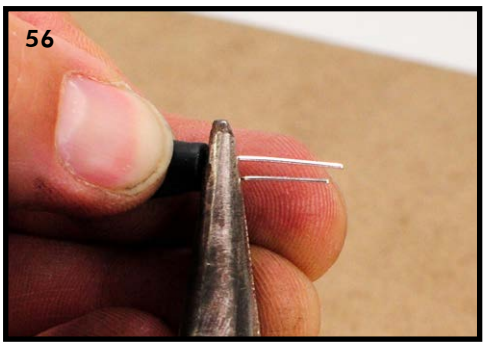


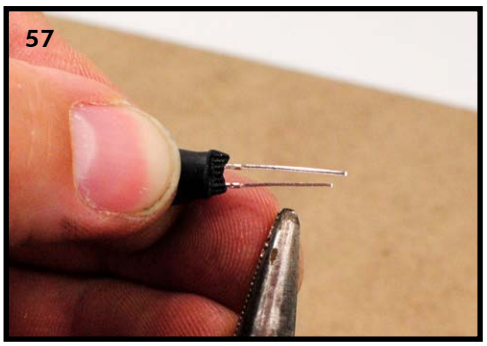


c. As you hold the LED in this position from the outside of the tube, carefully heat up the end of the tube with your soldering iron until it closes around the LED leads (54,55). Once it has stopped shrinking but while it is still very hot, use your pliers to pinch the shrunken tubing closed around the leads to seal the opening (56,57).

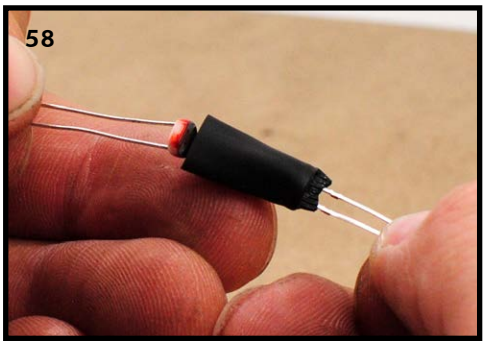


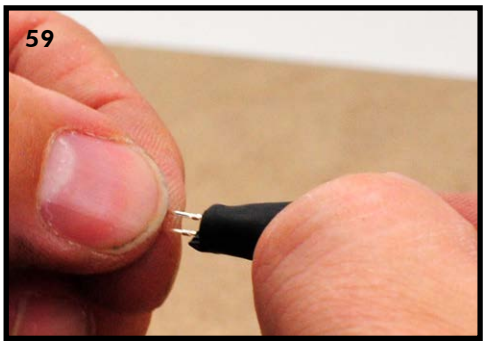




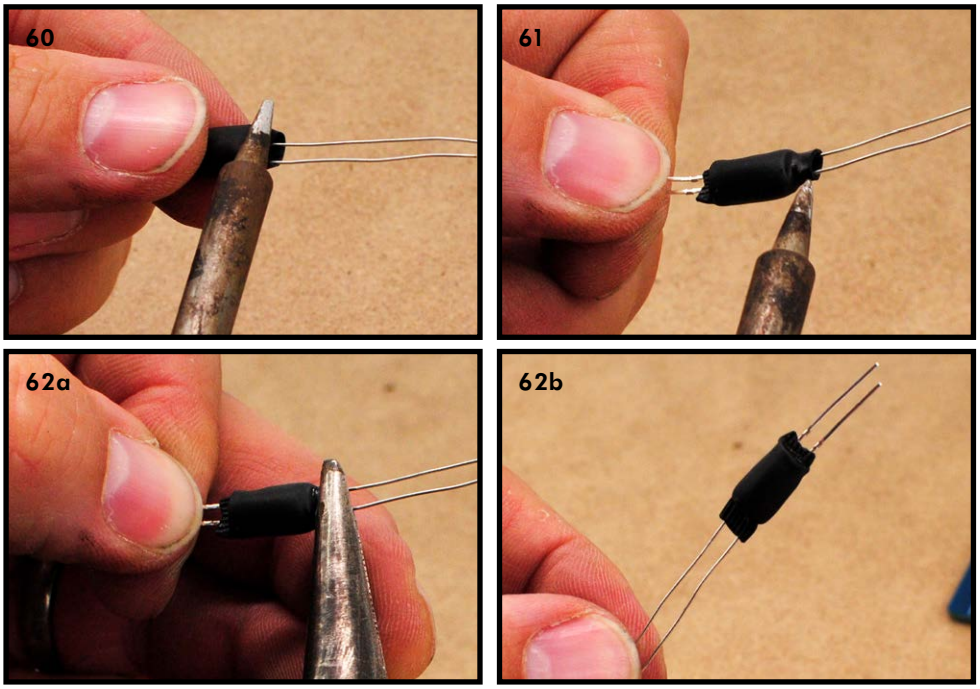


d. Slide the LDR **with the black mark** into the other end of the tube until it is touching the LED (58). Rotate the LDR to put the leads in the same plane as the LED leads (59).

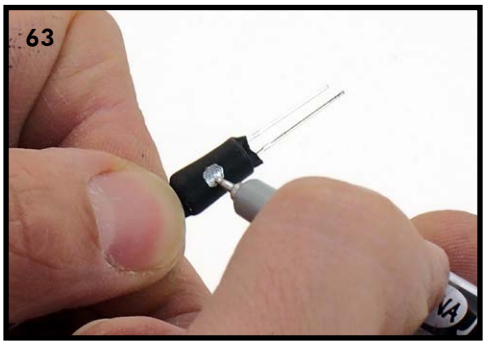




e. Hold the head of the LDR from the outside of the heat-shrink. It is important that the LDR and LED are in direct contact with each other. Carefully heat this end of the tube until it closes around the LDR leads (60,61). While it is still very hot, use your pliers to pinch the end closed around the LDR leads (62a,b).

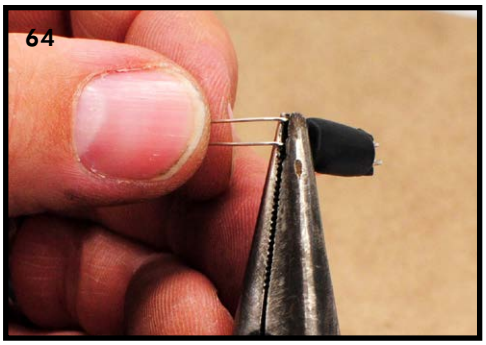


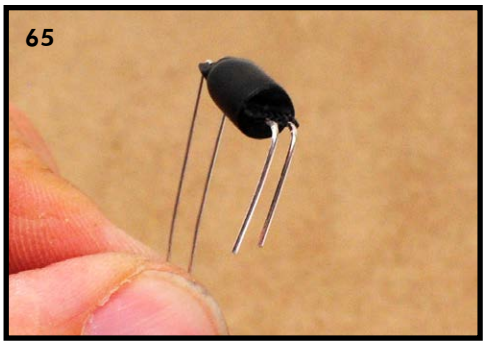
f. MARK THIS OPTOCOUPLER CONTAINING THE MARKED LDR with a scrap of tape or a dot of ink (63).



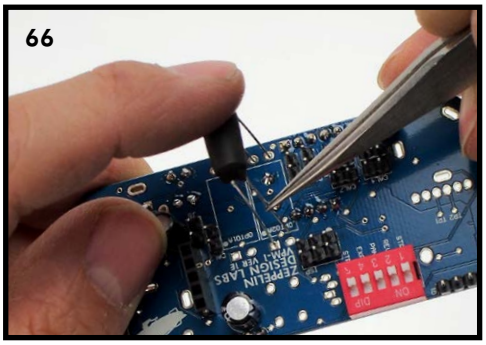
g. Repeat this process to make the second optocoupler. If you are making the Stereo upgrade, please do not make the second pair of optocouplers at this time. Leave the second pair of LDRs sealed in their bag so you cannot mix up the pairs of optocouplers. Do not make the second pair until the first pair is safely installed on the main PCB.

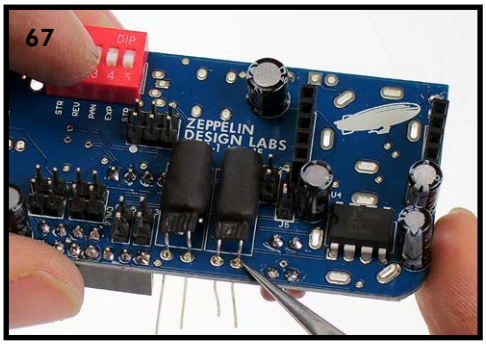
h. Now we'll install the optocouplers on the main board. The leads need to be bent 90 degrees, but it matters which way you bend them for them to fit in the proper orientation. If you put the opto in backwards your volume pedal will not work. Note the PCB graphics indicate where the LDR and LED are intended to go. On your optocoupler, the LED has one long lead and one short lead. The long lead of the LED goes into the hole with the square pad. Note which side of the optocoupler needs to face up as you bend the leads down in order for it to fit into the holes properly. Grip the leads with your pliers as shown (64) and bend them down 90 degrees with your fingers. Bend the LDR's leads in the same way, holding with pliers and bending with fingers (65). Repeat for the other optocoupler.



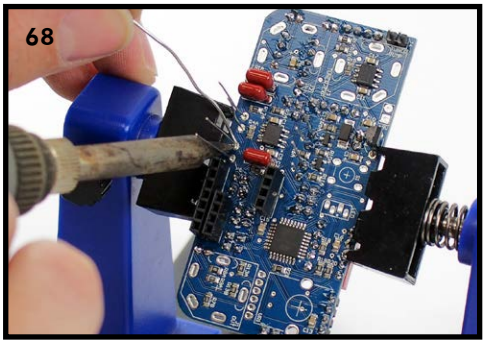


i. Carefully install the optocoupler pair on the main PCB. The marked optocoupler goes in OPTO1A. Make sure the long LED leads are in the holes with square pads (66,67).



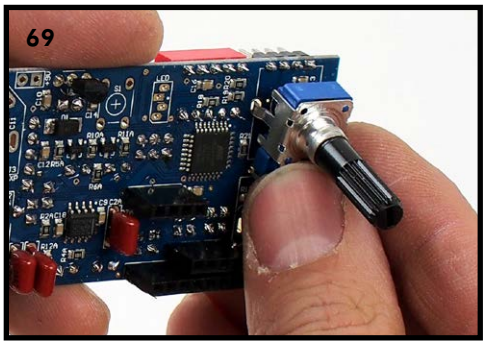


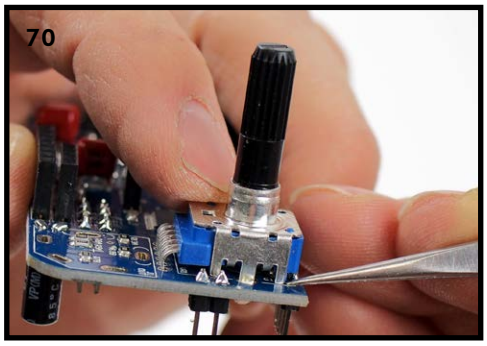
j. Bend the leads out on the back, solder all 8 leads, and snip them flush (68).



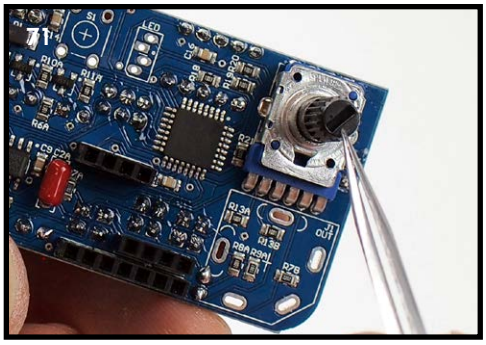
7. Potentiometer (VR1) and Knob:

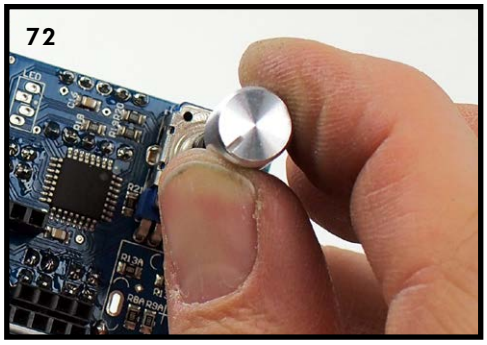
a. Install the stereo potentiometer (aka "pot") on the main PCB (69). Make sure the bottom of the pot is flush with the top of the board, and the shaft is perpendicular to the PCB (70). Solder the leads on the back.

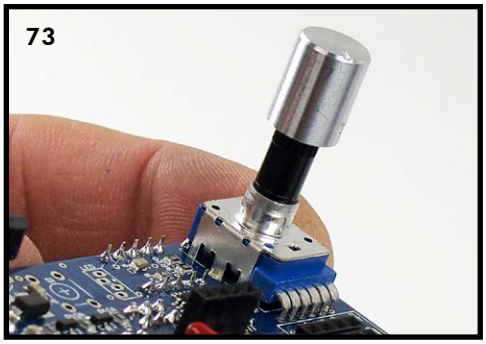




b. Turn the shaft of the pot all the way counter clock-wise. Place the knob on the shaft with the line on the knob at about the 7:00 position (71). Make sure the knurls on the shaft line up with the knurls on the inside of the knob and press the knob firmly onto the shaft (73).

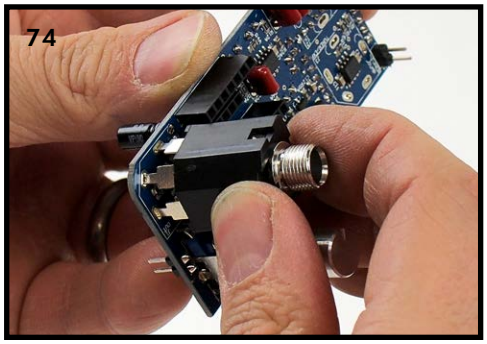


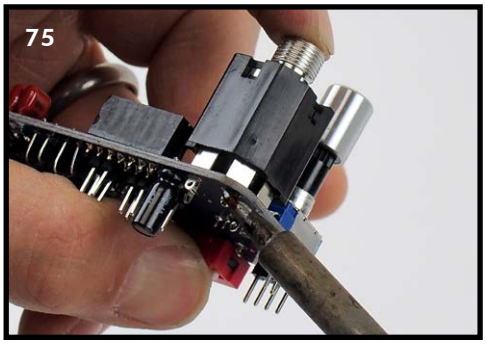


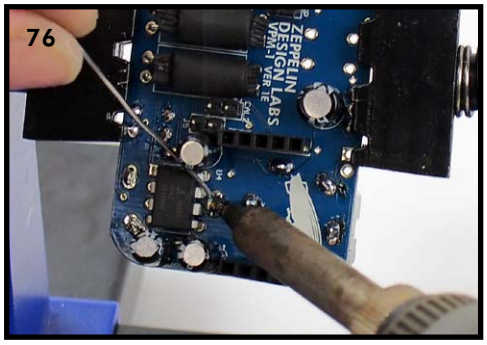


8. Jacks (J1,J2,J3): The 1/4" jacks can only be installed in one orientation on the PCB (74). They can be soldered in much the same way as the headers: hold them in with one finger while you tack a pin down with solder on the other side of the board (75). It is very important for the jacks to be perfectly perpendicular to the board, so make sure they are sitting flush against the board before you solder the rest of the pins; otherwise, the assembly may not fit into the chassis properly. Please note the jacks in your kit may only have 3 pins, instead of 5 pins, as in the pictures. We switched jack types on later production runs.

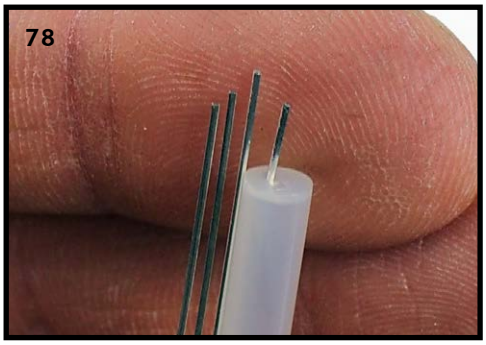
   Solder in J1, J2, and J3 (76). Because of the tight spacing, when soldering J2 keep your soldering iron on the outside of the pins so as to stay away from the pins of U4 (the charge pump IC). It's also helpful to not use lots of solder on the pins of J2 that are close to the pins of U4 to ensure none of the pins get shorted.



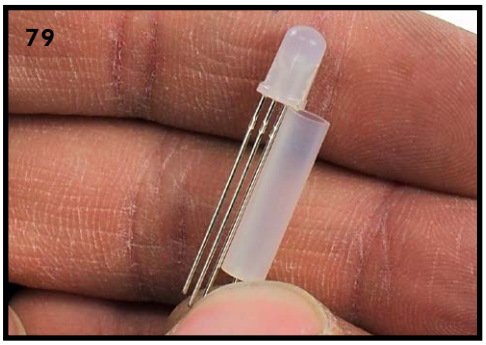


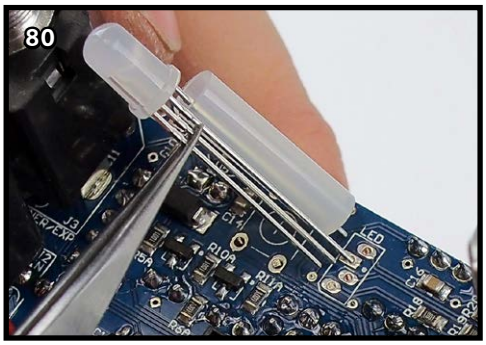


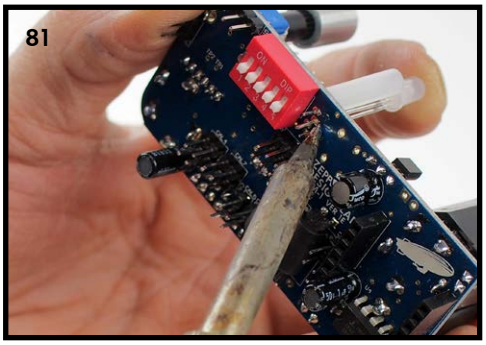
9. RGB LED: The LED has 4 leads and it is polarized. The standoff is used to hold the LED at the proper height above the board. Only one hole on the standoff is used. See how the leads are short-short-long-short? Place the open end of the standoff over the single short lead next to the long lead (77). Direct the lead out through one of the holes in the standoff (78).

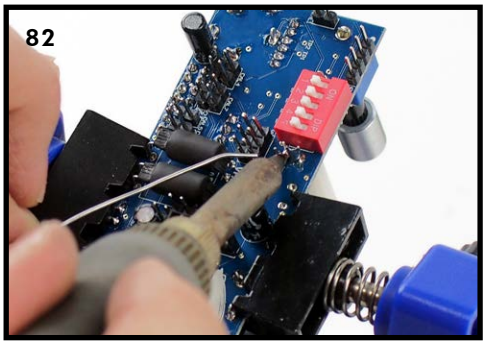


The open end of the standoff should be up against the bottom of the LED body (79). Place the LED in its position on the board. The longest lead goes in the hole with the tiny white dot next to it (80). As you hold the LED perpendicular to the board, making sure the standoff is flush with the board's surface, solder it in place and clip off the leads (81,82). Be sure to not over-apply solder to these joints; they are so close together it's easy to bridge them.

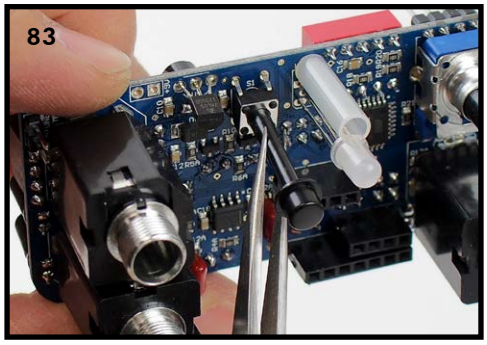


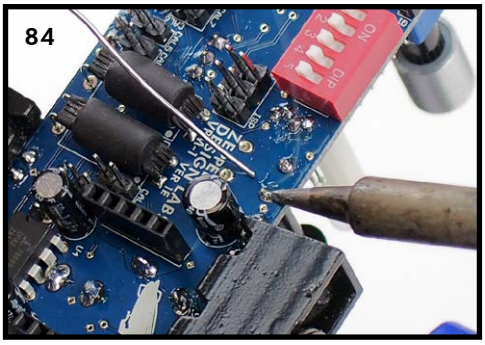


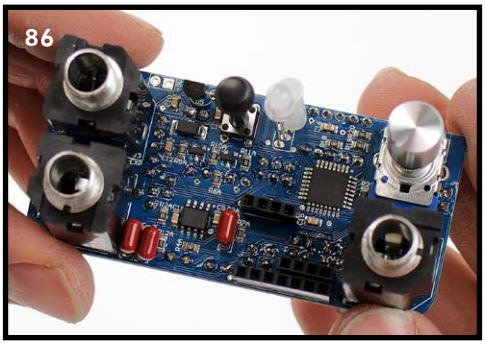


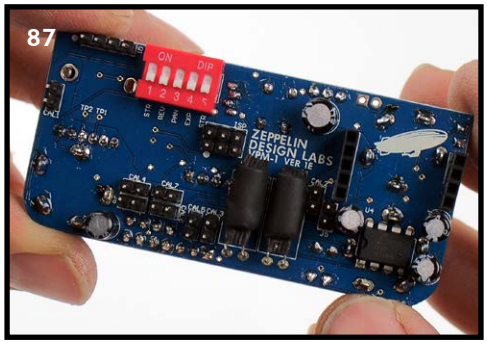


10. Tact Switch (S1), Revisited: You glued the cap to the tact switch back in Step 1. Now that the glue is nicely cured, install the tact switch on the main PCB (83,84). It doesn't matter which direction it is installed. The pins should snap into place. Once again, make sure the bottom of the switch is flush with the top of the board (85). Solder all the pins on the other side (87).







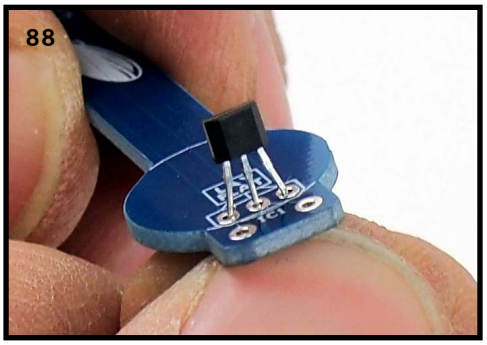


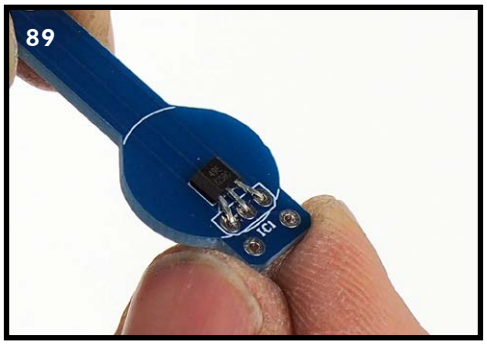
The main board is now complete! Take a break, and when we come back we'll assemble the sensor board – a much quicker job.

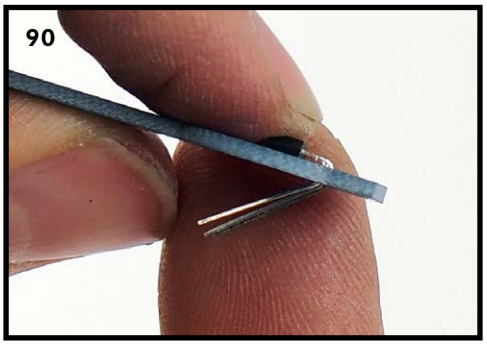
SENSOR BOARD

1. Hall Effect Sensor (IC1): The Hall effect sensor is a special device that is sensitive to magnetic flux. The sensor gives a DC voltage on one of its pins in proportion to the amount of magnetic flux it senses. Because the magnetic flux of a magnet is proportional to distance from the magnet, these devices are often used as distance sensors in industrial applications.

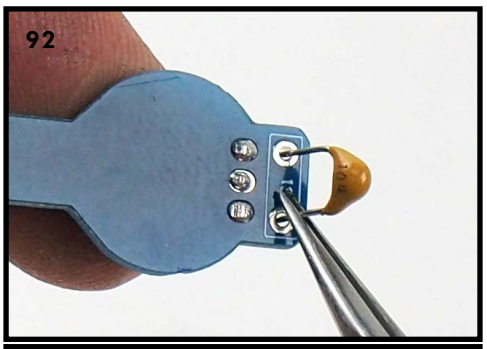
   Hall effect sensors are polarized, so be mindful of how you install it. Push the component into its holes with the smaller face of the sensor closest to the letters "IC1" printed on the board (88). Push down until the body of the sensor is about 1/8" (3-4 mm) above the top of the board. Then bend the body back against the board (89). The body of the sensor should be inside the box labeled "LAY FLAT." Bend the leads back on the bottom of the PCB in the same direction; it is important to make sure the body of the sensor lays flat against the top of the PCB (90). Solder the leads on top of the board (91). Clip the leads on the bottom of the board.

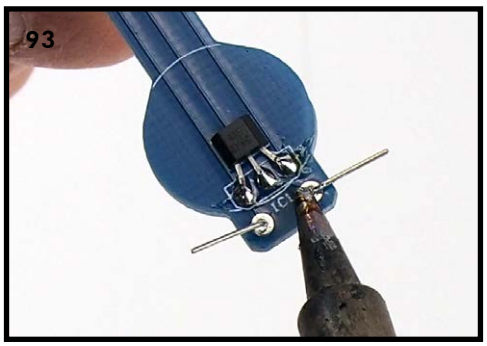




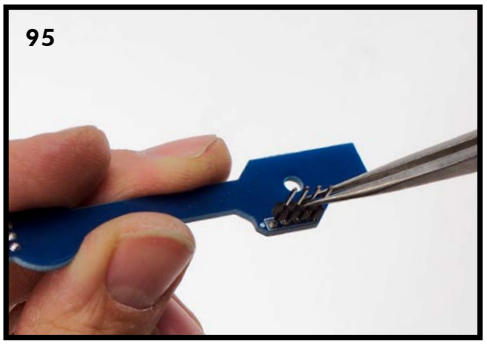


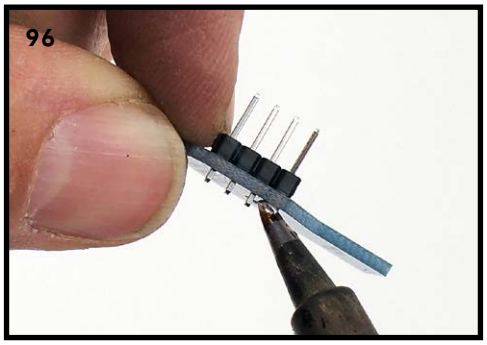
2. Ceramic Capacitor (C1): Install the 100nF (.1uF) yellow ceramic cap on the *bottom* of the board (92). Solder the leads on the *top* of the board (93), and then clip them flush (94).



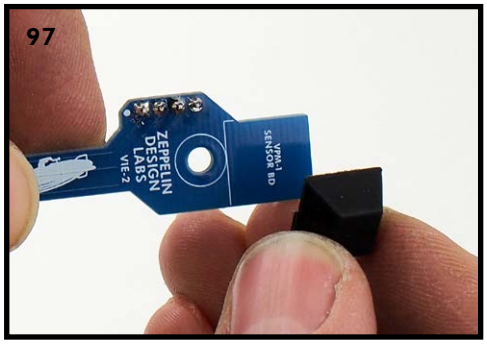


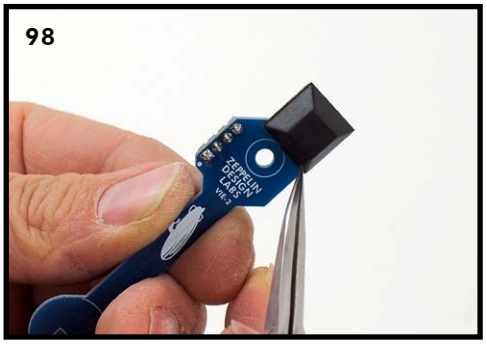
3. Cable Header: Install the 4-pin male header on the bottom of the board – the same side as the ceramic cap. Make sure it's flush with the bottom of the board and not installed crooked.

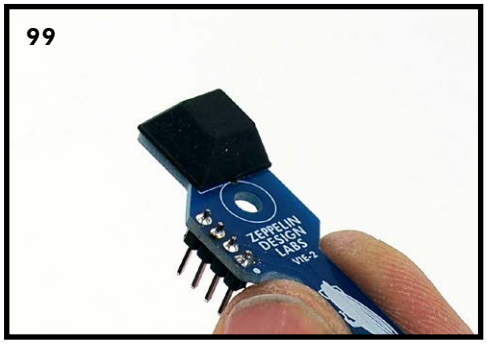




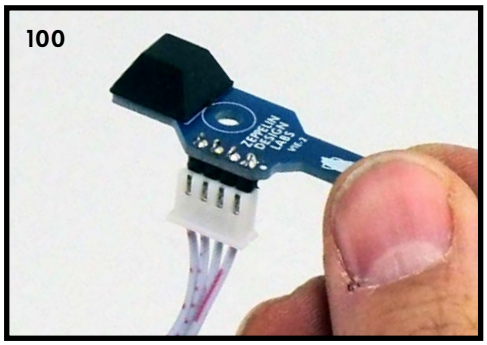
4. Rubber Foot: Peel the paper backing off the rubber foot and place it on the top of the board, in the square marked "VPM-1 SENSOR BD" (97). Line it up carefully and keep it out of the printed circle directly below the square (98). Squeeze it down tightly (99).

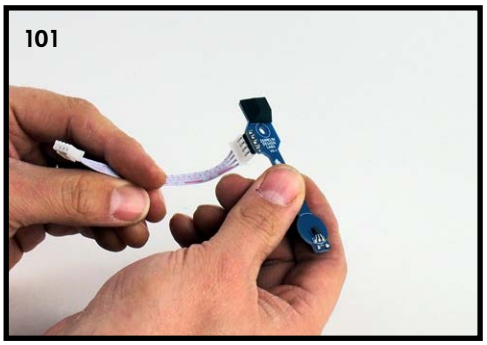






5. Ribbon Cable: Place the ribbon cable on the header (100). Do you see the little white dot on the PCB, at one end of the header? Let's call that Pin 1. Now notice that all four wires of the ribbon cable are marked with unique patterns of dashes and dots. Note which pattern is associated with Pin 1. You will need this knowledge later.



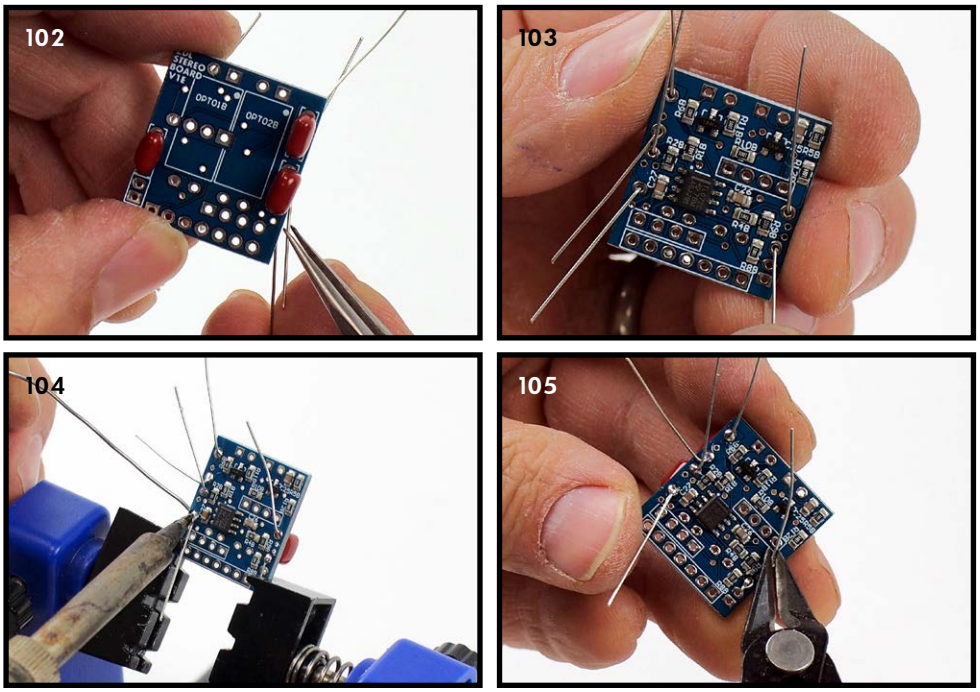


That's it for the sensor board. If you are not installing any of the upgrade boards then you can move on to "PREPARING THE VOLUME PEDAL CHASSIS" on page 42.

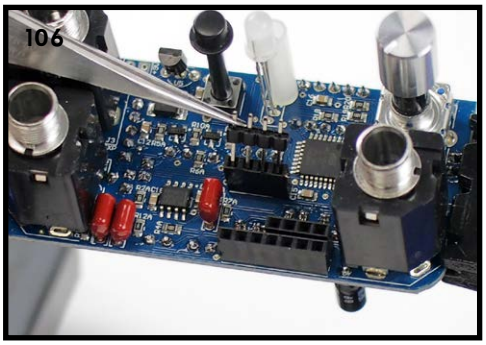
STEREO UPGRADE BOARD

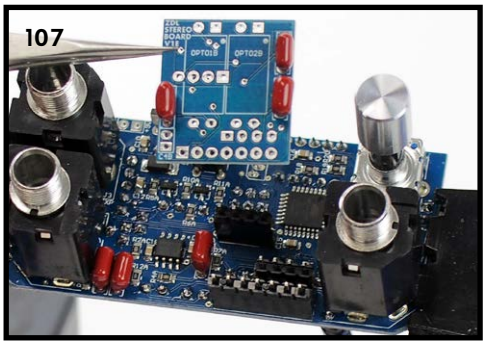
If you opted for the Stereo upgrade, we will now assemble the stereo board.

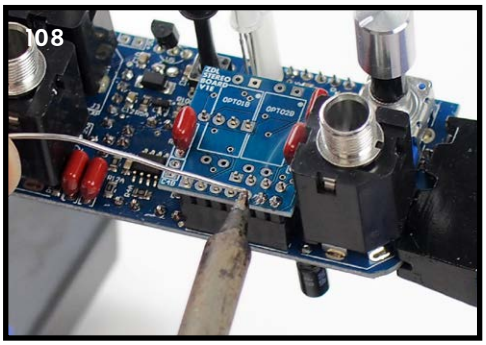
1. Film Capacitors (C1B,C2B,C3B): Install the three red film caps in the same way that you did on the main board. Install, bend leads, then solder and clip (102-105).

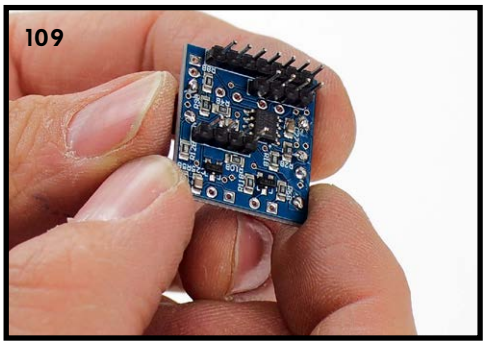


2. Male headers: Break the male header row into 3 sections: two 4 pin sections and one 7 pin section. These male headers on the stereo board eventually get plugged into the female headers on the main board, so we will use the female headers as a jig to help us install the male headers. Back on the main board, press the male headers into the female headers (106). Orient the stereo board as shown in 107, and align it with the top ends of the male headers. Press it into place. If you installed the female headers onto the main board properly, you should have no trouble setting the stereo board onto the male headers. Solder the male headers to the stereo board (108). Remove the board from the female headers to continue installing the rest of the components (109).

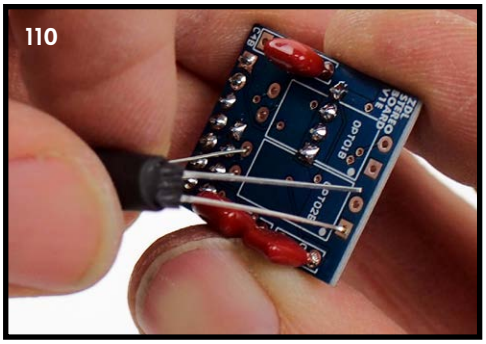


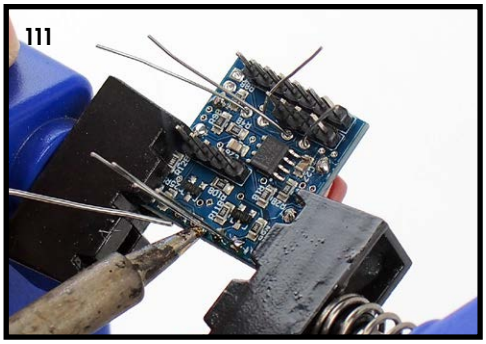






3. Optocouplers: Make the second pair of optocouplers (see page 24). Install this second pair of optocouplers on the Stereo board. Remember that the long lead goes in the square hole, and your marked optocoupler, the one with the marked LDR inside, goes in OPTO1B (110). Solder and clip the leads (111).

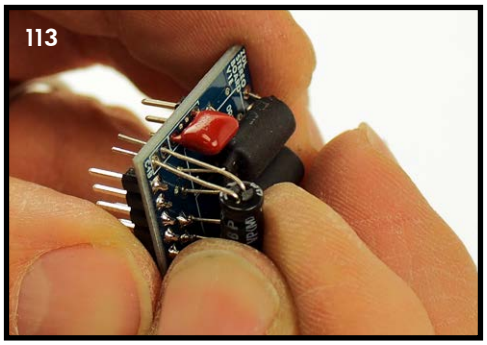


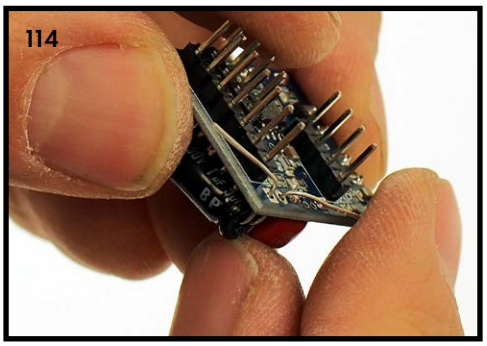


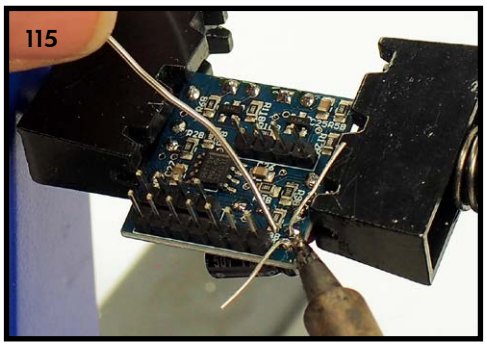
4. Electrolytic Capacitor (C4B): This last electrolytic cap is installed laying on its side, so bend the leads to 90 degrees before you insert it into its holes (112,113). This cap is bi-polar so it doesn't matter which way it is installed, and therefore it doesn't matter which way you bend the leads.

Keep the body of the cap a few millimeters off the surface of the board. Bend the leads on the back (114) and solder them in place (115). Clip the leads.

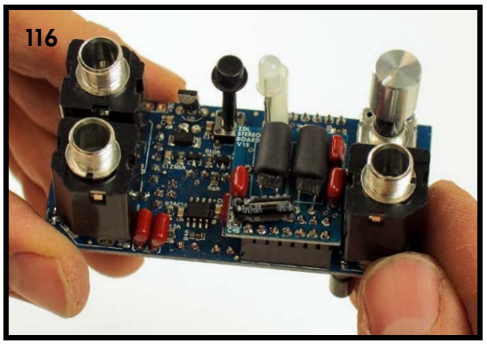

112


113


114


115

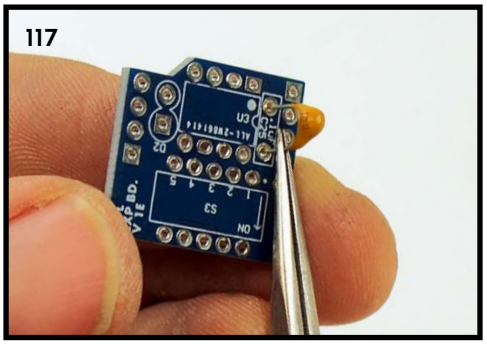
The stereo board is now complete. You can now install it on the main board by pressing it back onto the female headers. Later we will run an internal software routine to fine-tune the four optocouplers for optimum performance (see "SETTING UP STEREO CONFIGURATION" on page 54).


116

EXPRESSION UPGRADE BOARD

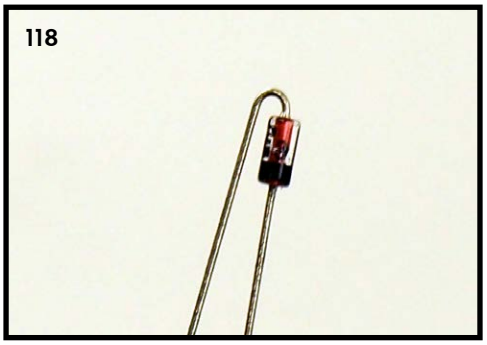
Make sure there is NO pin jumper installed on the main board at TUNER JMP. Now let's assemble the expression board.

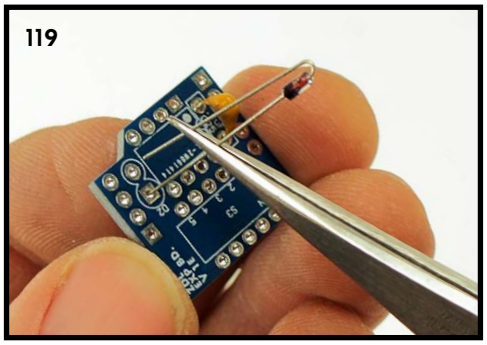
1. Ceramic Capacitor (C25): Install the 100nf (.1uF) ceramic cap in its place on the face of the board (117); bend the leads on the back of the board; solder and clip the leads.

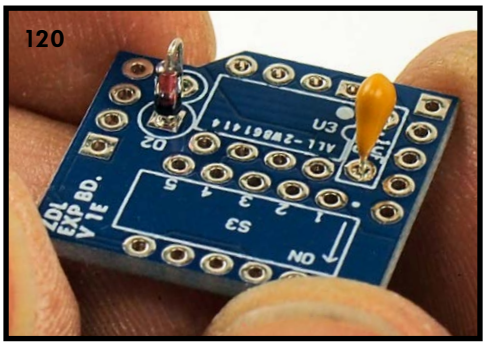


2. Zener Diode (D2): The 5.1V Zener diode is used to protect the digital potentiometer from being subjected to excessive voltage. The digital pot shouldn't have much more than 5 volts on its pins, so any voltage on the expression jack over 5.1V will be shunted to ground via this Zener diode.

   This diode is polarized. The black stripe indicates the lead that goes into the hole with the square pad. The other (non-striped) lead must be bent and placed into the round pad.
   BLACK STRIPE = STRAIGHT = SQUARE PAD
   NO STRIPE = BENT = ROUND PAD
   Bend down the lead WITHOUT the black stripe until it is about parallel with the diode body (118). Slide the Zener diode into its location on the board with the black stripe against the square pad (119,120). Bend the leads out on the back. Solder and clip the leads.



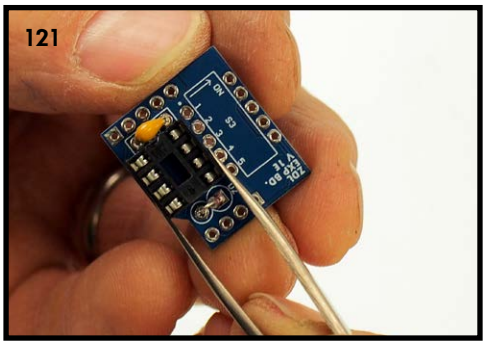


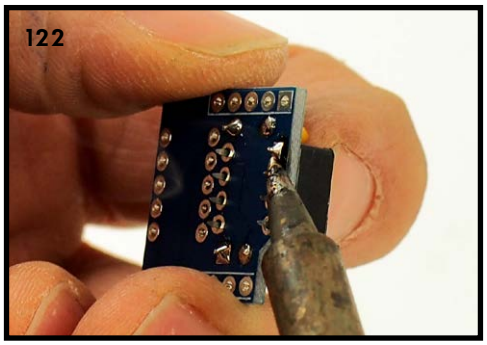


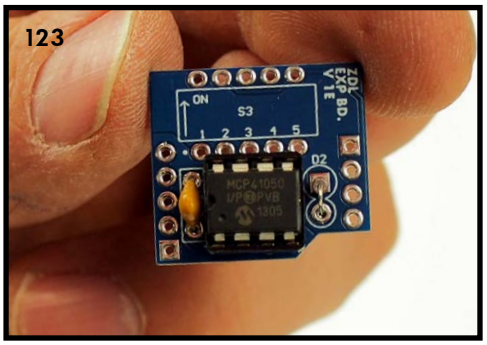
3. Digital Potentiometer (U3): The expression upgrade comes with two different digital potentiometer ICs. One is labeled MCP41050, which is a 50K ohm pot. The other IC is labeled MCP41010, which is a 10K ohm pot. We suggest using the 50K digital pot (MCP41050) in most cases, but we provide the optional 10K pot because some newer pedals will perform better with this value (most Line6 pedals perform better with this 10K pot, for example).

   The digital potentiometer is installed into an 8-pin socket on the board so we'll install this socket first. This IC is polarized so make sure to install these parts in the proper orientation. Align the little divot on the socket with the divot shape printed on the board. The divot should be facing the ceramic cap (121). Hold the socket in place as you tack down a pin on the back (122). Make sure the socket is flush with the top of the board and solder the rest of the pins in place.

   Once the socket is installed, press the digital pot IC into place. The divot on the IC should line up with the divot on the socket, facing the yellow cap (123).

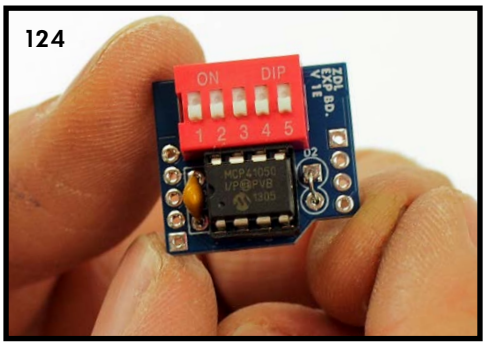

121


122



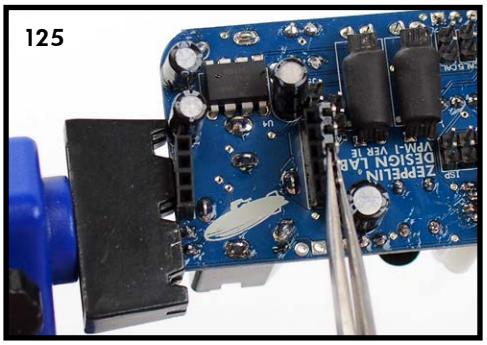
123

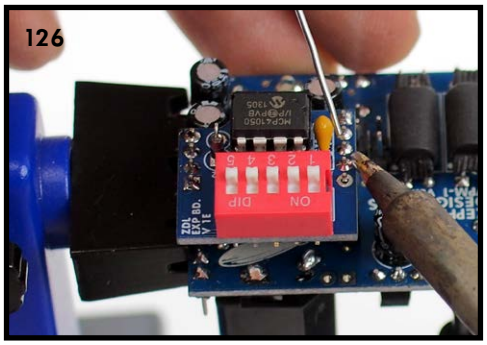
4. DIP Switch (S3): Install the DIP switch the same way you did on the main board. Line up the printing on the switch with the printing on the board. Solder it in place (124).



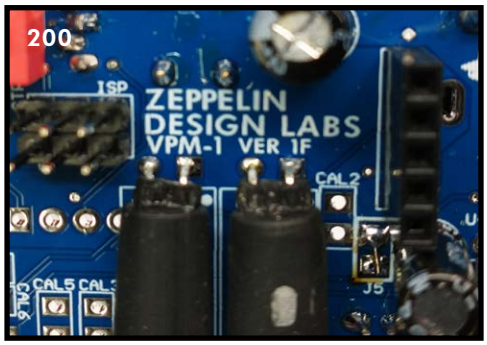
124

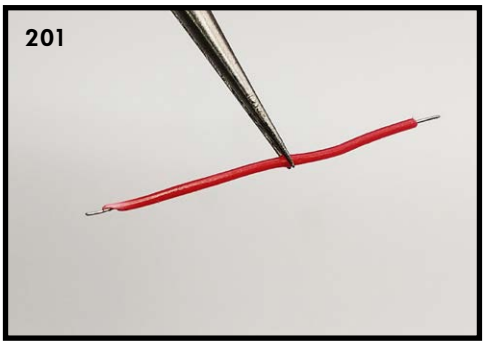
5. Male Headers: Break the male header row into 2 sections: one 4-pin section and one 5-pin section. These male headers on the expression board get plugged into the female headers on the main board, so we will use the female headers as a jig to help us install the male headers. Back on the main board, press the male headers into the female headers (125). Align the expression board with the top ends of the male headers and press it into place. If you installed the female headers onto the main board correctly, the expression board should set onto these male headers easily. Solder the male headers to the expression board (126).





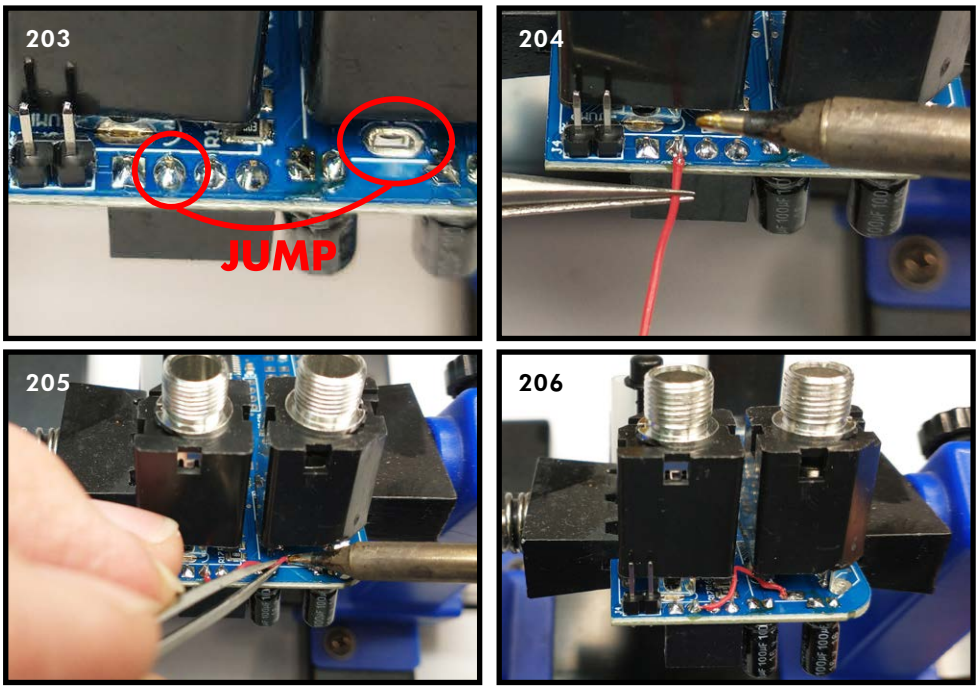
If you are working with version "1F" of the main circuit board (200) you'll need to add a jumper wire. Please follow the steps below. If your circuit board version is something other than "1F" then your expression board is now complete. Keep it installed on the main board. For guidance on how to configure this board to work with your particular expression controllable effect, see the VPM-1 Owner's Guide.





Find the thin red wire that came with your expression board kit (it's not pictured in the parts list). Cut a piece about 1" (or 25mm) long. Strip the insulation from about 1/16" (or 2mm) from the both ends (201). If your wire strippers are having a hard time stripping the insulation from this tiny wire, you can just tin the ends of the wire with your soldering iron and the insulation should easily melt off. If you do this make sure you clean your soldering iron tip well so none of the plastic is left on the tip; it would contaminate your solder joints.

The wire jumper needs to be run from pin 2 of the four-pin expression header to the empty pad on the input jack (which is ground) (203). Use tweezers to hold the wire in place as you solder it (204,205). When both sides are soldered, tuck the wire under the jacks (206).

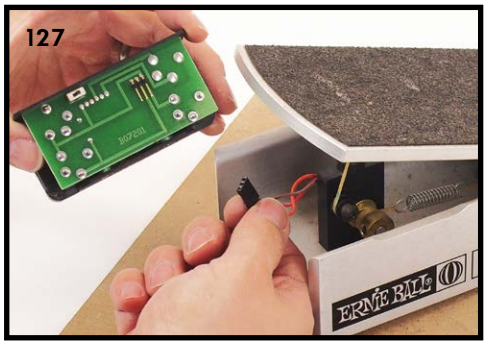


That's all that needs to be done in order to get your expression circuitry working correctly! See the VPM-1 Owner's Guide for information about how to use the expression upgrade.

Now we'll move on to modifying the pedal.

PREPARING THE VOLUME PEDAL CHASSIS

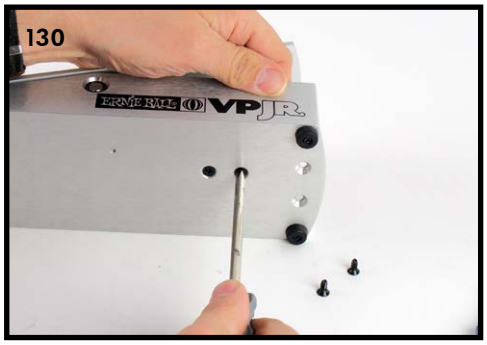
1. JACK MODULE: With your #2 Philips screwdriver, remove the two jack module screws from the bottom of the pedal chassis (127). If you have a large format pedal you'll probably be able to remove the potentiometer wire header from the jack module. If you have a VP Jr. or the wires are soldered onto the jack module you'll need to use your flush cutters to snip off the wires on the potentiometer (128). Hang on to the screws; we will use them to install the VPM-1 main board module.

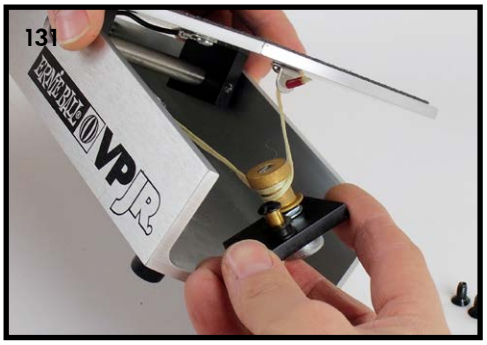


2. POTENTIOMETER BLOCK:

   a. Using your #2 Philips screwdriver, remove the two screws that hold in the potentiometer block (130). Note these screws are longer than the screws that came from the jack module.

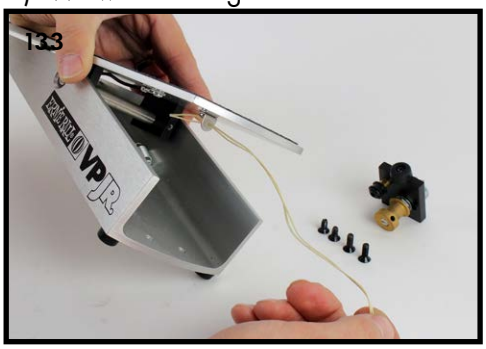
   b. Now unwind the string from the pulley to get the block out (131).

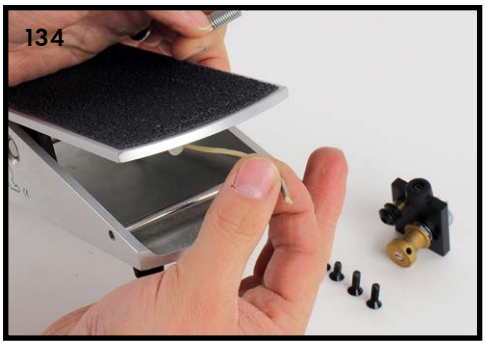


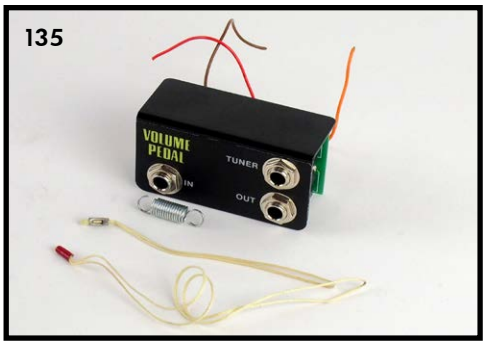


   c. At this point the strings and spring should be loose in the pedal. You can pull the strings out though their eyelets and the spring should just fall out (133,134). You can set the strings,

spring and jack module aside because we won't be using these again (135), but hang on to the screws and potentiometer block (136,137). We will be using them in the next section.







d. While it is empty, use a rag to wipe out the dust and dirt from the bottom of the chassis.

e. If you notice the treadle is very loose and isn't able to stay in one position between the two extremes, you should probably tighten the treadle. You'll need to do that now when the pedal chassis is empty. Please see Appendix A. If your pedal's treadle is tight enough, please move on to "PUTTING IT ALL TOGETHER."

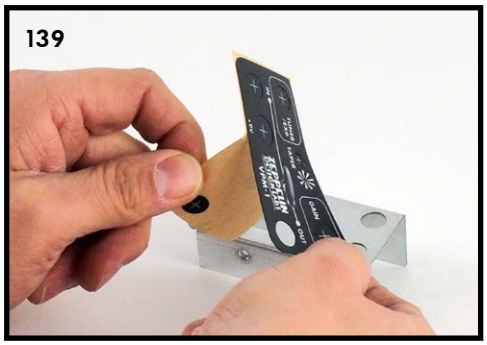
PUTTING IT ALL TOGETHER

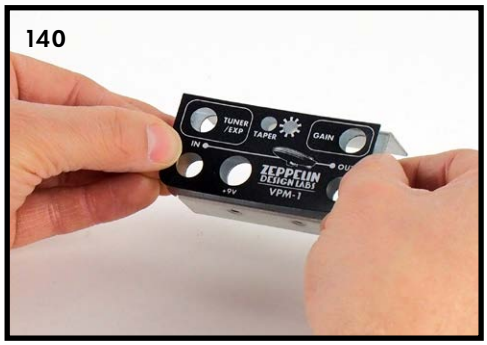
CHASSIS

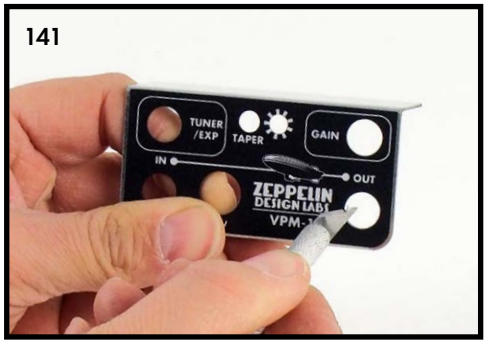
1. Labels

   a. Use some isopropyl alcohol and a rag to clean the chassis of grease and dust.

   b. Remove the backing paper from the label and very carefully align it to the holes in the chassis (139,140). Don't let it touch the chassis until you are ready to stick it in place. Once it's aligned properly press one edge of the label down firmly and work your way to the opposite edge, to prevent any air bubbles from getting trapped under the label. If any of the holes are misaligned, you can cut out the label from the hole with an X-acto knife (141).



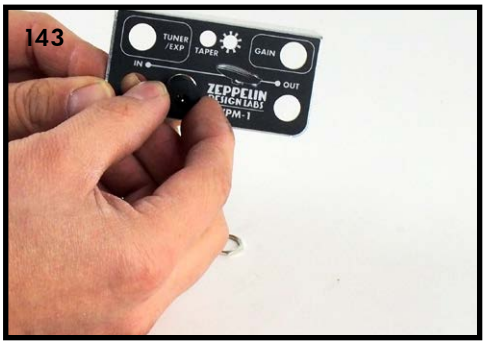




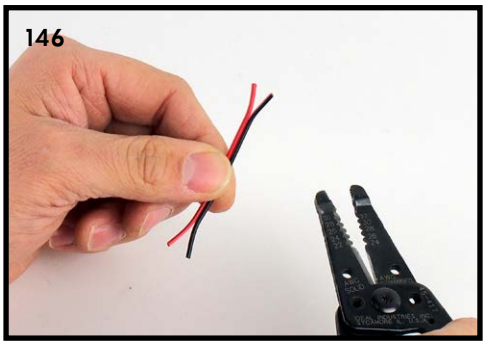
c. Place the Zeppelin Design Labs serial number label on the top of the chassis (142).

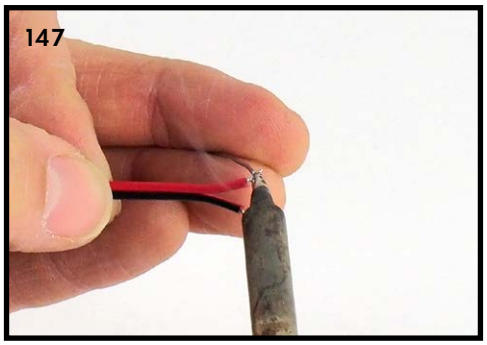
2. DC Jack

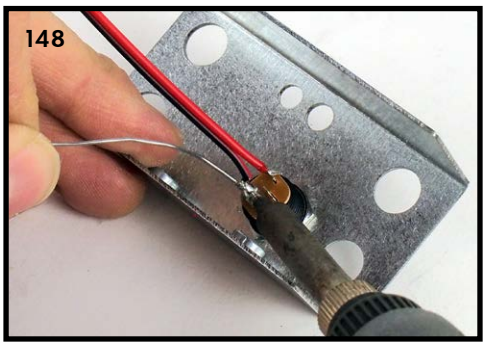
a. Attach the DC jack to the chassis with the provided nut. Tighten the nut down with a 9/16" (15mm) socket or some pliers. If your kit contains two nuts, apply the second after the first, as a lock.

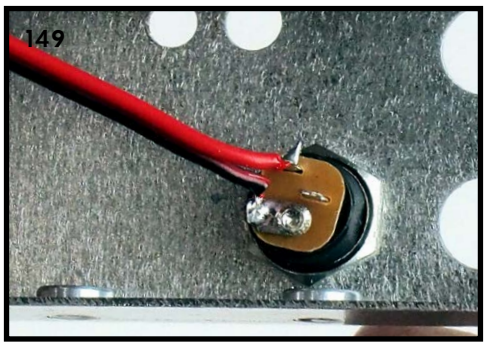


b. Split the 22awg wire pair about 1/2″ (12mm) on both ends. Strip about 1/8″ (3mm) off of each wire on both ends (146). Twist the fine strands of wire together and tin (147). Solder the black wire to the center lug and the red wire to the ring lug of the DC jack (148,149).



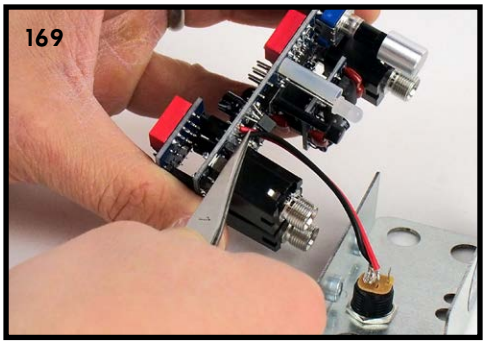


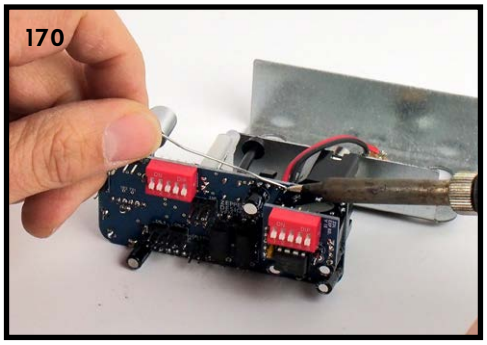




MAIN BOARD & CHASSIS

1. Now it's time to put the main board in the chassis. Solder the wires coming from the DC jack to the "+9V" pads on the main PCB (169,170). The red wire goes to the square pad and the black wire goes to the round pad. Don't mix them up or your VPM-1 won't work!!

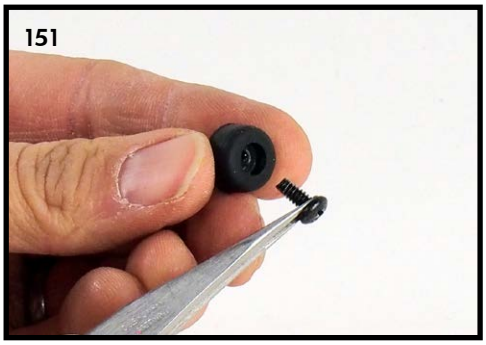




2. Line up the jacks, knob, switch, and LED to their holes in the chassis. You may have to gently prod the LED and tact switch to line up to their holes with some tweezers or other small tool (171). Once the chassis is seated properly, place the washers and nuts on the jacks and tighten them down with a 1/2" (12mm) socket (172,173).

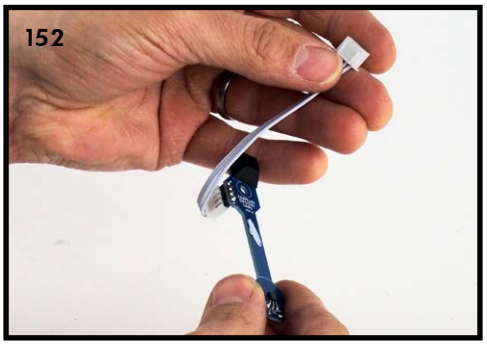
POTENTIOMETER BLOCK

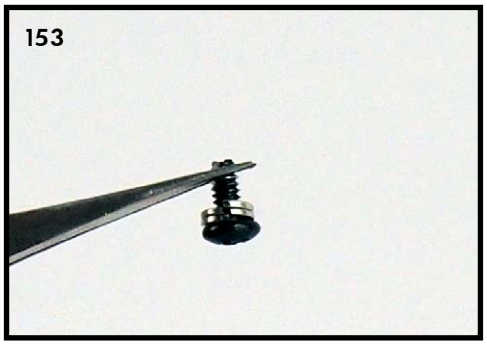
1. Unscrew the rubber foot from on top of the potentiometer block (150). Once the foot is off, remove the screw because we'll use it next to attach the sensor board (151).

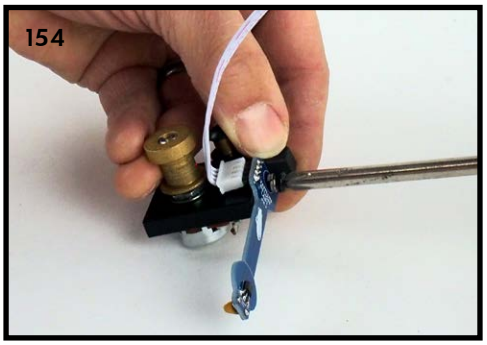


2. Bend the ribbon cable on the sensor board upward, so it will not conflict with the pulley (152). Place the two lock washers (part FA-93-35) on the rubber foot screw (153) and use the screw to fasten the sensor board to the potentiometer block (154). Make sure the PCB is laying perfectly

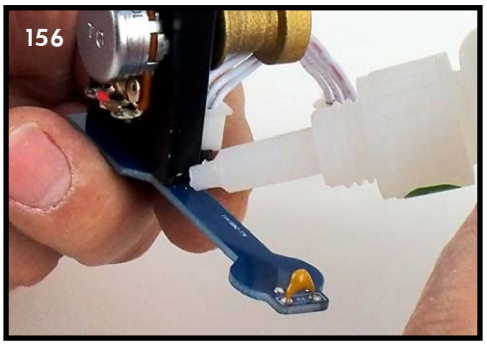
flat against the top of the potentiometer block (155). Sometimes when the screw is over-tightened the back of the PCB has a tendency to lift off the block a bit, so make sure that doesn't happen.

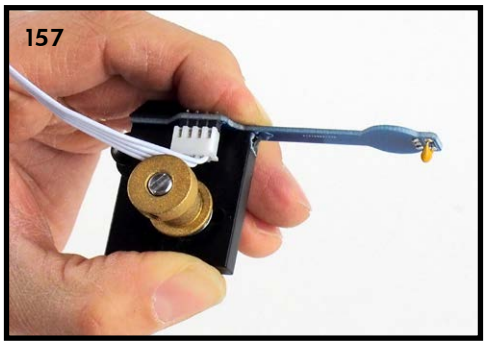






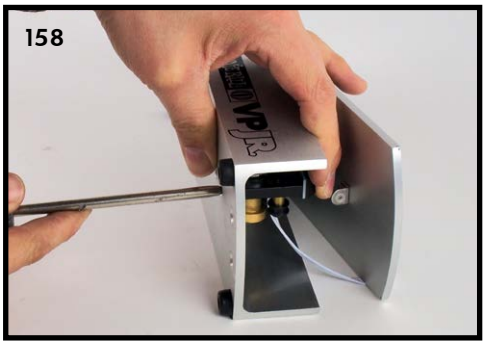
3. Align the sensor board with the top of the potentiometer block and add a drop of super glue to the back, top edge of the block (156). This should affix the sensor board to the block to keep it from rotating as the pedal gets hauled around from gig to gig. It may be necessary to hold the board down to the top of the block as the glue sets to ensure the board is laying on the surface of the block. Once the glue cures you can tighten up the screw a bit more, if needed.

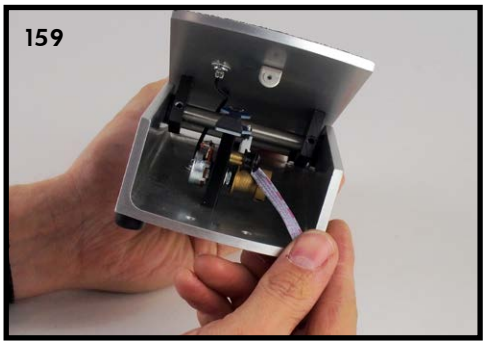


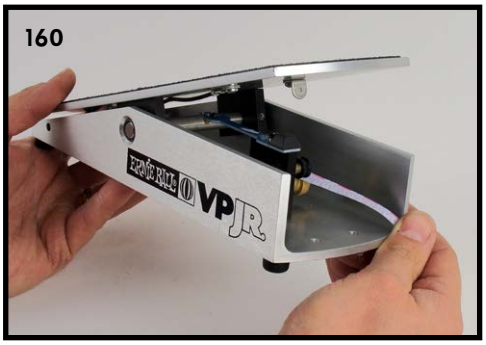


4. With the sensor board screwed and glued in place, you can now re-install the potentiometer block in the pedal chassis (158). Remember, the two longer screws are used to attach the potentiometer block. There is some play in how this block fits inside the pedal so snug the screws down but don't

tighten them up tight. Visually line up the sensor board so it is aiming straight to the back of the pedal (159), then tighten the screws.

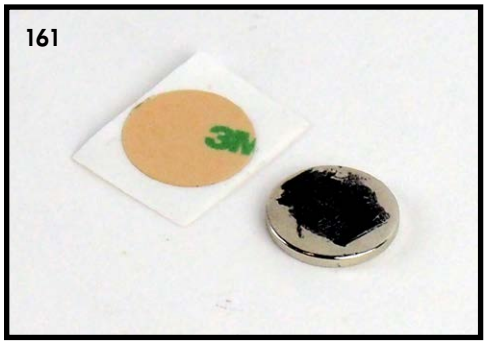


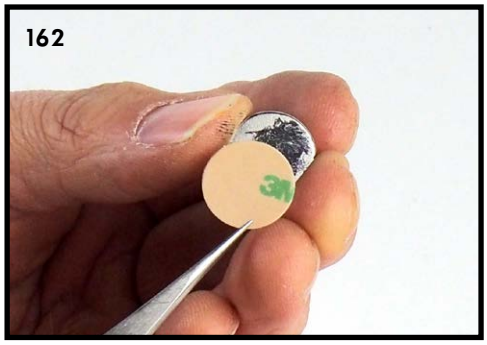




MAGNET

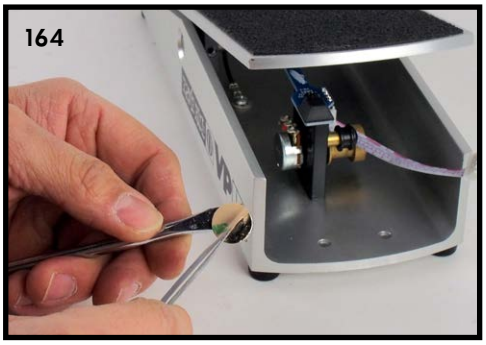
1. The magnet will be held on with the double-sided adhesive disc (TP-30-21). You'll notice the magnet has a black marking on one side (161). This marking indicates the side that the adhesive disc should be stuck to. Line the disc up to the magnet and press it firmly into place.

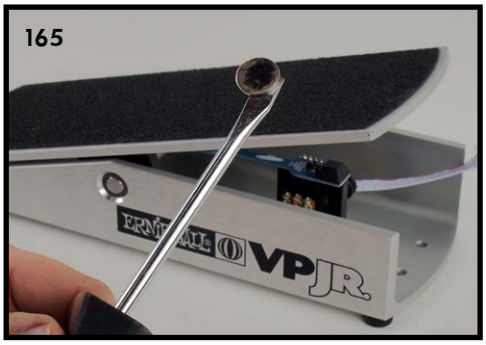




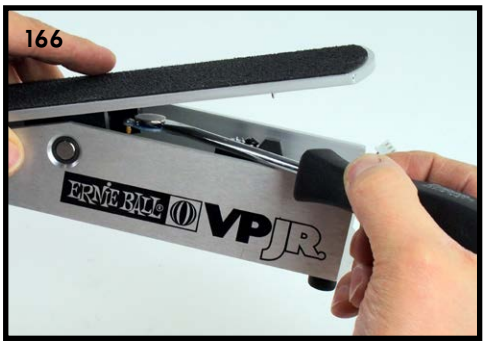
2. Now we need to attach the magnet to the bottom side of the treadle. With your rag and isopropyl alcohol, clean the area on the treadle directly above the Hall effect sensor (163).

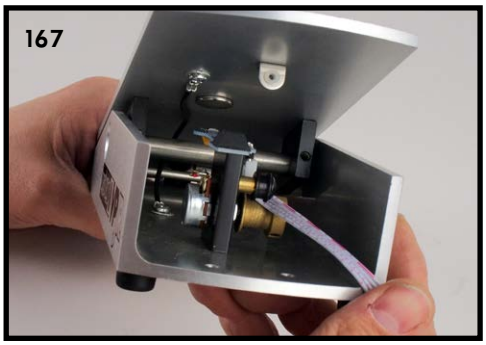
3. Attach the magnet to the end of a flat screwdriver with the adhesive disc facing up. Then peel off the backing paper on the adhesive disc (164,165).

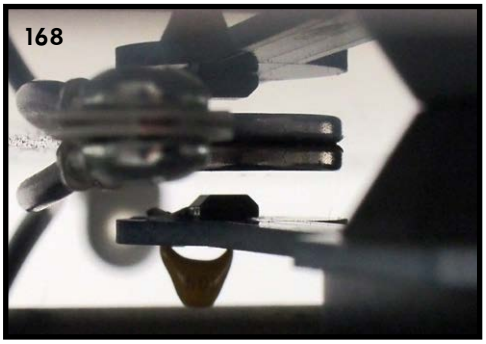




4. With the treadle wide open, place the end of the screwdriver (with the magnet still attached) on top of the circular part of the sensor board. The circular part of the board serves as a template for placement of the magnet. Make sure the Hall effect sensor is lined up to the center of the magnet. The magnet may need to be hanging off of the end of the screwdriver to be lined up properly (166). When the magnet is in the correct position, bring the treadle down on top of the magnet and screwdriver. The magnet should stick to the bottom of the treadle in the proper location (167,168). Press the magnet tightly to the treadle and hold it for a few seconds to bond it tightly. Now as the treadle moves down and up, the magnet gets closer to and farther from the sensor.





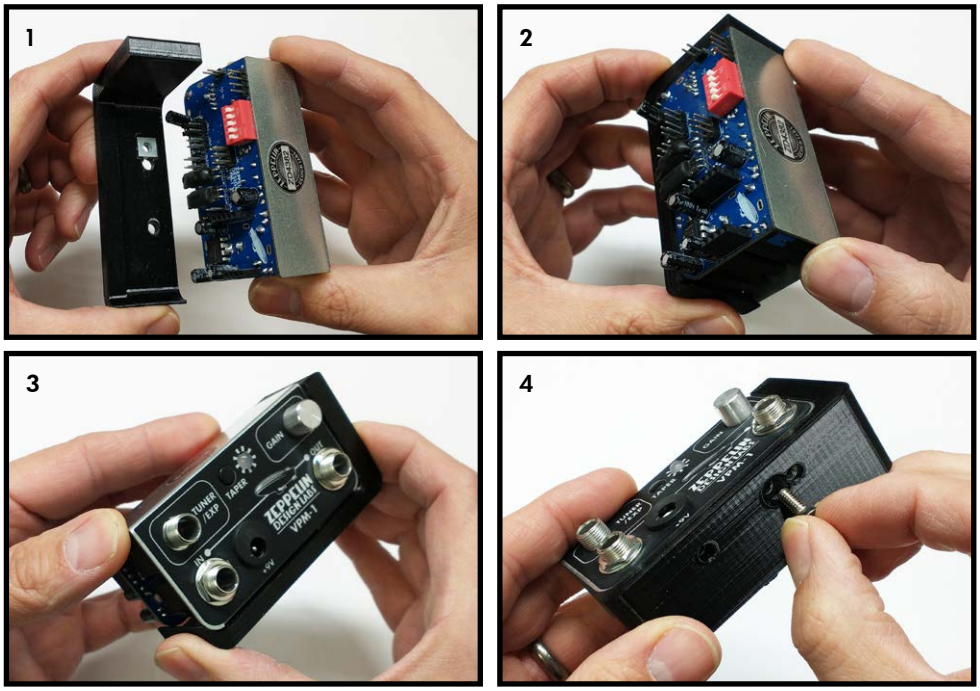


THE LARGE FORMAT ADAPTER (FOR MODEL NUMBERS: 6165, 6166, 6167, 6168)

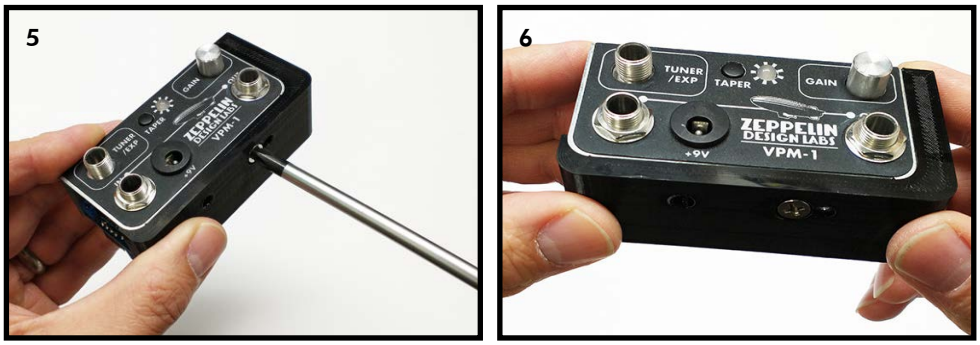
If you have a VP Jr. model volume pedal then please continue on to the next section: "INSTALLING THE MAIN BOARD MODULE."

If you have an original large format volume pedal (model numbers: 6165, 6166, 6167, 6168) you'll need to use our adapter kit to allow the VPM-1 main board module to screw into the volume pedal chassis. It is very simple to assemble, and only takes one screw to attach the main board module to the adapter.

1. Line up the main board module to the adapter and slide the module chassis against the ridge on the bottom of the adapter. On the bottom of the adapter, make sure the screw holes in the module chassis are visible through the adapter holes.



2. In the middle hole of the adapter (the beveled hole) use one of the supplied 1/2" screws to attach the two pieces together.



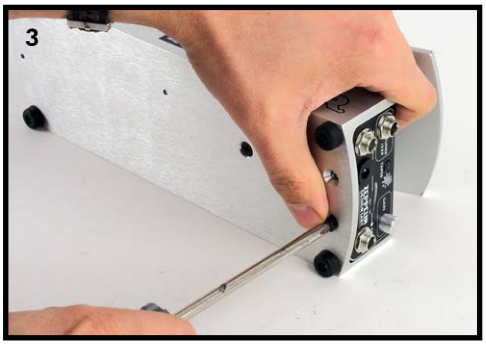
Now you can move on to "INSTALLING THE MAIN BOARD MODULE" where you will attach these combined parts into the pedal chassis.

INSTALLING THE MAIN BOARD MODULE

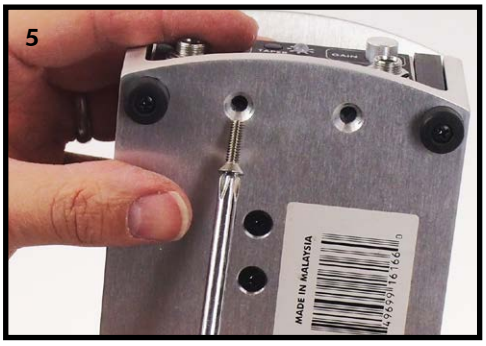
At this point, if you have installed the Stereo upgrade, please move on to "SETTING UP STEREO CONFIGURATION" on page 54 and then return to step 1 below. If you have not installed the Stereo upgrade, please continue on to step 1 now.

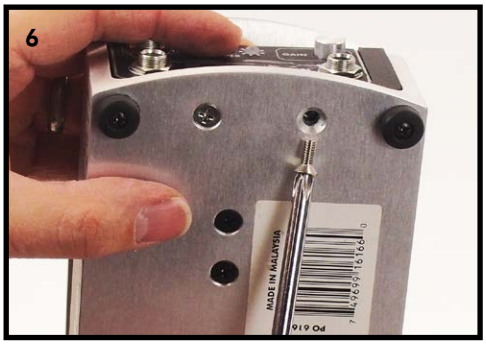
1. Attach the ribbon cable to the main board header. Remember earlier when you noted the pattern on the cable wire near the dot on the sensor board? It is important that the pin by the dot on the sensor board is attached to the pin by the dot on the main board. Make sure it is not reversed.

2. If you have a VP Jr., slide the main board chassis into the VP Jr chassis and screw it in place with the short screws that held in the original jack board module (3). If the main board chassis has trouble fitting into the VP Jr. chassis it may help to use a file to remove a small amount of metal from the corners of the aluminum chassis (4).



If you have a large format pedal, use the long screw in the left hole and the short screw in the right hole (into the square nut in the adapter).



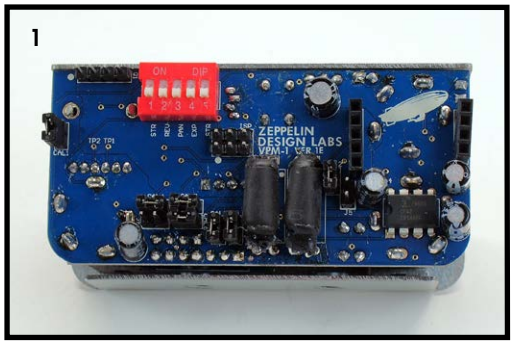


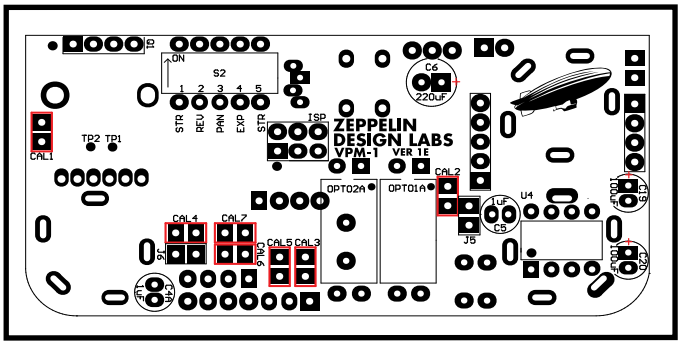
That's it! You are almost ready to go. Skip down to "CALIBRATING THE VPM-1" on page 55.

SETTING UP STEREO CONFIGURATION

Stereo configuration setup is an automatic process handled by the VPM-1 microcontroller. During this process the microcontroller tests the two sets of optocouplers (for the left and right channels) and internally populates two tables of LDR resistance values for given LED brightness levels. The microcontroller then compares the two tables and adjusts the values of one to match the other. Because of this process, plus the fact that we hand select the matched pairs of LDR's, the stereo channels will be very close in volume to each other. The microcontroller's matching data is stored permanently, so this setup process is only required one time for the life of the pedal. All you need to do is set up some header jumpers on the main board and plug in the power; the rest of the process is automatic. However, it does take a long time – usually about ten minutes. As long as you see the LED blinking, be assured the VPM-1 is hard at work. Follow these steps:

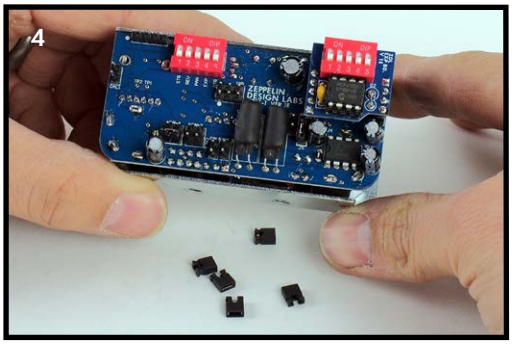
1. Set the calibration jumpers on headers CAL1, CAL2, CAL3, CAL4, CAL5, CAL6 (177). The headers outlined in red should be jumped (178, not labeled).

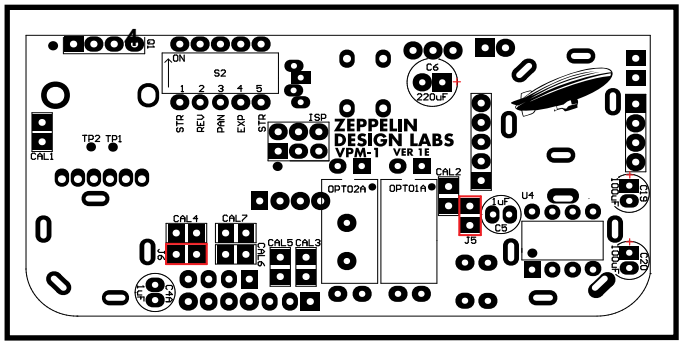




2. Plug in the power to the main board module. The ribbon cable of the sensor board does not need to be connected. The LED will blink red while thinking, and will take several minutes to complete. It will blink a total of 256 times, if you care to count. When the process is done, the LED will flash green rapidly. You can now disconnect the power.

3. Re-set jumpers. Remove all 6 calibration jumpers and add jumpers to JMP5 and JMP6 (the headers outlined in red in the graphic blow). This re-routes the audio signal through the pedal to the output jack.





4. Now go back up to "INSTALLING THE MAIN BOARD MODULE" on page 53 to complete putting it all together.

CALIBRATING THE VPM-1

We made a video to illustrate the following procedure, which you can find on our YouTube channel, in the VPM-1 playlist.

One of the things that makes the VPM-1 very versatile is the ability to set the active range (or sweep) of the treadle to a position that is most comfortable for you. This means that you can set the minimum volume position and maximum volume position anywhere along the pedal's range of movement. Any point below the minimum-volume position will be zero volume, and anything above the maximum-volume point will be maximum volume. Calibrating the VPM-1 is the process of setting these two points, plus three equidistant points in between. Since these five points are stored in the microcontroller's memory, calibrating the VPM-1 is only necessary once; but you may want to experiment with different sweep distances and placements to find what works best for you.

The five calibration points must be equally spaced across the desired range of treadle movement in order to produce the best volume linearity. The microcontroller will then manipulate these five points in different ways to create the four other available tapers. To help with this calibration procedure, we have included a "calibration card." The front of this card provides a colorful variety of ranges of treadle movement to choose from. On the back is something like a protractor. You might use this figure to lay out a custom sweep by choosing your own five points (just make sure they are equally spaced).

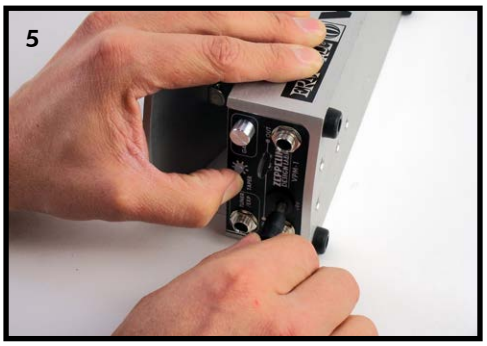
If this whole idea is a bit confusing to you, never fear! Just watch the video, follow the instructions, calibrate your pedal, and mess around with it for a while. Experiment with a few different sweep ranges until you are happy with the action. It is easy and hurts nothing to calibrate the VPM-1 again and again.

In this example (as in the video),we will use the calibration points shown in red on the card. If we wanted to adjust the maximum volume position of the treadle (in the toe down direction), we would choose one of the other colored lines.

Set the treadle position where you want the minimum volume point to be. We have found that what typically works best is to move the treadle until the gap at the back is about ½ inch (12mm) (183,184). If you use the pedal's fully-open position for minimum volume, then depending on the variations in your pedal build, the minimum volume may not get all the way down to zero.

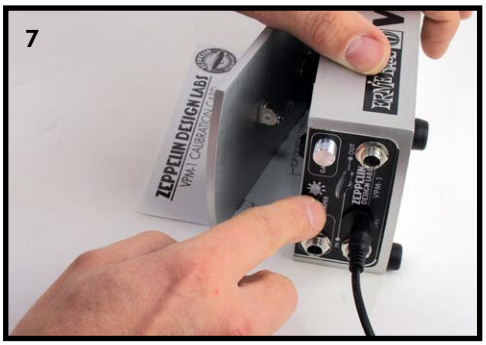
1. With the treadle set to your chosen minimum volume point and the pedal controls pointing left, slide the calibration card on the back side of the pedal chassis. Align the black line on the card with the top of the pedal chassis (3). Slide the card toward the axle until the top dot on the red line is flush with the bottom of the treadle (4). Now tape the card in position.

2. While holding down the TAPER button, plug the power into the VPM-1 (5). The LED should start flashing, indicating that the VPM-1 is in calibration mode. Release the button.

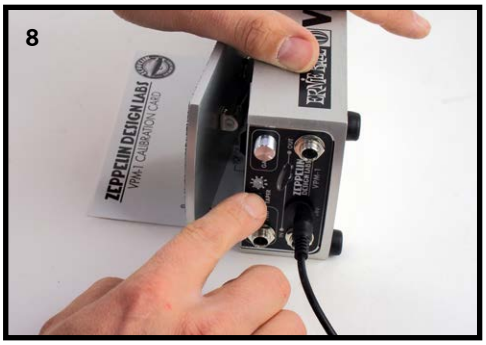


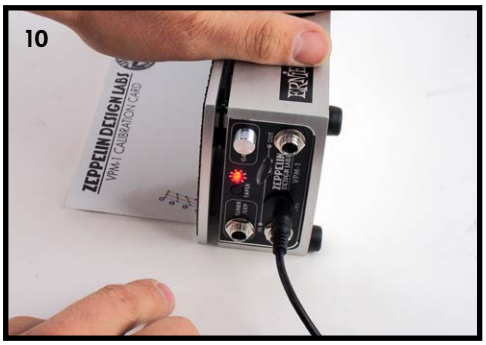
3. With the treadle still lined up with the top point on the red line, press the button. The LED will briefly flash again to indicate that this point was recorded in the microcontroller's memory.

4. Move the treadle to the next point down on the red line and press the button again. The LED will flash again indicating that this point was recorded.



5. Repeat this process for the three remaining points on the red line (8). After the last point is recorded, press the button one more time to exit calibration mode (9). You should see the LED cycle through all the colors, indicating the calibration process is done (10).





Your VPM-1 is now ready to use!

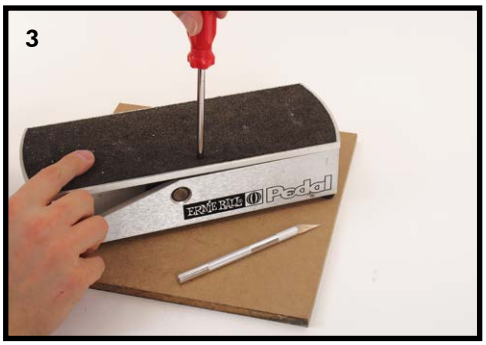
For more information on how to use this volume pedal mod, including its many features and options, please see the VPM-1 Owner's Guide available on our web site, www.zeppelindesignlabs.com. If you have trouble with getting your VPM-1 kit working correctly, see the VPM-1 Troubleshooting Guide in the same location.

APPENDIX A: TIGHTENING THE TREADLE ACTION

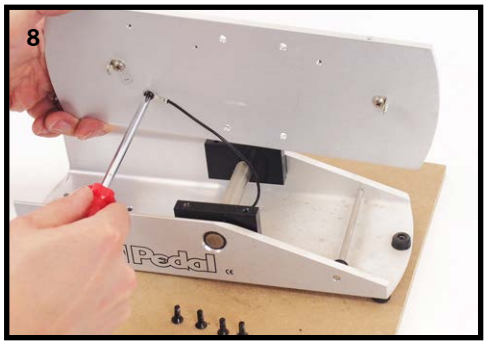
Sometimes when the string is removed from the volume pedal the tension of the treadle can become somewhat looser. This can be rectified by tightening or installing tension washers on the axle of the pedal. This requires the treadle and axle to be removed from the pedal. You will need a #2 Phillips screwdriver, a 2mm or 5/64" Allen (hex) wrench, needle nose pliers, and an X-acto (hobby) knife to perform this operation. (This process is demonstrated here on a large format Ernie Ball volume pedal, but the process is the same for the VP Jr. line of pedals)

1. There are 4 Phillips screws holding the treadle on to the axle mounts. These screws are hidden by the rubber grip on top of the treadle. Use your X-acto knife to find the slots in these screws by poking through the rubber at various places. When you have found the screws, cut slots into the rubber over the slots in the screws.

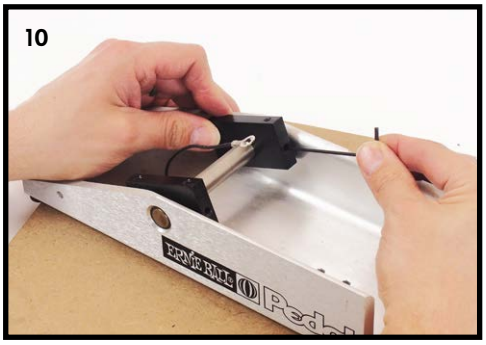
2. Use your Phillips screwdriver to back out each of the screws. Once the screws are partly out, it may be helpful to cut a circle out of the rubber grip around the screw heads. This helps to access the screws better.

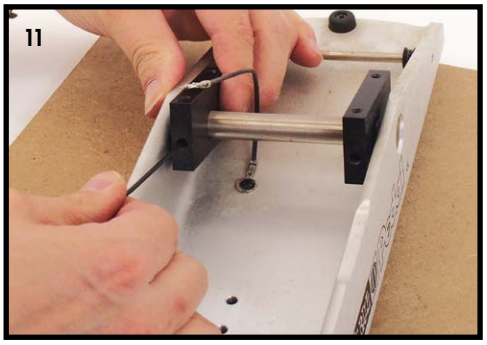


3. Unscrew the grounding wire lug on the bottom side of the treadle. Then mark the bottom of the treadle with an arrow pointing to the front of the pedal. This makes it much easier during re-assembly to quickly know which direction the treadle fits on the chassis..

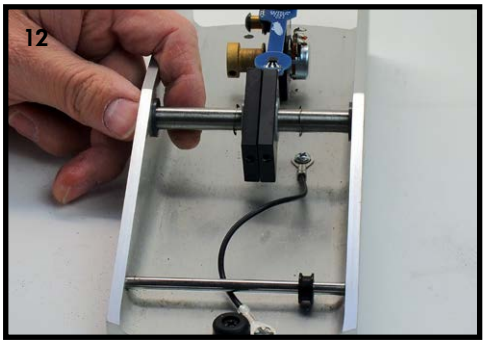


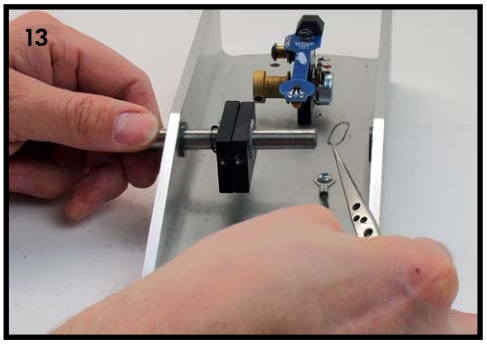
4. Use your Allen wrench to loosen both treadle mounting blocks on the axle.



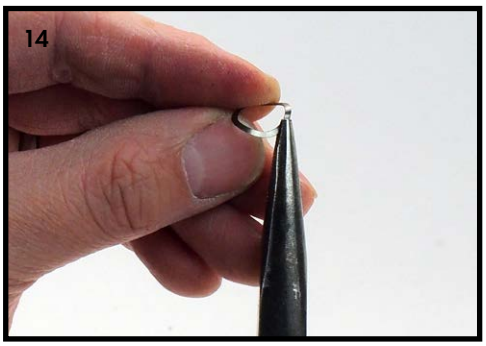


5. Once the treadle mounting blocks are loose, you can slide them toward the center of the axle. Slide the axle one direction, partly out of the chassis. If you have a large format volume pedal (models 6185, 6186, 6187, 6188), jump to step 7 (with the tension washers that came with your Large Format Adapter kit). If you have a VP Jr. or if tension washers are already on the axle, please continue with step 6.

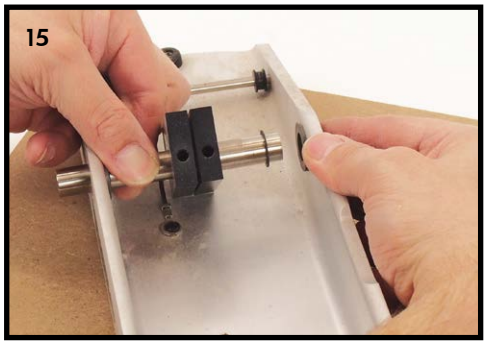


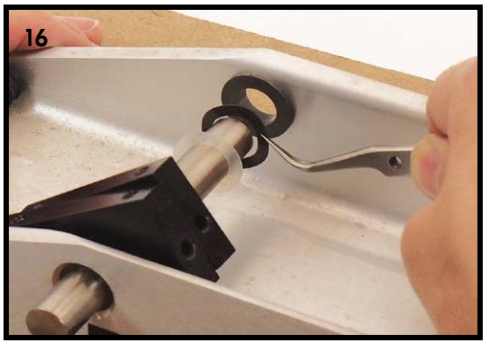


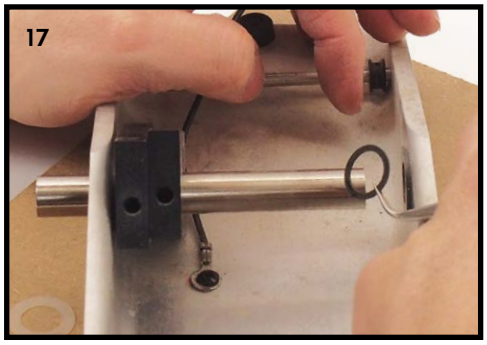
6. On your VP Jr., please remove the tension washer from the open side of the axle. Make sure to leave the white nylon washer where it is.
   You'll notice that the tension washer is bent in two different directions. Use your needle nose pliers to increase the angle of these bends a little bit more. Don't bend the washer too much that it breaks, but just enough to increase the bend angle. The more tension this washer applies to the treadle mounts, the tighter the treadle will be.



7. Slide the axle to one side of the chassis. Insert the tension washer on the axle between the plastic washer and the axle insert on the chassis. If your pedal happens to have phenolic washers installed on the axle in addition to the nylon washers, you can remove them. The phenolic washers are not necessary because the tension washers will take their place.

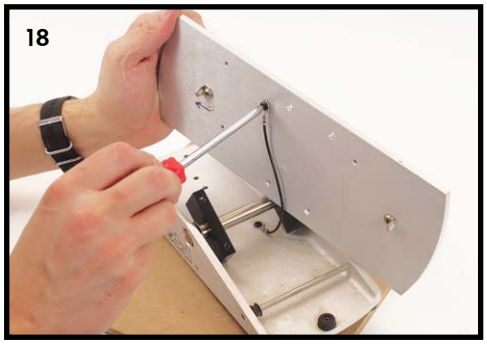






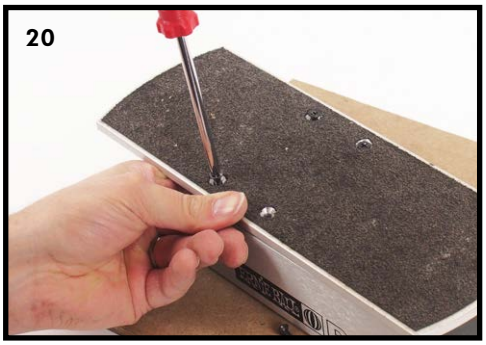
8. Slide the axle through it's insert until the other side of the axle is open. Repeat steps 6 and 7 with this side of the axle.

9. Re-attach the ground wire to the treadle. Make sure it is facing the correct way on the pedal chassis.



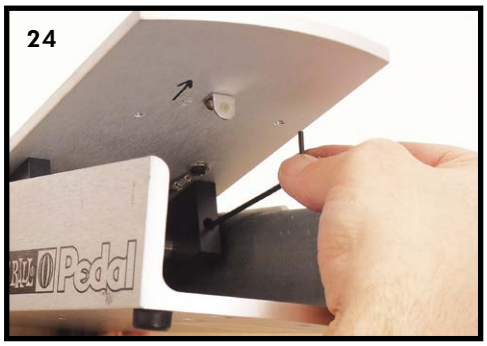
10. Partially screw the treadle to one of the mounting blocks. Only turn the screws 2 or 3 times into the mounting block. The treadle needs to still be loose enough to move around quite a bit in order to fit the screws in the other mounting block

11. Now that one side of the treadle is attached to one of the mounting blocks, reach under the treadle and pull the other mounting block to the side of the pedal. While holding it in this position you should be able to start attaching one screw through the treadle into that block. Only turn this screw enough turns to get the other screw started in it's hole.



12. Once all four screws have been started in their holes, you can now begin tightening them all, a little at a time,until they are all fully seated.

13. Once the treadle is fastened to the mounting blocks, open the treadle and use your 5/64" allen wrench to tighten each mounting block's set screw.



If you did everything correctly then the treadle action should be "stiffer" than it was before. If the treadle isn't as stiff as you'd like, feel free to repeat this process and bend the tension washer a little bit more (as described in step 8).

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