The PZM Modification Kit

The PZM Modification kit is a small kit of parts to help home constructors modify their microphones. The original concept was just a bag of parts with a schematic and an assembly drawing. Perhaps this deterred some constructors, but after spending the time and effort redesigning the board, it seemed to warrant including instructions. Those "skilled in the art" may proceed without further assistance. The kit includes the new circuit board, these instructions, the schematic, and all electronic parts needed to finish the circuit board. There's even some small-diameter solder included as some of the circuit board pads are teeny-tiny indeed. The microphone is NOT included. Unlike a Heathkit, this kit does not include an enclosure, hardware, or connectors.

If you've ever done any sort of electronic assembly, and you know how to solder on a printed circuit board, you should have no trouble assembling this. You should have a temperature controlled soldering iron that can be set to 600-700 degrees F, with a small chisel tip. No soldering guns, please. Flush cutters are nice for lead trimming, but diagnonal cutters will do.

Soldering

With any circuit, proper soldering is essential. It's not difficult, but this kit is not recommended for a first soldering project. A length of suitable solder is included with the kit. You'll need the following soldering equipment:

1. Temperature controlled soldering iron capable of being adjusted to a tip temperature between 600-700 degrees Fahrenheit.
2. 63/37 alloy rosin-core solder, .031" diameter. 60/40 alloy is acceptable. (supplied)

Desoldering

If you goof, be very careful when desoldering. Each hole has plating that connects the top layer with the bottom layer. If you're not careful, you'll pull the plating out when you remove the part. If this happens, be sure to solder the part on both sides of the board. The very best tool for this sort of work is a vacuum powered solder sucker. In 2nd and 3rd place are the hand operated desoldering pumps and solder wick. It may be easier to mount the board in a vise, grasp the lead with a pair of pliers, heat the connection while pulling on the pliers. Afterwards use something like a dental pick or the desoldering pump to remove the solder from the hole. Best, of course, is to not goof in the first place!

Cable Length

The output of the PZM plate is moderate impedance (under 10k-ohms). It is unbalanced, but since one end of the unbalanced line is floating out in free space, there is little likelihood of any current flow in the shield, which is usually the undoing of an unbalanced interface. The cable supplied by RS is fairly long, and you may want to clip it shorter, which is your privilege. All testing was performed with the cable cut about 12-inches shorter than it was supplied. The test lab is in a moderate RF environment, which is the biggest concern with leaving the cable at the factory supplied length. Should you choose to shorten it, consider leaving the cable long enough to reach the floor from the highest height that the microphone is likely to be operated from, 10-feet perhaps? The cable at the balanced low-impedance output can be nearly any length, several hundred feet should not be a problem.

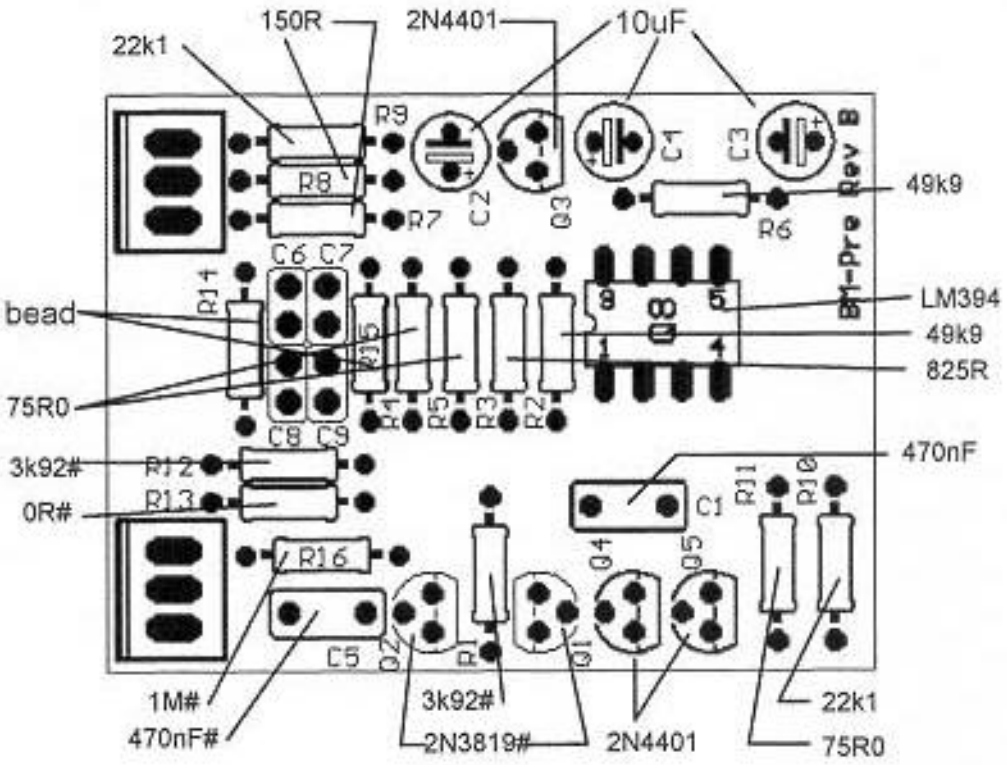
Parts Identification

There are many 1% resistors used in this design. Some are marked with the value, some are color coded, and some may not have any value markings at all. When in doubt, use an ohmmeter.

Unlike a 5% or 10% resistor, a 1% resistor has three digits as part of its value. The fourth digit is the multiplier. The colors used are the same as for other resistors, however the tolerance band is brown rather than gold or silver. If the resistor is marked with numbers, the first three digits are significant, the fourth is the multiplier. If the resistor is banded, then (again) the first three bands are significant and the fourth band is the multiplier. Here are some examples:

Value	Marked	Value	Marked
75R0, 75.0 ohms	75R, vio/grn/blk/gold	22k1, 22100 ohms, 22.1k	2212, red/red/brn/red
825R, 825 ohms	8250, gry/red/grn/blk	100k, 100000 ohms	1003, brn/blk/blk/org
3k92, 3920 ohms, 3.92k	3921, org/wht/red/brn	1Meg, 1000000 ohms, 1M	1004, brn/blk/blk/yel

PCB Assembly Instructions



Note: Parts marked with # are version dependent

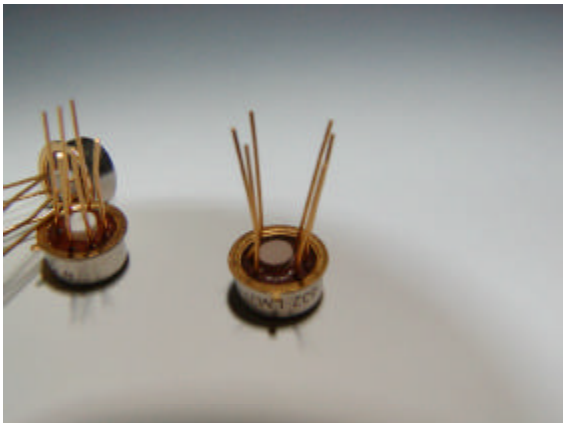
Parts List

Qty	Ref Des	Description	Remarks
1	R1, R12	Res, MF, 3k92, 1%	Only one part used
2	R2, R6	Res, MF, 49k9, 1%	
1	R3	Res, MF, 825R, 1%	Gain set resistor
3	R4, R5, R11	Res, MF, 75R0, 1%	
2	R7, R8	Res, MF, 150R, 1%	
2	R9, R10	Res, MF, 22k1, 1%	
1	R16	Res, MF, 1M0, 1%	
1	R13	Jumper, 0-ohm	Version 3
2	R14, R15	Bead, Ferrite, FBA04VA450BA-00	Taiyo Yuden
2	C1, C5	Cap, film, 470nF	
3	C2, C3, C4	Cap, lytic, submini, 10uF, 15V	
2	C8, C9	Cap, cer, 120pf	
2	Q1, Q2	Transistor, JFET, N-CH, 2N3819	10% match
3	Q3, Q4, Q5	Transistor, NPN, 2N4401	
0	Q6, Q7	This reference not used.	
1	Q8	Transistor, dual, supermatch, NPN, LM394	
1	PCB	Printed Circuit Board	

Basic Board Assembly

The basic idea behind the sequence used is component height. That way, when you flip the board over to solder, gravity will help you pin the components against the board. All three configurations of the board require stuffing the following components.

1. Stuff these resistors:
   R2, R6: 49k9, yel/wht/wht/red
   R3: 825R, gry/red/grn/blk
   R4, R5, R11: 75R0, vio/grn/blk/gold
   R7, R8: 150R, brn/grn/blk/blk
   R9, R10: 22k1, red/red/brn/red
2. Flip the board over and solder all the resistor leads and trim the excess wire from each connection.
3. R14 and R15 are ferrite beads. Stuff , solder, trim.
4. Stuff C2, C3, C4 (10uF, electrolytic). Don't force them flush with the board. Observe polarity. Solder and trim.
5. Stuff and solder C1 (470nF, film). There are 3 pads for this part, and two are connected together, allowing for two different lead spacings. The third pad is located outside of the component outline.



LM394 details: Note the metal tab. There are two rows of leads on each side of the tab.

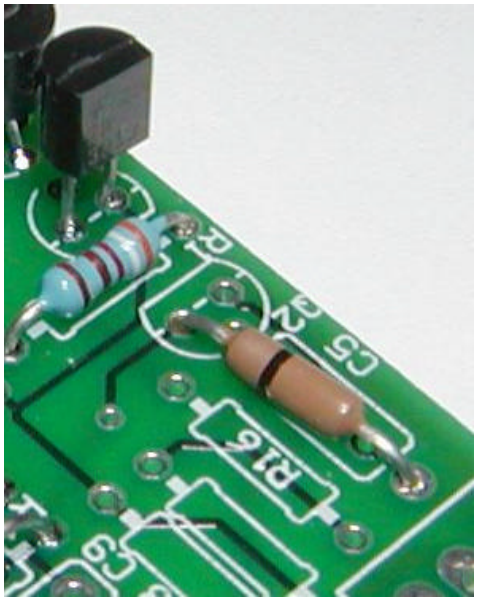
6. Stuff transistors Q3, Q4, and Q5 (2N4401). Pay attention to the orientation of each transistor. Q8, the LM394 may be packaged in an 8-pin DIP or in an 8-pin metal can. The metal can package has pins 1 and 6 aligned with the metal tab, and the leads are numbered clockwise from pin 1. The metal tab aligns with the orientation slot of the IC pattern. Three leads insert into the first three holes of the IC pattern and the remaining three leads insert into the holes on the opposite side of the pattern. Pins 4 and 5 remain empty. Solder and trim the transistor leads. Refer to the pictures of the PCB.

   Note: The circuit board has the pins for Q8 numbered from 1-9. Pin 9 is actually pin 8.
   Pins 5, 6 and 7 are not used.

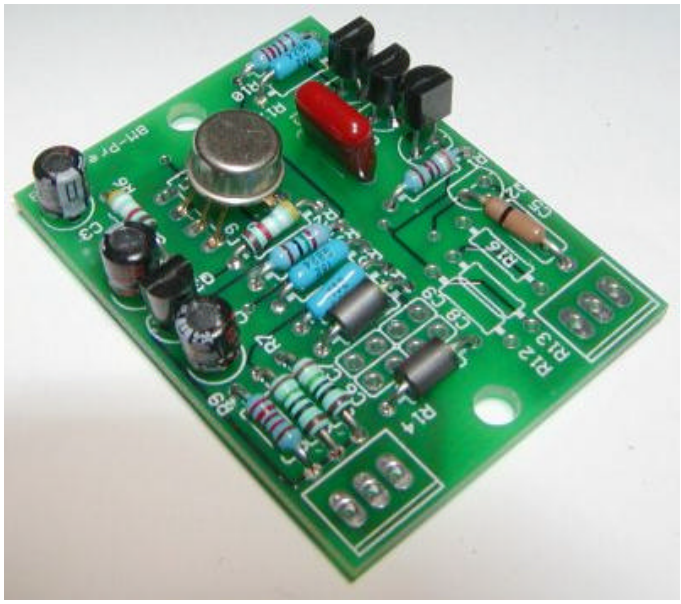
This completes the portion of the circuit that is common to all configurations.

For use with RS 33-1080 and 33-1090) (version 1)

1. Stuff and solder a zero-ohm jumper (looks like a resistor, but has a single black band) between the drain connection of Q2 to the pad nearest C5 and the input connections. Circuit-wise this connects the output of Q3 to terminal 1 of the input.
2. Stuff Q1 (2N3819) and R1 (3k92, org/wht/red/brn). Solder and trim.
3. Snip the wire between the battery box and the microphone. Toss the battery box.
4. Strip the cable coming from the microphone. Connect the shield to X2-1, connect the inner conductor to X2-2.
5. Wire the output connections as follows:
   X1-1 - XLR pin 3
   X1-2 - XLR pin 2
   X1-3 - XLR pin 1



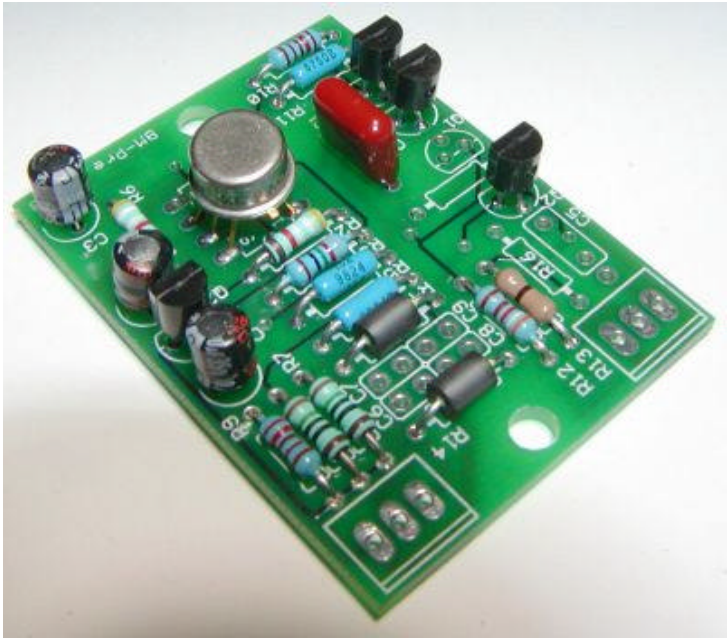
Stuffing the zero-ohm jumper in step 1



Completed Version 1 board

For use with RS 330-3020 and 330-3022, or a generic electret capsule. (version 2)

1. Stuff Q2 and R12. Solder and trim.
2. Stuff and solder a zero-ohm jumper (looks like a resistor, but has a single black band) for R13.
3. Snip the wire between the battery box and the microphone. Toss the battery box. This step does not apply to the generic capsule.
4. Strip the cable coming from the microphone. For the 330-3022 model, snip the white wire and ignore it. Connect the shield to X2-3, connect the inner conductor to X2-2. For the generic capsule, the ground lead connects to X2-3 and the 'hot' lead connects to X2-2.
5. Wire the output connections as follows:
   X1-1 - XLR pin 2
   X1-2 - XLR pin 3
   X1-3 - XLR pin 1

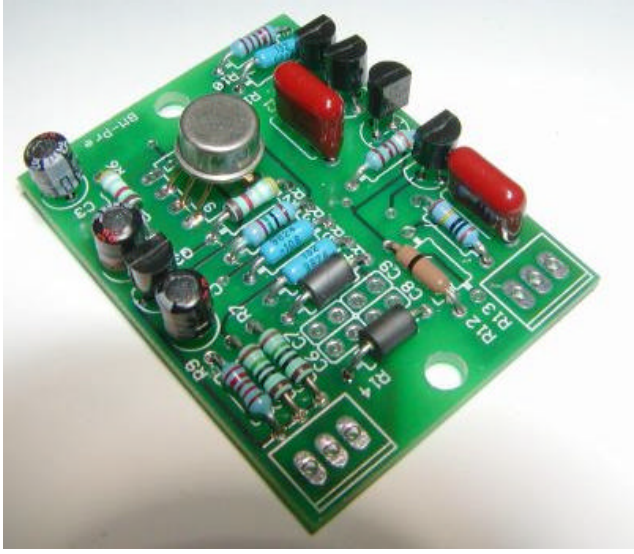


Completed Version 2 board.

For use as a direct box (version 3)

The direct box configuration provides a high (> ½ megohm) input impedance which is ideal for piezo and other self-generating pickups. There is no provision for floating the ground between the DI box and the console's ground. For this reason, this configuration can not be used with a companion amplifier that is multed to the pickup and the DI box. In a studio application, this should not be a problem.

1. Stuff R1 (3k92, org/wht/red/brn), R16 (1Meg, brn/blk/blk/yel). Solder and trim.
2. Stuff a zero-ohm jumper for R12 (looks like a resistor but has a single black band). Solder and trim.
3. Stuff Q1 and Q2 (2N3819). Solder and trim.
4. Stuff C5 (470nF, film). Solder and trim.
5. Connect the input jack shield to X2-3, the hot lead to X2-1. Add a 1-megohm (or larger) resistor between hot and shield at the jack.
6. Wire the output connections as follows:
   X1-1 - XLR pin 3
   X1-2 - XLR pin 2
   X1-3 - XLR pin 1



Completed Version 3 board.

Remaining Parts

Because of the multiple configurations, there will be some parts left over. There are two 120pf ceramic capacitors (C8, C9). Use them if you have trouble with radio frequency interference (radio/tv station pickup) caused by long mike lines, otherwise leave them out. It's ok to put them in for insurance. C6 and C7 are normally not used.

Choice of Enclosure and Connectors.

The completed board needs to be mounted in a metal enclosure. The die-cast aluminum alloy cases made by Bud Metal Products (CU-124) and Hammond (1590B-BK). The Hammond part comes pre-painted.

The input connector (coming from the PZM plate) could be a 3.5mm TRS plug, but that is only really suitable for version 2, where the cable shield is actually connected to circuit ground. The Switchcraft mini-XLR connector is a better choice, as you have total control over which conductor goes where.

The output connector should be an XLR-male connector. Connect pin-1 of the XLR connector directly to the chassis box through a very short wire.

Circuit Description

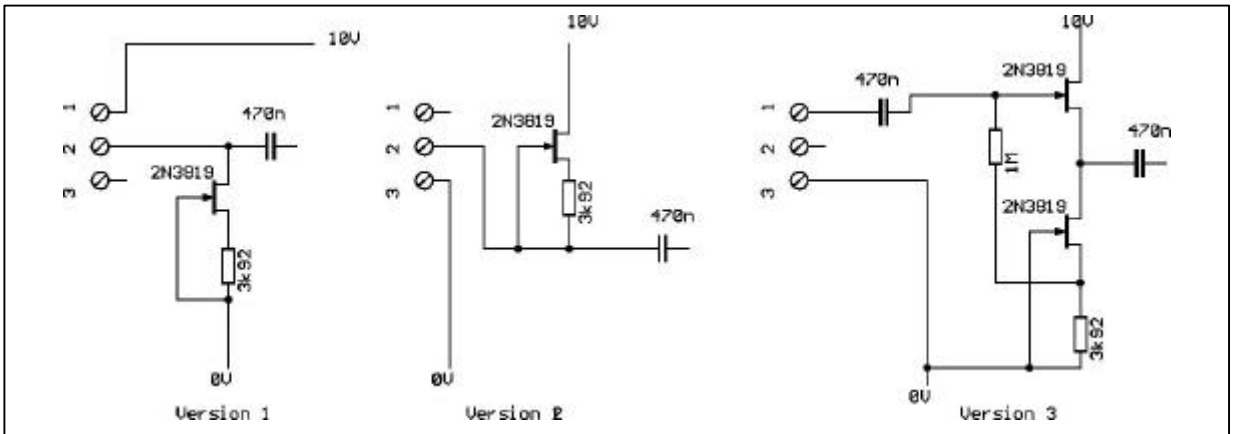
Refer to the schematic diagrams. The first, Input Configurations, shows the three different variations of the input circuit. For the original RS PZM microphones, Q1 acts as a current source load for the microphone capsule. The output of the microphone circuit is coupled via C1 to the differential line driver stage Q8.

For the other microphone configurations (version 2), Q1 is not present, and Q2 acts as a current source load for the microphone capsule. The output of the microphone circuit is coupled via C1 to the differential line driver stage Q8.

For the direct box application (version 3), matched JFETs Q1 and Q2 are connected as a current-source loaded source follower. Q2 is the source follower and Q1 is the current source load.

The differential line driver uses supermatch transistor Q8 connected as a differential amplifier. R4 and R5 provide some degeneration and R3 partially couples the emitters to change the gain. The supplied value of R3 provides about 6dB of gain. Yes, you could use a pot here to make the gain variable, but it would need to have a reverse-log taper, which is difficult to find. Another possibility would be to use a make-before-break switch with discrete resistors. Q4 and Q5 make a current source that sets the operating point of the diff-amp. C3 ensures that the base of Q8B is at AC ground.

R7 and R8 are the collector load resistors for Q8 (along with the phantom feed resistors at the microphone input).



Input Configurations
Note: Only the connections that are actually used are shown here.

Their junction provides a place to pick off the dc phantom power voltage. This voltage operates the remainder of the circuitry.

The currents drawn by the different portions of the circuit cause the collector voltage of Q8A/B to be roughly 25V. The output voltage depends on the voltage divider R9/R10, Since R9/R10 are equal, the voltage at their junction is roughly 1/2 the voltage at the top of the divider, just slightly more than 10V. Emitter follower Q3's base is tied to the junction of R9 and R10, so its emitter voltage is the base voltage minus one V_{be} drop or 10V to the microphone capsule and the two input FETs. C2 ensures that there is no residual audio at Q3's base and C4 nails any noise output from Q3 to ground.

The two ferrite beads and C8, C9 make a lowpass filter at RF frequencies to guard against RFI caused by the balanced output line acting as an antenna. C6 and C7, normally not used, allow changing the filter to a PI configuration or to a lowpass filter looking towards the microphone cable.

Licensing Information

NOTE: No license is granted with respect to this circuit. Permission is hereby granted to construct the circuit and use it for your own use. Permission to use this circuit in a commercial context (i.e. turn it into a product for sale) is not granted.

Warranty

This circuit is warranted to work when constructed properly. Only the circuitry contained on the printed circuit board is warranted. The microphone element connected thereto and its connecting cable is specifically excluded. The kit is warranted to contain all parts shown in the parts list. Defective parts will be replaced at no charge. There are no other warranties, expressed, implied, for fitness for purpose, for loss of revenue or for anything else due to the use of this circuit.

Circuit boards damaged by poor soldering technique or improper solder or solder flux will not be replaced. Circuit boards returned for repair will be repaired for the cost of time and materials unless our inspection reveals a faulty component. The criteria for this judgement rests soley with Uneeda Audio and no other person or persons.

By modifying your Radio Shack product in this manner, you acknowledge and understand that any Radio Shack warranty that your product may have had is now void. Always remember the microphone's humble beginnings.

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