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Introduction

The Uneeda Audio PZM Modification kit is a 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 more detailed instructions. Those “skilled in the art” may proceed without further assistance. The kit comprises: the 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. (Available separately from Uneeda Audio)

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 need a temperature-controlled soldering iron that can be set to 600-700 degrees F, with a small chisel or conical tip. No soldering guns, please. Flush cutters are nice for lead trimming, but diagonal cutters will do. Long-nose pliers are handy for wire forming.

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. (only for kits sold within the USA or Canada) You’ll need the following soldering equipment:

- Temperature controlled soldering iron with a suitably small tip capable of being adjusted to a tip temperature between 600-700 degrees Fahrenheit. We like the Hakko FX888D.
- 63/37 alloy rosin-core solder, .031” diameter or smaller. 60/40 alloy is acceptable. (63/37 supplied, see footnote)

There are solder pads on both sides of the board, but they are internally connected together **and it is NOT necessary to solder the parts on both sides of the board nor is it necessary to apply enough solder that you see a solder bead on both sides of the board. You can solder either side of the board. The correct solder is supplied with the kit. Please use it, because we know that it works. Do not use other solders or separately applied flux. It simply is not needed nor necessary.**

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 next to last, and last place are the hand operated desoldering pumps and solder wick. **If you don’t have a vacuum powered desoldering tool, you want to avoid having to desolder anything.**

- **The best thing you can do is to be double damn sure before you solder, so you don’t have to desolder.**
- If you have to desolder a resistor, put the board in a vise, grab the lead with a pair of long nose pliers, apply tension, heat the joint from the other side of the board. Once the solder melts, the lead should pull free. Repeat for the other end of the part.
- Anything with more than 2 leads can be very difficult (like the IC). Likewise things that mount flush to the circuit board.
- Consider sacrificing the part (cut the body off) so you can remove the leads one at a time. Resistors are cheap. Lytics less so. The most expensive part is the THAT 300P transistor array.
- Once you get the part clear of the hole, you can clear the hole with a round toothpick, or something straight and pointy that doesn’t take solder, like a dental pick.

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. If you don’t have a vacuum powered solder sucker, the safest method is to cut the part in two (or cut the leads at the part body), and then work from the component side of the board. For radial leaded components, like the capacitors, this may not be possible. Where the pads are close together, you can try heating both at once.

Replacement Parts

If you need a replacement part for any reason, Uneeda Audio will replace up to 6 parts at no charge except for the THAT 300 transistor array. There are limits to our generosity, and you are advised to not test them. Circuit board damage is not included in this offer.. **Best, of course, is to not goof in the first place!**

-
1. With the adoption of RoHS restrictions in EU countries, solder is not supplied with kits sent to RoHS countries .

2. The replacement parts offer can be withdrawn at a moment's notice, at our whim and/or caprice.

PZM Cable Length

The output of the PZM plate is moderate impedance (well 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 why unbalanced wiring likes to hum. The impedance is reasonably low, so high-frequency loss is not an issue. The cable supplied by RS is fairly long, and you may want to shorten it, which is your privilege. All testing was performed with the cable cut to about 10-feet. 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. In use, don't coil the cable coming from the PZM plate, and keep mobile phones away.

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. All parts are pre-sorted for you. We use the European convention of writing values without using a decimal point (which can get lost).

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. These resistors are all used in the circuit.

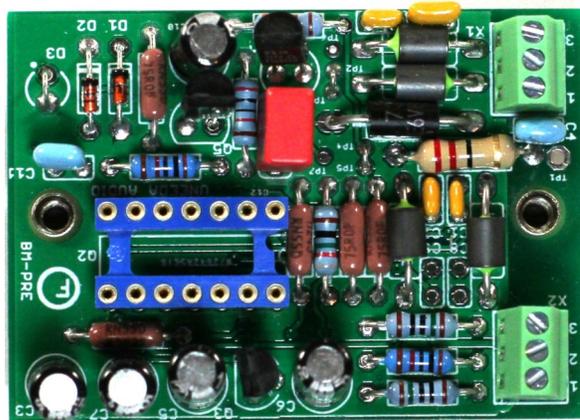
If you can't figure out the color code, use an ohmmeter to be sure you have the right value. Resistors are also bagged separately and marked, which should help.

| <u>Value</u> | Marked |
|-------------------------|-----------------------|
| 22R, 22-ohms | 22R, red/red/blk |
| 75R0, 75.0 ohms | 75R, vio/grn/blk/gold |
| 150R0, 150.0 ohms | 1500, brn/grn/blk/blk |
| 825R, 825 ohms | 8250, gry/red/grn/blk |
| 3k92, 3920 ohms, 3.92k | 3921, org/wht/red/brn |
| 10k0, 10000 ohms, 10.0k | 1002, brn/blk/blk/red |
| 20k0, 20000 ohms, 20.0k | 2002, red/blk/blk/red |
| 49k9, 49900 ohms, 49.9k | 4992, yel/wht/wht/red |
| | |

Parts List

| CFG 1&2 | Reference Designator | Description | Remarks |
|---------|----------------------|---|---|
| 0 | R2, R4, R6 | These are not used | |
| 1 | R1 | Res, CF, 22R, 1W <red/red/blk> | |
| 1 | R15 | Res, MF, 3k92, 1% <org/wht/red/brn> | |
| 2 | R3, R9 | Res, MF, 49k9, 1% <yel/wht/wht/red> | |
| 1 | R11 | Res, MF, 825R, 1% <gry/red/grn/blk> | Gain set resistor |
| 3 | R13, R14, R16 | Res, MF, 75R0, 1% <vio/grn/blk/gold> | |
| 2 | R7, R8 | Res, MF, 150R0, 1% <brn/grn/blk/blk> | |
| 2 | R12 | Res, MF, 20k0, 1% <red/blk/blkred> | |
| 1 | R5, R10 | Res, MF, 10k0, 1% <brn/blk/blk/red> | |
| | | | |
| 2 | C1, C2, C8, C9, C13 | Cap, cer, 150pf | C8, C9 not stuffed |
| 5 | C3, C5, C6, C7, C10 | Cap, lytic, 105C, 10uF, 35V | |
| 2 | C4, C11, C14 | Cap, cer, 100nF | |
| 1 | C12 | Cap, film, 470nF | |
| | | | |
| 2 | D1, D2 | Diode, 1N914/1N4148 | |
| opt | D3 | Red Led or jumper. If no LED, then stuff jumper. | Not supplied. Other colors ok, but red preferred. |
| 1 | D4 | Diode, TVS, 600W 5v8 | Mouser 621-PK6E6V8CA-T |
| | | | |
| 3 | L1, L2, L3, L4 | Bead, Ferrite, Taiyo Yuden FBA04VA450BA-00 | |
| | | | |
| 1 | Q2 | Transistor, quad NPN, THAT 300P14-U | There is no Q1 |
| 2 | Q3, Q5 | Transistor, NPN, 2N4401 | |
| 1 | Q4 | Transistor, JFET, N-CH, 2N3819 | |
| | | | |
| 1 | PCB | Printed Circuit Board | Revision F |
| 1 | none | Socket, 14pin DIP, machined contact | Mouser 575-2104731441001000 |

PCB Assembly Instructions



Completed Ref F PCB
(Note jumper instead of LED)

Appendix B describes the different microphone models and their configuration requirements. Parts supplied may look different from those shown in the above picture. A larger sized image of the picture can be found on the cover page of this manual.

Initial Board Assembly

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

1. Stuff and solder the two diodes, D1 and D2. Mind their polarity. Trim the leads. (the color bands correspond to the bar in the symbol) Save the trimmed diode-wire leads. They will be used in a later step.
2. Stuff these resistors:
R3, R9: 49k Ω , yel/wht/wht/red
R11: 825R, gry/red/grn/blk
R13, R14, R16: 75R Ω , vio/grn/blk/gold
R7, R8: 150R, brn/grn/blk/blk
R10, R5: 10k Ω , brn/blk/blk/red
R12: 20k Ω , red/blk/blk/red
3. Flip the board over and solder all the resistor leads and trim the excess wire from each connection.
4. L1, L2, L3 and L4 are ferrite beads. Stuff, solder, trim.
5. Stuff C1, C2, C13 (150pf ceramic), . Do the same for C4, C11, and C14 (100nf ceramic) Solder and trim.
6. Stuff C3, C5, C6, C7, C10 (10uF, electrolytic). Don't force them flush with the board. Observe polarity. Solder and trim. The ground stripe is always towards the outside of the board.
7. Stuff D4 and R1. Although D4 is a diode, it has no polarity and can be inserted either way.
8. Stuff and solder C12 (470nF, film).
9. D3, a red LED, is optional. If you're not going to use it, the two holes must be connected together with a short piece of wire. Use a piece of resistor wire. Bend it into a U and solder it into place. If you are installing the LED, then see the section following this assembly list. We prefer RED because it has the lowest voltage drop.
10. Stuff transistors Q3, and Q5 (2N4401) as well as Q4 (2N3819). Pay attention to the orientation of each transistor. Get them in the correct location.
11. Q2, the THAT 300P uses a 14-pin DIP package. Double check before soldering; you want to get this part right on the first try. Find the orientation notch and align the socket accordingly. Now solder the socket in. A good method is to solder two of the corner pins, then ensure that the socket is flush with the board, then solder the rest. A socket is included, however your religious preferences may dictate not using it. If you ever have to replace Q2, you'll appreciate that socket.

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

Two Configurations

Refer to the assembly drawings on pages 13 and 14. The configuration changes are necessary because the original PZM microphone uses a different connection scheme for the electret microphone capsule than later units do.

Locate the jumper points on the circuit board. They are just to the left of the 470nf capacitor. They are labeled TP2, TP3, TP4, TP5, TP6, and TP7. Those are the jumper points. The holes are teeny-tiny. Scraps of diode wire fit just fine here.

As supplied, the cable from the PZM plate and the battery box is quite long. However convenient this may seem, it is also a pretty good antenna. Our recommendation is to cut it to about 10 feet. That way the preamp box can sit on the floor near the microphone.

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

In this configuration, Q4 operates as a current source load for the microphone capsule.

1. Make two hairpin jumpers out of scraps of diode wire.
2. Install one from TP2 to TP3.
3. Install the 2nd jumper from TP4 to TP5.
4. Solder and trim the jumper wires.
5. Snip the wire between the battery box and the microphone. Toss the battery box. No, it's not a chew toy for fido or your kid. Cut the wire near the battery box end.
6. Strip the cable coming from the microphone. Connect the shield to X1-3, connect the inner conductor to X1-2. Note: X1-3 (the cable shield) is **not grounded**.

For use with RS 33-3020 and 33-3022, or a generic electret capsule. (config 2)

In this configuration, Q4 operates as a current source load for the microphone.

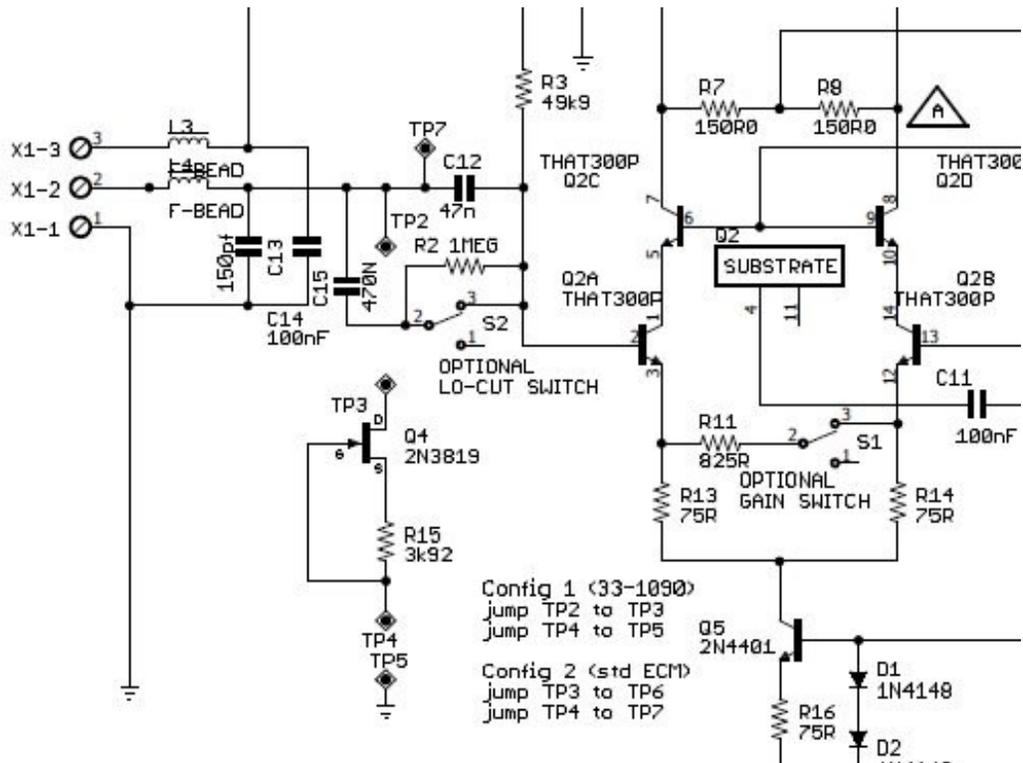
1. Make two hairpin jumper wires from scraps of diode wire.
2. Install one jumper between TP3 and TP6
3. Install one jumper between TP4 and TP7
4. Solder and trim the jumper wires.
5. Snip the wire between the battery box and the microphone. Toss the battery box. This step does not apply to the generic capsule.
6. Strip the cable coming from the microphone. For the 330-3022 model, snip the white wire and ignore it. Connect the shield to X1-1, connect the inner conductor to X1-2. For the generic capsule, the ground lead connects to X1-1 and the 'hot' lead connects to X1-2.
7. Wire the input/output connections as follows:

| | |
|-------------------|-------------------------|
| X1-1 - Shield | X2-1 - XLR pin 1 + case |
| X1-2 - Hot/Signal | X2-2 - XLR pin 3 |
| X1-3 - NC | X2-3 - XLR pin 2 |

Further details can be found on page 19.

Options

Refer to the schematic fragment to see how the two optional switches are connected. S1, the gain switch connects or disconnects R11. S2, the optional Low Cut switch replaces C12 with a smaller value, and in the bypass position, shunts it with a larger value.



Optional Gain Switch

R11 sets the gain of the preamp. After you remove the 3dB loss of the transformer in the battery box, the circuit here adds about 6dB of gain, for about 9dB higher level. If you record loud sources, this may be too much.

If you put a switch in series with R11, then opening the switch removes R11 from the circuit, and the gain drops by about 6dB. It's possible to get more loss, but this requires more changes, and we haven't worked them out. The microphone capsule is a further limitation.

There aren't isolated pads for the switch wires on the board, so the usual practice is to lift one end of R11 from the board, and to solder a wire to it, insulating with shrink sleeving. Then another wire goes to the PCB pad that used to get the loose end of R11. These wires go to the switch. You could use TP2 or TP7, which ever isn't used.

Operating the switch when the circuit is live produces a click, which could be loud, depending on the amount of gain following the preamp. Mute the input when setting the switch. Maybe test it first, so you know. It's not worth the trouble to make the switch clickless.

Low Frequency Rolloff

As designed, the circuit's LF limit is quite low. The -3dB point is about 7Hz. Room rumble or disturbances caused by air currents flowing past the microphone could be a problem. The value of C12 could be reduced, say to 47nF from 470nF, which would reduce the LF response without too much ill effect.

Of course, you can use a switch to shunt C12 with a larger value. See S2 in the above drawing.

XLR Connector

If you are using the Switchcraft XLR connector, before mounting it in the box, get a small screwdriver and use it to tighten the fixing screw in the connector insert. Turn the screw clockwise to tighten it. Seal the screw to the connector body with paint (nail polish)

The LED

D3, a red LED, is optional. It serves as a pilot light. It can be another color, but we prefer red because the voltage drop is lowest. Whatever part you choose, use a high-efficiency LED because there isn't much current flowing and there is no way to increase it without affecting another part of the circuit.

The LED is polarity sensitive. The two wires are unequal length. When you insert the LED, orient it so the longer lead is in the hole nearest the mounting hole for the circuit board. **If you don't stuff it, you must connect the two holes with a piece of wire. If you get it backwards, the circuit won't work, and the LED won't illuminate.**

The pads that the LED mounts to are small and fragile, so it pays to get the LED inserted correctly the first time, because you risk damaging the board if you get it wrong and have to desolder it. (don't go there!)

If you trim the leads before installing the part, cut them to preserve the unequal length.

The two leads (wires) are different length for a reason: the longer one is the anode of the part (the anode is the arrow part of the symbol). If you look closely at the LED, you'll see there is a flange at the bottom, and one side of that flange is flat. The flat indicates the cathode (bar part of the symbol) of the LED.

On the board, locate the spot for D3, and look closely at the symbol. On one side of the symbol, there is a dot. That's where the cathode (short lead) of the LED goes.

Finally, if this is too complicated, then save the LED for last. Do this instead:

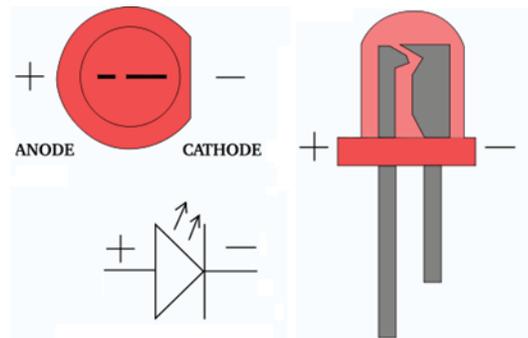
1. Complete all other wiring, including the microphone capsule.
2. Insert, but **DO NOT SOLDER** a jumper at D3 (you're shorting D3 out). Use a piece of resistor wire. You have lots of those right now, yes?
3. Connect the board to a P48 equipped microphone input. Ensure that P48 is enabled.
4. Turn the gain up and listen. It should work, and the microphone should pick up audio. Caution: D3 is not soldered and it can cause loud ugly noises. If not, try wiggling the jumper at D3, or spreading the legs slightly. Turn the gain down when you do this, as it **will** make loud/ugly noises. The point is to test the preamp and microphone, to ensure that they work. If there is no sound, then troubleshoot to figure out why and fix it. Got that? **It will make loud and ugly noises because D3 isn't soldered. (for good reason)**
5. Once it works, mute the monitors, remove the jumper and insert the LED but **DO NOT SOLDER**. Leave monitors muted. P48 is still applied.
6. If the LED lights, then unplug the preamp from the input, turn the board over and solder the connections. It is now OK to trim the LED leads to any length you want. You have a 50-50 chance of getting it right the first time.
7. If the LED doesn't light, then remove it and reverse it. It should now light. If so, then unplug the preamp from the input, turn the board over, and solder and trim the connections.
8. If the LED doesn't light in either of the two preceding steps, then there's something else wrong with the circuit (which you supposedly troubleshooted in step 4). Troubleshoot that, and then deal with the LED. It will make things easier if you insert (but do NOT solder) the jumper in place of the LED, then do your troubleshooting. Voltage measurements will be completely wacko without the jumper in place (and the preamp **won't** work). Don't try to use the LED here; you don't know that you got the polarity right, and if the polarity is wrong, then it's the same as no jumper installed here. It's only a Freakin' LED!

The *@#%!!! LED still doesn't work!

If you manage to get the LED in backwards, and you don't have a vacuum powered desoldering tool, the best way to remove the LED from the board is to sacrifice it by cutting it off of its leads. Desoldering will probably kill it anyway. Now that you don't have to fight with getting both wires loose simultaneously, it should be easy to heat one of the leads while pulling on it with pliers. Then clean the hole out (heat, insert toothpick, or dental probe) and try again. Yes, you get to replace the LED with a new one. Get it right this time.

n.b. It is far better and easier to sacrifice the LED than it is to damage the board because you don't have the right desoldering tool. NONE of the other stuff (braid, hand-desoldering pump, etc.) works effectively with plated-thru-holes. You're going to risk damaging the circuit board because of a 10-cent LED? We have seen attempts. It's ugly.

If all else fails, just short the two LED pads together. Remember that the LED is an option.



Choice of Enclosure and Connectors.

The completed board must be mounted in a metal enclosure. The die-cast aluminum alloy cases made by Bud Metal Products (CU-124) and Hammond (1590B-BK) are perfect. The Hammond part comes pre-painted. The Hammond enclosure is available from Uneeda Audio with all holes predrilled. These cases are particularly suited for this application because they are exceedingly strong yet are easy to machine. The male XLR connector needs a 3/4" mounting hole, and the TB4M mini-xlr requires a 15/32" mounting hole. The larger hole can be drilled using a step (cone) bit or punched using a Greenlee socket punch. The smaller hole is best drilled.

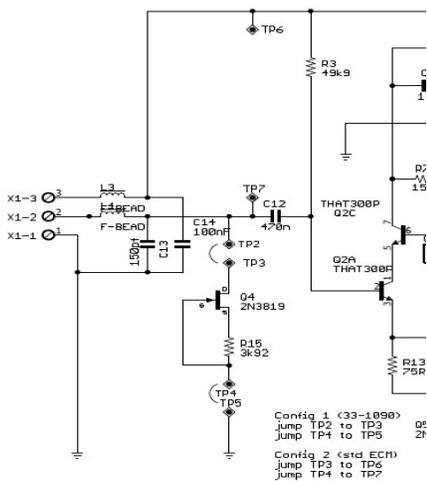
We supply a 7/16th internal star lockwasher with the mini-XLR. The correct order of washers for the mini-XLR is: connector, flat washer, chassis, star lockwasher, nut. Prior to threading the nut onto the connector body, apply a drop of Loctite or nail polish to the threads as a chemical lockwasher. Then tighten the nut. Now put a smear of paint from the nut onto the chassis.

A pair of threaded spacers are included for mounting the board into your enclosure. The spacers need to be swaged into the circuit board. Do this by inserting the spacer from the bottom (solder side) of the board, then place the assembly solder side down on a hard surface (like concrete). Insert the point of a #2 phillips screwdriver into the end of the spacer where it emerges on the component side of the board. Strike the handle of the screwdriver smartly with a hammer to swage the spacer in place. Repeat for the remaining spacer. The spacers are threaded for 4-40 machine screws (included).

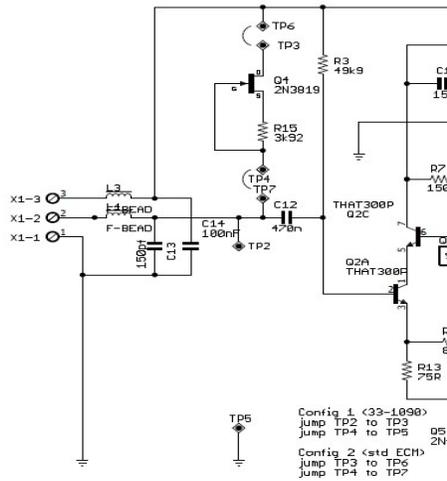
The input connector (coming from the PZM plate) could be a 3.5mm TRS plug, but that is only really suitable for version 2, where the cable shield is actually connected to circuit ground. The 4-pin mini-XLR connector is a better choice, as you have total control over which conductor goes where and the connectors lock together. Contrary to common practice, put the female connector on the cable coming from the mic and use the chassis-mount male (TB4M) in the box. See Appendix A for mini-XLR connector wiring.

The network consisting of R1, C4, and D4 allow grounding the box in such a way as to avoid a possible ground loop should the box come in contact with a metallic surface. Connect TP1 to the metal enclosure via a short wire. Use the ground lug supplied with the kit. The XLR connector's ground lug on the insert does not reliably connect to the enclosure ground.

Circuit Description



Configuration 1.
Q4 serves as a current-source load for the microphone



Configuration 2
Q4 serves as the FET (in the microphone) load resistor

Refer to the schematic diagrams. The first, *Input Configurations*, shows the two different variations of the input circuit, somewhat simplified. In both circuits, Q4 serves as a current source load, however the difference is where the load is placed relative to the FET in the microphone capsule. Jumpers on the circuit board rearrange the circuit to accommodate either microphone. In configuration 1, The mic capsule connects between X1-3 and X1-2. Note that neither wire of the capsule is grounded (however X1-3 is grounded for AC). For configuration 2, Q4 changes location, and the mic capsule connects between X1-2 and X1-1. The output of the microphone circuit is coupled via C12 to the differential line driver stage Q2.

The differential line driver uses matched quad transistor Q2 connected as a cascode differential amplifier. We use a cascode here to get sufficient collector breakdown voltage to withstand the 48V phantom voltage. Voltage divider R10, R5, and R12 divides the

supply voltage by 1.3 and 2. That puts 35v at the junction of R10 and R5, and that voltage biases the bases of the upper cascode transistors. The voltage at R5 and R12 is about 1/2 the supply voltage, and this biases the common-emitter transistors of the cascode as well as providing operating voltage for the microphone capsule via emitter follower Q3.

R13 and R14 provide some degeneration and R11 partially couples the emitters to raise the gain. The supplied value of R11 provides about 6dB of gain. Yes, you could use a pot in place of R11 to make the gain variable, but it needs to have a reverse-log taper (CCW-log). A linear taper pot will have most of its range in the first 50% of its rotation). Another possibility would be to use a make-before-break switch with discrete resistors. Gain and headroom are always a balancing act; increasing the gain is always at the expense of headroom. If you use a pot here, be sure to add a stop resistor to prevent the pot value from going to zero. R11 can go to open circuit. A simple on/off switch works here, but it may not be silent when operated. It is not worth the effort to de-click this part of the circuit.

Q5 is a current source that sets the operating point of the diffamp. C5 ensures that the base of Q2B is at AC ground. C10 bypasses any noise created by the diodes.

R7 and R8 are the collector load resistors for Q8 (along with the phantom feed resistors at the microphone input). Their junction also provides a place to pick off the dc phantom power voltage of about 20v. This voltage operates the remainder of the circuitry.

The two ferrite beads, L1 and L2 plus C1 and C2 make a lowpass filter at RF frequencies to guard against RFI caused by the balanced output line acting as an antenna. C8 and C9, normally not used, they allow changing the filter to either a PI configuration or to a lowpass filter looking towards the microphone cable. This may be needed in a high-RF environment.

Ferrite bead L4 and C13 act as a lowpass filter into the diffamp as insurance against RFI pickup in the unbalanced line coming from the PZM plate. Similarly, L3 and C14 lowpass filter the power line going to the microphone capsule. The circuit is NOT cellphone proof. (is anything?)

The network consisting of R1, D4, and C4 make up a grounding network for the case. The idea is to prevent a ground loop caused by setting the case on a metal surface, which may or may not be grounded. R1 and C4 serve to ground the case for RF while presenting a high enough resistance so as to not cause a severe ground loop. Should there be a substantial voltage difference between the two circuits, TVS diode D4 serves to join the two ground systems. In this event, the circuit will likely not operate properly, however D4 prevents further damage from occurring.

The LED, when installed, is in series with the ground return of the diffamp, nearly all of the current drawn by the circuit flows thru this point, and this allows having the LED, without having its attendant current drain.

In Case of Difficulty

A few builders have had trouble making the circuit work. Almost without exception, most problems are due to poor soldering technique. Check your connections. Look for stuffing errors. Try cleaning the residual flux off the solder side of the board using 95% isopropyl alcohol and a brush or a commercial flux remover so that you can truly see the solder joints.

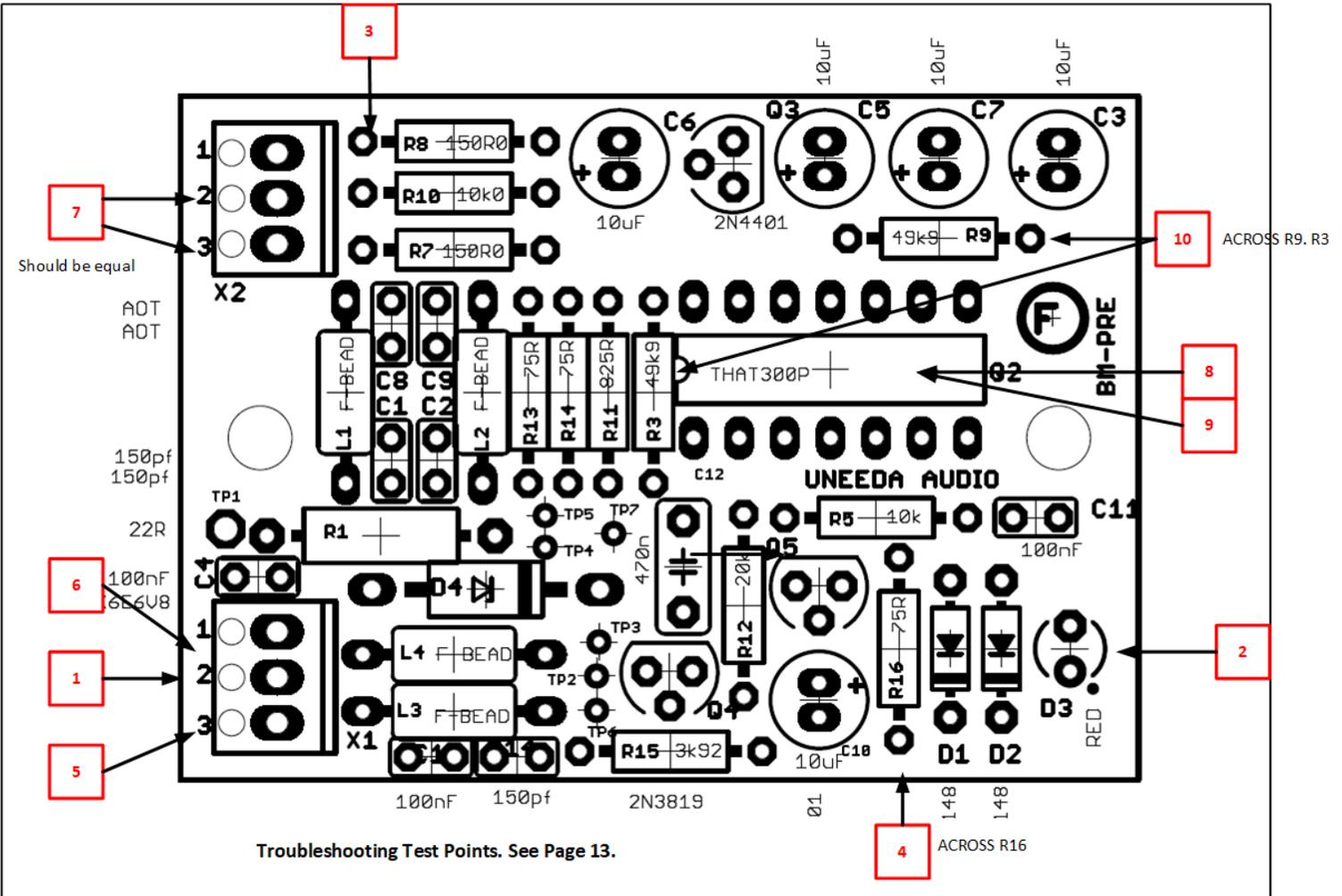
A troubleshooting guide is presented on Page 12. All voltage measurements made with a DMM, with respect to ground (Pin 1 of the XLR connector), unless otherwise noted, with the microphone capsule connected (except for step 1) and the circuit connected to an operating P48 input..

If you decide to contact Uneeda Audio, please include the results of the tests in Steps 1 and 2, and the voltages measured in steps 3-10. Please state the configuration you built, what other test equipment you have or don't have (DMM, O'Scope, Signal Generator), and your electronics experience level (rank novice, veteran kit builder, EE, etc.)

Troubleshooting. (refer to the drawing on Page 13)

| Step | What to do | Expected reading | Remarks |
|------|---|--|--|
| 1. | With the capsule <i>disconnected</i> , and the preamp connected to a working microphone input with P48 supplied and the gain turned up, touch X1-2 with your finger. | You should hear hum when you touch the input. (X1-2) | The preamp is (<i>apparently</i>) working. Reconnect the microphone capsule and continue. |
| 2. | If the LED is installed, is it illuminated? If it is not installed, there must be a wire jumper installed in its place. If the LED is installed and NOT lit, the circuit will NOT operate. | LED is lit. | Checks the current source, Q5 and for current flow from the P48 source. You can temporarily short out the LED for troubleshooting. The easy way is a blob of solder across the led pads on the solder side. |
| 3. | What is the voltage at the junction of R7, R8, and R10 to ground? | 18-22VDC | This is the supply voltage to the circuit. |
| 4. | The voltage ACROSS R16. | No more than 0.7v. | This is limited by the Vbe voltage of Q5 and the two series diodes D1 and D2. This is an across voltage because the presence or absence of the LED is not known. If this voltage is OK, AND the LED is lit (if present), then this part of the circuit is OK. If there is no LED, then the LED connections must be connected together. |
| 5. | The voltage at X1-3 should be about 1/2 of that measured in step 1 minus about 0.6v (the Vbe drop of Q3). | About 1/2 of reading in Step 1 | Power supply to the electret capsule and voltage reference for diffamp. If the voltage is high, then Q3 is probably toast. If it is low, then there's something wrong with R10, R5, or R12. Correct values stuffed? |
| 6. | If the voltage across the capsule matches (or nearly matches) the voltage in step 3, then the capsule isn't drawing current. That could be a bad capsule, bad cable, or bad connections between the board and the cable. This is independent of configuration. | 3 to 6v, possibly higher, but not 10v or more. | For either configuration, check Q4 and its circuit. |
| 7. | The voltages at the junctions of L1 and R7, and R8 and L2, should be equal, or very, very nearly so (within millivolts). Easiest to measure at X2-2 and X2-3. | 18 to 22v ref to ground | check voltage in steps 6 and 7; these should also be very, very nearly equal. These are the XLR connections. |
| 8. | The voltages at the bases of Q2 (ref to ground, Q2-2, Q2-13) should also be very, very nearly equal, if not equal (equal is ideal) | slightly less than what was measured in step 5. | component values (R3, R9) or capacitors C12, C5. |
| 9. | The voltages at the emitters of Q2 (ref to ground, Q2-3, Q2-12) should also be equal, or very, very nearly that. | about 0.6v less than that measured in step 8. | Q2 may have been maimed, especially if the collector voltages aren't very nearly equal. |
| 10. | There should be substantially no voltage drop across R3 and R9. or stated another way, the voltages at the BOTTOM (referring to the schematic) of R3 and R9 should be very nearly the same as that measured in step 3. | zero, 0. | If there is voltage drop, then Q2 may have been maimed, or C12 or C5 are defective (more likely C5). C5 may be soldered in backwards (white polarity stripe goes towards the OUTSIDE of the board). |

The numbers in the drawing correspond to steps in the Troubleshooting table found on the previous page.



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. Purchasing the kit is a per-instance license to construct the circuit. Doing this for someone else, for profit, is allowed.

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. There are no other warranties, expressed, implied, for fitness of purpose, for loss of revenue or for anything else due to the use of this circuit.

Completed preamps or circuit boards assembled by Uneeda Audio carry a one-year limited warranty.

With the exception of the THAT 300P, Uneeda Audio will supply up to 6 replacement parts at no charge. There are limits to our generosity, and you are advised to not test them.

Circuit boards damaged by poor soldering (or desoldering) technique or improper solder or added 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 criterion for this judgment solely rests with Uneeda Audio and with 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. (It's old enough now that the warranty has long since expired and the Radio Shack that we knew has ceased to exist.) Always remember the microphone's humble beginnings.

Disclaimer

Radio Shack (RS) is now a trademark of General Wireless. When RS sold the PZM microphones, they were a part of Tandy Corporation.

PZM is a trademark of Crown International, a Harman Corporation. Shure is a trademark of Shure Incorporated.

The PZM Patent, US4,361,736, expired in 1999, however Crown International still owns the trademark.

Shure is a trademark of Shure Brothers

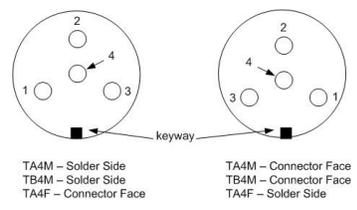
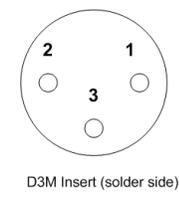
The mention or use of these and other trademarks in no way affects the rights of the trademark owners.

Appendix A. Quickie Mini XLR and XLR Connector Wiring

This Appendix presents the wiring for the two most common configurations, Configuration 1 (33-1090A PZM) and Configuration 2 (33-3020/3022 PZM). If you are doing something different, then refer to Appendix B and Appendix C.

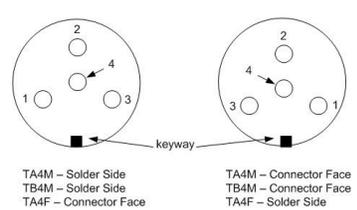
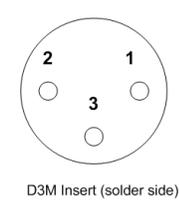
Configuration 1

| TB4M mini chassis male | PCB | TA4F mini cable female | cable from PZM plate | D3M chassis XLR | PCB |
|------------------------|------|------------------------|----------------------|-----------------|------|
| 1 | n/c | 1 | n/c | 1 | X2-1 |
| 2 | X1-3 | 2 | shield | 2 | X2-2 |
| 3 | X1-2 | 3 | hot | 3 | X2-3 |
| 4 | X1-2 | 4 | hot | | |

Configuration 2

| TB4M mini chassis male | PCB | TA4F mini cable female | cable from PZM plate | D3M chassis XLR | PCB |
|------------------------|------|------------------------|----------------------|-----------------|------|
| 1 | | 1 | shield | 1 | X2-1 |
| 2 | X1-3 | 2 | n/c | 2 | X2-3 |
| 3 | X1-2 | 3 | hot | 3 | X2-2 |
| 4 | X1-2 | 4 | n/c | | |

Appendix B. Connector Wiring

Because the connector wiring changes with configuration, it can be a bit confusing. Here, in one place, in tabular form, is the wiring for all configurations and all connectors. Connections for each connector are read DOWN in the table. There are no connections to be made based on the ACROSS direction. For example, for Configuration 1, the full sized XLR connector: Pin 1 connects to PCB connection X2-1, Pin 2 connects to X2-2, Pin 3 connects to X3-3. The case connection connects to pin 1 via 22R paralleled with 100nF (remarks column).

| XLR Connector wiring | | | | | | | |
|-------------------------------------|--------------|------------|---------------|------------|-----------------------------|-------------------------------------|--|
| | Male Std XLR | | Male Mini XLR | | Female Cable mount mini xlr | | |
| Config 1 | A3M | PCB | TB4M | PCB | TA4F | Microphone | Remarks |
| | 1+ case | X2-1 | 1 | NC | 1 | NC | For 33-1080 and 33-1090 Pin 1 not used Connect A3M pin 1 to chassis via 22R paralleled with 100nF ceramic. |
| | 2 | X2-2 | 2 | X1-3 | 2 | shield | |
| | 3 | X2-3 | 3 | X1-2 | 3 | Mic hot/center conductor | Jump 3 to 4 with a solder bridge. |
| | | | 4 | X1-2 | 4 | jump to pin 3 | For Shure compatibility |
| Config 2 | A3M | PCB | TB4M | PCB | TA4F | Microphone | Remarks |
| | 1+ case | X2-1 | 1 | X1-1 | 1 | Shield | For 33-3020, 33-3022, and 33-3041 or generic ECM. Connect A3M pin 1 to chassis via 22R paralleled with 100nF ceramic. |
| | 2 | X2-3 | 2&4 | NC | 2 | 5k1 from pin 2 to pin 3 inside TA4F | Pullup resistor for microphone. Probably should be 1/8-w for size. Only needed for shure compatibility. |
| | 3 | X2-2 | 3 | X1-2 | 3 | Mic center cond. | |
| | | | | | 4 | NC | |
| Note: NC means No Connection | | | | | | | |

Shure Bodypack Transmitter Wiring

| TA4 | Connection | Remarks |
|-------|------------------------|--------------------------------|
| Pin 1 | Shield / audio ground | |
| Pin 2 | Bias (+5Vdc) | for the electret capsule (ECM) |
| Pin 3 | Audio input | |
| Pin 4 | 20k resistor to ground | load for ECM |

Appendix C. Mini-XLR Wiring

Rean (Neutrik) RT4FC-B

The Rean RT4FC-B connector is an acceptable substitute for the Switchcraft part. It is less fiddly to assemble and has a better strain relief. We recommend it over the Switchcraft part. Most of the following comments also apply to the Rean/Neutrik part.

Switchcraft TA4F

The Switchcraft mini-XLR connectors require a bit of discussion on their own, especially if you don't have any previous experience with this connector. In particular, the cable connector warrants closer examination. Disassemble the connector by unscrewing the black strain relief at the rear of the connector. Grasp the connector body in one hand, and the metal strain relief in the other. Pull them gently apart. Disengage the metal strain relief from the connector body. The actual female connector insert may or may not come out. If it doesn't, then use a small screwdriver at the connector face to push the insert through the connector shell and out the rear.

Carefully disassemble the connector, taking note of how it goes back together. Practice reassembly several times until you are familiar with the process. Now begin wiring.

The female cable connector is fiddly. The insulator at the rear (solder end) detaches from the female insert, AND the female insert pushes out of the body to the rear. Thread the wire thru the strain relief, and then thru the detached part of the female insert. Now do your soldering. Take note of the pin locations before you start.

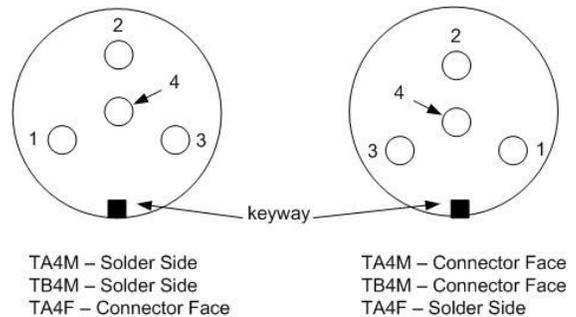
Assemble by pushing the insert into the connector shell, mate the other insulator part, then slide the crimp-on strain relief onto the cable and mate it with the insert. It does require a bit of force. Leave a bit of wire loose between the connector insert and the first crimp point (stress relief), then crimp the metal tangs down onto the cable. Screw the strain relief onto the connector shell.

Shrink sleeving between the exit point of the strain relief and into the crimp point can be used to reinforce this part of the assembly.

Note that the pin numbers are molded into the inserts. You need good eyesight to spot this.

| Config 1 Chassis | | Config 2 Chassis | |
|------------------|------|------------------|------|
| TB4M | PCB | TB4M | PCB |
| 1 | NC | 1 | X1-1 |
| 2 | X1-3 | 2 | NC |
| 3 | X1-2 | 3 | X1-2 |
| 4 | X1-2 | 4 | NC |

| Config 1 Cable | | Config 2 Cable | |
|----------------|------------------|----------------|--------------------------|
| TA4F | Cable | TA4F | Cable |
| 1 | NC | 1 | Shield |
| 2 | Shield | 2 | 5k1 across pins 3 and 2. |
| 3 | Center conductor | 3 | Center conductor |
| 4 | Tie to pin 3 | 4 | NC |



Shure Beltpack Mini XLR Connector Pin Assignments

[Pin 1](#) – Shield

Pin 2 – 5V power for ECM

Pin 3 – Audio Input to beltpack

Pin 4 – 20k resistor to pin 1.

Part number TA4(MF) is the cable mount connector.
Part number TB4(MF) is the chassis mount connector.

Shure Compatibility

If you use the same wiring that Shure does for their wireless mics, then you can also plug any microphone configuration into a Shure wireless transmitter (or one of their lavalier mikes into a configuration 2 preamp).

If you're using the configuration 1 wiring, note that the shield of the cable going to the PZM plate is **NOT** grounded, so you need to be careful that once the connector is assembled, the shield of this cable can not touch the connector shell or the crimp-on strain relief. Judicious application of shrink sleeving to the outer jacket of the cable helps here. Configuration 1 is NOT Shure compatible.

The configuration 2 wiring is compatible with Shure wireless hardware as long as you include a 5k1 resistor within the connector. For size reasons, an 1/8w resistor is preferred, but a 1/4w part will fit if you're meticulous.

If you have both microphone models, and you use this wiring scheme, then plugging the wrong microphone into the wrong box

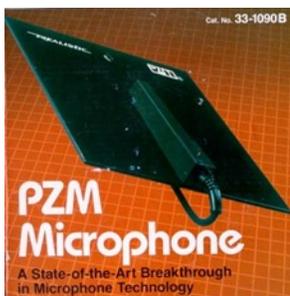
Appendix D. RS PZM (de)Evolution

There are now four microphones that have been sold over the years with the appellation, "Pressure Zone Microphone" or "Boundary Microphone."

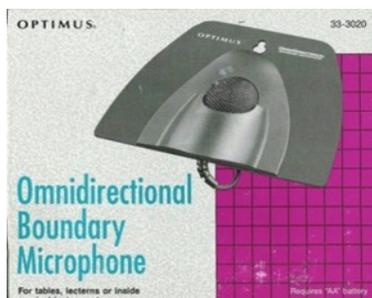
The 33-1090A is the only one of the four that uses the patented Pressure Zone principle. The second two are boundary microphones, in which a mike capsule is mounted parallel to a boundary plane (the diaphragm is perpendicular to the boundary). The 33-3022 was designed to work with an input having electret bias voltage present, such as the soundcard of a computer or the mic input of a camcorder. The latest and newest isn't a boundary microphone at all. It is just an omni capsule mounted at the top of the conical housing.

Only the 33-109A is a configuration 1 microphone. The rest are all configuration 2.

The 33-3041 Business Microphone is just an omnidirectional electret microphone capsule mounted at the end of the housing pointing straight up in the air (the 2nd object from the left in the photo). This is not a PZM nor is it a boundary microphone. It is a configuration 2 microphone.



33-01080 and 33-1090A PZM Config 1.



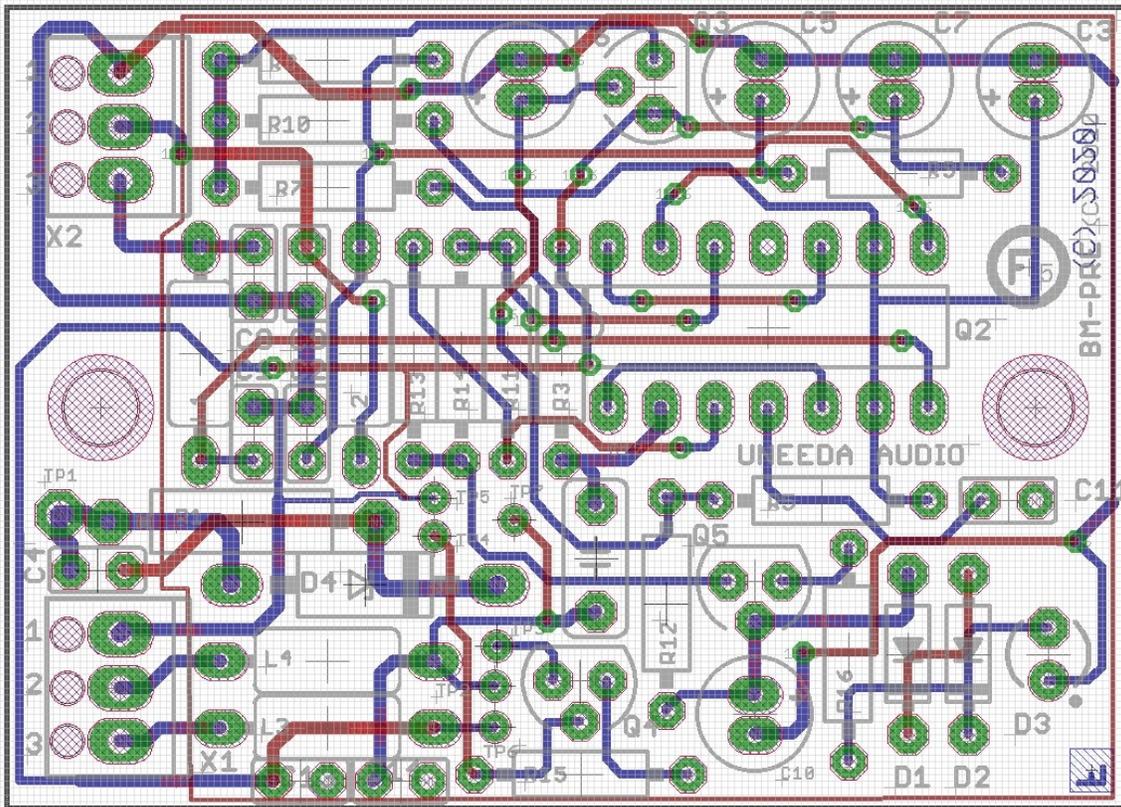
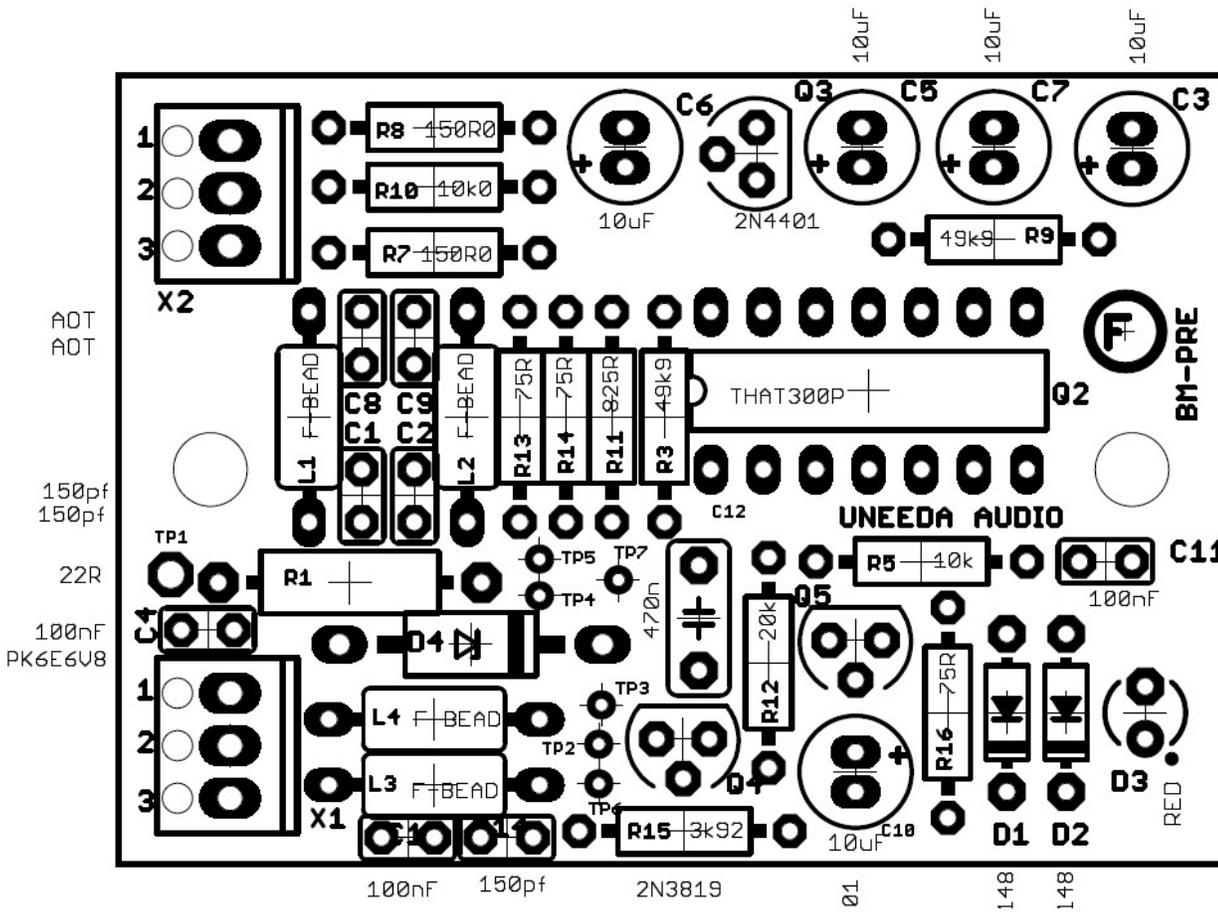
33-3020 Boundary Microphone Config 2



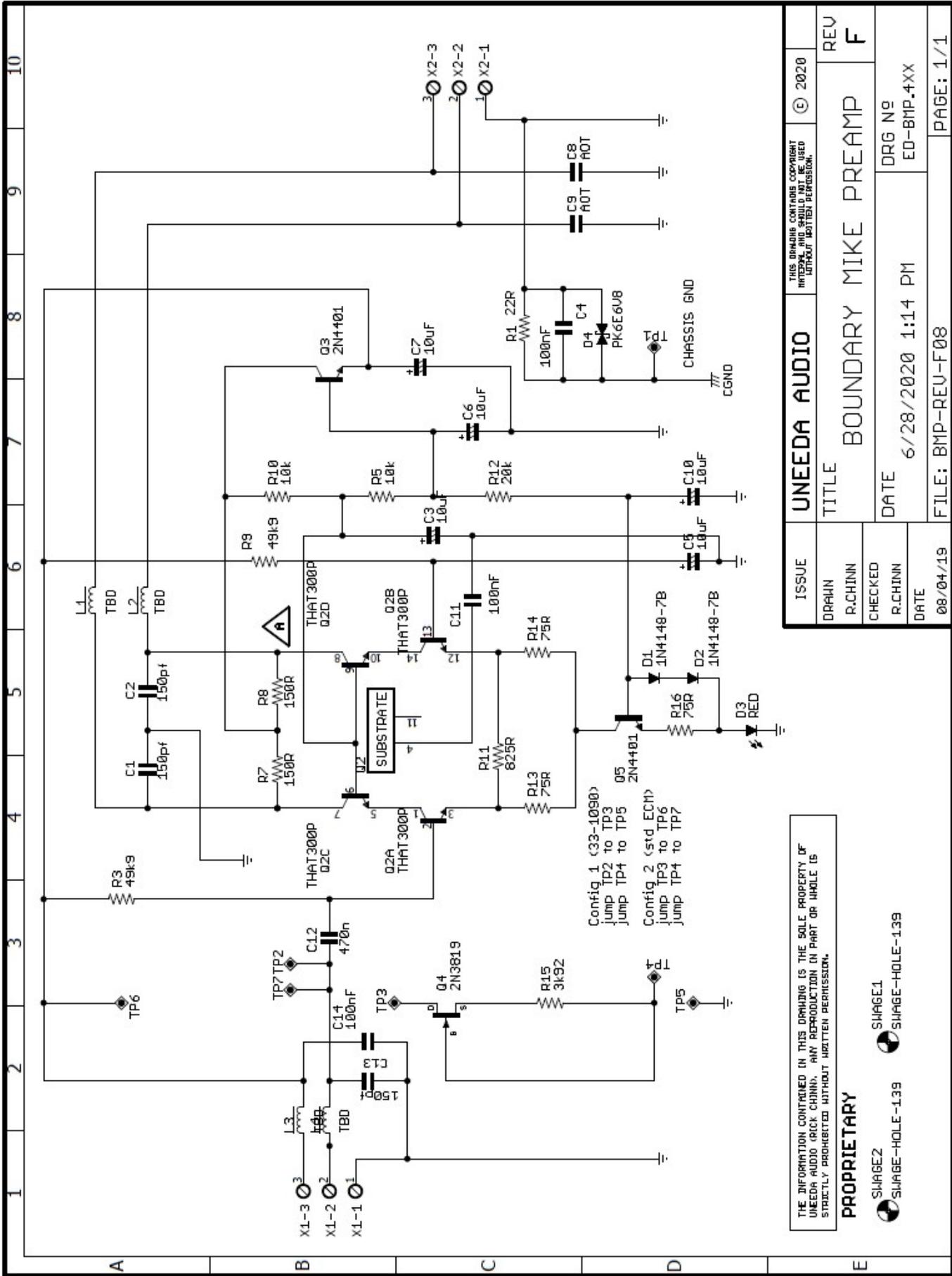
33-3022 Boundary Microphone Config 2



33-3041 Business Microphone Config 2



There is a ground plane on the component side of the board, and it is not shown here for clarity reasons.



| | | | | | | | |
|---------|--|-------------|--|--|--|----------------------|--|
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| DRAWN | | R.CHINN | | TITLE | | BOUNDARY MIKE PREAMP | |
| CHECKED | | R.CHINN | | DATE | | 6/28/2020 1:14 PM | |
| DATE | | 08/04/19 | | FILE: | | BMP-REV-F08 | |
| DRG N° | | ED-BMP-4XX | | REV | | F | |
| PAGE: | | 1/1 | | | | | |

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Revision History

| | |
|------------|--|
| 9/11/06 | Revised from 2003 version. Added new pix, added individual stuffing diags for each config. |
| 9/20/06 | Clarified connections for config 1, and changed wording for I/O connections for other 2 configs. Fixed error in Config 1 instructions; had Q2 rather than Q1 for the jumper location. |
| 3/24/07 | Rev C2. Revised and clarified wiring for Mini-XLR connector. Changed compatibility notice for Shure wireless transmitters. |
| 4/1/07 | RevC3. Added “in case of difficulty” section. |
| 2/21/08 | Rev C4. Corrected typo in “in case of difficulty” section and clarified things. |
| 3/16/08 | Rev C5. Corrected connections in text for config 2; checked others. |
| 3/22/08 | Rev C6. Removed Q4 from BOM, changed C1, C2, C8, C9 to be either 120pf or 150pf Added Appendix A, revised wiring for mini-xlr connectors (moved material from body) Added Appendix B, described the four different models. |
| 4/6/08 | Rev C7: Corrected typo for input connections in instructions for configuration 1 and 2 (page 4). Added language describing the mini-XLR connector assembly and caveats. |
| 11/4/08 | Rev C8 Slight change in circuit description (function of R11). Revised Mini-XLR connection diagram to make clearer. |
| 2/23/09 | Rev C9 Added D1, D2 to BOM. They were omitted. |
| 3/13/2009 | Rev C10 Added Appendix A with table for all configuration wiring. Original appendices A & B renamed. Changed case connection for Config 3. |
| 3/14/2009 | Rev C10.1 Clarified Appendix A table, Corrected value error in schematic (R10, R12). Schematic revised to show R1, R2 as inductors, now designated L1, L2. |
| 12/13/2009 | Rev C10.2 Clarified some small details. Added note about replacement parts. No major changes. |
| 3/15/2010 | Rev C10.3 Clarified color code in parts list, added note about color bands on diodes in assembly instructions, other small changes, revised configuration schematics drawing. |
| 4/1/2010 | Rev C10.4 Added per-instance wording in license disclaimer. |
| 7/25/2011 | Rev C10.5 Corrected color code for R6 and R15 on page 2. |
| 7/25/2011 | Rev C10.6 Added additional words for RF grounding the metal box. |
| 9/28/2011 | Rev C10.7 Added D1-D2 to assembly sequence, added words to assembly step 8, and Appendix B. |
| 11/28/2011 | Rev D.1 Revised for PCB Revision C. |
| 12/1/2011 | Rev D.2 Added jumpers around R4 and R17 in assembly sequence. |
| 8/25/2012 | Rev D.3 Revised pictures, and assembly drawings for Revision C PCB. |
| 9/1/2012 | Rev D.4 Revised pictures to correct errors, and added connection data to assembly drawings. |
| 4/5/2013 | Rev D.5 Added assembly details for D3 LED and revised jumpering for R4 and R11. |
| 6/26/2013 | Rev D.6 Added reminder on first assembly drawing for builder to use assembly drawings at the end of the manual, and that the initial drawing is provided to show the PCB traces. Also correct error in troubleshooting table involving R4 and R17. R17 was identified as R11 (See Rev D.5). Repaginated. Added note about R4 and R17 in each of the configuration specific assembly sequences. Revised Parts List, added Front cover and ToFC. |
| 7/15/2013 | Rev D.7 Further revision of the language around the LED, and removed “D3” as additional landmark for LED orientation. Added graphic to solidify relation between polarity, LED symbol, physical part, and basing. |
| 8/31/2013 | Rev D.8 Added Shure bodypack wiring to Appendix A, clarified XLR wiring. Added XLR wiring to stuffing diagrams. Revised jumper wiring across trimpots. Corrected wiring error for Shure wireless (TA4 wiring). |
| 9/12/2013 | Rev D.8.1 Further revisions of stuffing diagrams at end of manual |
| 11/24/2013 | Rev D.9 Fixed error in drawing of TB4M insert. Pins 2-3 were reversed. |
| 6/23/2014 | Rev D.10 Clarified drawing of mini-xlr connectors to indicate location of the keyway. Clarified swage standoff process. |
| 7/1/2014 | Rev D.11 Fixed error in troubleshooting table, steps 8 and 9, and elaborated on LED lighting as a requirement in step 2. Grounding network on page 10 clarified. Note about sending measurements back was clarified, as well as the paragraphs on soldering. Added words in section about LED, Added more about jumpers around R4 and R17 in procedures for all configurations. |
| 1/8/2016 | Rev D.12 Clarified the use of the 22R/100nF network and added refs to the page location in several places. Added these parts to the parts list. The Disclaimer was lengthened. Pages 3 and 4 wording modified, sometimes for strength/emphasis, others for clarity. Strengthened caution about desoldering. |
| 8/26/2016 | Rev D.13 Minor wording changes, grammar corrections. Uneda assembled units added to the warranty. XLR wiring sections reworked for clarity. Assembly drawings color coded. Gain Switch section on page 8 added. Resistor in mini-xlr plug clarified for configuration 2. Renumbered Appendices. Added new Appendix A. Revised Appendices B and C. |
| 6/29/2020 | Rev F.1.. Converted to MS-Publisher. Major revision for Rev F PCB. |
| 12/23/2020 | Ref F.2 Small changes for clarity. Rev F board now released. |

Parts List

| CFG 1&2 | Reference Designator | Description | Remarks |
|---------|----------------------|---|---|
| 0 | R2, R4, R6 | These are not used | |
| 1 | R1 | Res, CF, 22R, 1W <red/red/blk> | |
| 1 | R15 | Res, MF, 3k92, 1% <org/wht/red/brn> | |
| 2 | R3, R9 | Res, MF, 49k9, 1% <yel/wht/wht/red> | |
| 1 | R11 | Res, MF, 825R, 1% <gry/red/grn/blk> | Gain set resistor |
| 3 | R13, R14, R16 | Res, MF, 75R0, 1% <vio/grn/blk/gold> | |
| 2 | R7, R8 | Res, MF, 150R0, 1% <brn/grn/blk/blk> | |
| 2 | R12 | Res, MF, 20k0, 1% <red/blk/blkred> | |
| 1 | R5, R10 | Res, MF, 10k0, 1% <brn/blk/blk/red> | |
| | | | |
| 2 | C1, C2, C8, C9, C13 | Cap, cer, 150pf | C8, C9 not stuffed or supplied |
| 5 | C3, C5, C6, C7, C10 | Cap, lytic, 105C, 10uF, 35V | |
| 2 | C11, C14 | Cap, cer, 100nF | |
| 1 | C12 | Cap, film, 470nF | |
| | | | |
| 2 | D1, D2 | Diode, 1N914/1N4148 | |
| opt | D3 | Red Led or jumper. If no LED, then stuff jumper. | Not supplied. Other colors ok, but red preferred. |
| 1 | D4 | Diode, TVS, 600W 5v8 | Mouser 621-PK6E6V8CA-T |
| | | | |
| 3 | L1, L2, L3, L4 | Bead, Ferrite, Taiyo Yuden FBA04VA450BA-00 | |
| | | | |
| 1 | Q2 | Transistor, quad NPN, THAT 300P14-U | There is no Q1 |
| 2 | Q3, Q5 | Transistor, NPN, 2N4401 | |
| 1 | Q4 | Transistor, JFET, N-CH, 2N3819 | |
| | | | |
| 1 | PCB | Printed Circuit Board | Revision F |
| 1 | none | Socket, 14pin DIP, machined contact | Mouser 575-2104731441001000 |

