THE CORTADO

Assembly Instructions

BALANCED PIEZO CONTACT MIC

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THE CORTADO

Balanced Piezo Contact Microphone

INTRODUCTION

Piezo sensors are quite incredible little things. They can be used to detect the slightest variation in pressure, force, or strain and convert that energy into a voltage. Over the past several decades they've been used in numerous applications in several fields including the audio industry. Unfortunately, they've developed a bad reputation for sounding "harsh" and "brittle" when used as contact microphones in acoustic instruments. This is due to improper impedance matching and the inadequate driving circuits that are usually used with these sensors in audio applications. Piezo sensors in themselves are capable of a very wide bandwidth, and when used properly, can achieve excellent results. So with the intention of getting the most out of a piezo sensor, we here at Zeppelin Design Labs have developed The Cortado – a balanced piezo contact microphone. This mic contains a phantom powered circuit that properly matches the piezo sensor input impedance and drives the signal via a balanced output, which allows for wide bandwidth (~20Hz-30kHz), low signal losses, and high signal to noise ratio. The Cortado's circuit was originally designed by Alex Rice (http://www.zachpoff.com/diy-resources/alex-rice-piezo-preamplifier/) for use in his contact mic hydrophone, but it can be used in countless other applications with excellent results. In the recording studio or on stage the Cortado can be used on pianos, percussion, guitars or other stringed instruments. It can be used for a variety of mic and sensor applications such as a plate reverb pickup or wooden stomp box mic. We even created a tin can vocal microphone out of stuff we found in the trash (as pictured on this manual's cover). This is the perfect accessory for a lofi geek or a field recording enthusiast. Let your imagination run wild... discover what the pipes in your apartment building sound like, what bridge suspension cables sound like, even what melting ice sounds like. Anything that vibrates or resonates with an audible frequency can be captured by The Cortado contact mic. Several field recording enthusiasts around the web use this circuit (or something similar) to record some pretty cool stuff. Just do a Google or Youtube search for "contact mic field recording."

The assembled Cortado kit can take a few different forms, suiting many different applications. In this manual we'll show you how to build the "standard" Cortado mic, in which the circuit board is housed in a metal tin and the piezo disc and cable is shielded. We'll also point out some assembly variations to build it for use in a tin can mic (see our instructable) or as a permanently installed instrument pickup.

WHAT YOU WILL NEED

Following is a complete list of all the tools and supplies you will need to build The Cortado DIY kit as shown (Figure 2 on page 4).

TOOLS

1. Digital Multimeter, able to measure Resistance
2. #2 Phillips Screw Driver
3. A Ruler
4. A small awl, or metal poking probe
5. Soldering Iron (not a soldering gun, or a "cold heat" iron), good quality, 15-50 watt, with a good medium or small sized tip, conical or "screwdriver" shape. One with a temperature control and a stand is best.
6. Wet sponge or dry solder-cleaning pad
7. Wire strippers

8. Flush cutters or small diagonal cutters
9. Needle-nose pliers
10. Some sort of clamp or fixture to hold the printed circuit board while soldering (optional, but it's nice to work with).
11. Solder sucker or solder braid – optional, but very handy if you have to remove / repair any components!
12. Scissors
13. Drill and bits: 9/64" and 3/8"

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, denatured alcohol, or rubbing alcohol
3. Rough grit sandpaper or metal file (optional, depending on the container you use)
4. Electrical tape

WHAT'S IN THE BOX

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.

Table 1: The Cortado Balanced Piezo Contact Mic 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 FETs (Q1,Q2,Q3) on page 10 before removing them from the static-protective bag. Note that some of the components are 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 support@zeppelindesignlabs.com. If we are reasonably convinced that 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 support@zeppelindesignlabs.com). For more common parts, like resistors, caps, or screws, you may just want to go to a local electronics or hardware store.

Figure 1: What's In The Box

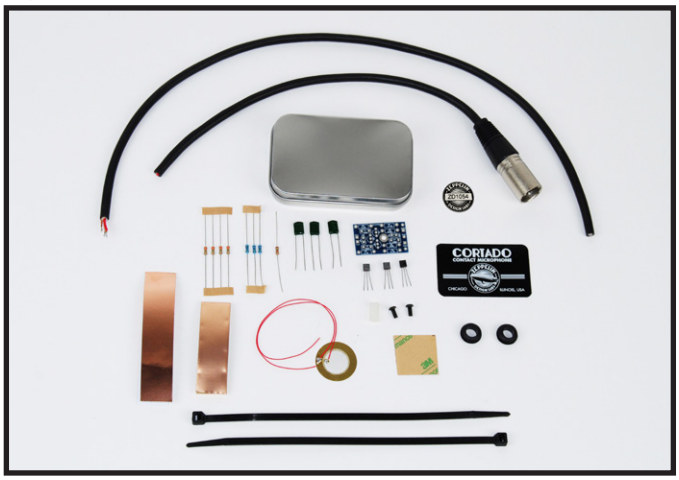


Figure 2: The Finished Kit

Table 1: The Cortado Balanced Piezo Contact Mic Bill Of Materials

Part #	Description	Notes	Qty
CB06	Male XLR Jack with 12" Cable		1
PZ01	Piezo disc with 6" wire leads		1
CB05	Microphone cable	18"	1
CP10.5	7cm Hookup Wire 20/1	Ground	1
TP01	Double-Sided Tape	~1" sq.	1
TP02	Copper tape	7" and 4.5"	2
ZT01	Zip Tie		2
SP11	Nylon Hex Standoff M3x12		1
SC38	Phillips Machine Screw – Pan head M3x6		2
CH10	Tin Box		1
PL31	Cortado Label Sticker		1
PL30	Serial Number Plate		1
GR02	Rubber Grommet		2
PC25	PCB	Printed Circuit Board	1
R8*	Resistor 680R (Labeled 1K5 on the PCB)	Blue, Grey, Brown, Gold	1
R3,R4,R5	Resistor 150R / 1%	Brown, Green, Black, Black, Brown	3
R1,R2,R6,R7	Resistor 3.3M (or 3M3)	Orange, Orange, Green, Gold	4
C1,C2,C3	Film Capacitor 220pF/100V		3
Q1,Q2	Matched Pair FETs	2N3819 - Painted Silver	2
Q3	Unmatched single FET	2N3819	1


CB06


PZ01


CB05

CP10.5

TP01


TP02

ZT01


SP11

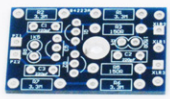

SC38

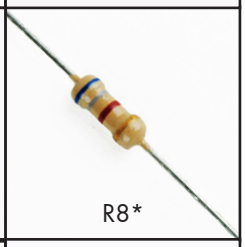

CH10

PL31

PL30


GR02

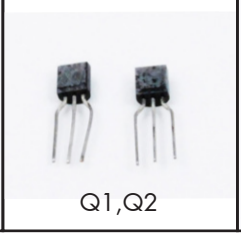

PC25


R8*


R3,R4,R5


R1,R2,R6,R7


C1,C2,C3


Q1,Q2


C1,C2,C3

*If your kit's serial number is higher than ZD1251, R8 has been changed to 680 ohms in order to accommodate a higher bias current through Q1 and Q2. Disregard the "1K5" marking on the circuit board for R8.

If your kit's serial number is between ZD1201 and ZD1251 then you received a 1K5 Resistor for R8. Most likely your circuit will work fine using this bias resistor value for R8. On some rare occasions (depending on the transconductance of the FETs), the circuit will not bias properly using this resistor value. This would appear as a very low output, and then only when the piezo disc is hit very hard, as if the signal just barely has enough current to get through the circuitry. This is documented in the Service Bulletin #15.11.1 on our website, in which the solution to this issue is described.

THE PRINTED CIRCUIT BOARD

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 cover 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 onto 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.

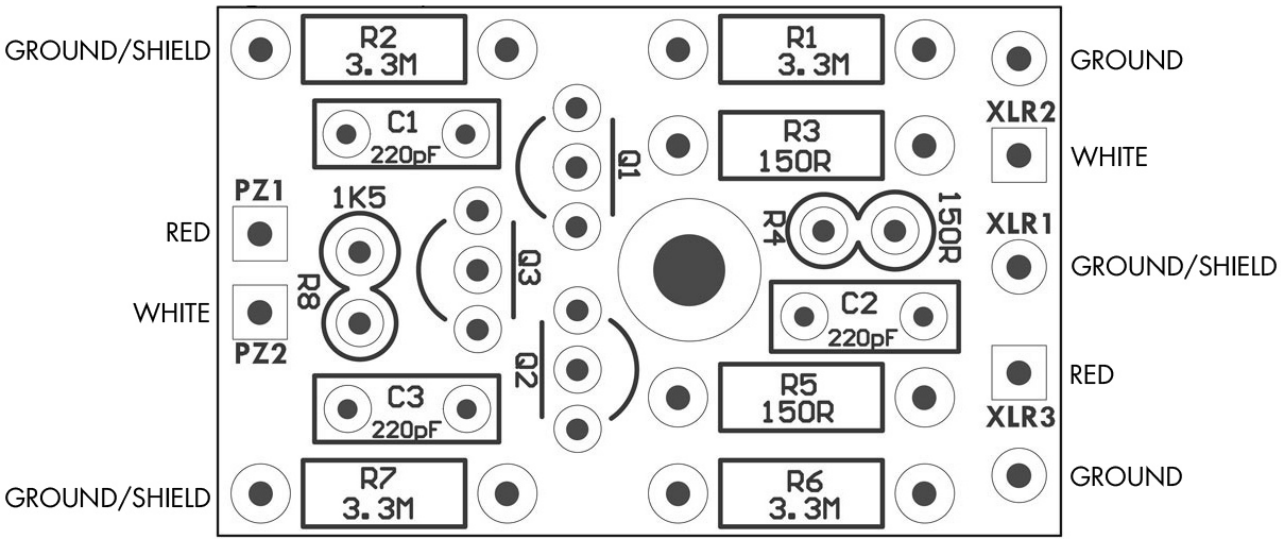
The printed circuit board (PCB) holds the components in this circuit. All of the components will be installed on the "component side" of the board, which is the side that has the part numbers on it. The other side of the board is called the "solder side", which, as the name implies, is the side on which the legs of the components are soldered to the board. 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 of its holes.
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.
6. Clip the leads off (with small diagonal cutters) right at the solder joint.

Let's begin!

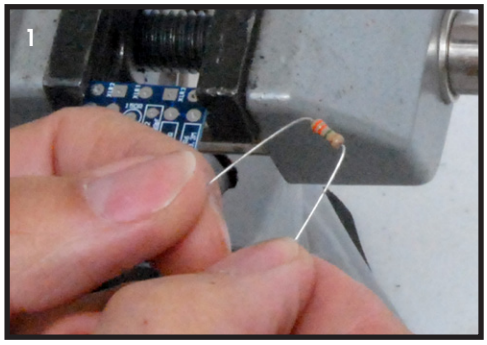
1. Resistors: The values of resistors are given by a series of colored stripes on their body. There are several tutorials on line describing how to decode these stripes, but we will identify each resistor for you by simply naming the stripe colors, and giving you the value and the part number. "Figure 3: Component Values and Locations" is a good reference. If you are color blind or can't see the stripes clearly, then you must use your digital multimeter to measure the resistance of each resistor.

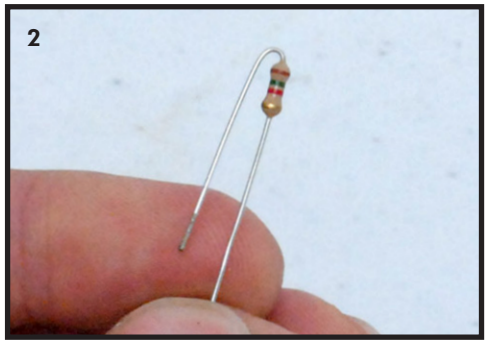
Figure 3: Component Values and Locations



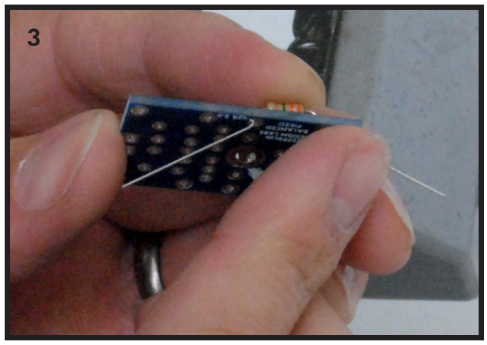
Resistors are not polarized, meaning they can be installed in their holes in either direction. It doesn't matter which lead goes in what hole.

The hole spacing of most of the resistors on the circuit board allows the leads to be (gently) bent 90 degrees at the body of the resistor(1). This allows most resistors to slip into their holes very easily. Resistors R4 & R8 are exceptions to the normal hole spacing. Notice the picture of how those two components are bent(2).

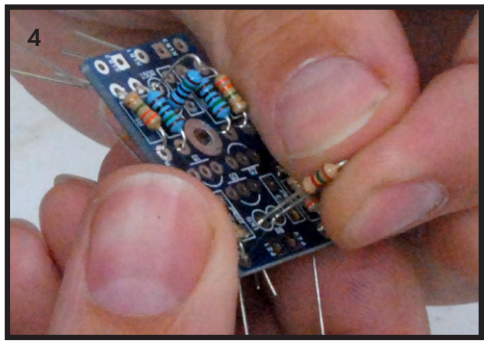




a. Start with the 3.3M resistors (R1, R2, R6, R7), labeled ORANGE, ORANGE, GREEN, GOLD. Compare to its picture in the BOM. Find their locations on the circuit board and install and bend the leads as described above(3). Don't solder any of them until all 8 resistors are installed; just bend the leads to keep them in their place.

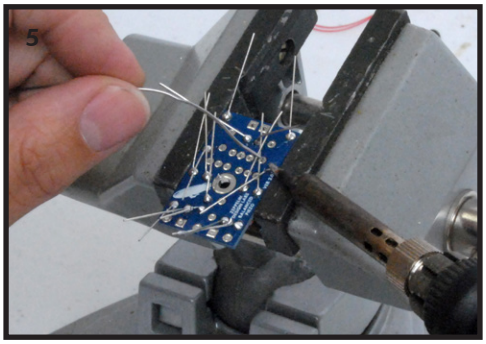


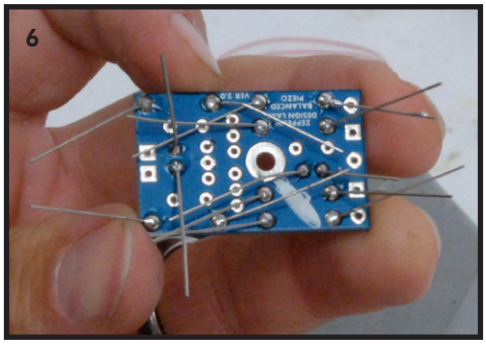
b. Continue with the 150 ohm (150R) resistors (R3, R4, R5). The body of these resistors are blue and are labeled BROWN, GREEN, BLACK, BLACK, BROWN. R4 stands upright on the PCB so bend one lead nearly parallel with its body and install it standing up(4). Bend the leads on the back so it won't fall out.



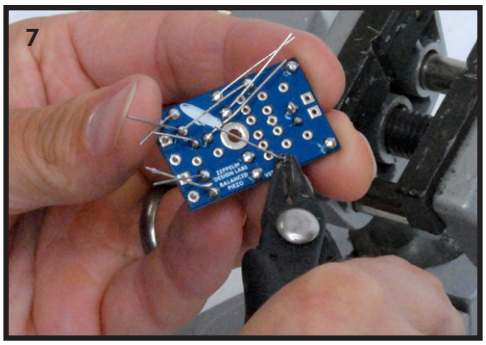
c. Continue with the 680 ohm resistor (R8), labeled BLUE, GREY, BROWN, GOLD. R8 also stands upright on the PCB. (Picture 4 shows a 1K5 resistor used for R8). Note: R8 is labeled "1K5"on the circuit board.

d. You should have a whole forest of bent leads coming out the solder side of the board. Now you can turn the board solder-side-up and solder each one to the board. Use a clamp or vise if you have one; it makes soldering much easier(5,6).





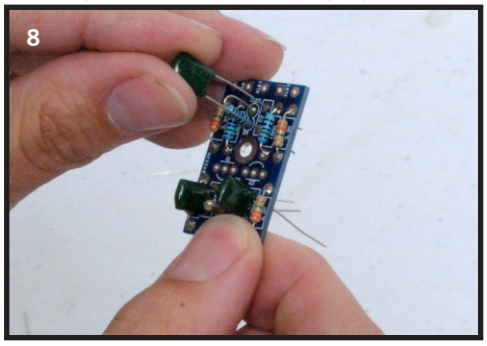
e. Now clip each lead with your flush cutters at the solder joint(7).

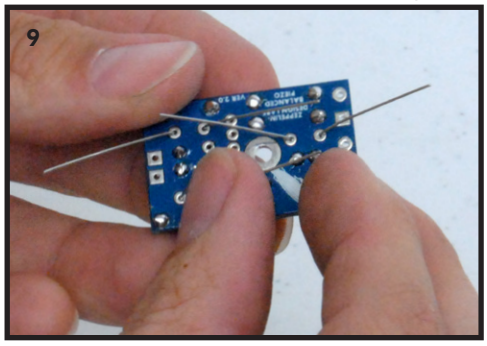


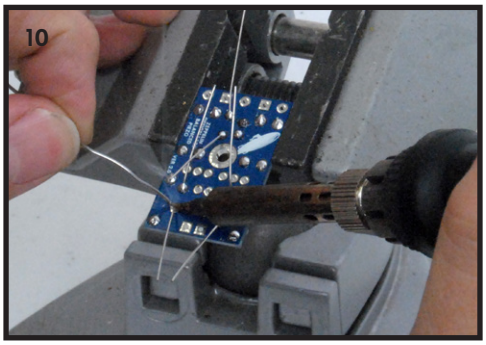
f. Before installing any more components on the circuit board, double check the resistance values of each of the installed resistors. Set your digital multimeter to the "ohms" or "resistance" setting, and measure across all of the resistors. Compare the measured value to the listed value in Table 1 and in Figure 3. Make sure they are all correct (within 5%) before moving on!

2. Capacitors: There are three film capacitors in this circuit that are all the same value. Much like the resistors, these capacitors are not polarized. They can be installed either direction, and it doesn't matter which lead goes in which hole.

   Place all three capacitors (C1, C2, C3) in their holes and bend the leads on the back(8,9). When you have all three caps placed, turn the board over, solder and then clip the leads(10).





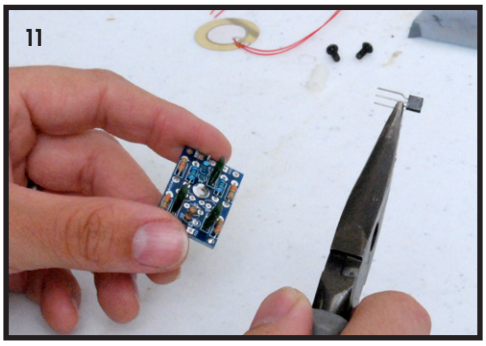


3. Transistors: This circuit contains three field effect transistors (FETs). FETs are quite sensitive to static electricity and could easily be damaged if they are exposed to moderately high voltages. The voltage rating of these FETs is only 25V, meaning that if over 25 volts is applied across two leads on one of these components it will most likely be damaged to the point of not being usable. Unfortunately, most of us are not sensitive to static electricity at such low levels; in fact, most people can't even feel a static discharge less than 1000 volts! So it is very easy to damage these components without even knowing it. Consequently, it is important to handle these components as little as possible. When you do have to handle them make sure you are grounded, preferably by touching something grounded to the mains like the metal chassis of a plugged in amplifier, or a refrigerator. At the very least you should touch a large conductive object like a metal desk or a filing cabinet. With this information in mind please proceed carefully.

   Two of the three FETs have silver paint on their face. We painted them to indicate that these two FETs have been "matched" to each other. This means that the gate-source turn-off voltage of these transistors were measured to be within about 100th of a volt of each other. This allows both sides of the circuit to be balanced very closely, achieving very high common mode rejection, which results in a very quiet microphone.

   Transistors are polarized, meaning it is important which way they fit into the holes. The component side of the circuit board has a silk screened outline of the transistor body in the correct orientation.

   Place the silver-painted FETs in the locations of Q1 and Q2. Either silver FET can be Q1 or Q2; it doesn't matter which one goes in those locations as long as they are both silver(11,12). Note the flat sides of Q1 and Q2 face in opposite directions(13). On the bottom of the board bend the leads a bit so they won't fall out of their holes. Place the other FET in the Q3 location(14). Please be mindful of the correct orientation. Bend the leads of Q3. Turn the board over, solder and clip all the transistor leads(15,16,17).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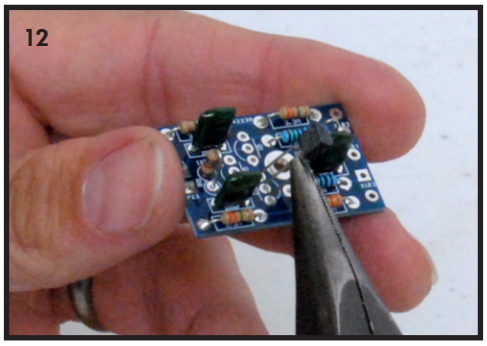
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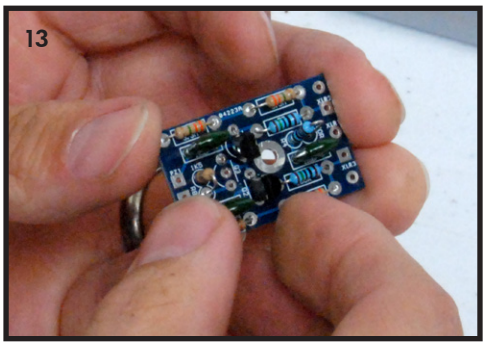
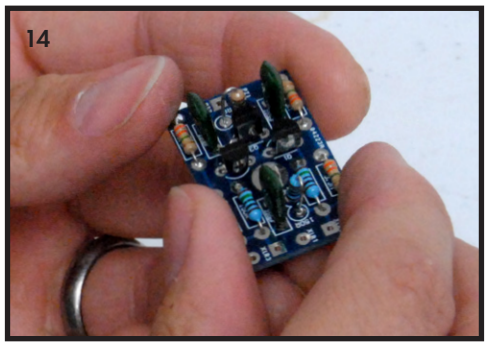
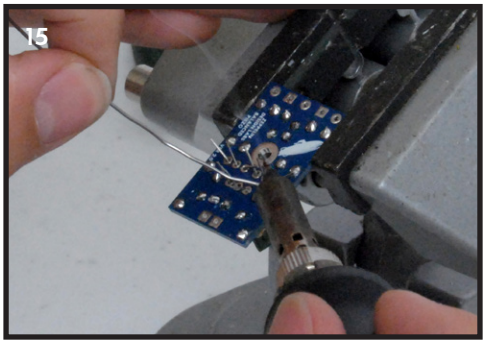
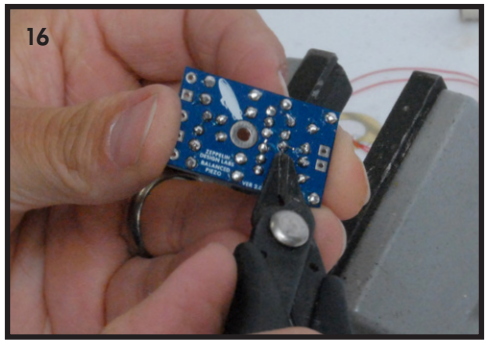
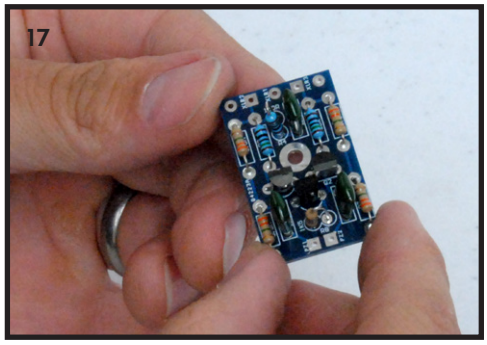


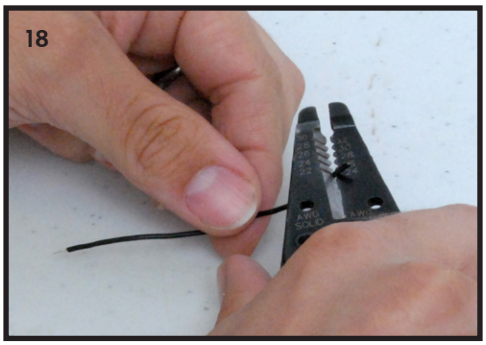


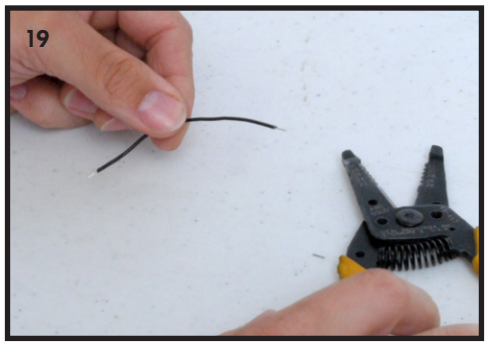


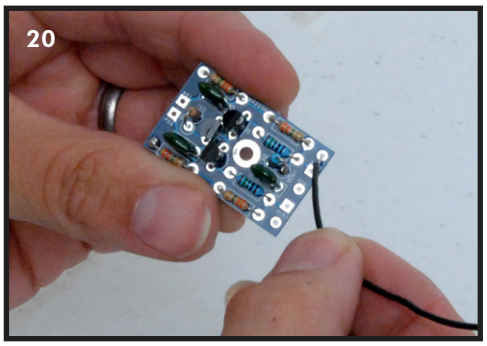




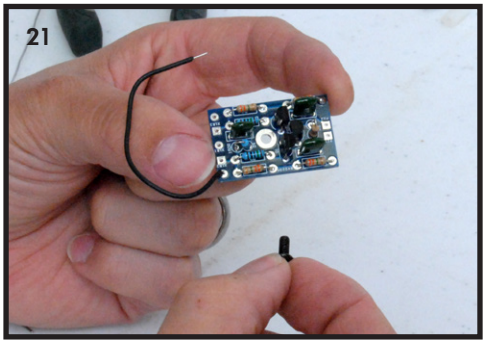
4. Grounding wire: Strip about 1/4" off of both ends of the black grounding wire(18,19). Place one of the ends of the wire in one of the holes in the corner of the board (note the picture)(20). Solder the wire in place.

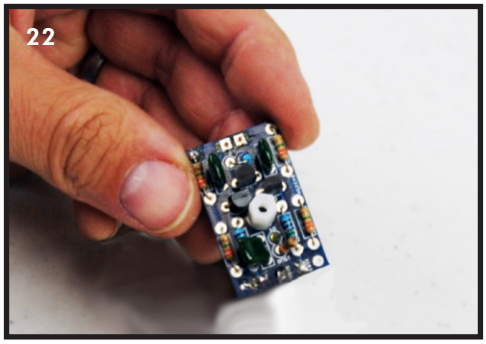






5. Use one of the black M3 screws to screw the standoff to the board. The standoff should be on the component-side of the board (note the picture)(21,22).



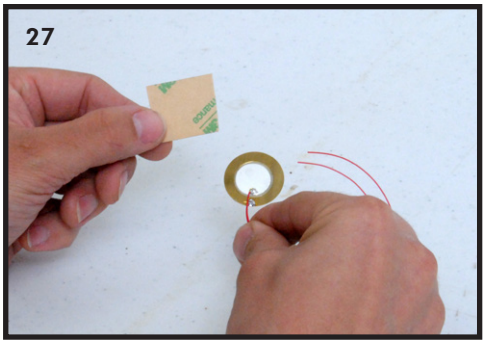


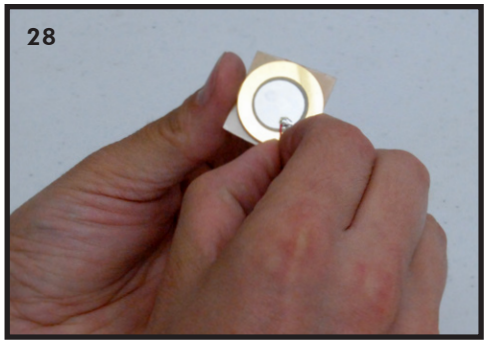
THE PIEZO DISC

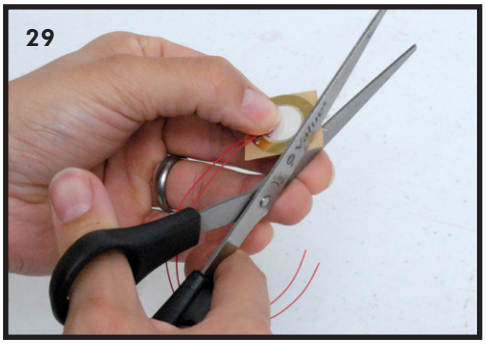
1. Both the circuit board and piezo disc must be shielded. In the standard configuration that we are describing here, the circuit board is mounted in a tin box, and the piezo disc is shielded in copper foil, and the two are connected using a shielded cable. Another option is mounting both the PCB and disc in the same shielded container, such as in our Tin Can Mic or something similar. If this is your intended application then follow steps 1a-1e; otherwise continue with step 2 on page 14.

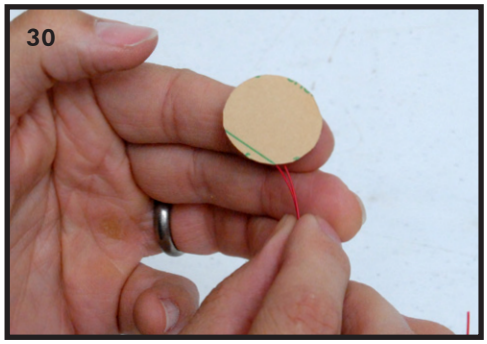
   a. Clean all the finger oil and other contaminants from the bottom of the piezo disc with rubbing alcohol and a rag or paper towel(25). Make sure you don't touch the surface you just cleaned!

   b. Place the double sided tape on the bottom of the piezo disc(27,28). Make sure it covers the entire bottom surface. Trim off the overhanging excess with scissors(29,30).



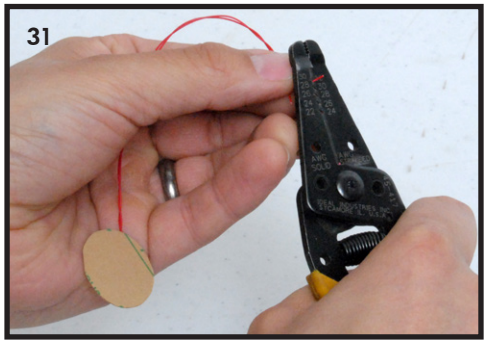


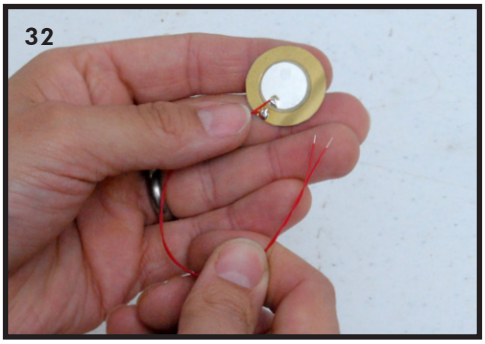




c. Twist the wires of the disc together. They don't have to be tight, just enough to keep them together.

d. Strip off about 1/8" of insulation on each of the two wires(31,32).



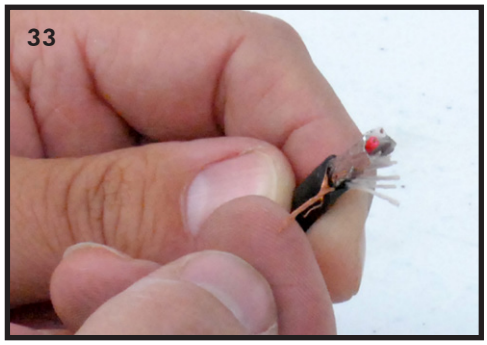


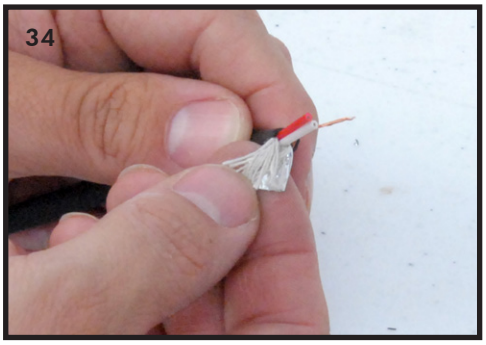
e. Depending on your application, this may be the time to solder the piezo disc wires to the PCB. Use a multimeter/continuity tester to identify the wire attached to the brass part of the disc, and solder this to the hole labeled PZ1 on the PCB. The wire attached to the white ceramic part of the disc should be soldered to PZ2. If you are making the Tin Can Mic, you should be reading our Instructable because there is some specific sequencing at this point.

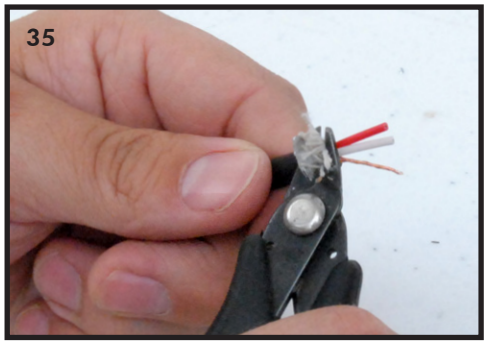
Now skip down to "The Container" section on page 18 for general steps for completing the mic. Again, based on your application, you may need to do some steps in a different order.

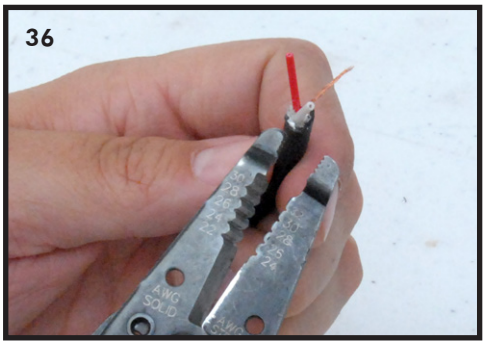
2. To build the standard Cortado, follow steps 2a-2e. The PCB is shielded by a metal tin; the piezo disc is shielded by copper foil; and they are connected with a shielded cable. By shielding the PCB, cable, and disc the noise floor will be lowered over 6dB in most applications.

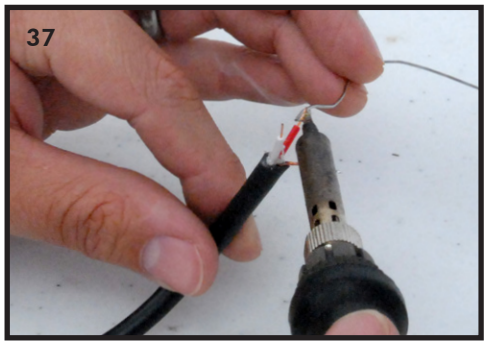
a. Strip off about 1/2" of outer insulation from the 18" mic cable. When stripping the outer insulation be careful not to cut too deep and cut through thin copper wires acting as the cable shield. Pull all of these copper shield wires to one side of the cable and twist them together(33). Pull the layer of foil and the cotton strings to the other side of the cable and cut all of them off with your snips(34,35). Strip off about 1/8" from the white and red wires(36). Tin the twisted copper shield wire, the red wire, and the white wire(37). Repeat this step for the other end of this cable.





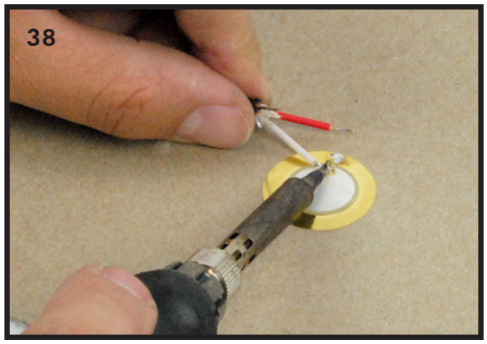


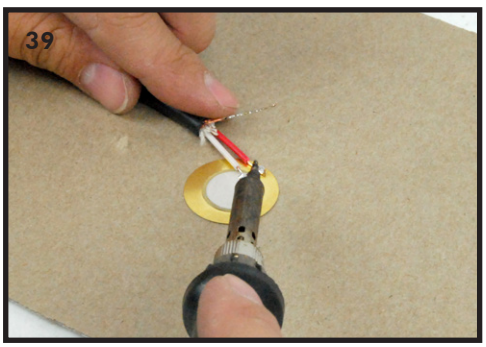


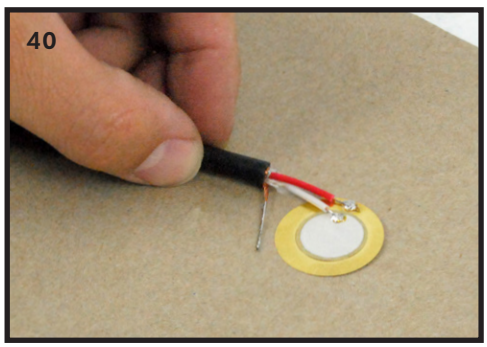


b. The microphone cable will replace the thin red wires on the piezo disc so very carefully de-solder the red wires from the disc. Do not heat up the ceramic part of the piezo disc too much or it will start melting off. Use as little heat as possible.

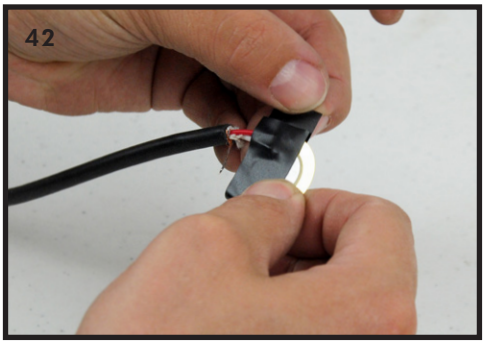
c. Solder the white wire to the ceramic part of the piezo disc(38). Be very careful when soldering to the ceramic material. Don't use too much heat or it will melt and destroy your piezo disc. Solder the red conductor of the mic cable to the brass part of the disc(39,40).

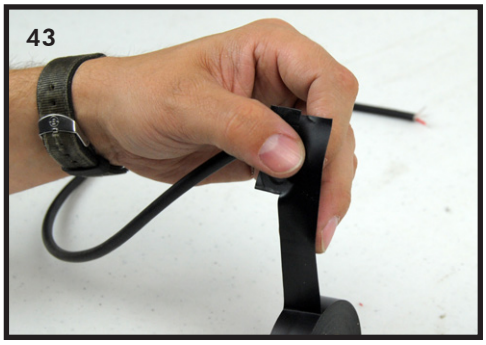


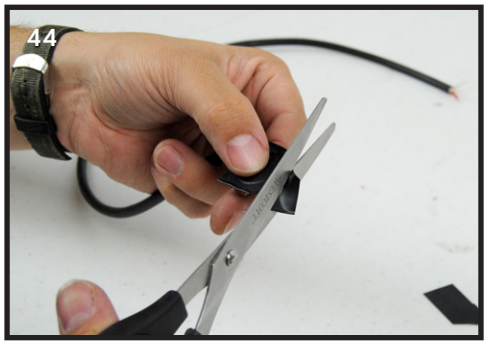




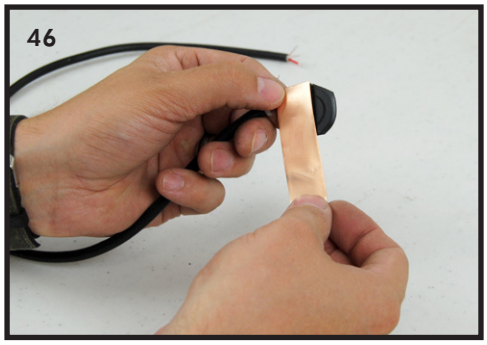
d. Wrap the piezo disc in electrical tape to electrically isolate it(41,42). Keep the tape only one layer thick, especially on the back (the flat side) of the disc. We use two pieces of electrical tape butted side-by-side to wrap the disc(43). Use your scissors to trim off the excess tape to within about a millimeter around the edge of the disc(44,45).

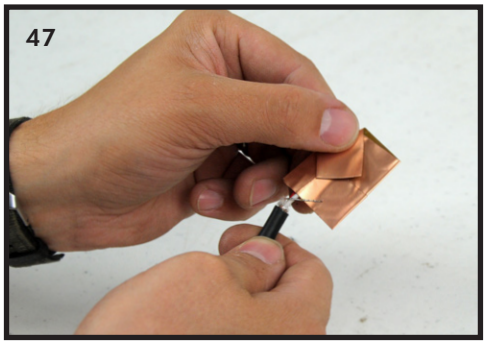


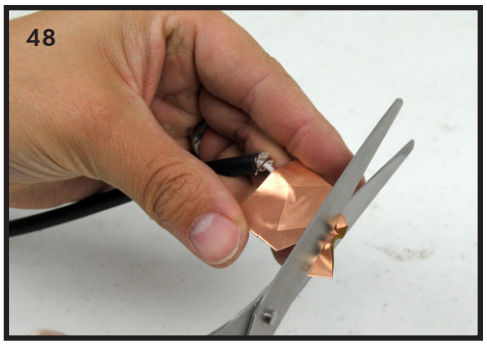




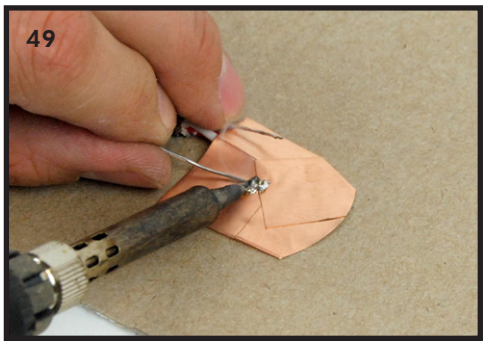
e. Cut the 4.5" copper tape that came in your kit into two equally long pieces. Use one piece of copper tape to wrap the disc in a similar way as with the electrical tape(46,47). Once again, try to keep the tape only one layer thick on the back of the disc. Trim off some of the excess copper tape around the disc(48), but make sure to keep a conductivity path all the way around the disc, meaning the copper tape on the front of the disc should be electrically connected to the copper tape on the back side of the disc.

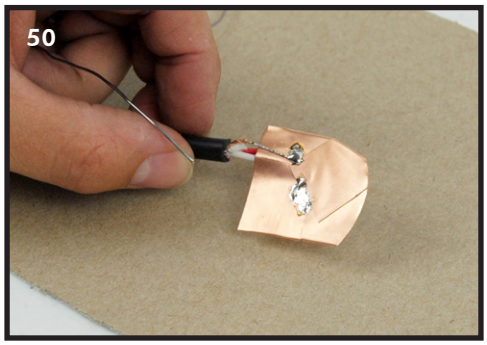


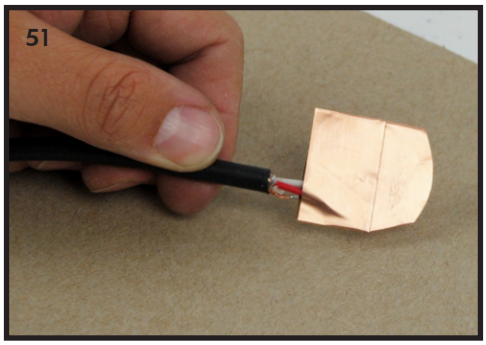




f. With as little heat as possible, solder the two pieces of copper tape together on the top of the disc(49). Also solder the shield of the microphone cable to the copper tape. Make sure the back of the disc remains flat so it can be mounted on a flat surface(50,51).



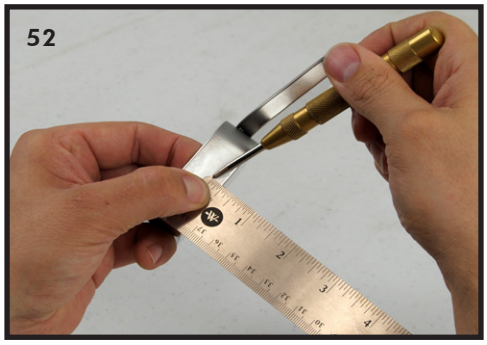


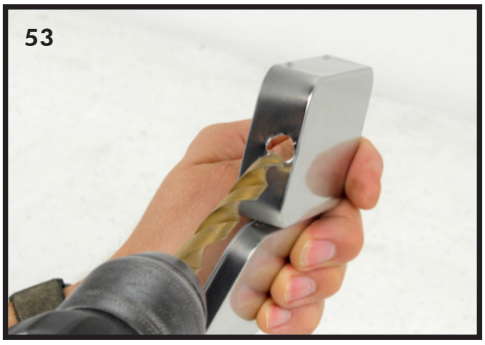


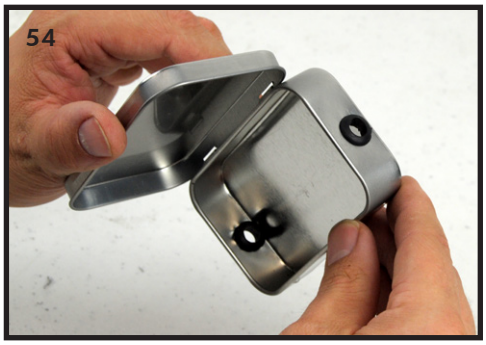
THE CONTAINER

1. There are a few different options for shielding the PCB. One way is to enclose the circuit board inside the metal tin that came with your kit, or any other grounded metal container. This would work well for most field recording or studio applications. To permanently install the Cortado as a pickup inside an acoustic instrument, you may want to shield the PCB with copper tape instead. If you'd like to use the metal tin for the PCB enclosure follow steps 1a-1j, otherwise skip to step 2 on page 22 to shield the board with copper tape.

   a. Drill a 3/8" hole on both sides of the metal tin,17/64" up from the bottom edge, and place the grommets in each hole(52,53,54).


52


53


54

   b. Next, drill a 9/64" hole in the bottom of the tin, roughly in the middle, to hold the PCB standoff (55,56).

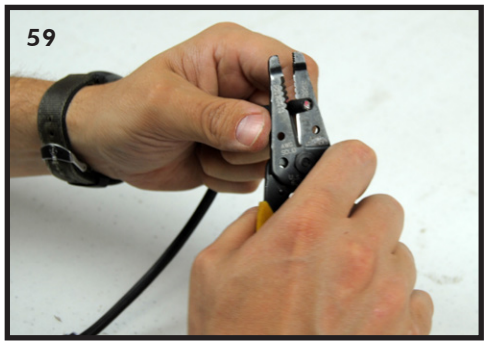

55

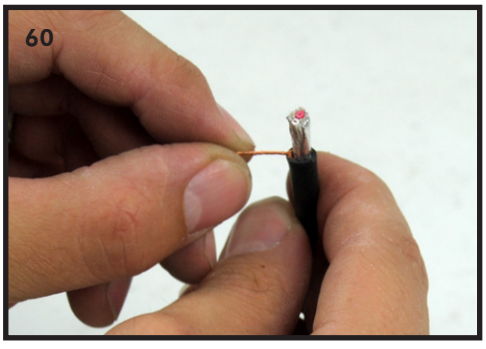

56

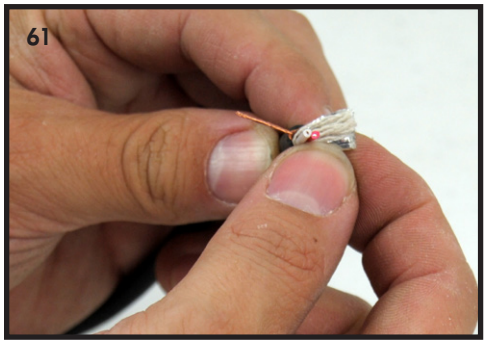
c. With your soldering iron, tin a small area inside the container near one of the corners. This will be for the ground wire (57).

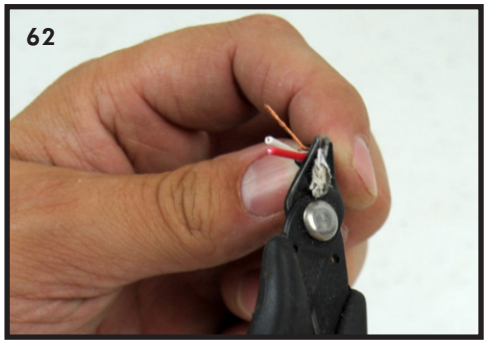
d. Solder the ground wire to the tinned area(58). Let it cool off.

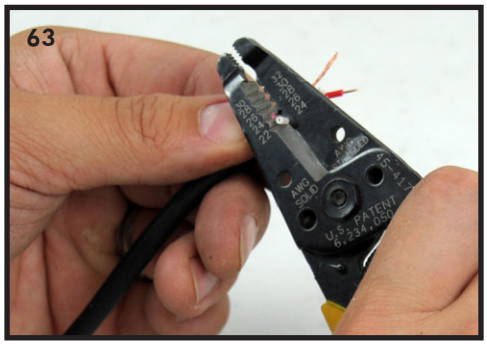
e. Strip off about 1/2" of outer insulation from the mic cable attached to the XLR jack(59). When stripping the outer insulation be careful not to cut too deep and cut through the thin copper wires acting as the cable shield. Pull all of these copper shield wires to one side of the cable and twist them together(60). Pull the layer of foil and the cotton strings to the other side of the cable and cut all of them off with your snips(61,62). Strip off about 1/8" from the white and red wires(63). Tin the twisted copper shield wire, the red wire, and the white wire(64).

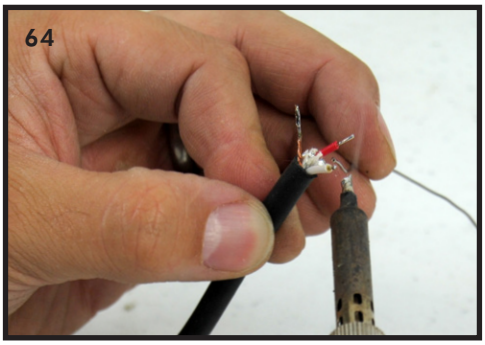




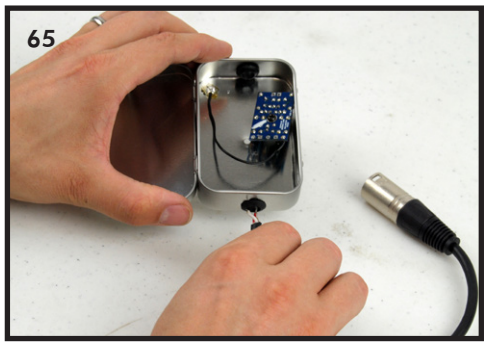




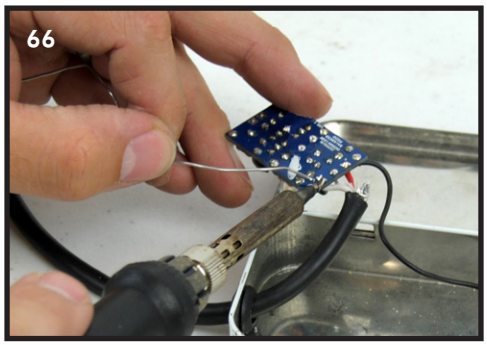


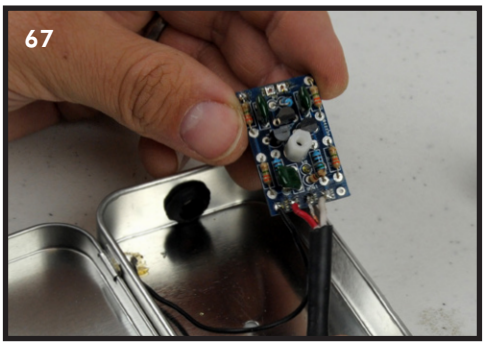


f. Pinch all three wires together on the mic cable and slide the cable through the grommet from the outside of the tin(65).

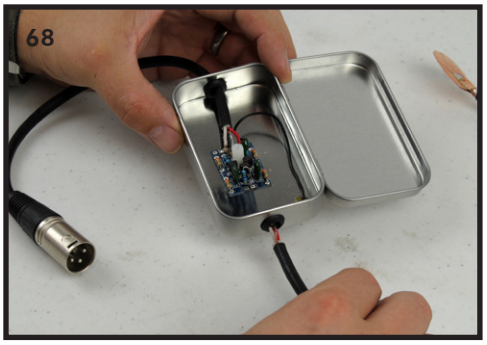


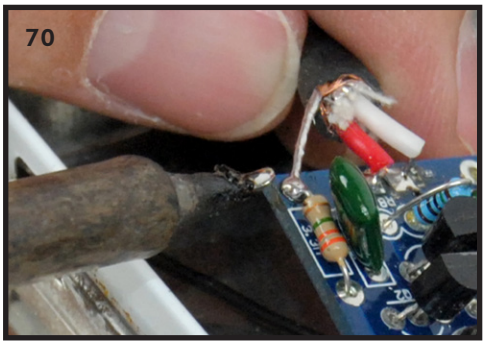
g. Solder the XLR cable to the PCB(66,67). The red goes to the hole labeled XLR3 and the white wire goes to the hole labeled XLR2 The copper shield wire goes in the round hole labeled "XLR1.

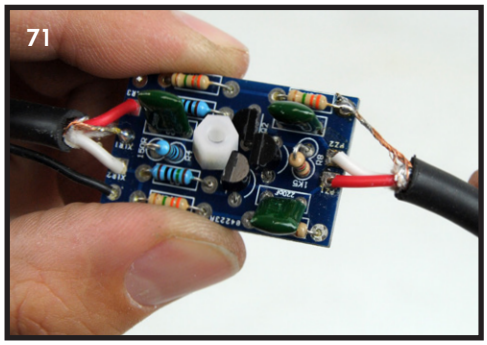




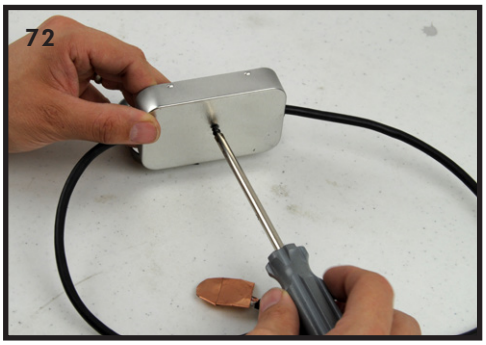
h. Slide the piezo disc cable through the other grommet and solder the red wire to the hole labeled PZ1 and the white wire to PZ2. Solder the shield of the cable to ground, which would be the pads of either R2 or R7 that are closest to the corners of the PCB(68,69,70,71).

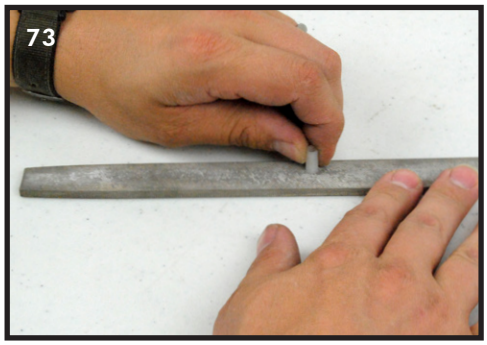






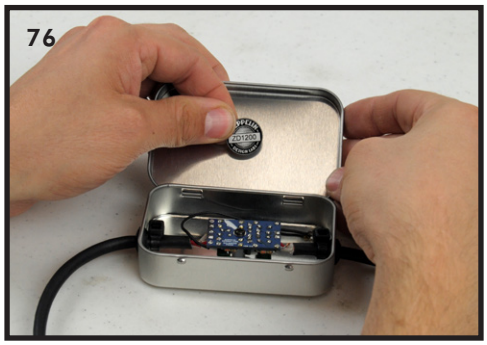
i. Screw the PCB via its stand-off to the hole you previously drilled through the bottom of the tin(72). If the tin is a little too shallow, and doesn't close very easily, sand, file or grind the standoff down a little bit to make it shorter(73).



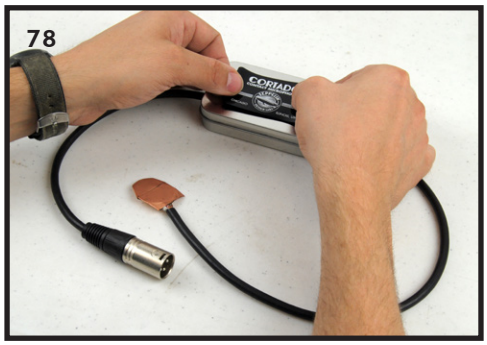


j. Fasten the zip ties around each of the cables on the inside of the tin(74). This acts as a "stop" against pulling the cable too far out of the tin and stressing its solder connection on the PCB. Trim the zip tie with your snips(75).

k. Place the serial number sticker on the inside of the lid (76,77).



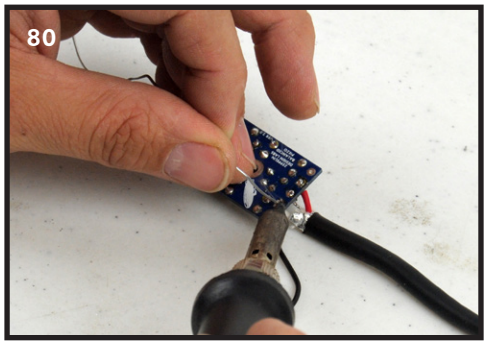
l. Place the Cortado Label sticker on the top of the box (78,79). Your standard Cortado is done!



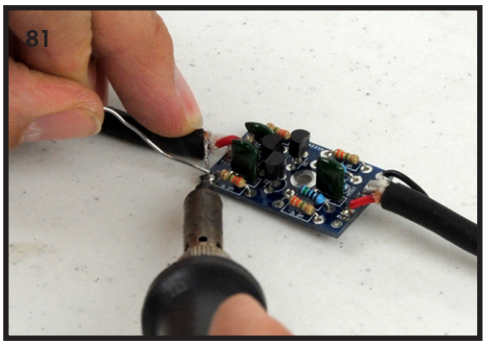
2. If you want to permanently install your Cortado somewhere, such as inside a musical instrument or other sound making device you may want to use the copper tape to shield the PCB instead of the metal tin. This will keep the over-all size of the Cortado small and easy to tuck inside a soundhole or instrument body. Follow steps 2a-2f to shield the PCB with copper tape.

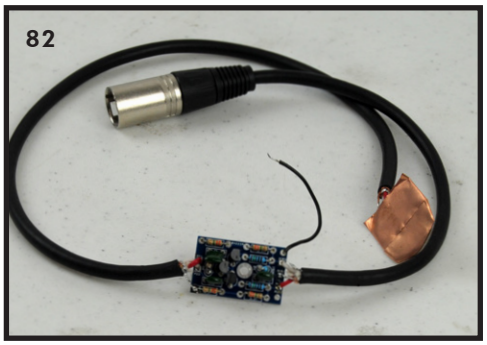
a. Unscrew the standoff from the PCB.

b. Solder the XLR cable to the PCB(80). The red goes to the hole labeled XLR3 and the white wire goes to the hole labeled XLR2 The copper shield wire goes in the round hole labeled XLR1

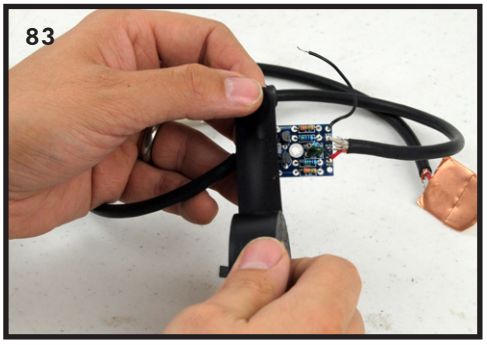


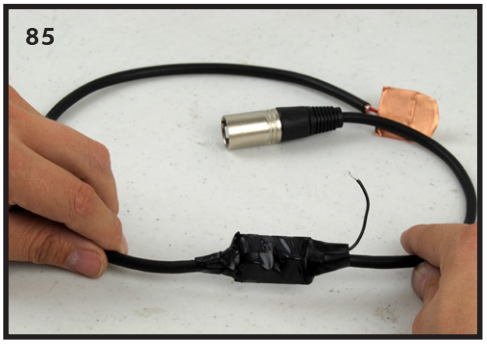
c. Attach the piezo disc cable to the PCB. Solder the red wire to the hole labeled PZ1 and the white wire to PZ2. Solder the shield of the cable to ground, which would be the pads of either R2 or R7 that are closest to the corners of the PCB(81,82).



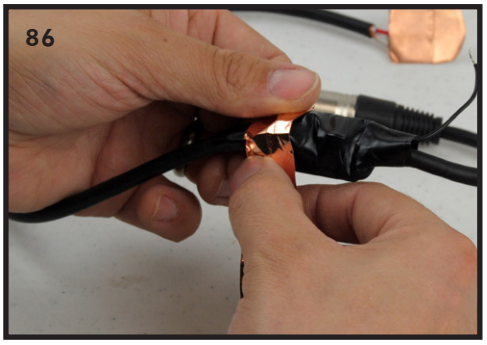


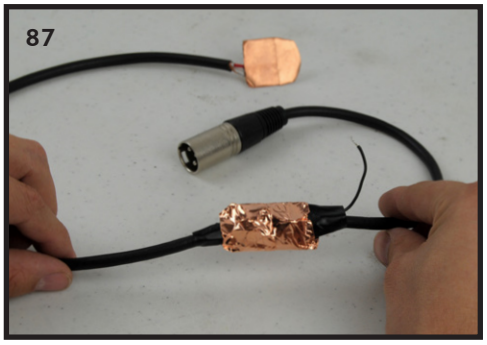
d. Wrap the entire PCB and exposed cable wires in electrical tape (83,84,85).



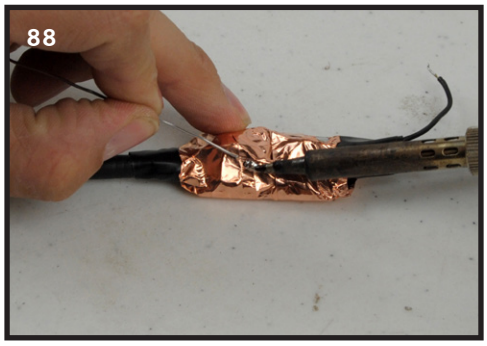


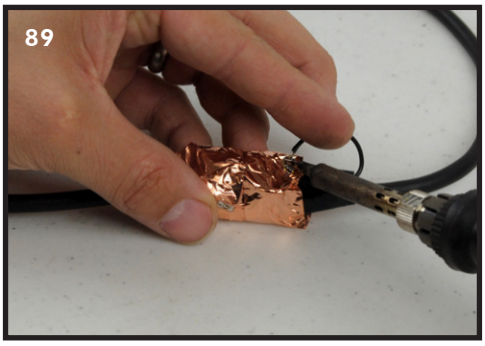
e. Very carefully remove the backing from the 7" piece of copper tape. Very carefully wrap the copper tape around the circuit board. The goal is to encase as much of the circuit board as possible. It may be easier to handle the tape if you cut it into two equal lengths. The 7" tape should be long enough to encase all of the PCB (86,87).





f. If you cut the copper tape into two pieces put a solder joint spanning the edge of the two pieces so they will be electrically connected (88). Solder the ground wire anywhere on the copper tape(89). When soldering the copper tape make sure you don't use too much heat which could melt the electrical tape under the copper.





The copper shielded electronics of the Cortado can be anchored to the inside of the instrument with velcro. The disc should be mounted to a flat, resonating surface inside the instrument, such as the sound board of an acoustic guitar. An efficient way to permanently wire the output of the Cortado is to replace the XLR jack with a balanced female endpin jack installed through the body of the instrument. You can plug the instrument into a sound system using a balanced 1/4" male to XLR male cable.

USING YOUR CONTACT MICROPHONE

There are about as many applications for the Cortado as there are sound sources in the world. Please read this section carefully to learn how to get the most from your contact mic and how to use it properly. With some basic supplies and a little creativity your Cortado contact mic should give you years of great service.

MOUNTING

One of the most important things to know when using piezoelectric devices is how to mount them to obtain the best pickup. If your piezo disc is mounted incorrectly most likely it will have a very narrow bandwidth (meaning it won't pick up a wide range of frequencies), have a low signal to noise ratio, and in a worst-case scenario, get damaged. Piezo electric devices pick up the best when they are very tightly coupled to a vibrating surface. The more securely mounted they are, the better. The best place to mount the piezo disc is on a smooth, flat surface, where the surface area of the disc can make the most contact with the vibrating material. The double-sided tape provided with your kit is excellent for permanently installing the disc on a flat sound source. If non-permanent installation is required, then just taping the piezo disc to a sound source with painter's tape also works sufficiently; just make sure it can't rattle or vibrate against the surface and it is held securely. Sticky-tack (the stuff used to hold posters on the wall) also works well for non-permanent installations. If you need to mount it on a round or uneven object a plastic clamp works well, but do not allow the piezo disc to bend at all; this will damage the disc. The disc is rather fragile and the ceramic element can crack if it is not handled carefully.

The circuit board is intended to be mounted inside a shielded enclosure, such as the tin can furnished with the kit. However, any conductive container to which you can attach the ground wire will work, such as a tuna can or soup can. A die-cast aluminum box (like the Hammond 1590 series) would also work well as long as you can figure out a way to attach the ground wire (such as a solder lug attached via a nut and bolt). The PCB is easy to mount with the stand-off and the two screws it comes with, but it's not necessary to use them. If the container you use is too small to mount the board via the standoff, it is possible to just wrap the board in electrical tape and leave it floating (not anchored to anything). In the container you use, you must drill two 3/8" holes for the XLR cable and piezo disc cable. Two rubber grommets are provided in the kit for mounting in the holes around the cables. Two zip ties are also provided in the kit to tie around the cables on the inside of the container to provide strain relief.

USING MULTIPLE MICS AT ONCE

Some applications may require more than one contact mic being used on the same source. This works very well for many musical instruments particularly stringed instruments and pianos. The main thing to be mindful of in these situations is the phase of each microphone. In most situations the relative phase of all mics should be the same. This means that a positive impulse from the sound source will be picked up as a positive (not negative) signal from all the microphones. If you followed these assembly instructions properly, then any Cortado you build should be in the same relative phase.

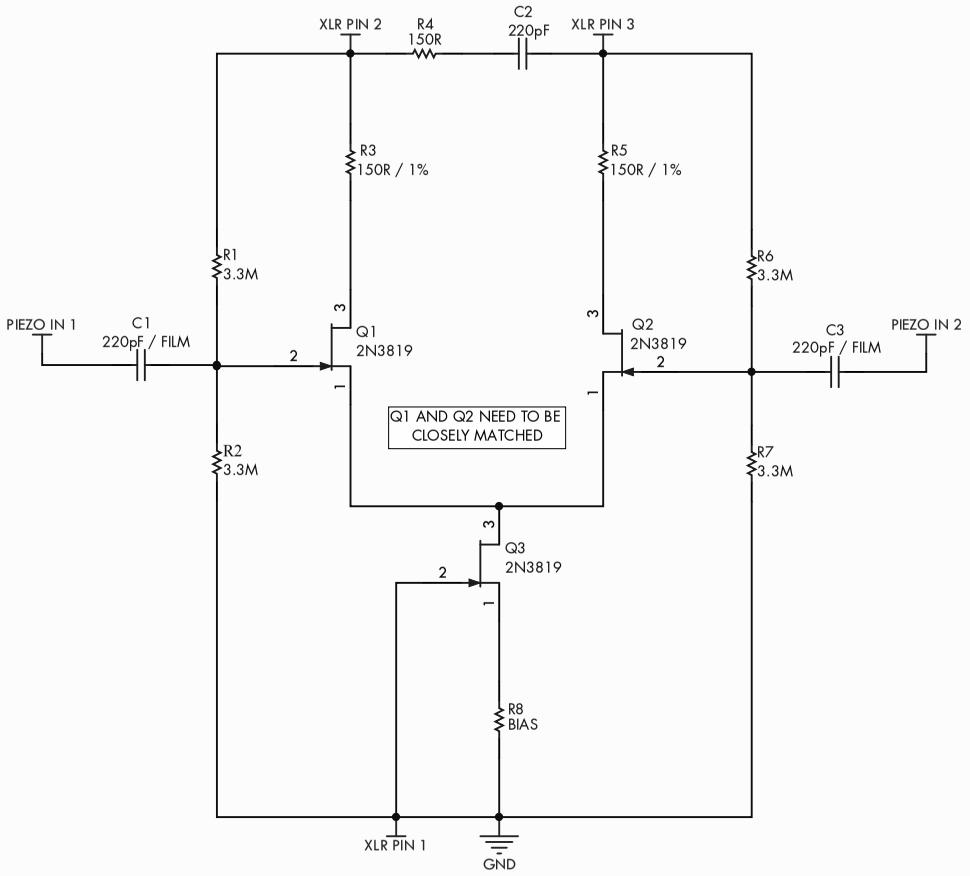
In some cases you may want to invert the phase of one of the microphones. One example of when you might want to do this would be when you use two mics on opposite sides of a vibrating plane, such as an acoustic guitar soundboard. With one mic on the bottom (inside the body) of a guitar soundboard, and another mic on the top (outside the body) of the soundboard, these mics should be out of phase with each other. This can be accomplished by reversing the two piezo disc conductors (the red and white wires in PZ1 and PZ2) on only one of the mics. But manually reversing these wires may not be necessary if the equipment you are using has a phase switch.

A WORD ABOUT CABLES

In some cases you may find it useful to extend the distance between the piezo pickup and the circuit board. This is possible by replacing the 18" cable with a shielded balanced cable of your desired length. The maximum cable length that you can use without experiencing signal degradation will depend on the quality of cable used, but in most cases it should easily be over 100 feet. The length of the XLR cable could also be extended, theoretically even further than the piezo cable (assuming it is connected to a good quality receiving circuit). One of the main things to keep in mind when using long balanced cable lengths is the quality of the shielding. Only use cable that has a tight shield. The more area the shield covers around the internal wires, the better.

PHANTOM POWER

The Cortado microphone circuitry does need power to operate. This is provided through phantom power via pins 2 and 3 of the XLR jack. The circuit works best at 48Vdc phantom power, but can function with much less voltage. It is not recommended to use less than 18Vdc or the mics headroom will be too low for most applications. If the device you are plugging the microphone into doesn't provide phantom power then you need to use an external phantom power supply (available at most pro-audio stores). Zeppelin Design Labs is currently developing an external phantom supply DIY kit which should be available soon.



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Title: **CORTADO** BALANCED PIEZO CONTACT MIC		
Size: A	Engineer: Brach	Revision: 2.0
Date: 11/17/2015		Sheet 1 of 1

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