

PAiA Phantom Power Pre-amp

Model 9215
Assembly and Using Manual

You already know that Condenser Microphones offer a sonic “transparency” that you can’t get with their Dynamic counterparts, but how do you use them? Your mixer has Mic inputs, but Condenser Mics need “Phantom Power” and have balanced outputs, features that are usually only available on the most expensive consoles.

There's no need to buy a new mixer just because you found a good deal on an AKG 414. This Pre-amp provides phantom power, adjustable gain up to 60 dB and converts balanced inputs into single ended outputs. Its two identical sections can be used with any kind of Condenser Mic.

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ASSEMBLING THE Phantom Power Pre-amp

Before beginning assembly, go through the manual. Look at the drawings. Feel the parts. You're naturally eager to plunge right in, but take a few deep breaths first.

Notice that each step in the manual is marked with a checkoff box like this:

DESIGNATION	VALUE	COLOR CODE
() R27	100 ohm	brown-black-brown

Checking off each step as you do it may seem silly and ritualistic, but it greatly decreases the chance of omitting a step and also provides some gratification and reward as each step is completed.

Numbered figures are printed in the illustrations Supplement in the center of this manual. These pages may be removed for easy reference during assembly.

THE CIRCUIT BOARD

The Phantom Power Pre-amp is built on a single-sided circuit board. Before beginning assembly, clean oxidation from the copper side of the circuit board using scouring cleanser and water. The copper should be bright and shiny before beginning assembly.

Once you begin putting parts on the circuit board, it's a good idea to continue until all the parts are mounted. Stopping overnight may allow the copper to oxidize and make soldering more difficult.

TOOLS

You'll need a minimum of tools to assemble the kit - a small pair of diagonal wire cutters and pliers, screwdriver, sharp knife, ruler, soldering iron and solder.

Modern electronic components are small (in case you hadn't noticed) and values marked on the part are often difficult to see. Another handy tool for your bench will be a good magnifying glass. Also

use the magnifier to examine each solder joint as it is made to make sure that it doesn't have any of the problems described in the SOLDERING section which follows.

SOLDERING

Select a soldering iron with a small tip and a power rating not more than 35 watts. Soldering guns are completely unacceptable for assembling solid state equipment because the large magnetic field they generate can damage components.

Use only rosin core solder (acid core solder is for plumbing, not electronics work). A proper solder joint has just enough solder to cover the soldering pad and about 1/16-inch of lead passing through it. There are two improper connections to beware of: Using too little solder will sometimes result in a connection which appears to be soldered when actually there is a layer of flux insulating the component lead from the solder bead. This situation can be cured by reheating the joint and applying more solder. If too much solder is used on a joint there is the danger that a conducting bridge of excess solder will flow between adjacent circuit board conductors forming a short circuit. Accidental bridges can be cleaned off by holding the board upside down and flowing the excess solder off onto a clean, hot soldering iron.

Use care when mounting all components. Never force a component into place.

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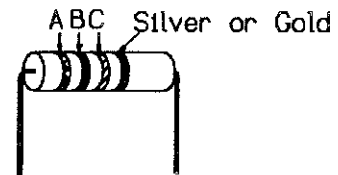
This product originated as a Do-It-Yourself article by Jules Ryckebusch in the April 1993 issue of Electronic Musician magazine. There may be differences between what appeared in the article and what is supplied with the kit. These differences, and any discussion of them, will be set aside with this italicized type. In some cases, notes packed with the parts will be used to call your attention to special situations.

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RESISTORS

Solder each resistor in place following the parts placement designators printed on the circuit board and the assembly drawing Fig 1. Note that resistors are nonpolarized and may be mounted with either lead in either of the holes in the circuit board. Before mounting each resistor, bend its leads so that they are at a right angle to the body of the part. Put the leads through the holes and then push the resistor firmly into place. Cinch the resistor in place by bending the leads on the solder side of the board out to an angle of about 45 degrees. Solder both ends of each resistor in place as you install it. Clip each lead flush with the solder joint as the joint is made. Save the clippings, we'll use them later as circuit board jumpers.

The Phantom Power Pre-amp uses 1% film resistors in critical audio path circuitry and 5% carbon film resistors in non-critical locations. First we'll install the 5% resistors. These resistors are identified by their 4 color bands.



DESIGNATION	VALUE	COLOR CODE A-B-C
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<i>listed below:</i>	1000 ohm	brown-black-red
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() R14	() R18	() R19
() R29	() R33	() R34

() R2	33k	orange-orange-orange
() R3	33k	orange-orange-orange
() R4	270 ohm	red-violet-brown
() R5	100 ohm	brown-black-brown

<i>listed below:</i>	10k	brown-black-orange
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() R8	() R9	() R16	() R17
() R23	() R24	() R31	() R32

DESIGNATION	VALUE	COLOR CODE A-B-C
() R20	100 ohm	brown-black-brown

The 1% metal film resistors are identified by their 5 color bands.

DESIGNATION	VALUE	COLOR CODE A-B-C-D
<i>listed below:</i>	6.81k	blue-grey-brown-brown

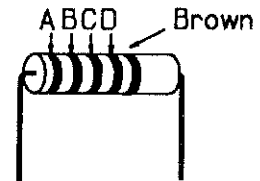
() R6 () R7 () R21 () R22

listed below: 1000 ohm brown-black-black-brown

() R10 () R11 () R25 () R26

listed below: 10k brown-black-black-red

() R12 () R13 () R27 () R28



CERAMIC DISK CAPACITORS

Some of the capacitors used in the Phantom Power Pre-amp are non-polarized ceramic disks, either lead can go in either of the holes on the circuit board. Leads are already parallel to one another but still may need to be bent slightly to match the spacing of the circuit board holes. Like the resistors, push the leads through the holes in the board and push the part against the circuit board as far as it wants to go. Don't force it, it's OK if it sits a little off the board.

Disk Capacitors



Capacitors are often marked with obscure codes that indicate their values. The 3 digit number that specifies value may be preceded or followed by letters indicating such things as tolerance. If you get confused about which capacitors are which, it may help to group them by same type and check them against quantities on the packing list at the end of this manual.

DESIGNATION	VALUE/TYPE	MARKING
listed below:	.01 uF	103
() C5	() C6	() C7 () C8
() C9	220 pF	221
() C15	.05 uF	503
() C20	47 pF	47
() C24	47 pF	47

Disk Capacitors



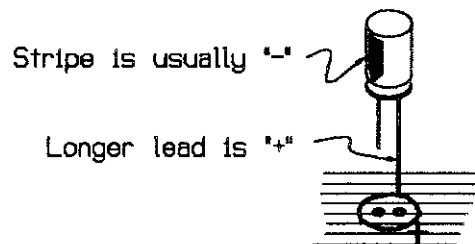
ELECTROLYTIC CAPACITORS

Some of the capacitors used in the Phantom Power Pre-amp are electrolytic types. Unlike the previous components, electrolytic capacitors are polarized and the leads are not interchangeable. Leads are marked "+" and/or "-" and the "+" lead must go through the "+" hole in the circuit board. Frequently the positive lead of the capacitor is significantly longer than the negative lead.

Usually the Negative lead of the capacitor is marked rather than the positive. It naturally goes through the hole not marked "+".

Capacitors supplied with specific kits may have a higher Voltage (V) rating than the minimum specified below.

DESIGNATION	VALUE
() C1	470 uF / 25V
() C2	470 uF / 25V
() C3	1 uF / 16V
() C4	1 uF / 16V



DESIGNATION VALUE

listed below: 33 uF / 16V

() C10 () C11 () C12 () C13
() C14

listed below: 47 uF / 50V

() C16 () C17 () C21

TANTALUM CAPACITORS

Four of the capacitors used in the Phantom Power Pre-amp are low-noise, low-leakage tantalum types that can be recognized by their distinctive balloon shape. Tantalum capacitors are generally marked with their values (in very tiny type) and since all four tantalum caps are the same value there is little chance of confusion.

Tantalum capacitors are usually polarized with a "+" mark associated with one of the leads and like the other polarized components this "+" lead should be put in the similarly marked circuit board hole.

DESIGNATION VALUE/TYPE

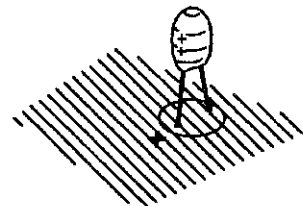
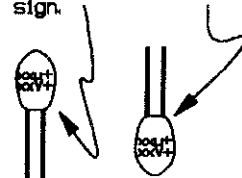
listed below: 4.7uF / 35v.

() C18 () C19 () C22 () C23

DIODES

Three types of diodes are used in the Phantom Power Pre-amp, five 1N4148 silicon signal diodes in small transparent glass cases, 9 zener diodes also in small transparent cases and two 1N400x power diodes in larger opaque cases.

The positive lead will be identified with a "+" sign.

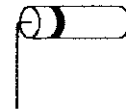


When you receive your kit, these parts will be separately packed. Do not remove them from their packing until you're ready to install them; if they get mixed up you will have a hard time sorting them back into types.

Diodes are polarized and must be installed so that the lead on the banded end of the part corresponds to the banded end of the designator on the circuit board. Bend the leads so they are at right angles to the body of the part and insert them through the holes provided in the circuit board.

Diodes are also somewhat heat sensitive so the soldering operation should be done as quickly as possible.

1N914 / 1N4148 and zener diodes are in small, transparent cases



1N400x diodes are in larger, opaque cases

DESIGNATION TYPE

- () D2 1N400x Power Diodes
- () D3 1N400x Power Diodes

listed below: 1N914/1N4148 Silicon Diodes

- () D4 () D5 () D6 () D7
- () D8

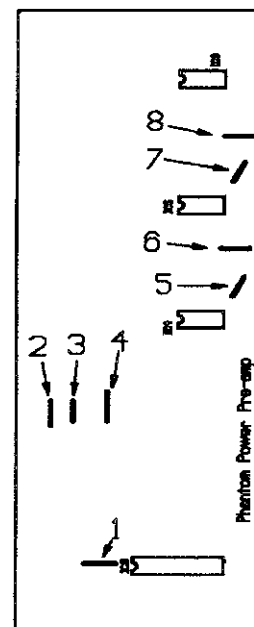
- () D9 39V 400 mW. Zener Diode

listed below: 6.8V 400 mW. Zener Diodes

- () D10 () D11 () D12 () D13
- () D14 () D15 () D16 () D17

JUMPERS

- () Using the wire clippings saved while installing the previous parts, form and install the eight circuit board jumpers which are designated on the circuit board by bold lines.

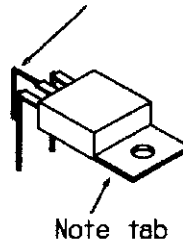


There are eight jumpers on the circuit board.

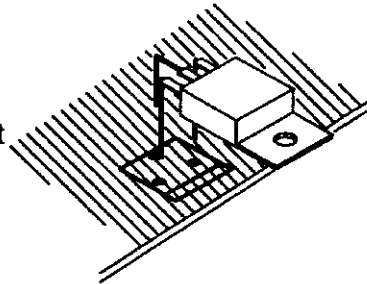
VOLTAGE REGULATORS

Locate the 7812 (+12V) and 7912 (-12V) voltage regulators. Form the leads as shown in the illustration to match the pattern of holes in the circuit board for IC1 and IC2. Notice that these parts are polarized and the leads must be bent **DOWN** (toward the rear tab of the part).

Bend leads down



Install each Voltage Regulator by pressing the part against the board and soldering all three leads. Clip any excess off flush with the solder joint. When properly installed, the Voltage Regulators will extend over the edge of the circuit board.



DESIGNATION TYPE

- () IC1 7812 +12V Voltage Regulator
- () IC2 7912 -12V Voltage Regulator

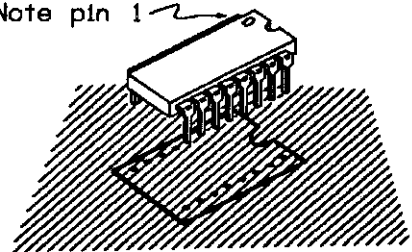
When properly installed, the tabs of the Voltage Regulators will project over the edge of the board.

INTEGRATED CIRCUITS

Of all the parts, the ICs are the most easily damaged and should be treated with some respect. In particular, they may be destroyed by discharges of static electricity. Modern ICs are not nearly as sensitive to this kind of damage as were earlier versions, but it is still good practice to handle these parts as little as possible. Also good practice: don't wear nylon during assembly. Don't shuffle around on the carpet immediately before assembly (or if you do, touch a lamp or something to make sure you're discharged). Don't be intimidated. It's rare for parts to be damaged this way.

ICs are polarized in one or both of two ways; A dot formed into the case of the IC corresponding to pin 1 or a semicircular notch that indicates the end of the package with pin 1. Take care that this

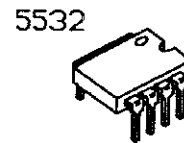
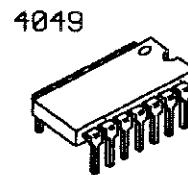
Note pin 1



polarizing indicator corresponds to the similar indicator on the circuit board graphics.

The pins of the ICs may be splayed somewhat and not match up exactly with the holes in the circuit board. Carefully re-form the leads if necessary so that they are at right angles to the part. Solder each IC in place as it is installed by initially soldering two pins in diagonal corners of the pattern. Make sure that the part is seated firmly against the pc board by pressing it down while re-melting the solder joint at first one corner, then the other. Finally, solder the remaining connections.

DESIGNATION	TYPE
() IC3	4049 CMOS Hex Inverter
() IC4	5532 Dual Low Noise Opamp
() IC5	5532 Dual Low Noise Opamp
() IC6	5532 Dual Low Noise Opamp



“FLYING” WIRES

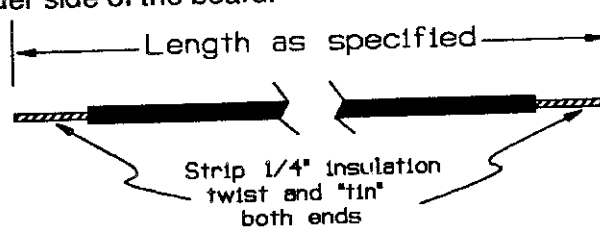
(i.e. those which go from circuit board to panel mounted parts.)

In the following steps, wires will be soldered to the Phantom Power Pre-amp circuit board which in later steps will be connected to the front panel controls and connectors. Three different kinds of wire are used; Shielded Twisted Pair (“twin-ax”) that connects the XLR inputs, Co-ax which connects to the potentiometers and single stranded wire for the remaining connections.

Stranded Wire

The first wires are #22 stranded. At each step, cut a piece of wire to the specified length and strip 1/4” of the insulation from each end. Twist the

exposed wire strands together and "tin" them by melting a small amount of solder into the strands. This will make soldering easier when the wires are installed and prevents fraying of the wire strands when they are pushed through the holes. Solder each connection as it is made and clip any excess wire from the solder side of the board.



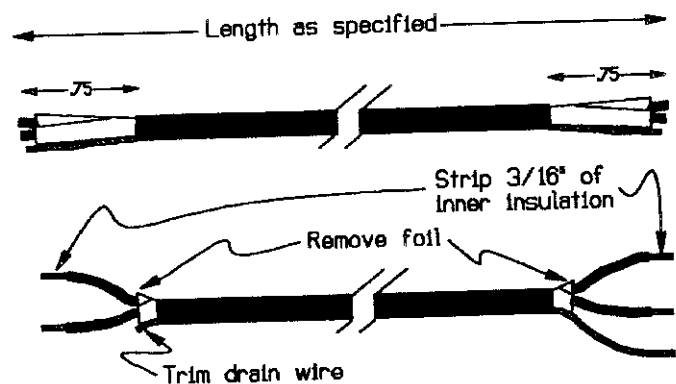
PC POINT/Length	PC POINT/Length
() "F" 7"	() "H" 7"
() "G2" 4-1/2"	() "M" 5"
() "N" 5"	

Twin-Axial Cable

Belden 9501 twin-ax will be used to make shielded connections between the circuit board and the XLR connectors. Make two cable sections by cutting a 3-1/2" piece from the length supplied. Prepare the ends of the two pieces as follows:

On each end of the cable, remove 3/4" of the outer insulating sleeve. Cut off the exposed foil layer flush with the outer insulation.

On both ends, strip 3/16" inch of insulation from both the red and black leads. Twist and tin the exposed wire strands. On one end, tin about 1/4" of the drain wire. On the other end, clip the drain wire off flush with the outer insulation.



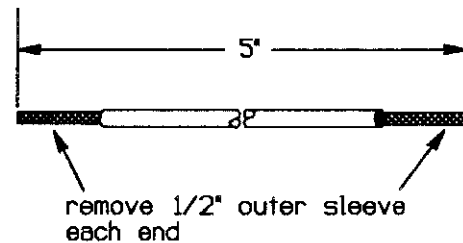
Use the end with the drain wire cut off to make these connections to the circuit board.

CABLE LENGTH	WIRE Color	PC point
() 3-1/2"	red	"I"
()	black	"J"
() 4-1/4"	red	"B"
()	black	"C"

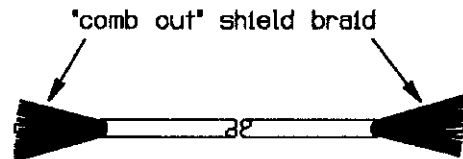
Co-Axial Cable

RG-174/U coaxial cable will be used to make shielded connections between the circuit board and Potentiometers. Both pieces of co-ax should be prepared in the same way:

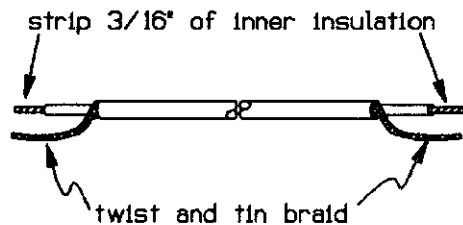
Cut the 10" length of co-ax supplied into two equal length sections. Strip 1/2" of the outer insulation at each end of both pieces to expose the braided shield beneath it.



Unbraid the shield by "combing" it with the dull edge of a knife blade or a ballpoint pen. This will expose the separately insulated inner conductor.



On both ends of both pieces, pull the strands of the shield to one side and twist them together. Tin this pigtail by melting a small amount of solder into it.



Strip about 3/16" of the insulation from the inner conductor of both ends of both cables and twist and tin the exposed strands.

Using the lengths of co-ax prepared as above, solder the inner conductor and shield on one end of each piece to the circuit board points given in the steps.

WIRE	PC POINT	WIRE	PC POINT
() #1 center	"D"	() #2 center	"K"
() #1 shield	"E"	() #2 shield	"L"

Notice that circuit board points "A" and "G" do not yet have wires connected to them.

We will now put the circuit board aside and begin putting parts on the front panel. This is a good time to kick back and admire your work to this point. Be critical - are the solder joints nice and shiny? Are there any blobs of solder on the board that could use cleaning up (see SOLDERING on page 3). Are the polarized components mounted properly?

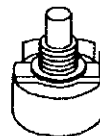
PANEL CONTROLS

If you have the optional case available from PAiA, you will be installing these parts as shown in Fig 2. Note that this illustration shows the case with the switch mounting holes cut away for better viewing.

() Using four 4-40 X 1/4" machine screws and four #4 nuts, mount the two Female XLR connectors J1 and J4. Fully tighten this hardware.

() Using the two washers and two nuts supplied, mount the two 100k Potentiometers R15 and R30. Since being able to move these parts slightly while wires are being soldered to them in later steps will be helpful, do not fully tighten this hardware.

Potentiometers may have a locating tab which is not used.



Bend or remove this tab so that the pot will seat flush against the front panel.

- () Using the four washers and four nuts supplied, mount the four Phone Jacks J2, J3, J5 and J6. Do not fully tighten this hardware.

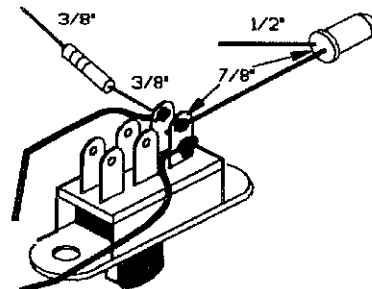
Before mounting the power switch, we'll get some preliminary wiring out of the way. Notice that the DPDT slide switch provided for S1 is symmetrical. It doesn't matter which end has lugs 1 and 6 as long as you're consistent throughout assembly.

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In the EM article a SPST switch was specified. We will be using the extra lugs on the DPDT switch as tie points.
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The POWER LED is completely supported by the wiring that connects it to S1. The following instructions should be followed carefully so that the LED will align with the hole provided for it in the case top. In this application the LED is not sensitive to polarity so you need not be concerned with the orientation of the polarizing flat on the case.

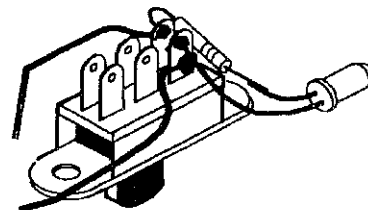
- () Locate the DPDT Slide Switch S1 and the Red LED D1. Slide one of the leads of the LED through Lug #4 of the switch so that the body of the led is slightly less than an inch away from the switch. Solder this connection.

- () Locate the 1000 ohm 5% resistor (color code brown-black-red) and slide one of its leads through lug #3 of S1 so that the lead extends a little less than 1/2" from the switch. Solder.



- () Cut a 3-1/2" length of #22 stranded wire and strip 1/4" of insulation from both ends. Tin the exposed wire strands and form a hook in one end. Loop the hook over Lug #4 of S1 and solder.

- () Cut a 5" length of #22 stranded wire and strip and tin as above. Form a hook in one end, loop it over Lug #3 of S1 and solder.



- () Using two 4-40 X 1/4" machine screws and nuts, mount S1 in the location shown in Fig 3. Bend the LED so that it protrudes through the hole in the top of the case.

- () Bend the resistor R1 around and align its free lead with the free lead of the LED. Overlap the two leads and solder together.

PANEL PRE-WIRING

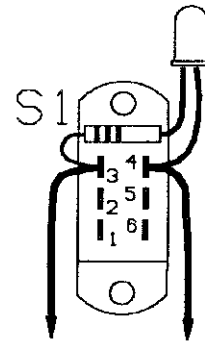
Now we'll do some preliminary wiring on the front panel jacks and controls as shown in Fig 4. At each step prepare a wire of the length specified by stripping 1/4" of insulation from the end and twisting and tinning the exposed strands.

Individual solder lugs are identified by part number and lug number. For example, J2-G means the lug labeled "G" of the Jack J2 as shown in the illustrations.

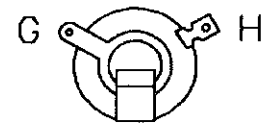
This convention will be followed in these steps: Do not solder a connection to a lug until told to do so with an instruction such as (S2), which means that at that point there will be two wires on the lug in question. If there are not the number of wires specified at the lug when you get ready to solder, recheck to see what has gone wrong. Connections which should not be soldered yet will be marked (NS) for No Solder. On these unsoldered connections simply push the end of the wire through the lug and crimp it back to mechanically secure it.

LENGTH	FROM	TO
() 2"	J2-G (S1)	J3-G (NS)
() 2-1/2"	J3-G (NS)	J5-G (NS)
() 2"	J5-G (NS)	J6-G (NS)

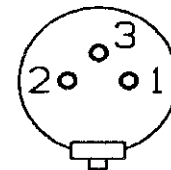
The "solder lugs" on the XLR Connectors are unusual because there's nothing to wrap the wire around. Everyone has their own favorite way of dealing with this, ours is to first heat the lug while feeding some solder into its hollow middle. When enough solder has been added to form a small pool, the



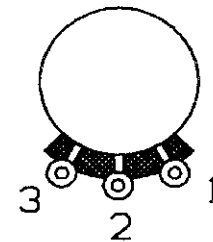
Phone Jack



XLR Connector



Pots



pre-tinned wire is pushed into the lug and the heat held long enough for the solder on the tinned lead to remelt. Remove the heat and let everything cool.

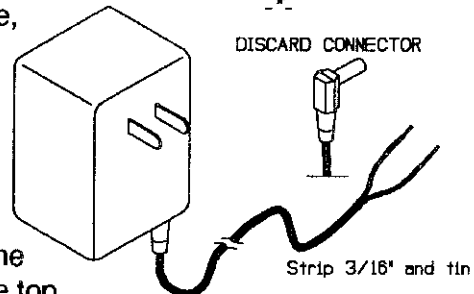
Continue with #22 stranded wires.

LENGTH	FROM	TO
() 3"	J3-G (S3)	J1-1 (S1)
() 3"	J6-G (S2)	J4-1 (S1)

- () Using a piece of resistor clipping, connect Lug #2 to Lug #3 on potentiometer R30. Solder the connection at Lug #3, but DO NOT solder Lug #2 yet.
- () Do the same thing on Lugs #2 and #3 of R15.

POWER TRANSFORMER

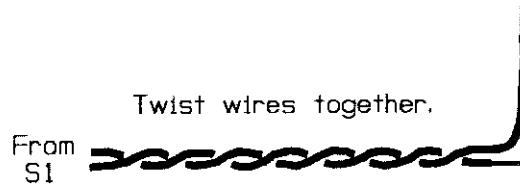
Locate the Wall-Mount Power Transformer PWR1. If this part has a connector on the end of its cable, remove and discard it as shown. The two wires coming from the transformer are not polarized and may be used interchangeably. Transformers provided with individual kits may have a current rating greater than the 100mA minimum.



- () Push the 1/4" rubber grommet supplied into the power cord hole in the rear lip of the case top as shown in Fig 3. Push the Transformer power cord through the grommet from the back and tie a knot about about 3" from the end.
- () Separate the Transformer power cord into its two component wires back to the knot and prepare the ends of these wires by removing 3/16" insulation and twisting and tinning the strands.
- () Connect either of the Transformer wires to Lug #2 of S1. Solder this connection. See Fig 4.

() Connect the other Transformer wire to Lug #5 of S1 and solder.

() Twist the two wires coming from lugs #3 and #4 of S1 together as shown. There should be 10 full twists between the switch and the end of the shorter wire.



() Begin connecting the circuit board to the panel mounted parts by soldering the shorter of the two leads from the above step to circuit board point "A". See fig 5.

() Connect the longer wire of the twisted pair to circuit board point "G".

In the remaining steps, wires and cables previously soldered to the circuit board will connect to pots and jacks as shown in Fig 5. Notice that previous wiring has been eliminated from these drawings to give a better view of the present operations.

The following connections are made with the center and shield conductors of the 2 co-ax sections.

ORIGIN	TO
() "D" (center)	R15-2 (S2)
() "E" (shield)	R15-1 (S1)
() "K" (center)	R30-2 (S2)
() "L" (shield)	R30-1 (S1)

These connections are made with the #22 stranded wires coming from the circuit board.

ORIGIN	TO	ORIGIN	TO
() "F"	J2-H (S1)	() "H"	J3-H (S1)
() "G2"	J5-G (S3)	() "M"	J5-H (S1)
() "N"	J6-H (S1)		

These connections are made with the free ends of the two twin-ax sections.

ORIGIN	TO
() "I" (red)	J4-3 (S1)
() "J" (blk)	J4-2 (S1)
() "B" (red)	J1-3 (S1)
() "C" (blk)	J1-2 (S1)

Wiring is completed by attending to the drain wires of the twin-ax sections.

- () Solder the drain wire from the twin-ax associated with J1 to lug #1 of this jack. There is already a piece of #22 stranded wire terminated there and this new wire should be added by applying heat to this lug until the solder remelts. Add the drain wire (there is room for both wires in the terminal) and hold the heat until the tinning of the drain wire remelts then remove heat and allow the joint to cool.

- () Similarly, connect the drain wire to lug #1 of J4.

Tighten all hardware.

THIS COMPLETES THE ELECTRONIC ASSEMBLY OF THE Phantom Power Pre-amp. Before plugging the unit in and testing it, take a well earned break then come back and check your work completely. Don't be afraid to tug on wires to test connections, now's a good time to find out whether they will hold or not. Check the wiring around the Power switch S1. There's some point-to-point wiring involving D1 and R1 that is susceptible to wires touching and shorting.

POWER UP & TESTING

This is a good time to mount the circuit board to the case bottom plate as shown in Fig 6. In our testing this will prevent circuit board traces from shorting against wire clippings or the odd piece of metal on the workbench.

- () Mount the circuit board to the case bottom using four 4-40 X 1/2" machine screws and nuts and the four #4 X 3/16" rolled aluminum standoffs supplied. One side of the case bottom may be covered by a film, this is the outside and the circuit board should be mounted on the other side. Note that the circuit board is mounted off-center on the bottom plate to allow room for the tabs on the Voltage Regulator.

Plug the wall-mount transformer into an electrical outlet. Slide the power switch up to turn the unit on. The LED should light and if it doesn't stop immediately and find out why. It may be something as simple as a dead electrical outlet, or it may be a bad connection or solder bridge on the circuit board. If the LED lights, let the unit idle for a few minutes while you check for overheating components (in particular the ICs). There should be no hot spots on the board, so if you feel a lot of heat coming from a component, unplug and find out why - solder bridges are a likely candidate.

Assuming that everything is OK so far, connect the +OUT to your amplifier, mixing board or tape recorder and set the channel faders and masters to nominal settings. Connect a condenser microphone to the Mic 1 input and bring the gain up while checking that the Microphone signal is passing through. This circuit can provide more gain than you should ever need for most situations. Move the output to the -OUT jack and observe that it behaves the same as the +OUT.

Check the Mic 2 input and outputs and if any one of them does not behave like the rest, check your work in that area of the circuit.

CASE ASSEMBLY

When you're through testing the unit and have confirmed that everything is working properly, the case can be fully assembled and the knobs put on the pot shafts.

The wood case ends supplied with this kit are unfinished and, while not absolutely necessary, an oil finish will keep the wood from staining and discoloring non-uniformly. This is not complicated, simply wipe the exposed wood with Tung oil available from any hardware store. The ends may be darkened by applying several coats of Tung oil that has a stain of the desired color.

Trial fit the wood ends into the open case ends as shown in Fig 6. When fully assembled, the edges of the bottom plate should be hidden by the case metal. If the ends do not fit far enough into the case for this to happen, it may be because the right angle cut of the wood ends is not fitting into the slightly radius of the bend in the case top. Use a sharp knife to remove the point of these right angles in the wood end.

- () When you have assured proper fit, fasten the wood ends in place with the (4) #4 X 1/4" self-tap screws supplied. To keep the wood from splitting and provide a better fit, pilot holes for these screws should be pre-drilled with a 1/16" drill bit.
- () In a similar manner, use the remaining (4) #4 X 1/4" self-tap screws to mount the bottom plate.
- () Install the (4) self adhesive rubber feet by peeling their backing and placing them in the corners of the case bottom as shown in Fig 8.
- () Install the knobs. Rotate the shaft of the control on which the knob will be placed fully CCW and align the pointer with the 7 O'clock position of an imaginary clock face. Push the knob on only slightly and rotate it back and forth to see how well it's range of rotation is balance with the panel graphic. Reorient if not satisfied and then push the knob firmly in place on the shaft.

Using The Phantom Power Pre-amp

by
Jules Ryckebusch

When using the Phantom Power Pre-amp, bring the gain up just enough to get the job done. This keeps the signal path as clean as possible. All too often, people turn up the gain on the mic pre-amp too much then either over compress, or turn the channel fader down to compensate. This limits the dynamic range and brings you closer to clipping, which distorts the signal.

Now let's take a look at those inverted (-OUT) outputs. They are perfect for MS (mid-side) stereo miking. If you have never tried this you should; it sounds awesome. You need three input channels on a mixer and two microphones, one of which must be a dual capsule condenser. This means it actually has two mic elements inside and a switch for different pickup patterns (AKG 414s are perfect for this).

Set the dual-element mic for a figure-eight pattern; this lets it pick up signals from both sides equally well. Place the pick up faces perpendicular to the sound source so the mic catches all the side sounds but not the direct signal. Place the other microphone right next to the first, pointing toward the sound source to pick up the direct signal. If it's another AKG 414 (I should be so lucky), set it for a cardioid pattern. From the dual mic, take the two outputs (in-phase and out-of-phase) into two mixer channels, and pan them hard right and left. To achieve correct levels on the input faders, listen to the mic in mono and slightly adjust one input level to minimize the signal. Bring in the second mic panned center.

I have used this technique with my Tascam Porta One with superb results. It also works well on overhead drum miking. Listen to any acoustic guitar on Windham Hill Records, and you will probably hear MS miking. The inverted outputs are also useful with other stereo mic configurations.

For balanced outputs, wire up a male XLR jack: pin 1 to ground, pin 2 in-phase, pin 3 out-of-phase.

The Phantom Power Pre-amp is a quiet, functional piece of studio gear. It was tested with an AKG 414, AKG 451 (several variations), Shure SM81, and a couple of electret condensers, which only use phantom power for their internal preamps. If you have always wanted that condenser clarity, but didn't want to buy a new board just to get phantom power, or you do a lot of location recording with less-than-adequate mic preamps, this amp's for you.

HOW IT WORKS

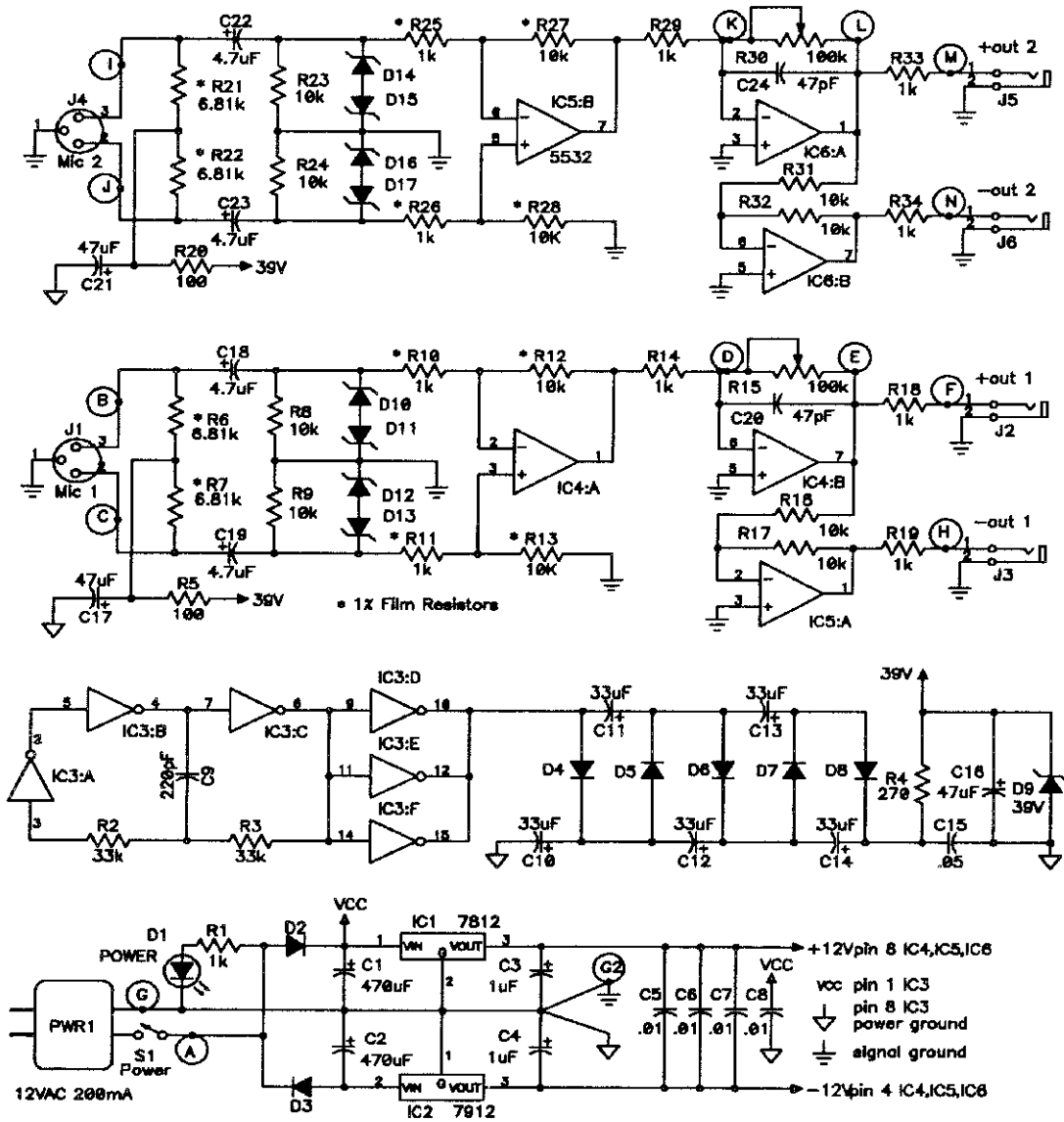
The Phantom Power Pre-amp consists of three basic blocks: the power supply, the preamps and the output phase inverters. Each input has two outputs, one of which is 180 degrees out-of-phase with respect to the other.

In this design, the phantom power is 39 volts and comes from a voltage-tripler circuit. The first three stages of a 4049 CMOS hex inverter (IC3) form a 60 kHz oscillator. The last three stages are arranged in parallel, for more current, and drive a voltage-tripler circuit consisting of capacitors C11 to C14 and diodes D4 to D8. The output is filtered and regulated by zener diode D9. The supply can deliver about 12 ma of current at 39 volts, which is plenty for two microphones. The rest of the supply is a standard, half-wave regulated, split supply comprising D2, D3, C1-C4, IC1 and IC2.

The preamps each include two gain stages, with some input coupling circuitry to get the phantom power to the microphones. Since the preamps are identical, only the lower one in the schematic will be detailed. The traditional 6.81k ohm resistors (R6, R7) couple the phantom power to both active input lines (XLR pins 2 and 3). The 47 mf capacitor (C17) and 100 ohm resistor (R5) provide additional filtering, while the two 4.7 mf capacitors (C18, C19) couple the audio input to the first gain stage. The 10K ohm resistors (R8, R9) provide a ground reference, while the four zener diodes (D10 through D13) provide protection to the amplifier circuitry. Note their back-to-back wiring. If a voltage at the input exceeds the reverse conduction voltage of the diodes, the signal will be shorted to ground, protecting the op amps.

Two gain stages are used to improve the bandwidth and frequency response of the preamp. Op amp IC4:A and the associated 1 k ohm (R10, R11) and 10 k ohm (R12, R13) resistors form the first gain stage, a true differential amplifier. It has a voltage gain of about 20:1, and with 1% resistors, an acceptable common-mode rejection ratio.

The second stage consists of op amp IC4:B and the 1 K ohm resistor (R18) and 100 K ohm gain-adjust potentiometer (R15). The 47 pf capacitor (C20) in the feedback path rolls off the high frequency response above 30 kHz at full gain. This second stage provides an additional voltage gain of up to



Phantom Power Pre-amp Schematic

100:1. The total available gain is in excess of 60 dB, more than enough for most applications.

The inverter stage built around IC5:A provides an output that is out of phase from the normal output. As mentioned earlier, this is handy when using multiple mics, or wiring balanced outputs.

Phantom Powered Preamp

9215

Packing List

1	4049 CMOS Hex Inverting Buffer		
3	5532 Dual Low Noise Op-Amp		
1	7812 +12V Voltage Regulator		OPTIONAL CASE
1	7912 -12V Voltage Regulator		
4	.01uF Ceramic Disk Capacitor	1	9215 Case Top
1	.05uF " " "	1	9215 Case Bottom
1	220pF " " "	2	"A" Size Wood Ends
2	47pF " " "	4	#4 X 3/16" Aluminum Standoffs
2	1N4001 50V 1A Silicon Diode	8	#4 X 1/4" Self Tap Screws
5	1N4148 Signal Diode	4	4-40 X 1/2" Machine Screws
1	39V zener diode	6	4-40 X 1/4" Machine Screws
8	6.8V zener diode	10	#4 Nuts
1	Red LED	1	1/4" Rubber Grommet
4	1/4" O.C. Phone Jack		
2	470uF / 25V Electrolytic Capacitor		
4	4.7uF / 35v Tantalum Capacitor		
2	1uF / 16V Electrolytic Capacitor		
5	33uF / 16V " "		
3	47uF / 50V " "		
2	100k Potentiometer (w/nuts & washers)		
2	100 ohm 1/4w 5%		
8	10k " " "		
7	1k " " "		
1	270 " " "		
2	33k " " "		
4	1k ohm 1/4W 1%		
4	10k " " "		
4	6.81k " " "		
1	DPDT Slide Switch		
1	12VAC 100mA Wall Mount Transformer		
2	Panel Mount Female XLR conn.		
1	Circuit Board		
2	Push-on Knobs		
8	inches Twin-Ax		
10	inches Co-Ax		
54	inches #22 Stranded Wire		

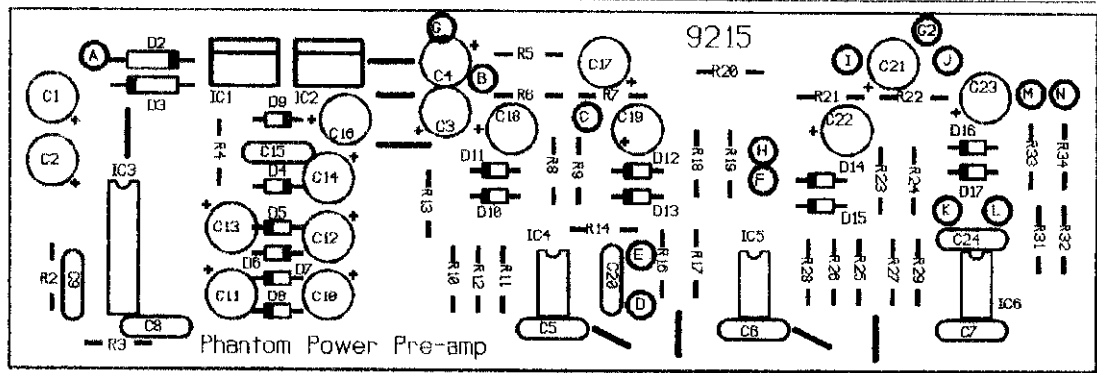


Fig 1a. Components mount on the circuit board as shown in this parts placement diagram.

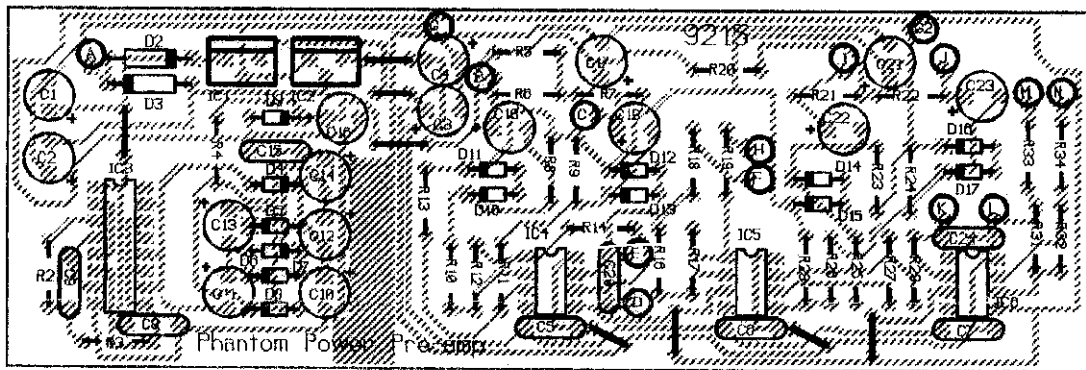


Fig 1b. This phantom view of the traces will be useful if you have to trace out the circuit.

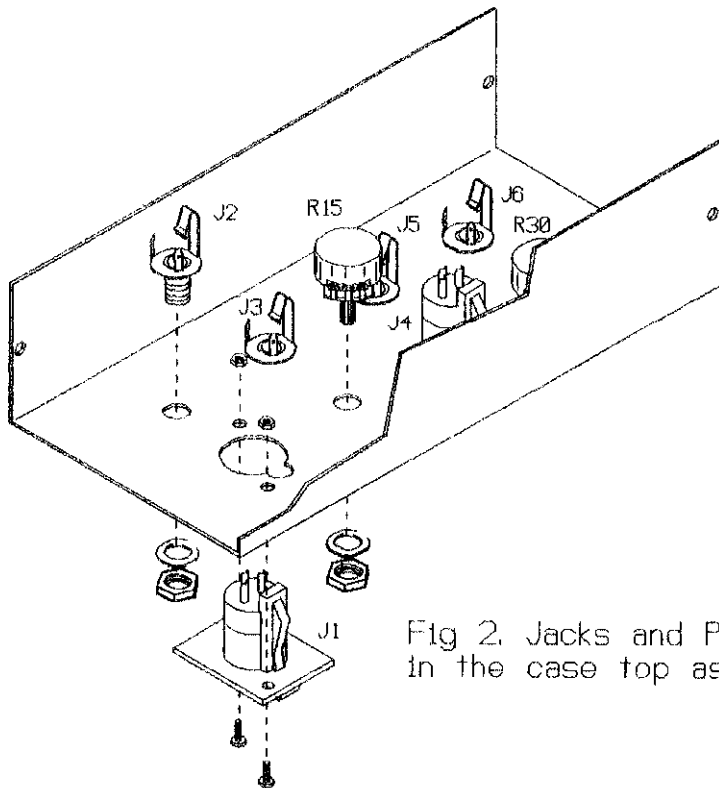


Fig 2. Jacks and Potentiometers mount in the case top as shown.

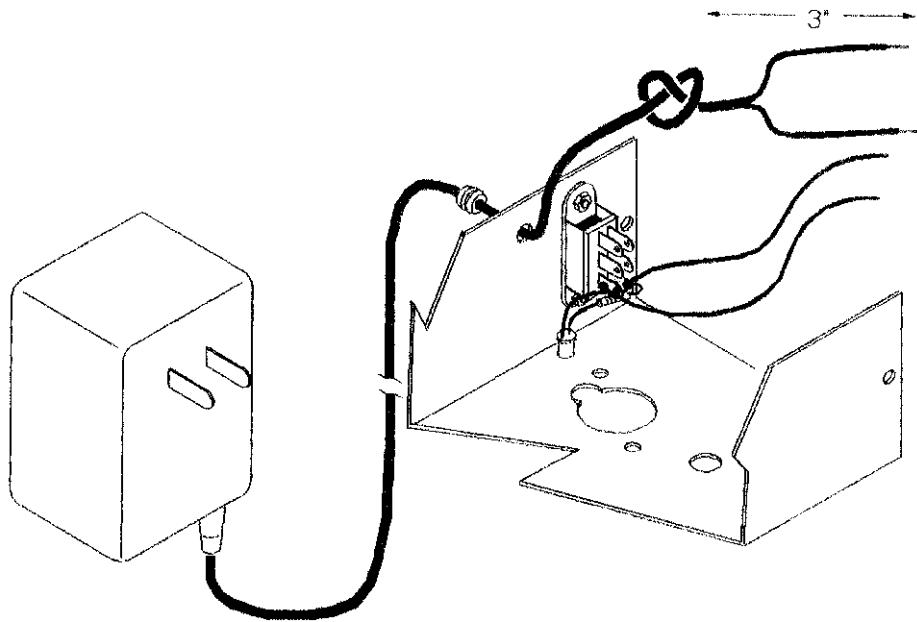


Fig 3. The power switch is mounted so that the LED protrudes through the hole in the case top. The wires from the power transformer are interchangeable.

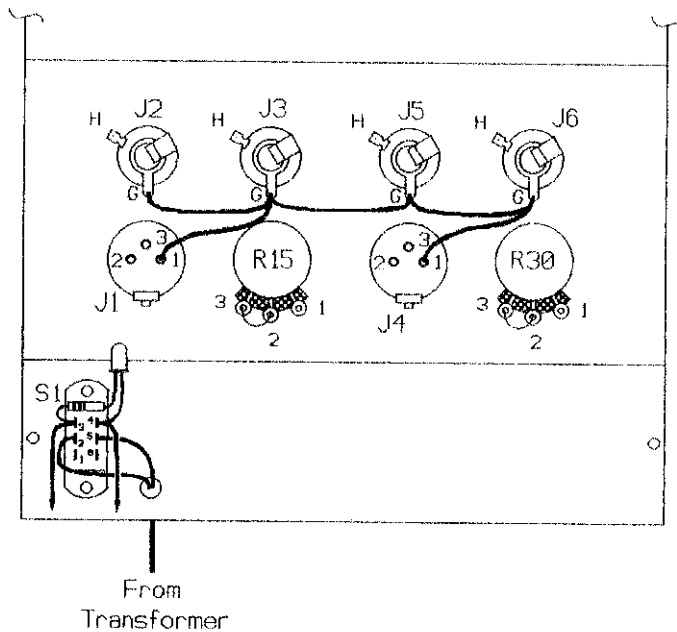


Fig 4. Preliminary wiring interconnects front panel controls and jacks. Leads clipped from resistors are used to jumper Lugs #2 and #3 of R15 and R30.

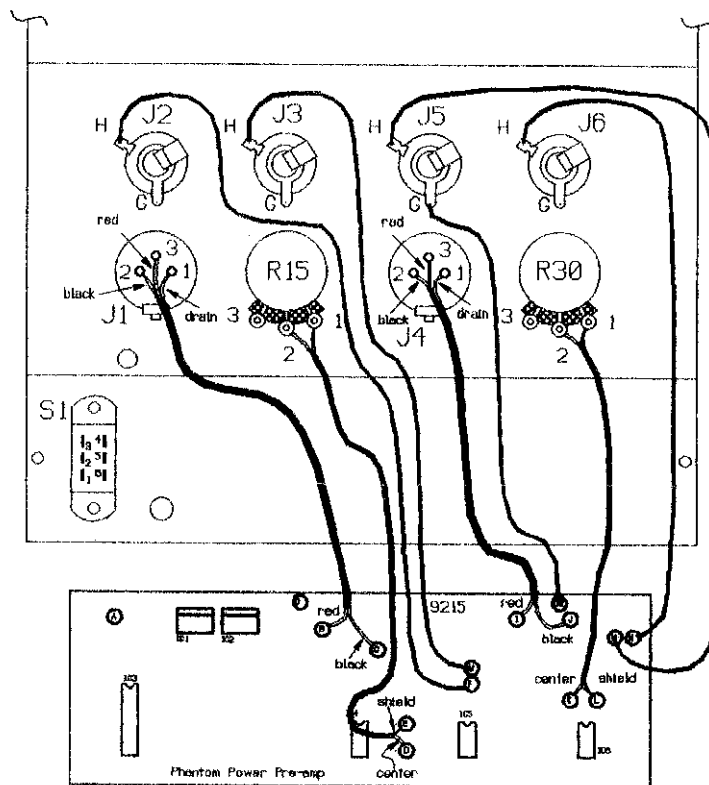


Fig 5. A combination of #22 stranded wire, twisted shielded pair and co-axial cable is used to make the connections between the circuit board and case top.

