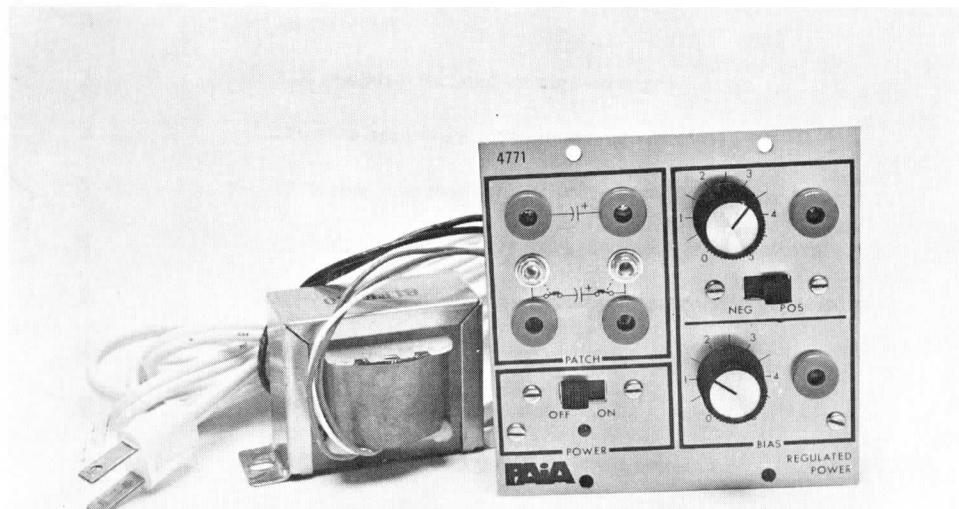


Regulated Power Supply



The 4771 Regulated Power Supply offers three voltage outputs, two of which are regulated for use with audio modules where excessive supply loading can cause hum, distortion, or possible decalibration. The positive and negative regulated supplies can be calibrated to provide outputs ranging from ± 5 volts to ± 15 volts, thus making this module a handy power supply for the test bench or your custom projects. The third power supply line provides unregulated +18 volts for powering switching and LED functions in PAIA synthesizers. Front panel features include two bias controls which can be calibrated, a patch bay which allows capacitive coupling of control voltages or interfacing audio and control voltages to each other.

Prior to beginning assembly, check the supplied parts against the following parts list.

QUANTITY	ITEM
1	4771 Printed Circuit Board
1	4771 Front Panel
2	Push-on knobs
1 bundle	4 X 12 inches - hookup wire
1	2N5129 or 2N3904
1	50K trimmer
3	1K trimmer
1	33K resistor (orange-orange-orange)
3	330 ohm resistors (orange-orange-brown)
1	4700 ohm resistor (yellow-violet-red)
4	10 mfd, 10 volt (or greater) electrolytic capacitors
2	1000 mfd., 20 volts (or greater) electrolytic capacitors
4	1N4001 or 1N4003 Rectifier diodes
2	THM 6043 clip-on heatsinks
1	LM340T-5 or 7805 positive 5 volt regulator
1	LM320T-5 or 7905 negative 5 volt regulator
1	24 volt center-tapped 1 Amp power transformer (NOTE: some units may be supplied with transformer #81FK010 which is labeled '12 Volt Secondary'. This is actually a 24 volt secondary transformer.)
6	Flea Clips
1	Line Cord
2	#6 X 1/2 inch self tap screws
4	#4 X 3/8 inch self tap screws
2	L brackets
6	#4-40 nuts
8	#4 internal star lockwashers

6 Tinnerman nuts

4 3/8 inch potentiometer mounting nuts

2 5K potentiometers

1 TIL-209 LED

2 SPDT slide switch

2 2.2 mfd., 10 volt (or greater) electrolytic capacitors

2 Closed-circuit mini-phone jacks

6 Red pin jacks

If you should find any of the parts missing, damaged, or otherwise unusable, contact PAIA Electronics Technical Services for replacement. Along with your request, we must have the packer number from the parts bag, and the order number which contained this kit.

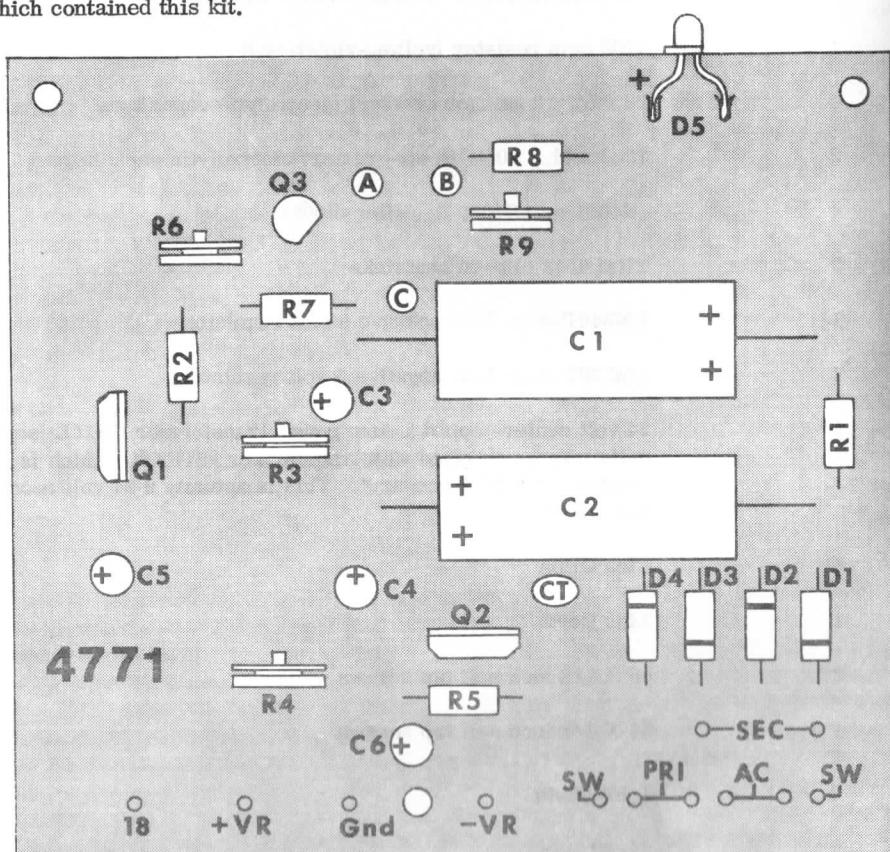


Figure 1 - Circuit board parts placement diagram

SOLDERING

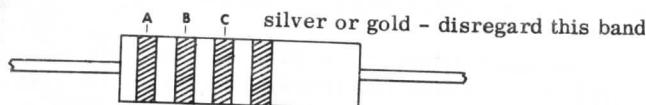
Use care when mounting all components. Use only rosin core solder. Use of acid core solder or paste fluxes will void the warranty of this kit. A proper solder joint has just enough solder to cover the round soldering pad and about 1/16 inch of the lead passing through it. There are two improper connections to beware of: Using too little solder will result in a connection which will appear 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 connection and flowing additional solder into the joint. If too much solder is used on a connection, there is a danger of the excess solder flowing between adjacent connections or circuit paths causing a short circuit. Unintentional bridges can be cleaned off by holding the board up-side down and flowing the excess solder off onto the tip of a clean, hot soldering iron.

Select a soldering IRON with a small tip and a power rating of not more than 35 watts. Soldering GUNS are completely unacceptable for assembling solid state equipment, as the large magnetic fields they generate can damage some components. Be sure to **KEEP YOUR SOLDERING IRON TIP CLEAN**. Before soldering a connection, wipe the tip on a damp sponge or rag. This will aid in heat transfer and prolong tip life.

CIRCUIT BOARD ASSEMBLY

() Prepare the circuit board for assembly by thoroughly cleaning the conductor side of the board with a scouring cleanser or steel wool pad. Rinse the board completely with clear water and allow to fully dry. A BRIGHT SHINY BOARD AIDS IN SUCCESSFUL SOLDERING!

Solder each of the fixed resistors in place following the parts placement designators printed on the circuit board and the assembly drawing figure 1. Note that the fixed resistors are non-polarized and may be mounted with either of their leads in either of the holes provided. Insert both leads in the mounting holes and push the resistor FULLY against the board. On the conductor side of the board, bend the leads outward to about a 45 degree angle to help hold the component in place. AFTER SOLDERING, clip off each lead flush with the solder joint.



DESIGNATION	VALUE	COLOR CODE A-B-C
() R1	4700 ohm	yellow-violet-red
() R2	330 ohm	orange-orange-brown
() R5	330 ohm	orange-orange-brown
() R7	330 ohm	orange-orange-brown
() R8	33K	orange-orange-orange

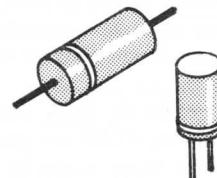
Install the trimmer potentiometers as shown.

DESIGNATION	VALUE
() R3	1K
() R4	1K
() R6	1K
() R9	50K



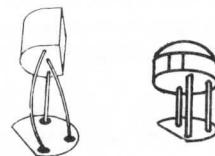
Install the electrolytic capacitors. Note that these components are polarized, and the component lead which has been designated positive "+" on the body of the part MUST be installed in the circuit board hole which is labeled "+". In the event that the capacitors supplied have their negative lead (-) marked, it is to go through the unmarked hole in the circuit board. Note that the specified operating voltage is a minimum acceptable rating. Capacitors supplied with specific kits may have a higher voltage rating than that specified, however they will not affect the performance of the kit.

DESIGNATION	VALUE
() C1	1000 mfd., 20 volt
() C2	1000 mfd., 20 volt
() C3	10 mfd., 10 volt
() C4	10 mfd., 10 volt
() C5	10 mfd., 10 volt
() C6	10 mfd., 10 volt



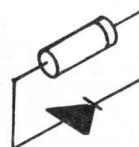
Install the transistor. The actual unit supplied may be in one of two different case styles. Mounting orientation is shown for each style. All semiconductors are heat sensitive and may be damaged if allowed to get too hot while soldering. To be on the safe side, heat sink each transistor lead during the soldering operation by grasping it with a pair of needle nose pliers at a point between the circuit board and the body of the component.

DESIGNATION	TYPE NO.
() Q3	2N5129 or 2N3904

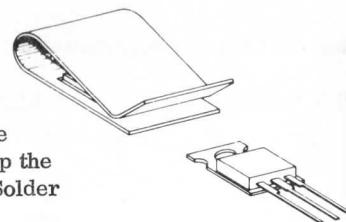


Install the diodes. Like transistors, diodes are heat sensitive so the heat sinking procedure should be repeated for diode installation. The physical orientation of the diodes is related to the circuit board graphics as shown in the drawing below.

DESIGNATION	TYPE NO.
() D1	1N4001 or 1N4003
() D2	1N4001 or 1N4003
() D3	1N4001 or 1N4003
() D4	1N4001 or 1N4003



At this point we will install the two voltage regulators. Note that the regulator cases are square plastic cases (which we will call the "front") mounted on a larger metal tab (which we will call the "back"). On each regulator, pull the center lead slightly towards the back of the regulator until the three leads fit the triangular lead layout of the circuit board. When properly installed, the back (metal tab) should align with the twin parallel lines of the circuit board graphics, while the body will be facing in the direction of the "angled" edges of the designator on the circuit board. Insert the regulator fully into the mounting holes until the broader mounting leads stop the regulator about 1/4 inch (6 mm) above the board. Solder in place.



DESIGNATION	DESCRIPTION
() Q1	LM340T-5, or 7805 positive regulator
() Q2	LM320T-5, or 7905 negative regulator

() After installation of the regulators, press the two THM 6043 heat sinks into place. The flat surface of the heat sink should contact the back of the regulator, and the curved section of the heat sink should press against the plastic body. NOTE that the heat sink is made with internal flanges to guide the sink over the regulator, and there will be a "snap" which locks the sink in place when it is fully installed.

Install the flea clips. When installing the clips, the "open" side of the "U" shape should be facing the adjacent edge of the circuit board. The clips fit tightly into their holes, so it may be necessary to grasp the top edge with needle nose pliers and slowly work the clip into the hole. Note that the clip should be pushed in as far as it will go, so the narrow half of the clip is passed completely through the mounting hole.

() Install the two flea clips at location D5.
 () Install four flea clips at the power output locations: +18, +VR, Gnd, and -VR.
 () Install the LED. Note that, like other diodes, LEDs are very sensitive to heat. During the installation procedure, follow the heat sinking technique used earlier for transistors and diodes. Also note that the LED is polarized. The cathode, or negative lead of the diode, will be shorter than the positive lead, and/or will be adjacent to a small "flattened" spot on the side of the LED package. Before installing the LED in the flea clips, it will be necessary to form the LED leads. VERY CAREFULLY work the LED leads apart and bend as shown in figure 1. While working with the LED, note that the small plastic body is very fragile and can easily break if you are not careful to bend only the lead instead of just pushing the lead to one side. Do not put excessive stress on the LED body. When properly installed, the LED leads will be flush with the top of the flea clips, and when looking straight down on the LED/circuit board assembly, the rear edge of the LED case should be even with the front edge of the circuit board. Carefully solder in place. Trim excess leads after soldering.

In the following steps, wires will be connected to the circuit board which will later connect to components on the front panel. At each step, prepare the wire by cutting it to the specified length and stripping 1/4 inch (6 mm) of the insulation from each end. "Tin" each end by twisting the exposed strands tightly together and melting a small amount of solder into the strands.

- () a 2 inch (5 cm) length to "A".
- () a 2-1/2 inch (6.4 cm) length to point "B".
- () a 4 inch (10.2 cm) length to "C".
- () a 4 inch (10.2 cm) length to one of the holes labeled "SW".
- () a 4 inch (10.2 cm) length to the remaining "SW" hole.

THIS COMPLETES ASSEMBLY OF THE 4771 CIRCUIT BOARD. Set aside and proceed with the front panel assembly.

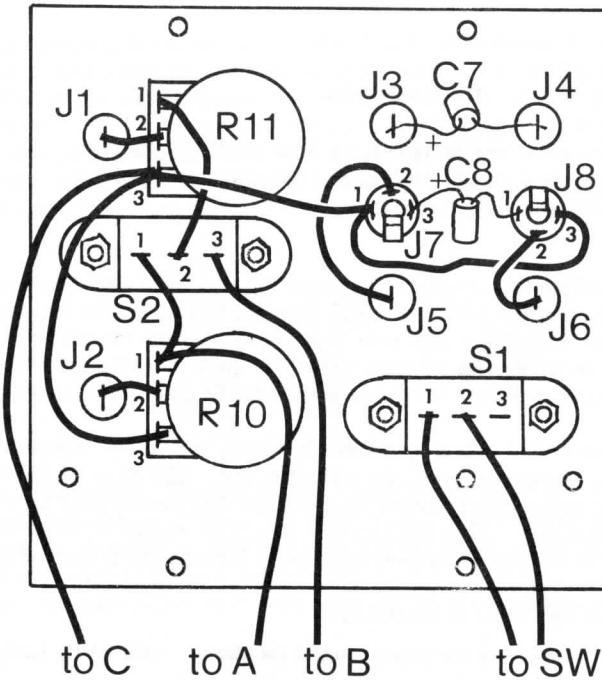


Figure 2 - Front panel parts installation & wiring diagram

Place the front panel face down on a soft rag during these operations to prevent marring the finish.

- () Place a red pin jack J1 in the hole provided as shown in figure 2. Fasten in place with a tinnerman nut as shown as shown in detail drawing figure 3. Press the tinnerman nut down firmly.
- () In a similar manner, mount red pin jacks J2 through J6.
- () Mount the closed circuit mini-phone jack, J7, on the front panel in the position shown in figure 2. Orient the jack as illustrated and fasten in place with the nut provided.
- () In a similar manner, mount mini-phone jack J8.
- () Mount one of the 5K potentiometers, R10, in the position shown in figure 2. Use two of the 3/8 inch nuts provided, one behone the panel as a spacer and

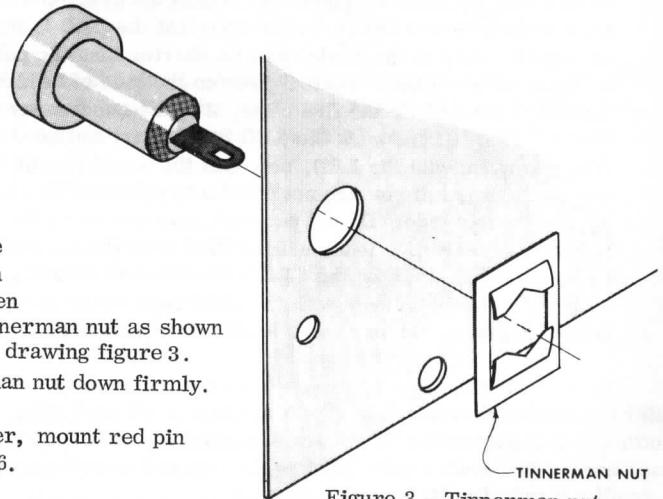


Figure 3 - Tinnerman nut mounting detail

the second one in front of the panel to hold the control in place. Adjust the rear nut so that none of the threaded shaft is exposed when the front nut is tightened down. This will allow the control knob, which will be mounted in a later step to be seated as close to the front panel as possible. Orient the control as shown in figure 2.

- () In a similar manner, mount the remaining 5K potentiometer, R11, as shown in figure 2.
- () Using two #4-40 X 1/4 inch machine screws, two #4-40 nuts, and two #4 lockwashers, mount slide switch S1 as shown in figure 2.
- () In a similar manner, mount slide switch S2 as shown.

In the following steps, wires will be used to interconnect various components on the front panel. In each case, cut the specified length of wire, and prepare the ends by stripping 1/4 inch (6 mm) of insulation from each end. Twist and tin the exposed strands. Solder the wires to the connection points only when the instruction says to do so.

- () a 2 inch (5 cm) length from lug 1 of R11 to lug 2 of S2. Solder both connections. See figure 2.
- () a 1-1/4 inch (3.2 cm) length from lug 1 of R10 to lug 1 of S2. Solder the connection at S2 only.
- () a 3/4 inch (1.9 cm) length from lug 2 of R11 to J1. Excess component lead clippings may be used for this short jumper if you wish. Solder both connections.
- () a 3/4 inch (1.9 cm) length from lug 2 of R10 to J2. As above, clipped leads leftover from component mounting may be used. Solder both connections.
- () a 2-1/2 inch (6.3 cm) length from lug 3 of R10 to lug 3 of R11. Solder only at R10.
- () a 2 inch (5 cm) length from lug 3 of R11 to lug 1 of J7. Do not solder either connection at this time.
- () a 2-1/2 inch (6.3 cm) length from lug 1 of J7 to lug 3 of J8. Solder both connections. There will be two wires soldered at J7 lug 1.
- () a 1-1/2 inch (3.8 cm) length from J7 lug 2 to J5. Solder both connections.
- () a 1-1/2 inch (3.8 cm) length from J8 lug 2 to J6. Solder both connections.
- () Select one of the 2.2 mfd. electrolytic capacitors to be used as C7. Cut each lead to a length of 3/4 inch (1.9 cm) as measured from the body of the capacitor. Install C7 between J3 and J4 such that the positive lead of C7 is connected to J3. Solder both connections.
- () Select the remaining 2.2 mfd. capacitor for use as C8. Cut both leads to a length of 3/8 inch (1 cm). Install C8 between lug 3 of J7 and lug 1 of J8 such that the positive lead is connected to lug 3 of J7. Solder both connections.

THIS COMPLETES PREPARATION OF THE FRONT PANEL SUBASSEMBLY.

The front panel may now be bolted to the circuit board as follows:

() Fasten the two "L" brackets to the front panel using one #4-40 X 1/4 inch machine screw, one lockwasher, and one #4-40 nut on each bracket. Note that the unthreaded hole is used in this operation as shown in figure 4. Do not fully tighten these screws at this time.

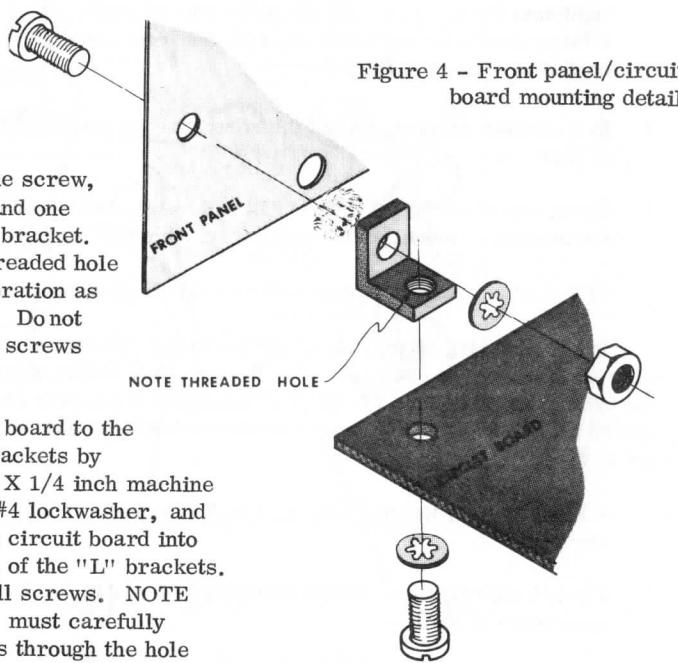


Figure 4 - Front panel/circuit board mounting detail

() Fasten the circuit board to the front panel "L" brackets by passing two #4-40 X 1/4 inch machine screws through a #4 lockwasher, and finally through the circuit board into the threaded holes of the "L" brackets. Securely tighten all screws. NOTE that the LED, D5, must carefully align with and pass through the hole in the front panel under S1.

MAKE THE FINAL FRONT PANEL CONNECTIONS FROM THE CIRCUIT BOARD AS FOLLOWS:

() Connect the wire coming from point "A" to lug 1 of R10. Solder two wires at this connection.

() Connect the wire coming from point "B" to lug 3 of S2. Solder this connection.

() Connect the wire coming from point "C" to lug 3 of R11. Solder three wires at this connection.

() Connect one wire from one of the points labeled "SW" to lug 1 of S1. Solder.

() Connect the remaining "SW" wire to lug 2 of S1. Solder.

() Rotate the two front panel control shafts fully counterclockwise as viewed from the front of the module.

() Once the control knobs are installed, they will be difficult to remove. Before installing the knobs, align the pointer with the front panel designation "0". Push the two knobs firmly onto the shafts.

This completes assembly of the modular section of the 4771. The remaining components will be mounted as the module is installed in its final position in the case.

INSTALLING THE 4771

The 4771 is designed to be mounted in either the 2720-8 Keyboard/Case or in the 4761 Wing Cabinets. In the '-8, the supply should occupy the two leftmost module spaces. In the 4761, the supply should occupy the upper left corner of the right hand case (in case you are using them in pairs). In either case (sic), the power transformer should be mounted prior to installation of the module. In order to ease installation of the transformer, it is recommended that all modules be removed from the case to allow access to the transformer mounting screws.

() Mount the transformer on the left wall of the case such that the transformer is as far as possible against the top of the case and the rear of the case. Do not allow any of the transformer to contact the power buss rods running along the rear of the case. Install the transformer using the two #6 X 1/2 inch self tap screws. To ease installation, drill or punch pilot holes for the screws.

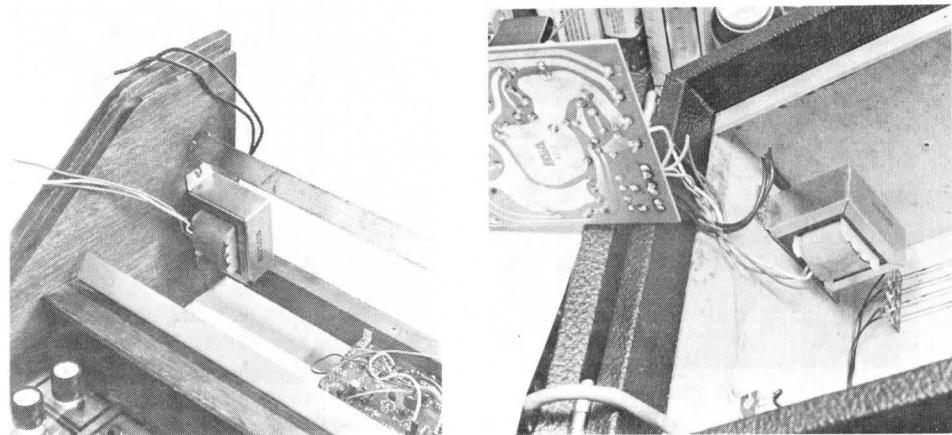


Figure 5 - Power transformer mounting detail

() Next we will install the line cord. For installation in the 2720-8 case, clamp the strain release (provided with the case kit) over the line cord at a point 5 inches (12.5 cm) from the raw end of the cord. Re-install the strain relief in the notch on the metal cover. Make sure the end of the line cord has been prepared by stripping 1/4 inch (6 mm) of insulation from the end of each wire. Tin the exposed, twisted strands by flowing a small amount of solder into the strands. The two wires of the line cord should also be separated for a length of two inches (5 cm) from the end of the cord.

For installation in a 4761 wing cabinet, clamp the strain relief over the line cord at a point 5 inches (12.5 cm) from the raw end of the cord. While squeezing the strain relief with a pair of pliers, insert the relief into the 4761 front panel power hole which will be farthest from the left case side. Insert the relief until it snaps into place. NOTE that the rubber grommets should still be installed in the power holes nearest the wing cabinets side, but that an AC line cord will not be passed through them as mentioned in the 4761 case manual. Rather, we recommend that a 12 inch length (30.5 cm)

of 4 conductor cable (Belden #8444 or similar) be used to jumper the four power buss lines from the right cabinet to the left cabinet via the grommeted holes. Alternatively, you could use Belden #8446 or similar 6 conductor cable to also jumper the two AC lines as outlined in the 4761 manual. This would allow for the possibility of requiring AC in the other cabinet at some future date, however, the 4771 supply is sufficient for powering two wing cabinets of modules so additional supplies should not be needed.

Solder the line cord ends to the three lug terminal strip of the 4761 as outlined in the 4761 manual. Cut and prepare a pair of 6 inch (15.2 cm) lengths of wire. Solder one end of each of these wires to the two power lugs on the three lug terminal strip. These wires will be used to supply AC up to the 4771 circuit board.

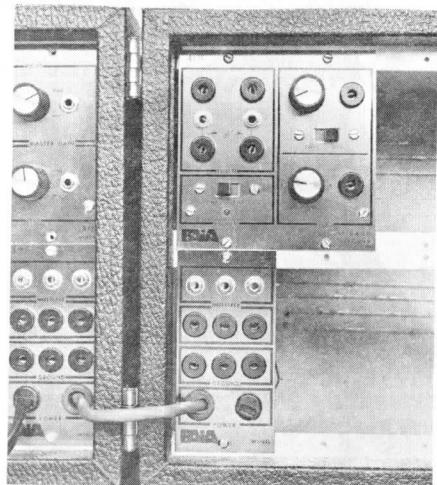
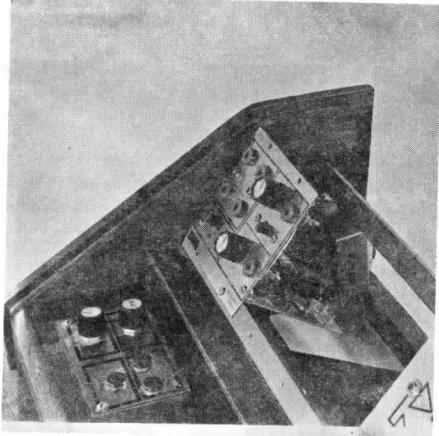


Figure 6 - Module installation detail

- () We are now ready to install the module. Connect the two conductors of the line cord (2720-8) or the two AC supply wires (4761) to the two holes labeled "AC" on the rear of the 4771. Solder both connections.
- () Connect the two black primary leads of the power transformer to the two holes labeled "PRF". Solder both connections.
- () Connect the two red secondary leads of the transformer to the holes labeled "SEC". Solder two wires.
- () Connect the white or striped transformer lead to the hole labeled "CT". Solder.
- () Cut and prepare four wires to connect the four power output terminals of the 4771 to the power buss rods at the rear of the case. Note that the +VR terminal should connect to the +9 volt buss rod, and the -VR terminal goes to the -9 volt buss rod. The +18 and ground terminals connect to the similarly labeled buss rods.

After calibration, the module can be mounted to the metal mounting strips with the four #4 X 3/8 inch self tap screws provided.

TESTING AND CALIBRATION

To test the 4771 Power Supply you will need a voltmeter or 'scope capable of measuring 20 volts DC. First make sure the AC wiring at the rear of the circuit board is clear of any shorts, module mounting brackets, etc. Plug the line cord into a wall outlet. Apply power by sliding the front panel power switch to the right. The LED indicator should glow. Using the test instrument, confirm that there is approximately +18 volts at the terminal so marked at the rear of the 4771.

Measure the voltage at the terminal labeled +VR. While monitoring this voltage, rotate R3 and note that this output is fully variable from +5 volts to +18 volts. Set this trimmer to provide +9 volts at the output and proceed.

Measure the voltage at the -VR output. If you are using a voltmeter, remember to reverse the polarity of your test leads. As before, rotate R4 and confirm that the -VR will vary from -5 volts to -18 volts. Set R4 to provide -9 volts at the output.

Set the front panel bias select switch, S2, to the positive setting. Measure the voltage at the upper bias output jack, J1. As the front panel control is rotated clockwise, the bias voltage should increase. When the control is at maximum, adjust trimmer R6 to provide +5 volts at the output jack. Move your test lead to the lower bias output jack and confirm that it also puts out 0 to +5 volts.

Return the test lead to the upper jack and switch the bias select switch to the negative position. With the upper bias control at maximum, adjust trimmer R9 to provide -5 volts at the upper bias jack. Move the test lead to the lower bias supply and confirm that it still produces a 0 to +5 volt bias output regardless of the polarity selection of the upper bias supply.

Note that the bias controls on this power supply are calibrated and marked in 1/2 volt increments. While these markings may be slightly "off" from the actual voltage at the output, they will still provide a means of logging and repeating exact control settings for patch reproduction.

The small patch bay area at the left of the panel provides two sets of control voltage pin jacks which are capacitively coupled. These jacks are useful for VCO voltage pin jacks which are capacitively coupled. These jacks are useful for VCO techniques where average DC levels of control waveforms can cause detuning of the VCOs. Additionally, the bottom pair of pin jacks is provided with a pair of "interrupt" mini-phone jacks. Whenever a patch cord is inserted in either mini-phone jack, the two pin jacks are disconnected from each other and are converted to two sets of control-to-audio converters or vice-versa. These jacks are useful when you wish to use an audio signal as a modulating or control signal for another module. They will also allow control signals to be processed through audio modules, although this technique will be used less often.

DESIGN ANALYSIS

The circuitry employed in the 4771 is standard regulated supply design. The 24 volt RMS secondary of T1 is rectified by the bridge consisting of D1 through D4. The resultant bipolar 18 volts is dropped across primary filters C1 and C2. LED D5 and associated current limiter R1 provide positive indication of applied power. The +18 volt supply is fed out to supply the switching, LEDs, and other circuits which require higher power or which could cause transients in audio circuits.

The positive 18 volt source is also applied to the positive regulator Q1. The voltage between the output pin and reference pin of Q1 will always be 5 volts. But, by using the variable resistor network consisting of R2 and R3, the reference pin can be re-referenced at a point higher than ground to provide a regulated supply with a variable output. C3 provides stabilization for the new reference voltage and

helps provide better transient response. C5 across the output helps improve stability as the voltage is fed to the external circuitry.

The negative regulator circuitry is functionally identical to the positive section just described.

The positive regulated voltage is fed to divider R6/R7 and emitter follower Q3 to provide a trimmable source of 5 volts for the variable bias controls, R10 and R11. For the negative bias supply, the variable bias control is actually the bottom half of the voltage divider which is driven with the negative regulated voltage. Trimmer R9 and paralleled R8 are used to trim the negative bias output to - 5 volts.

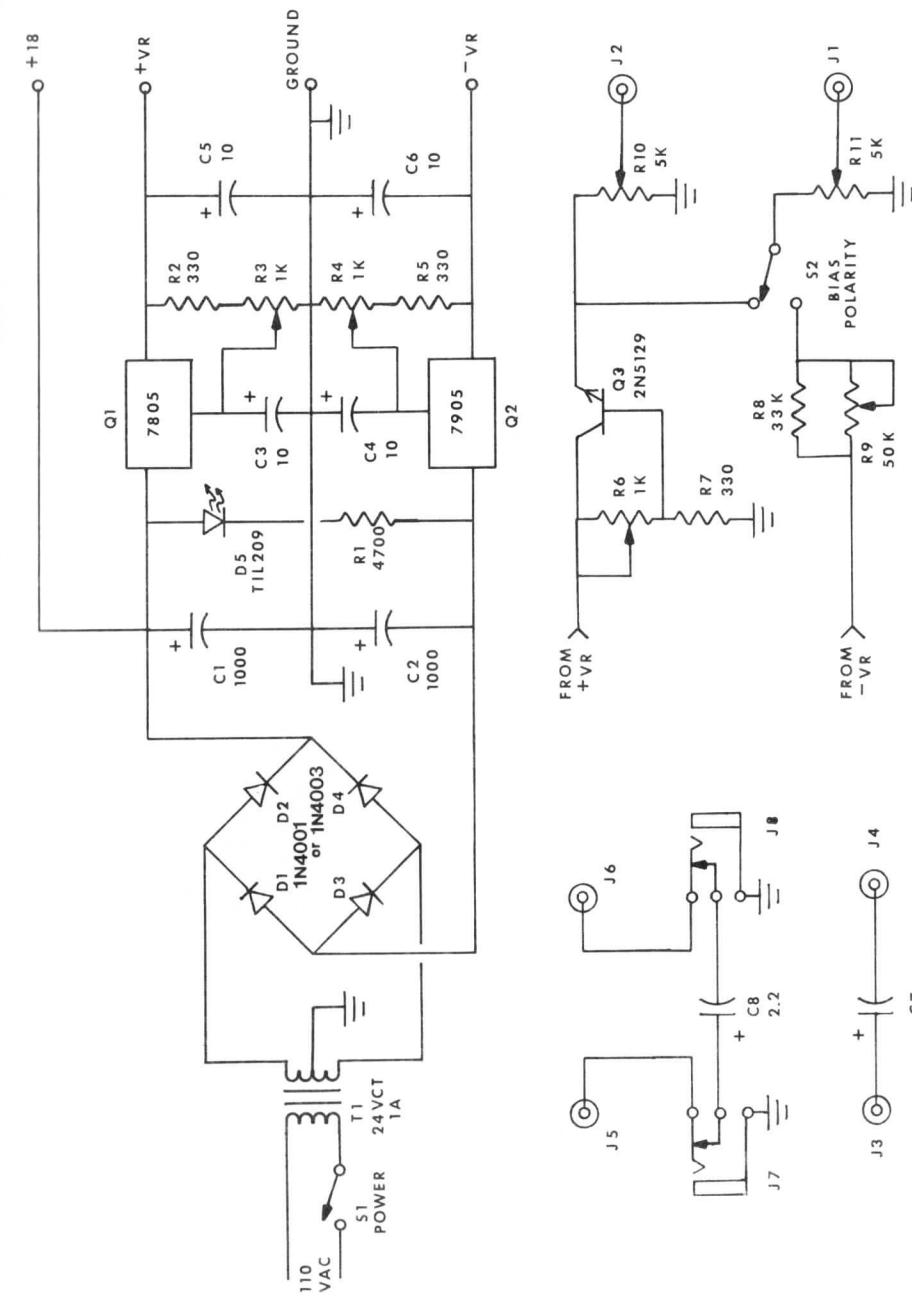


Figure 7 - Schematic diagram