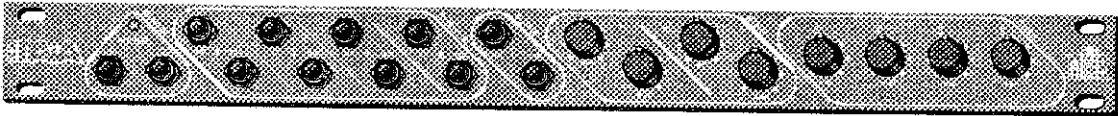


PAiA SubMixer

Model 9402
Assembly and Using Manual



Sometimes you need a few more inputs than the average compact mixer offers. Moving up to a larger board may be an optimal solution that provides extensive EQ and routing features. Unfortunately, that's also an expensive solution and it may be overkill. If all you need is a few more line inputs, the SubMixer could be the perfect solution.

The PAiA SubMixer has four stereo inputs, two pannable mono inputs and one stereo output. It is perfect as a dedicated effects-return mixer, a stand-alone "disco mixer," or for adding a few extra inputs to your existing console.

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ASSEMBLING THE SubMixer

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 SubMixer 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.

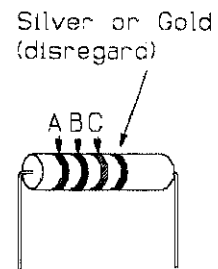
Use only rosin core solder (acid core solder is for plumbing, not electronics work). A proper solder joint has just enough solder to cover the soldering pad and about 1/16-inch of lead passing through it. There are two improper connections to beware of: Using too little solder will sometimes result in 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.

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 circuit board holes. 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 jumpers.

DESIGNATION	VALUE	COLOR CODE	A-B-C
<i>listed below:</i>	15k	brown-green-orange	
() R9	() R10	() R11	() R12
() R13	() R14	() R15	() R16
<i>listed below:</i>	22k	red-red-orange	
() R17	() R18	() R19	() R20
() R21	() R22	() R23	() R24
() R25	82k	grey-red-orange	
() R26	47 ohm	yellow-violet-black	
() R27	82k	grey-red-orange	
() R28	47 ohm	yellow-violet-black	
() R29	100 ohm	brown-black-brown	
() R30	100 ohm	brown-black-brown	
() R31	2200 ohm	red-red-red	



DISK CAPACITOR

Only one of the capacitors used in the SubMixer is a Ceramic Disk type. This part is nonpolarized and either lead can go in either of the holes in the circuit board. The leads are already parallel to each other but still may need to be bent slightly to match the spacing of the circuit board holes. Like the resistors, insert 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. Solder each part in place as it's installed and clip its leads off flush with the solder joint.

Disk



DESIGNATION	VALUE	MARKING
() C3	.01uF	103

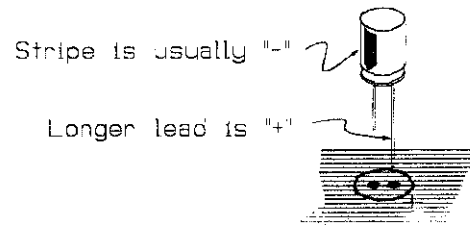
ELECTROLYTIC CAPACITORS

Capacitors C1 and C2 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.

Solder each part in place as it is installed. Clip leads off flush with the solder joint.



DESIGNATION	VALUE
() C1	100 uF / 16V
() C2	100 uF / 16V

WIRE JUMPER

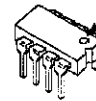
- () Using an excess lead clipped from the resistors, form and install the circuit board jumper designated by the bold line above IC1. Solder and clip flush with the solder joints.

INTEGRATED CIRCUIT

Of all the parts, the IC should be treated with the most respect. In particular, they may be destroyed by discharges of static electricity. This is highly unlikely with the 5532 OpAmp used in the SubMixer, but it is still good practice to handle this part 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).

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

Note pin 1



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 the IC in place 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 remelting the solder joint at first one corner, then the other. Finally, solder the remaining connections.

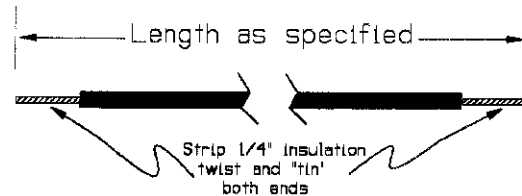
DESIGNATION	PART NO.	DESCRIPTION
() IC1	5532	Dual Low Noise OpAmp

“FLYING” WIRES

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

In the following steps, wires will be soldered to the SubMixer board which in later steps will be connected to the front panel controls and phone jacks. At each step, cut a piece of wire to the specified length and strip 1/4" of 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.

Notice that there will be some circuit board points that will not have wires connected to them until later.



Solder each connection as it is made and clip any excess wire from the solder side of the board.

PC POINT	WIRE LENGTH	PC POINT	WIRE LENGTH
() "A"	4-3/4"	() "K"	3-1/2"
() "B"	5-1/2"	() "L"	3"
() "C"	6-1/2"	() "M"	2-1/2"
() "D"	3"	() "N"	2-3/4"
() "E"	3-3/4"	() "O"	2-1/4"
() "F"	4-3/4"	() "P"	7-3/4"
() "H"	4-3/4"	() "R"	8"
() "I"	4-1/4"	() "S"	15-3/4"
() "J"	4"	() "T"	15"
		() "SG"	7-1/2"

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 panel available from PAiA, you will be installing these parts as shown in Fig 2. Note that this figure shows the panel from the rear.

- () Using the flat washers and nuts provided, mount the eight potentiometers as shown in Fig 2. Note that single section 10k ohm pots are used for R1-4. Dual section 100k ohms pots are used for R5-R8. Orient the lugs of the pots as shown in Fig 3 and fully tighten the nuts to secure these parts.

- () Using the flat washers and nuts provided with them, mount the 12 Open Circuit jacks J1-J12 as shown in Fig 2. Orient as shown in Fig 3 and tighten the hardware.

PANEL PRE-WIRING

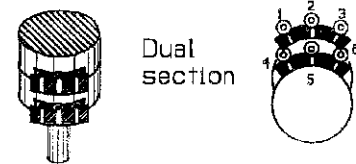
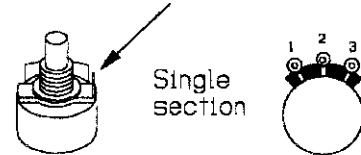
The dual section potentiometers have some wiring between the lugs. All of these pots (R4-R8) are wired in the same way.

- () On each of the dual section pots use a resistor lead clipping to connect Lug #4 to Lug #1. Solder the connection at Lug #4. DO NOT SOLDER Lug #1.

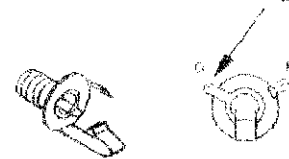
Stranded wire is used for the remaining connections between front panel jacks and controls as shown in Fig 3. At each step prepare a wire of the length specified by stripping 1/4" of insulation from the end and twisting and tinning the exposed strands.

Individual solder lugs are identified by part number and lug number. For example, R8-3 means the lug labeled "3" of the Potentiometer R8 as shown in the illustrations.

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



The ground ("G") lug attaches to the threaded bushing.



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. Sequence is by columns.

LENGTH	FROM	TO	LENGTH	FROM	TO
() 10-1/2"	R8-3 (s1)	J10-H (s1)	() 3"	R4-2 (s2)	R1-1 (ns)
() 11-1/2"	R8-6 (s1)	J9-H (s1)	() 3"	R1-1 (s2)	R2-2 (ns)
() 11"	R7-3 (s1)	J8-H (s1)	() clipping	R2-2 (ns)	J12-G (ns)
() 11-1/2"	R7-6 (s1)	J7-H (s1)	() 2"	J12-G (ns)	J10-G (ns)
() 11-1/2"	R6-3 (s1)	J6-H (s1)	() 2"	J10-G (s2)	J8-G (ns)
() 11-1/2"	R6-6 (s1)	J5-H (s1)	() 2"	J8-G (s2)	J6-G (ns)
() 11-1/2"	R5-3 (s1)	J4-H (s1)	() 2"	J6-G (s2)	J4-G (ns)
() 11-1/2"	R5-6 (s1)	J3-H (s1)	() 2"	J4-G (s2)	J2-G (s1)
() 11-1/2"	R3-3 (s1)	J2-H (s1)	() 3"	J12-G (s3)	J11-G (ns)
() 10-1/2"	R1-3 (s1)	J1-H (s1)	() 2"	J11-G (s2)	J9-G (ns)
() 1-3/4"	R8-1 (s2)	R7-1 (ns)	() 2"	J9-G (s2)	J7-G (ns)
() 1-3/4"	R7-1 (s3)	R6-1 (ns)	() 2"	J7-G (s2)	J5-G (ns)
() 1-3/4"	R6-1 (s3)	R5-1 (ns)	() 2"	J5-G (s2)	J3-G (ns)
() 2"	R5-1 (s3)	R3-1 (ns)	() 1-3/4"	J3-G (s2)	J1-G (s1)
() 3"	R3-1 (s2)	R4-2 (ns)			

The circuit board should now be mounted to the rear of the front panel as shown in Fig 2.

- () Using the (2) "L" brackets, (2) #4 nuts and (4) 4-40 X 1/4" machine screws provided, attach the partially wired circuit board to the rear of the rack panel. Notice that the "L" brackets have both threaded and unthreaded holes. Use the unthreaded holes and machine nuts to attach the bracket to the circuit board and the threaded holes to attach the bracket to the panel.

Wiring of the SubMixer continues by connecting the wires previously soldered to the circuit board to the pots and jacks as detailed in Fig 4. Notice that previous wiring has been eliminated from this drawing to give a better view of the present operations.

ORIGIN	TO	ORIGIN	TO
() "A"	R1-2 (s1)	() "J"	R6-2 (s1)
() "B"	R2-3 (s1)	() "K"	R6-5 (s1)
() "C"	R2-1 (s1)	() "L"	R7-2 (s1)
() "D"	R3-2 (s1)	() "M"	R7-5 (s1)
() "E"	R4-3 (s1)	() "N"	R8-2 (s1)
() "F"	R4-1 (s1)	() "O"	R8-5 (s1)
() "H"	R5-2 (s1)	() "P"	J11-H (s1)
() "I"	R5-5 (s1)	() "R"	J12-H (s1)
		() "SG"	R2-2 (s3)

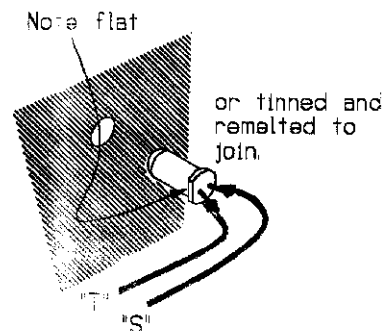
The final two connections from the Circuit Board to the Front Panel solder directly to the leads of the LED. Begin by trimming the two LED leads off to a length of 3/8". The wire and LED lead may be twisted together before soldering or simply soldered side-by-side.



The leads may be twisted before soldering.

() Solder the wire originating at circuit board point "T" to the cathode lead of D1 (the lead adjacent to the polarizing flat in the collar of the LED case).

() Solder the wire originating at circuit board point "S" to the anode lead of D1 (the unconnected lead).



Push the LED into place in the front panel hole and secure it with your favorite adhesive. Finally, install the knobs.

THIS COMPLETES THE ELECTRONIC ASSEMBLY of the SubMixer. Before hooking up a power supply and testing the unit, take a break then come back and check your work completely. Make sure that all polarized parts are mounted properly, that the leads from the front panel controls and jacks are correct and take a critical look at all your soldering.

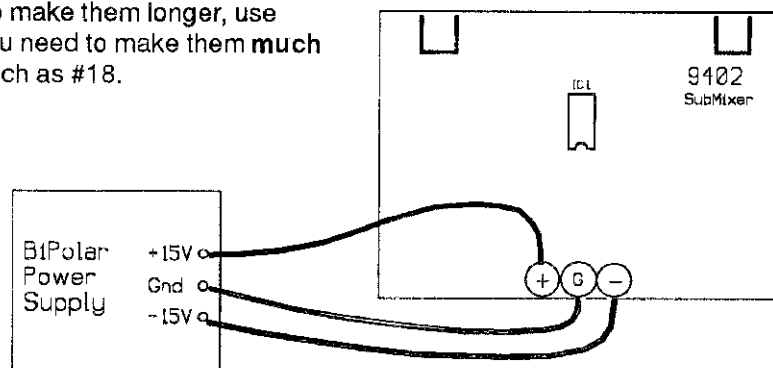
POWER HOOK-UP

When you've checked your work thoroughly and feel confident that there are no errors in the wiring or solder bridges on the board, it's time to apply power for the first time.

The SubMixer requires a bi-polar power supply with a voltage rating of $\pm 15\text{v}$. Each side of this supply should be able to provide at least 30 mA. of current. If you have elected to use the PAIA BPS-15, you can power a SubMixer and several other modules as well with no problems. The BPS-15 should be assembled following the instructions supplied with it.

Most power supply transformers (such as that used in the BPS-15) will be well designed with a shield to contain the magnetic field they generate. But it is still a good idea to mount the power supply some distance from the SubMixer so as to eliminate completely the possibility of hum pickup. A distance of about 12 inches between the transformer and the closest point on the circuit board should be sufficient. More is better, up to a point.

Power supply connections are made to the SubMixer at the circuit board points labeled "+" (+15V), "G" (ground) and "-" (-15V). Wire lengths for these connections are not given since exact lengths will depend on the specifics of where and how the supply and compressor are mounted. 2 feet of #22 stranded wire has been provided for these connections. If you need to make them longer, use this same kind of wire. If you need to make them **much** longer, use a larger wire such as #18.

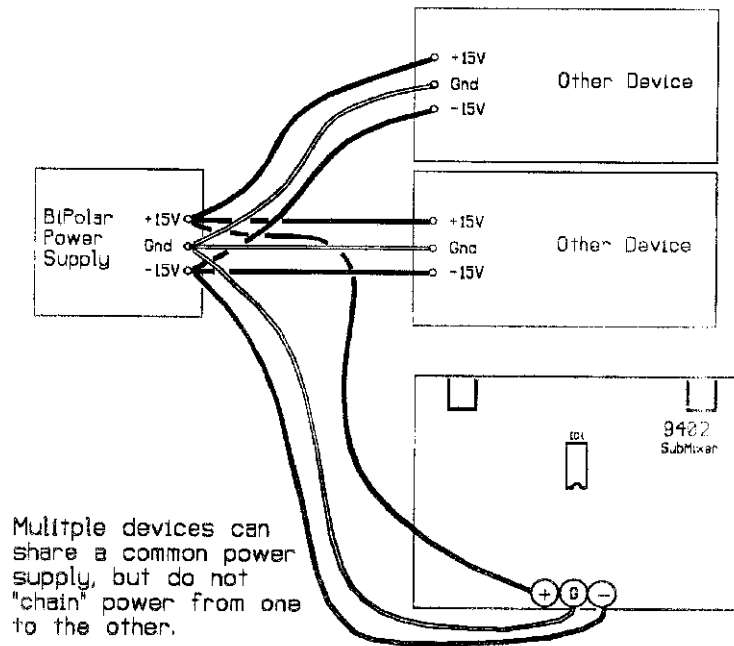


If you are powering multiple devices from a single power supply, they should simply be wired in parallel; that is, the +15V input on each unit will connect to the +15V output of the power supply, the -15V input to the supply's -15V output and ground to the supply ground.

While power to these units is wired in parallel, you should avoid "chaining" these connections. In other words, don't make the power supply connections to one board and then power the next board by taking power from the first. Instead, run separate wires to each unit from the power supply as shown below.

CAREFULLY CHECK THE POWER CONNECTIONS BEFORE ACTUALLY TURNING THE POWER ON. Backwards connections here can be disastrous. When you are confident that everything is OK, turn on the power and observe that the POWER LED D1 lights. If it does not, immediately turn off the power and find out why.

When the LED lights, place your finger on the IC to monitor its temperature. If it gets hot rapidly, immediately disconnect the power and find out why (assuming that the power connections are correct, a solder bridge is the most likely problem)



TESTING IT

With the all-important "smoke test" out of the way, test the individual inputs and outputs of the SubMixer. Patch the left and right outputs of the SubMixer into the stereo inputs of an amplifier or mixer. Plug a high level mono source into the jack for input 1 and observe that the channel 1 level control adjusts the signal level of the output. Observe that rotating the channel 1 pan pot between left and right pans the source correspondingly.

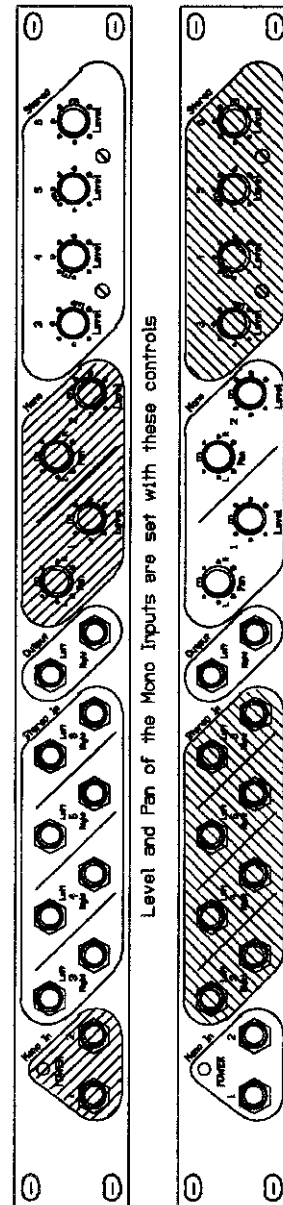
In the same manner, verify that channel 2's level and pan pots are functioning properly. In these tests, if there is no signal present at either output, check the obvious, is there really signal going in? Is the power on? Is the amplifier on and speakers connected? If problems persist, the main suspect is the IC, particularly if there is no output from the following tests either.

If one output is OK, but the other dead, check the wiring peculiar to that output. If there is no left output, for example, check the wiring to the left output jack J11. Maybe one of the two amplifiers in IC1 is bad, but this is very rare; usually an IC fails completely.

If one of inputs doesn't work, check the wiring from the jack to it's level control. If one side of the pan pot is wacko check the wiring from the ends of the pan pot to the circuit board and the resistors that these wires connect to.

Plug a stereo source into the left and right inputs of channel 3 and observe that the output maintains the balance of the input and that the channel 3 level control sets the level of the outputs. Similarly check stereo inputs 4, 5 and 6

If things are hummy and buzzy, it may be the filter capacitors C1 and/or C2. Maybe bad, maybe backwards. If things are generally quiet but one or more inputs hum, check the wiring between the ground lugs of the jacks and circuit board as well as the ground line that runs between the pots.



USING the SubMixer

by: Jules Ryckebusch

The SubMixer is simple, but useful, offering no fancy bells or whistles. I use it to bring multiple stereo effects returns into my main mixing board. I also use one of the mono inputs to return a delay line. This lets me pan the delay and still use only two channels on the main console, controlling the master effects return level with just two faders. In addition to providing inputs for sound modules and effects returns, the SubMixer can be used as a small deejay mixer for multiple playback sources. With two CD players and the SubMixer, you can make some serious party tapes, with actual fade-ins for each song. Add a microphone preamp, such as the PAiA Phantom-Power Preamp; and you're in business.

SUMMARY

There is one thing you should be aware of: The SubMixer inverts the phase of the incoming audio signal. This poses no problem if you use the unit for extra inputs or deejay applications. In addition it's no problem for effects returns if you run all your effects fully wet (which you should in most cases). If not, you will notice cancellation in the dry signal as you bring up the level of the effects. Because the 5532 is such a quiet op-amp, you can expect better than 96 dB S/N from the mixer. And direct, rather than capacitive, coupling between stages enhances sonic transparency. You can easily add more mono or stereo inputs: just duplicate the existing circuitry up to the summing amplifier. However, keep at mind that each additional input adds a little more noise to the signal.

HOW IT WORKS

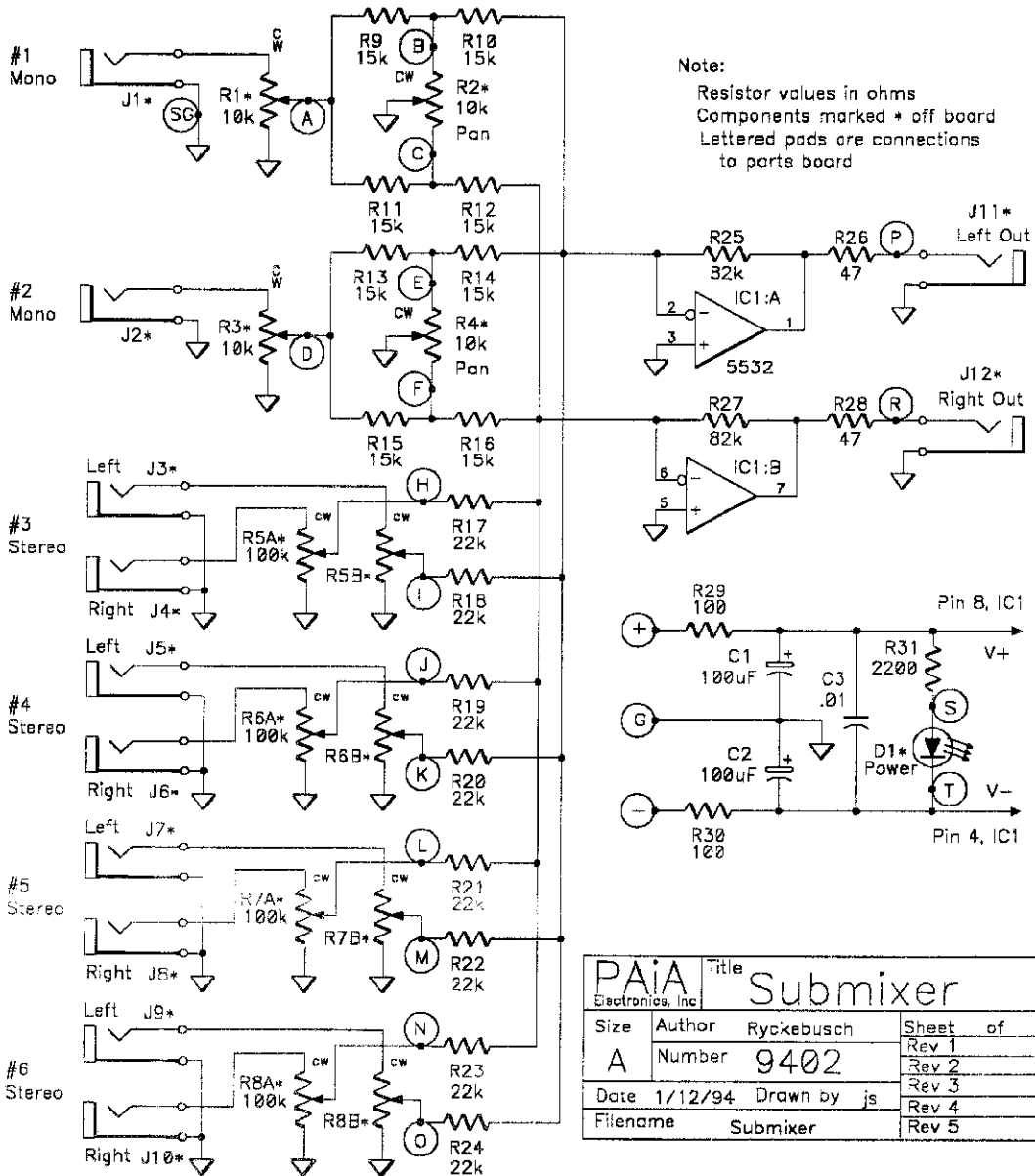
The heart of the circuit is an NE5532 high-performance, dual operational amplifier (op amp), which functions as a summing amplifier for all the inputs. In the schematic on the facing page, notice that there are two types of inputs: mono and stereo.

The mono inputs are typified by input 1. The signal enters through a 1/4-inch phone jack (J1) and heads to a 10k pot (R1) that serves as a simple, adjustable voltage divider to set the input level. The signal then proceeds to a resistor network formed by four 15k ohm resistors (R9-R12) and another 10k ohm pot (R2). This is called a constant power pan circuit. When the pan pot is hard right or left, it completely grounds the signal on the opposite side, preventing any output from that side. Centering the pan pot attenuates each channel by about 3 dB. (half power). However, the apparent sound level remains constant because there are two channels. The result is a smooth transition as the signal is panned left or right.

Input 3 is identical to the other stereo inputs. The left and right signals enter two 1/4 inch phone jacks (J3 and J4) and connect to the high sides of a 100k, dual-section potentiometer (R5). This pot adjusts the level of the incoming audio. The wipers of both sections connect to the right and left summing buses through R17 and R18, respectively.

A value of 82k for the summing amp feedback resistors (R25 and R27) was selected to bring the signal back to the nominal input level. The 47 ohm output resistors (R26 and R28) protect the op amps in case the outputs are accidentally shorted to ground.

The output from the power supply is filtered by R29/C1 and R30/C2, while C3 provides a high-frequency bypass to compensate for the increased impedance of electrolytic capacitors C1 and C2 at high frequencies. C3 should be placed as close as possible to the power pins (4 and 8) of IC1. R31 limits the current to the LED (D1), which indicates that the power is on.



PAIA Electronics, Inc.		Title Submixer	
Size A	Author Ryckebusch	Sheet Number 9402	of Rev 1
			Rev 2
			Rev 3
Date 1/12/94	Drawn by js		Rev 4
Filename Submixer			Rev 5

SubMixer
 Packing List
 94.7.13

1	.01uF Ceramic Disk Capacitor	C3	8	Set Screw Knobs
2	100uF / 16V Electrolytic Capacitor	C1,C2	3	10' lengths #22 Stranded Wire
4	100k Dual Section Potentiometer	R5*-R8*	4	4-40 X 1/4" Machine Screws
4	10k Potentiometers	R1*-R4*	2	#4 Machine Nuts
			2	"L" Brackets
2	100 ohm	R29,R30	1	9402 Printed Circuit Board
8	15k	R9-R16		
1	2200	R31		
8	22k	R17-R24		<i>parts marked * mount on front panel</i>
2	47	R26,R28		
2	82k	R25,R27		
1	5532	IC1		
1	Red LED	D1*		
12	1/4" O.C. Phone Jacks	J1*-J12*		

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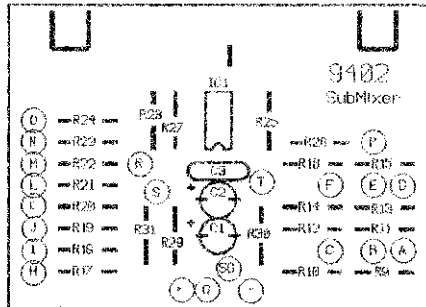


Fig 1a Components mount on the circuit board in the locations shown in this parts placement drawing

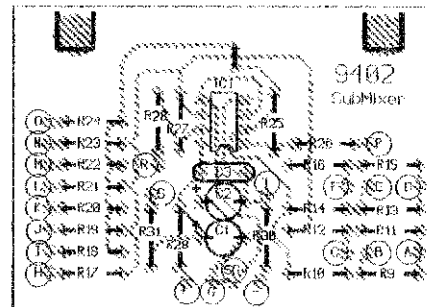


Fig 1b. This drawing with phantom conductors may be useful if you must trace out the circuit.

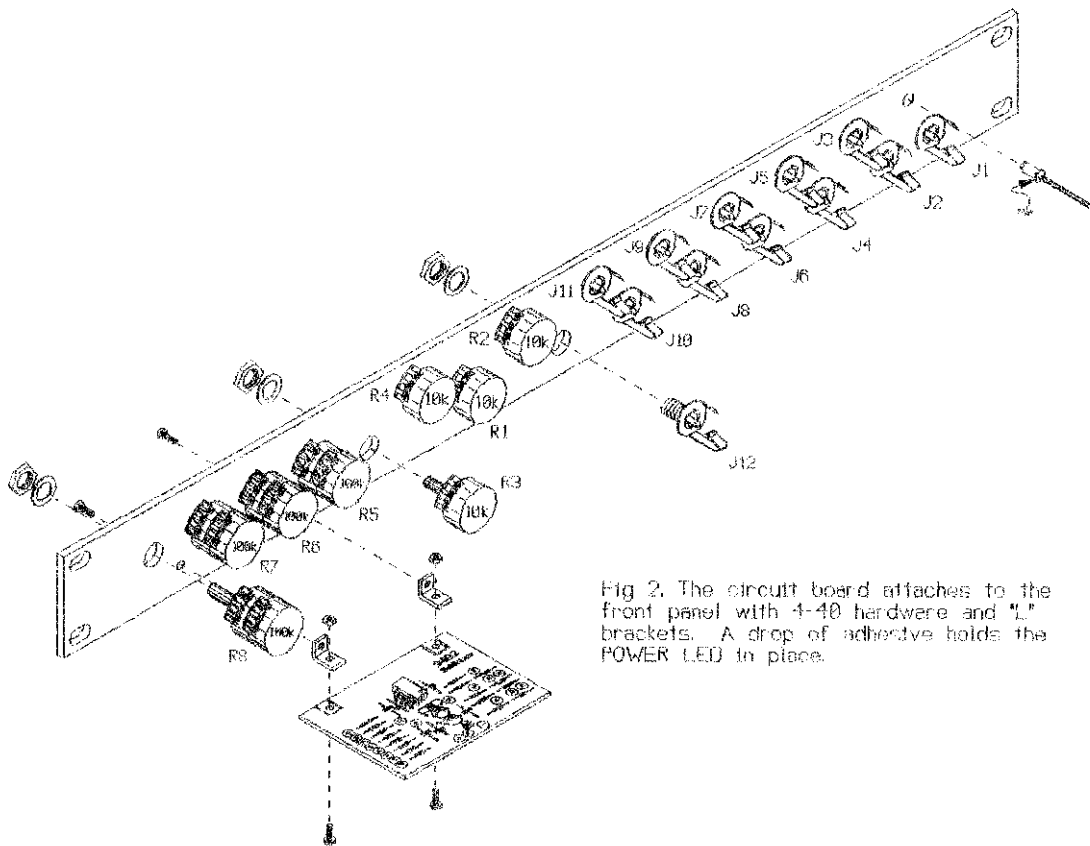


Fig 2. The circuit board attaches to the front panel with 4-40 hardware and "L" brackets. A drop of adhesive holds the POWER LED in place.

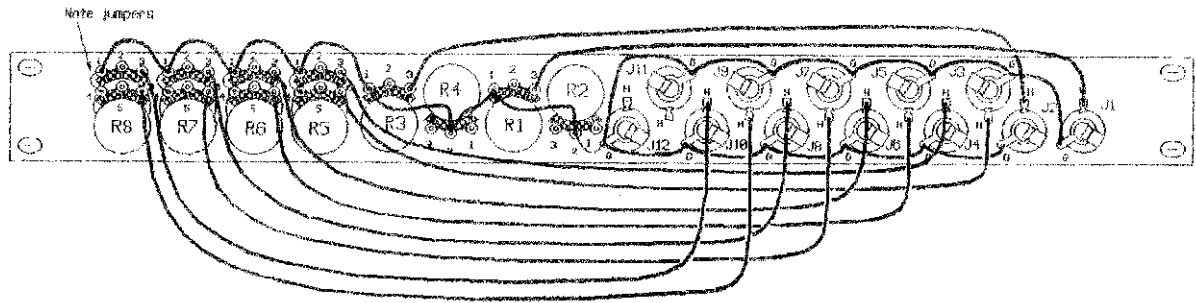


Fig 3. Lengths of #22 stranded wire are used to make connections between most controls and jacks. Excess lead clippings from resistor installation are used in five places.

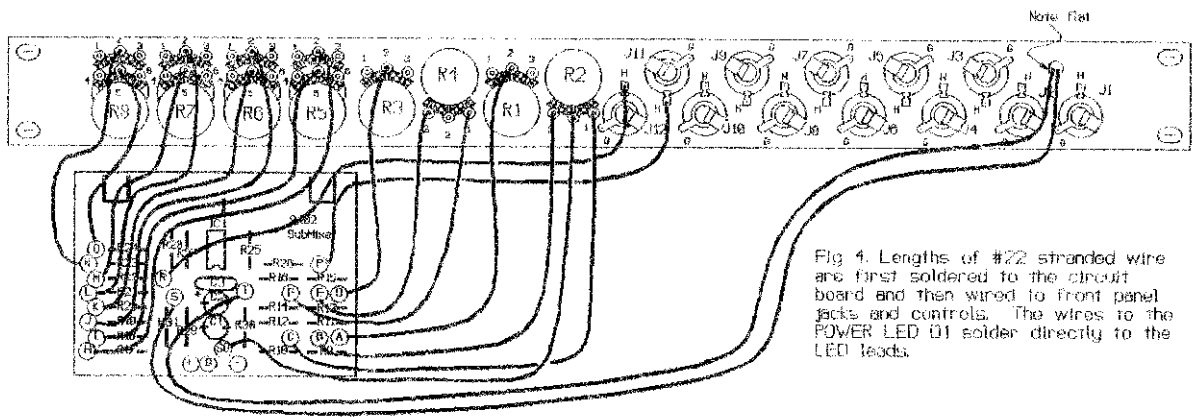


Fig 4. Lengths of #22 stranded wire are first soldered to the circuit board and then wired to front panel jacks and controls. The wires to the POWER LED U1 solder directly to the LED leads.