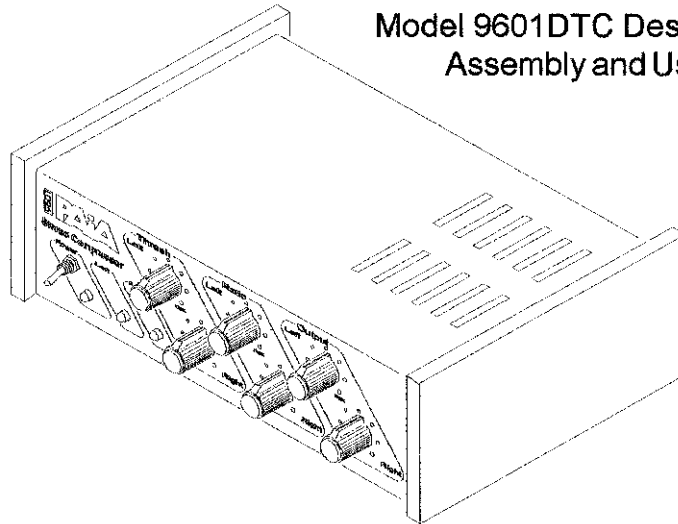


PAIA Stereo Compressor

Model 9601K Electronics Kit and
Model 9601DTC Desk Top Case
Assembly and Using Manual



Film and TV producers take advantage of the wide dynamic range of modern VCRs, DSS and Home Theatre setups by having normal conversation and background sounds 6 to 12 decibels below the maximum signal level. Then for dramatic effect, music and sound effects such as explosions can be that much louder than the dialogue track. Really shows off your rig.

But, for late-night viewing, when you're specifically trying to be quiet, you have to turn the TV up just to hear the dialogue and then quickly turn it down for the car chase. With the Stereo Compressor you don't need to constantly "ride the gain" - It will automatically do that for you! When the Stereo Compressor is patched between your Hi-Fi VCR or DSS and your stereo, you can enjoy listening to movies late at night in full fidelity, at low volume, without being blasted out of your chair when Rambo raids your living room.

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an article in the August 1996 issue of
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ASSEMBLING THE Stereo Compressor

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.

In some cases, notes packed with the parts will be used to call your attention to special situations. These notes may be in the yellow "MISSING PARTS" postcard. If parts are missing please notify PAiA at 405.340.6300, 434.6378, or damn!@paia.com .

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 Stereo Compressor 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.

-*-

*This product originated as a Do-It-Yourself article
by Jules Ryckebusch in the August 1996 issue of
Electronics Now magazine.*

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Wire Jumpers

Assembly begins by forming and installing the seven wire jumpers indicated by bold lines on the circuit board parts placement designators and numbered in the illustration to the right. For each jumper, cut a length of the bare wire supplied by measuring it against the distance between the circuit board holes and adding about 1/2". Bend 1/4" of each end down and push through the circuit board holes. Press the jumper fully against the board and solder both ends. Trim off excess wire flush with the solder joint.

Notice that the #7 jumper is covered with the small diameter insulating sleeving supplied. Slip the sleeving over the jumper before bending the wire ends down and placing.

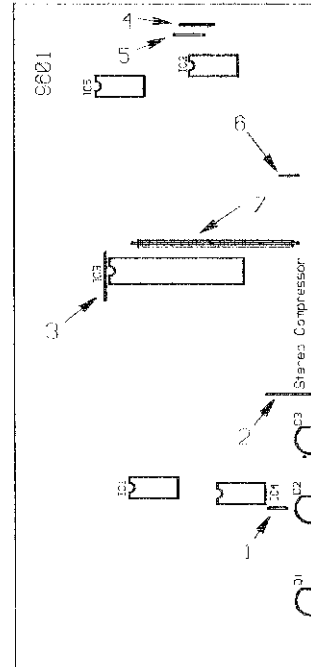
- () As outlined above, form and install the seven wire jumpers used on the circuit board.

Resistors

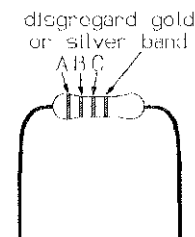
Solder each resistor in place following the parts placement designators printed on the circuit board and the assembly drawing fig 1. Note that resistors are nonpolarized and may be mounted with either lead in either of the holes in the board. Before mounting each resistor, bend its leads so that they 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.

A Tip: If you can't find the location for a resistor, go on to the next one and come back. DO NOT CHECK OFF A PART UNTIL IT IS INSTALLED AND SOLDERED.

Save a few of the resistor clippings for use in later steps.



One of the seven jumpers on the circuit board is insulated with sleeving



DESIGNATION	VALUE	COLOR CODE A-B-C
() R22	1.5m	brown-green-green
() R25	1.5m	brown-green-green
listed below:	1000 ohm	brown-black-red
() R5	() R35	() R37 () R39
() *R49	() *R50	

*** - These resistors mount off the circuit board when side chain circuitry is installed**

listed below:	10k	brown-black-orange
() R30	() R31	() R32 () R34
() R36	() R38	() R40 () R44
() R57	1m	brown-black-green
() R58	1m	brown-black-green
() R13	1500 ohm	brown-green-red
() R21	1500 ohm	brown-green-red
() R27	1500 ohm	brown-green-red
() R9	150k	brown-green-yellow
() R16	1800 ohm	brown-grey-red
() R17	1800 ohm	brown-grey-red
listed below:	200 ohm	red-black-brown
() R23	() R24	() R28 () R29
listed below:	2200 ohm	red-red-red
() R3	() R11	() R12 () R14
() R15	() R45	
() R4	22k	red-red-orange
() R19	22k	red-red-orange
listed below:	330k	orange-orange-yellow
() R7	() R8	() R10 () R20
listed below:	39k	orange-white-orange
() R2	() R33	() R43 () R46
() R1	47 ohm	yellow-violet-black
() R18	47 ohm	yellow-violet-black
listed below:	68k	blue-grey-orange
() R6	() R26	() R41 () R42

Disk Capacitors

Two of the capacitors used in the Stereo Compressor are nonpolarized Ceramic Disk types. Either lead can go in either of the holes in the circuit board. The leads of the Ceramic Disk capacitors 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 of these parts 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 characteristics. The 3 digit number that specifies value may be preceded or followed by letters indicating such things as tolerance. Since both capacitors are the same value there should be little chance of confusion.

DESIGNATION	VALUE	MARKING
() C1	2000pF	202 or .002
() C8	2000pF	202 or .002

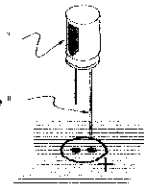
Electrolytic Capacitors

The remaining capacitors 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.

Electrolytic capacitors

Stripe is usually "+"

Longer lead is "+"



Usually the Negative lead of the capacitor is marked rather than the positive. It naturally goes through the unmarked hole.

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

DESIGNATION VALUE

listed below:	10uF / 16V Electrolytic		
() C2	() C3	() C4	() C5
() C6	() C7	() C9	() C10

DESIGNATION VALUE

- () C13 470uF / 25V Electrolytic
- () C14 470uF / 25V Electrolytic

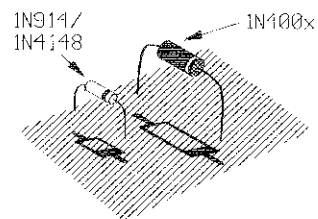
- () C11 47uF / 16V Electrolytic
- () C12 47uF / 16V Electrolytic

Diodes

Two types of diodes are used in the circuit, four 1N914 or 1N4148 silicon signal diodes in small glass cases and two 1N400x power diodes in larger cases.

Like the Electrolytic Capacitors, 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.



The polarizing color band corresponds to the filled end of the circuit board graphic.

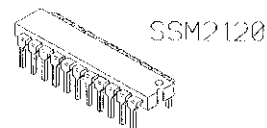
DESIGNATION TYPE

- () D8 1N4001, 1N4002, 1N4003 Silicon Power Diodes
- () D9 1N4001, 1N4002, 1N4003 Silicon Power Diodes

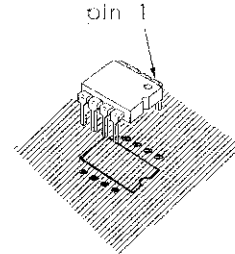
- listed below: 1N914, 1N4148 or equiv. Silicon Signal Diodes
- () D4 () D5 () D6 () D7

Integrated Circuits

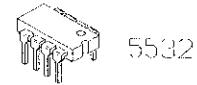
Of all the parts, the ICs are the most easily damaged and should be treated with some respect. In particular, they may be destroyed by discharges of static electricity. Modern ICs are not nearly as sensitive to this kind of damage as were earlier versions, but it is still good practice to handle these 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.



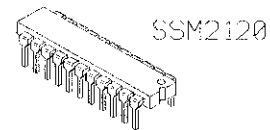
ICs are polarized in one or both of two ways; A dot formed into the case of the IC corresponding to pin 1 or a semicircular notch that indicates the end of the package with pin 1. Take care that this polarizing indicator corresponds to the similar indicator on the circuit board graphics.



The pins of the ICs may be splayed somewhat and not match the holes in the circuit board exactly. Carefully re-form the leads if necessary so that they are at right angles to the part. Solder each IC 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 remelting the solder joint at first one corner, then the other. Finally, solder the remaining connections.

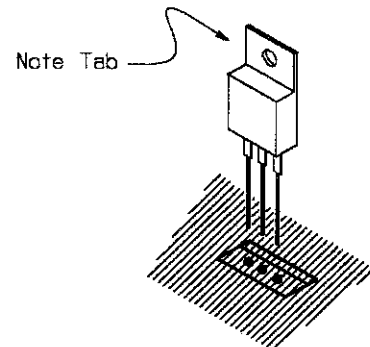


DESIGNATION	PART NO.	DESCRIPTION
listed below:	5532	Dual Low Noise OpAmp
() IC1	() IC2	() IC4 () IC5
() IC3	SSM2120	Dynamic Range Processor



Voltage Regulators

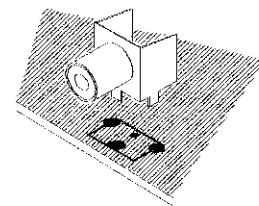
The two voltage regulators are polarized and must be mounted so that their tabs correspond to the tab markings on the circuit board graphics. Solder all three leads and clip any excess off flush with the solder joint.



DESIGNATION	PART NO.	DESCRIPTION
() IC6	7812	+12V Regulator
() IC7	7912	-12V Regulator

PC Mount Phono Jacks

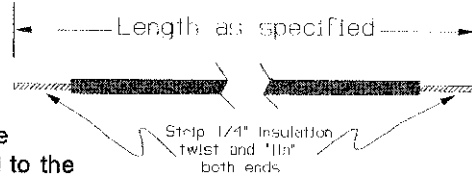
The four Phono Jacks mount to the circuit board by pushing their three mounting tabs and the smaller center conductor through the holes in the board. On the trace side of the board, bend the tabs inward slightly to cinch the connector in place before soldering the smaller center conductor and mounting tab closest to the board edge. The mounting tabs on the side of the connectors need not be soldered.



DESIGNATION TYPE

listed below: PC Mount RCA Phono Jacks
 () J1 () J2 () J3 () J4

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



In the following steps, wires will be soldered to the circuit board which in later steps will be connected to the front panel controls and switches. 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. Solder each connection as it is made and clip any excess wire from the solder side of the board.

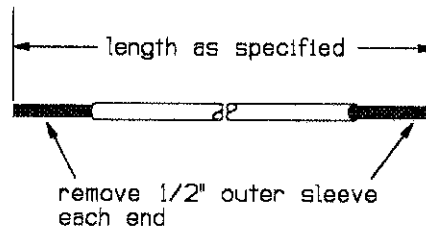
Before installing any wires cut two 16" lengths of two colors from the wire supplied and put these wires aside for use when installing the LEDs. **TIP:** *If you cut the specified length from the longest wire available you will not be left with several pieces that are too short for the last length required.*

PC POINT	WIRE LENGTH	PC POINT	WIRE LENGTH
() "A"	5-3/4"	() "H"	7-3/4"
() "K"	9-1/2"	() "F"	7-3/4"
() "L"	9"	() "B"	8-3/4"
() "M"	10-1/4"	() "D"	9-1/4"
() "N"	9-3/4"	() "C"	9-1/2"
() "E"	9"		

SHIELDED CABLE

RG-174/U coaxial cable will be used to make shielded connections between the circuit board and two of the potentiometers. Cut the length of co-ax supplied into two equal length pieces and prepare them for use as follows:

Strip 1/2" of the outer insulation at each end of both wires to expose the braided shield beneath it.

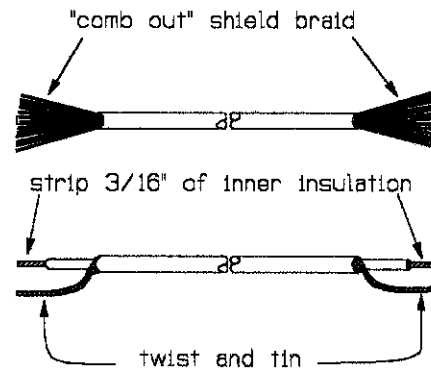


Unbraid the shield by "combing" it with the dull edge of a knife blade or a ball-point pen. This will expose the separately insulated inner conductor.

On each end of both cables, pull the strands of shield to one side and twist them together. Tin these pigtails by melting a small amount of solder into them.

On each end of both cables, strip about 3/16" of the insulation from the inner conductor and twist and tin the exposed strands.

Using the lengths of co-ax prepared above, solder the inner conductor and shield at one end of each cable to the circuit board points listed in the following steps (see fig 3).



WIRE PC POINT

Cable #1

() (shield)

"W"

() (inner)

"V"

Cable #2

() (shield)

"Y"

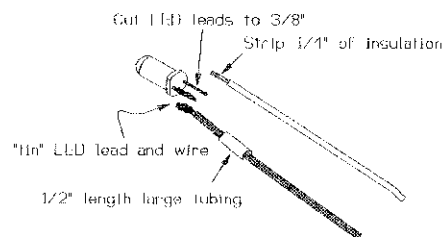
() (inner)

"X"

LEDs

Two different kinds of LEDs are used in the Stereo Compressor, a Red LED to indicate power is on and bi-color LEDs to indicate the active status of the two channels.

To reach from the circuit board to the holes in the front panel of the case the LED leads must be extended using the #22 stranded wire supplied. All three LEDs are prepared in the same way. Begin by cutting two wires to the length specified in the step then stripping 1/4" of insulation from each end of each wire and tinning the exposed wire strands on each end. **TIP: use two colors of wire for each LED.**



Trim the LED leads to 3/8" and tin them by melting a small amount of solder onto each one. **TIP: A pair of pliers can serve as a small vice by wrapping a rubber band around the handle to keep the jaws closed - handy for holding the LEDs while tinning the leads.**

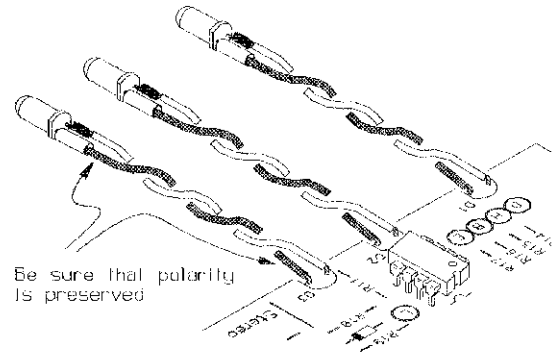
Join the stranded wire to the LED lead by remelting the solder on each while holding them together (the surface tension of the solder will help pull them together). Hold until the solder has cooled and the joint has set solid. Before going on to next LED, slip a 1/2" length of the large diameter tubing supplied over one of the Leads as shown in the illustrations. Twist the two leads loosely together.



Remelt solder to join wires, slide tubing over solder joint and twist wires loosely together.

Note that the LEDs are polarized by the flat in the collar at the base of part. When properly installed, the lead corresponding to this flat will connect to the hole closest to the flat in the LED symbol printed on the circuit board.

Push the two leads through the holes provided in the circuit board and solder both. Trim the leads off flush with the solder joint.



Be sure that polarity is preserved

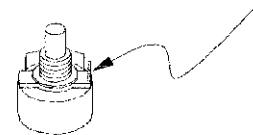
DESIGNATION	LENGTH	TYPE
() D1	4"	Red LED
() D2	5-1/2"	Bicolor LED
() D3	6-1/2"	Bicolor LED

We can now put the circuit board assembly aside while we do some pre-wiring to the front panel controls. This would be a good time to check your work on the circuit board to this point. Make sure polarized components are placed properly and be critical of all your soldering joints.

PANEL CONTROLS

Because there will be limited space available in the Stereo Compressor case when the electronics are installed, some point-to-point wiring will be done on the potentiometers before they're installed.

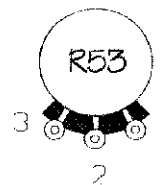
Bend or remove this tab so that the pot will seat flush against the front panel.



If you have the optional Case, its bottom panel can be used as a temporary fixture to hold the pots in place while soldering to them. Using the flat washers and nuts supplied, mount the six potentiometers, R51-R56, to the bottom panel as shown in fig 3. Notice that the pots are not all the same value - R51 and R52 are 10K (10,000) ohm while the other four are 100k units. Also note the orientation of the panel (vinyl covered side is down).

Align the pots so their solder lugs are oriented as shown in fig 3. Hand-tighten the nuts so they will be easy to remove when the pots are moved to the inside of the case.

In the following steps individual solder lugs are identified by part number and lug number. For example, R53-1 means the lug labeled "1" of the Potentiometer R53. Each step includes an instruction such as (s2), which means that the connection should be soldered and 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 marked (ns) should be crimped to make a good mechanical connection but will be soldered in later steps.



The resistor leads saved in previous steps are now used to make connections between lugs on R53 - R56. Notice that only one end of each connections is soldered.

FROM	TO
() R53-1 (s1)	R53-2 (ns)
() R54-1 (s1)	R54-2 (ns)
() R55-3 (s1)	R55-2 (ns)
() R56-3 (s1)	R56-2 (ns)

Two 1000 ohm resistors (brown-black-red) are mounted directly on the solder lugs of the potentiometers. Install the resistors by pushing their leads through the lugs and "dressing" the part so that it's leads do not touch the body of the pots or any lugs to which they do not connect. Cut the leads off so they extend about 1/8" beyond the lug and crimp them to the lug to hold the part in place. Do not solder any of these connections.

DESIGNATION	FROM	TO
() *R47	R52-3 (ns)	R52-1 (ns)
() *R48	R51-3 (ns)	R51-1 (ns)

Now we're ready to begin connecting the ends of wires and cables originating at the circuit board to the panel controls (see fig 3).

PC BOARD ORIGIN	TO
() "B"	R52-3 (s2)
() "C"	R52-2 (s1)
() "D"	R52-1 (s2)
() "E"	R51-3 (s2)
() "F"	R51-2 (s1)
() "H"	R51-1 (s2)
() "K"	R53-3 (s1)
() "L"	R53-2 (s2)
() "M"	R54-2 (s2)
() "N"	R54-3 (s1)

These connections use the co-ax.

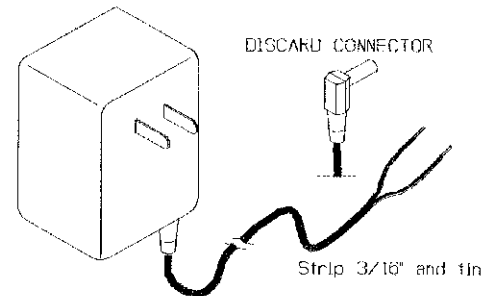
() "W" (shield)	R55-2 (s2)
() "V" (center)	R55-1 (s1)
() "Y" (shield)	R56-2 (s2)
() "X" (center)	R56-1 (s1)

We're just about ready to start moving things into the case, but first we'll do a little prep work involving the Case Top.

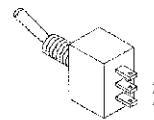
- () Install the rubber grommet in the power supply cord hole as shown in fig 4. A pen point or small screwdriver may be helpful in deforming the grommet into the hole.

Locate the Wall Mount Transformer (PWR1). If this part has a connector on the end of its cable, remove and discard it as shown.

- () Pass the Transformer cord through the grommet from the outside of the Case and put a knot in the cord 7" from the end. Separate the two wires from the loose end back to the knot. Strip 3/16" of insulation from ends of both wires and twist and tin the exposed wire strands.



-
- () Install the Power Switch (S1) in the location shown in fig 4 by passing its shaft through the hole in the Case Top and securing it with the nut provided.



SPDT switches may be supplied even though only SPST are required.

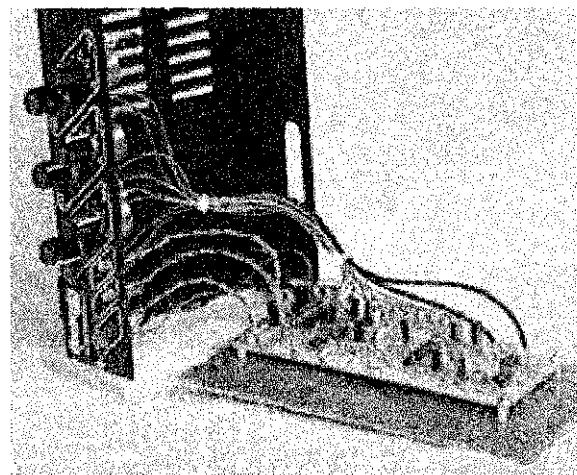
- () Connect either wire from the Transformer to lug #2 of the Power Switch and solder.
NOTE: The switch can be damaged by too much heat while soldering. Tin the solder lugs before attaching wires and do not hold the soldering iron in place for more than 5 sec.



We can now begin installing the electronics in the case.

- () Carefully remove the assembly of pots and fixed resistors from their temporary position on the Case Bottom Panel and move them into the Case Top as shown in fig 4. Secure each pot with a washer and nut. Make any adjustment in the pot locations to center them in the panel graphics before fully tightening the hardware. Clearance is tight around the pots so be careful that the pot lugs don't touch the case top, bottom or adjacent potentiometer cases.

- () Connect the free wire of the Transformer to circuit board point "G" and solder.
- () Connect the free end of the wire originating at circuit board point "A" to lug #3 of the Power Switch and solder.
- () Gather the wires from the circuit board to the front panel controls together and cinch the bundle with the two Nylon wire ties supplied as shown. **NOTE:** do not include the LED wires or the wire from circuit board point "A" in the bundle



THIS COMPLETES THE ELECTRONIC ASSEMBLY OF THE Stereo Compressor.

Before completing the Case Installation we will run some preliminary tests while things are still easily accessible. Before plugging the unit in and testing it, take a break then come back and check your work completely.

TESTING THE STEREO COMPRESSOR

After rechecking your work, it's time for the all important smoke test. If anything unfortunate is going to happen, this is the most likely time. Since the bottom of the circuit board is exposed for these first tests, make sure there are no wire clippings or other conductive debris on your work surface that could cause short circuits. Placing the assembly on a towel will also help protect the case.

Plug the wall-mount transformer into a 120VAC outlet and toggle the Power switch to "ON." The Power LED (D1) should light and if it doesn't you should immediately unplug the unit from the wall and find out why. The problem could be nothing more than a dead wall outlet. Improperly placed components or solder bridges on the circuit board may be the cause. Check the orientation of the Integrated Circuits.

When the Power LED lights. Let the unit idle for a few minutes while you check for parts that may be getting hot or any unusual smell, smoke, etc.

The best way to test the compressor is to connect it between a CD or cassette deck and your stereo. Set the Ratio Control fully counter clockwise and the Threshold Control fully clockwise. Set the Output Level Control to about ten O'clock. These are the "minimum" settings. You should hear undistorted, noise free audio. Both LEDs should be green. If there is distortion or noise, you need to go back and check your wiring and component polarities. If everything sounds good and you have green LEDs, then everything should be working fine. Now slowly rotate the Threshold Control. At some point around mid-rotation, the Active LED for that channel should start to indicate red. (If this works backwards, your LED wiring is reversed.) This means that compression is starting to occur. Rotate the Ratio Control clockwise and you should hear a decrease in volume as the compressor "squashes" the signal.

FINAL CASE ASSEMBLY

When you're through testing the unit and have confirmed that everything is working properly, the case can be fully assembled. Notice that the vinyl covered side of the Bottom Plate will be on the outside of the case, but the vinyl should be removed before final assembly.

-
- () Mount the Stereo Compressor circuit board to the Case Bottom using four 4-40 X 1/2" machine screws, four #4 X 3/16" spacers and four #4 nuts as shown in fig 4.

The wood end caps 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 oil that has a stain of the desired color.

Trial fit the wood ends into the open case ends as shown in fig 4. When fully assembled, the unfinished edges of the bottom plate will be hidden by the Case Top metal. In most kits, manufacturing tolerances will make the end caps slightly undersized and allow for their vertical adjustment so that the bottom edges of the front and back Case Top aprons are flush with the bottom of the Bottom Plate (which centers the output jacks in the hole in the rear of the Case Top.) In some rare instances the end caps may not fit far enough into the case for this to happen and it may be necessary to use a sharp knife to trim off the points of the right angle cut of the wood ends to better fit the slight radius of the bends in the case top.

- () 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 predrilled with a 1/16" drill bit.
- () While placing the Case Bottom and circuit board in their final position, also insert the three LEDs into the holes provided for them in the Case. A dab of household cement or super-glue will hold the LEDs in place. Use the remaining (4) #4 X 1/4" self-tap screws to mount the Case Bottom.
- () Install the (4) self adhesive rubber feet by peeling their backing and placing them in the corners of the case bottom.

-
- () Install the knobs. Rotate the shaft of the control on which the knob will be placed fully CounterClockWise and align the knob pointer with the marking at the extreme CCW end of the dial. Loosely tighten the set screw and rotate the knob back and forth to see how well it's range of rotation is balanced with the panel graphic. Reorient if not satisfied and then firmly tighten the set-screw.

USING THE COMPRESSOR

When the Stereo Compressor is connected to a hi-fi VCR or DSS for late night viewing, set the THRESH control to change the LEDs color during quiet spoken passages and set the RATIO control as high as possible without distorting. This allows you to preserve the fidelity and stereo spread of the movie sound track, hear all the dialog, but not get blown out of your seat when the F-114 does a strafing run in your living room. The above settings are intended to be starting points, so feel free to experiment.

Compressors in Studio and PA

by Jules Ryckebusch

The main use for a compressor is to keep signal levels from getting out of control while recording vocals and acoustic instruments. This takes a little experimentation. For a vocalist I usually start out around a 4-to-1 compression ratio with the THRESH set so the LED indicates red when the singers reach their nominal level. This way if they hit a note 20 dB higher than nominal (which would definitely clip most tape decks) the signal out of the compressor only increases by about 5 dB.

The Stereo Compressor can increase the apparent sustain of a sound. By using a large amount of compression and restoring the level with the OUTPUT control, the compressor will initially reduce the output signal by a large amount. As the input signal level decreases, the amount of compression will decrease and the output level will remain relatively constant. The Beatles used this on the final piano chord of "A Day In The Life" to make the sound linger on.

There are time when you don't want to affect the dynamic range of the signal but still keep sudden signal peaks from overloading the signal chain. This function is frequently called limiting. To use the Stereo Compressor as a limiter while recording, set the Ratio as high as possible and set the THRESH control so that the LEDs momentarily change from green to red on peak signals. This will preserve as much dynamic range as possible.

Also note the optional side-chain jacks. By doing some external processing of the audio signal (or substituting a completely different audio signal) before it is turned into a control signal, we can achieve some real useful functions. *Fig 3a shows the wiring of the side chain jacks. Note that J5 and J7 are Open Circuit Jacks and J6 and J8 are Normally Closed (Switching) Jacks.*

Using the Sidechain Jacks

By patching audio processors of different kinds into the side chain, all sorts of cool things are possible. One of the most useful is creating a de-esser. This is a device used to remove sibilance from vocals. Sibilance is that nasty "Shh" sound that occurs when "S" words are spoken or sung. When we form an "S" sound, air passes between the teeth and tongue forming a burst of white noise and a short blast of air. If the speaker or vocalist is close to the microphone, this is picked up as a brief overload and noise burst. This burst of sound mostly contains high frequencies. By setting an equalizer to boost high frequencies and patching it into the side chain, the Stereo Compressor will drastically compress the signal when the high frequencies are present, but act normally when they are not. You cannot eliminate sibilance, but it can be minimized with a de-esser.

Any equalizer will work. The best way to figure out what frequencies to boost is to listen to the audio through the equalizer (not in the side-chain yet). Start boosting until you have noticeably *increased* the sibilance then patch the equalizer with this setting into the side-chain. Anything above 3 kHz. usually works; you may have to experiment. A similar problem, although at the other end of the audio spectrum, relates to plosive sounds such as "P" and "B" and the "thump" sounds they can produce. These can be minimized the same way by boosting the offending bass frequencies (less than 300 Hz) via the side-chain.

Another abuse of a compressor is to totally squash an individual instrument signal, then restore its level. This is done with vocals, snare drums, kick drums, etc. U2 does this on a lot of their recordings. By squashing instruments that have a percussive quality (such as drums or slap bass) the amount of percussive attacks is increased. This occurs because the circuitry does not respond instantly. The initial attack transient portion of the signal gets through unaffected while the remainder of the signal is compressed normally. The end result is overall increase in the percussive quality of the processed sound.

The Stereo Compressor can also be used as a ducker, a device that reduces one signal's level based on a different signal. This effect gets used a lot on radio commercials. In this case, a different audio signal, such as an announcer's voice, is fed into the side-chain. When the

announcer speaks, the output of the compressor is reduced. This is useful for keeping background music at maximum volume, but letting the announcer's voice cut through the background by reducing the music level when the announcer speaks. Listen closely to any radio commercial and you will notice this effect. Duckers are also great for DJs or a presentation with background music.

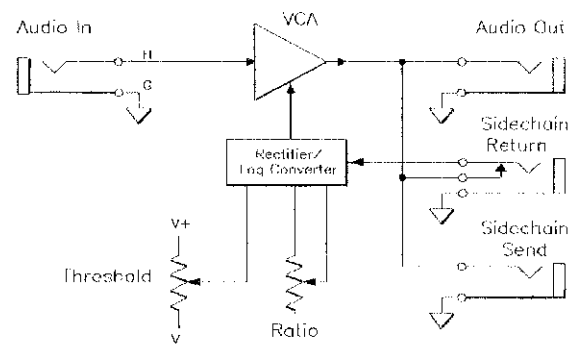
Ducking is also used in the studio to allow one instrument to cut through on a mix. If you want a particular instrument to be more noticeable, such as a snare drum, send the snare signal into the side-chain and have the rest of the mix feeding the compressor normally. Whenever the snare drum plays, it will reduce the level of the main mix, increasing the presence of the snare drum without increasing its level. Just by adding a few jacks, we have increased the power of an already useful tool.

The Stereo Compressor is a state-of-the-art audio processor. It can be used to upgrade your home recordings, as an addition to a professional recording studio or it can just allow you to enjoy late-night movies without riding the volume.

HOW IT WORKS

The basic block diagram of a compressor is shown in the illustration. The input signal is fed to a VCA that has a nominal gain of unity. Some of the output signal is fed to a precision rectifier followed by a logarithmic circuit. The output of this block is a DC voltage proportional to the log of the average level of the input signal. By sending some of this DC voltage to the VCA we can reduce the gain of the VCA if our input signal exceeds a user determined threshold level.

It is important to note that we are determining the signal level after the VCA and not before. This allows the output level to still increase and sound normal, but not increase as much as the input signal does. By varying the amount of feedback signal we can adjust the compression ratio, which in conjunction with the threshold control, determines the operating characteristics of the compressor.



DESIGN ANALYSIS

Fig 5 is the schematic diagram of the Stereo Compressor. The device has two independent channels of compression, right and left. The heart of the circuit is the SSM2120 dual dynamic range processor integrated circuit IC3. The SSM2120 features two complete dynamic range processors. Each one consists of a voltage-control amplifier, a logarithmic converter, and a precision rectifier. The chip also features a dynamic range of 100 dB. at only .01 percent total harmonic distortion at +10 dB. input. The remainder of the circuit consists of input and output buffers, the control circuitry and the comparator that drives the Active LEDs.

Since the electronics for both channels is identical, we will look at the right channel in detail. The input audio signal from J1 goes to an inverting buffer circuit consisting of R40 and R44 and IC1-b. Its output signal (IC1-b, pin 7) is coupled to the signal input on IC3, pin 8, via C4, which blocks any DC component of the input signal. The SSM2120 chip is actually looking for a current input source, and R43 provides the proper amount of current to the chip. The RC filter formed by C8 and R18 eliminates any stray RF interference. The output signal from the internal VCA (IC3 Pin 4) is actually a current signal. It is restored to a voltage signal by current-to-voltage converter IC1-a and its feedback resistor R46. The signal from IC1-a, pin 1 is routed to output stage amplifier IC5-a via R34. The output signal from IC5-a, pin 1, is coupled via R35 and C9 to jack J3. Output potentiometer R55 lets you adjust the unit's gain.

The output signal is also sent to the rectifier input (IC3, pin 9) via R36 and C7 either directly, or via the optional side-chain jack circuitry including R50. The side-chain jacks consist of a standard 1/4-inch open-circuit phone jack (J7 - Out) and a 1/4-inch phone jack with a normally-closed switch built in (J8 -IN). These jacks form a normalized patch point for additional audio processing. Inserting a phone plug into the side-chain IN jack (J8), breaks the normal signal path and allows either the original signal with additional processing, or a completely different (new) signal to be sent to the rectifier input.

Looking at the control side of the house, resistor R22 provides a reference current to the log-averaging circuit within IC3 via pin 2. It also forms an RC timing circuit with C5. This RC circuit determines the response time. The time constant is set so that the compressor will respond rapidly without distorting.

Potentiometer R51, along with other resistors, develops the threshold level signal. The voltage from the wiper of R51 is sent to the threshold input of IC3 (pin 1) via R42. Another resistor, R41, across the threshold pin 1 and the control output pin 3 establishes the internal gain of the control stage.

The control output signal from pin 3 goes to a voltage-divider network centered around potentiometer R53 then to the inverting VCA input of IC3 (pin 7). A positive voltage on this input reduces the VCA gain, which is what we need to make the compressor work. Note that both the inverting and non-inverting control inputs (pins 7 and 5 respectively) are tied to ground via R28 and R24. The control inputs must remain close to ground potential for proper operation. A 6-millivolt change in voltage at these control pins causes a 1 dB change in VCA output. Diodes D6 and D7 ensure a unipolar control voltage. Potentiometer R53 is the compression RATIO control. It gives an adjustable compression ratio of 2 to 1 all the way to about 25 to 1.

The last portion of the circuit is the comparator formed by IC4-b, two input resistors, R10 and R20, a bicolor light-emitting diode LED3 and current limiting R11 for the light-emitting diode D3. Notice that op-amp IC4-b is wired as a comparator. Normally it is unwise to use an op-amp for this purpose because the output stage saturates, which will slow down the comparators response time. In this instance we need to get an output that changes from one supply rail to the other. This makes dual-LED interfacing very simple. Along with being an excellent audio op-amp the 5532 functions well as a comparator in this application.

The power supply circuit consists of an externally connected Wall-Wart 12-volt AC transformer PWR1 and associated diodes and capacitors. One side of the 12-volt AC line is tied to ground and the hot side goes to half-wave rectifiers D8 and D9. These diodes deliver bipolar unfiltered DC, and each supply is filtered by electrolytic capacitors C13 and C14. Even though PWR1 is rated at 12 volts AC, the filter capacitors charge closer to the peak value of the 12-volt AC, and just about 15-volts DC is delivered to the +12-volt DC regulator IC6 and -12-volt DC regulator IC7. The output of each voltage regulator section is filtered for decoupling purposes by electrolytic capacitors C11 and C12.

Two ground systems are used in the Stereo Compressor, one for power return and the other for signal return. This design practice reduces the possibilities of ground loops that introduce unwanted AC hum to the audio signals.

NOTES

96.8.20

Home Theatre Compressor (9601K)

Parts List

Semiconductors

4	5532 Dual Low Noise OpAmp	IC1,IC2,IC4,IC5
1	SSM2120 Dynamic Range Proc.	IC3
1	7812 +12V Regulator	IC6
1	7912 -12V Regulator	IC7
1	Red LED	D1
2	BiColor LED	D2,D3
2	1N4001 Silicon Power Diodes	D8,D9
4	1N4148 Silicon Signal Diodes	D4,D5,D6,D7

Capacitors

2	2000pF Ceramic Disk	C1,C8
8	10uF / 16V Electrolytic	C2,C3,C4,C5, C6,C7,C9,C10
2	470uF / 25V Electrolytic	C13,C14
2	47uF / 16V Electrolytic	C11,C12

Potentiometers

4	100k Panel Mount	*R53,*R54, *R55,*R56
2	10k Panel Mount Pot.	*R51,*R52

all resistors 1/4W 5% values in ohms

2	1.5m	brown-green-green	R22,R25
8	1000	brown-black-red	*R47,*R48,*R49, *R50,R5,R35,R37,R39
8	10k	brown-black-orange	R30,R31,R32,R34, R36,R38,R40,R44
2	1m	brown-black-green	R57,R58
3	1500	brown-green-red	R13,R21,R27
1	150k	brown-green-yellow	R9
2	1800	brown-grey-red	R16,R17
4	200	red-black-brown	R23,R24,R28,R29
6	2200	red-red-red	R3,R11,R12,R14, R15,R45
2	22k	red-red-orange	R4,R19
4	330k	orange-orange-yellow	R7,R8,R10,R20
4	39k	orange-white-orange	R2,R33,R43,R46
2	47	yellow-violet-black	R1,R18
4	68k	blue-grey-orange	R6,R26,R41,R42

Misc

1	SPST Min Toggle Switch	S1
1	12VAC 400mA Transformer	PWR1
6	Knobs	
1	Circuit Board	
1	Instruction Manual	

Wire, etc.

4	36" lengths #22 Stranded Wire
1	24" length RG-174/U coax
1	1-1/2" length large dia. Tubing
1	1" length small dia. Tubing
1	7" length Bare Wire
2	Nylon Wire Ties

Desk Top Case (9601DTC)

Packing List

1	Set Wood Ends
1	Case Top
1	Case Bottom
4	PC Mount RCA Phono Jacks
4	Stick-on Rubber Feet
4	4 - 40 x 1/2" Machine Screws
4	#4 Nuts
4	#4 X 3/16" Aluminum Stand-off
8	4 - 40 X 1/4" Self-tap Screws
1	1/4" Rubber Grommet

Fig 1a. Components mount on the circuit board at the locations shown in the parts placement diagram

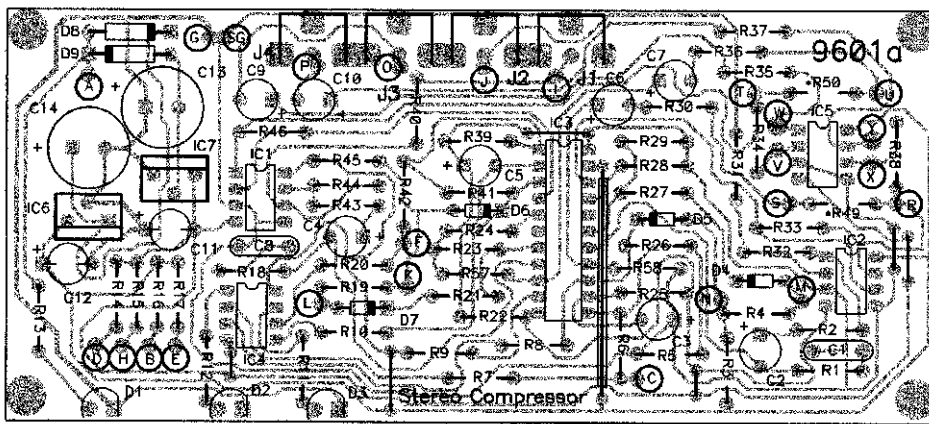
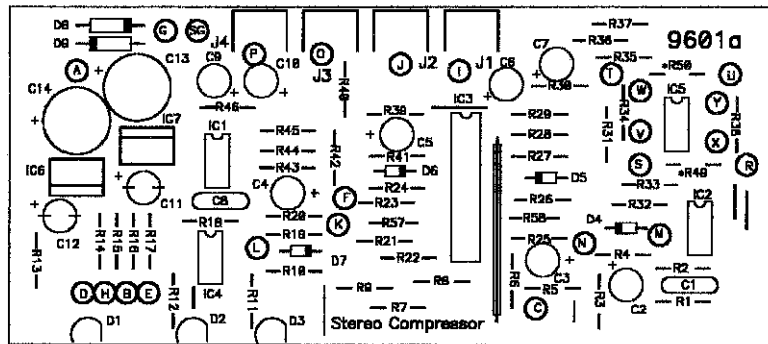
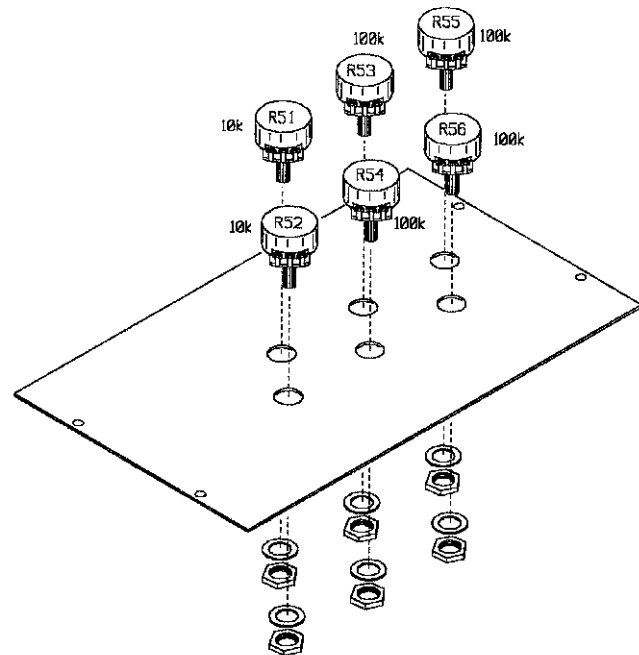


Fig 1b. This phantom view of the circuit board conductors will be useful if you need to trace out the circuit.

Fig 2. The hole pattern in the case bottom allows it to be used as a fixture while wiring the controls. The vinyl covered side of the panel is down in this illustration.



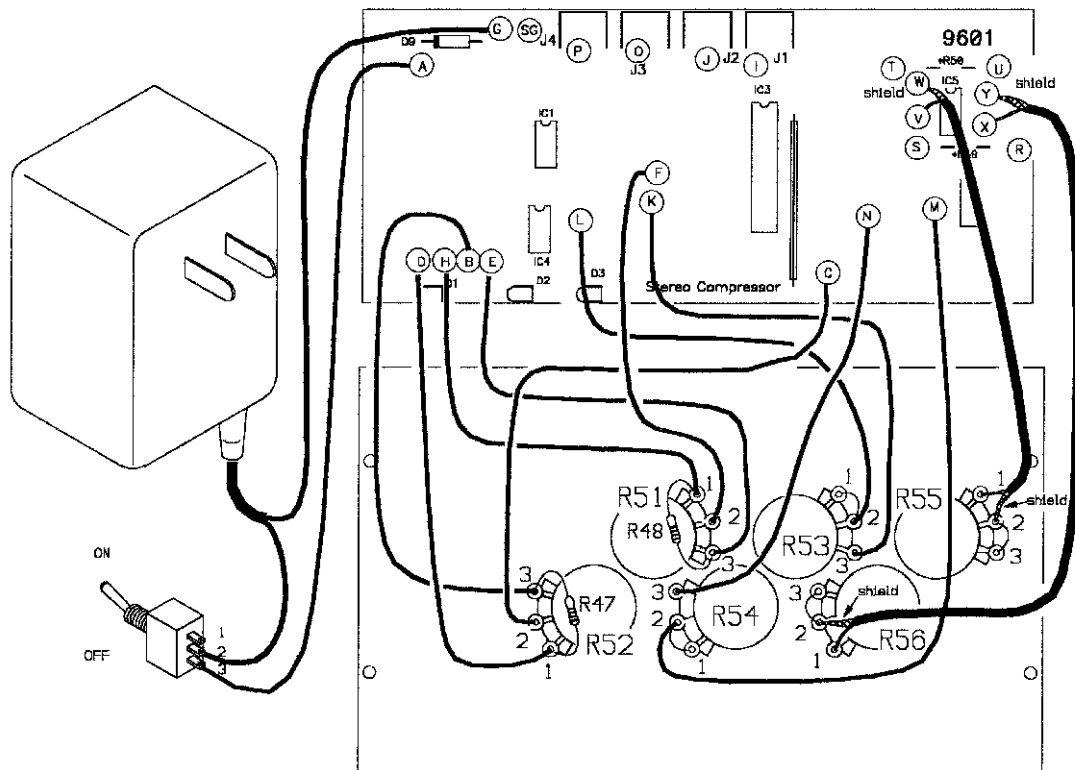


Fig 3. The pots and power switch are wired the same in either Home Theatre or Studio version. Note R47 and R48 mounted on the threshold controls and the Rg-174/U coax used to connect the Output controls.

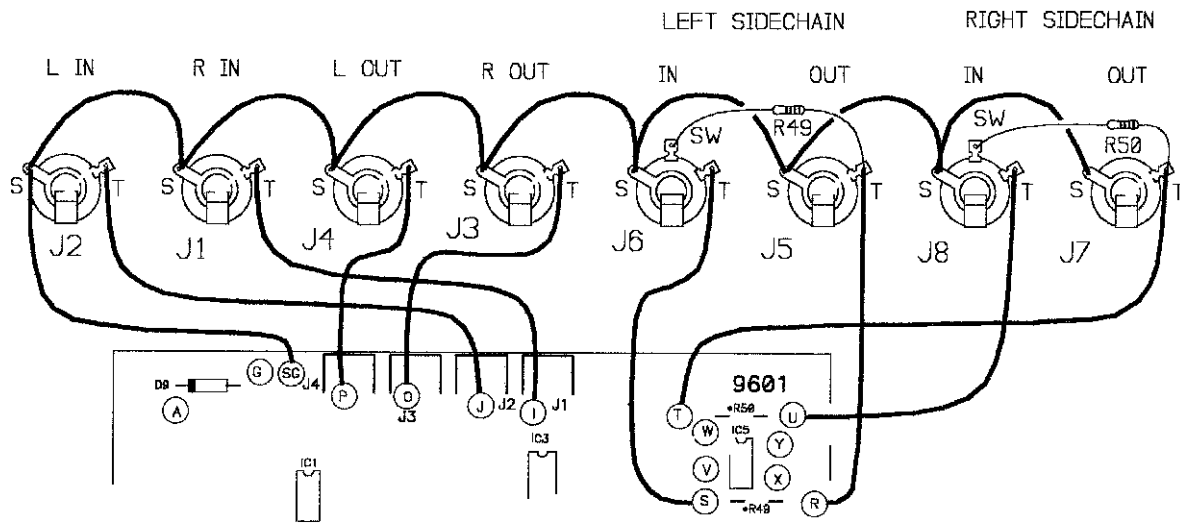


Fig 3a. When side-chain Jacks are added for the Studio version, R49 and R50 move from the circuit board to the Jack lugs.

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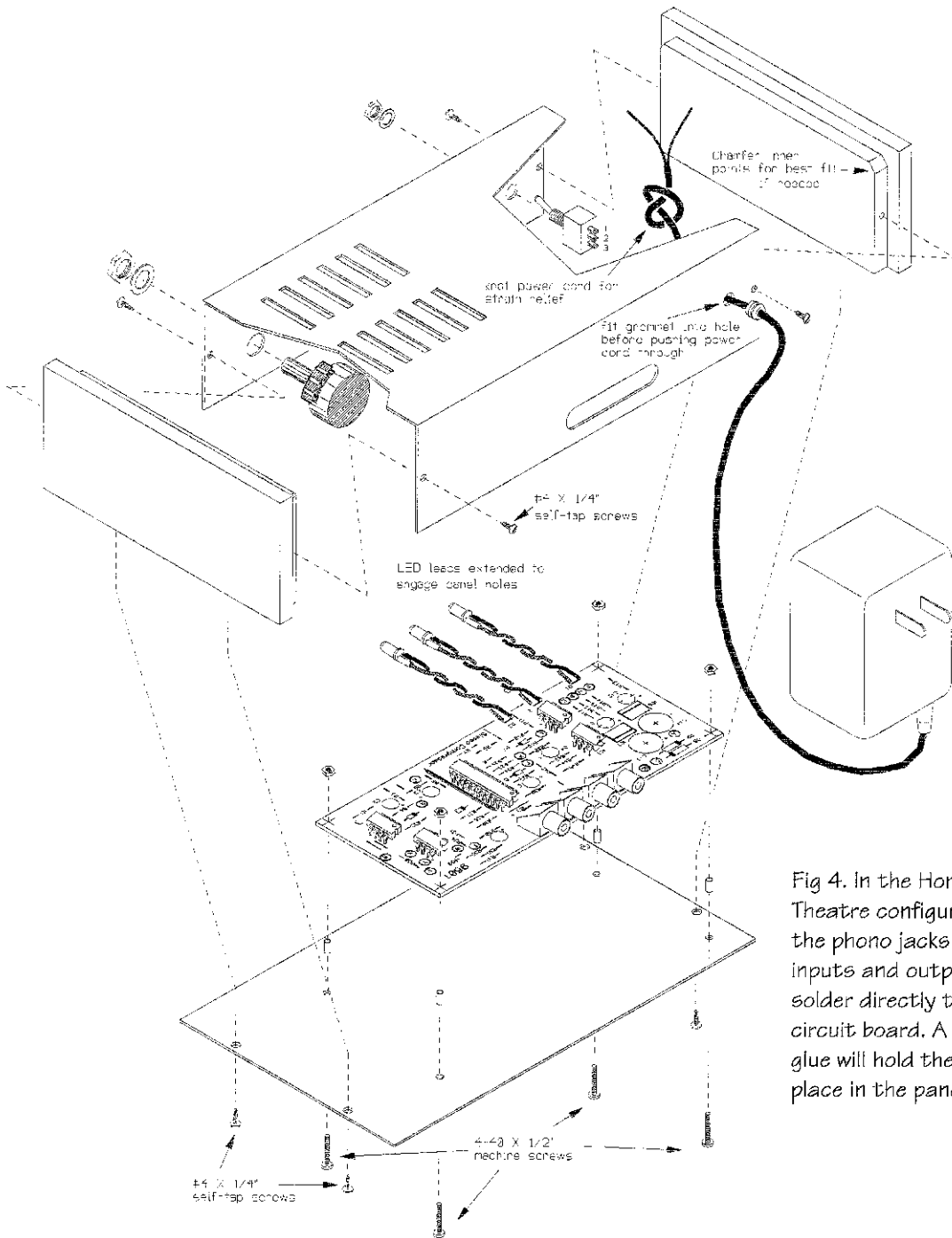


Fig 4. In the Home Theatre configuration, the phono jacks used for inputs and outputs solder directly to the circuit board. A drop of glue will hold the LEDs in place in the panel holes.

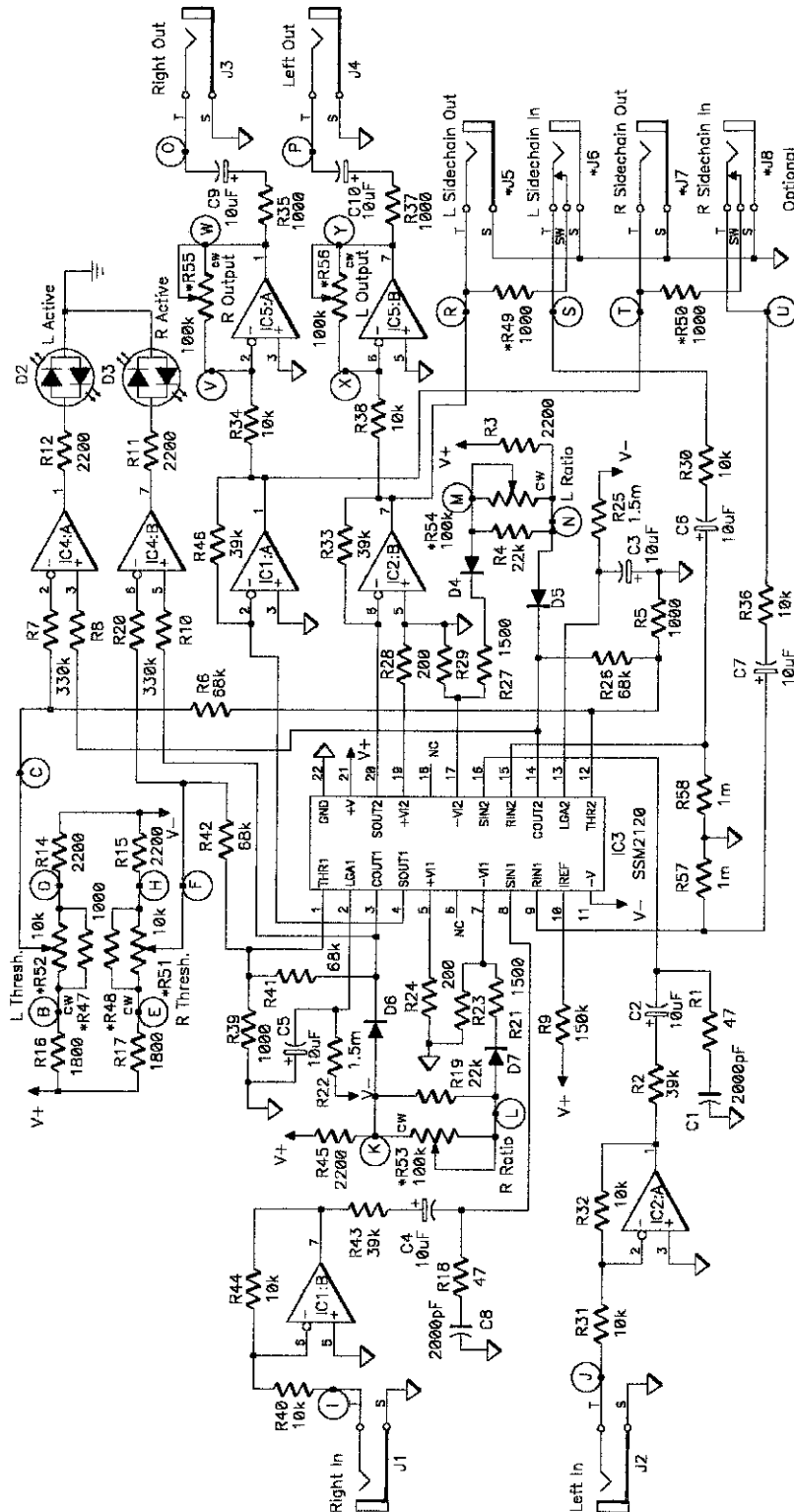
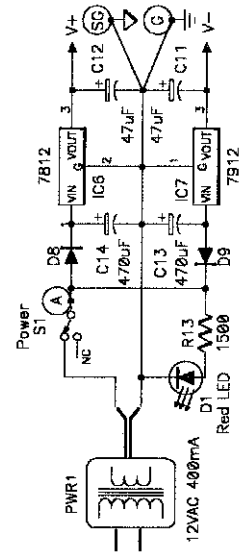


Fig 5. Stereo Compressor Schematic. The side chain circuitry is not used in the desktop Home Theatre configuration, but can be added by adding the jacks J5-J8 and moving *R49 and *R50 from the circuit board to the new Jacks. Power supply components are shown below.



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