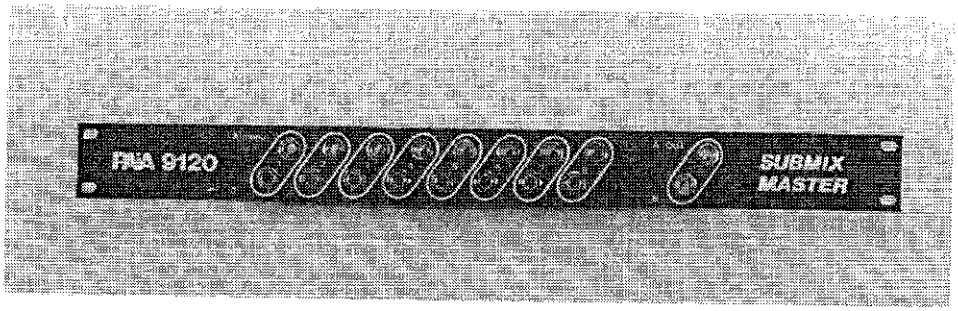


SUBMIX MASTER

ASSEMBLY AND OPERATION INSTRUCTIONS

One of the problems that seems to get worse as time goes by is an extreme lack of inputs in most recording studios. And project studios, as they evolve into things resembling the bridge of the next generation Enterprise seem to have everything but .... enough inputs.

Craig Anderton attacks this problem with the insight that has become his hall-mark and the result is the SUBMIX MASTER. Who else would think of a no-knob mixer. Most MIDI wonder machines are stereo, with on-board effects and panning and can be mixed via MIDI controller 7 messages. Once these Keyboards are set up and hooked into a sequencer they are essentially "set and forget" devices, yet they still take up two inputs each on your board.

Studios with lots of effects have a similar problem, so many processors these days are stereo that boards never seem to have enough returns.

The SUBMIX MASTER combines up to 8 stereo or mono keyboards into a master stereo output. Panning, effects and levels are taken care of at the MIDI instrument itself. Feeding the SUBMIX MASTER output into two mixer inputs frees up all the mixer inputs that would otherwise be occupied by keyboards.

Circuit design by: Craig Anderton & Associates
Kit design and production: PAIA Electronics, Inc.

PARTS LIST

Check the parts supplied with the kit against this parts list prior to beginning assembly. Report any shortages or discrepancies immediately.

2	270 ohm resistors (red-violet-brown)
18	10K ohm resistors (brown-black-orange)
2	22K ohm resistors (red-red-orange)
2	47 pf ceramic disk capacitors (47K)
2	.1 mf mylar capacitors (100n or 104)
2	33mfd 25 volt electrolytic capacitors
1	5532 op amp
10	1/4 inch open circuit phone jacks
8	1/4 inch closed circuit phone jacks
1	9120 SUBMIX MASTER printed circuit board
1	2 ft. length of 22 gauge insulated wire
1	1 ft. length of plastic tubing

ASSEMBLY

CLEAN THE CIRCUIT BOARD

To assure good solder connections first clean the circuit board with a scouring cleanser, rinse with clear water and dry completely.

SOLDERING

Use a pencil-type soldering iron with a small tip and a power rating of 25 to 35 watts. Soldering guns are completely unacceptable for assembling electronic circuits because the large magnetic field they generate can damage solid state components.

Use only rosin core solder. Acid core or paste flux solder is never used for electronic circuits.

Keep the soldering iron tip clean and avoid excessive heat when soldering components in place.

INSTALL COMPONENTS ON THE CIRCUIT BOARD

Following the parts placement diagram (figure 1) and the designations printed on the circuit board install the following components on the circuit board in the order listed below. Clip excess component leads off flush with the connection after soldering in place. Save component leads for use in a later step.

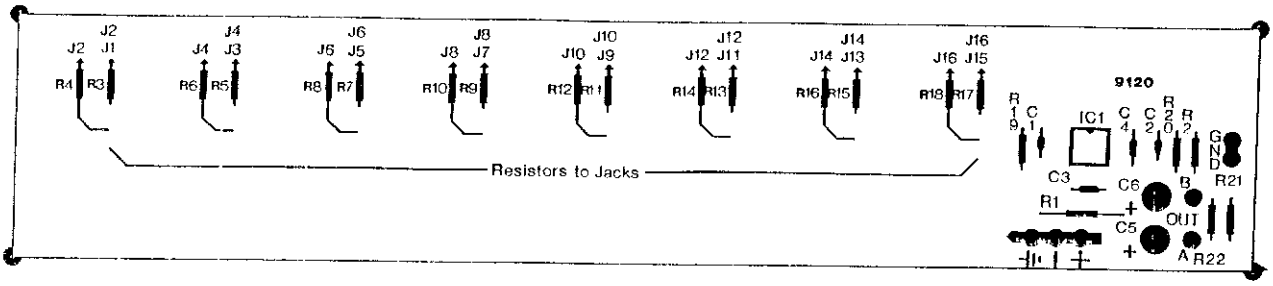
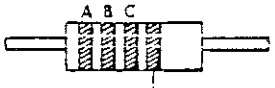


FIGURE 1
CIRCUIT BOARD PARTS PLACEMENT

RESISTORS



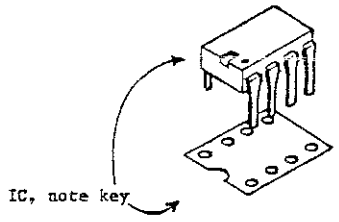
DESIGNATION	VALUE	COLOR CODE A-B-C
R1, R2	270 ohm	red-violet-brown
R19, R20	10K ohm	brown-black-orange
R21, R22	22K	red-red-orange

NOTE: DO NOT INSTALL RESISTORS R3 THROUGH R18 AT THIS TIME.

INTEGRATED CIRCUIT

Install the NE 5532 IC. Note that the notch or dot on one end of the integrated circuit aligns with the semi-circular key on the parts placement designator on the circuit board and shown in figure 1.

Avoid damaging heat build up by heat sinking the leads of the IC while soldering.



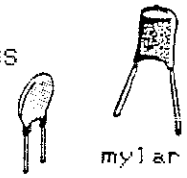
IC1	NE5532

CAPACITORS

DESIGNATION	VALUE/TYPE
C1, C2	47 PF. CERAMIC DISC
C3, C4	.1 MFD. MYLAR

MARKINGS

47K
100N
or 104



Note the following electrolytic capacitors are polarized and must be oriented according to the parts placement diagram and pc board designations.

Either the positive (+) or negative (-) lead of these capacitors may be marked. The positive lead must be installed in the circuit board hole marked (+) in order for the circuit to function.

electrolytic capacitor

DESIGNATION	VALUE
C5, C6	33 mfd., 25 volt electrolytic capacitor

PANEL MOUNTED COMPONENTS

Orient the panel as illustrated in figure 2. Note that the panel is up-side down and you will be working from the rear of the panel.

Studying the illustration, note that the circuit board is mounted directly on the ground lugs of open circuit phone jacks J1, J3, J5, J7, J9, J11, J13 and J15. Prior to installing these jacks on the panel you will want to bend their ground lugs inward slightly to about a 90 degree angle to facilitate circuit board installation in a later step.

Use the hardware supplied with the jacks to install the jacks on the panel.

MOUNT OPEN CIRCUIT PHONE JACKS ON THE PANEL

J1, J3, J5, J7, J8, J11, J13, AND J15.

Open Circuit

Orient these jacks as illustrated in figure 2, with their ground lugs parallel to the lower edge of the panel.

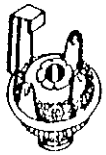
Mount open circuit phone jacks for outputs.

J17 and J18.

Orient as illustrated in figure 2 for easy wiring reference.

MOUNT CLOSED CIRCUIT PHONE JACKS ON THE PANEL.

J2, J4, J6, J8, J10, J12, J14, AND J16.



Closed Circuit

Orient these jacks so that their ground lugs are slightly off of parallel with the upper edge of the panel. Note that there is some leeway here. Adjust the position of these jacks so that there is adequate spacing between the lugs of the open

circuit jacks previously installed. The objective in positioning these jacks is to keep the tip contacts from shorting when a plug is in the jack.

JACK LUG COMPONENT CONNECTIONS AND WIRING

In the following steps you will want to lay the panel face down on your work surface. Orient the panel as illustrated in figure 2 for easy reference.

To assure good solder adhesion you may wish to "tin" the jack lugs with a small amount of solder prior to making component connections.

Begin by connecting a 10K ohm resistor to lug 2 of jacks 2, 4, 6, 8, 10, 12, 14, and 16 respectively. You will want to leave approximately 1/4 inch of component lead between the connection and the body of the resistor. (See assembly detail figure 3 A) For easy reference and ease of assembly, lay the resistor body across the center opening of the jack, inserting the lead through lug 2 and solder. Trim the excess lead at the solder connection and bend the resistor outward perpendicular to the panel. (See fig. 3 B)

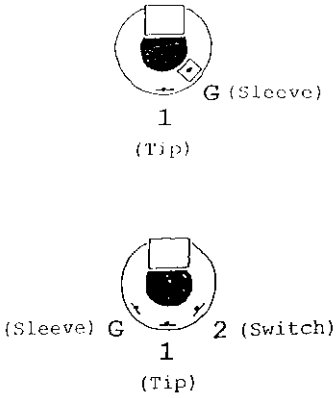
Connect 10K ohm resistors (brown-black-orange) as follows:

J2 lug 2
J4 lug 2
J6 lug 2
J8 lug 2
J10 lug 2
J12 lug 2
J14 lug 2
J16 lug 2

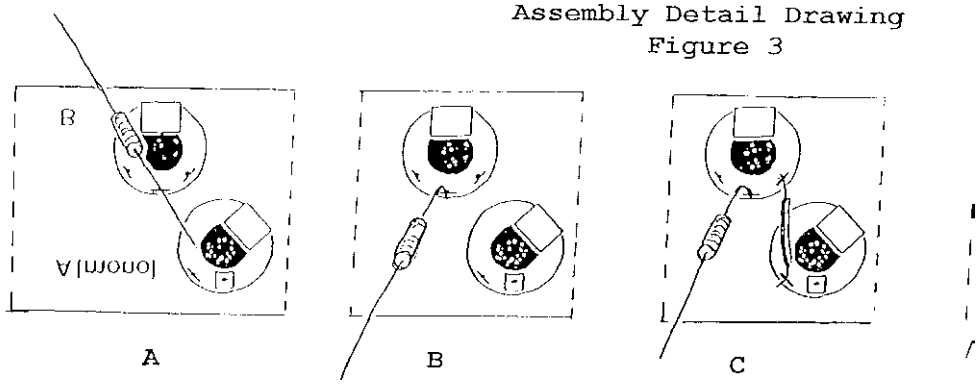
Next make the wire jumper connections. Slip 1/2 inch of insulating plastic tubing over a length of resistor lead saved from previous steps. Insert the lead between each of the following jack lugs. (See fig. 3 c) Solder only as directed below.

POINT	to	POINT	
J2 lug 1	.....	J1 lug 1	(solder at J2 only)
J4 lug 1	.....	J3 lug 1	(solder at J4 only)
J6 lug 1	.....	J5 lug 1	(solder at J6 only)
J8 lug 1	.....	J7 lug 1	(solder at J8 only)
J10 lug 1	.....	J9 lug 1	(solder at J10 only)
J12 lug 1	.....	J11 lug 1	(solder at J12 only)
J14 lug 1	.....	J13 lug 1	(solder at J14 only)
J16 lug 1	.....	J15 lug 1	(solder at J16 only)

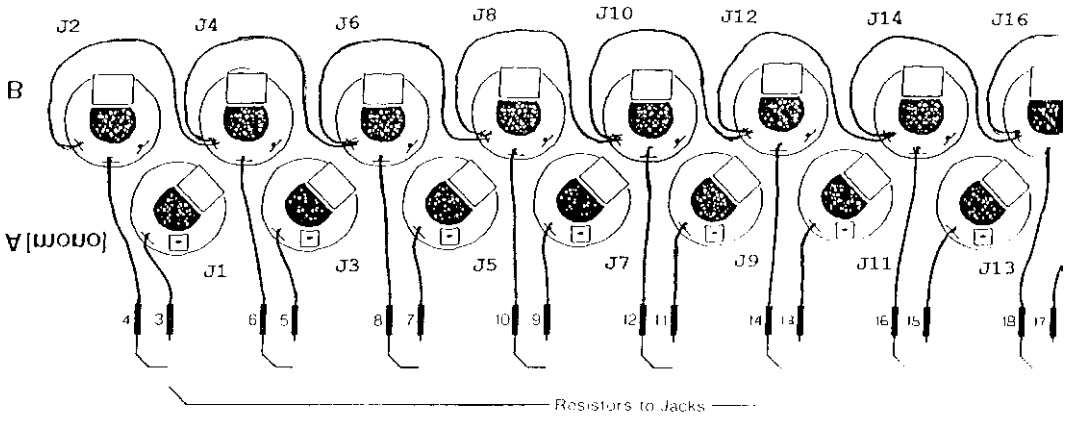
Assembly Detail Drawing
Figure 3



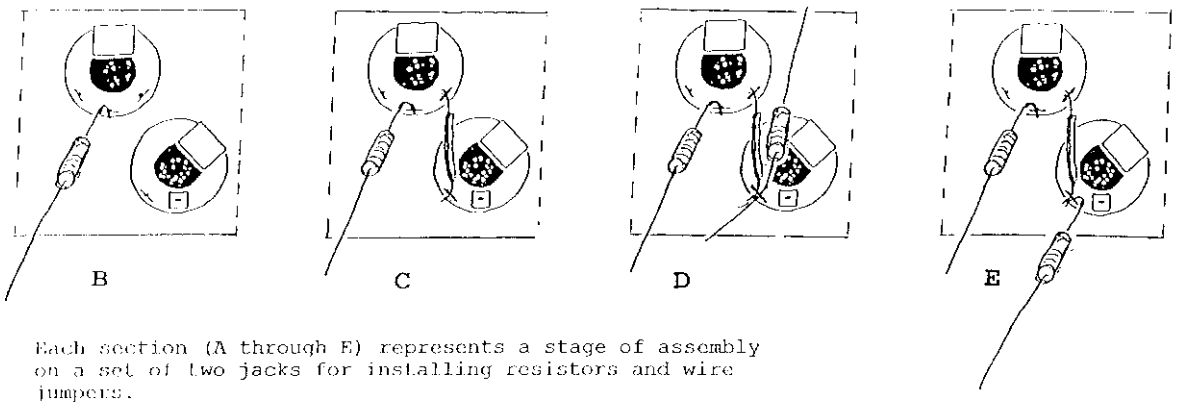
Jack Lug/Terminal Readout



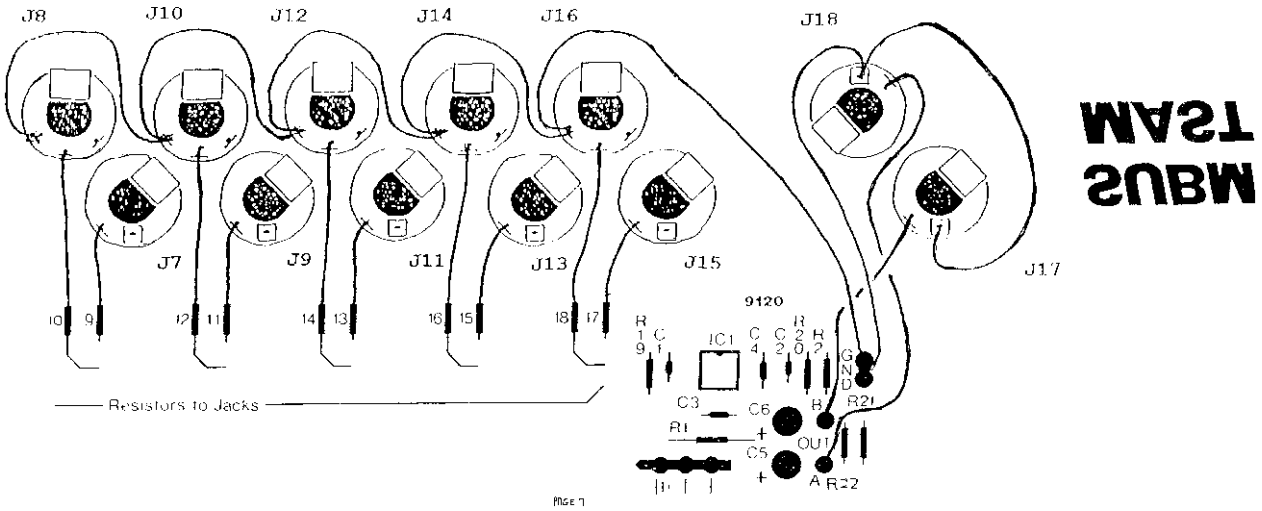
Each section (A through E) represents a stage on a set of two jacks for installing resistors jumpers.



Assembly Detail Drawing
Figure 3



Each section (A through E) represents a stage of assembly on a set of two jacks for installing resistors and wire jumpers.



In a manner similar to resistor installation in previous steps, install 10K ohm resistors on the following jack lugs, leaving approximately 1/4 inch of component lead between the resistor body and the solder lug. Insert the resistor from the same side that the wire jumper inserts from. (see fig. 3 D) Clip excess leads and bend outwards after soldering.

J1 lug 1 (solder resistor and jumper wire)
J3 lug 1 "
J5 lug 1 "
J7 lug 1 "
J9 lug 1 "
J11 lug 1 "
J13 lug 1 "
J15 lug 1 "

GROUND LUG CONNECTIONS

Following figure 2, connect the ground lugs of Jacks J2, 4, 6, 8, 10, 12, 14 and 16 using a three inch length of the 22 gauge insulated wire provided . Prepare each wire by cutting to length, stripping 1/4 inch of insulation from each end. Twist the exposed strands and "tin" by melting a small amount of solder into the wire.

Make the following ground lug connections:

J2 lug "G"	to	J4 lug "G"	solder at J2
J4 lug "G"	to	J6 lug "G"	solder at J4
J6 lug "G"	to	J8 lug "G"	solder at J6
J8 lug "G"	to	J10 lug "G"	solder at J8
J10 lug "G"	to	J12 lug "G"	solder at J10
J12 lug "G"	to	J14 lug "G"	solder at J12
J14 lug "G"	to	J16 lug "G"	solder at J14
			DO NOT SOLDER AT J16

Cut and prepare a 3 inch length of insulated wire and connect to J16 lug "G". Solder two wires at this connection. The other end of this wire will connect to the circuit board in a later step.

INSPECT YOUR WORK

Carefully inspect the jacks to be sure that no lead clippings have lodged between jacks, lugs or between the panel and the jacks.

CIRCUIT BOARD INSTALLATION

Check to be sure that the Ground ("G") lugs of Jacks J1, 3, 5, 7, 9, 11, 13 and 15 are perpendicular to the panel. Make any necessary adjustments now.

Tin the circuit board solder pads by melting a generous

amount of solder onto the pads that the jack lugs will connect to. Likewise, "tin" the ground ("G") lugs of the jacks that it will be connected to.

At this point it is a good idea to insert a plug into Jack J1 for reference in installing the circuit board so that the board does not interfere with the operation of the jacks.

Align the circuit board foil pads with the jack lugs oriented as illustrated in figure 2. Notice that the circuit board mounts on the inside of these jack lugs, between the lug and jack center opening. While pressing the board against the lugs heat each connection until the solder flows between the lug and solder pad.

PANEL TO CIRCUIT BOARD CONNECTIONS

Insert the resistors extending from the jack lugs into the designated circuit board locations as follows and solder.

PC POINT	JACK
R3	J2 & 1 via wire jumper
R4	J2
R5	J3 & 4 via wire jumper
R6	J4
R7	J5 & 6 via wire jumper
R8	J6
R9	J7 & 8 via wire jumper
R10	J8
R11	J9 & J10 via jumper
R12	J10
R13	J11 & 12 via jumper
R14	J12
R15	J13 & 14 via jumper
R16	J14
R17	J15 & 16 via jumper
R18	J16

Connect the wire extending from J16 lug "G" to either of the two holes at circuit board point "GND" and solder.

Cut and prepare the following insulated wire lengths and make the following connections:

J17 lug G ...	J18 lug G	2-1/2 inch wire length (solder at J17 only)
J18 lug G ...	PC point "GND"	2-1/2" wire length (solder two wires at J18)
J18 lug 1 ...	PC point "A"	2-1/4 inch wire length
J17 lug 1 ...	PC point "B"	2-1/4 inch wire length

THIS COMPLETES ASSEMBLY

HOW IT WORKS

Many of today's keyboards feature stereo outputs, built-in effects, panning, and automated level control via MIDI controller 7. In essence, they already have an automated mixer built in, yet each keyboard takes up to two mixer inputs that will never be used to their full capacity. You can probably even trim the overall level with the synth's master level control. You don't necessarily need nifty faders, an effects bus, or mic preamps; what you need is more inputs.

The Submix Master accepts eight stereo or mono keyboard outputs and mixes them into a stereo pair. This feeds two inputs of your existing mixer, so you basically give up two inputs in order to get 16 more.

A 5532 dual op amp is the heart of the circuit. IC1B mixes together the eight left or "A" inputs (J1-J8) and IC1A mixes the eight right or "B" inputs (J9-J16). You'll notice no input coupling caps or level controls; they simply aren't necessary since you can adjust levels at the synth itself, and synth outputs are normally already capacitor-coupled. Also to minimize noise, the input impedance is restricted to 10K. This makes the Submix Master unsuited to passive guitars and other high impedance outputs.

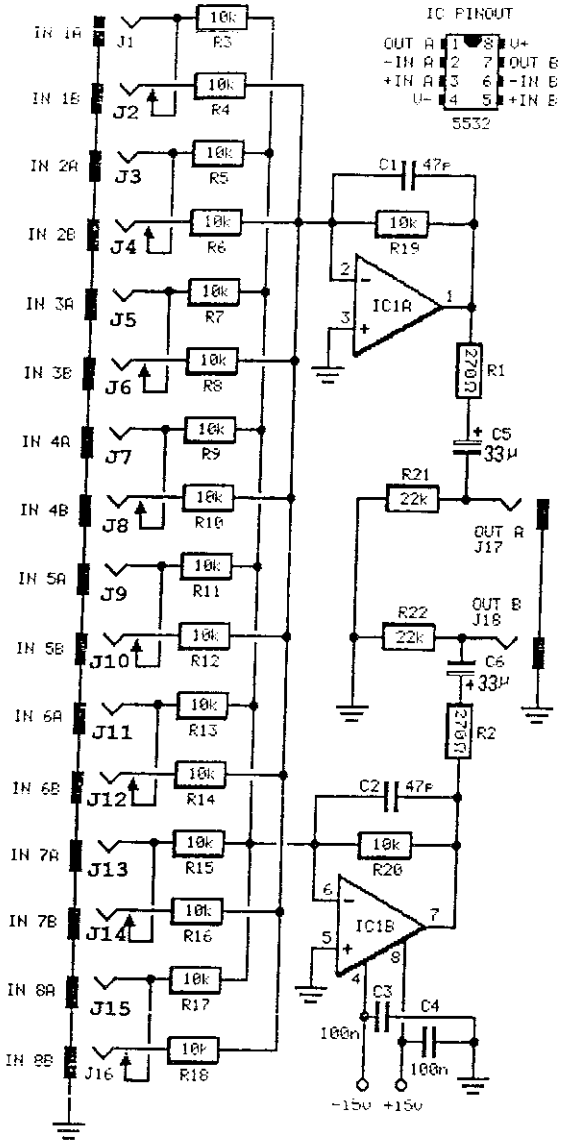
While not essential, C1 and C2 remove extreme high frequency signals. R1/C5 and R2/C6 couple the opamp outputs to the subsequent mixer inputs; R21 and R22 bleed any charge off C5 and C6 to prevent "pops" when you plug the outputs into your mixer. C3 and C4 provide power supply bypassing. These are necessary only if the leads connecting the op amps to their power supply exceed several inches, but it's good practice to leave the capacitors in regardless.

The power supply can be any +/- 15V capable of delivering +/- 20mA. Two batteries will do in a pinch or bi-polar supplies of lesser voltage; however, lower voltages decrease the available headroom, hence the signal to noise ratio.

USING THE SUBMIX MASTER

Operation is simple. Plug a keyboard's stereo outputs into any input jack pair (e.g., 1A and 1B). For mono synths, plug into only the A jack of the pair. Because of the way the input jacks are wired, this signal will appear in both channels and therefore end up in the center of the stereo spread.

It's also possible to weight a stereo signal left or right of center, although this uses up two input pairs. Plug



SCHEMATIC DIAGRAM
FIGURE 4

the left output into IN 1A. This places the signal in both channels. Plug the right output into IN 2B, and the stereo image will tilt toward the right. To tilt the image toward the left, plug the right output into IN 1A, the left output into IN 2A, and insert a dummy plug into IN 2B (this is

necessary to defeat IN 2B's switching action, which would otherwise send what was plugged into IN 2A to both channels).

Plug the outputs into two mixer inputs, which should be panned left and right.

MODIFICATIONS

R19 and R20 set the overall gain at 1 (unity gain). For more gain, increase these values according to the following formula:

(Desired gain) X 10,000 = New feedback resistor value

For example, for a gain of five, R19 and R20 should equal 50,000 ohm. However, too much gain may lead to distortion. Use a fractional gain value to attenuate the overall output level.

To vary the gain of individual inputs, change the associated input resistor value (R3-R18). Smaller resistor values increase gain; larger values reduce gain. The formula is:

(10,000/Desired Gain) = New Input Resistor Value

For example, for a gain of 2, change the input resistor to 5K. For a gain of 1/2 (50% attenuation), change the resistor to 20K. Do not choose a resistor value lower than 2.2K as this may load down the synth output.

APPLICATIONS

The SubMix Master has good enough specs that it can be used as the primary mixer when recording directly into DAT. Sequence your synths, mix their outputs via the SubMix Master, and send them to DAT. The effect is pretty close to recording through a straight piece of wire, although in the quest for minimum noise, please note this circuit does reverse the signal polarity.

SPECIFICATIONS

Frequency Response:	+/-0.25 dB, 10Hz-40kHz
Signal to Noise Ratio (unweighted):	-94 dB
Input Impedance:	10K ohm
Max Headroom (+/-15V power supply):	greater than 26V p-p
Gain:	unity

9120 SubMixMaster 1/4" Jack Substitution

The readout/I.D. of the terminals/lugs of the jacks supplied with this kit differ from the ones originally included with this kit. The following changes have been made to the manual:

*Figures 2 and 3 of this manual have been updated.

*An extra 24 inch length of 22 ga. ins. wire is listed on the parts list and in the page 8 'Ground Lug Connections' step to accomodate the readout variation.

*The labeling of the input jacks has been corrected on the schematic.

*The last two steps on page 9 are updated and correct the connections of the output jacks to the circuit board (IC1A to J17/Out A; IC1B to J18/Out B).

*The 'Circuit Board Installation' step of the manual has not been changed; however, the board should be soldered to the tip (1) lug/terminal out at the end of the terminal rather than at the base (see below).

sl 7/12/2000