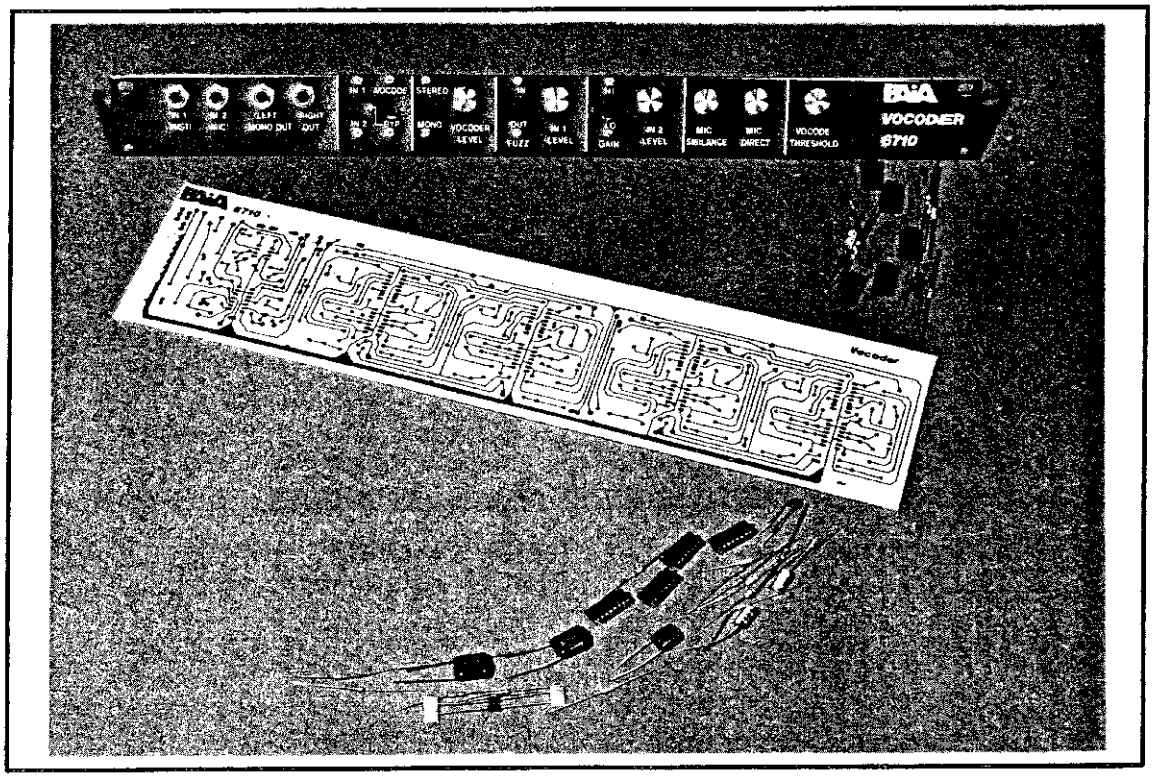
VOCODER 6710

ASSEMBLY AND USING MANUAL



PAiA Electronics, Inc.

● Phone (405) 340-6300

PARTS LIST

Carefully check the parts packed with your kit against the parts list, and notify PAIA immediately if there are any discrepencies.

Resistors

R#	Value (USA)	Value (International)	Description A B C
R1	1k	1k	brown-black-red
R2 - R7	3.3k	3k3	orange-orange-red
R8 - R25	4.7k	4k7	yellow-violet-red
R26 - R28	5k	5k	potentiometers
R29 - R39	10k	10k	brown-black-orange
R40 - R41	10k	10k	potentiometers # RS1369
R42	22k	22k	red-red-orange
R43	33k	33k	orange-orange-orange
R44 - R45	100k	100k	brown-black-yellow
R46	100k	100k	dual-ganged pot
R47 - R48	150k	150k	brown-green-yellow
R49 - R51	1M	1M	brown-black-green (installs on panel)
R52 - R67	2.2M	2M2	red-red-green
R68 - R75	10M	10M	brown-black-blue

Capacitors

C#	Value (USA)	Value (International)	Description
C1	15 pF	15p	ceramic
C2, C3	47 pF	47p	polystyrene
C4 - C7	680 pF	680p	"
C8 - C11	560 pF	560p	"
C12 - C15	1000 pF	1n	"
C17-C21, C34	1500 pF	1n5	"
C22 - C25	2200 pF	2n2	"
C26 - C29	3300 pF	3n3	"
C30 - C33	4700 pF	5n	mylar
C35	0.1 uF	100n	"
C36, C37	0.22 uF	220n	"
C38, C39	0.22 uF	220n	ceramic (or mylar)
C40 - C49	1 uF	1u	electrolytic
C50 - C77	2.2 uF	2u	"
C78 - C80	4.7 uF	4u7	"
C16, C81	10 uF	10u	"
C82, C83	33 uF	33u	16 volt minimum voltage rating electrolytic

In this kit we have included two 47pF Ceramic Disk Capacitors instead of two 47pF Polystyrene Capacitors due to the unavailability of the Polystyrene in this value.

Semi-Conductors

Qty	Type
D1 - D2	1N4001 or equivalent
IC1	LM 301 or 748 op amp
IC2 - IC6	4136 quad op amp
IC7 - IC10	571 compander

Mechanical Parts

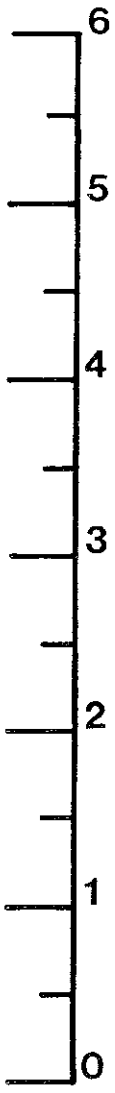
Qty	Type
J1 - J6	Jacks (mono-open circuit)
S1 - S3	SPST switches
S4 - S5	DPDT switches
Misc.	Circuit board, knobs

Hardware

12	#4-40 X 1/4" machine screws
10	#4-40 nut
2	"L" brackets
6	3/8" pot nuts
2	#4 lockwashers
5	14 pin IC sockets
4	16 pin IC sockets
1	8 pin IC socket

Wire

39 ft.	22 ga. insulated stranded wire
6.5"	Bare wire



VOCODER INSTRUCTIONS

IMPORTANT: This kit is designed for those with some experience in building electronic devices. Upon looking over the Vocoder, if it appears that this kit is beyond your particular level of expertise you may return the unassembled kit to PAIA for a refund of the kit price. For those who need a refresher course on building electronic projects (soldering technique, etc.), study the first five chapters in "Electronic Projects for Musicians" (available from PAIA Electronics for $14.95 plus shipping).

This kit includes the circuit board, rack panel, and all components but does not include an outboard ±15V regulated power supply. Since the unit draws less than ±75 mA, you can often tap power from an existing power supply. Alternately, you can build the PAIA #7700 rack mount power supply.

ASSEMBLY

Be patient and take your time. Most kit failures are due to impatience and not following directions, so if you want your kit to work, work carefully and slowly. Here are some very important tips (and note that **PAIA IS NOT RESPONSIBLE FOR DAMAGED OR NON-WORKING PARTS KITS IF YOU DO NOT STRICTLY OBSERVE THE FOLLOWING**):

1. Use rosin-core solder and a low-wattage (no more than 40 watts) soldering iron (not soldering gun). Acid-core or paste flux solder is NOT acceptable.

2. Make sure the circuit board is clean and shiny before doing any soldering by lightly steel wooling the copper side of the board, then rinsing in cold water and drying.

3. Note that electrolytic capacitors have a (+) lead and a (-) lead, just like a battery (usually the (-) is indicated). These must be oriented properly on the circuit board (see Fig. 1) or the vocoder will not work. Also note that the diodes will have a band located close to one end. The diodes should be oriented on the circuit board as shown in Fig. 2.

FIG.1

Electrolytic Capacitor Orientation

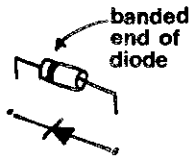


FIG.2

Diode Orientation

4. The various ICs have a dot or notch at one end of the case (see Fig. 3); Fig. 4 shows how the IC pin numbers relate to the IC package.

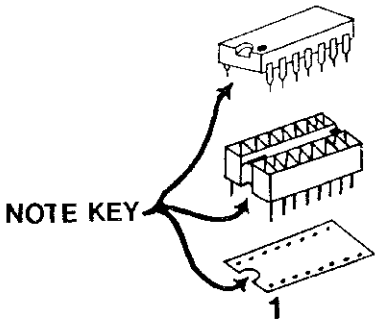


FIG.3 IC Orientation

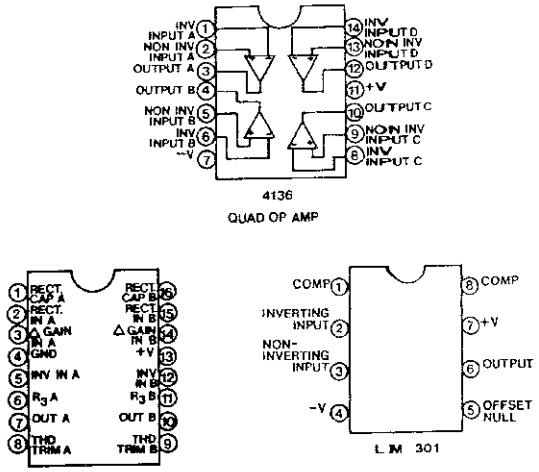
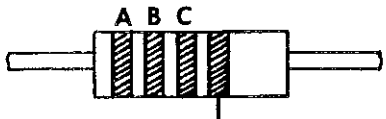


FIG.4 IC Pinouts

5. Use IC sockets for all the ICs. If you ever have to replace one, you'll be glad you did!

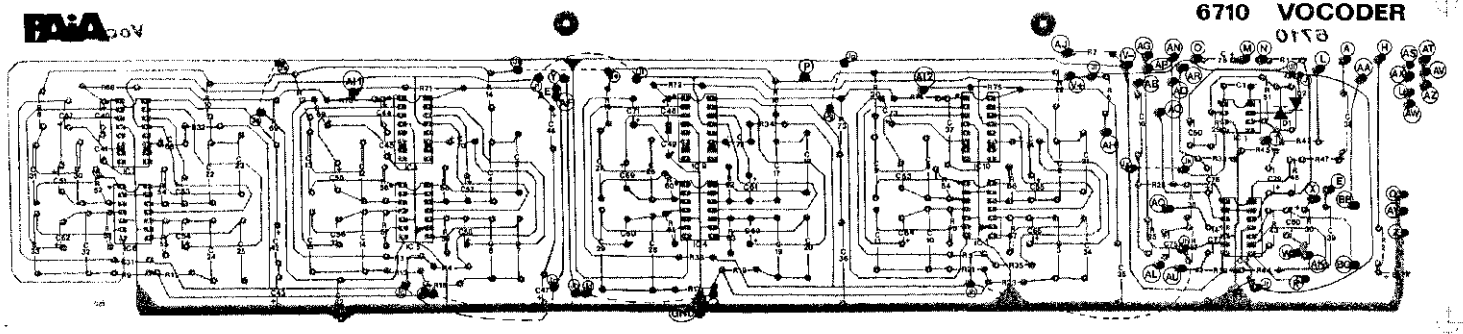
6. Note that there are several wire jumpers on the board. These must be wired up as indicated in order for the Vocoder to work.

7. Double-check your work carefully before applying power. Look diligently for any unsoldered connections, solder bridges between adjacent traces, improperly inserted ICs, etc.



Silver or gold - disregard this band.

Example: 10K
A= brown
B= black
C= orange



Printed Circuit Board Parts Placement

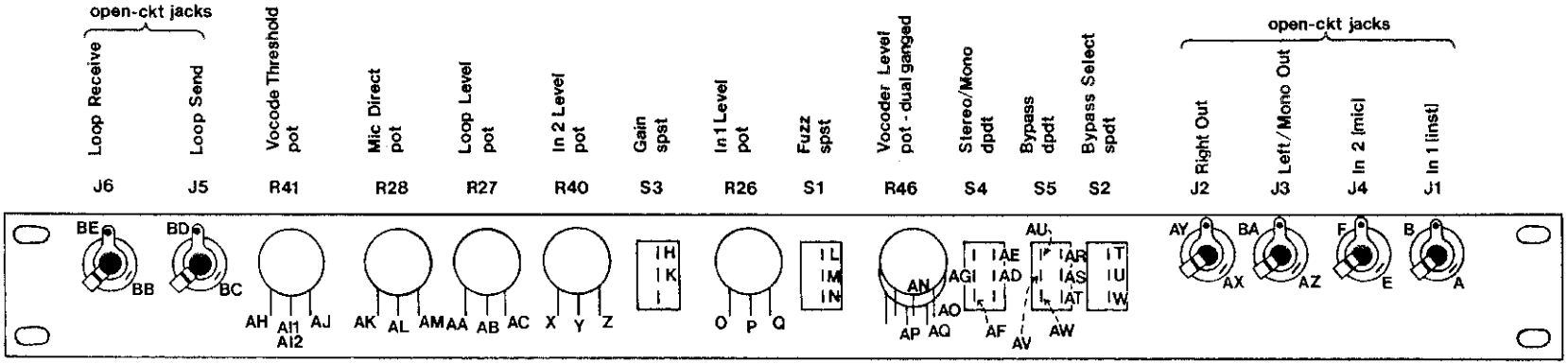


FIG.5a Front Panel Parts Placement

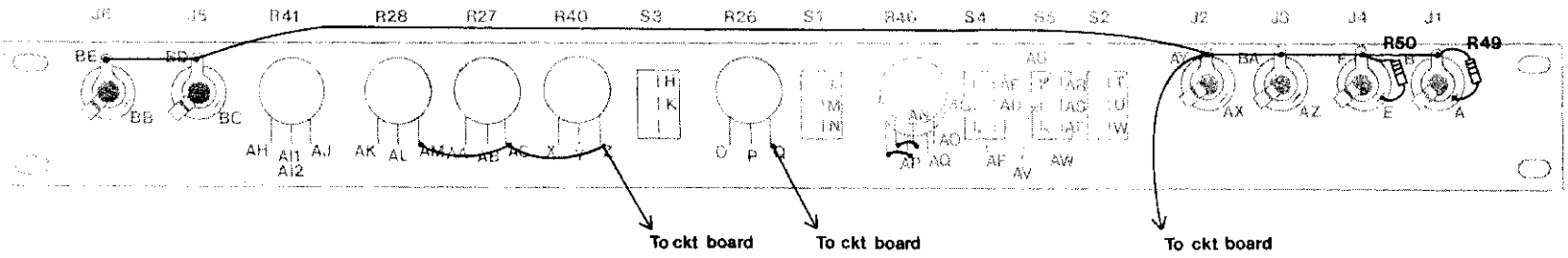


FIG. 5b Front Panel Wiring Designations

A. **Circuit Board Construction**

1. Put sockets in first. Solder diagonal, corner pins first, making sure the socket is flush with the board. Once this is assured, solder the other pins. Do not insert the ICs until you have completed assembly and are ready to test the Vocoder.

2. Install the resistors (R1 - R75).

3. Install the capacitors (C1 - C83). Be sure to observe polarity with the electrolytic capacitors.

4. Install diodes (D1 - D2).

5. Install jumpers Ja - Jj. The following lists the length of wire for each jumper. (All measurements are in inches).

Ja	2"
Jb	4.5
Jc	4.25
Jd	3.5
Je	3
Jf	3.25
Jg	2
Jh	7
Ji	5.5
Jj	8.5
Jk	2"

B. **Front Panel Wiring**

1. Refer to Fig. 5 -- "Front Panel Parts Placement and Wiring Designations".

2. Mount the switches, potentiometers, and jacks on the front panel. Carefully observe the orientation of the various lugs.

3. Install wires A - BE. The following is a list of the lengths of wire needed for each front panel connection. Cut the longer lengths first. Connect each of these front panel wires to their corresponding letter on the circuit board. Attach <u>all</u> the wires to the front panel **first**; then, connect the other ends to the circuit board.

A	3"
B	*
E	4.25
F	*
H	10.25
K	9
L	8
M	7
N	7
O	7.5
P	2.5
Q	9

All measurements are in inches.

T	4.25
U	5.25
W	5.25
X	11
Y	2.5
Z	11
AA	12.75
AB	9.5
AC	*
AD	4
AE	7.25
AF	7.25
AG	3.75
AH	11.5
AI1	3.25
AI2	9.5
AJ	12.25
AK	14.25
AL	12
AM	*
AN	4.25
AO	4.5
AP	4
AQ	5
AR	4
AS	5.5
AT	5.75
AU	4
AV	7
AW	7.5
AX	4
AY	4
AZ	3.5
BA	*
BB	17
BC	17
BD	*
BE	*

* Connect AM to AC, and AC to Z with two 1.75" pieces of insulated wire. Connect B, F, BA, and AY with a 5" piece of bare wire. Connect BD and BE with a 1.5" piece of bare wire, then connect BD to AY with a 13" piece of insulated wire.

4. As in Fig. 5, connect center terminals AN and AP to their adjacent, unused terminals with two small pieces of wire. Do NOT connect AN to AP.

5. Connect R50 between F and E.

6. Connect R49 between B and A.

7. Connect power supply wires. If these must be longer that 3 feet, double up on the wire or use heavier gauge wire for every extra 3 feet.

V^+ = 2.5 ft., GROUND = 2.5 ft., V^- = 2.5 ft.

TESTING THE VOCODER

One of the recurring fears of anyone who writes do-it-yourself articles is that someone will make a minor mistake which doesn't prevent the unit from working, but keeps it from working up to spec. With sixteen filters, eight envelope followers, eight VCAs, a fuzz, and various input and output stages, there's a lot that can go wrong...so here are some testing procedures to let you know whether all is well. Before deciding there's a problem, however, remember that vocoders can be somewhat tricky to operate. Make sure you aren't simply the victim of a misadjusted control.

Before turning on power, plug a microphone into IN 2 and set GAIN to HI, then plug a sustaining, harmonically-rich tone source into IN 1. For the latter, a poly synth set for either a sawtooth or wide pulse waveform is ideal for testing purposes. If the synth has a "Hold" feature, use it to latch a complex chord; or, tape down keys to provide a steady signal source. Remember, the ADSR sustain must be up full (after all, if you hold a chord without sustain it won't stay held for very long). Turn all vocoder controls fully counterclockwise, and patch the mono output to a suitable monitor or amp. After verifying your wiring, turn on the power supply. Look at the board; if any parts are smoking, something smells "hot", or any of the ICs are too hot to touch, immediately shut down power and try to locate the source of the problem (usually this will be incorrect power supply wiring or solder bridges on the circuit board).

Now set S5 to BYP, and S2 to IN 2. Speak into the mic, and adjust your monitoring system for a low-to-moderate volume level. Next, set S2 to IN 1 and you should hear the poly synth (or other tone source) through the amplifier. If you don't hear the mic with IN 2 selected and the synth with IN 1 selected, turn off the power and look for problems in assembly.

Change S5 to the VOCODE position, set VOCODE THRESHOLD clockwise 2/3 of the way, and turn up VOCODER LEVEL about halfway. Make sure that FUZZ is in the OUT position. Now slowly turn up IN 1 LEVEL. You should hear the synth very faintly in the background until a certain point; past this point, you will hear nasty distortion. Back off on IN 1 LEVEL until the distortion just goes away; this feeds the maximum signal level possible (short of distortion) into input 1 to insure the best vocoder effect.

Now speak into the mic and start turning up IN 2 LEVEL. If you hear the sound of a vocoded synth, congratulations! You are at least heading in the right direction. If not, check that the synthesizer is still holding a chord. Also make sure that the mic is working properly (to check, bypass temporarily to the mic).

Assuming that all is well, adjust VOCODER LEVEL for a comfortable listening level and experiment with setting the input level controls. The mic input is quite sensitive; turn it up too much, and you'll hear distortion but if you turn it down too

much, the vocoder effect will be choppy and not too intelligible. It cannot be emphasized enough that proper level setting is crucial to getting good vocoder effects. This is true whether we're dealing with a $100 or $3500 vocoder, so experiment. And remember that distortion can be caused by either the IN 1 or the IN 2 control being turned up too far.

After setting levels, check out the VOCODE THRESHOLD control. The one caution with this control is that there is some "settling time"; it takes about a second or so for the circuitry to react to control changes. Turn VOCODE THRESHOLD fully clockwise, and you should hear some of the IN 1 signal leaking through. For most applications, and for the most "natural" noise reduction curve, set this control just a tiny bit counter-clockwise from the point where the leakage disappears. With a linear pot, this should occur around the half-way point while the "magic spot" with an audio taper pot is about 2/3 of the way clockwise. Turning VOCODE THRESHOLD further counter-clockwise decreases the Vocoder's sensitivity to low-level signals, which gives more percussive vocoder effects.

To mix in some straight mic signal, turn up MIC DIRECT. You can add other signal processors in parallel with the MIC DIRECT line by plugging into the LOOP SEND and RECEIVE jacks. For example, to accent the voice midrange frequencies connect LOOP SEND to the input of one or more stages of the PAIA Parametric EQ, and patch the EQ output to LOOP RECEIVE. Turn up LOOP LEVEL for the desired amount of additional signal, then adjust the parametric for the desired midrange frequency. These jacks are also suitable for adding a phase shifter, digital delay, etc.

Now change the FUZZ switch to IN (re-adjust IN 1 LEVEL if necessary). The fuzz is most effective with harmonically simple signals, such as triangle waves and some acoustic instruments. Also, check out the stereo outputs; if you have a stereo board, try patching in both outputs and panning them to opposite sides of the stereo field. Don't expect to learn how to use the vocoder in an hour, or even a day -- it took me a couple weeks of light experimentation to find out which instruments work best, how to best use the controls, and so on. Be patient, and you'll feel totally at home with the Vocoder after a little while.

If the Vocoder is working to spec, attach the circuit board to the front panel using the provided angle brackets and 4-40 hardware (see Fig. 6). Otherwise, proceed to the next section.

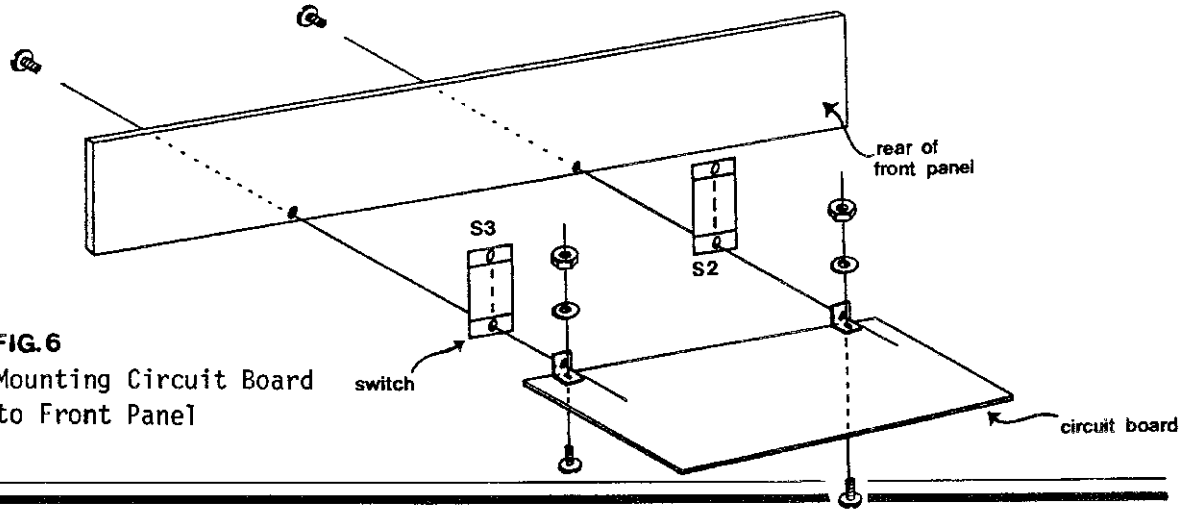


FIG. 6
Mounting Circuit Board to Front Panel

IN CASE OF TROUBLE

If you have access to a scope, you might want to check various points to make sure that all the filters, VCAs, and envelope followers are working correctly. We will assume a steady, harmonically-rich signal source plugged into IN 1 and a microphone plugged into IN 2.

As you speak into the mic, pin 10 and pin 4 of IC3 - IC6 should show some kind of output that varies with your speaking. It is normal for the level to drop off at the higher frequency and lower frequency filters. Also, check pin 1 and pin 16 on each 571. As you speak, there should be a fluctuating DC voltage that is roughly proportional to the level of your voice.

Pin 3 and pin 12 of IC3 - IC6 are the IN 1 filter outputs, and should show a more or less constant output since we're feeding a constant signal into IN 1. Again, the levels may vary from filter to filter. As you speak into the mic, pin 7 and pin 10 of each 571 should show fluctuating audio outputs from the instrument plugged into IN 1; these fluctuations should roughly correspond to the level of your voice.

If the Vocoder is mounted in a grounded, all-metal rack enclosure ground loop problems are theoretically possible (although they have not been observed during the vocoder's development and testing). Should problems occur, try leaving out the ground connection between the front panel and circuit board ground. Instead, run one wire from the circuit board ground to the power supply ground, and let the front panel make its ground connection via the grounded rack enclosure. Alternately, if the panel-to-rack ground connection is not good, run a second wire from the front panel ground (i.e. input jack ground lug) to the power supply ground.

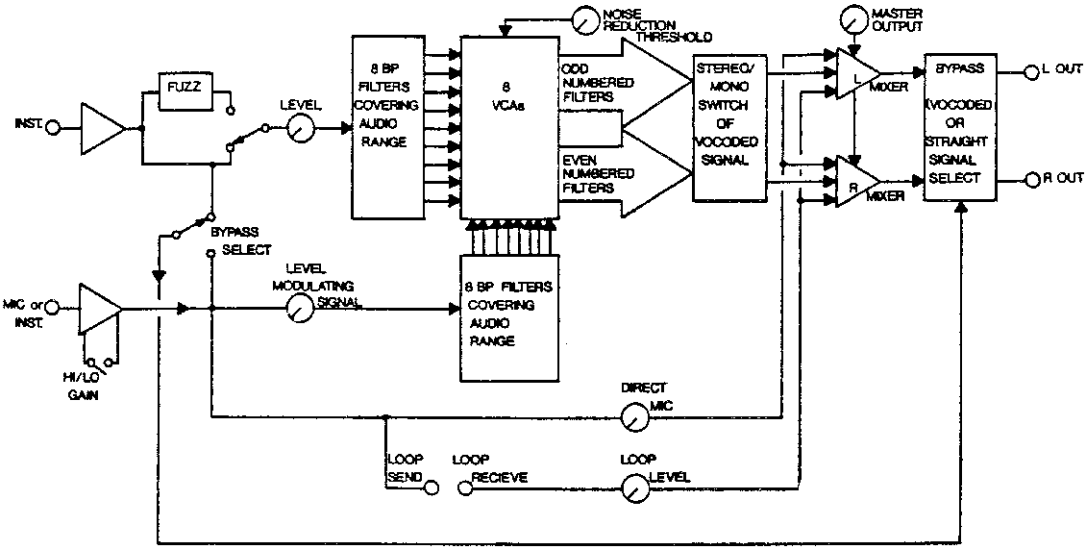
Should you encounter serious trouble getting the vocoder to work, a repair service is available through PAIA.

One final tip: If setting the input levels seems like an overly difficult process, try limiting the signals going into these inputs. This will make it easier to feed in lots of signal level without excessive amounts of distortion and is probably necessary on the Mic input for those vocalists without good mic technique.

VOCODER THEORY

Fig. 7 shows the Vocoder's block diagram. Most vocoders are similar, except the more expensive ones have more bands of filters. Note that it has two inputs; typically, one is for an instrument such as keyboard or guitar, while the other is for a microphone (or other signal source, such as electronic drums). Talking into the microphone impresses vocal effects on to whatever is plugged into the instrument input via a fairly complex process, as described below.

FIG.7 Vocoder Block Diagram



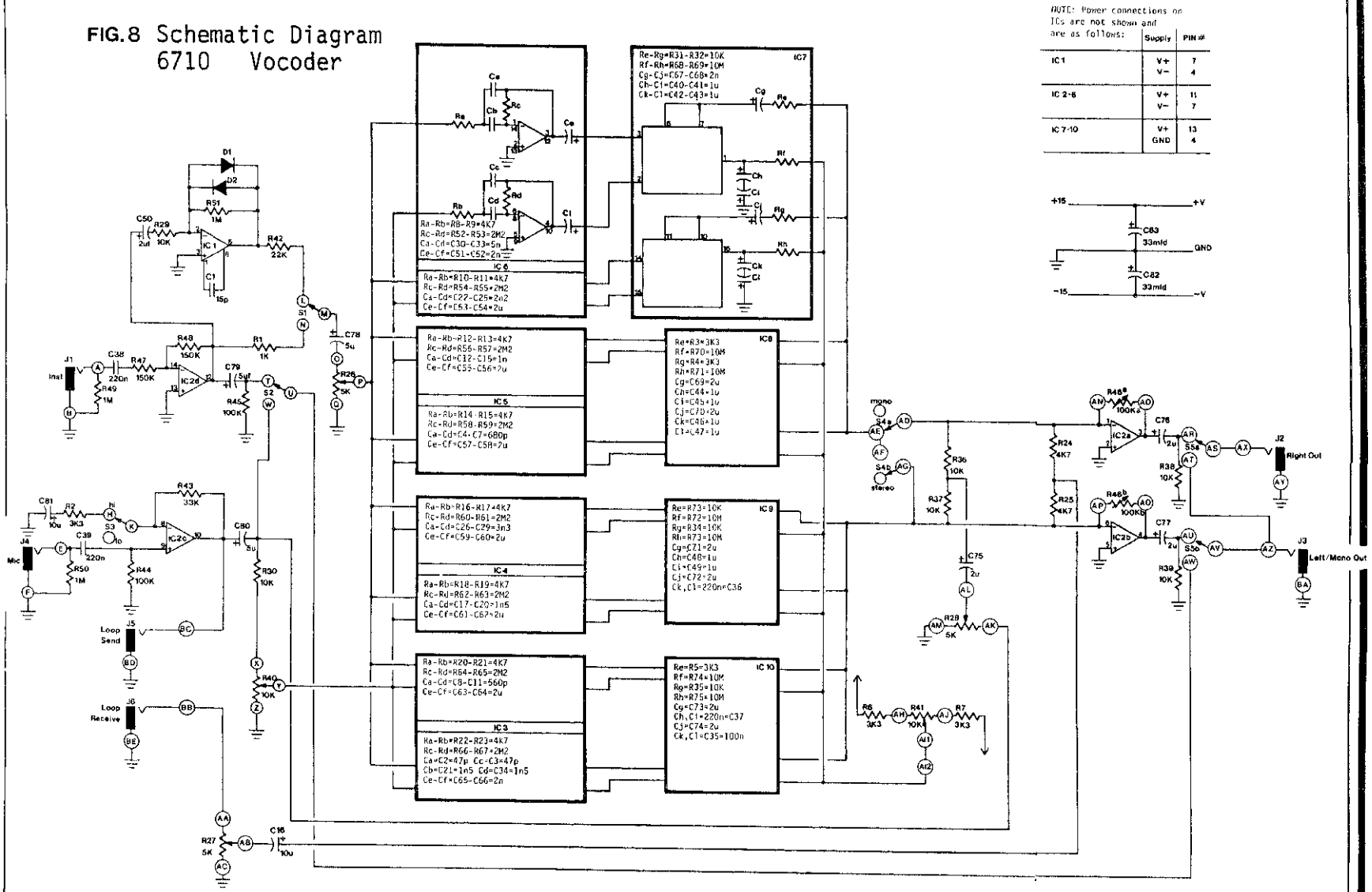
With human speech, different sounds are associated with different parts of the frequency spectrum. For example, an "S" sound contains lots of high frequencies, whereas plosive sounds (such as "P", "B", and the like) contain lots of low frequency energy. One section of the vocoder splits the microphone signal into eight separate filter sections; each filter covers a specific part of the audio spectrum (somewhat like a graphic equalizer). Therefore, when you speak an "S" into the microphone, the higher frequency filters fed by the mic will produce an output but there will be no output from the lower frequency filters. Speaking a plosive into the microphone will give an output from the low frequency filters, while little (if any) signal will pass through the higher frequency filters. Vowel sounds produce outputs at the various midrange filters. These outputs go through individual envelope followers to provide a control voltage that tracks the energy in the part of the spectrum covered by the filter.

To understand the reason for splitting the mic signal into frequency bands, we need to turn our attention to the instrument input signal. Like the mic channel, the vocoder splits the instrument signal into eight different filters, which are tuned to the same frequencies as the mic channel filters. However, these filters are followed by VCAs (voltage controlled amplifiers); therefore, the filter outputs may be amplified or attenuated by a control voltage increase or decrease.

Now consider what happens when you play a note into the instrument input while speaking into the mic input. If an output occurs from the mic's lowest frequency filter, then its envelope follower controls the VCA of the lowest instrument filter, and passes the corresponding frequencies from the instrument. If an output occurs from the mic's highest frequency filter, then that output controls the VCA of the highest instrument filter, and passes any instrument signals present at that frequency. The midrange sections act similarly.

As you speak, the various mic filters produce output signals which correspond to the energies present in your voice. Since these signals control the VCAs, which in turn control the set of equivalent filters connected to the instrument, you superimpose a replica of the voice's energy patterns on to the sound of the instrument plugged into the instrument input. Of course, you are not limited to plugging a mic into the mic input; in fact, percussive instruments and program material can produce very interesting results.

FIG.8 Schematic Diagram
6710 Vocoder



DESIGN ANALYSIS

Referring to Fig. 8, the mic input passes through IC2C, which can be set for either low or high gain. At high gain (mic level), recommended input levels are 20 mV to 2V peak-to-peak (p-p); at low gain (line level), 100 mV to 10V p-p. The output feeds a level control, R40, which is later adjusted so that the mic channel doesn't overload the high-gain filtering circuits.

The instrument input passes through unity gain buffer IC2D. The recommended instrument output level is from 100 mV to 10V p-p. The buffer can feed the instrument channel level control directly or pass through the fuzz built around IC1 (as selected by S1). The reason for putting a fuzz in the instrument channel is that complex sounds (i.e. polyphonic synthesizer) work best for vocoding, and the fuzz can increase the harmonic content of simpler signals (i.e. acoustic guitar) for more dramatic effects.

Expensive vocoders use complex filter circuits that require many precision parts; to minimize costs, this Vocoder uses simple filter structures for the eight pairs of filters built around IC3 - IC6. Nonetheless, these filters work quite well providing you do not substitute inferior capacitors for those specified in the parts list. For example, substituting ceramic capacitors for polystyrene capacitors can lower the filter's bandwidth (resonance), as well as change the filter's "tuning". If you're really a fanatic, you can match resistors and capacitors for each pair of filters although I haven't felt any need to do this.

A single NE571 provides the VCA and envelope follower circuits for two channels, thus saving cost, cutting the parts count, and giving improved performance since the VCAs and envelope followers are closely matched. Interestingly, the 571 was designed for telecommunications devices, not vocoding; however, since the vocoder is an outgrowth of telephone technology (it was developed by Homer Dudley in the late 1930s to convey voices over long distance lines by indirect means), it seems only fitting that the vocoder include some of its telephone "roots".

The eight VCA outputs are alternately sent to two separate mixers (IC2A and IC2B), thus providing true stereo effects that do not cancel when recombined back into mono. S4 chooses between mono and stereo operation. If desired, R28 mixes in direct signal from the mic channel. With a signal processor inserted in the loop send and receive jacks, R27 mixes in this processed version of the direct mic channel signal. In stereo, these signals will appear in the center of the stereo field.

R46 sets the overall vocoder level, from less than 1V p-p to

over 10V p-p. J3 is the output jack for mono operation and provides the left channel output for stereo applications; J2 provides the right channel output for stereo, and is disabled with mono selected.

The bypassing protocol is unique to this particular vocoder. S2 determines whether the mic or instrument signal appears at the output when the vocoder is bypassed (as determined by S5). This is particularly useful if you are, say, modulating synthesizer with electronic drums; sometimes, you might want to bypass to the synth signal, while at other times you might want to bypass to the drums.

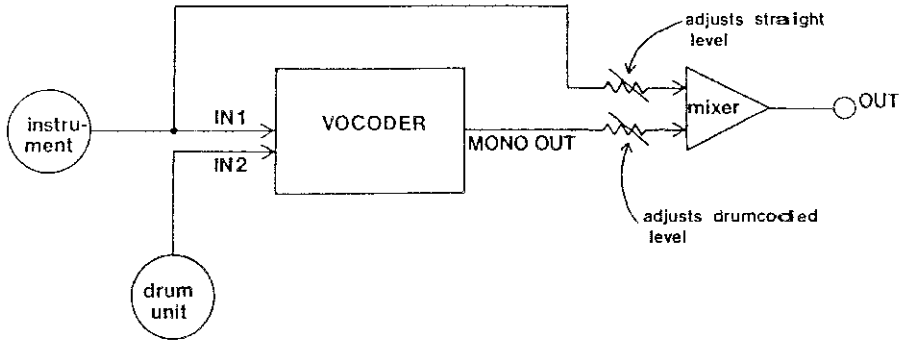
R41, the Threshold control, is another unique feature. This control affects the noise reduction characteristics, as well as performing a couple of other tricks. When turned fully clockwise, the VCAs are all turned on somewhat, thus letting through some of the instrument signal. About 2/3 of the way clockwise, the VCAs are set for a linear response that provides the most natural-sounding noise reduction. Turning the control counterclockwise from this point expands the dynamic range downward, which has the practical effect of limiting the vocoder's response to low-level signals. This is handy when limiting or compressing signals going into the vocoder, as it prevents the vocoder from reacting to low level hum, noise, and other garbage coming out of the limiter or compressor. It takes a little practice to learn this control, but the results are worth it.

APPLICATIONS NOTE

One of my favorite vocoder applications is called "cross-synthesis" or "cross-modulation", where another instrument -- rather than a mic -- modulates the instrument plugged into IN 1. For example, electronic drum units can "drumcode" a part. I particularly like the patch in Fig. 9 for bass, guitar, and synthesizers, as you can impart rhythmic qualities to these instruments by "drumcoding". (Those who have heard the Craig Anderton/Scientific Americans flexi-disc in the W issue of OP magazine will probably recognize the drumcoding on the rhythm guitar part.) I won't spoil your fun by giving away too many secrets; play with the Vocoder, and you will find them too.

Vocoders are also great for creating synthetic choirs. Program a polyphonic keyboard for a voice-like waveform (i.e. pulse waveforms), and patch the synth out into IN 1. Saying "la-la", "ooooh", "ahhh", and similar sounds into the microphone input imparts these vocal characteristics to the keyboard. Playing in different registers will create different types of "choirs".

FIG. 9 Drumcoding Patch



CREDITS

Designed by.....Craig Anderton
Project consultants....John Simonton, David Karr, Vanessa Else
Parts kit produced by.....Vanessa Else, Scott Lee
Documentation.....Vanessa Else, Craig Anderton

SPECIFICATIONS

IN 1 recommended input level: 100 mV to 10V peak-to-peak.

IN 2 recommended input level, LO gain: 100 mV to 10V p-p.

IN 2 recommended input level, HI gain: 20 mV to 2V p-p.

Approximate bandpass filter frequencies: 200 Hz, 400 Hz, 600 Hz, 950 Hz, 1300 Hz, 2200 Hz, 3000 Hz, and 4900 Hz (the latter provides a modified bandpass response).

Power supply required: Regulated ±15V.

Current consumption: Typically +60 mA, -40 mA.

Signal-to-noise ratio: Typically greater than 60 dB (unweighted).

Maximum available output: Greater than 10V p-p.

Bypass protocol: Bypasses to either input.

Stereo protocol: Alternate filters go to opposite channels.

* * * * *

Portions of the section on how a vocoder works are excerpted with permission from the book "Guitar Gadgets" (by Craig Anderton; published by Music Sales; available through PAIA).

Much of this manual is reprinted with permission from an article by Craig Anderton in KEYBOARD magazine (20085 Stevens Creek Blvd., Cupertino, CA 95014).

6710 Vocoder Assembly Details Supplement

Please read through this information before beginning assembly of the kit.

Two printed circuit traces were omitted in this updated version of the board. Two patches are needed to link the following sets of circuit points:

a) R9/R11 and R13/R15/JB.
b) R21/R23 and R17/R19/JD.

Tack solder two 4.5 inch lengths to the sets of points as follows to make the patch:

a) the "9" end of the resistor at R9 and the "3" end of the one at R13.
b) the "7" end of R17 and the "1" end of R21.

note if you're 'building-in' the mod for the board this patch is not needed

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Update the following wires with these new lengths:

a) JB 3.5", b) JH 3.5", c) JI 4", d) JJ 4", e) K 10.5", f) Z 12.5", g) AN 5", h) AY 5".

Note on the parts list that only resistors R49 and R50 install on the panel, R51 is on the board.

Note on the parts list that ICs 7-10 may also be 570 compandor ICs.

Note on the parts list that the 47pF polystyrene capacitors may be ceramic disk ones.

Capacitors are often marked with a code to eliminate the decimal point. There will be significant digits listed with a number of the zeros that follow. This number is the value in pF. Moving the decimal six places to the left is the value in uF (ie, 0.1uF may be marked 104 or 10_0000 pF which is the same as 0.1uF). Significant values of 4.7 or 2.2 may interchange with 5 or 2.

Rotate through the colors of the insulated wire as the lengths are cut. This will make it easier to check your work if needed. Also, it is mentioned to cut and solder the longest lengths first. This ensures all lengths can be cut from the amount provided. Here is the order of the wire lengths from longest to shortest: BB, BC, AK, AA, Z, AJ, AL, AH, X, K, H, AB, AI1/AI2, Q, L, O, AW, AE, AF, M, N, AV, AT, AS, U, W, AQ, AN, AY, AO, E, T, AD, AP, AR, AU, AX, AG, AZ, A, P, and Y. Refer to this list when cutting and soldering the wires, or number the list in the manual according to this sequence and proceed in this order.

The potentiometers have a mounting tab that is not needed. Use pliers to bend it outwards and break it off so the part sits flat against the panel.

The spdt switches supplied in the kit may be substituted with dpdt type. There is an unused half or row of three terminals in this instance.

The slide switches supplied in the kit may include a type with threads for the mounting screws. On the two lower and outermost mounts, the screw goes through to the threads of L-brackets. Before installing the L-brackets at these positions overtighten the screws here so they turn freely and can tighten into threads of the brackets.

The circuit is designed for operation on a dual-dc (bipolar), regulated +and-15vdc power supply such as our 9770R-15 or similar.

The Vocoder orginally appeared as a diy project in the May 1985 issue of Keyboard magazine and included a schematic for a power supply for the unit.

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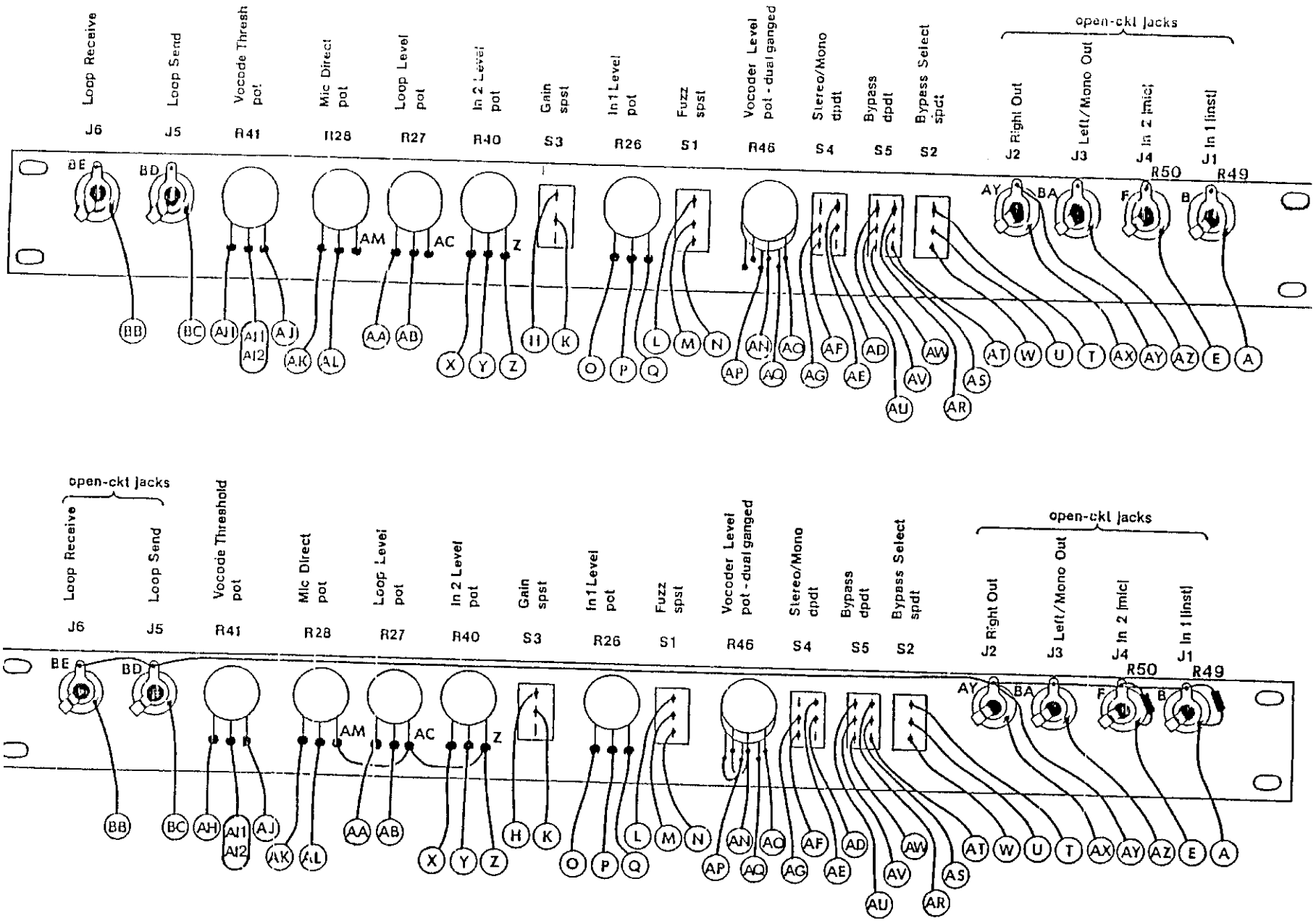
sl 5/4/2004


Loop Receive
J6
Loop Send
J5
Vocode Thresh pot
R41
Mic Direct pot
R28
Loop Level pot
R27
In 2 Level pot
R40
Gain spst
S3
In1 Level pot
R26
Fuzz spst
S1
Vocoder Level pot - dual ganged
R46
Stereo/Mono dpdt
S4
Bypass dpdt
S5
Bypass Select spdt
S2
open-ckt jacks
J2 Right Out
J3 Left/Mono Out
J4 In 2 (mic)
J1 In 1 (inst)
R50
R49
BE
BD
BB
BC
AJ
AJ1
AJ2
AK
AL
AM
AA
AB
AC
X
Y
Z
H
K
O
P
Q
L
M
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Vocoder Noise Reduction Modification

This mod to the 6710 Vocoder virtually eliminates an otherwise objectionable amount of hiss from the mono or stereo outputs. A voltage follower op-amp circuit (buffer) inserts at the input to each filter, isolating the IN1 and IN2 level controls from the eight filters they feed. Each follower drives its own load instead of the variable resistance of the level controls driving all eight. This means more signal with a flatter response gets to the output of the bands, there's more dynamic range, and the signal to noise ratio is improved. Additionally, the summing resistors to the mono/stereo output amps can be larger which lowers the gain of these stages contributing to lower noise.

A Component PC Board (general purpose) available at Radio Shack (276-168b) makes it easy to add the four ICs and wiring for the mod. The board is full of holes and soldering points/grids optimized for wiring IC circuits. Sockets for the four ICs can be soldered and connections between the output pin to the inverting (-) input pin is easily made with a wire jumper. Two busses facilitate common circuit connections and the IN1 and IN2 taps can distribute to IC pins on these. The IN1 and IN2 taps, the buffered outputs, and the V+/V- power supplies connect using #22 insulated, stranded wire (about a foot for each connection with the mod board situated behind and at about the middle of the vocoder circuit board).

Notice on the vocoder that the IN1 and IN2 level controls wire to circuits from their #2 terminals (via wire P for IN1 and wire Y for IN2) and these two circuits each have eight 4700 ohm (yellow-violet-red-gold) spaced across the board which are the inputs to the band filters. Remove and discard the P and Y wires; they'll be replaced with new ones to the mod board. Desolder and lift the ends of the 4700 ohm filter input resistors from the circuits that tie them to the P and Y wiring points; they become the connecting points for the mod board buffer outputs.

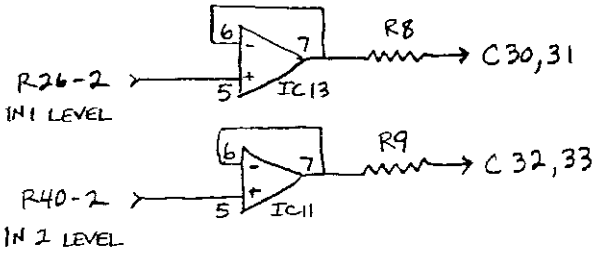
The summing resistors which set the mix of the bands should be replaced before the mod board and its wiring are added. Remove resistors R31, R32, R3, R4, R33, R34, R5, and R35. Install 33k (orange-orange-orange-gold) resistors at all these positions except R5 and R35. Install a 22k (red-red-orange-gold) at R5 and a 68k (blue-grey-orange-gold) at R35.

Finally, wire the mod board to the points on the vocoder. When making the connections to the filter input resistors with the wires from the buffers, a piece of tubing can be slipped over the wire before it's soldered to the end of the resistor so the joint can be covered/insulated. Make the V+ and V- connections from the mod board to the vocoder power supply (there is no ground circuit to the mod board). Test operation.

If it didn't look like you had a plate of spaghetti in front of you before, it should now! Enjoy.

Scott Lee - Paia tech

mod parts list:
1 component pc board
4 14 pin IC sockets
4 TL 084 quad op-amps
6 33k resistors
1 22k resistor
1 68k resistor
appx. 20 ft. #22 ins. stranded wire



EXAMPLE FOR ONE BAND