

# **RAVA** Vocal Zapper

Model 6730  
Assembly and Using Manual



Whether you want to sing Karaoke to essentially any recording, practice and improve your vocals or just feel like a rock star for a few minutes, then the Vocal Zapper is for you. This low-cost device, when used in conjunction with any conventional stereo system, removes the lead vocal from most CDs, records and tapes, and puts your voice in its place.

There are somewhat more serious uses for the Zapper, too; for example, with the lead vocal removed, you'll hear harmony and background parts on records that you've never heard before. Some aspiring singers have used the Vocal Zapper to record demo tapes featuring their voice in place of another singer's. Perhaps best of all, this is a simple, non-critical circuit that is easy to construct and use.

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## ASSEMBLING THE VOCAL ZAPPER

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. Check the parts supplied against the packing list on the last page of this manual.

*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 p405.340.6300, f340.6378, or [missing@paia.com](mailto:missing@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 that serves as a wrapper for this manual. Remove the wrapper for easy reference to the illustrations during assembly.

## THE CIRCUIT BOARD

The Vocal Zapper is built on a circuit board with solder masks and plating to help prevent short circuits. No special preparation or cleaning is necessary before assembly. The "top" of the board is the side that is printed with component designations and parts are mounted from this side. The "bottom" of the board is also called the solder side.

## 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.

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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**

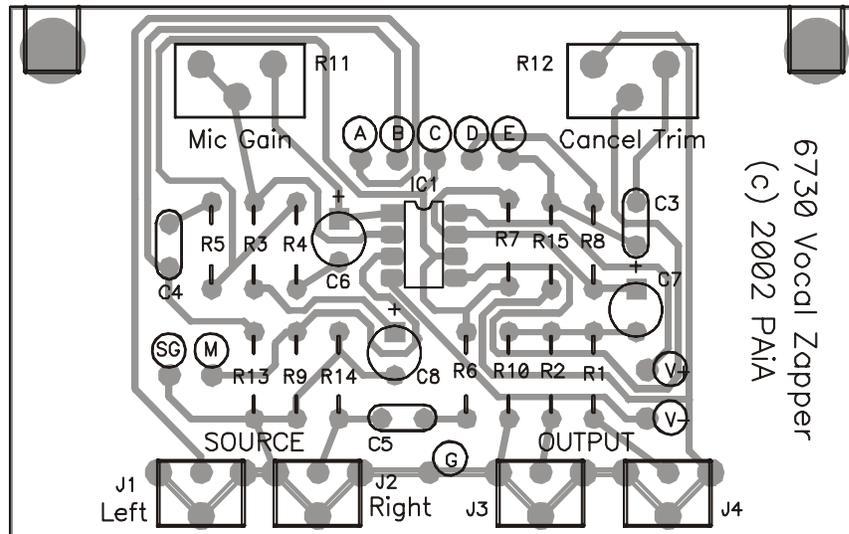
Select a soldering iron with a small tip and a power rating not more than 35 watts. Soldering guns are completely unacceptable for assembling solid state equipment because the large magnetic field they generate can damage components.

Use only a high quality 60/40 alloy rosin core solder (acid core solder is for plumbing, and silver solder is for jewelry - neither is for 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.

Too much solder may produce a conducting bridge of excess solder between adjacent pads causing a short circuit. If WAY too much solder is used it may flow through the hole and cause bridges between conductors on the component side of the board or even impede the action of mechanical components such as trimmer potentiometers. 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.



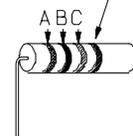
**Fig 1.** Parts are mounted on the circuit board in the locations shown.

Solder each of the fixed resistors in place following the parts placement designators printed on the circuit board and the assembly drawing (figure 1.). Note that the fixed resistors may be mounted with either of their two leads in either of the holes provided. Insert both leads in the mounting holes from the non-foil side of the board, and push the resistor fully against the board. On the conductor or foil side of the board, bend the leads outward to about a 45 degree angle to help hold the component in place while soldering. **AFTER SOLDERING**, clip off each lead end flush with the top of the solder joint. Save some of these clipped leads for use as wire jumpers in later steps.

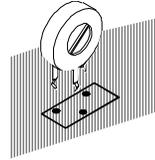
DESIGNATION    VALUE    COLOR CODE A-B-C

( ) R1	1K	brown-black-red
( ) R2	1K	brown-black-red
( ) R3	2.2K	red-red-red
( ) R4	22K	red-red-orange
( ) R5	47K	yellow-violet-orange
( ) R6	47K	yellow-violet-orange
( ) R7	47K	yellow-violet-orange
( ) R8	68K	blue-grey-orange
( ) R9	100K	brown-black-yellow
( ) R10	100K	brown-black-yellow
( ) R13	470K	yellow-violet-yellow
( ) R14	470K	yellow-violet-yellow
( ) R15	470K	yellow-violet-yellow

Silver or Gold  
(disregard)



- ( ) Install 100K trimmer potentiometer R11 and solder in place.
- ( ) Install 100K trimmer potentiometer R12 and solder in place.

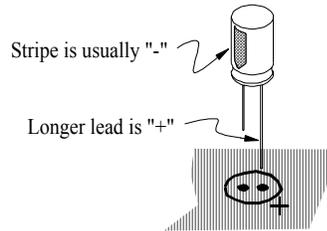


Install the ceramic disc and mylar capacitors. Like resistors, either of the two leads can go in either of the holes provided. The value of the capacitor will be marked on the body of the part. Solder in place according to figure 1 and clip the excess leads.

DESIGNATION	VALUE	may be marked	Capacitors	
			Disk	Mylar
( ) C3	.01 mfd.	103		
( ) C4	.22 mfd.	224		
( ) C5	.22 mfd.	224		

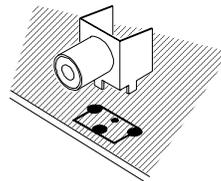
Up to this point, all components have been non-polarized (i.e. either lead can go into either hole). Electrolytic capacitors are polarized; just like a battery they have a (+) and a (-) end, and like a battery, if installed incorrectly the circuit won't work. The capacitors supplied will have either the (+) lead or the (-) lead marked on the body of the part. The (+) lead MUST go through the circuit board hole which has also been labelled positive (+). In the event that the capacitors have their negative (-) lead marked, this lead should go through the unmarked hole in the circuit board. Voltage rating is a minimum value and parts supplied may have a higher rating.

DESIGNATION	VALUE
( ) C6	1 mfd.
( ) C7	10 mfd.
( ) C8	10 mfd.

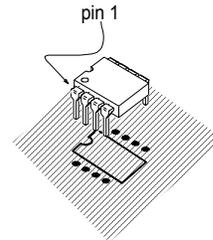


Install the 4 PC mount phono jacks on the board in the places designated in figure 1. Note these will only install in one way so that all the lugs fit into the board. Press flush against the board, and then solder from the foil side of the board.

- DESIGNATION
- ( ) J1 phono jack
  - ( ) J2 phono jack
  - ( ) J3 phono jack
  - ( ) J4 phono jack



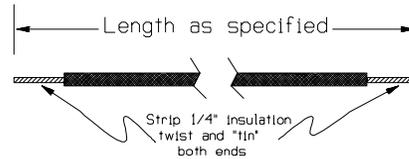
Install the integrated circuit. Note that the orientation of the IC is keyed by a notch at one end of the case which aligns with the semicircular key on the designator printed on the circuit board. Use particular care when installing this part, like any other semiconductor it is heat sensitive and should not be exposed to extraordinarily high soldering temperatures. Make sure that the orientation is correct before soldering, Once they are in place they are difficult to remove.



DESIGNATION TYPE NO.

( ) IC1 5532 Dual Low Noise OpAmp

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



Using the wire provided, make the following connections to the circuit board. Use different colored wire for connections to point "M" and "SG" so the origin can be easily identified after the wires are twisted together in a later step.

PC POINT	WIRE LENGTH	PC POINT	WIRE LENGTH
( ) "M"	4"	( ) "C"	2"
( ) "SG"	4"	( ) "D"	2"
( ) "A"	2"	( ) "E"	2"
( ) "B"	2"	( ) "G"	4"

( ) Solder the black lead from one of the battery clips to the hole marked "V-" on the circuit board.

( ) Solder the red lead from the other battery clip to the hole marked "V+" on the circuit board. The remaining leads from the clips will be connected to the switch in a later step.

Temporarily set the circuit board aside and mount the controls to the panel as shown in Fig 2.

( ) Using the nuts provided with them, mount DPDT toggle switches S1 and S2 and the Microphone input jack J5 to the front panel. Do not use any washers supplied with the switches.

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Continue by wiring the front panel parts as shown in Fig 3. Notice that Individual solder lugs are identified by part number and lug number. For example, S1-2 means the lug labeled "2" of the switch S1.

( ) Use a piece of excess resistor lead to connect S2-6 to S2-3. Solder the connection at S2-3 but a second wire will connect to S2-6 later and both wires soldered at that time.

**Note:** Be careful when soldering the wires to the switch. Too much heat can soften the body of the part causing the solder lugs to shift position. If you are using a 30W or less soldering iron there is little danger, but higher power irons should not be left on the lugs too long.

In the following steps, connect wires from the circuit board to front panel parts as listed. Solder each connection as it is made.

FROM	TO	FROM	TO
( ) "A"	S1-2	( ) "D"	S1-4
( ) "B"	S1-1	( ) "E"	S1-3
( ) "C"	S1-5	( ) "G"	S2-6 (solder 2 wires)

Loosely twist the wires from points "SG" and "M" together before making these connections.

FROM	TO	FROM	TO
( ) "SG"	J5-S	( ) "M"	J5-T

( ) Connect and solder the free RED wire from one of the battery clips to S2-5.

( ) Connect and solder the free BLACK wire from the other battery clip to S2-2.

THE FRONT PANEL MAY NOW BE BOLTED TO THE CIRCUIT BOARD AS FOLLOWS:

( ) Attach the two "L" brackets to the front panel by passing a 4-40 X 1/4" machine screw through the holes in the panel and the unthreaded holes in the "L" brackets. Secure each machine screw with a #4 hex nut. Do not fully tighten until the front panel is aligned and attached.

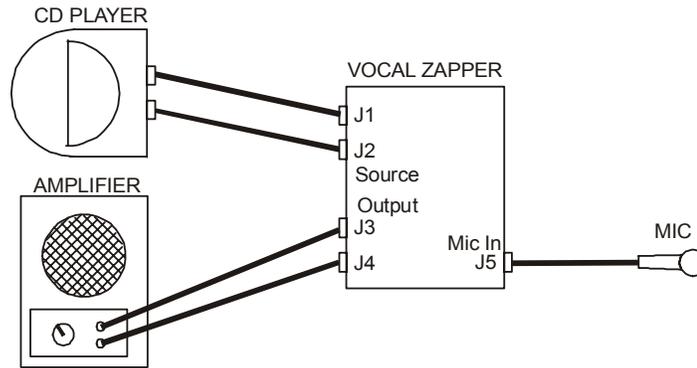
( ) Fasten the front panel to the circuit board by passing a 4-40 X 1/4" machine screw through the corner holes in the circuit board from the solder side and into the threaded holes in the brackets. Tighten all screws.

( ) Mount the four rubber feet by peeling the protective backing and adhering them to the corners of the bottom of the circuit board. See figure 2.

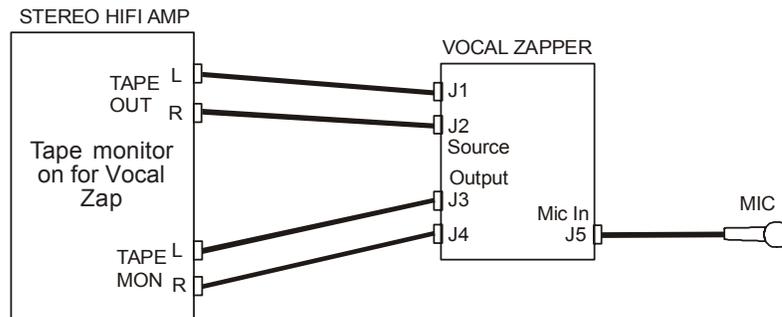
THIS COMPLETES ASSEMBLY OF THE VOCAL ZAPPER

Before proceeding with testing and calibration, thoroughly check the bottom of the circuit board for solder bridges and cold solder joints. Clip off any component leads that extend beyond the height of the rubber feet. Recheck parts placement and values. Once satisfied that all is well, snap two fresh 9v. transistor radio type batteries into the battery clips with the power off.

By far the easiest way to use the Vocal Zapper is to connect it between a CD player and amplifier as shown in the illustration below. Alternately, it may be connected between the preamp and power amp of nonintegrated systems.



The Vocal Zapper can also be connected to a stereo system through the TAPE OUT and TAPE MONITOR jacks, as shown below. Note that the stereo's TAPE MON button must be in the IN position to put the Zapper into the stereo signal path.



After hooking the Zapper into your system, turn on the power switch of the Zapper and all other components and start playing the program material you will be working with. With S1 on the Vocal Zapper in the NORMAL mode (right most position when viewing the panel from the front) you should hear the program material, but in mono; and you may notice a slight drop in overall volume level, which can be compensated for with the stereo system's volume control.

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Now comes the big test. Switch S1 to the Zap mode, and the lead vocal should drop out as if by magic. If it doesn't, adjust trimpot R12 for the maximum amount of cancellation (this should occur somewhere near the midpoint of rotation). Once set, this trimpot need not be changed as you play different records unless you are altering it for a specific effect.

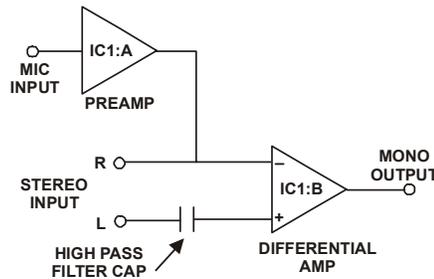
Now that the lead vocal has been eliminated, it's time to try out the microphone preamp. Plug a microphone into the J5 with trimpot R11 set full counter-clockwise and the gain on your stereo tuned all the way down. TO PREVENT FEEDBACK THE USE OF HEADPHONES IS RECOMMENDED.

Adjust trimpot R11 for the proper blend between microphone and program material. Note that most people tend to set the mic gain too high at first so that they can hear themselves well; however, excessively high mic gain settings can cause distortion. If you experience such distortion, back off on R11 a bit. Now with the unit in the Zapped mode, you can sing (or howl) along with some of the world's best backup musicians playing for you. Please note that the Zapper will not work with mono program material, but stereo tapes, records, or FM with good separation will work in almost all cases.

#### PRINCIPLES OF VOCAL CANCELLATION

With most stereo records, certain instruments are traditionally placed in the center of a stereo mix, such as vocals, bass, and bass drum. Other instruments, such as lead guitar, keyboards, vocal harmonies, and the like are mixed more towards the right or left side of the stereo spread.

The Vocal Zapper removes the lead vocal according to the process shown in the figure. The right and left channels of a conventional stereo recording are summed together in a differential amp (IC1). As a result, all center channel material, including the lead vocal, is cancelled at IC1's output. The remaining instruments that are mixed more to the right and left sides are relatively unaffected.



In order to prevent complete cancellation of the bass and bass drum, C3 only allows frequencies above approximately 160 Hz to be cancelled. Frequencies below 160 Hz are not mixed differentially, meaning that bass information present in the right channel will appear at IC1's output. If you prefer complete suppression of the center of the stereo field and do not mind losing some bass, you can change the value of C3. Values between C3's current value of .01 mfd and .22 mfd. will cause greater rejection as the value is increased.

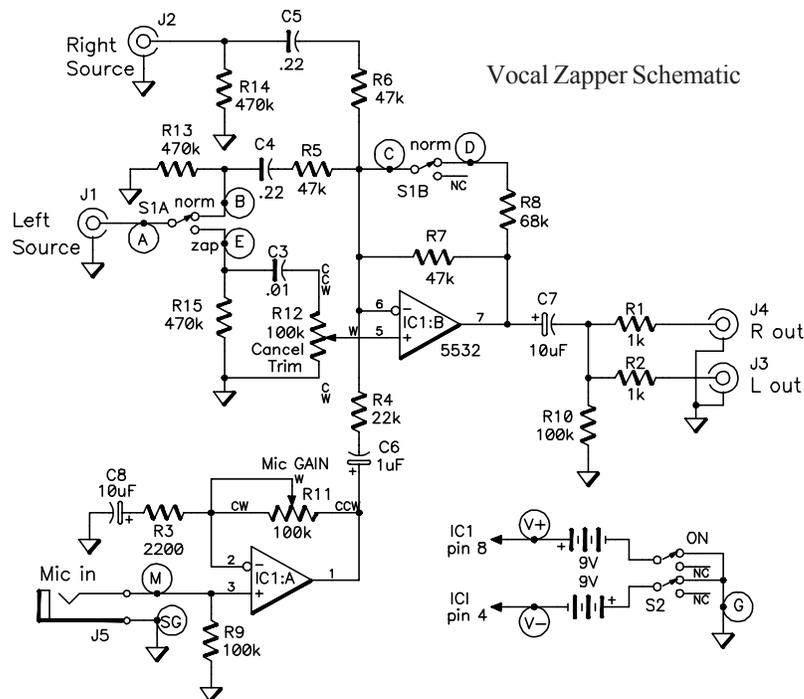
## CAVEATS

There are a couple of fine points. The Vocal Zapper will not work with mono recordings, since in this case everything is center channel material. Also, any reverb added to the vocal will tend to remain -- but in most cases, the reverb is at a low enough level to not be objectionable (and if you're singing along with the record, it even helps to have little remaining reverb underneath your vocal to add depth).

It should also be noted that some recordings use vocal processing techniques where digital delays and other enhancers spread the vocal across both channels in unequal amounts. Luckily for us, these records are definitely in the minority; greater than 95% of all pop, rock, and C&W records sampled during development of the Vocal Zapper had the lead vocals mixed in the center channel, and were therefore eligible for cancellation.

## ABOUT THE CIRCUIT

Referring to the schematic, IC1 is a differential amplifier, built around a 5532 or equivalent type dual low-noise opamp. The right channel signal couples through C5 into the (-) input of the opamp; the left channel signal feeds either the (-) input or (+) input of IC1, depending on the setting of S1. In the normal mode, the left channel signal feeds the (-) input, and the IC1 acts as a simple mixer. This produces a mono output that is the sum of the left and right channels. With S1 in the Zap (or cancel) mode, the left channel signal feeds the



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(+) input of IC1, thus producing cancellation of common-mode information (i.e. anything in the center channel above approximately 160 Hz). Note that in the zap mode, the overall output level may seem slightly lower since the center channel information is missing. S1b compensates for this effect by slightly reducing the gain of IC1 in the normal mode. R12 allows the user to adjust the Vocal Zapper for the maximum amount of lead vocal cancellation. IC1:B's output couples back into the stereo system through R1 and R2.

IC1:A is a simple mic preamp that accommodates a variety of different microphones, and mixes the microphone signal into IC1:B to replace the lead vocal with your voice. The mic output goes directly into the (+) input of IC1:A, whose gain is set by R11. IC1:A's output then couples through C6 and R4 into the (-) input of IC1. Power for both opamps is provided by a +9v (bipolar) transistor radio battery supply. The Vocal Zapper is intended for use with stereo systems having TAPE OUT and TAPE MON jacks (see INSTALLATION).

#### IN CASE OF DIFFICULTY

Recheck the wiring according to the instructions given previously in this manual. Also, make sure the batteries are fresh and functional. Pay special attention to the orientation of the ICs and to the solder connections. Many kits are returned for repair having nothing more wrong with them than a bad solder connection or two. Finally, check for solder bridges, wire bits, or other foreign matter which may be lodged across conductors on the circuit board.

Should you be unable to determine the source of the difficulty, a repair service is available. BEFORE sending the unit back, write us for return instructions and authorization to the addresses on the back cover of this manual or email to [tech@paia.com](mailto:tech@paia.com). Give as full a description of the malfunction as possible; in many cases your problem may be diagnosed by mail. If no diagnosis can be made, you will be supplied with a repair address and shipping instructions.

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## Vocal Zapper Packing List

### ***all resistors 5% tolerance 1/4W.***

1	22K	red-red-orange
2	1K	brown-black-red
1	2.2K	red-red-red
3	47K	yellow-violet-orange
1	68K	blue-grey-orange
2	100K	brown-black-yellow
3	470K	yellow-violet-yellow

### ***variable resistors***

2	100K	Trimmer Potentiometers
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### ***disk and mylar capacitors***

1	.01uF	Ceramic Disk
2	.22uF	Mylar

### ***electrolytic capacitors (minimum voltage specified)***

1	1uF/10V
2	10uF/15V

### ***semiconductors***

1	5532	Dual Low Noise Op-Amp
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### ***hardware and miscellaneous***

2	DPDT	Toggle Switch
4	PC	mounted Phono Jacks
1	1/4"	OC Phone Jack
2	18"	lengths insulated wire
2	#4	"L" Bracket
4	4-40 X 1/4"	Machine screw
2	4-40	Hex Nut
4	Stick-on	Rubber Feet
2	9V	Battery Snap
1	Circuit	Board
1	Front	Panel

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# **RAIA** Vocal Zapper

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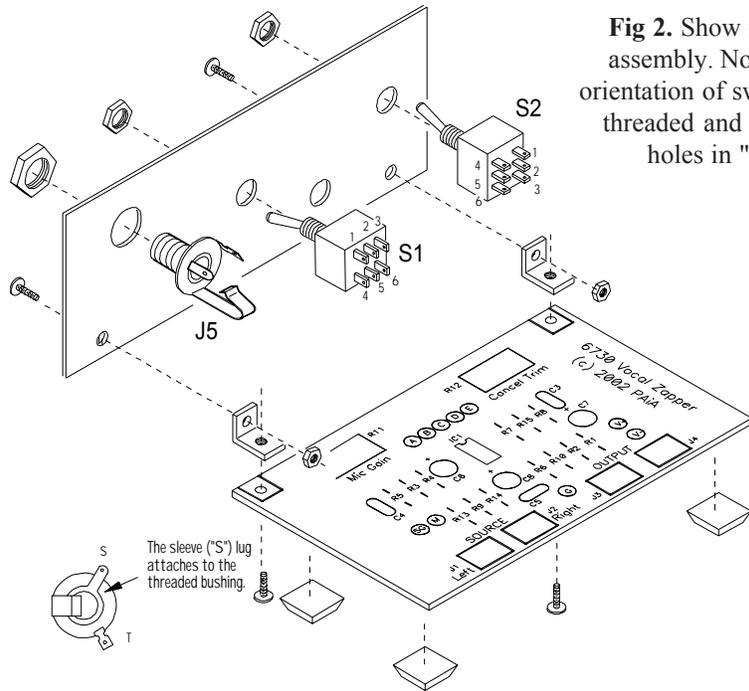
Model 6730  
Illustrations and Supplemental Information

This wrapper page for the Vocal Zapper manual may be removed for easy access to the illustrations.

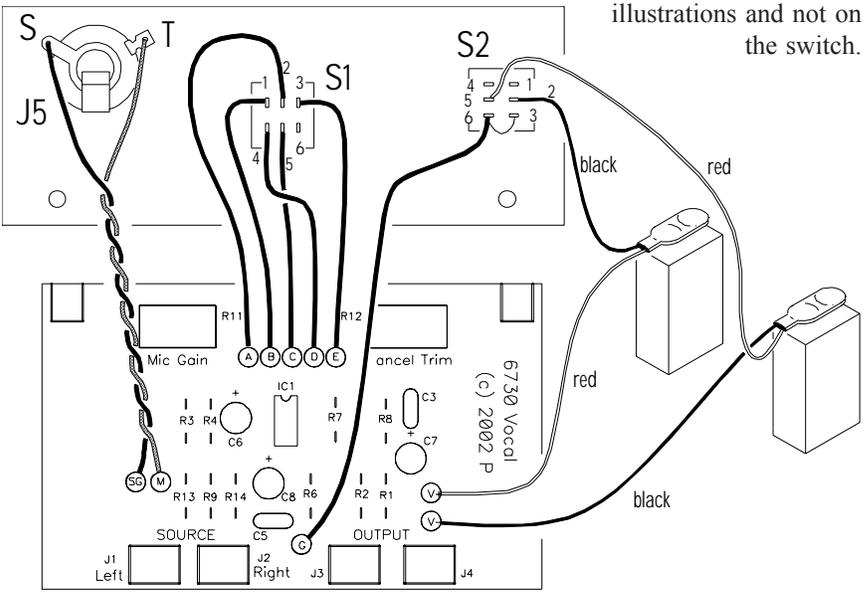
## BEFORE GOING ANY FURTHER, READ THIS

The Vocal Zapper is most easily used by placing it between a CD player and CD or Aux inputs of a component amplifier and speaker system. It can also be easily inserted into the signal path of packaged stereo systems or boom boxes that have "Tape Out" and "Tape Monitor" jacks. If you have a packaged system that does not include these features, use of the Vocal Zapper may require some internal modification to the system.

Also be aware that a filter is included in the Vocal Zapper design to allow bass lines, which are ordinarily mixed to the center of the stereo field, to pass without being zapped. This filter may allow some of the vocal to bleed through but is easily modified for more complete suppression at the cost of losing some bass. For more on this see "Principles of Vocal Cancellation" on page 9 of the manual.



**Fig 2.** Show mechanical assembly. Note different orientation of switches and threaded and unthreaded holes in "L" bracket.



**Fig 3.** Shows panel wiring. Switch lug numbers are only on illustrations and not on the switch.

## More on connecting and testing the 6730 Vocal Zapper

The 6730 Vocal Zapper can easily connect to the external tape recorder connectors on a stereo receiver. These are specified as Tape Out and Tape Monitor in the manual for the kit, but basically they correspond to line-level outputs and inputs.

The Tape Out is a signal from the receiver that is the selected 'source' (phono, CD, Radio, Auxillary, etc). This set of connectors may also be called Tape Record, left and right. When the source is 'played' the line-level signal appears at these jacks and to confirm this, you could connect these 'line outs' to a separate amp/speakers to hear the selected source.

Tape Monitor may also be labeled Tape In or Tape Playback. It is a set of line-level inputs that route to the power amp section when the Tape Monitor switch is asserted. Recorded material on the external tape recorder is input back to the receiver via these connectors. Normally, this would be the signal from output of a tape deck, but with the vocal zapper, it is the zapper's outputs. With only cables connected to these inputs on the receiver (and Tape Monitor asserted) you should be able to touch the tip of the cable and hear a buzz or hum through your speakers indicating the inputs are 'live'. An external CD player could be played through these jacks. The Vocal Zapper sends the 'zapped' signal in on these jacks.

A quick and simple way to get an idea of whether the Zapper circuitry is operating or not is to advance the mic gain trim cw and touch the tip contact of the MIC Input jack to find out if this introduces a hum or buzz like touching the cables to the Tape Monitor jacks does. If not, it might be soldering trouble on the vocal zapper kit. The first check would be of the soldering and battery condition.

A VOM or multimeter can be set to measure 9V DC and the power to the ICs tested by putting the black probe to the circuit ground/common while the red probe is put to pin 8 of the IC. Read the

pins by counting up in a ccw direction around the part from the notch or pin 1 indicator. This should measure +7 to 8V DC. If the tester is digital readout, it will autopolarize and you can go on and measure the negative DC on pin 4 for a -7 to 8V DC reading. If it is analog with a meter movement, put the red on ground/common and measure with the black so the needle doesn't try to swing the wrong direction.

The output pins of the op-amp IC (pin 1, pin 7) should measure approximately 0V DC.