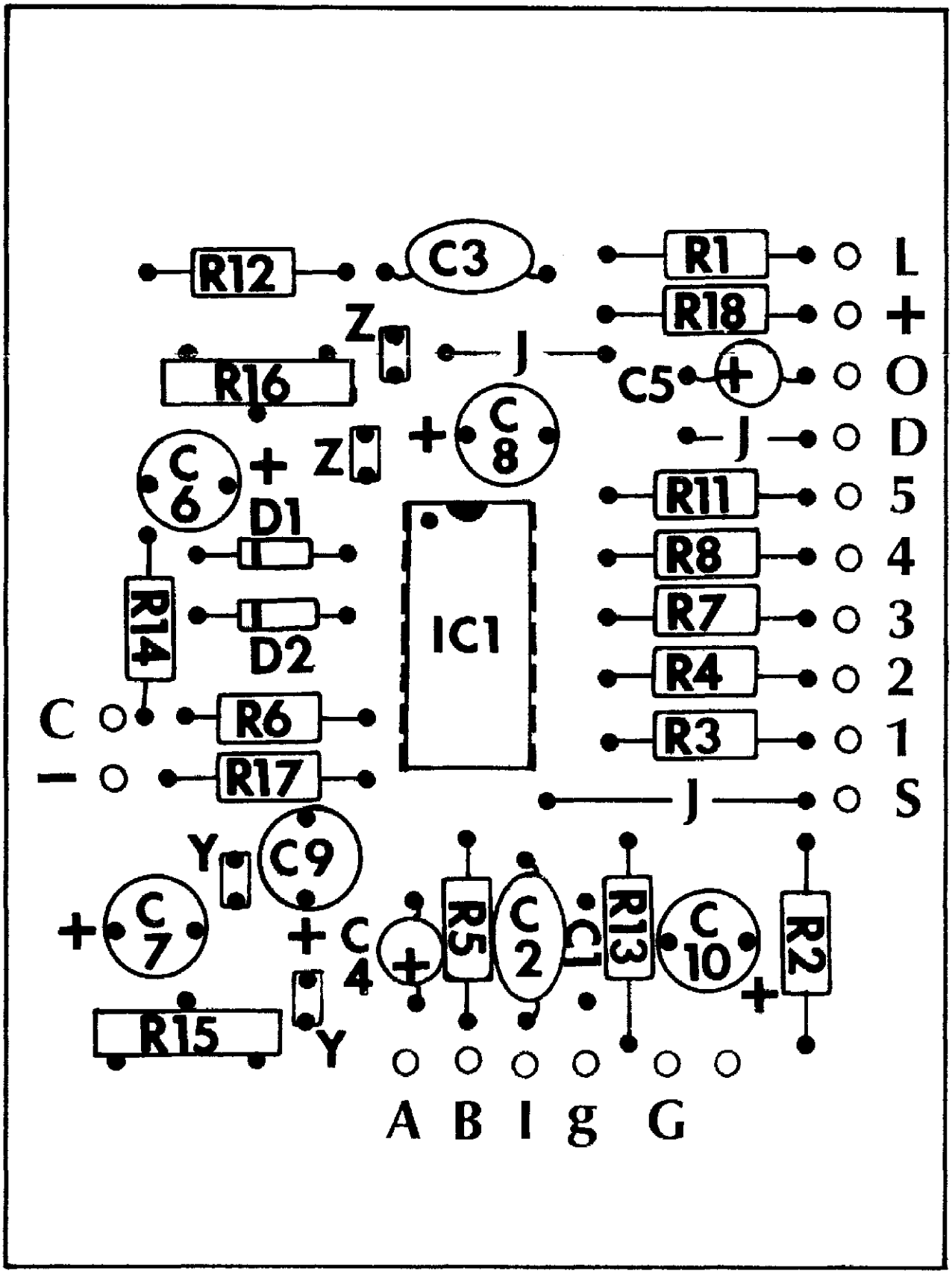
PAiA

PREAMP
1720



PREAMP COMPONENT LAYOUT
(top view, non-foil side)

PARTS LIST

RESISTORS

R1	560 ohms (green-blue-brown)
R2, R3	3.3K (orange-orange-red)
R4	6.8K (blue-gray-red)
R5	10K (brown-black-orange)
R6	27K (red-violet-orange)
R7	**30K (orange-black-orange)**
R8-R10	100K (brown-black-yellow)
R11	330K (orange-orange-yellow)
R12-R14	1M (brown-black-green)
R15, R16	10K trimpots
R17, R18	10 ohms (brown-black-black)

CAPACITORS (all electrolytics 15V or more)

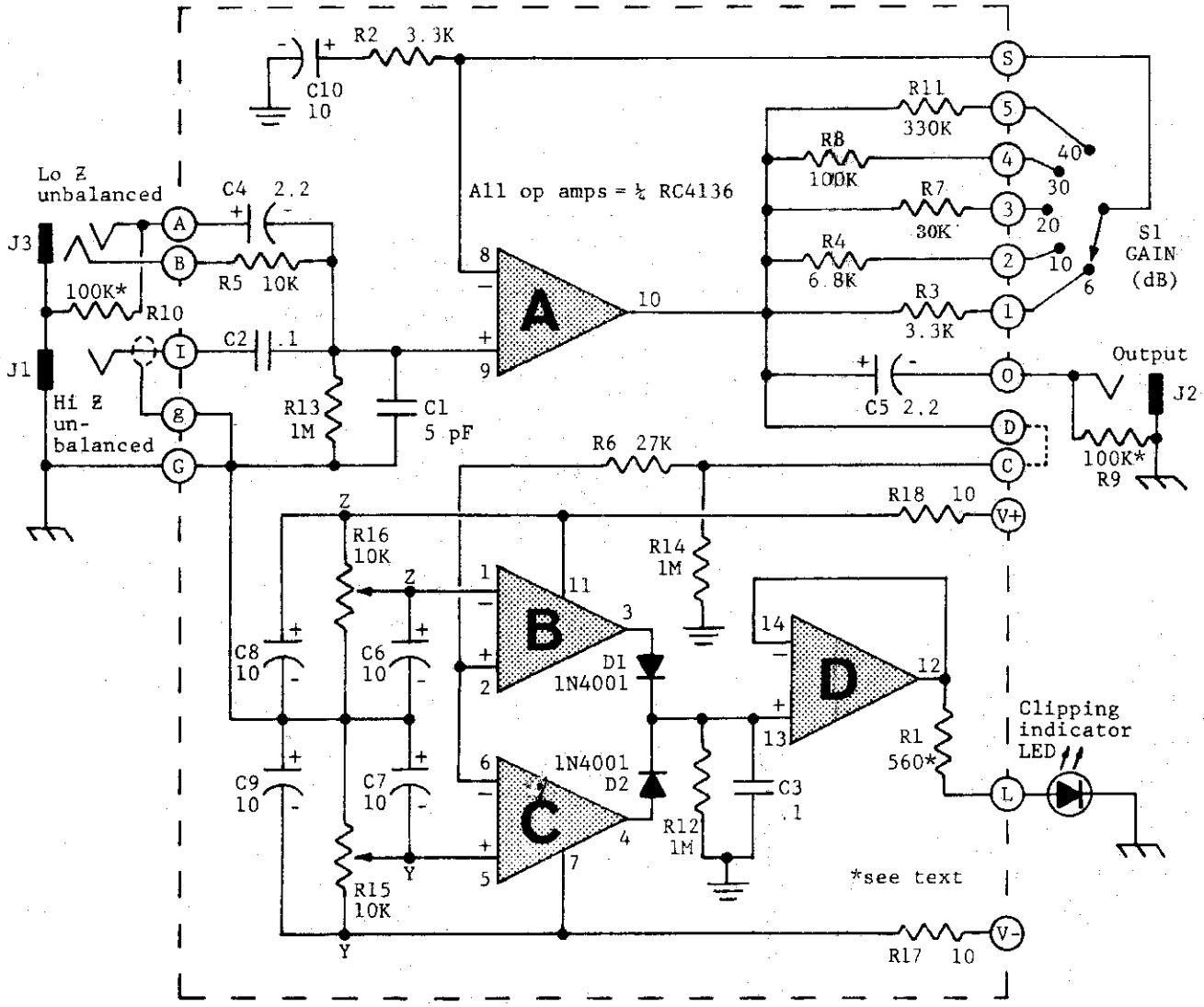
C1	**5 pF ceramic disc capacitor**
C2, C3	.1 uF ceramic disc
C4, C5	2.2 uF electrolytic
C6-C10	10 uF electrolytic

OTHER ELECTRONIC PARTS

IC1	4136 Quad Op Amp
D1, D2	1N4001 or equivalent diodes
LED	Red LED

MECHANICAL COMPONENTS

S1	SP5T rotary switch with knob
J1, J2	¼" mono phone jack
J3	¼" stereo phone jack
(1)	Circuit board
(1)	Instruction sheet



All resistors are in Ohms, all capacitors in uF unless otherwise noted

ASSEMBLY INSTRUCTIONS---The "Preamp" is designed as a universal preamp, capable of use with keyboards, microphones, electric guitars, and similar sound sources. It has 5 switch selected gain options, along with a clipping indicator (with variable threshold) that responds to both positive and negative signal peaks. We will cover applications more thoroughly on the other side. This project originally appeared in the column, "Craig Anderton's Electronic Projects" (Contemporary Keyboard magazine, August/September issues).

Check your parts against the parts list for completeness, then read these instructions over carefully to get a feel for the project before you actually begin construction.

One key to successful operation of your kit is good soldering. We recommend looking at the solder connections on commercially available amps and effects and trying to imitate them as closely as possible. Avoid using too much solder, which can cause solder bridges between traces on the circuit board, or too little solder, which can cause intermittent or high resistance connections. Use a 25 to 40 Watt pencil type iron with a fine point; soldering guns are not acceptable. You must use 60/40 rosin core solder when assembling this kit. Do not add solder paste or use any other type of solder; failure to observe this precaution will void your warranty, and the unit will probably not work properly either.

Before soldering, use steel wool or a similar fine abrasive to clean the copper side of the circuit board; then rinse thoroughly with water and dry. Remember, a nice shiny board aids tremendously in successful soldering.

To solder, hold the tip of the iron up against the wire to be soldered and the circuit board trace (or jack lug, or whatever). Hold it there for a second or two to let things heat up, then feed in an amount of solder onto the connection. (Do not feed the solder on to the tip of the iron and expect it to run down over the connection.) Continue holding the iron against the connection until the solder melts fully and flows freely over the connection. Then, remove the iron and let the joint cool. Do not move any of the wires while the solder is cooling; if this happens, re-heat the connection, feeding in a tiny bit more solder.

Begin assembly by identifying all resistors and mounting them flush against the non-foil side of the board in the places indicated on the component layout. Bend the leads at a right angle, parallel to the foil surface of the board; then clip off any excess lead lengths to prevent shorts between adjacent traces on the circuit board. Solder all leads; do not mount trimpots just now.

Note that there are 3 wire jumpers on the board; they are indicated with a broken line that has a "j" in the middle. Mount and solder these three jumpers using resistor leads from the previous step or three separate pieces of wire.

Next, mount diodes D1 and D2 on the board. Note that each diode has a small band towards one end of the part---this band must be oriented in the same direction as the band indicated on the component layout. When soldering the diodes, solder quickly and carefully as these parts are heat sensitive.

Capacitors **C1 thru C3** are ceramic disc capacitors. Mount and solder them in place as indicated on the circuit board. Capacitors C4 through C10 are polarized, which means they have a (+) end and a (-) end...just like a battery. When mounting and soldering these capacitors, note that some have the (+) end indicated, while some will indicate the (-) end and some have both ends identified. Make sure that the orientation of the (+) lead agrees with the component layout.

Next, carefully observe IC1. One end of the package will have either a dot in the left-hand corner, or a semi-circular notch cut in the middle of the end of the IC. Orienting this notch or dot as shown in the component layout, solder IC1's pins in place. Careful---this IC is heat sensitive, so wait a few seconds between soldering adjacent pins.

Mount trimpots R15 and R16 in place on the circuit board, and solder. At this point, check the board over carefully; make sure the solder connections all look good, and that the electrolytic capacitors, diodes, and integrated circuit are all properly oriented. Temporarily lay the circuit board aside.

You may mount the preamp in any type of enclosure you wish; one possibility is to attach the circuit board to a panel plate compatible with the PAIA series of synthesizer modules. If you elect to build the preamp in a separate box, make sure you use an aluminum box instead of a plastic or bakelite one. You will need to drill 5 holes: one for the gain select switch, one for the output jack, one for the clipping indicator LED, one for the high Z input jack, and one for the low Z input jack (optional).

The preamp requires a source of power. If you are tapping from a PAIA or similar power supply, simply run the (+) output from the power supply to the (+) pad on the board, the (-) output from the supply to the (-) pad on the board, and the ground from the power supply to point G on the board. This power supply may be anywhere from ±5V to ±15V. You may also use two batteries hooked up to a DPDT on-off switch as shown in figure 2.

Referring to the wiring diagram, connect wires between the circuit board and the various panel parts. Remember that this preamp has the capability of quite a lot of gain, which requires three cautions. One, keep the input and output leads separated from each other. For example, under no circumstances would you want to carry both leads in the same cable, or run the wires for the input and output close to each other in the box. Two, use shielded cable when running from J1 to point I on the circuit board (note that there is a hole labelled "g" for attaching the shield---attach the shield at the board only). Three, keep all leads as short and direct as possible.

Use 4 leftover resistor clippings to form 4 small, semicircular hooks. These insert as shown in figure 3 in the two holes located near each point "Z" and "Y". Also, add a wire jumper between pads C and D if you wish to connect the clipping indicator to the output of the preamp.

Carefully examine the LED; one side of the plastic case will be flattened, or have a small dab of paint. This indicates the cathode of the LED, which should connect either directly to power supply ground or to the ground lug of the output jack. The other lead of the LED connects to pad L on the circuit board.

If your panel ground already connects to power supply ground through a good, low resistance connection, leave the unlabelled hole next to pad G unconnected. If the panel does not connect to ground, run a wire from the unlabelled hole to the ground lug of J1, the input jack. Once again check over your work, then proceed to calibration.

CALIBRATION. Apply power to the preamp. If there are any obvious signs of malfunction, turn off power and check over your wiring. Otherwise, prepare to calibrate trimpots R15 and R16.

You may calibrate the clipping indicator section in various ways, depending upon your application. If you wish to indicate when a signal exceeds the "headroom" of the preamp, simply set both trimpots to their halfway point. If the peak to peak voltage of the signal exceeds ½ the supply voltage, the LED will light. While the preamp will not actually clip at this point, it's a good idea to set the clipping indicator slightly below the distortion point... after all, if it lights only when you're distorting, it's too late to do you any good.

To set for an arbitrary level (such as +3 VU, which we'll use in the following example), observe the output of the preamp on a scope or tape recorder VU meter. While feeding a sine wave signal into the preamp, adjust the output of the sine wave signal generator until the tape recorder meter shows +3 VU. I'd recommend using about a 1 KHz tone on a fairly low gain range of the preamp. Connect a 1K resistor using alligator clips between the two points labelled "Y" on the PC board; adjust R16 until the LED just comes on. Then connect the 1K resistor between the two points labelled "Z" on the circuit board, and adjust R15 until the LED just comes on.

You'll note on the schematic that I've drawn the input of the clipping amp as jumpering to the output of the preamp. If you wish, you could connect the input of the clipping indicator to a rotary switch that could monitor a choice of several points in a circuit. For example, if the preamp was part of one channel of a mixer, the clipping indicator could also check the equalizer modules, compressor, or whatever.

If the LED flash is too long for your taste change C3 to .05 or .01 uF.

EXPLANATION OF J3. When used with a mono cord, J3 presents a low impedance, unbalanced input. The plug's "hot" lead connects to C4 and couples into the preamp; the ground of the plug grounds R5, furnishing a 10 KOhm input impedance.

MODIFICATIONS. I've shown R7 as 33K because that's the nearest available 10% resistor value to 30K. However, 30K will give a true 10 dB gain; with 33K it's a tiny bit more. If you have a six position switch, you can wire the remaining position so it connects to point D. In this setting, the preamp wouldn't add any gain, but could buffer a device with a high output impedance (like a magnetic pickup) from devices (like effects boxes) with low input impedances.

R9 and R10 are optional; they provide a path to ground for C5 and C4 to keep them discharged when nothing is plugged in. This helps to prevent "pops" when you plug the preamp into an amp. If you expect the preamp to be permanently wired into a particular configuration, these resistors are not necessary.

Also, if you don't plan on using the unbalanced low impedance input you may delete C4, R5, R10, and J3.

MATCHING LOW IMPEDANCE LINES TO THE PREAMP. If you have a device such as a low impedance, balanced line microphone, you may use a transformer to match this device to the preamp. These transformers are common audio accessories that are generally available in stores that sell home recording equipment. You can go into either the hi Z or low Z input; even though the low Z input theoretically gives the least amount of input noise, try both inputs and see which one you prefer. As a general purpose, low noise preamp for PA or home recording, this preamp performs quite well.

TYPICAL SPECS (with ±15V supply and 0 VU at output of preamp)

Preamp frequency response, 6 through 30 dB ranges:
±0.5 dB, 30 Hz - 20 KHz

Preamp frequency response, 40 dB range:
+0, -1 dB, 30 Hz - 10 KHz; +0, -3 dB, 30 Hz - 20 KHz

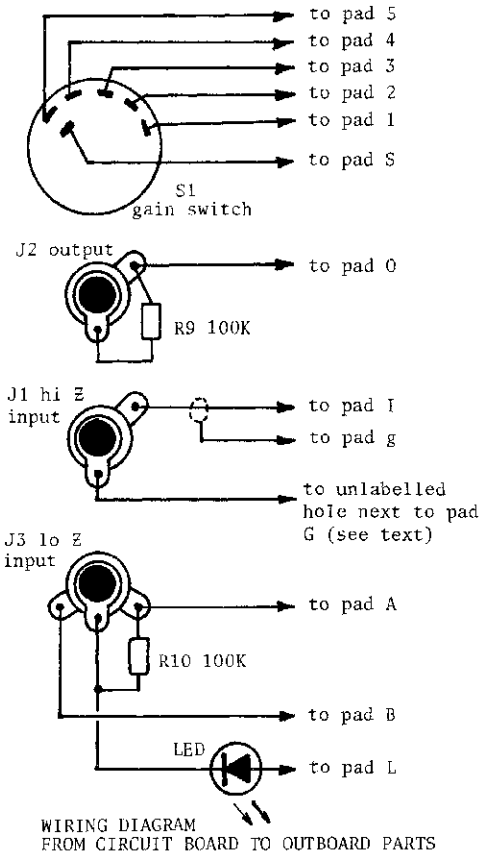
Clipping indicator response (0 VU clip point):
±1.5 dB, 30 Hz - 10 KHz

Headroom: ±12V

DESIGN ANALYSIS. Op amp A is the preamp; op amps B, C, and D make up a clipping indicator that responds to both positive and negative peaks of a signal presented to the input of the clipping amp (this is necessary because not all waveforms are symmetrical). This indicator has adjustable positive and negative trip points; when an input signal exceeds either of these pre-set trip points, the output of either op amp B or C (or both) supplies current to C3 through D1 and D2. This makes a voltage appear across C3, which when buffered by op amp D, drives the LED. Because C3 holds this charge for about half a second, even very fast transients are captured by the clipping indicator.

The preamp has two unbalanced inputs; one is high impedance (approximately 700 KOhms) and the other is low impedance (10 KOhms) Please note that this preamp is not designed to handle balanced lines; to do so, you will need a matching transformer as outlined in the text.

S1 selects the feedback resistor that determines the gain of the non-inverting gain stage built up around op amp A.



WIRING DIAGRAM
FROM CIRCUIT BOARD TO OUTBOARD PARTS

(Note on wiring J3: the wire connecting to pad A of the circuit board should connect to the terminal on J3 that touches the TIP of a stereo plug. The wire connecting to pad B should connect to the terminal on J3 that touches the RING of a stereo plug. However, J3 should be used with a mono plug during actual operation.)

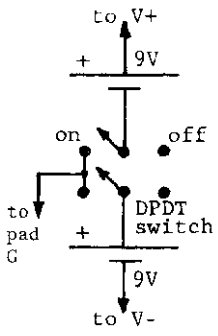


Figure 2

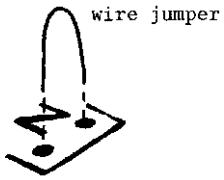


Figure 3

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