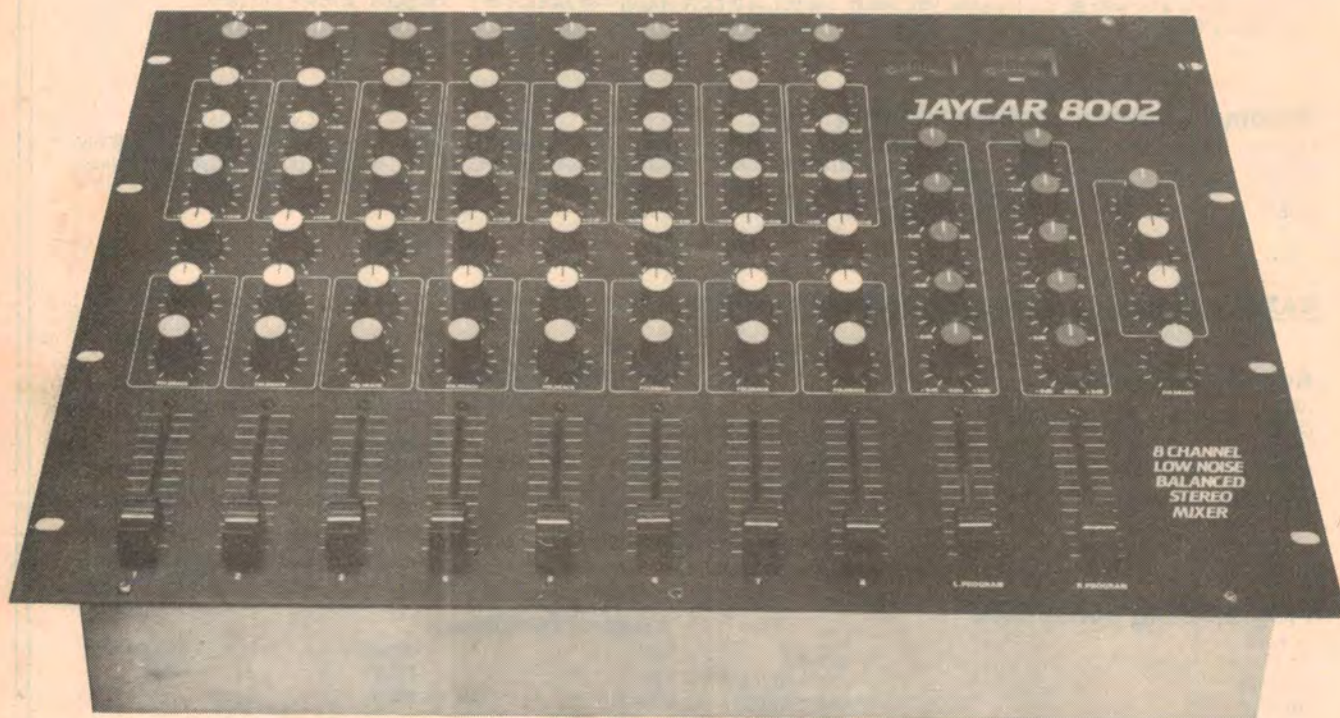


A completely new design for stage or studio with

Balanced 8-chan



For a long time now there has been a need for an up-to-date mixer design with low noise output and comprehensive facilities at a reasonable price. Therefore we are pleased to present this new high performance design in conjunction with Jaycar Pty Ltd.

by LEO SIMPSON

The design of this mixer was specially commissioned by Jaycar to meet the requirements of typical band groups performing on stage or in a studio. The unit uses low noise op amps throughout and balanced inputs and outputs to minimise hum pickup and grounding loops. The large number of control features plus the simple construction method make this a very attractive mixer at a particularly keen price.

Physical layout

At first sight, a comprehensive mixer such as this Jaycar 8002 looks dreadfully complex but in just a little time the overall scheme becomes apparent and logical. The "8002" designation, by the way, comes from the fact the mixer has

eight input channels mixing down to two output channels.

Two physical modes of operation are possible. First, since the mixer panel is designed to fit a 19-inch rack, it may be used vertically, with the panel height being 355mm. Second, the chassis has been arranged to allow the unit to be used in a free-standing situation, with a sloped control panel. We think most users will prefer the latter arrangement but that is just our opinion.

All told, there are 70 knobs, ten 60mm sliders and eight toggle switches, making for a total of 88 controls on the panel. And that is not counting the power switch toggle on the back panel. Each knob is colour-coded so that its function, in each particular channel, is clarified.

With the aid of this colour-coding and the logical panel layout, we feel that most users will become quickly familiar with the unit and will not have to peer at control labels each time an adjustment has to be made.

Mixing Features

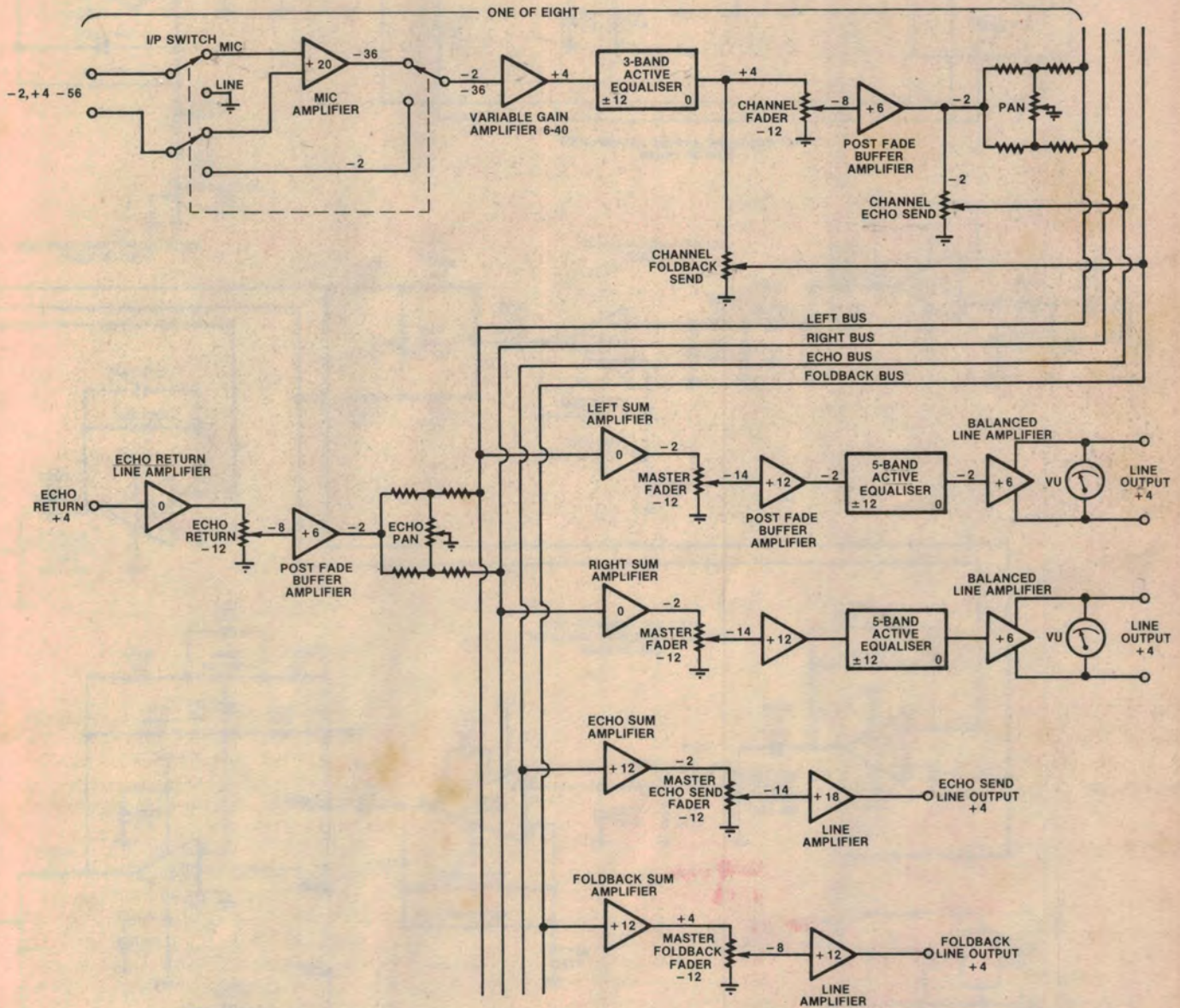
Essentially, the large number of controls is the result of the duplication of controls for each input channel. The eight input channel controls are arranged in eight columns, starting from the lefthand side of the panel.

At the very top of each column is a toggle switch to select either microphone or line input. Just below this is an attenuator knob for initial signal level adjustment. Below this is a group of three knobs which provide a three-band equaliser giving a range of ± 12 dB boost and cut at treble, midrange and bass frequencies.

There is an assumption here that each instrumentalist will have a preamplifier which may possibly incorporate fuzz or other effects and so will have a line level signal of several hundred millivolts

inbuilt equalisers on each channel

Channel Master Mixer



rather than the low level high impedance output direct from a guitar.

Next, below the three-band equaliser is the pan pot. This allows the input signal to be directed to either left or right channel outputs or any combination between the two. The word "pan" by the way, derives from "panoramic" camera motion in film and television work. By suitably manipulating the pan pot, an instrument or vocalist can be made to float from left to right or vice versa.

Below the pan pot is a grouping of two

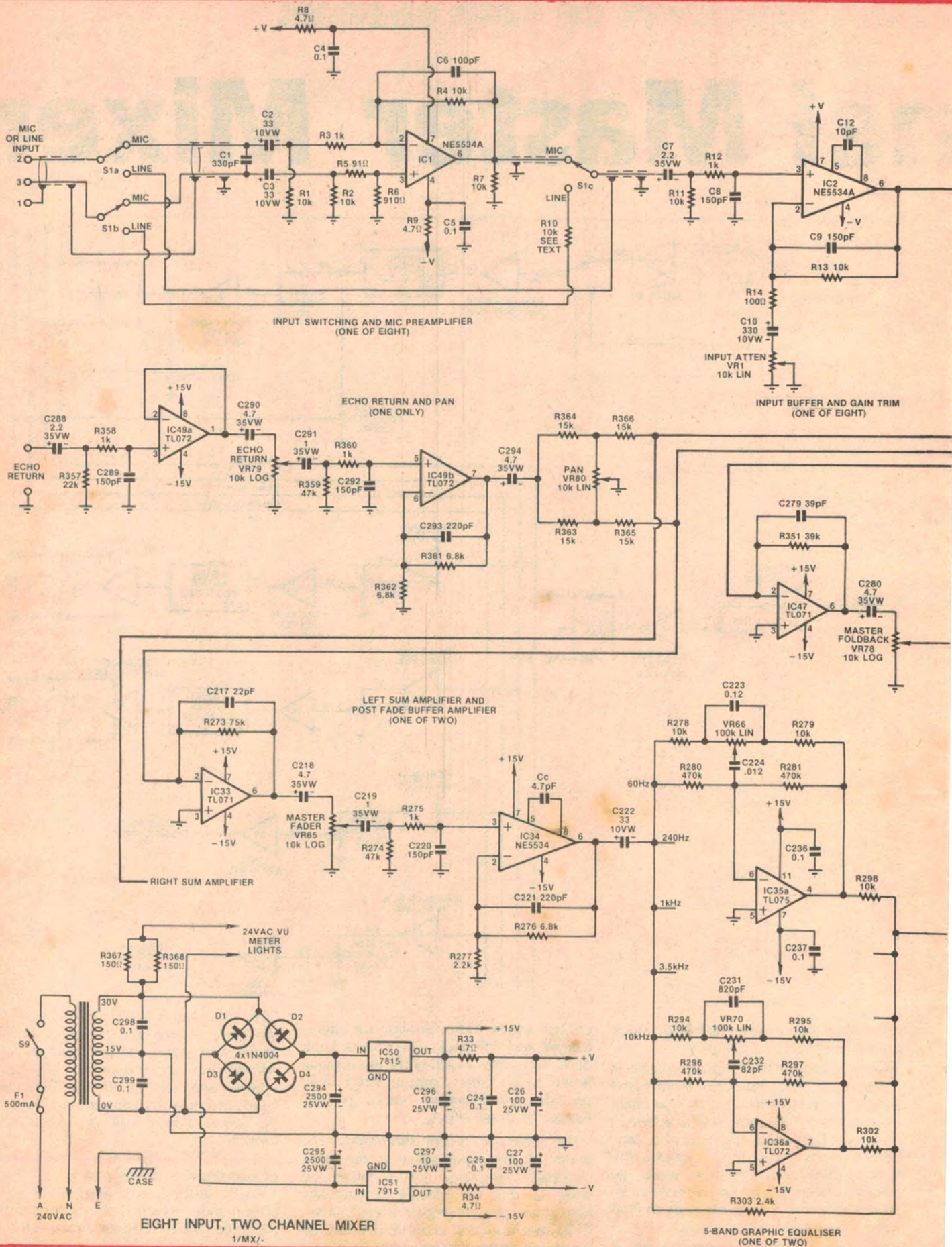
control knobs which provide for Effects (sends) and Foldback. The Effects knob determines how much of the input signal is fed to an effects output which may provide reverberation, echo, phaser, flanger or other effect.

The Foldback control determines how much of the input signal is fed to a "foldback" amplifier and speakers on stage so that the players can actually hear their own playing or a lead player. Only one foldback channel is provided which is possibly the only important area

Over the page is the circuit diagram for the Mixer. To save space, only one input channel (of eight) and one output channel (of two) are shown. For the same reason, only two of the five equaliser bands are shown. Component values for the other bands will be given next month.

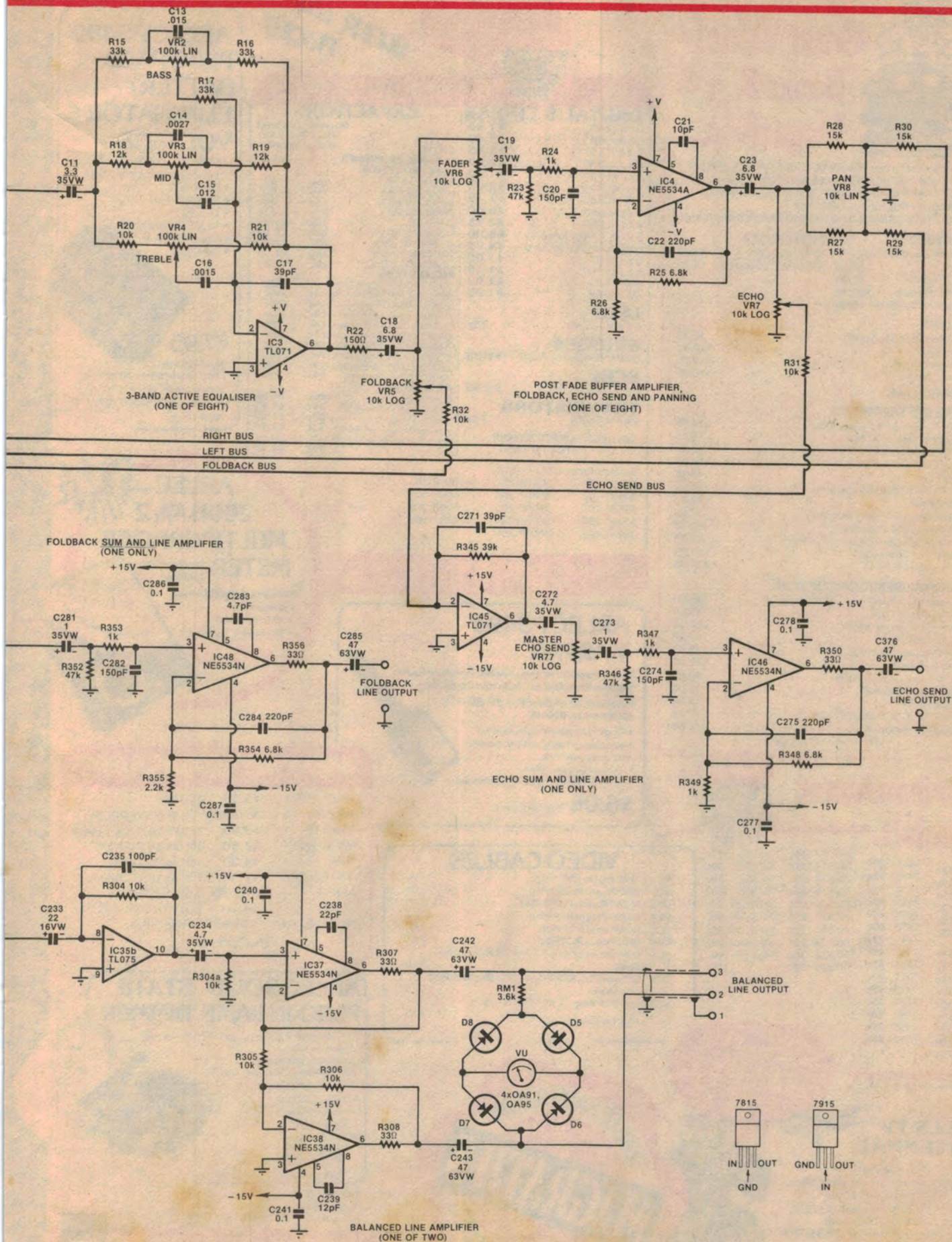
of compromise in this design.

Finally, at the base of each column is a 60mm slider which is the Fader for the particular input channel. Since each of the channel controls is multiplied by



EIGHT INPUT, TWO CHANNEL MIXER
1/MX/-

5-BAND GRAPHIC EQUALISER
(ONE OF TWO)



BALANCED 8-CHANNEL MASTER MIXER

eight, so far we have accounted for eight switches and eight faders plus 56 knobs.

VU meters

On the righthand side of the panel, at the top, are two VU meters for monitoring the left and right outputs. Below these meters are two columns of five knobs which provide five-band equalisers for each output channel. And below the equalisers are the two master faders, one for each output channel.

Finally, on the far righthand side of the mixer panel is a column of four knobs which controls the effects and foldback channels. The effects channel (echo, etc), can be panned into left or right output channels.

On the rear panel is the power switch already mentioned plus a fuseholder. There are three 6.5mm jack sockets, one each for the foldback line output, the effects send line, and the effects return line. For the eight inputs there are female Cannon XL sockets while for the two outputs there are male Cannon XL sockets.

Block diagram

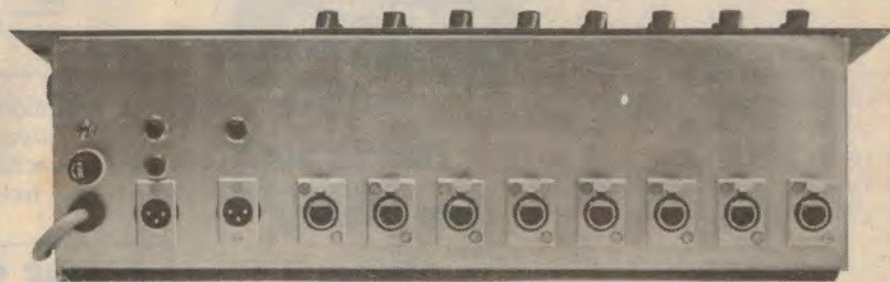
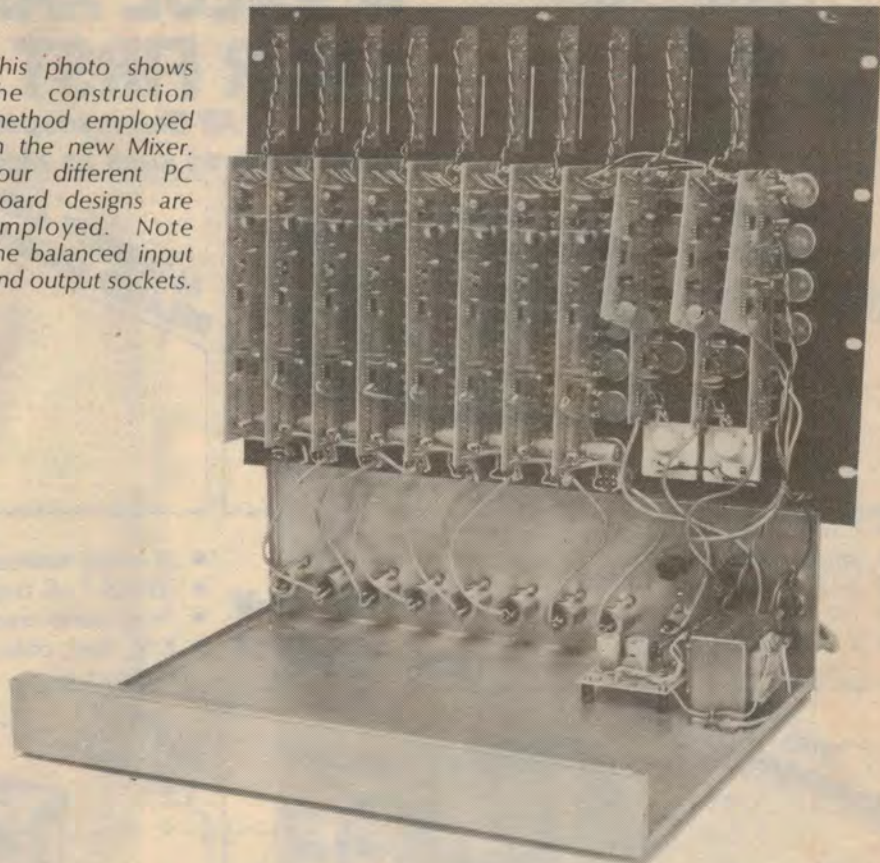
Some idea of the control functions can be gained by examining the block diagram on the first page of this article. This shows one input channel (of which there are eight), the two output channels with their five-band equalisers and VU-metering plus the foldback and effects (echo) amplifier circuitry.

One point which should become immediately obvious is that, while the control layout of the mixer panel is logical and easy to use, it does not really relate to the signal flow through the circuitry — for example, the pan pot for each channel comes after the channel fader. These differences do not make the mixer control layout any less valid and so can be regarded as unimportant.

Refer now to the block diagram and the chain of circuitry across the top starting with the "mic amplifier". Input to the microphone amplifier is made via balanced low impedance lines and the signal is amplified by 20dB (10 times). If the signal level is at line level, ie, around several hundred millivolts, the mic amplifier is switched and the input line is unbalanced. From there, the signal is coupled to a variable gain amplifier which can provide a range of gain from +6dB (two times) to +40dB (100 times). The output from this amplifier is then fed to a three-band equaliser and thence coupled to the "foldback send" control and the channel fader.

The signal from the fader wiper is fed to a further amplifier stage with a gain of +6dB. This is called, appropriately

This photo shows the construction method employed in the new Mixer. Four different PC board designs are employed. Note the balanced input and output sockets.



This is the business end of the Mixer, showing the power switch, mains fuse and the input and output sockets.

enough, a "post fade buffer amplifier" because it comes after the fader and it does buffer the fader signal against any undue loading by following circuitry which happens to be the effects send (echo) and the pan pot networks.

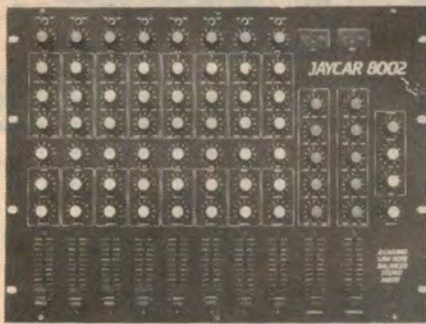
All of the circuitry so far described on the block diagram is multiplied by eight times, to account for the eight input channels. And signals from the foldback send, effects send and pan pot go to four signal bus lines which are labelled on the diagram.

The rest of the block diagram is fairly self-evident except to note that the two main outputs, left and right, use balanc-

ed output lines while the echo send and foldback line outputs are unbalanced.

Signal levels are shown on the block diagram in "dBm", ie, referred to a one milliwatt signal in a 600Ω line. This 0dBm reference level is 0.775 volts across 600Ω. By way of explanation, the input signal levels are shown as -2, +4, -56. The first two figures refer to the intended range of line input levels of -2 to +4dBm or approximately 600mV to 1.2 volts RMS.

Similarly, -56dBm corresponds to a signal level of about 1mV RMS, which is in the ball-park for a low impedance microphone signal.



Circuit diagram

The general concept depicted in the block diagram is fleshed out in the two page circuit diagram although even here, there is insufficient space to show all the circuitry. Therefore, only one (of eight) of the input channels is shown and one (of two) of the output channels.

Starting at the same point as we did in the block diagram, look at IC1 the microphone preamplifier which has balanced inputs. The input impedance of this stage is essentially set by the sum of R3, R5 and R6, which gives a figure of 2kΩ. This is higher than the nominal impedance for typical balanced microphones normally used with transformer coupling but has been selected as an optimum for a balanced active circuit.

IC2, the variable gain amplifier following the mic/line switch S1c, is a conventional non-inverting op amp circuit. IC3, the following three-band equaliser stage, uses Baxandall feedback circuitry to provide what is really a three-range tone control with fairly broad bands.

IC4 is the post-fade buffer amplifier. As with IC1 and IC2, this uses the Signetics NE5534A low noise op amp. But whereas the reason for selecting this op amp for IC1 and IC2 is its low noise, it has been selected for IC4 because of its ability to drive low impedance loads. The same can be said of IC37 and IC38 which are of the balanced line output drivers.

The other op amps used in the mixer are Texas type TL071 and its multiple op amp relatives, the TL072 and TL075. These op amps are also notable for their good low noise performance and high slew rate limit which is far better than the old standard workhorse, the 741.

5-band equaliser

The five band equaliser involving ICs 34, 35 and 36 is of particular interest. It is not a gyrator design as was the Playmaster graphic equaliser published in May 1979. Instead it is based on an octave analyser published in the National Semiconductor Audio Handbook. Effectively what happens in the circuit is that

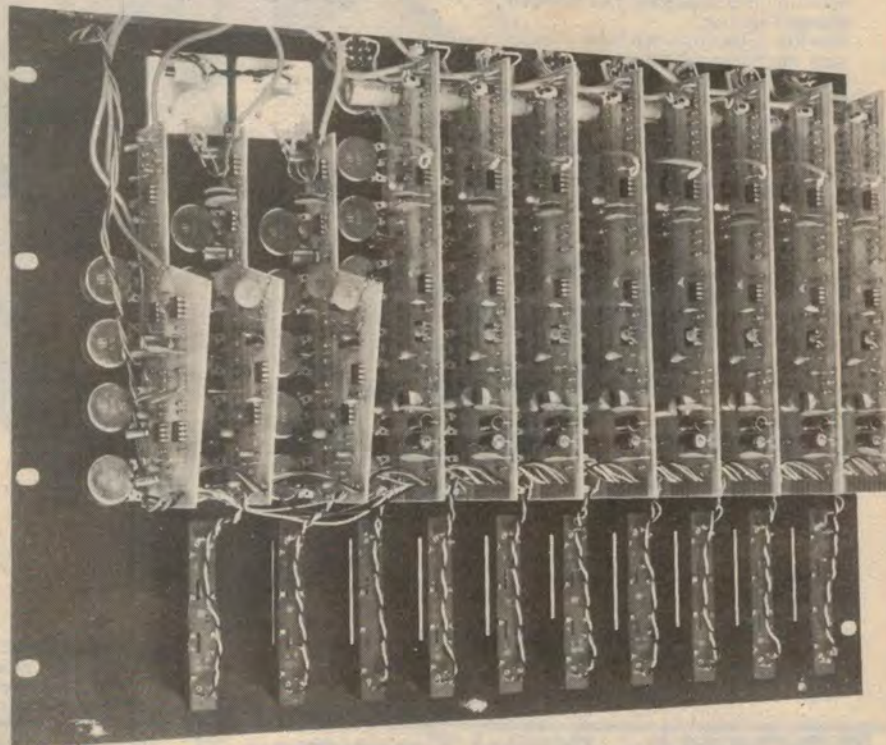
the audio signal from IC34 is split into five bands which are separately amplified by five adjustable gain band-pass stages.

The five bands are then added together again by IC35b which is a summer amplifier with the odd aspect of R303 which acts to subtract the original signal from the sum. It is subtracted rather than added because each equaliser section is an inverter stage

There is little else in the circuit which requires particular comment. In summary, we think that this is a most practical design using high performance ICs to obtain low parts count.

Mechanical design

The mechanical design of the mixer is as practical as the electronic design. Four different PC board designs are employed, one for the input channels (eight of these), one for the five band



Very little wiring is required for the Mixer and what little there is mostly repetitive. All potentiometers are soldered directly to the PC boards.

(note that only two of the five equaliser sections are shown on the circuit) and R303 delivers an uninverted signal.

Subtraction is necessary in order to maintain unit gain through the whole equaliser circuit. If R303 was not present, the output signals would be five times the input signal.

IC49a and IC49b provide the effects (echo) return and pan control functions while IC47 and IC48 provide the master foldback control function. Similarly, IC45 and IC46 provide the effects (echo) send function.

The power supply is straightforward and uses a 30V centre-tapped transformer and bridge rectifier to provide balanced supply rails. These are regulated to +15VDC with three-terminal regulators.

equalisers and line output drivers (two of these), one for the effects and foldback output drivers (one only), and one for the power supply board.

All potentiometers, with the exception of the main sliders, are mounted directly on the respective PC board. This minimises control wiring and provides the method of mounting the boards themselves to the control panel.

Next month

Next month we shall conclude with the presentation of the full construction details of the mixer, including component layout diagrams for each of the four PC boards. Kits for the project are available now from Jaycar stores at 125 York Street, Sydney or Cnr Carlingford and Pennant Hills Road, Carlingford. ☛