The SynthMix

Part 1 Preliminary Details

The SynthMix is a major new constructional project we'll be running over two issues. It's a six-channel stereo keyboard mixer featuring basic EQ facilities and three auxiliary sends per channel, and is therefore unique in offering a specification designed with modern keyboard players' needs in mind. Designer Paul White **takes us through the project's design philosophy and how it's been implemented.**

In a multikeyboard set-up, the musician often resorts to a PA-type mixer to fulfil his needs but it's rapidly becoming clear that this solution is less than ideal. Modern keyboard instruments generally require little in the way of EQ but, because of the number of effects units at the disposal of today's musician, more than one effects channel is often essential. A typical PA mixer does not meet these requirements, as it generally has a very comprehensive EQ system but only one effects channel.

The SynthMix, on the other hand, is designed with the keyboardist's specific requirements in mind, and so each input channel is fitted with three auxiliary sends. This enables three different effects units to be connected, their outputs being linked to the auxiliary master section, which permits control over effects return levels and pan positioning.

EQ was originally considered to be virtually unnecessary, but the single control incorporated into the final design gives a surprisingly wide range of control, and is therefore more than adequate for most normal requirements.

The prototype was built in a seven inch deep 19" rack-mounting case, all connections being brought out to the rear panel in order to keep the front clear, an arrangement that should be quite satisfactory in everyday use.

A stereo headphone output is incorporated for private practice or pre-gig tuning, and the choice of case means that the unit may be mounted in a standard rack along with the power amps or fitted into a simple wooden sleeve for protection.

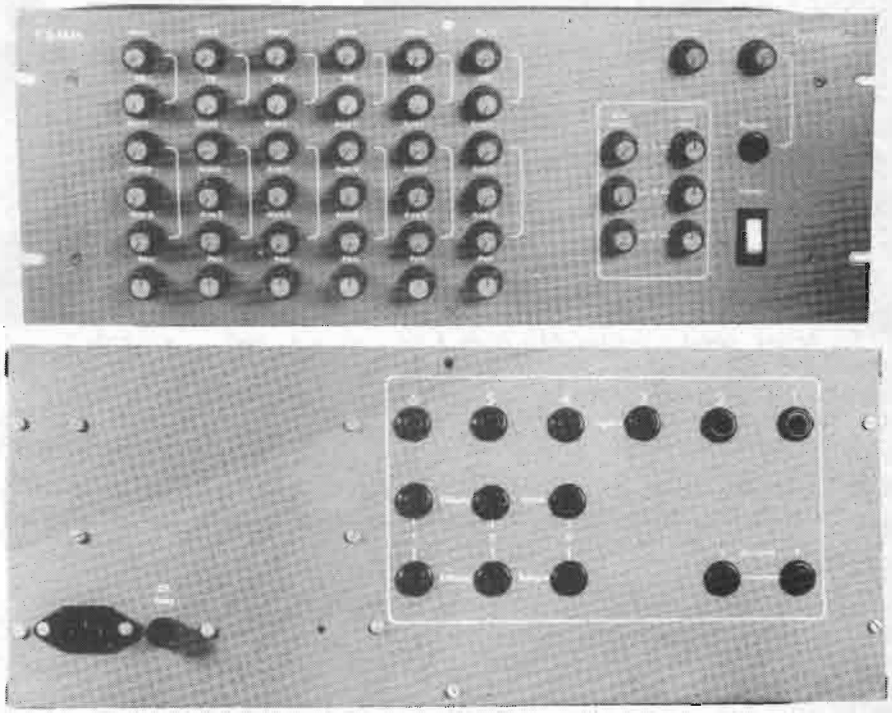
Design

The SynthMix circuitry is designed to be built on ten PCBs, consisting of six identical input channels, an auxiliary PCB, a master PCB, a headphone amp PCB and a power supply board. All these boards are easy to assemble and wiring is kept to a minimum in order to simplify construction. The power supply PCB is the same as that used for the RackPack project published in E&MM July, while the headphone amp PCB is the same as that used in the headphone amp project featured in the July issue of *Home Studio Recording*.

If the unit is built in the rack case as suggested, there's room to fit two E&MM 75W MOSFET power amplifier modules and a suitable power supply which are sold in kit form by Maplin, thus producing a self-contained 150W stereo system of exceptional quality and reliability.

Circuitry

The design makes extensive use of operational amplifier ICs, making construction simple whilst keeping the cost down. There is no need to describe the power supply PCB as this was fully covered in the July issue but, just in case you missed it, the layout will be printed in the concluding part of this project next month.



Channel PCB

The input is first amplified by IC1 which is configured as a non-inverting amplifier with a fixed gain of around five, this being independent of source impedance. IC2 forms the variable gain stage, and this is followed directly by the passive EQ control RV2, which provides treble boost with bass cut at one extreme, and top cut with bass boost at the other, this range being more than adequate for just about any foreseeable requirement.

The EQ stage is followed by another non-inverting gain stage (IC3), which presents a very high input to the EQ network, and the gain is set to about five in order to overcome losses in the passive EQ circuitry. After this

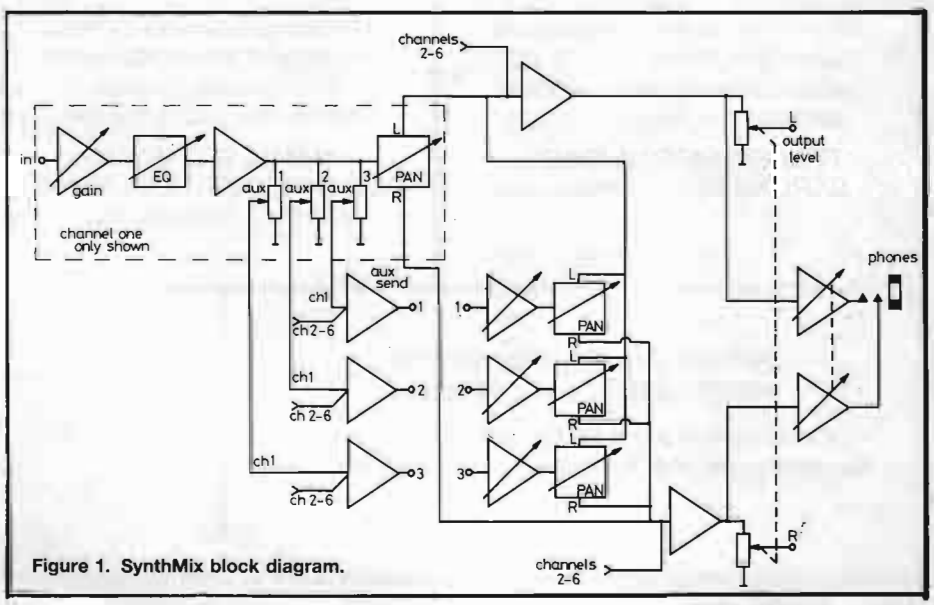


Figure 1. SynthMix block diagram.

amplifier come the auxiliary send controls RV3, 4 and 5, and the panning components, all outputs being fed to bus lines for connection to virtual earth mixing stages on the Auxiliary and Main PCBs.

Auxiliary PCB

This PCB contains three operational amplifiers (IC1, 2, and 3) configured as non-inverting, virtual earth mixers. Here the auxiliary sends from each channel are summed and fed to the three auxiliary send sockets on the rear panel *via* decoupling capacitors.

Also on the rear panel are the three auxiliary return sockets, which are buffered by the three inverting amplifiers (IC4, 5 and 6) before being connected to the auxiliary pan controls on the master PCB.

Master PCB

This is a straightforward, virtual earth summing arrangement, there being one amplifier for each of the left and right outputs.

All three auxiliary returns are brought in *via* pan circuits so that the effects signals may be positioned at any point in the mix, and the overall output level is controlled by a ganged log pot wired into the feedback loop of both op-amps.

Headphone Amp

Built on a separate PCB, this module may be omitted if not required. Designed around the popular LM380 amplifier IC, the headphone output is independent of the master gain control and is capable of supplying a very high sound level into headphones of any reasonable impedance.

The PCB is the same as that featured in the Home Studio Recording headphone amplifier project (July '84) in which several boards were mounted in a rack case for studio monitoring purposes.

Next month, we'll be printing the concluding part of this project which will describe the PCB layouts and give full constructional details.

Paul White **E&MM**

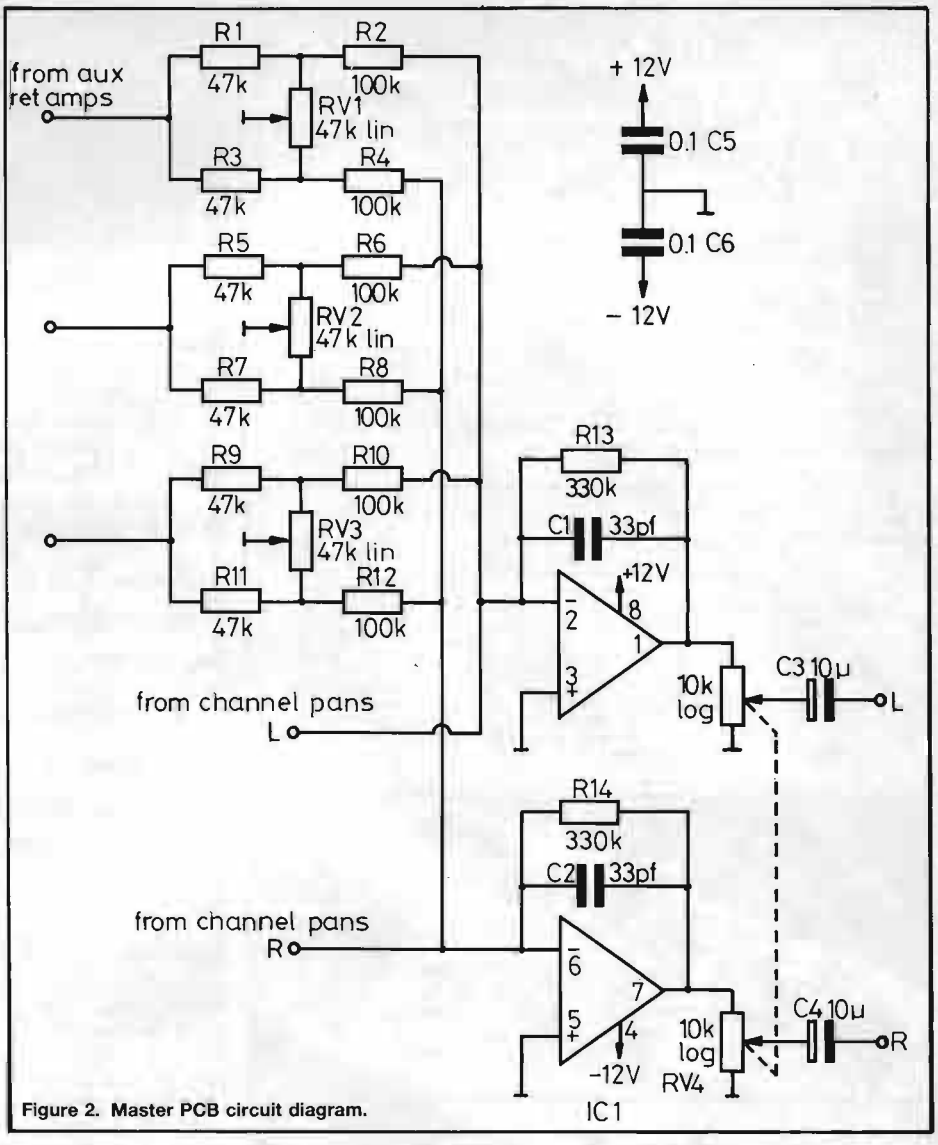


Figure 2. Master PCB circuit diagram.

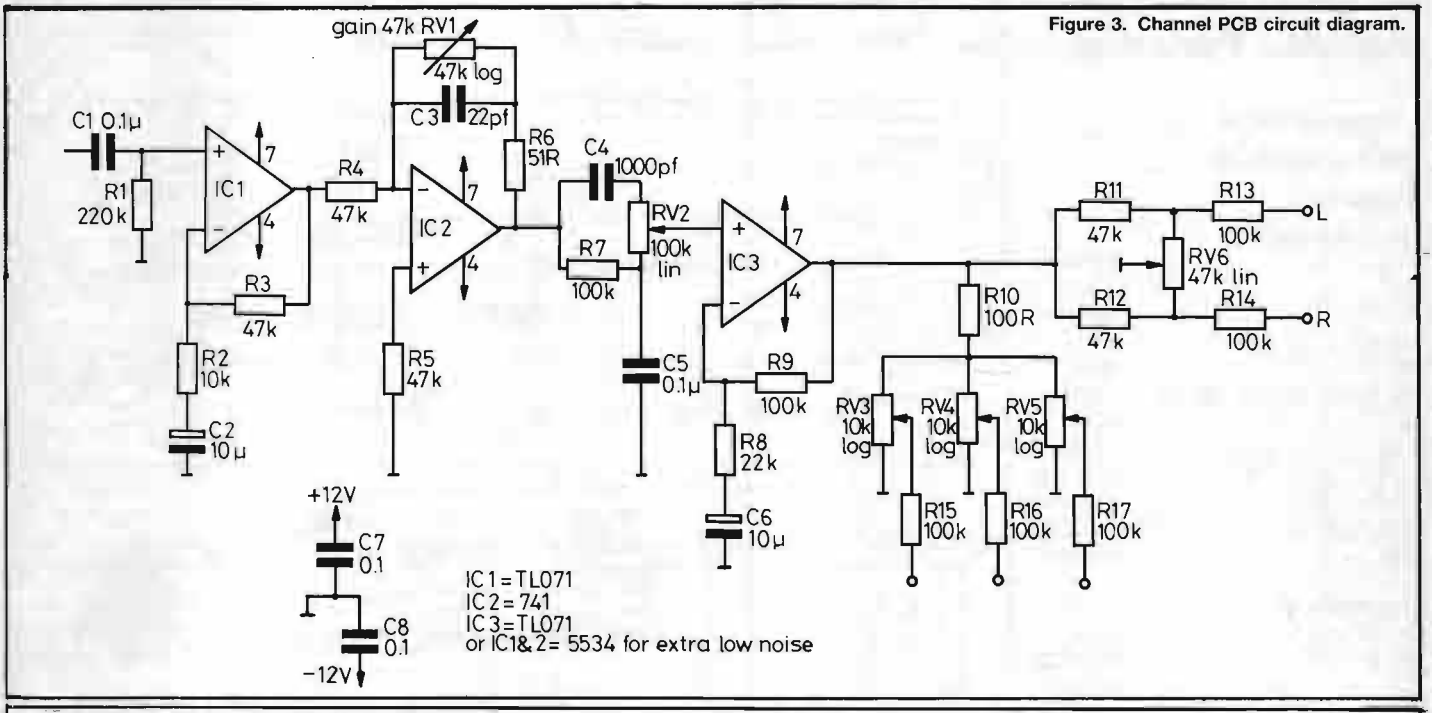
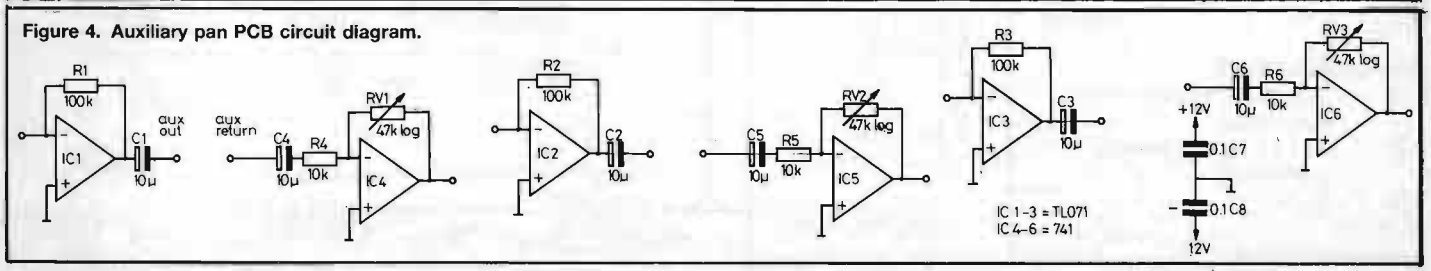


Figure 3. Channel PCB circuit diagram.

Figure 4. Auxiliary pan PCB circuit diagram.



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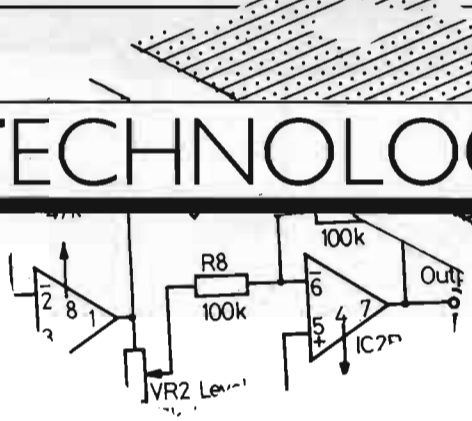
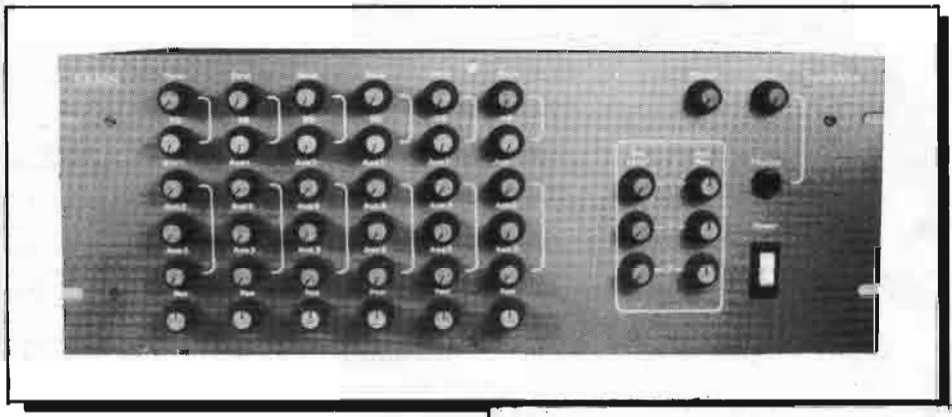


The SynthMix (2)

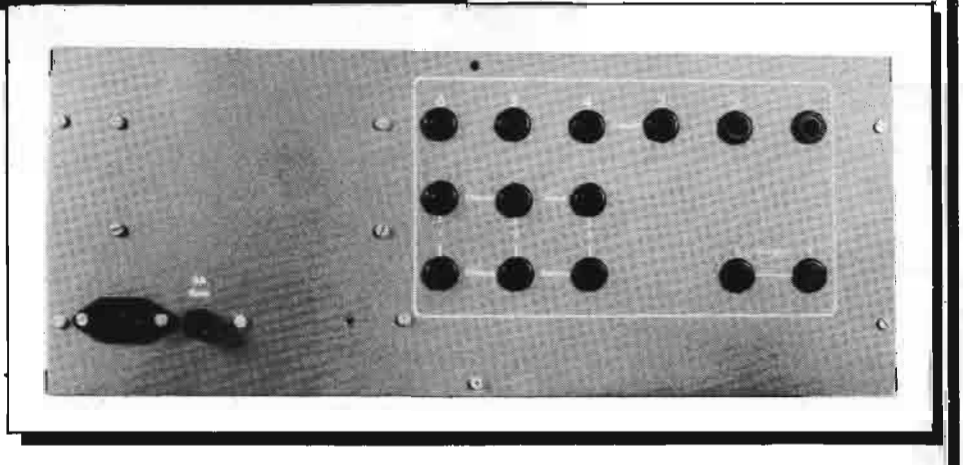
The conclusion of our keyboard mixer project, with PCB layouts and full wiring details. *Paul White*



3 Fit the −12V bus bar which joins all PCBs except the headphone board. Refer to Figures 1-5 when wiring to ensure that the connections are correct and that you are using the right holes.

4 Next come the three auxiliary bus bars which pass through the six-channel boards before splaying out to join the auxiliary PCB. Refer to Figure 3 and join these bus bars to the points labelled Aux bus 1, 2 and 3 respectively.

5 The left and right busses pass through all the PCBs except for the headphone amp board; there is no connection to the auxiliary PCB, but two holes are drilled to allow the wires to pass through.



Before starting on the constructional details, there are a few ambiguities concerning the power supply that need clearing up, due mainly to problems encountered in translating the circuitry from the original RackPack design.

The PCB itself is identical to that used in the RackPack, but the components relating to the power LEDs are now omitted as these are not required. Referring to the PCB overlay, Figure 1, the component values should be REC1 – 2A/100V bridge rectifier; C1, C2 – 2200μF/63V electrolytics; C3, C4, C5, C6 – 0.1μF; R4, R5 – 4K7; RG1 is a 7812 and RG2 a 7912.

The wiring diagram in Figure 6 is correct as it stands, but if an illuminated rocker switch is to be fitted, use a double pole type and check the manufacturer's wiring instructions before connecting up, otherwise the neon may end up being permanently on.

Assembly of the PCBs is straightforward and if the Maplin PCB mounting pots are used, these will fit directly to the boards making the wiring very simple. As always, check that electrolytics and ICs are mounted the correct way round, and I would recommend the use of sockets for all ICs except those used on the headphone amp, where the circuit track is used as a heatsink.

If you have made your own front panel as detailed last month, the PCBs may be fitted to it by means of the pot nuts, after the painting and legending is complete.

Once the PSU has been assembled, it should be tested before connection to the rest of the circuit, and all exposed mains connections should be insulated with rubber sleeving or plastic tape.

As can be seen from Figure 6, most of the wiring consists of bus bars passing through the PCBs, and tinned copper wire is the best material for this purpose.

This should be stretched before use to straighten it so that it can be threaded easily through the necessary holes.

Figure 6 also shows the correct position for each circuit board, and the bus bars should be fitted as follows:

1 Fit the +12V bus bar which passes through the top holes in all boards.

2 Fit the 0V bus bar through the second hole down on all PCBs.

It's important to fit the two 100μF electrolytic capacitors to the power buses as shown in Figure 6, and these should be at least 16 volts working. The headphone amp is wired to the master PCB with insulated flexible wire, and the connections are from the top of the two sections of the ganged master gain pot to the left and right inputs on the headphone amp board.

All six inputs, the two outputs and the auxiliary send and returns are wired using coax-to-jack sockets on the rear panel and the earth or screen connection should be made to the 0V track which runs up the back of each PCB (see Figure 6).

The prototype was built using a conventional transformer, and this had to be screened as a certain amount of mains hum was noticeable at

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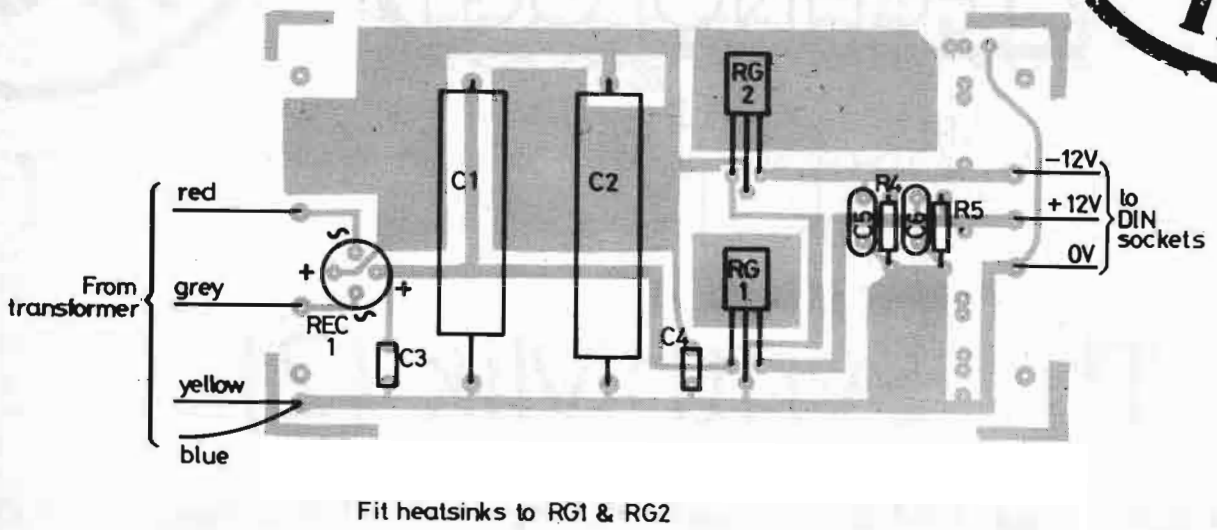
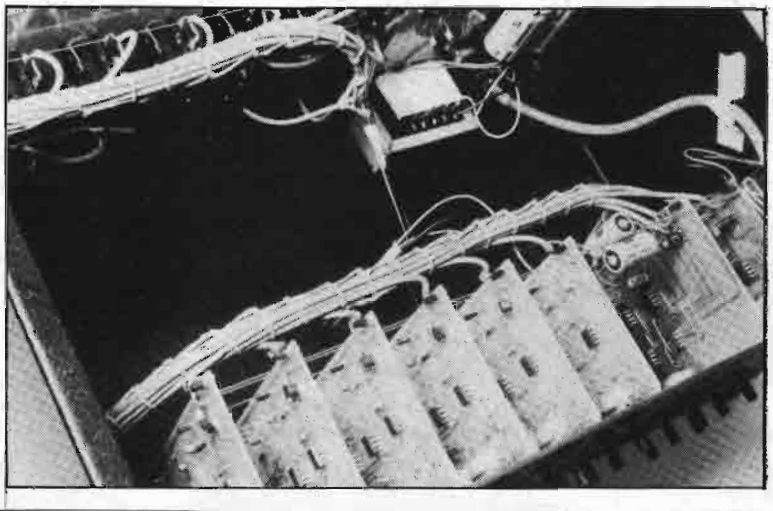


Figure 1. SynthMix power supply PCB component overlay.



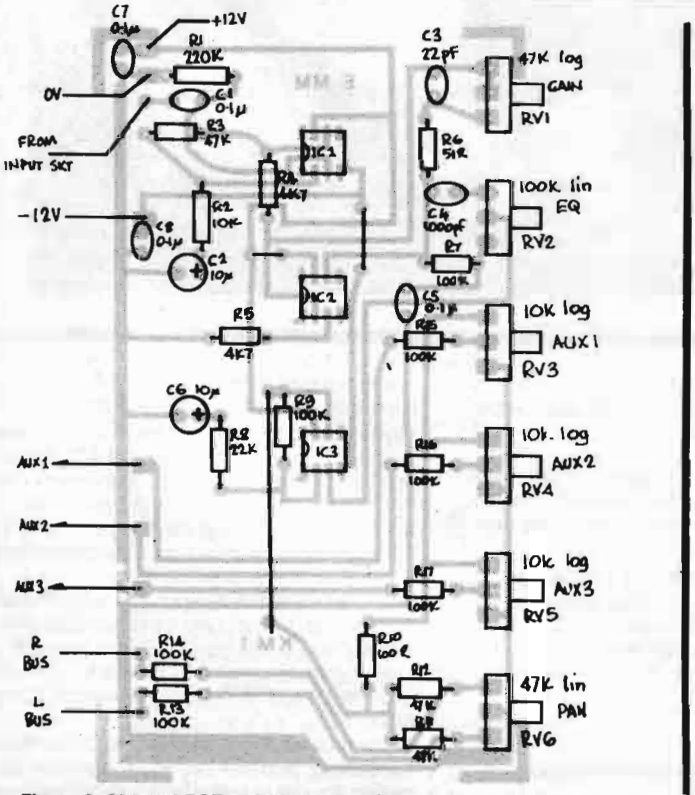


Figure 2. Channel PCB component overlay.

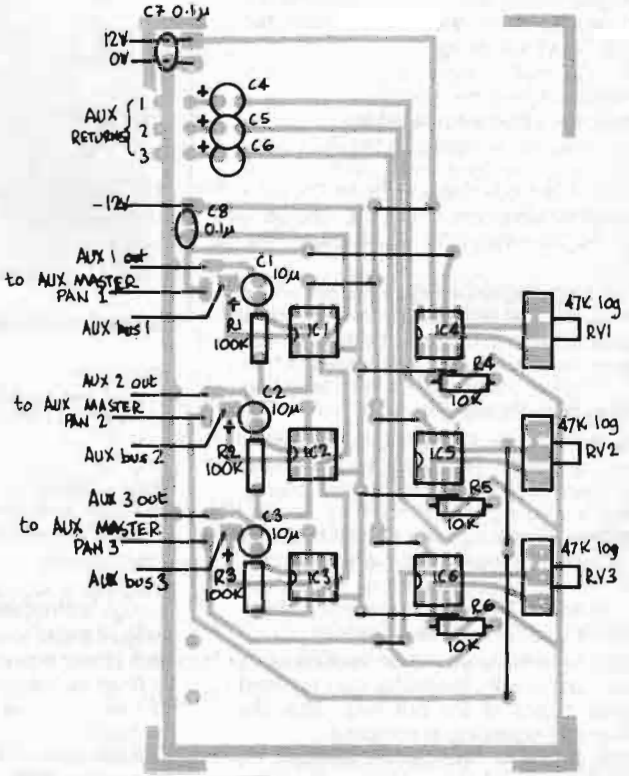


Figure 3. Auxiliary PCB component overlay.

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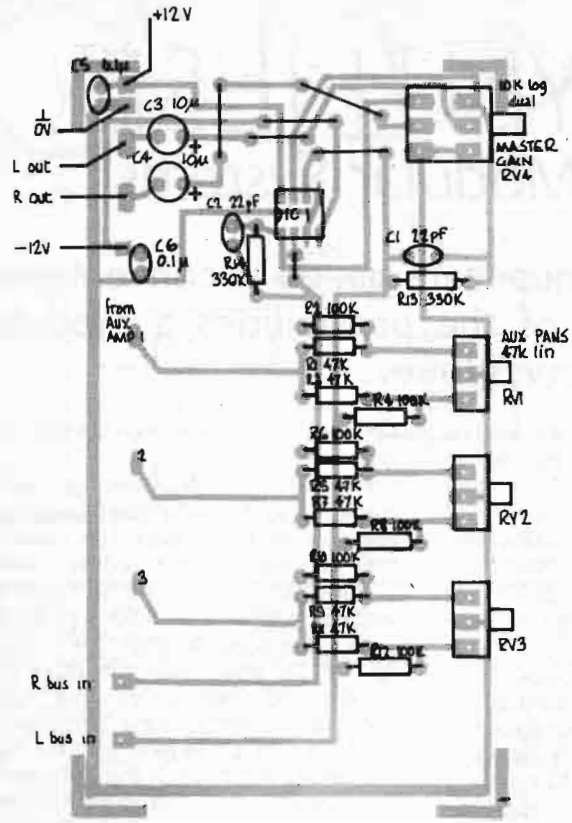

Figure 4. Output and aux pan PCB component overlay.

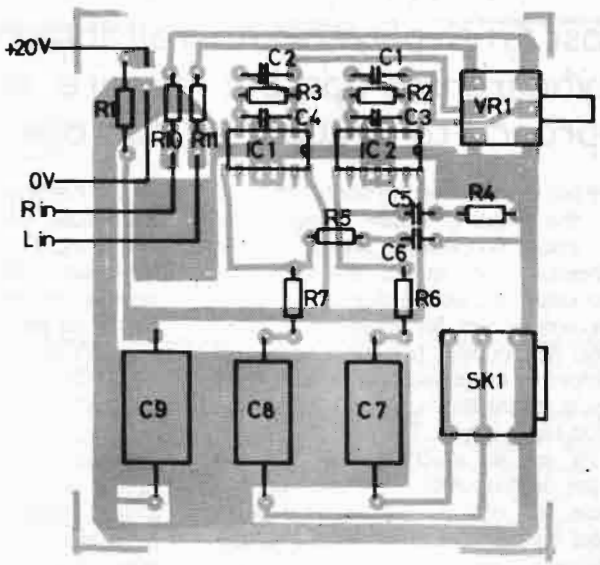

Figure 5. Headphone amp PCB component overlay.

high master volume settings. A far better alternative is to use the toroidal transformer specified in Figure 6, and this is available from Maplin, as indeed are all the other components. No additional screening should then be necessary in the transformer department, but it does make a small further improvement if the leads to the front panel mains switch are screened, the screen being connected to the chassis at one end only.

Figure 6 clearly shows the PSU wiring, and it's best to check that the power supply still provides +/− 12V when connected to the rest of the circuitry, preferably with the ICs unplugged first time round.

Testing

When all the ICs have been refitted and it's been confirmed that there are no power problems or elusive wisps of smoke, the unit may be tested with an audio signal.

Plug in two suitable power amplifiers and turn all the volumes to minimum before switching on, and don't forget to connect some speakers! There should be little or no background noise at this point, and if all is well, plug in a suitable keyboard instrument so that the level controls, EQ and pan functions can be tested. Check out each channel separately and then connect an effects pedal to auxiliary send and return 1 to verify the auxiliary functions, thus ensuring that the auxiliary level and pan controls work properly. Repeat this test for Aux 2 and 3, and if everything is working OK, test the headphone output, taking care to start off with the headphone volume set low.

At this point, the covers may be fitted and your SynthMix is then ready for use. ■

Pricing details for the complete SynthMix project will be announced in a forthcoming issue of E&MM. Meanwhile, a range of 19" rack-mounting cases – suitable for housing all present and future rackable projects published in both E&MM and its sister magazine, Home Studio Recording – are available direct from our Mail Order Dept at the editorial address. Top and side covers of the boxes are finished in textured black, while the front and rear panels are unpainted, allowing the user to finish the case in any suitable colour. Prices are as follows: 1U high – £9.95; 2U – £14.95; 3U – £16.95; 4U – £22.95, all including VAT and carriage. Please make cheques/POs payable to Music Maker Publications Ltd., and allow 28 days for delivery.

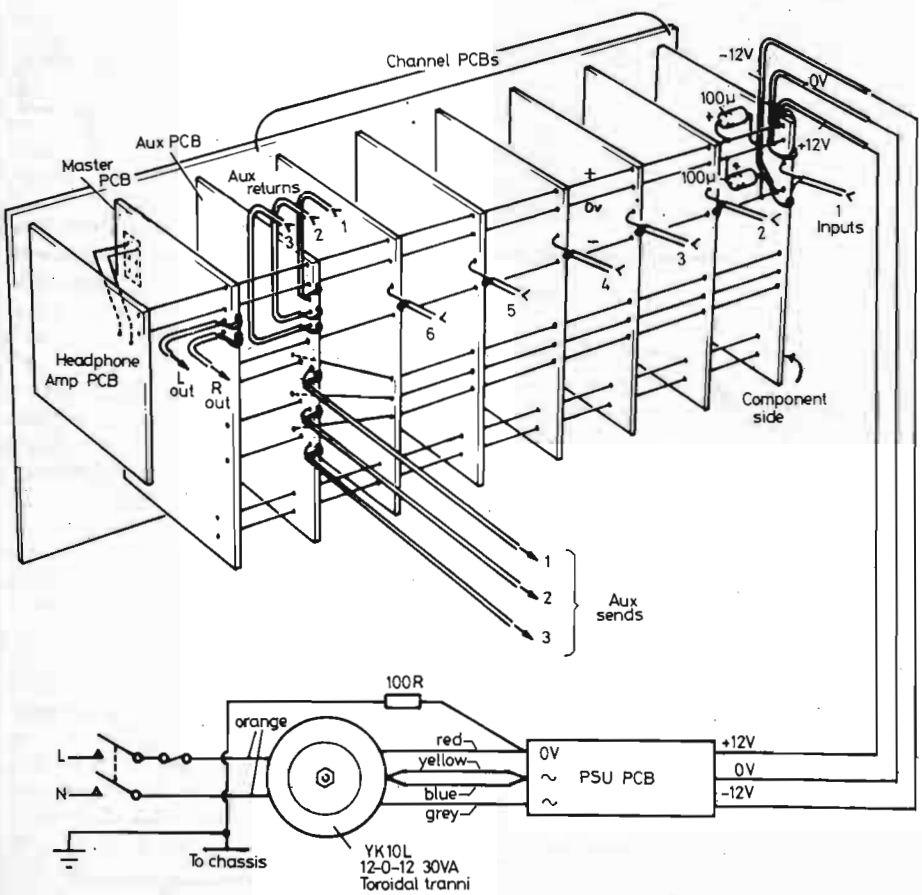

Figure 6. SynthMix internal layout and construction.