ETI 1424 VERSATILE GUITAR PRE-AMPLIFIER

Guitar players always place over the top demands on their gear. This guitar pre-amp certainly delivers over the top specifications.

Terry Kee

COMMERCIAL GUITAR AMPLIFIERS do not appear to be getting any cheaper so a good low cost alternative is to build your own. Power amplifier modules are commonly available from your local kit suppliers at very reasonable prices with excellent performance, particularly those published in this very magazine.

The ETI-1424 is intended to provide high quality pre-amplification especially tailored for the electric guitar. The equalizer sections are optimised for the frequency range where the guitar needs them most.

The main features of the pre-amp include a top boost and normal input for guitars, two pre-eq line inputs, bass and treble controls, effects send and return, a sweep eq section, four post-eq line inputs and a master level control. No level control is provided for the line inputs as typical inputs would be drum machines and synthesisers that have their own individual volume controls. This set-up is designed for the all too common situation where there are insufficient amplifier inputs for all the instruments. More often than not, this happens in a rehearsal situation.

The bass and treble are designed to provide maximum cut and boost of frequencies at 100 Hz and 8 kHz to obtain a wide tonal range for an electric guitar. To give a harder edge to sounds, a top boost input is available whereby frequencies above 1 kHz are amplified; at around 10 kHz there is a massive 20 dB of boost! The normal input has a flat response and is excellent for those mellow rhythm chords. A bass cut is built into the input amplifiers IC1a and b as in a live set-up, very low frequencies combined with speaker cabinet resonances tend to muddy the overall guitar sounds, not to mention setting off the cymbols at some resonant frequency! The guitar inputs have a fairly high input impedance of 220 k to ensure that the pick-ups are not loaded and thus obtain maximum sustain. Due to the high input impedance hum pick-up can be a problem, so the jack sockets are wired in such a way that any unused inputs are shorted to ground. No casing details will be described here as it is likely that the pre-amp will be built into the box that houses the power amplifier. A metal box is recommended to minimise hum pick-up.

Many of the facilities of the 1424 can be tailored to your requirements. If you decide that you do not want any pre or post eq line inputs, as an example, then it is simply a matter of linking the relevant inputs to ground on the pc board. A similar procedure applies if you do not want an effects send and receive, simply link the effect send out pad to the effect return pad with some hook-up wire.

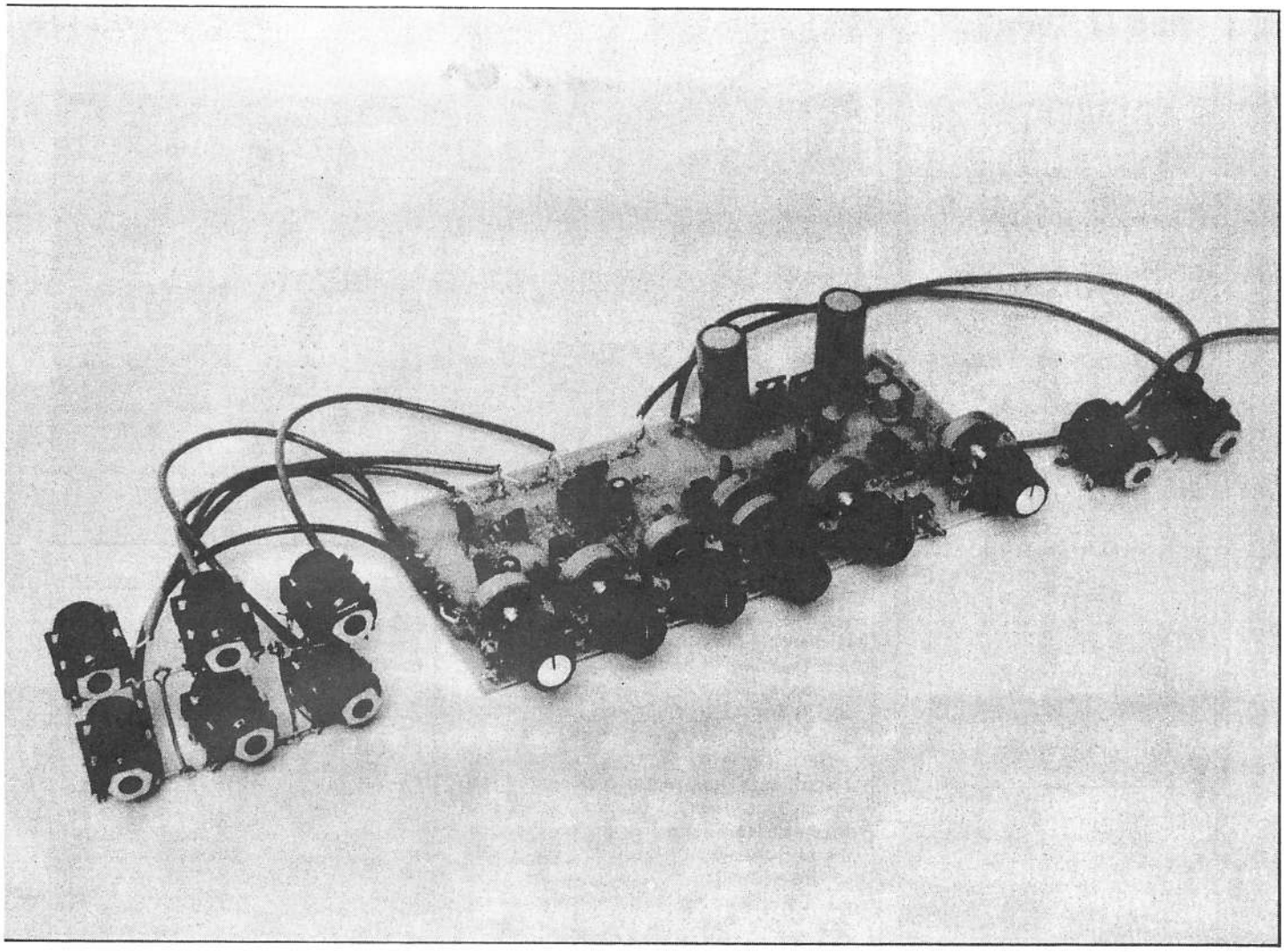
The effects return is fed to a sweep equaliser that has an adjustable frequency and gain control. The circuit is a modified version of the parametric equaliser that appeared in an earlier ETI. A bandpass or bandstop type of response is exhibited with the resonant frequency made adjustable over an extremely wide range of 200 Hz to 8.5 kHz using a single control. The sweep eq supplies a massive 18 dB of boost and −22 dB of cut at the resonant frequency and can be adjusted by the gain control. The Q-factor is fixed and gave good tonal variations with a guitar signal. A bypass switch is included to switch the effect in or out when required. It's useful for pre-setting the eq for that funky toppy rhythm lick! The 1424 derives it's +/− 12 Vdc power from it's on board regulated power supply.

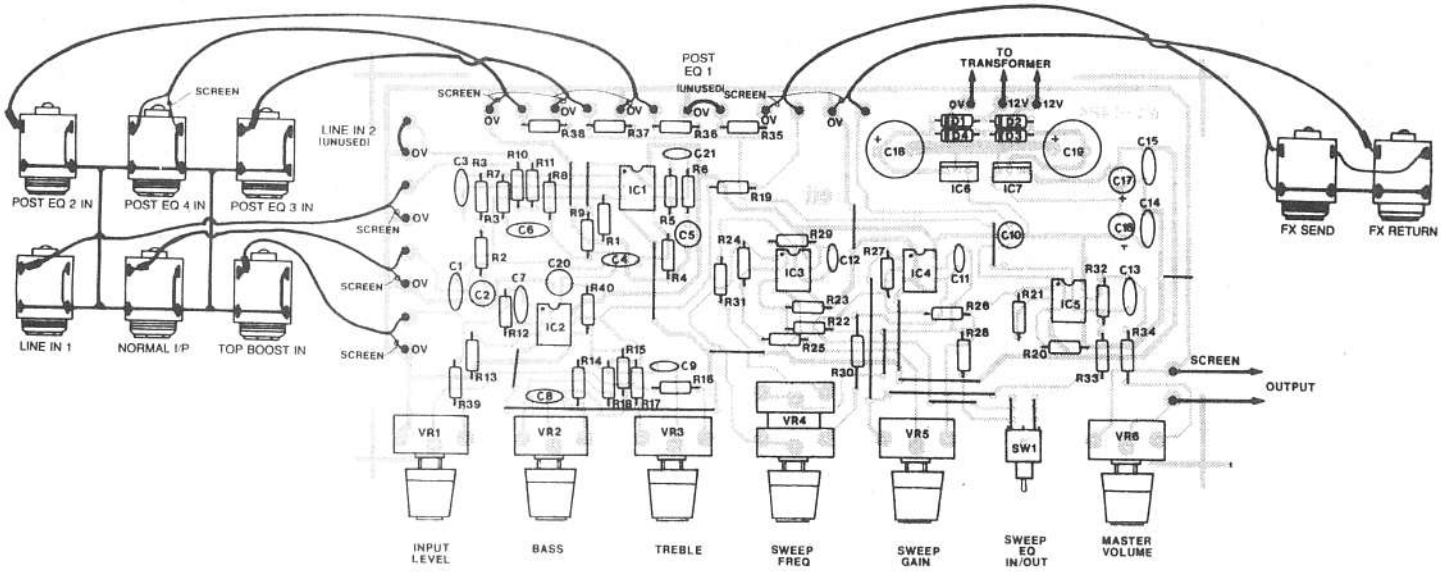
Construction

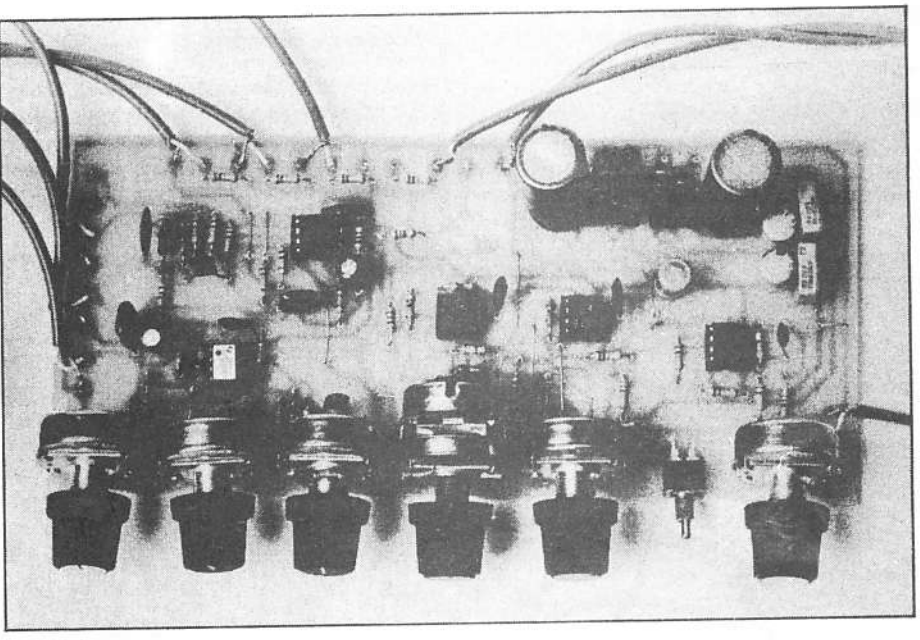
The pc board is designed to be mounted directly to the front panel of the amplifier box and is fastened down via the nuts on the pots. If you do not want to use pc mount pots and pc mount switches then use the shortest length of hook-up wire to make the connections to these components to minimise hum and pick-up. You will also have to drill some mounting holes on the pc board. Make sure that the holes do not break any tracks.

Building up the pc board should not present any problems as the entire circuit is contained on one single-sided board. The first task is to check the board for track breakage and shorts. It's a good idea to go through this process even though you may have obtained the board from a kit supplier. No-one is perfect! Faults will be much easier to spot now than when the board is populated with components. Once you are satisfied it's time to drill the component holes, if it is an undrilled board. Make sure that the holes for the pc mount pots are large enough, a 2 mm drill bit should be adequate.

Construction can start by inserting the links, resistors, capacitors, and ic sockets and soldering them in. Take note of the polarity of the electrolytic caps, refer to




POST EQ 2 IN
POST EQ 4 IN
POST EQ 3 IN
LINE IN 1
NORMAL I/P
TOP BOOST IN
LINE IN 2 (UNUSED)
POST EQ 1 (UNUSED)
SCREEN
0V
TO TRANSFORMER
12V
FX SEND
FX RETURN
OUTPUT
VR1
VR2
VR3
VR4
VR5
VR6
SW1
INPUT LEVEL
BASS
TREBLE
SWEEP FREQ
SWEEP GAIN
SWEEP EQ IN/OUT
MASTER VOLUME



the component overlay. Do not as yet insert the IC's themselves. Insert and solder in the pc mount pots and switch, making sure that they sit firmly and parallel to the pc board. The +/− 12 V regulators (IC6 and 7) are the final components to solder in, note the orientation on the overlay.

Next comes the wiring of the inputs, output, send and return sockets and the mains transformer, if required. After you have decided what inputs you require then it's just a matter of measuring the length of shielded cable to connect to the sockets. Do not forget to link any unused inputs to 0 V on the pc board. It is a good idea to mount the input sockets as far away from the mains transformer as possible to minimise hum pick-up. Also mount the inputs away from the outputs to minimise cross-talk. Use insulated 6.5 mm jack sockets to avoid hum loops. The hot end of the input sockets need to be grounded when no plugs are inserted hence sockets with closed contact are required. The input sockets should have their earth connected together at the sockets with some tinned copper wire. A single connection from the braiding of one of the input screening cable is all that is required to connect the socket earths to the pc board. Refer to the wiring diagram on the overlay. The earth screen of the other inputs needs to be soldered to the 0 V but cut off at the socket end. Make sure that the open ended screen does not short any of the inputs, use some sleeving or insulated tape if you are unsure of your wiring.

The same procedure applies to the effects send and return sockets. Do not forget to link the send out to the return in on

ETI 1424 Parts List

Resistors

All ¼ W Metal film, 5% tolerance

R1,4	220k
R2,6,30,31	2k2
R7,13,40	1k
R8,9,10,11,12,18,20,21,26,28,32,33,35,36,37,38	10k
R3,5,14,15,27	22k
R16,17	4k7
R19,34,39	56R
R22,25	56k
R23	3k9
R24,29	100k
VR1,6	10k log pc mount pot
VR2,3	100k lin pc mount pot
VR4	100k lin pc mount dual-gang pot
VR5	10k lin pc mount pot

Capacitors

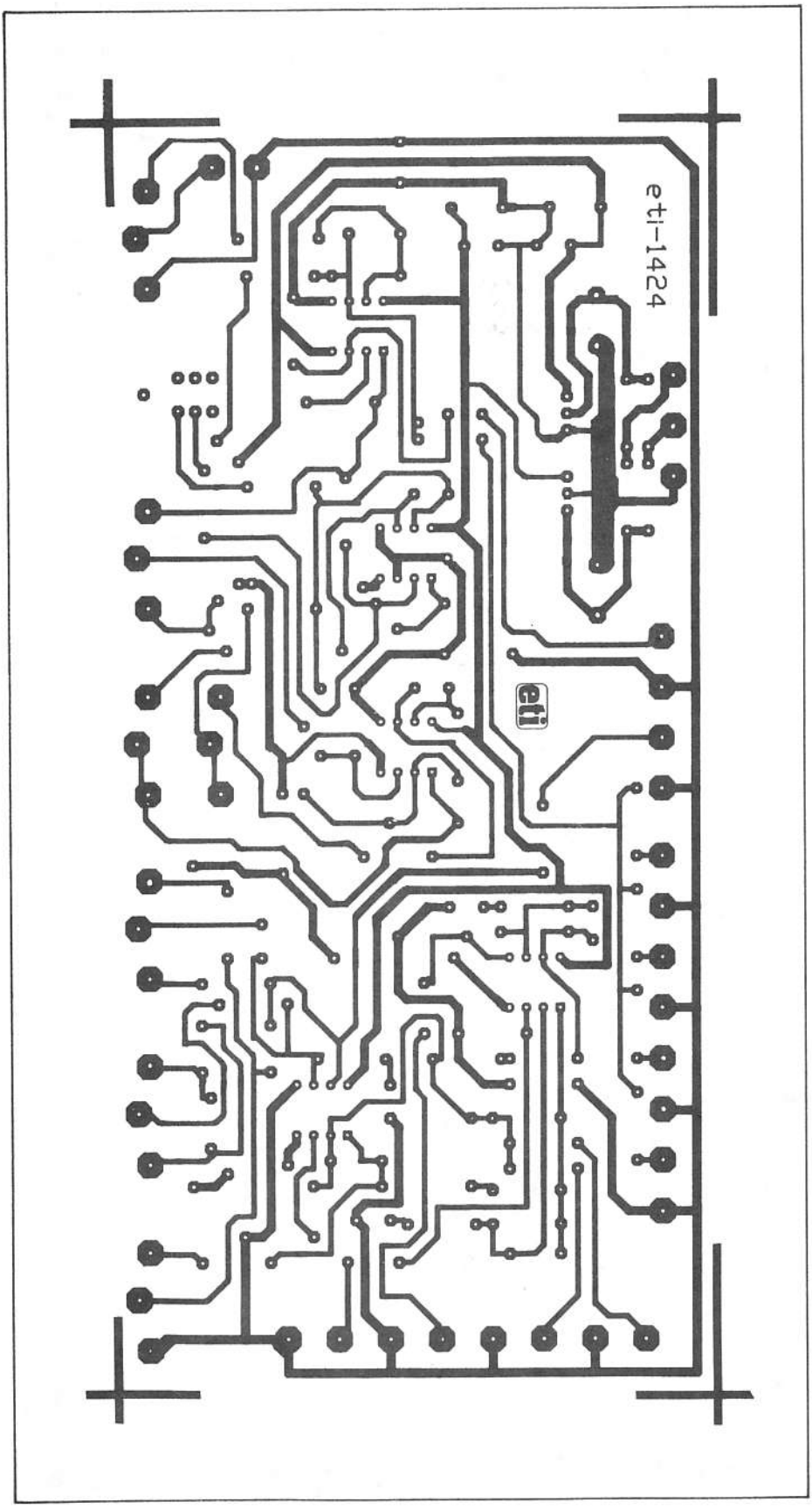
C1,4	56n greencap
C2,5	1u/35V bipolar electro
C3,21	82p ceramic
C6	10n greencap
C7,13	560p ceramic
C8	22n greencap
C9,11,12,20	8n2 greencap
C10	3u3/35V bipolar electro
C14,15	100n greencap
C16,17	33u/35V axial electro
C18,19	1000u/35V axial electro

Semiconductors

IC1,2,3,4,5	TL072
IC6	7812
IC7	7912
D1,2,3,4	1N4001

Miscellaneous

SK1 to 11 .. 6.5mm Mono Insulated Jack Sockets (contacts closed when plug is not inserted)
SW1 ..... PC Mount Miniature DPDT toggle
T1 ..... 12V-0-12V at 500 mA Mains Transformer
Shielded Audio Cable
5 off 8 pin dil IC sockets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the pc board, if you are not using this facility. These sockets are wired in such a way that the signal path is broken when a plug is inserted otherwise continuity is made, refer to the wiring diagram. Use a length of screened cable to connect the output of the pre-amp to the power amplifier.

The mains transformer for your power amplifier may have 12V-0-12 Vac tappings that can power the 1424 directly, otherwise a separate transformer will be required. Ensure that you use mains cable for all connections that carry mains voltage and that the metal chassis of the box is securely earthed. Be extra careful with any mains wiring.

Testing

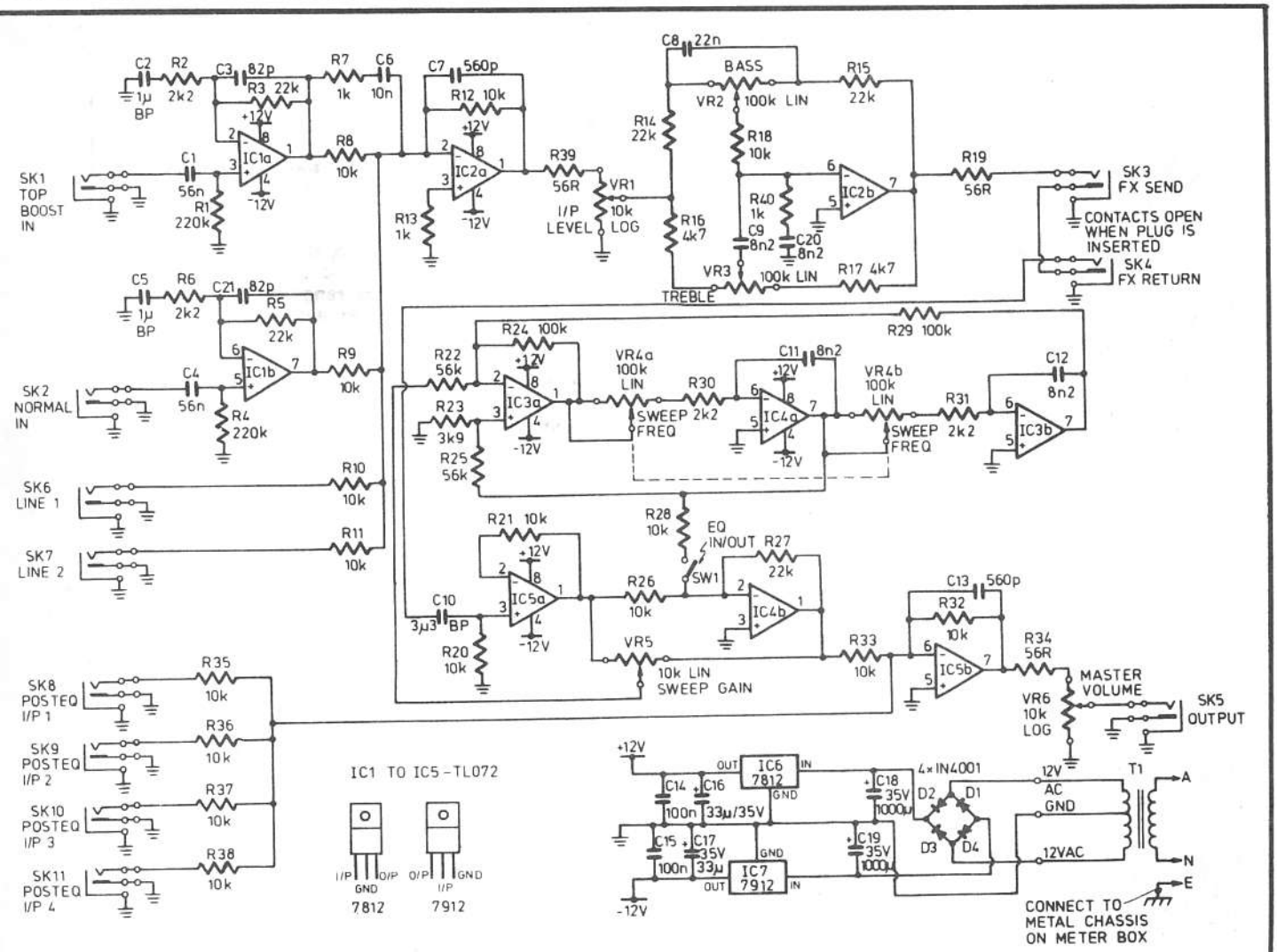
Once you are satisifed that the pc board is free of solder splashes and dry joints, then it's time to fire up the circuit. Without any of the ic's inserted, apply the power and check that there are +12 Vdc at pins eight and −12 V at pins 4 of the IC's. When it has been established, switch off the supply and insert the IC's. Make sure that they are orientated the correct way, refer to the overlay. Power up again and re-check the dc rails. It would be a good idea to disconnect the output to the power amp for this test. Set the bass and treble knob to midway and the sweep eq to out. Plug in a guitar and check that each input produces an output signal at the output of the pre-amp. Twiddle the tone controls individually and you should hear the difference! Switch in the sweep eq and turn the gain control clockwise to give a boost. Twiddle the frequency knob and you should hear the peak being swept over the frequency range. ●

ETI 1424 How it works

IC1a and b are connected as non-inverting amplifiers with a 20 dB fixed gain set by R2, R3 and R5, R6 for each input amplifier. The sensitivity of these amplifiers can be altered quite easily to suit the different levels of various pick-ups and to match the input sensitivity of different power amplifiers. The voltage gain equation is given by Av1a=1+R3/R2 and Av1b=1+R5/R6, hence to reduce the gain R3 and R5 need to be reduced. These amplifiers are ac coupled via C1 and C4 and the input impedance is set to 220 k for both the normal and top boost guitar input. The output of IC1a is fed to an equalizer network consisting of R7, R8 and C6 that boosts signal frequencies above about 1 KHz and will have a massive 20 dB boost at 10 kHz. The outputs of IC1a and b are mixed in IC2a which is connected as a adder, the two pre-eq line inputs are also summed at this point via R10 and R11. The level can be adjusted via VR1 before it is fed to the bass and treble tone controls built around IC2b. It is an active tone filter with the frequency selective components in the feedback path of IC2b. The bass control has a +/− 12 dB of cut and boost at 100 Hz and the treble control has a +/− 20 dB at 8 kHz. With the tone controls set to midway a flat response within 3 dB can be expected. R40 and C20 provides attenuation at high frequency for stability. The output of IC2b is buffered by a 56R resistor R19 to aid stability when driving capacitive loads.

The effects return is ac coupled via C10 and is buffered by IC5a and provides an input impedance of 10 k set by R20. The sweep eq is based on a standard active state variable filter, built around IC3a, 3b, 4a and b. The centre frequency is determined by VR4a and b, R30, R31 and the capacitors C11 and C12. An extremely wide frequency range of 200 Hz to 8.5 kHz can be obtained using a single pot control, VR4. The Q-factor is set to 4 by R25 and R22 and VR5 allows a variation over the stated frequency range. SW1 allows the sweep eq to be bypassed with an overall unity signal level except at the boost or cut frequency. The eq output is then mixed with the four post-eq line inputs in the summer, IC5b, VR6 controls the main output level of the pre-amp.

The 12 V-0-12 Vac is rectified by D1 to D4 which are connected as a full wave rectifier and smoothed by capacitors C18 and C19. A regulated +/−12 Vdc supply is derived from the 7812, (IC6) and 7912, (IC7) regulators. The circuit draws a dc current of around +/− 21 mA.


SK1 TOP BOOST IN
SK2 NORMAL IN
SK6 LINE 1
SK7 LINE 2
SK8 POSTEQ I/P 1
SK9 POSTEQ I/P 2
SK10 POSTEQ I/P 3
SK11 POSTEQ I/P 4
SK3 FX SEND
CONTACTS OPEN WHEN PLUG IS INSERTED
SK4 FX RETURN
SK5 OUTPUT
BASS
TREBLE
I/P LEVEL
SWEEP FREQ
SWEEP GAIN
EQ IN/OUT
MASTER VOLUME
IC1 TO IC5 - TL072
7812
7912
4 x IN4001
AC
GND
12VAC
CONNECT TO METAL CHASSIS ON METER BOX