Project 1410

150W BASS GUITAR AMP

Part 2

Robert Irwin

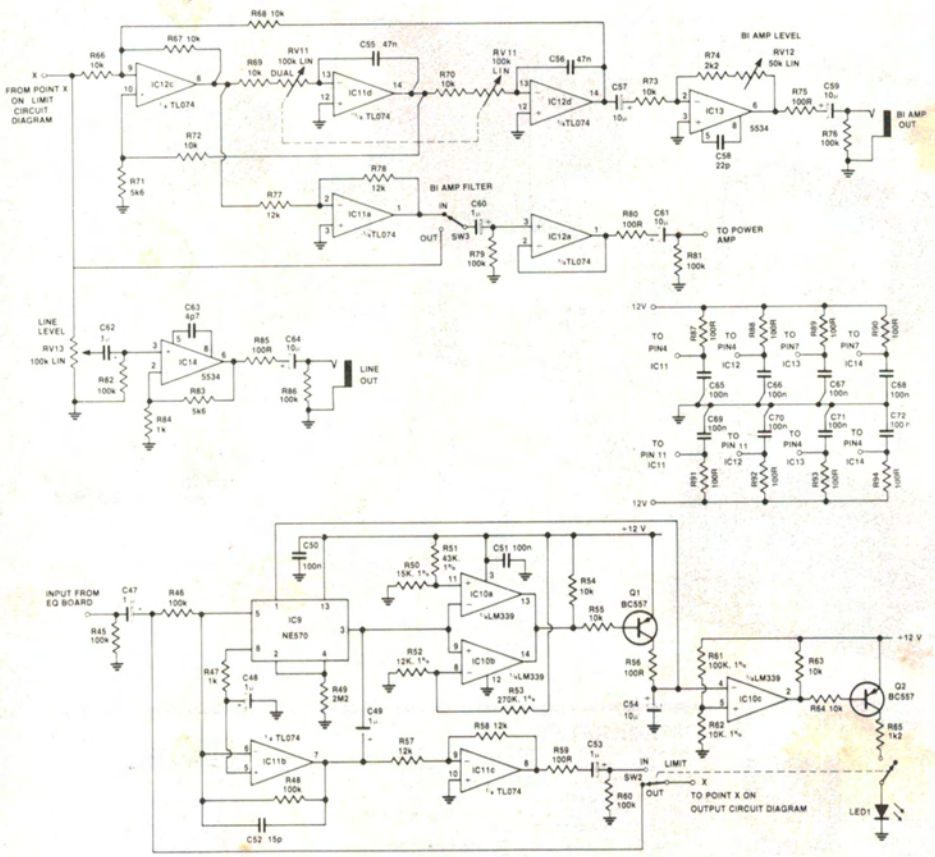
IN PART 1 the constructional details for the power supply board and input board were given. This article completes the picture, with details of the equaliser board and the output/limiter board, plus gives full constructional details for the complete amp.

Construction of the boards

The equaliser circuitry is contained on two boards, ETI-1410 c & d. The ETI-1410d board contains the main circuitry and the ETI-1410c board supports the six slider pots used for the adjustment of boost and cut. The construction of both boards is straightforward.

Start with the ETI-1410d. Solder in all the resistors first. The capacitors should be soldered in next but take special care to get the values in the correct place as these set the equaliser frequencies. Take care to get the orientation correct on the electrolytics and tantalums. Solder pins should be soldered into the holes for the input, output and power supply connecting leads as these will be connected after the board has been mounted and the underside will not be accessable for soldering.

The next step is to locate and solder in the ICs. This should be done with care as it is easy to bridge the tracks between IC pins with solder. Also take care to get the ICs the right way round. The only thing left to do on this board at the moment is to solder lengths of tinned copper wire (about 40 mm each) into the holes which will join to the board containing the sliders. These will be connected to the other board after both boards have been mounted in the case. The switch and pot shown on the circuit diagram are external to the board and will be attached with hookup wire at a later stage.

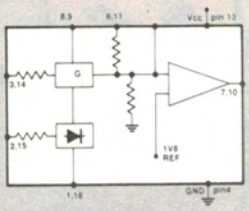


HOW IT WORKS ETI 1410e LIMITER/OUTPUT BOARD

This board has two main areas of circuitry, the limiter circuit and the output circuitry. They are independent of each other, so we can deal with them separately.

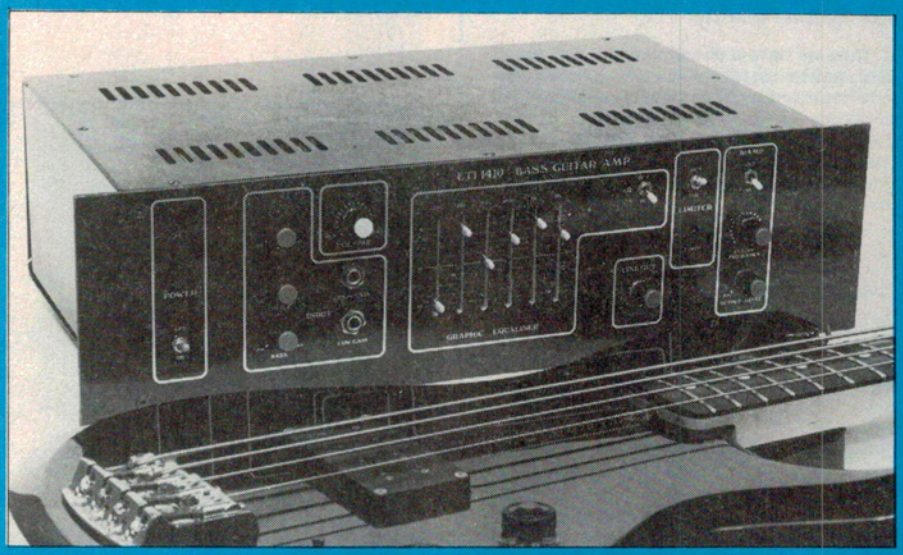
LIMITER

The heart of the circuit is the NE 570 Compander IC. This IC contains two identical gain control circuits which can be configured to produce a variety of compression and expansion type circuits. In this application only one of the circuits is used and this is configured as a hard limiter circuit designed to limit the output to a maximum of 1 V RMS.



The input from the EQ board is ac coupled by C47 and R45. The input is taken to an inverting amplifier stage formed by R46, R48 and IC11b (¼ of a TL074). Note that IC11b is used as a replacement for the internal op-amp incorporated on the NE570 chip which is not used here. Also incorporated in the feedback network of IC11b is the variable gain cell of the NE570 (pins 3 and 5) which is in paral-

bass guitar amp



The final part of this project looks at the operation of the sections not covered in Part 1. There are also full details of construction, powering-up and testing.

The ETI-1410c board contains only the six sliders. These should be soldered in at the top and bottom lugs only. The slider lugs will be connected to the main board once the boards have been mounted. Make sure that the sliders sit flush against the pc board and are sitting straight and square.

The final board left to construct is the limiter/output board (ETI-1410e). This is a relatively complex board and should be checked thoroughly for any bridged or broken tracks before you start. If all is well then start in the usual manner with the resistors and capacitors. After these have been soldered in, the eight links should be soldered in place. Tinned copper wire can be used for the links as they have been spaced far enough from other component leads so as not to be in danger of shorting.

Once again, solder pegs should be soldered in to the input, output and power supply holes. Solder in the ICs and transistors next; making sure that you get them the correct way round (note that the two NE5534's are the opposite orientation to the other IC's). An IC socket can be used with the NE570 in case it is necessary to replace it at some later date.

Once you have finished soldering in all the components, go back and double check that they are all in the right places and are the right way round. Once you are satisfied that all the boards are correct we can get on to the job of putting the thing together.

Constructional details

The prototype unit was mounted in a standard 19" (424 x 250 x 140 mm) rack-mount, black anodised instrument case. This was supplied disassembled, but if you have one already built up then start by taking it apart. ▶

lel with the feedback resistor, R48.

C49 insures that the dc gain of the op-amp is not afected by changes in the variable gain cell. For small input signals less than 1 V RMS the variable gain cell is turned off and presents a high impedance which won't affect the gain of IC11b.

The gain for the signals less than 1 V RMS will be unity (set by R46 and R48). If the input signal rises above 1 V RMS a threshold level will be exceeded on the dual comparators formed by IC10a and IC10b. IC10a will detect positive going peaks and IC10b will detect negative going peaks. Pin 3 of the NE570 is internally biased to 1.8 Vdc so the threshold voltages for the positive and negative comparators are 3.2 Vdc and 0.4 Vdc respectively (since 1 V RMS represents a peak voltage of 1.4 V).

When a comparator threshold is exceeded then the comparator output will swing low and turn on the transistor Q1. This charges C54 through R56. As the voltage on C54 rises the variable gain cell is turned on due to the increase in voltage on pin 1 of the NE570. This has the effect of lowering the effective resistance of the variable gain cell which, in turn, increases the ac feedback on IC11b and lowers the ac gain. This will hold the output voltage to 1 V RMS regardless of how high the input voltage is.

IC10c is another comparator which detects the rise in voltage on C54 and turns on Q2 to supply current to the LED which indicates that limiting has occurred. R49 trickles a small amount of current through the variable gain cell so as to keep the capacitor C54 slightly biased on. This ensures a fast turn on time when the limit circuit is activated. The attack time of the limiting action is set by the RC time constant of R56 and C54. The component values shown given an attack time of less than 1 millisecond. This can be varied by varying R56. When the limit action is turned off (i.e: when the input falls below 1 V RMS) C54 discharges through an internal 10k resistor in the NE570. The components given give a release time of around 100 mS. To vary this you can vary the value of C54 but the value of R56 will have to be adjusted to give the correct attack time.

The positive input of IC11b is connected to pin 8 of the NE570 which is internally biased to 1.8 Vdc. This biases the op-amp output. R47 and C48 provide noise decoupling.

IC11c is configured as a unity gain inverter which is used to buffer the output and to put the output in phase wiht the input. C53 and R60 provide ac output coupling and R59 isolates any capacitive loading. The limiter circuitry can be bypassed using SW3.

OUTPUT

The output circuitry provides three separate outputs: line output, the bi-amp output and the power amp drive. The line out is provided by IC14, an NE5534 op-amp. This is configured as a non-inverting amp with a gain of 6.6 set by the equation:

$$Av = 1 + R83/R84$$

RV13 provides level control and C62 and C64 provide ac input and output coupling. C63 provides frequency compensation for the 5534.

IC12c, IC12d and IC11d form a state variable filter network. A state variable filter produces a highpass, lowpass and bandpass output all with the same cutoff frequency. Only the highpass and lowpass outputs are used here. The highpass output comes from the output of IC12c and is fed to an inverting buffer, IC11a. This gives the correct phase on the output. The output is then fed to IC12a which provides output drive to the main power amp. C61 provides ac coupling to the power amp.

The lowpass output is derviced from the output of IC12d and is ac coupled via C57 to an inverting amp stage formed by IC13. The gain is given by

$$Av = (R74 + RV12)/R75$$

This can be varied from 0.2 to 5.2 by varying RV12. The output of IC13 is ac coupled to the bi-amp output jack by C59 and R76. C58 provides compensation for the 5534.

The cutoff frequency of the filter network is given by:

$$F_c = \frac{\pi}{2}(RV11 + R69 \times C55)$$

For the values given this can be varied from 30Hz to 340Hz by varying RV11. The input to the power amp can be switched from bi-amp to the output of the limiter section by SW4.

Power supply noise de-coupling to all the IC's is accomplished by R87 to R94 and C65 to C72.

HOW IT WORKS ETI-1410c and 1410d EQUALISER BOARD

The equiliser board is an adaptation of the series 5000 ⅓ octave graphic equiliser published in the November 1982 issue of ETI. It incorporates selective filters in the feedback loop of an op-amp, to generate frequency selective gain.

Signals from the input board are fed to IC6c, which is connected as a buffer and provides a low driving impedance for the equiliser section. The input impedance is set to 10K by R20. RV4 provides a master control and feeds signals to IC8, an NE5534 op-amp which is connected as a non-inverting ac amplifier. The gain of this op-amp is set at 58 by the network R24 and R25. This can be altered if desired by changing R25. C48 is used to lower the effective gain at high frequency and thus prevent oscillation. C27 and C28 provide ac coupling. A switch, SW2, is provided to switch the equiliser in or out of circuit.

Figure 1 is the equivalent circuit of the graphic equiliser. The way it works is best understood by considering its behaviour with only a single frequency dependant circuit (labelled Z). If Z is a high impedance, then the op-amp will act like a simple unity gain voltage follower. However, if Z is low the circuit will exhibit both cut and boost depending on the position of RV. When the wiper of RV is in the centre position the input resistor forms a potential divider with half of RV. The other side of RV forms a potential divider with the feedback resistor. If both feedback and input resistors are the same value then the op-amp gain will be the inverse of the input attenuation, so the overall gain will be unity.

However, if the wiper is moved towards the inverting terminal, then the attenuation in the feedback loop will increase causing the gain of the op-amp to increase. At the same time the input attenuation will decrease, so adding to the overall increase in gain of the network. If the wiper is moved in the opposite direction, then a similar chain of reasoning shows that gain will decrease.

Thus we have a circuit that will give boost and cut when at resonance, and merely buffer any frequencies not at resonance. In the 1410 there are six impedances connected in parallel. Each one consists of a capacitor and a simulated inductor, the gyrator. The resonant frequency can be calculated in the traditional manner from

$$F = \frac{1}{2\pi\sqrt{LC}}$$

The general circuit of a gyrator can be seen in figure 2. It was used to avoid the necessity of winding up six coils of the appropriate inductance. The amount of inductance present can be calculated from:

$$L = 2K2 \times 220K \times C1$$

In the 1410 the gyrators are formed by IC6a, 6d, 7a, 7b, 7c and 7d plus their surrounding networks.

The power supply for all the op-amps is decoupled from the power supply noise by an RC filter network. This is formed by R39-44 and C41-46.

FIG 1

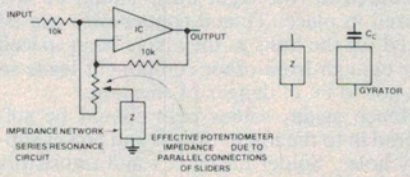
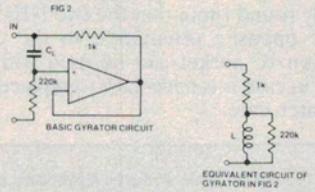
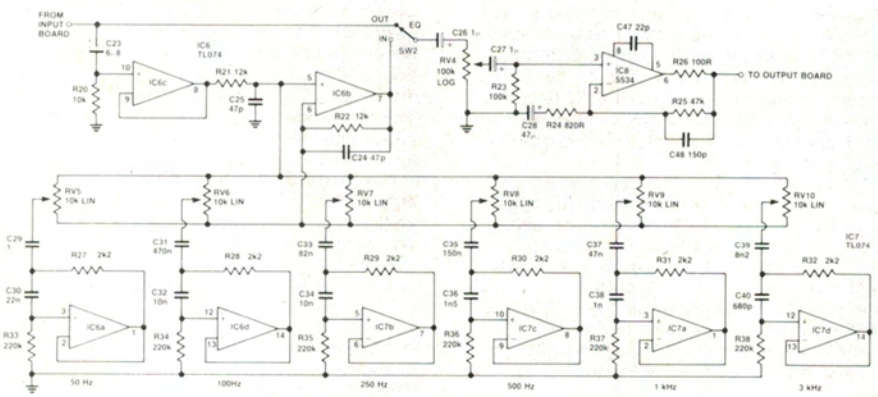
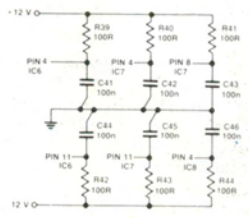


FIG 2







Slider hookup. View behind the front panel, showing how the sliders for the eq board are hooked up. Note the use of twisted wires to RV4 and SW2 from the front left-hand end of the board.

PARTS LIST ETI-1410c and d

Resistors

R20	10k, ¼ Watt, 5%
R21, R22	12k
R23	100k
R24	820R
R25	47k
R26	100R
R27, R28 . . . R32	2k2
R33, R34 . . . R38	220k
R39, R40 . . . R44	100R
RV4	100k log rotary pot.
RV5, RV6 . . . RV10	10k lin 45 mm slider.

Capacitors

C23	6µ8, 35 V Tant.
C24, C25	47p ceramic
C26, C27	1µ, 35 V electro.
C28	47µ, 35 V Tant.
C29	1µ Greencap
C30	22n Greencap
C31	470n Greencap
C32	10n ceramic
C33	82n Greencap
C34	10n ceramic
C35	150n Greencap
C36	1n5 ceramic
C37	47n Greencap
C38	1n ceramic
C39	8n2 ceramic
C40	680p ceramic
C41, C42 . . . C46	100n ceramic bypass
C47	22p ceramic
C48	150p ceramic

Semiconductors

IC6, IC7	TL074 quad op-amp
IC8	NE5534 op-amp

Miscellaneous

SW2	SPDT Toggle

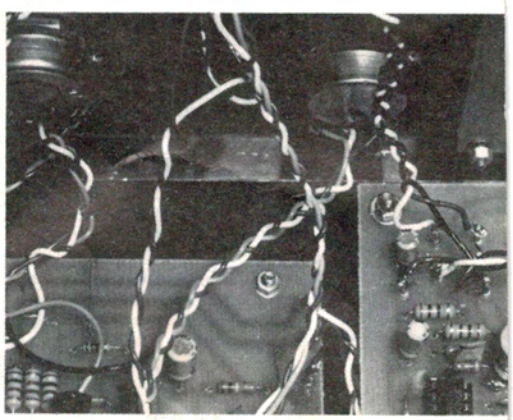
ETI1410c and ETI1410d pc board.

General Parts

T1	Ferguson PF4361-1

Mains flex and plug, terminal block, DPDT mains toggle, NE2 Neon, six insulated stereo 6.5 mm sockets, 3AG panel mount fuse holder, 3AG in-line fuse holder, 3A 3AG fuse, 8A 3AG fuse, 42.5 x 25 x 14 cm rack mount case, seven small plastic knobs, ETI-1410 front and back panel, 300 mm length of radial fin heatsink, two 100n ceramic bypass caps, shielded hook-up cable, mains grommet, mains clamp, two solder lugs, eight 12 mm pc board spacers, hook-up wire, nuts and bolts, 4 rubber feet.

Estimated price: $250-$280
including ETI-499 power amp module



ETI-1410e

Resistors

R45, R46, R48, R60, R76, R79, R81, R82, R86	100k, ¼ W, 5%
R47	1k
R49	2M2
R50	15k, 1%
R51	43k, 1%
R52	12k, 1%
R53	270k, 1%
R54, R55, R63, R64, R66, R67, R68, R69, R70, R72, R73	10k ¼ W, 5%
R56, R59, R75, R80, R85, R87, R88, R89, R90, R91, R92, R93, R94	100R
R57, R58, R77, R78	12k
R61	100k, 1%
R62	10k 1%
R65	1k2
R71, R83	5k6
R74	2k2
R84	1k
RV11	100k lin dual ganged rotary pot
RV12	50k lin pot
RV13	100k lin pot

Capacitors

C47, C48, C49, C53, C60, C62	1µ, 35V electro
C50, C51, C65, C66, C67, C68, C69, C70, C71, C72	100n ceramic bypass
C52	15p ceramic
C54, C57, C58, C61, C64	10µ, 35 V tant.
C55, C56	47n greencap
C58	22p ceramic
C63	4p7 ceramic

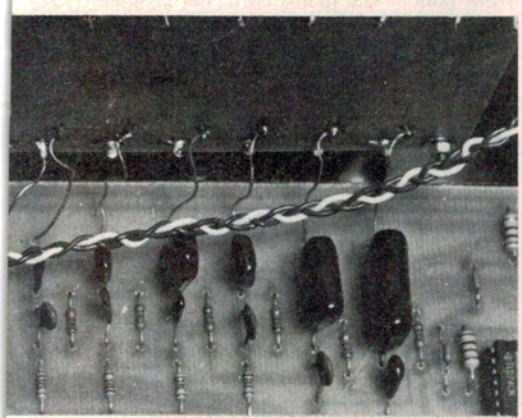
Semiconductors

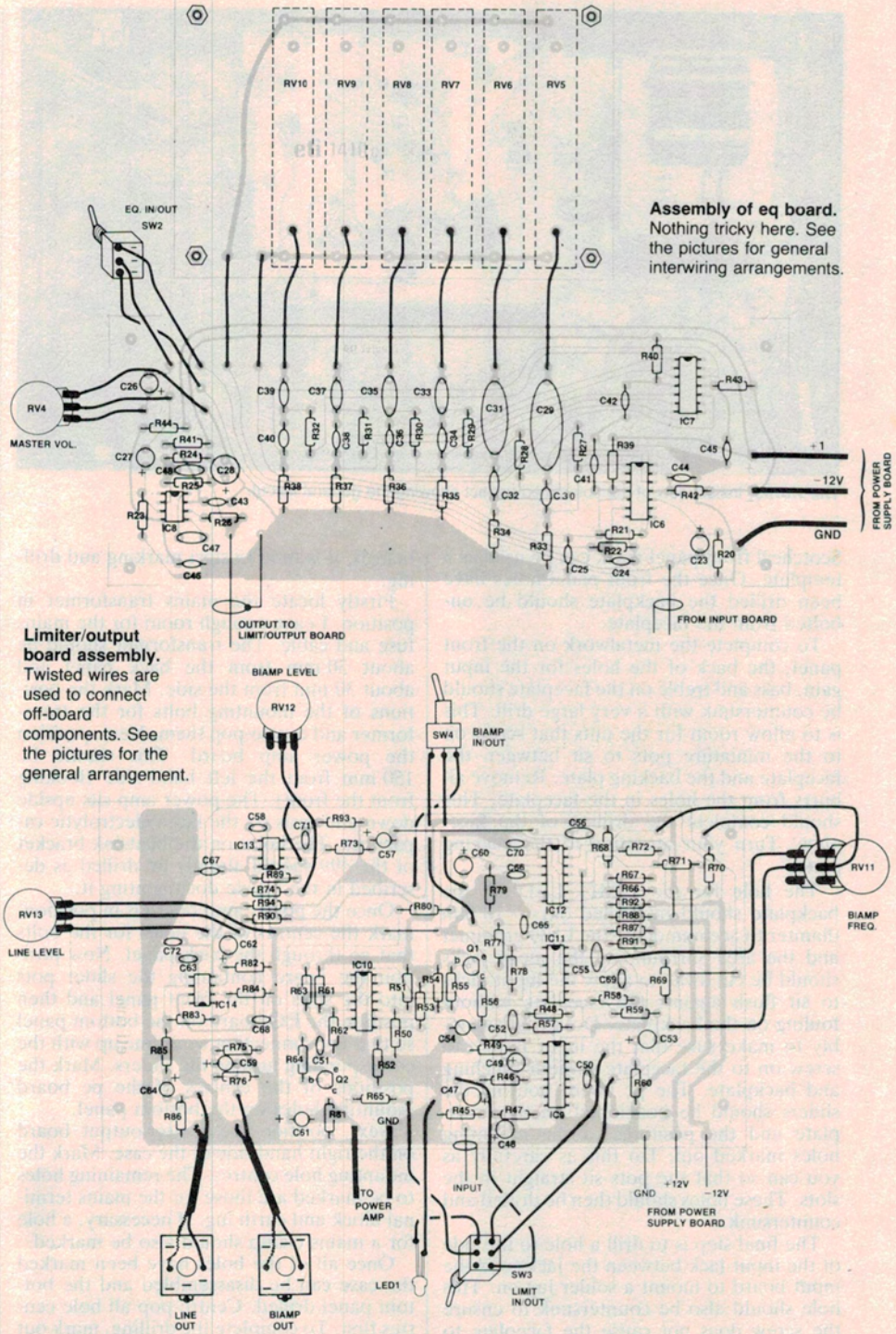
IC9	NE570 compander
IC10	LM339 Quad comparator
IC11, IC12	TL074
IC13, IC14	NE5534
Q1, Q2	BC557
LED1	Red LED

Miscellaneous

SW3	DPDT Toggle
SW4	SPDT Toggle

ETI-1410e pc board, 1 x 16 pin DIL IC socket, LED mounting Grommet.





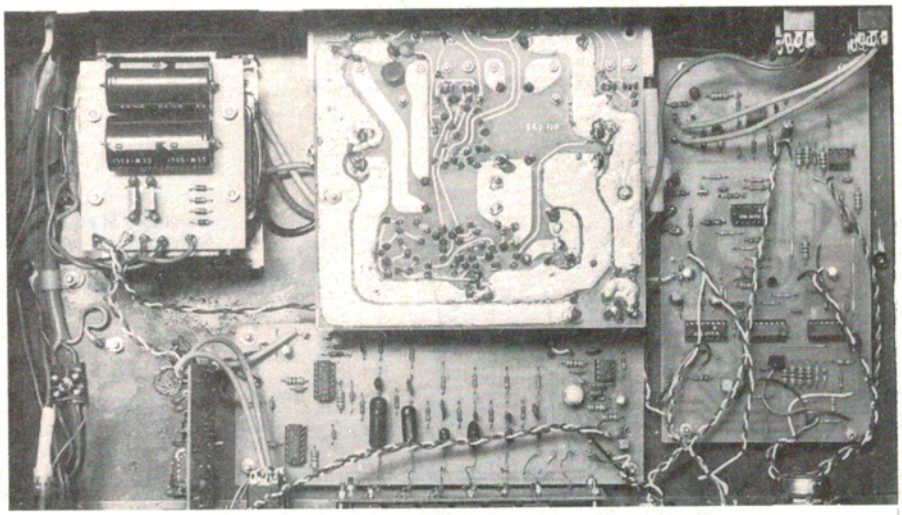
Assembly of eq board. Nothing tricky here. See the pictures for general interwiring arrangements.

Limiter/output board assembly. Twisted wires are used to connect off-board components. See the pictures for the general arrangement.

The first thing to do is to cut the slots for the sliders in the front panel. If you're handy with a drill and file then you can get into a bit of manual labour and, using a 3 mm diameter drill, drill a series of holes where the slots are supposed to go and then file away the intervening metal to form a nice, smooth, even, straight slot (or so the story goes!).

If your vocation doesn't lie in the metal-working field, then an alternative is to ring around the local engineering machine shops and see if you can get the front panel slots milled (thats what we did anyway). Note that the front of the case consists of two parts, the thick front panel and the backing plate. These should be bolted together and cut together to ensure that the holes line up accurately.

After the slots have been cut the rest of the front panel holes should be drilled. This can be done from the drilling diagram or the ▶



The works! Inside view of the completed project showing the general layout.

Scotchcal front panel mask can be used as a template. Once the front panel holes have been drilled the backplate should be unbolted from the faceplate.

To complete the metalwork on the front panel, the back of the holes for the input gain, bass and treble on the faceplate should be countersunk with a very large drill. This is to allow room for the nuts that screw on to the miniature pots to sit between the faceplate and the backing plate. Remove all burrs from the holes in the faceplate. This should complete the drilling of the faceplate. Turn your attention to the backing plate.

The hole for the LIMIT LED on the backplate should be drilled out to 10 mm diamter to accommodate the LED grommet and the area surrounding the input jacks should be cut away to allow the input jacks to sit flush against the faceplate without fouling on the backplate. Do a trial assembly to make sure that the input jacks can screw on to the faceplate without touching and backplate. The pc board housing the sliders should be positioned on the backplate and the positions of the mounting holes marked out. Do this as carefully as you can so that the pots sit straight in the slots. These holes should then be drilled and countersunk.

The final step is to drill a hole to the side of the input jack between the jacks and the input board to mount a solder lug on. This hole should also be countersunk to ensure the screw does not cause the faceplate to stand off from the backplate when it is mounted.

At this point it is advisable to re-assemble the case so that the layout of the boards can be seen. The picture of the inside layout will give you a general idea of where the boards are positioned. Note that the power amp board is positioned upside down and that the power supply board is mounted on top of the transformer. Once you have familiarised yourself with the position of all of the boards, it is time to start marking and drilling.

Firstly locate the mains transformer in position. Leave enough room for the mains fuse and cable. The transformer should be about 30 mm from the back panel and about 30 mm from the side. Mark the positions of the mounting bolts for the transformer and centre-pop them. Next, position the power amp board. This should be 150 mm from the left hand side (looking from the front). The power amp sits upside down and rests on the large electrolytic capacitors. The holes on the heatsink bracket of the 499 should already be drilled as described in the article documenting it.

Once the power amp board is in position, mark the centres of the holes for the bolts that go through the back panel. Now position the board containing the slider pots into the slots on the front panel and then position the EQ board on the bottom panel so that the connecting wires line up with the corresponding lugs on the sliders. Mark the positions of the centres of the pc board mounting holes on the bottom panel.

Next, position the limiter/output board on the right hand side of the case. Mark the mounting hole centres. The remaining holes to be marked are those for the mains terminal block and earth lug. If necessary, a hole for a mains clamp should also be marked.

Once all of the holes have been marked the case can be disassembled and the bottom panel drilled. Centre-pop all hole centres first. To complete the drilling, mark out the positions of the mains fuse and mains grommet and also the four output jacks. The output jacks should be kept so far to the right hand side (looking from the front of the amp) as possible and the Scotchcal back panel label should be used as a template to get the spacing. Drill the back panel holes. Note that if a locking type mains grommet is used then the hole will have to be drilled slightly smaller and filed out to the correct shape.

The heatsink specified is a 300 mm length of radial-fin extruded aluminium. This should be located in the centre of the back panel with the top edge of the heatsink flush with the top edge of the back panel. Be sure that the heatsink won't foul any of the output sockets. Once in position the centres of the holes should be marked using the previously drilled holes in the back panel. The holes in the heatsink should now be drilled. This should complete all the drilling needed.

Now for the fun part! The wiring up. Firstly, though, the Scotchcal front panel label should be attached to the faceplate. Drill small pilot holes at the centres of all the holes to give yourself something to line up with. If you don't have the steady hand of a microsurgeon then the best method is to peel the backing paper from the Scotchal and then run water over the back of the label. Also, run water over the faceplate. The Scotchcal can then be applied to the faceplate and the water allows you to move the label into position. Once in position, press the Scotchcal firmly into place and squeeze out the excess water with a soft, dry cloth. The front panel should be left for a few hours to dry and stick properly. After it has dried, press it down firmly once again to make sure that it has stuck.

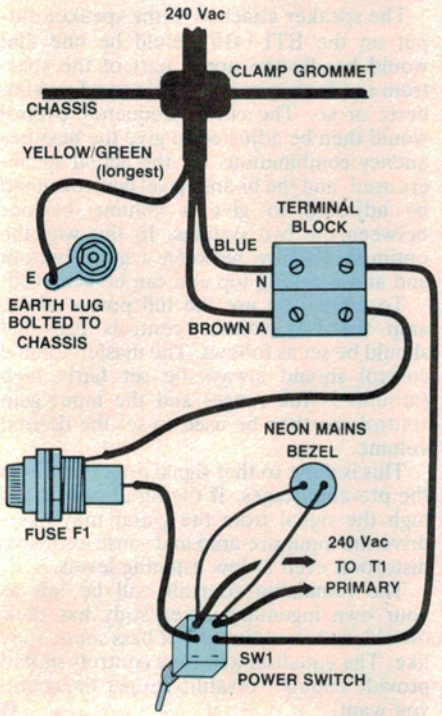
The input board should be bolted onto the frontpanel backplate. The pc board with the sliders should also be mounted to the backplate with 25 mm long countersunk bolts. Put the bolts through the holes in the backplate and then screw a nut on tight to hold the bolt in position. Place 12 mm spacers on the bolts and then bolt the pc board into position. The body of the pots should be standing a few millimetres off the backplate and the sliders should run smoothly and straight in the slots. The solder lug should be bolted in position next to the input jack hole. The case can now be reassembled.

The mains transformer should be mounted next. It should be mounted so that the input and output wires come out at the bottom of the transformer. This leaves the 15-0-15 V winding lugs facing up for easy access. The fuse holder can be mounted on the back panel and the power switch on the front panel. The mains cord and grommet can now be inserted and the mains wiring should be done in accordance with the mains wiring diagram. The mains input goes straight to the terminal block and the earth is connected to the chassis solder lug. It should be arranged so that the earth wire will be the last to break if the mains cord is somehow pulled out.

From the terminal block the active wire is taken to one side of the mains fuse. The other side of the fuse is connected to one pole of the mains switch. The neutral is taken from the terminal block straight to the other pole of the switch. The two outputs from the switch are then connected to both the primary of the transformer and the mains bezel. Make sure that the mains

NOTE: The front panel artwork is too large to reproduce in the magazine. Photostat copies may be obtained by sending an A4-sized stamped, addressed envelope to **ETI-1410 Artwork Photostats, ETI Reader Services, PO Box 227 Waterloo NSW 2017.** If you want positive or negative same-size film transparencies, the complete set costs $20 or front panel film only costs $10 from **ETI-1410 Artwork Sales, ETI Magazine, PO Box 227, Waterloo NSW 2017.** Make out your cheque or money order to 'ETI Artwork Sales' and ensure you ask for positives or negatives as you require. The printed circuit board and rear panel artwork are on page 156.

Power wiring. General arrangement for the mains power wiring. If you don't use a clamp grommet, use an ordinary grommet in the rear chassis backdrop and a cable clamp inside on the chassis bottom.

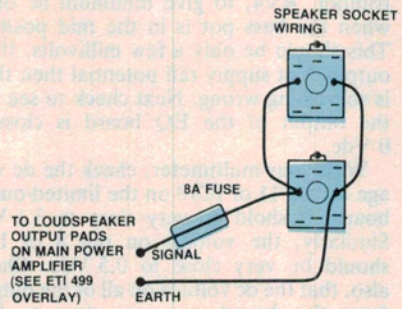


switch and bezel are both firmly screwed in place and will not come loose during operation. Be very careful when wiring up the mains side of the transformer since mains voltages are lethal.

All exposed terminals should be protected with heatshrink insulation to prevent anyone accidentally coming in contact with mains voltages. The mains cord should also be securely attached so that it won't come out even when pulled. Carefully double and triple check your mains wiring to make sure you haven't made any silly mistakes like connecting the active to the chassis. This completes the mains wiring.

The secondary of the transformer can now be connected to the power amplifier. Referring to the overlay for the ETI-499 MOSFET module on page 27 of the March 1982 issue of ETI, the two 35 V lines shown correspond to the yellow and black wires from the PF4361/1 transformer secondary.

Output jacks. Wiring up the speaker output jacks. Note the use of an in-line type fuse.

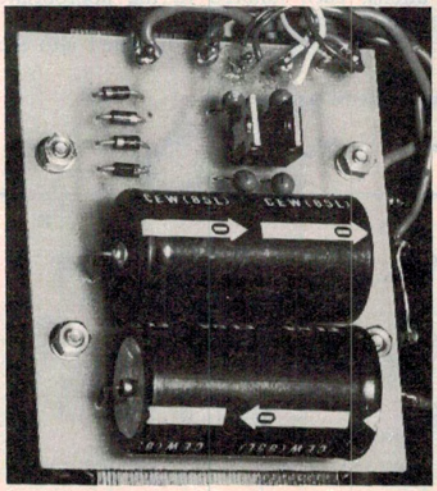


The orange and red wires are connected together and form the centre-tap connection on the board. At this time it is also advisable to connect good lengths of heavy duty hookup wire to the input and output holes on the power amp board. Colour code these and write down which is which so that you will know where to connect them later.

Note that an in-line fuse is used in the speaker output line. Before finally turning the power amp board topsy turvy and bolting it to the back panel you should carefully follow the power-up procedure given in the article. Be careful that none of the components or tracks of the power amp are shorting to the case when you are doing this and also make sure that the wires connected to the output terminals don't touch anything.

Once the power amp is set up OK you can then turn it off and pull out the plug. The power amp board and heatsink can now be bolted to the back panel. Heat conductive silicon grease should be liberally smeared between the power amp heatsink bracket and the backpanel as well as between the backpanel and heatsink. Securely fasten these bolts.

The next step is to bolt the power supply board to the top of the transformer. A nut is used as a spacer to lift the board off the transformer and ensure that the top of the transformer doesn't short out any of the tracks on the underside of the board. Once the board is mounted the 15 Vac should be connected. The transformer has four lugs which are the connections for the two 15 V windings. The two centre terminals should be connected together and a wire taken to the earth of the pc board. The two outside windings should be hooked up to the ac input of the power supply board.



Power supply. The power supply board (see Part 1) is mounted on top of the PF4361/1 transformer. The supply connections to the ETI-499 MOSFET module should be heavy duty hookup wire.

The unit can now be plugged in again and turned on. Measure the voltage on the outputs of the regulators to earth. You should get +12 V and −12 V dc respectively. If you don't then turn off, pull out the plug and double check all the wiring and components. Once you get the correct voltages you are ready to proceed. WARNING: Make sure that, from now on, whenever you are poking around on the inside of the case that the mains plug is pulled out of the wall socket. We don't like losing readers!

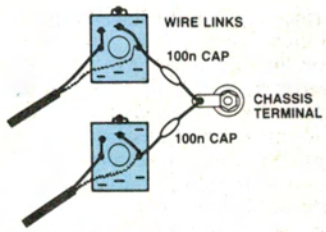
Bolts should now be put through the mounting holes for the two other pc boards and nuts screwed on to secure them. Place the equaliser board temporarily in position. Note the approximate distance from the master volume pot to the appropriate connection points on the pc board and cut suitable lengths of hookup wire. You will need to allow more wire than the actual distance since the wires will need to be twisted together.

Remove the board and solder the hookup wire to the pc board (if you have used solder pins for the connection points then you can mount the board permanently now). Once you have twisted the wire together and have the length right you can solder the wires to the pot (make sure you get them the correct way round). Repeat this procedure for the EQ IN/OUT switch and then do the same for the three pots, LED, and two switches connected to the limiter/output board.

Once all the pots and switches have been connected, the two boards can be mounted on the bolts using 12 mm spacers and bolted down. The wires connecting the slider pot board to the EQ board can now be attached and all the pots and switches mounted onto the front panel. The LED should be mounted using a standard LED mounting grommet.

The next step is to tackle the inter-board wiring. First, take three pieces of hookup wire and connect the +12 V, -12 V, and earth outputs from the power supply board to the appropriate pins on the input board. These should be twisted together. Do the same for the power supply connections to the EQ board and the limiter/output board. At this stage, if a CRO and signal generator are handy, the operation of each board can be checked individually. If not, then continue and live in hope!

Shielded cable should be used to make the connections between the output of the input board and the input of the EQ board and similarly between the EQ board and limiter/output board. Note that the shield is ▶



Input jacks. Wiring the input jacks. The inputs are shorted with no plug inserted.

connected *at one end only* since the earth connection between boards is already made by the power supply wiring. The input to the power amp should be left disconnected for the moment.

The only remaining connections are those to the input and output jacks. These should be wired as shown in the accompanying diagrams. Note the wire links used on the input sockets. This is done so that when there is no plug in the socket the input terminal is shorted to ground.Note also that 100 nF caps are connected from the input signal ground to the chassis. Once the input and output sockets have been wired they can be mounted and connected to the appropriate terminals. This then completes the construction.

Powering-up and testing

Without a signal generator and CRO there isn't a lot of testing you can do. The first thing to do though is, with the input to the power amp disconnected, switch on and measure the voltages at the power supply input pins to all the boards. These should all be within 0.1 V of +12 V or -12 Vdc. If the voltage regulator ICs start getting really hot at this point then there is probably a short somewhere on one of the boards. Take off the power supply leads to all of the boards and connect them back one board at a time to try to isolate which board has the short. Remove this board and check it thoroughly. NOTE: Make sure you always switch off at the wall socket before making any adjustments to the circuit.

Once the power supply wiring checks out look at the output (pin 6) of IC5. Set the trimpot, RV4, to give minimum dc offset when the bass pot is in the mid position. This should be only a few millivolts. If the output is at supply rail potential then there is something wrong. Next check to see that the output of the EQ board is close to 0 Vdc.

With your multimeter, check the dc voltage on pin 11 of IC10 on the limited/output board. It shold be very close to 3.1 Vdc. Similarly, the voltage on pin 8 of IC10 should be very close to 0.5 Vdc. Check, also, that the dc voltage on all of the outputs from this board are very close to 0 V. Switch the limiter switch to the IN position and ensure that the LED doesn't light.

If everything checks out OK then switch off, connect the power amp input to the appropriate terminals on the limiter/output board and insert a three amp fuse into the fuse holder in the speaker output line. Connect up a speaker and, with all the volume controls down, switch on. If no smoke comes from anywhere and the speaker is still intact then there is a reasonable chance that everything is fine. If so then turn off, replace the 3 A fuse in the speaker line with an 8 A one and plug in your bass (note that the mains power fuse must still be 3 A type).

Turn the amp on, turn up the volume a little and try a few notes. If you hear those mellow, bassy tones carressing your ears then all is well and you're on the way to rock 'n' roll stardom!

Hints on using it

All the controls are fairly self-explanatory with the possible exception of the bi-amp controls. To obtain the best sound from a bass it is often desirable to split the signals into a high end and a low end. This then allows the low and high frequencies to be driven by separate amp/speaker combinations, each tailored to the appropriate frequency range.

The bi-amp filter incorporated into the output board of the 1410 acts like a crossover which separates the signal into high frequencies and low frequencies. The crossover point (whether the signal is considered high or low) is set by the CUTOFF FREQUENCY control on the front of the amp. The high frequencies are sent to the internal power amplifier and the low frequencies are directed to the BI-AMP OUT socket at the rear of the amp.

A typical way to set up a bi-amp system would be as follows. The BI-AMP OUT would be connected to the input of an external power amp (which should be of a higher power than the 150 watts of the internal amp). A speaker, attached to the external power amp, should be particularly suited to the very low end of the audio spectrum i.e: 20 Hz to around 300 Hz.

The speaker attached to the speaker output on the ETI-1410 should be one that would handle the upper part of the spectrum i.e: from around 300 Hz to a few kilohertz or so. The cutoff frequency control would then be adjusted to give the best frequency combinations for the actual speakers used, and the bi-amp level control would be adjusted to give a volume balance between the two systems. In this way the optimum balance between a good bottom end and a cutting top end can be achieved.

To effectively use the full power of the amp the two volume controls provided should be set as follows. The master volume control should always be set fairly high (around ¾ full range) and the input gain control can then be used to set the desired volume.

This is done so that signal does not clip in the pre-amp stages. If the input gain is too high the signal from the guitar may overdrive the input pre-amp and cause excessive distortion even at low listening levels.

The remaining controls will be left to your own ingenuity. Everybody has their own idea about what sort of bass sound they like. The equaliser and tone controls should provide enough versatility to get the sound you want. ●

Front panel. Complete drilling details for the front panel to suit the case specified.