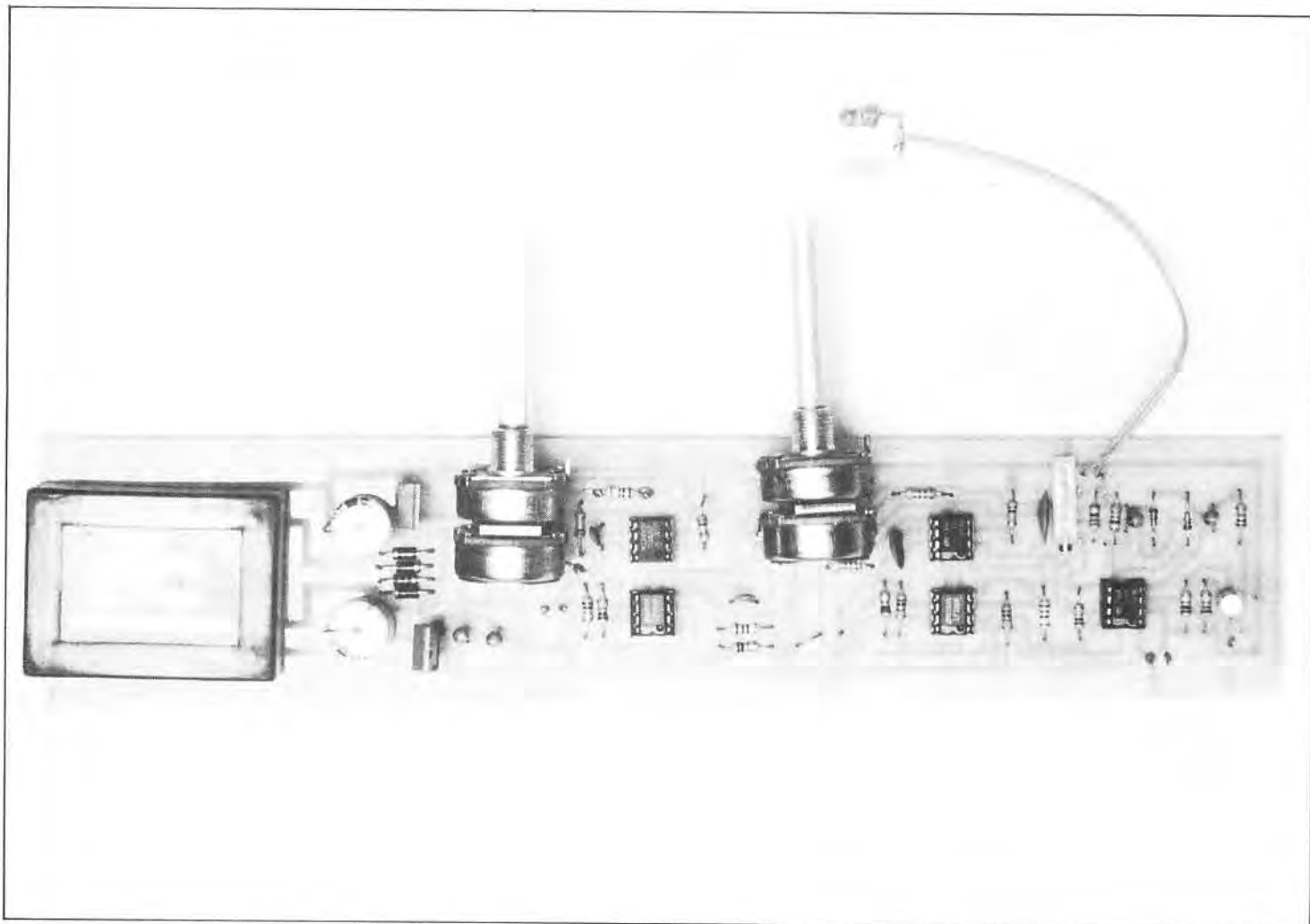


# ETI-1413 ELECTRONIC CROSSOVER

In the Past there have been many Circuits for Audio Electronic crossovers but the one presented here is based on an unusual circuit, is simple, versatile and above all easy to build and use.

Simon Leadley



**ELECTRONIC CROSSOVERS** are used to eliminate the need for the inefficient and heavy units that are used in conventional speaker crossovers. They are used to split the audio spectrum into 2,3 and sometimes 4 ranges, which are then fed to a separate amplifier for each speaker. The advantages lie in the fact that the drive to each of the speakers can be adjusted so that the different sensitivities of the drivers match. In an ordinary passive crossover this matching is done by attenuating the drive to the speakers with large wattage resistors which waste power. The passive crossover must be designed with the particular drivers in mind so that it will work properly. Putting a particular passive crossover in a speaker system for which it wasn't designed will result in poor sonic quality unless the drivers are very similar. With an electronic crossover, however, both the crossover frequency and the level of drive to each speaker can be varied, allowing it to compensate for a great range of driver specifications.

### Construction:

The whole unit is built on a single board that can be configured 2 ways. As a mono 3-way crossover or as a stereo 2-way. Begin by deciding which version you wish to build and then select the values from the table for the crossover frequency sweep that you desire. Check the circuit board for shorts between tracks and then place all the passive components (take care to orientate the capacitors as in the diagram) Next I suggest that you use IC sockets for all the op amps, it will make testing easier and replacement in case of component failure quicker in the future. (the extra cost is well worth it!) Then place the power supply components, taking care to put the regulators in the cor-

rect spot. The power transformer also fits on the board so it may be necessary to drill out the mounting holes to suit. The pots for the frequency adjustment also fit onto the board. Solder short lengths of wire to the six terminals of the pot and then pass these through the board at the correct points and solder them to the board. The two LEDS are soldered together with the Anodes of each connected to the Cathodes of the other. Two flying leads are then taken to the board. (Note: the anode is the longer leg of the LED).

### TESTING:

I found it best if the IC's weren't fitted at this point so that you can test if the power supply is functioning correctly. Connect 240v to the transformer input and then use a multimeter to see if the power rails are present at the correct pins of each of the IC sockets. If not, power down (remove the 240 V from the wall socket) and check that the diodes and the regulators are properly orientated. If all is well, power down and insert the IC's (check orientation!) Power up again and feed an audio signal into the input. Using an amplifier you should hear filtered output from each of the outputs. Turning the pots on each channel should sweep the frequency up and down. If not power down and check all connections. Because the two filter blocks are identical, at least one should operate so you can compare them.

Setting the LED threshold will depend on the usage that you have for the unit. Besides providing power on indication, the LED circuitry can be set to indicate that a predetermined input level limit has been reached. In a PA system this might be the 0dB level while in a home Hi-Fi it may indicate onset of clipping in the preamplifier. The multi-

turn trim pot is adjusted to give the required point.

### Packaging:

If you intend using the unit with a PA system you will probably want to mount the unit into a 19" rack mounting case. The frequency adjust pot will be best mounted on the rear of the unit as they will usually be set once and forgotten, also it is best that they are mounted far from prying hands. The level controls are best mounted on the front panel so that the system can easily be tuned in different rooms. Note that the Level control pots are connected to the outputs with flying leads so that the unit has flexibility in construction.

If, on the other hand the unit is being used with a home Hi-Fi unit then the construction can be more modest. A small instrument case is ideal, since the signal levels are quite high and a fully shielded case therefore unnecessary. Mount the power switch and power cord away from input circuitry to minimise hum pickup.

### Filter values

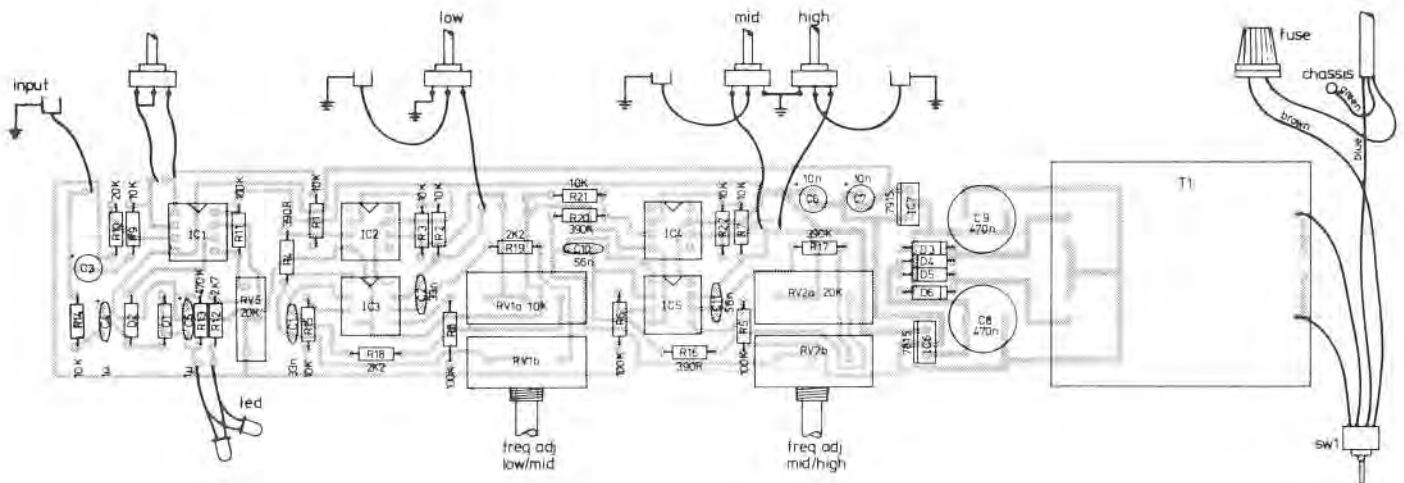
To set the cross-over frequencies, you need to select values for the resistors and capacitors that surround the filter elements. Around IC3a, for instance, we need values for RV1a, R18 and C1. To do this we apply the formula:

$$F = \frac{1}{2 \times 3.14 \times C1 \times (RV1a + R18)}$$

Assuming F for the low to Medium transition is 400 Hz, and we set C1=56n, we discover that (RV1a + R18) equals:

$$\frac{1}{2 \times 3.14 \times 56 \times 10^{-9} \times 400} = 12062 \text{ R}$$

which can satisfactorily be realised with a 10 k pot and a 2.2 k resistor in series.

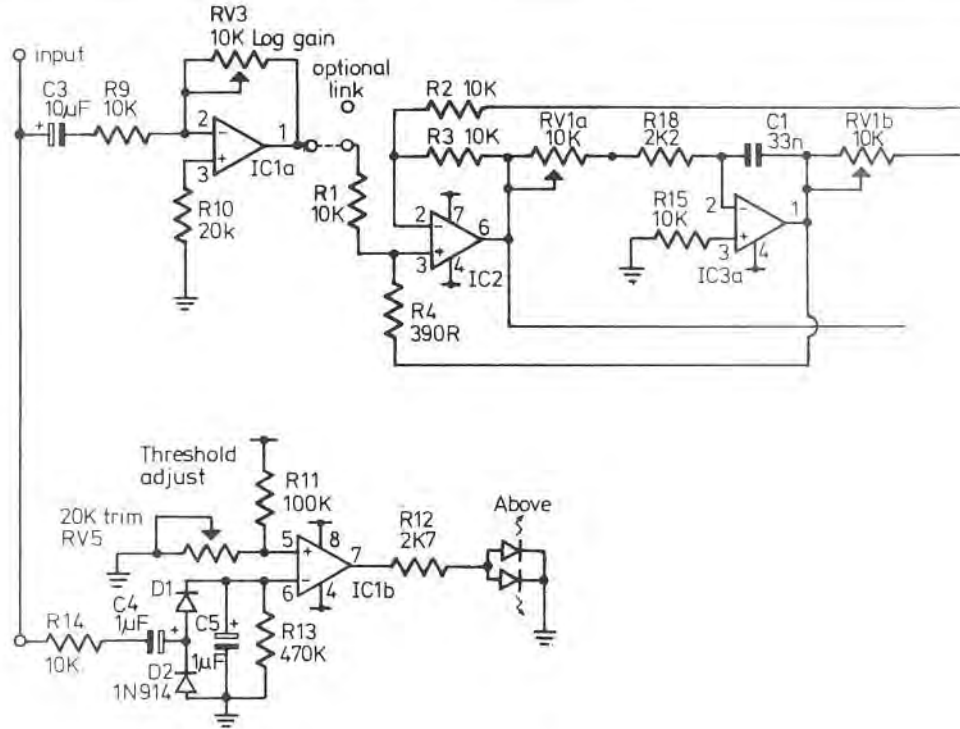


**How it Works ETI-1413**

The basic design is based on the State Variable Filter technique. The filter used three op-amps (IC2, IC3a and IC3b) to provide high pass and low pass outputs. Centre frequency and Q are independently variable. The circuit is often termed a *Universal Active Filter*. By varying the RC networks (and simplifying the design by allowing C1=C2, C10=C11, & Ra=Rb) then the filter becomes easily turnable.

The input buffer (IC1a) simply provides some gain to offset the loss in filters. If the gain is insufficient merely change the value of RV3. The threshold indicator (IC1b) is simply a comparator that shows when the rectified input voltage exceeds a certain value. The 1uF cap across the diodes (C5) provides a hold function so that peaks can be detected. The trim pot allows the threshold level to be adjusted over a wide range of values.

To calculate the values for the Cross-over Freq use the above formulas or refer to the values that we have chosen.



# Not your average disability.

Multiple sclerosis usually first affects people in their twenties and thirties. Its symptoms are unpredictable, sometimes causing severe disability. Thankfully the problems are more often only mild to moderate.

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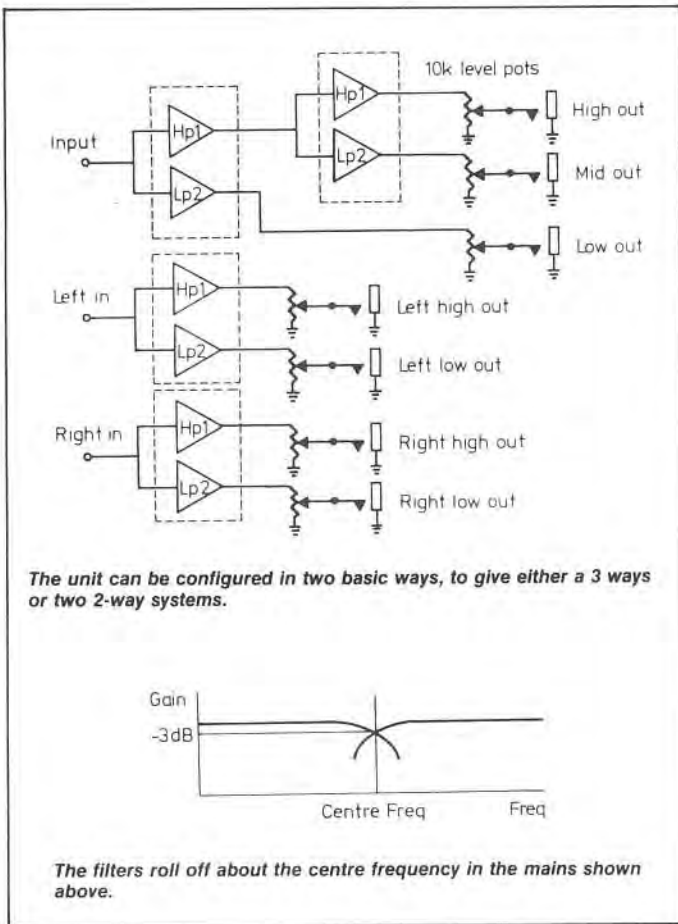
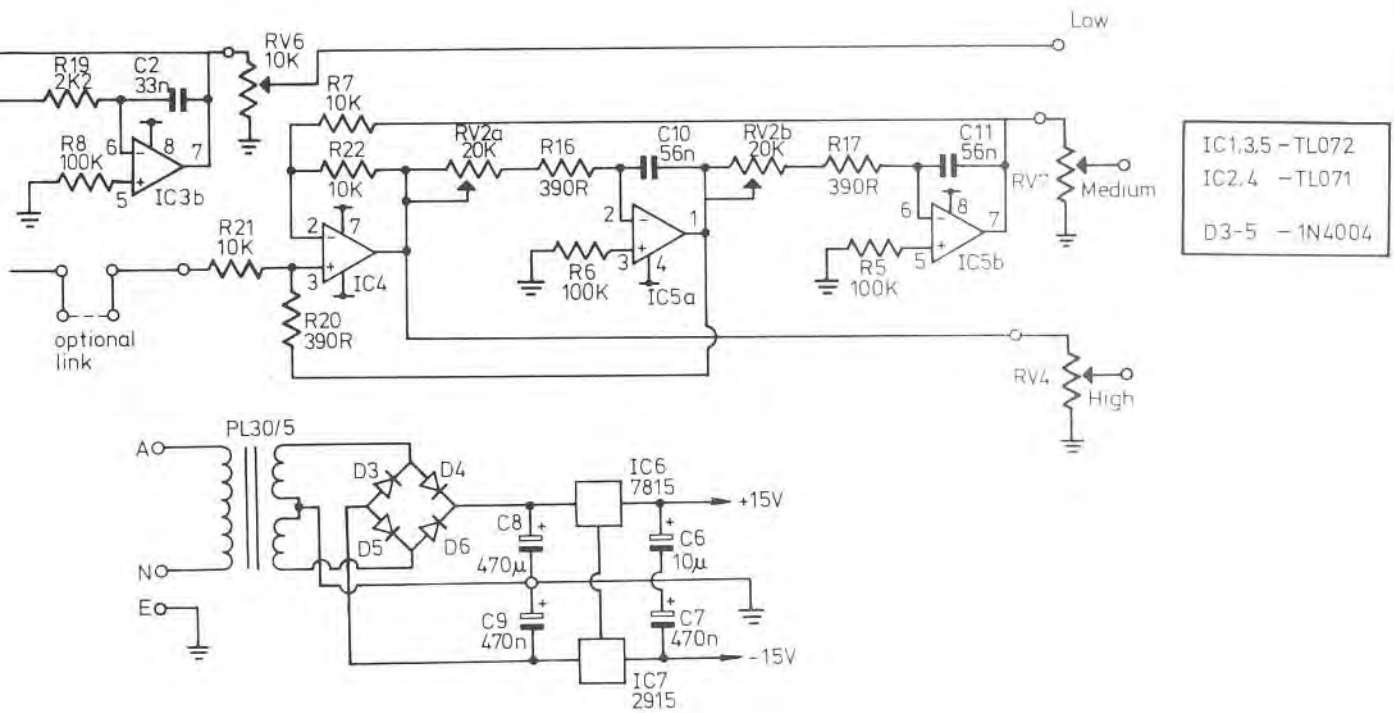
For more information about multiple sclerosis contact the MS Society.

The components around IC3b have the same values. Using the components in the circuit gives cross-overs at about 400 Hz and 7 kHz, which seems to be quite satisfactory. However, do not be afraid to select different values to suit your set up, or indeed, the type of music you like to listen too.

In the event that you decide to configure the network as two two-way cross-overs, you will need to make sure that both speakers cross over at the same frequency, so all the components will have the same values. In this configuration, the input buffer and the over range LED circuit can be removed.

**ETI-1413 — PARTS LIST**

<b>Resistors</b> — all resistors ¼ watt, 1% metal film unless otherwise specified. All values in ohms.	D1, 2, 3, 4, 5 .....1N4001
R1, 2, 3, 7, 14, 15, 21 .....10k	D6 .....1N4004
R4, 16, 17, 10 .....390K	<b>Capacitors</b>
R6, 5, 8, 11 .....100R	C1 .....33n
R10 .....20K	C2 .....33n
R12 .....2K7820R	C3 .....10µ
R13 .....470K	C4 .....1µ
R18 .....2K2	C5 .....1µ
R19 .....2K2	C6 .....10µ
<b>Semiconductors</b>	C7 .....10µ
IC2, 4 .....TL071	C8 .....470µ
IC3, 5, 1 .....TL081	C9 .....470µ
IC6 .....7815	C10 .....56n
IC7 .....7915	C11 .....56n
	<b>Potentiometers</b>
	RV1 .....10k dual
	RV2 .....20k dual
	RV3 .....10k log
	RV4, 6, 7 .....10k



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