VOCALS ELIMINATOR

BY GILES READ

CAPACITOR GOT YOUR TONGUE?

Just suppose you love the songs of Leonard Cohen, but can't bear the old gravel-voice... were born to boogie to Status Quo if it weren't for the little nasal whine... I would really groove to Wet Wet Wet if only they would shut up, up, up. Well, read on...

Almost every music-lover has a favourite track or two in which the lyrics really seem to spoil the music. A few years ago, there was a suggestion that 'sub-masters' of popular recordings might be issued in a four or eight track format. This would enable the suitably-equipped enthusiast to re-engineer classic tracks to his own personal taste. Similarly, fledgling bands or singers could use the backing of the original artists to practise against or to produce demo tapes. However, this idea has never got off the ground, mainly due to lack of demand and the inevitable copyright reasons.

Now, though, PE brings you the minor miracle of a Post-Recording Continuously Variable Singer-To-Backing Track Ratio Converter And Acronym Writer Defeater, or Vocals Eliminator for sanity. (*No, this is not a belated April Fool's joke. Ed*). The function of this curiously-named device is to enable one to vary the volume of a singer in relation to the accompaniment, or even dispose of the vocals altogether. But how is it done?

Most stereo recordings (well, of popular music, anyway) have the instruments carefully arranged in the stereo field, and the vocals slap in the middle. This is done by recording individual items (drums, guitar, vocals etc) on independant tracks on the master tape.

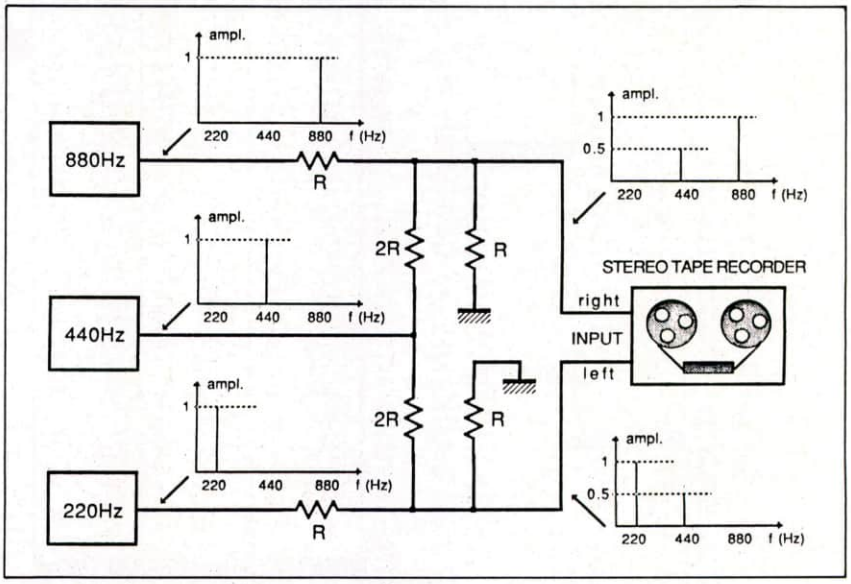

Fig.1 *Recording setup plus spectrum diagrams*

During subsequent mixing sessions, the final 'position' is determined by balancing the instrument between the left and right channels. Central positioning is achieved by having equal volume on both channels. To make the sound 'appear' from right of centre, slightly more signal is fed to the right than the left, and so on. There is rather more to it than that, but this explanation gives the essentials.

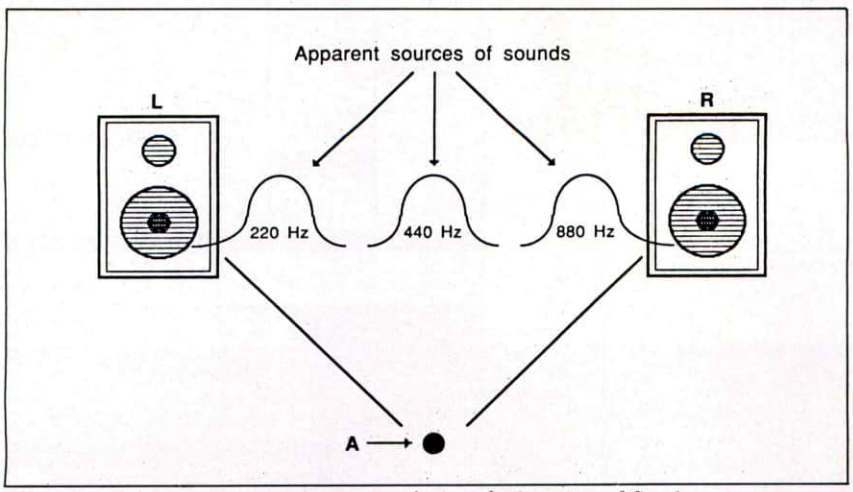

Fig.2 *Showing apparent sound sources when replaying tape of fig. 1*

ELIMINATION FOR BEGINNERS

Imagine a very simple stereo recording. Fig.1 shows three signal generators producing 220Hz, 440Hz and 880Hz at equal amplitudes. They are connected to a tape recorder via a simple passive mixer. The right channel will record 220Hz and 440Hz at half the amplitude of the 220Hz signal. Similarly, the left channel will record 880Hz and half-amplitude 440Hz. The spectrum diagrams show the frequencies and amplitudes at various points in the recording chain.

When the recording is played through speakers (Fig.2), a listener at A will hear the three tones at equal volume and correctly interpret them as coming from left, centre and right. Fig.3 shows how the spectrum diagrams add to confirm this.

If, however, we *subtract* the left channel from the right channel as in Fig.4, we end up with no 440Hz signal! In fact, the 880Hz signal also has a 180 degree phase change, but as we are only concerned with amplitudes and not

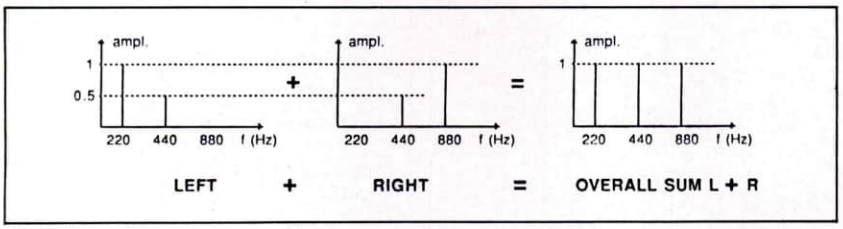

Fig.3 *Sum of two spectrum diagrams*

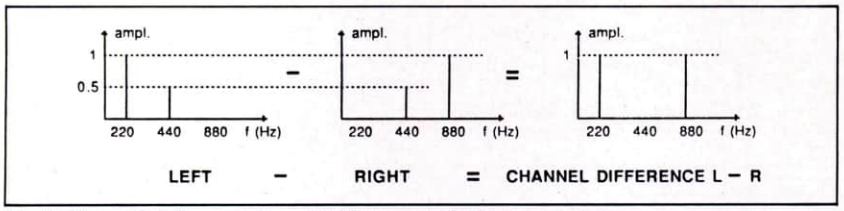

Fig.4 *Channel difference (L – R) Note no 440 Hz component*

phases, this is not shown. Subtracting the right channel from the left as well, we end up with the same frequency spectrum as in Fig.4, except that the phase of the 880Hz signals stays the same and the 220Hz signal suffers the phase change.

PHASERNATED

Unfortunately, there is a price to pay for removing the midddle of the signal: the resulting l–r and r–l signals are the same (but 180 degrees out of phase with each other), so we lose the stereo image. If our listener hitch-hiked over to point B in Fig.5 to hear the l–r and r–l signals, he would hear 220Hz and 880Hz signals appearing to the left of the left speaker and from the right of the right speaker. At this point he would probably ask if he could go and have a quiet lie-down somewhere to get rid of his headache, but that's another story.....

Incidentally, fm stereo radio works by transmitting the l+r (sum) and l−r (difference) signals. The l–r channel is encoded on an ultrasonic subcarrier, and sent at the same time as the mono (l+r or sum) channel. This means that radios without a stereo decoder receive a mono broadcast, while a stereo radio can unscramble the l+r and recovered l–r into normal left and right stereo. That process deserves a whole article to itself, so we won't describe it here.

PRACTICAL ELIMINATION

After that rather wordy description of the principles of stereo, a glance at Fig.5 will show that a quad op-amp is worth a thousand words. Fig.6 shows the basic principle of the Vocals Eliminator. Simple maths tells us 3 − 2 = 1 is exactly the same as 3 + (–2) = 1, and that is the basis of the circuit. The inverted left and right signals are each added to the (uninverted) opposite channel, thus producing l+(–r) and r+(–l). These two difference signals (with the 'middle bit' missing) form the circuit's output. It really is almost as simple as that!

While the Vocals Eliminator is a useful addition to any hifi chain, nobody really wants it in place all the time. Also it is sometimes useful to be able to fade the vocals slightly, rather than just have an 'all or nothing' switch. The circuit diagram (Fig.7) is a practical implementation.

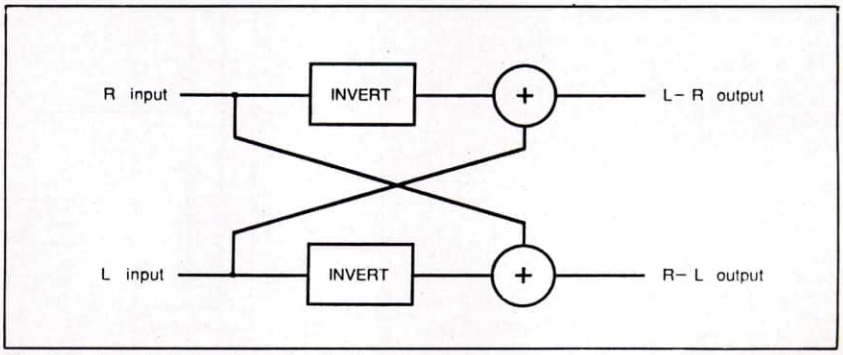

Fig.6 *Basic principle of vocals eliminator*

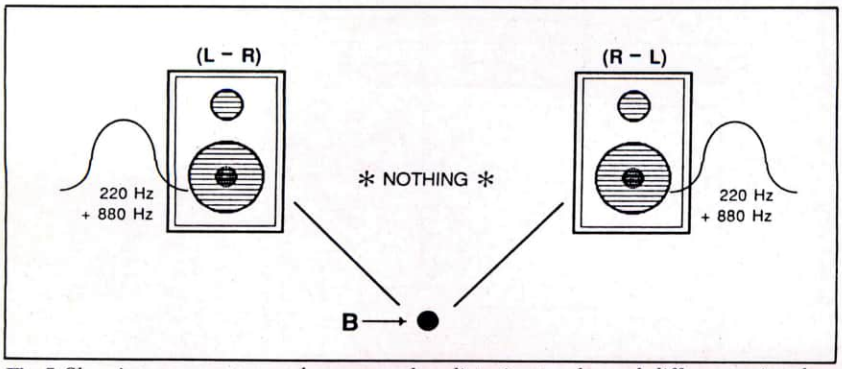

Fig.5 *Showing apparent sound sources when listening to channel difference signals*

CIRCUIT DESCRIPTION

As the circuit is symmetrical, only the signal path of the right channel will be described, to the left channel being very similar. C1 ac couples the input, and R1 provides a dc path to ground for the output side of the capacitor. IC1a, along with R3 and R5 form a unity-gain inverting amplifier, providing the (–r) signal. S1a either ignores this output, takes it directly or via VR1, through R8 to be summed with the univerted left signal connected via R109. IC1v forms a voltage follower to act as a buffer for the summed signal, and its output is taken to the output socket. Power is supplied to the circuit via S2, and decoupled by C3 and C4. Although ±12V is specified, anything from about ±3V to ±15V will work quite happily, as long as the supply is well smoothed. Current consumption is a miserly 8mA per rail, so you shouldn't have to feed the electricity meter too often on its account.

ELIMINATING CONSTRUCTION

Construction is pretty straightforward if the usual rules are obeyed. Specifically, start with the Veropins, then the ic socket, resistors and capacitors. Don't forget to observe the polarities of C1 and C2, and plug the ic in the right way round.

There is a reasonable amount of interwiring to complete, but it shouldn't present too much difficulty before installation. S1 must be converted from six positions to a three position device. Remove the fixing nut and washer and turn the spindle fully anti-clockwise. Now prise out the metal ring set into the body of the switch, and replace it so that the spigot slots into the hole marked 3. Replace the washer and nut, and check that the spindle now has only three stops. The pin numbers on the switch in the wiring diagram refer to Lorlin switches, as used in the prototype. Other types of switch may have different numbering, so beware. The pcb can

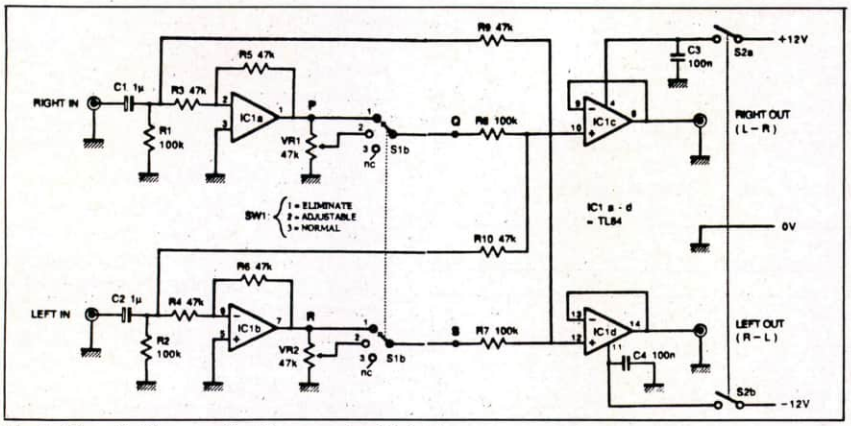

Fig.7 *Circuit diagram for the vocals eliminator*

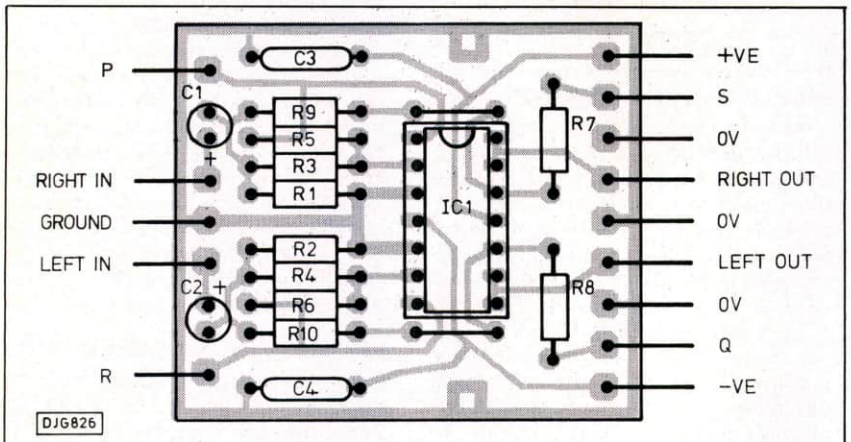

Fig.8 *Printed circuit board layout*

RESISTORS	
R1,R2	100k
R3,R4,R5,R6	47k 1%
R7,R8,R9,R10	1M
CAPACITORS	
C1,C2	1µ 16V
C3,C4	0.1µ polyester
SEMICONDUCTORS	
IC1	TL084 quad op-amp
POTENTIOMETERS	
VR1,VR2	47k log
MISCELLANEOUS	
S1	2 pole 6 way rotary switch
S2	dpdt toggle switch

(14-pin ic socket, veropins (14 off), 3-pin din sockets (3 off) plastic case approx 150 × 80 × 50mm.

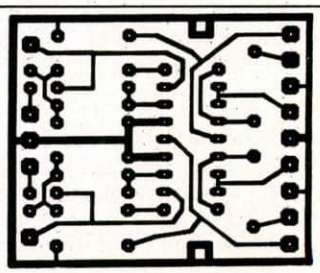

Fig.9 *PCB foil pattern*

either be secured in its case by a couple of bolts, or (again as in the prototype) held by a couple of self-adhesive pads. 3-pin din sockets are recommended for input andd output, and also for the power connection. Alternatively of course a couple of 9VPP3 batteries fitted within the case can be used to power the circuit.

ADVANCED ELIMINATION

The effectiveness of the Vocals Eliminator is heavily dependant on the stereo separation of the music source. Unquestionably, the best effect can be obtained from a compact disc recording, with the superb channel separation. Records and cassettes work reasonably well too, but don't expect the circuit to work from a mono source! The type of music also influences the efficiency. Practical experience shows that some effect will be observed with most types of music, but Queen, Dire Straits and Status Quo make good starting points. Start off with the circuit switched on and set to Normal. Start the music and wait until the artist starts singing and switch to Eliminate. Hey presto, no singing. Now switch to Adjust and check that the volume of the singing can be adjusted with VR1 and VR2. Happy Eliminating!

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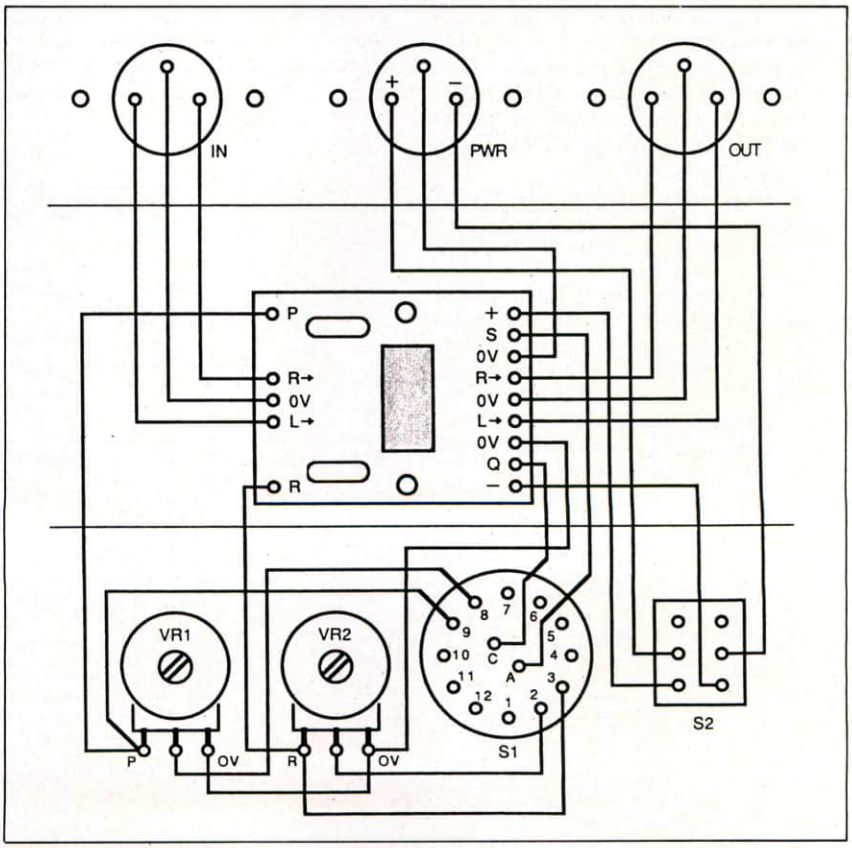

Fig.10 *Wiring diagram*