



EXPANDER COMPRESSOR

NOISE REDUCTION SYSTEMS ARE COMPLEX IN THEORY — AND USUALLY VERY COMPLICATED FOR THE HOME CONSTRUCTOR TO TACKLE. HERE IS ETI'S ANSWER TO THIS — AN EXPANDER COMPRESSOR WHICH IS EASILY CONSTRUCTED AND YET GIVES A FINAL PERFORMANCE EQUAL TO — AND IN MOST CASES SUPERIOR TO — COMMERCIAL UNITS COSTING MANY TIMES THE PRICE OF THIS ETI PROJECT TEAM DESIGN.

ONE LINGERING ADVANTAGE remains with reel-to-reel recorders and discs in their battle against the ever encroaching cassette - dynamic range.

As narrow-gap heads and special tapes i.e. TDK, SA and the rest, improve the frequency response and the linearity of that response, noise reduction systems are working to improve the dynamic range, which can be simply expressed as the difference between the loudest and quietest 'sound' in the music.

If the quietest piece gets lost in the noise, then the range is down to that between the NOISE and the loudest passage. And if the peaks are limited either by the studio when recording an LP, or your machine when taping, down comes the range yet again.

When recording tapes there has to be a compromise between signal to noise ratio and clipping the peaks of the music due to tape saturation. Many systems have been devised to help alleviate this problem with the most commonly known one being the Dolby

system. This effectively gives an additional 10 dB or so of dynamic range. Limiters are used on a lot of recorders to prevent tape saturation but these reduce the dynamic range

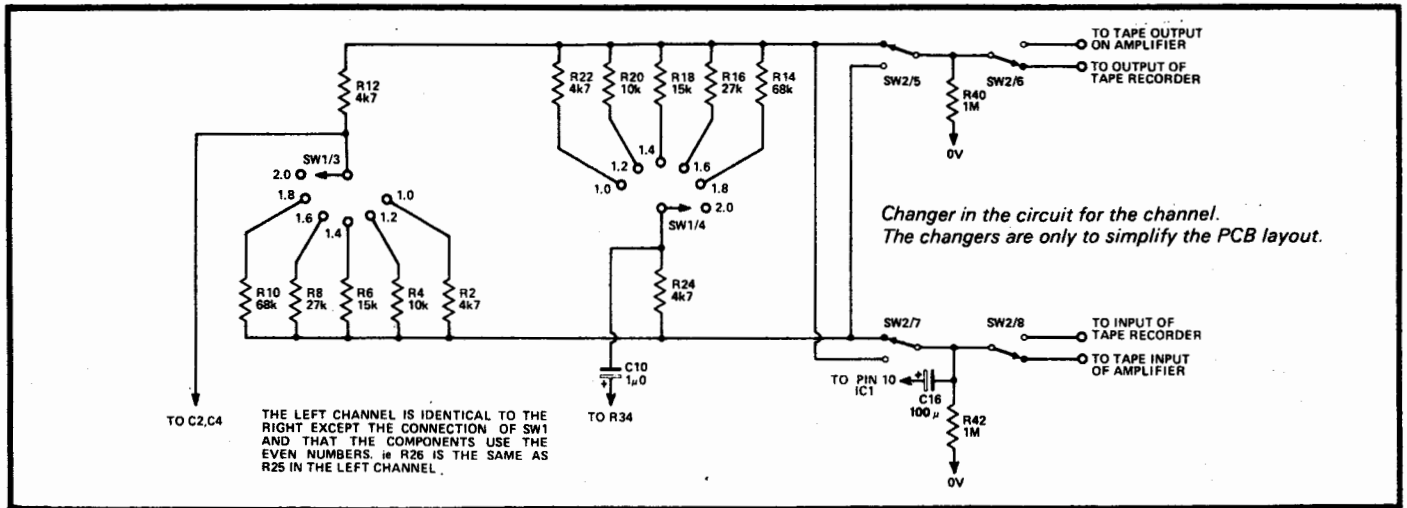
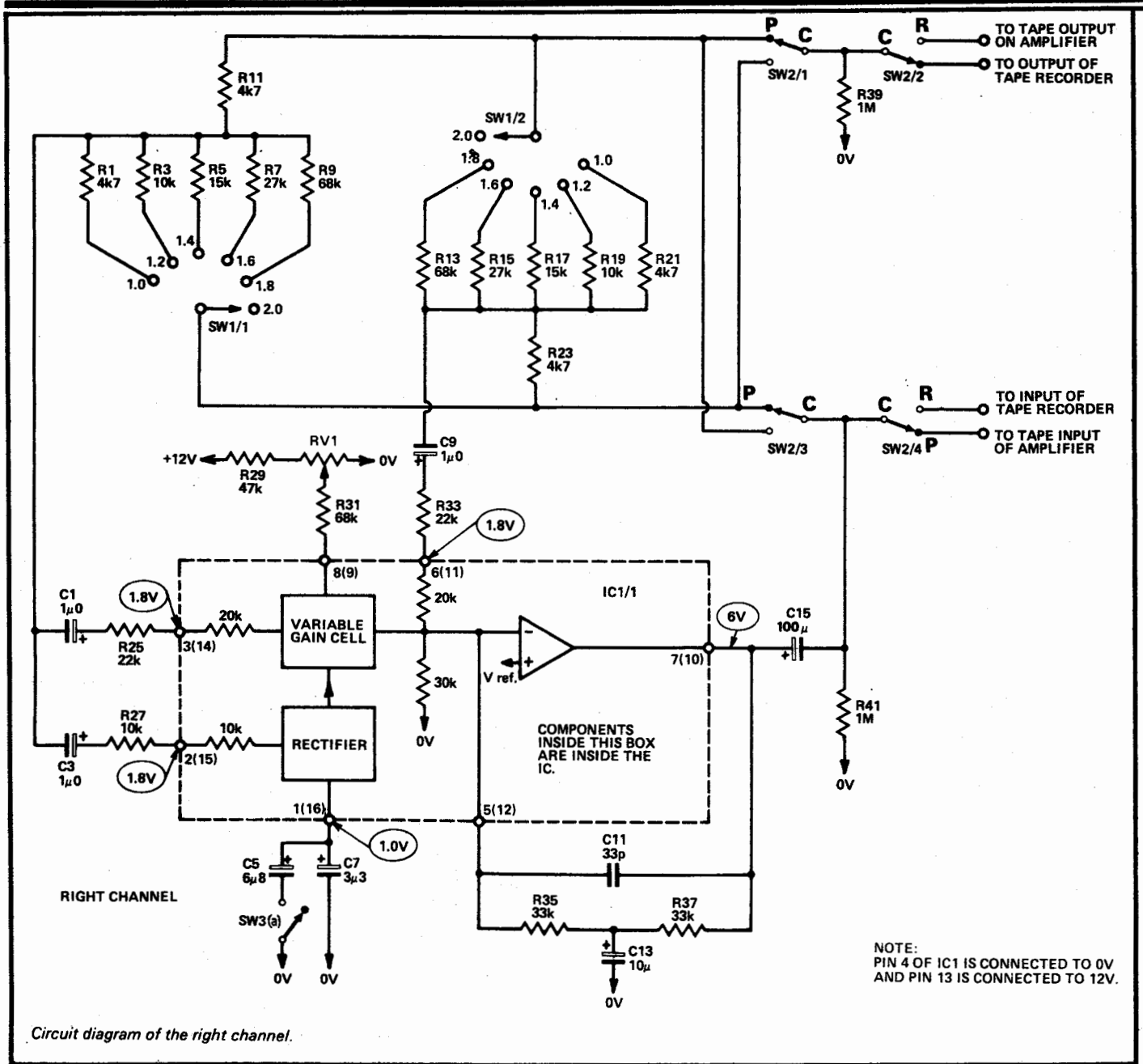
which is not acceptable to the hi-fi listener.

Another system used professionally and increasingly so in the domestic situation is the compressor expander.

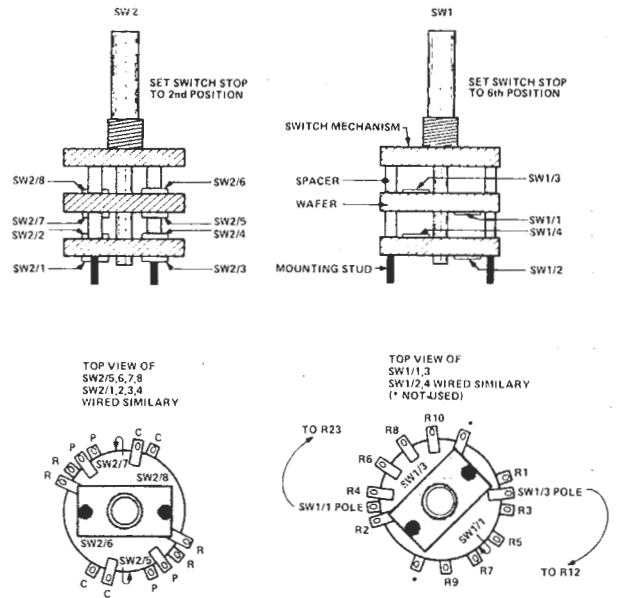
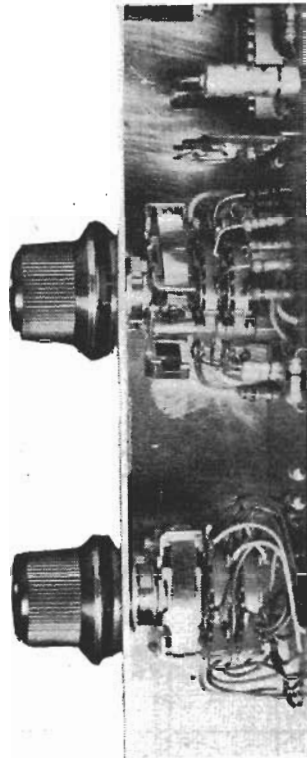
SPECIFICATION

Compression ratio	1.0, 1.2, 1.4, 1.6, 1.8, 2.0
Expansion ratio	1.0, 1.2, 1.4, 1.6, 1.8, 2.0
Attack time	
fast	10ms
slow	40ms
Maximum input voltage *	
R25—R28 = 0Ω	1 volt
Distortion 1 volt out	
untrimmed max.	2%
untrimmed prototype	0.25%
trimmed max.	0.2%
trimmed prototype	0.09%
Signal to noise ratio re 1V	
2.0 compression	45dB
2.0 expansion	90dB

* The max. input voltage can be increased to 3 volts using R25,26 = 22k and R27,28 = 10k



The best known unit here must be the DBX unit. With this type of system the full dynamic range, say 80 dB, is compressed to perhaps 40 dB (compression ratio of 2), then it is recorded. If the signal to noise ratio of the recorder is 50 dB and our peak recording level is 5 dB below maximum our minimum level is still 5 dB above the noise. On replay we now expand by the same factor giving us our full 80 dB dynamic range with the noise 10 dB lower. We have already published the design of a compressor expander (in ETI, May 1976) which worked well but was complex and used a double sided printed circuit board with eight ICs and four dual transistors. This new design is simplified by the use of a special IC which takes the place of all these separate components reducing the cost and complexity.



Construction

Commence assembly with all the components which are mounted flat

HOW IT WORKS

As most of the work is done inside the IC we must look inside the IC to explain the operation. The IC contains a rectifier circuit which is used to measure the actual signal level, a variable gain block which is controlled by the output of the rectifier so that the gain is proportional to the input signal, and an amplifier. By connecting the IC in various ways either a compressor or expander can be formed. We can do either by switching and also by mixing the two by a series of resistors we obtain ratios other than the preset 2. However due to the mixing being done before the logarithmic control of the variable gain cell the ratio is only true in the top 30-40

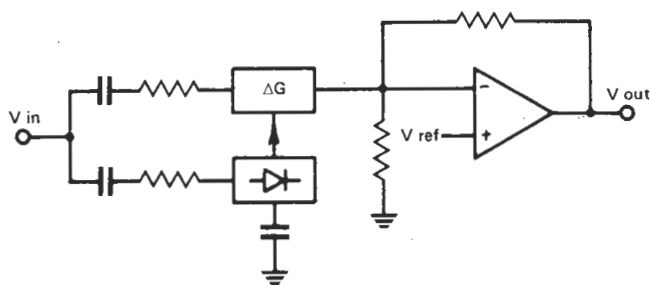
dB range reverting to a ratio of 1 below this level. Both compressor and expander however follow the same curve and compensate for each other.

We have provided two release times in the unit. With a fast release time there is distortion created at low frequency while if it is too slow the unit appears to 'breathe'. The slow time is slow enough to give reasonable low distortion while minimising breathing. However the distortion created by a fast release time is compensated in the expansion mode provided it is recorded and played back at the same settings.

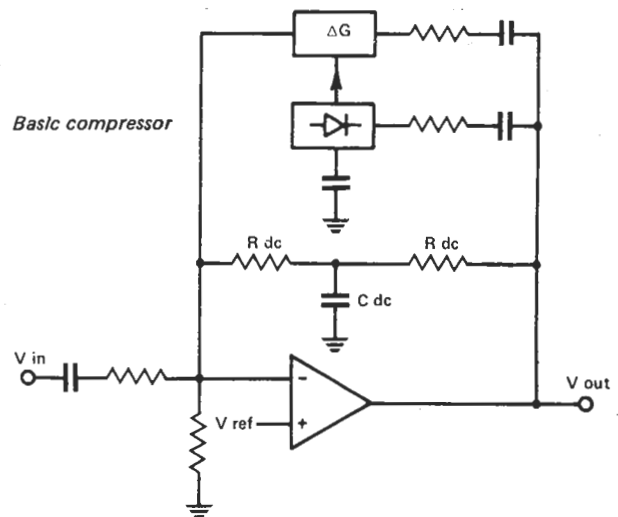
Expander or Compressor

These diagrams show how the IC is connected to operate as either a compressor or expander with a fixed ratio of 2.0.

Basic expander.



Basic compressor



PARTS LIST

RESISTORS all 1/4W 5%

R1,2,11,12,21,22,23,24	4k7
R3,4,19,20,27,28	10k
R5,6,17,18	15k
R7,8,15,16	27k
R9,10,13,14,31,32	68k
R25,26,33,34	22k
R29,30	47k
R35-38	33k
R39-42	1M
R43	1k5

CAPACITORS

C1-4,9,10	1u0 63V electrolytic
C5,6	6u8 16V tantalum
C7,8	3u3 35V tantalum
C11,12	33p ceramic
C13,14	10u 16V electrolytic
C15,16,18	100u 16V electrolytic
C17	220u 35V electrolytic

POTENTIOMETERS

RV1,2	25k vertical trim type
-------	------------------------

SEMICONDUCTORS

IC1	NE 571
IC2	78 L12
D1-4	1N 4001
LED1	.2" type

SWITCHES

SW1	4 pole 6 way rotary (2 sec, 2 pole 6 way) * see text and "Buy-Lines".
SW2	8 pole 2 way rotary (2 sec, 4 pole 3 way) * see text and "Buy-Lines".
SW3,4	D.P.D.T toggle.

TRANSFORMER

T1	240 - 12V 100mA
----	-----------------

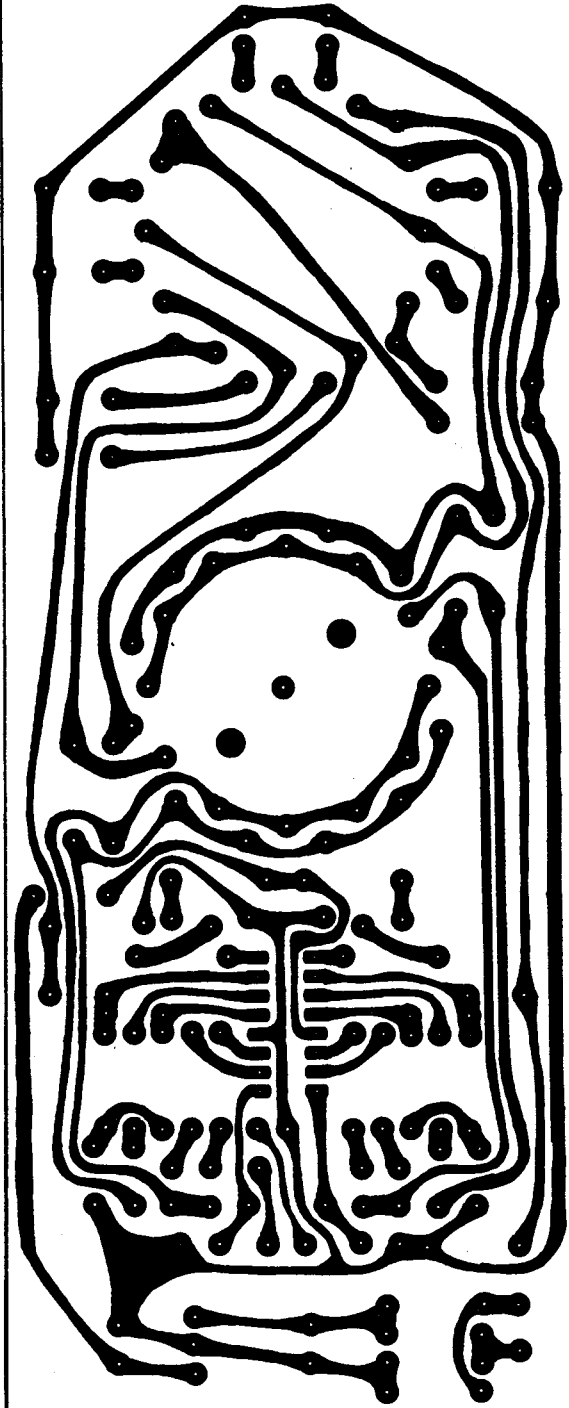
CASE

Norman type WB4 or similar (280mm x 150mm x 80mm approx.)

MISCELLANEOUS

Phono sockets or din sockets, knobs to suit, 3 core mains flex, connecting wire, screened wire, nuts, bolts, mounting-spacer pillars, grommets etc. P.C. Board as shown. Mounting feet. Fuse holder and fuse to suit.

ETI COMPANDER



Printed circuit layout.

The release time switch can now be wired and the printed circuit board mounted into the chassis. The transformer input sockets etc. can now be mounted and wired.

Distortion Adjustment

Distortion can only be adjusted with a meter. Set the ratio switch to 2 and feed about 1 to 1.5 V at about 1 kHz into the socket marked 'to tape output on amplifier' and measure the distortion at the socket marked 'to tape recorder input'. By adjusting RV1 and RV2 depending on which channel you are measuring it should be possible to adjust

the distortion to under 0.2%. This can be repeated with the second channel.

Input Levels

The maximum input level the IC can handle is 2 volts peak. However by using the resistors R25 - R28 the maximum

level is increased to 4 volt peak. They also affect the unity gain voltage and as signals higher than 2V will not be used these resistors should be replaced by links. Resistors R33 and R34 should also be replaced by links if R25 - R28 are.

ETI