

# Audio + Design

**EX·press LIMITER**

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IT IS ESSENTIAL THAT BROADCAST USERS READ THIS SECTION BEFORE OPERATION.

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## INTRODUCTION

The stereo Ex-Press Limiter is the first of a new family of 19" rack mounting auxiliary signal processing units. This uses the "one-card" construction technique within an extruded aluminium framework.

This philosophy out-dates multiple PCB construction methods and eliminates the need for complicated wiring harnesses. This results in a reliable, easy to understand system.

From the outset the design concept has been to create a system which is easy to understand and use. Specifically the Ex-Press Limiter combines the ever popular auto dual slope feature to be found in other ADR developments with well defined, fixed thresholds. Together these enable the user to take best advantage of the dynamic range available for compression and limiting effects. In addition a subtle low level expander can be switched-in to restore dynamic range.

Operationally the combination of CMOS switching functions with RMS or peak sensing side chain facilities and VU/Gain Reduction output metering allows the user to quickly and simply setup the system for a variety of programme situations. As such, the Ex-Press Limiter neatly fills the gap between the most sophisticated level control "tools" and their "too-simple" counterparts.

The operating instructions in this manual are divided into two parts:-

- i) operational: - aimed at the user
- ii) technical: - aimed at the user's maintenance department.

Whereas it is not essential that all users are necessarily familiar with both parts, an initial reading is recommended

for overall understanding and appreciation. Wherever possible pictures are used to convey a clear indication and explanation - any queries raised should be directed at your local distributor or, if more convenient, directly to Sales Administration at Audio & Design.

We believe that the most can only be had from your new investment by understanding it fully; with that in mind-

H A P P Y   R E A D I N G

OUTPUT pot.  
 Accurately scaled to show peak  
 output level.  
 Referenced to internal limiter.

RELEASE pot. with switched 'Auto'  
 position 25ms - 3sec

RATIO  
 Compressor slope selection

LOW LEVEL EXPANDER  
 with three pre-set thresholds.  
 HI ● ● ●  
 LO ● ● ●  
 MED 0 ● ●  
 OFF 0 0 0

METER SELECT  
 Gain reduction OR VU output.

POWER 'ON' indicator. Biased "PUSH-  
 PUSH" power on button.

TOP COVER

HANDLES



INPUT POT.

ATTACK pot.  
 In normal 'peak' sensing  
 mode (i.e not RMS)  
 determined as 500µs to  
 5ms.

AUTO. Fast initial release  
 (4dB) followed by slow 'platform':  
 (25ms - 3 secs variable on  
 5 sec platform).

'RMS' selects RMS type  
 'side-chain' sensing.  
 Otherwise normally 'Peak'  
 sensing.

NB Attack/Release  
 functions obviated by  
 RMS sensing. RMS times  
 constant 5ms attack on  
 500ms release.

SYSTEM  
 IN/OUT

SELECTS meter reading,  
 ● ● Sum (L+R)  
 ● ● 0 Left  
 ● ● 0 Right

DUAL SCALED VU standard  
 and ADR Gain Reduction  
 standard  
 © Audio & Design

INDICATORS FOR:  
 RED - LIMITER operation after  
 10dB of Gain Reduction.  
 ORANGE - COMPRESSOR operation  
 shows the first 10dB of Gain  
 Reduction.  
 GREEN - EXPANDER operation  
 shows 10dB attenuation with EXP  
 switched in, under no signal  
 condition.

2.2 Establishment in the Channel

## Set-up Procedure:

- i) With the 'System In/Out Switch' in 'Out' mode establish normal programme level through the channels. This should ideally be between 0dBm and +16dBm.
- ii) Select appropriate ratio, side-chain sensing and initially, Gain Reduction (GR) metering.  
NOTE: If RMS side chain sensing is chosen the Attack and Release controls become inoperative.
- iii) Set system 'In' and advance 'Input' pot to give the desired amount of compression and/or limiting.
- iv) Turn 'output' control to normal operating level (usually +6dBm - +8dBm) which will be maintained under 'limit' conditions. ie GR meter reading above mid-scale and red 'limit' led operative.  
NOTE: If 'limit' slope initially selected (see ii) this output level will prevail from the onset of gain reduction.
- v) When using the softer ratios (eg 1.5 and 2:1) the automatic limiter section will operate after 10dB compression. Whereas the 5:1 and limiter ratios will act as a soft limiter.
- vi) If 'Peak' sensing has been selected (ie not RMS) the desired 'Attack' and 'Release' characteristics should now be set. (ref 2.3 Application notes) - see Fig. Photo of 'Attack/Rel'.
- vii) At your option, add in the low level expander selecting, by multiple depressing, 'Hi', 'Med' or 'Lo' threshold settings. The expander operates with reference to the level at the input terminals, with thresholds of -12dBm (Hi), -26dBm (Med) and -40dBm (Lo). Thresholds may



be varied between these values by using the Exp Threshold pre-set accessible through the front panel.

Selection of Balanced or Unbalanced Mode: (Ref 3.5.1 General Arrangement)

The Ex-Press provides for electronic balancing of inputs and outputs (see 3.2 Unit Connections). Check the line output switch to ensure that the system is correctly adjusted for the mode of operation being used. The effect of having the unit in the unbalanced position when the system is wired for balanced operation will be 6dB increase in signal level at the output. Conversely there will be a 6dB loss with the switch to balanced mode when the system is wired unbalanced. (ref 3.1 Tech Spec).

Pre-Emphasis: (Ref 3.5.1 General Arrangement)

The Ex-Press Limiter provides the option to select any pre-emphasis time constant. This is a user-defined facility installed by the customer and entails selection of the appropriate capacitor value (C\*) shown in the table below.

IMPORTANT NOTE The table shown on the PCB is incorrect for units with serial numbers 0035 and below - please refer to the table shown below for models with latter serial numbers.

Where C\* = 500p for 25us  
= 1000p for 50us  
= 1500p for 75us

The value of C\* is derived the following formula:-

$$C^*R = t \text{ where } t = \text{Time Constant}$$

$$R = 47K \text{ (Fixed value on PCB)}$$

For Example

for a given constant of 47us the required formulae is:-

$$C = t/R$$

$$= \frac{47\mu}{47K}$$

$$47K$$

$$= 1 \times 10^{-9} \text{ F or } 1000\text{pF}$$

MODIFICATION TO EX-PRESS LIMITER AFTER DECEMBER 1980, ISSUE 4

Modification 1 - Compressor

The printed circuit board has been modified to allow the resistor marked "S" to be changed to any of the values shown in the Table below. This enables the user to change the amount of Gain Reduction available in compression before limiting occurs.

"S" = 3K9 = 10dB G.R.

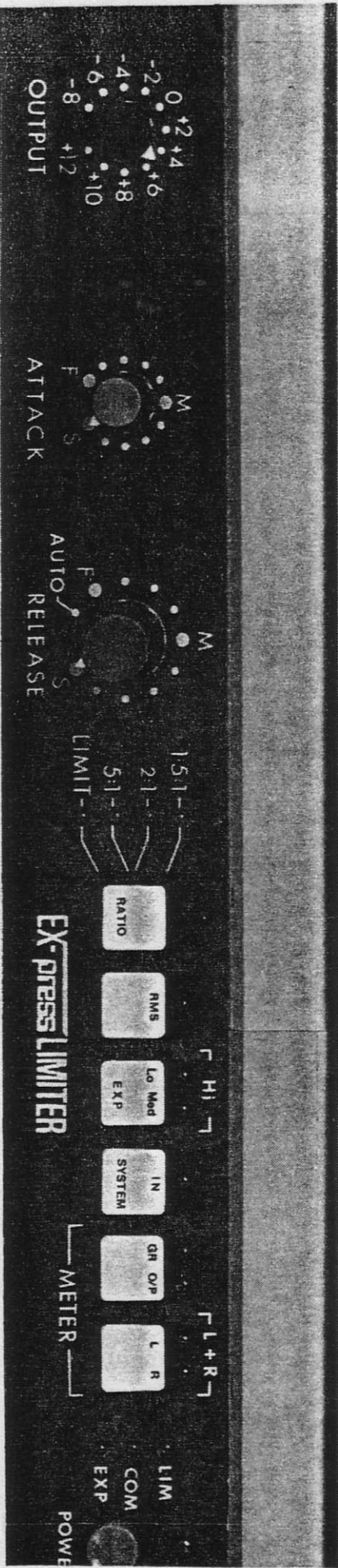
fitted standard

"S" = 22K = 6dB G.R.

"S" = Open Circuit = 3dB G.R.

Modification 2 - Expander

A pre-set marked "Exp Threshold", accessible through to front panel has been added to the Expander facilities. This will allow the pre-selected thresholds to be adjusted higher by up to 14dB, hence giving greater flexibility to the Expander section.



When RMS is selected, ATTACK and RELEASE controls become fixed

2 OPERATIONAL SECTION

2.3 Application Notes

The usual purpose of Limiting and Compression is to:-

- a) Increase loudness and
- b) to provide overload protection and generally control level.

2.3.1 Limiting

This is the use of a level control device providing overload protection or to 'limit' the signal amplitude above a certain threshold level. Transients are of major concern as they are composed of peaks of high energy, but of short duration. These can exceed the predetermined peak recording level. Control of these will not markedly affect the dynamic range of the input signal since gain reduction, when it does occur, will be momentary and of a relatively low order of magnitude. In most cases a fast release time will be desired so that transients are 'punched' down without apparently affecting the programme content and a 'tight' compression ratio (10:1) would be used. The engineer can now set the signal level closer to the system overload drive level and thus make better use of the dynamic range of the recording or transmission system.

2.3.2 Compression

This is the use of a level control device to modify the dynamic range of a signal. It does this by arranging that a change of input level above a set threshold value is presented at its output as a smaller change level. The ratio of these two levels is known as the slope of compression ratio. The compression ratio selected may be anything from the softest slope (say 1.5:1) to the tightest (say 20:1) dependent on the effect required.

When it is desirable to preserve some sensible relationship to the original dynamics, ratios of 1.5:1 or 2:1 would be used. For example: the effect of a 2:1 ratio on a 10dB change in input level above threshold will be to produce an output change of 5dB. Similarly the use of a 10:1 ratio would produce an output change of only 1dB. A 1dB change is approximately equivalent to 10%.

Figure 1 shows graphically the relationship of input to output.

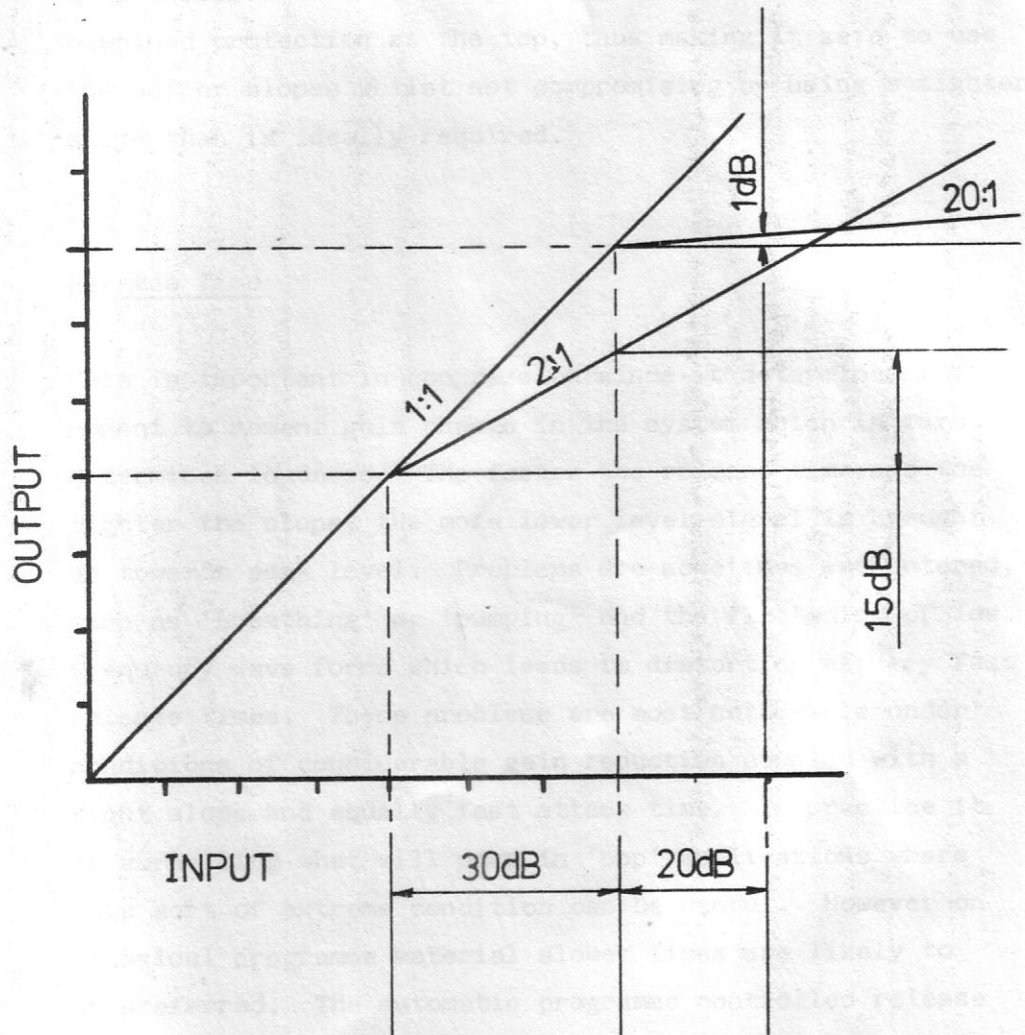


Fig 1: Input/Output characteristics of compressors and limiters.

Notice how 10dB of compression, or gain reduction, is achieved. At a 2:1 slope by starting at a lower threshold and allowing the unit to act on a 20dB range in input. At a 10:1 slope the threshold is higher and 10dB of input level change results in only 1dB of output level change. A 1.5:1 ratio is more subtle and the effect of fast release times less apparent.

The advantage of the Ex-Press Limiter over its competitors is that the softer slopes can be used to provide subtle compression. This is always combined with automatic limit overload protection at the top, thus making it safe to use the softer slopes whilst not compromising by using a tighter slope than is ideally required.

### 2.3.3

#### Release Time

This is important in compression since it determines the moment to moment gain change in the system which in turn determines loudness. The faster the release time and the tighter the slope, the more lower level signal is brought up towards peak level. Problems are sometimes encountered, such as 'breathing' or 'pumping' and the flattening of low frequency wave forms which leads to distortion at very fast release times. These problems are most noticeable under conditions of considerable gain reduction coupled with a tight slope and equally fast attack time. In practice it is surprising what will pass in 'pop' applications where this sort of extreme condition can be useful. However on classical programme material slower times are likely to be preferred. The automatic programme controlled release position provides for an initial fast release over a range of 5dB, after which the release time lengthens thus restricting short duration gain change and obviating most of the problems earlier described. It can also be adjusted to operate as a 'mean level' control so that the quieter sections are subtly lifted. Considerable overall compression can be

effected without being apparent and is ideal for background music or reducing dynamics for mediums of very limited dynamic range (eg AM radio, optical film track etc).

#### 2.3.4 Attack Time

This will determine the size of transients allowed to pass through the compressor section. In a limiter, attack should be very fast in order to control short duration transients and prevent overloading. Some mediums are more critical than others. On tape, optical systems and transmitters it is usually essential that overshoot be kept to the absolute minimum. In a compressor or limiter the slowing down of the attack time has the effect dynamically speaking, of reducing the static ratio, increasing the overshooting. Listening to 15dB compression on a 20:1 slope with a fast attack time 'tightness' will be quite apparent in the sound, this can be softened by reducing the attack time.

#### 2.3.5 Compression and Noise

From the point of view of minimal noise, it is preferable for the compression to be effected on direct microphone signal since the signal-to-noise ratio is best at this stage. It will be appreciated that 15dB compression will increase the source noise by 15dB when the compressor fully recovers. Off tape this would be more noticeable. Use of a correctly set expander/gate can greatly reduce this increased source noise.

#### 2.3.6 Modulation

If more than about 6dB compression is intended to be used on the overall programme it is desirable to treat individual instruments or groups of similar instruments separately. This avoids modulation effects when a dominant instrument

or sound modulates the rest of the signal. It is impossible to limit satisfactorily low frequency instruments on final balance, eg try limiting the low frequency sections of an organ recording or well modulated timpani in an orchestral recording. The effect on the remaining signal and particularly the change in ambience is most apparent. By separately compressing groups of similar instruments considerable compression may be effected on direct signal without difficulty.

N.B. Special units (E500/560 Selective Processor) which enable sections of the audio bandwidth to be separately limited/compressed without modulation effects are available from ADR for handling problematic masters in disc-cutting or high speed tape duplication. Your local distributor has details.

#### 2.3.7 The Clipper and Pre-Emph Facilities

An on board clipper is provided for use in AM/FM broadcast situations. This will provide an instant leveling off of peaks from a threshold set exactly 1.5dB above +12dBm. (Limit operation). The clipper will follow the pre-emphasis curve initially set up by the limiter and square off any transients escaping the attack of the limiter. Although a fully clipped signal represents approx 40% distortion this condition under normal use will never occur due to the limiting action on the signal before the clipper. The clipper has a peak responding action and can only be accurately observed on changing programme, using a peak programme meter or column. The distortion produced by the clipper will depend on the amplitude of the transient escaping the limiter attack. Generally speaking observations of up to 4dB of gain reduction shown above the limiter threshold set with a fast attack, will incur approximately 2% thd after the clipper.

With the assurance of the clipper at the very output of the unit, operating as close as 0.5dB below absolute transmitting levels can now be achieved.



The introduction of dynamic pre-emphasis in the clipper and limiter side chain gives the broadcaster the ability to dynamically bring up the mid to low frequency end of the programme, according to the overall level by limiting more and more those frequencies within the pre-emphasis curve. Ultimately de emphasis appears at the output with respect to +12dBm. With the Ex-Press Limiter positioned just in front of a transmitter with static pre-emphasis at the time of clipping, the output from the Ex-Press Limiter will momentarily cancel the transmission curve and a flat response will be transmitted at a level 0.5dB below maximum operating levels.

A frequency plot is shown in the appendix at the back of this manual.

Obviously in a receiver with static de emphasis built in, receiving a flat signal (but higher level) at its input will give an output equal to its de emphasis curve. As this occurs instaneously the degradation in frequency response at that time is not at all obvious (less that 10% of the time) but the overall increase in reception levels is very obvious.

A switch is provided on the clipper board to allow the engagement of the clipper facility.

**WARNING:** Never operate the RMS mode with the clipper selected.

It should be noted that the clipper and limiter can also be operated on full range signal if the two pre-emphasis switches (located on the main board) are switched out.

3 TECHNICAL SECTION

3.1 Technical Specification

FOR ONE CHANNEL

Frequency Response : +0-0.5dB, 20Hz to 25kHz at threshold  
Noise : Better than -82dB Ref to +12dBm (max limit level)  
Condition : Measured band limited 25Hz and 25kHz  
Distortion : @ 1kHz 0.15% Ref to +12dBm (max limit level)  
Condition : Measured with 3 sec release time @ 1kHz and 10dB Gain Reduction  
Common Mode Rejection : @ 1kHz-70dB  
@ 10kHz-50dB  
  
Clip Level : Output Stage +24dBm Balanced into 600 Ohms  
Input Stage +24dBm  
Crosstalk : @ 10kHz-87dB, ref to +12dBm on opposite channel  
Gain Control Range : 25dB from onset of limiting  
Make-Up Gain : 28dB  
Output : Calibrated -8dBm to +12dBm, ref to limit threshold  
Stereo matching worse case : +1dB channel to channel over 20dB gain reduction  
  
Compressor/Limiter  
Thresholds/Ratios: : Limit : -16dBm  
5:1 : -20dBm  
2:1 : -28dBm  
1.5:1 : -40dBm  
Limit Attack : Fast 500uS for 10dB over limit threshold  
Slow 5mS for 10dB over limit threshold  
Release : Fast: 25mS on 10dB over limit threshold  
Slow: 3 secs on 10dB over limit threshold  
Auto: 25mS on 5 sec  
"RMS" Sidechain : 5mS attack on 500mS release

Expander thresholds/ratio: 1.8:1 Low -40dBm to -26dBm  
Med -26dBm to -12dBm Ref to Input  
High -12dBm to +2dBm

Expander control range : 10dB

Pre-emphasis for 25, 50, 75uS options, switchable on side-chain

Clipper : Set at +12.5dBm ref to max output with  
pre-emphasis for 25, 50, 75uS options  
switchable on board

electronic balancing for input and output - on board switching for output

Input Impedance : Greater than 47K @ 1kHz

Output impedance : Less than 2 ohms (balanced) @ 1kHz

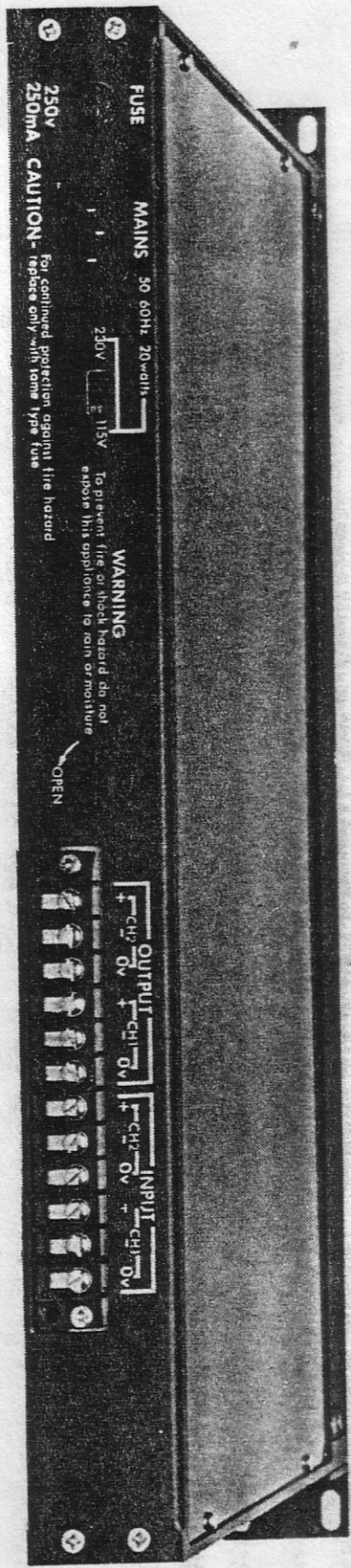
Metering: : 2 scales showing: standard V.U.  
gain reduction 0-20dB

Power Requirements : Main 230 VAC<sub>+7%</sub>  
Selectable on rear panel  
115 VAC<sub>+10%</sub>

Power Consumption : 20 watts

Size : STD Rack, 1 $\frac{3}{4}$ " x 19" x 11.4"  
(44.45mm x 482.6mm x 290mm)

Weight : 9.61B (4kg)  
Shipped in purpose built export packing



REAR PANEL CONNECTIONS

### 3.3 SET UP PROCEDURE AND FUNCTION CHECK FOR EX-PRESS LIMITER

#### 3.3.1 COMMON MODE REJECTION

Initial Set Up N.B All measurements taken unbalanced.

Set ALL presets midway

Input and output pots max

Release and attack fast

Bal/unbal sw to unbal, pre emph switches out

Select out

- a) Feed in 0dBm @ 1kHz
- b) Connect both phase inputs together
- c) Adjust CMR presets to measure -70dBm or better at output of each channel
- d) Increase frequency to 10kHz. Check outputs are -50dBm or better. Return frequency to 1kHz. Disconnect inputs from each other.

#### 3.3.2 METER ZERO AND OFFSET

- a) Remove input
- b) Select 5:1  
Select Exp off
- c) Select G.R.
- d) Turn Exp off - set fully anticlockwise
- e) Adjust GR zero pre-set to give approx 4dB gain reduction reading
- f) Adjust rec offset pre-set clockwise to give a small meter movement when sweeping release pot from fast to slow.
- g) Adjust GR zero pre-set for zero meter reading.

### 3.3.3 FET BIAS

#### Initial Set Up

System in

Select limit

RMS out

Exp out

Meter set to G.R.

NB Only feed one input at a time.

- a) Feed in -30dBm
- b) Turn FET law pre-set fully anticlockwise
- c) Plug in P channel control FET
- d) Turn bias preset fully anticlockwise
- e) Adjust FET law pre-set to read -28dBm @ output
- f) Adjust bias pre-set to read +2dBm @ output
- g) Increase input to 0dBm and adjust 20dB meter pre-set for meter F.S.D.
- h) Decrease input to -10dBm and adjust 10dB meter pre-set for mid scale deflection
- i) Repeat g) through h)
- j) Repeat a) through h) for next channel.

### 3.3.4 EXPANDER

- a) Turn input pot down
- b) Adjust expander off-set until meter just starts to read
- c) Select expander High Threshold In
- d) Feed in -7dBm check Exp is just open (no meter reading)
- e) Select med threshold  
Feed in -22dBm check as at c)
- f) Feed in -35dBm check as at c)
- g) Repeat for next channel

### 3.3.5 VU CALIBRATION

- a) Select O/P on meter switch and relevant L or R on meter monitor switch
- b) Remove input and adjust - pre-set for -20 VU scale
- c) Adjust I/P Pot so output reads +4dBm
- d) Adjust sense pre-set for 0 VU scale  
Check with 2nd channel

### 3.3.6 LIMIT THRESHOLD AND O/P POT CALIBRATION

#### Initial Set Up

Select: System in  
Limit  
G.R.  
Exp out  
Fast attack  
Fast release  
RMS off  
Clipper pff  
Pre-emph x 2 off

- a) Feed in -10dBm @ 1kHz
- b) Adjust input pot until 4dB of gain reduction occurs on GR meter
- c) Adjust output pot to +12 (fully clockwise)
- d) Adjust relevant channel threshold pre-set for output to read +12dBm
- e) Adjust output pot to -8 (fully anticlockwise) and cal output to -8dBm via relevant channel o/p pre-set
- f) Repeat a) through e) for 2nd channel

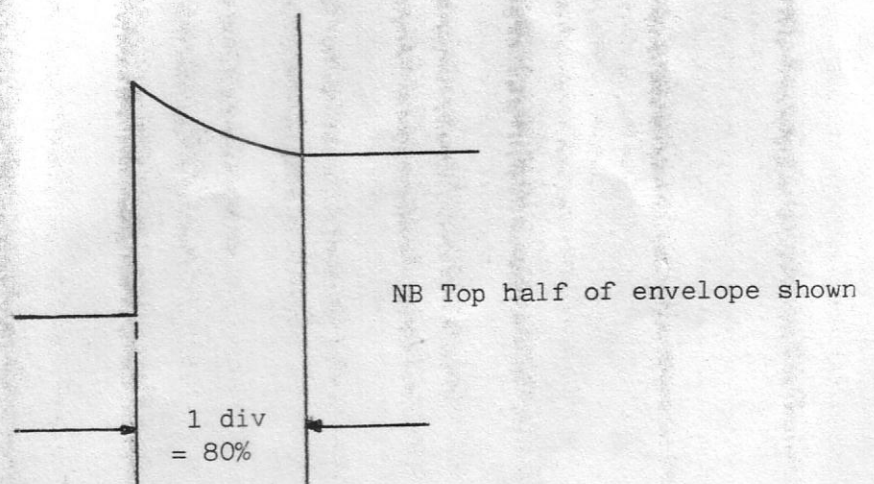
### 3.3.7 DISTORTION

- a) Increase output pot to max (+12dBm @ output)
- b) Select slow release

- c) Ref distortion equipment to output
- d) Adjust distortion pre-set for better than 0.15% THD
- e) Switch in clipper and check distortion does not rise above 0.3% - switch clipper out after check.
- f) Repeat for 2nd channel

### 3.3.8 RMS/ATTACK/RELEASE CHECK

- a) Increase input pot to achieve 10dB of gain reduction
- b) With release pot @ slow, switch system out and observe fall time of meter to be approx 3 seconds
- c) Turn release to auto
- d) Switch system in and out continuously @ 1Hz per sec and observe a fast fall time with a slow fall time building upon meter. (25ms on 5 secs).
- e) Turn release to Fast and make sure Attack is set to Fast.
- f) Set Scope for .5ms/div
- g) Switch system in and observe Attack wave form on scope: signal should come under control within 80% in 1 div.  
ie:



- h) Set scope to 5ms/div and Attack pot to Slow
- i) Observe same effect
- j) When RMS is selected note that Attack and Release controls become inoperative, and a slow attack with a slow release is apparent.



### 3.3.9 NOISE

- a) With input pot fully anti-clockwise, measure output noise to be  $-68\text{dBm}$  or better. (Check exp is out).

NB Use band limited filters on measuring equipment:-  $12\text{dB/Oct}$  and  $3\text{dB points @ } 25\text{Hz}$  and  $25\text{kHz}$ .

3 TECHNICAL SECTION

3.4 Routine Servicing

3.4.1 Preventative Maintenance

The Ex-Press Limiter is a part transistor, part IC unit, and the only maintenance necessary is to keep the unit clean. Contaminants may lead to short circuits, high resistance or generally erratic operation. The front panel is of brushed anodised aluminium and a light application of household detergent should do the job of cleaning it without fear of damage to nomenclature or plastic parts.

The pots are not, in the interest of economy, hermetically sealed and hence may in time become erratic because of wear, corrosion or dirt deposits. They may be cleaned with a commercial spray type contact cleaner but avoid letting excess cleaner contaminate other parts. Alignment instructions included in this manual are mainly for reference, it is recommended that only skilled, experience and suitably equipped technicians attempt maintenance. (See also 3.4.3 Factory Servicing).

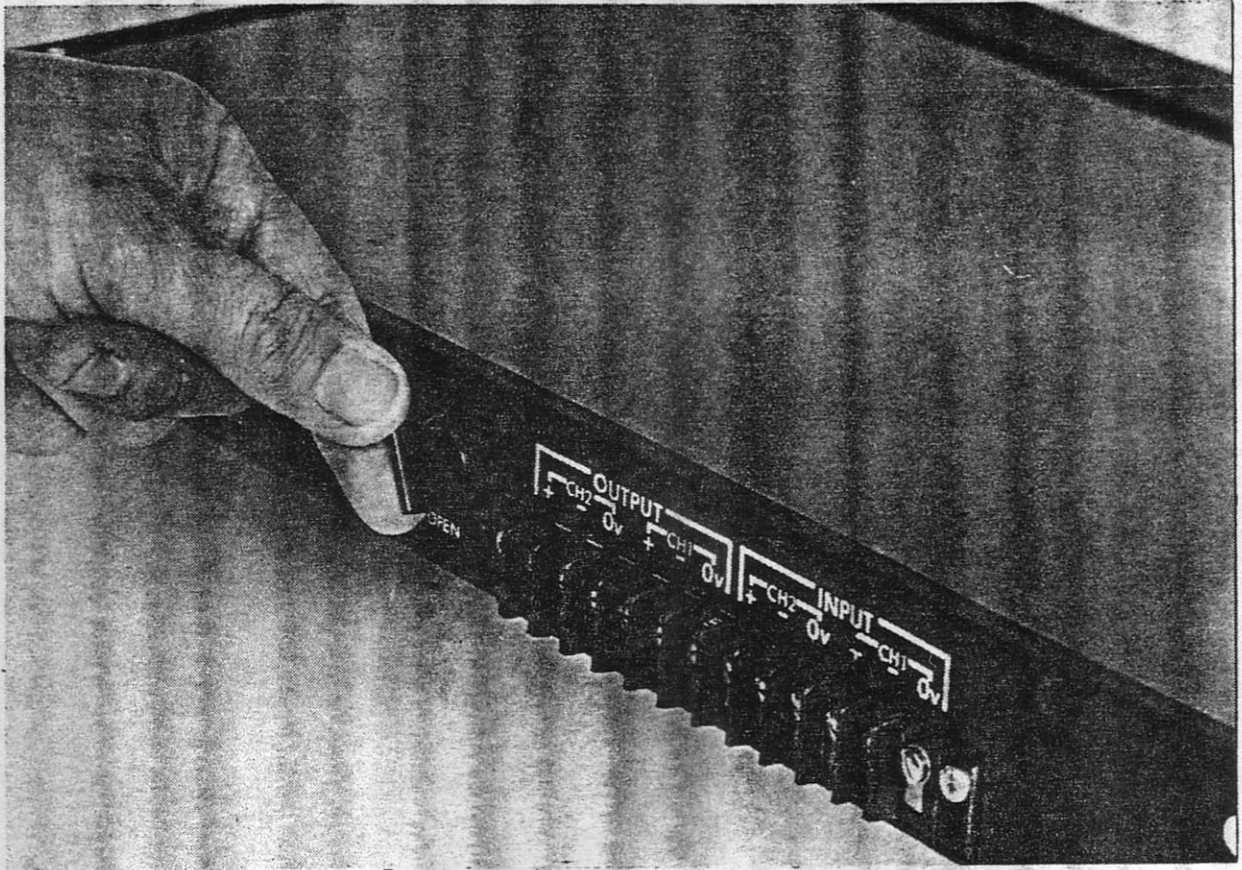
3.4.2 Fault Repair Maintenance

The Ex-Press Limiter is of highly advanced circuit design and technology. Where failure occurs it is advisable that repairs be performed by the factory where specific skills and correct parts are available. Customer initiated repairs should only be attempted by competent technicians experienced in the area of linear IC's (where applicable) and skilled in the art of working on double-sided printed circuit boards. Additionally, a number of specialised parts are used which must be replaced by direct equivalents or performance degradation may occur.

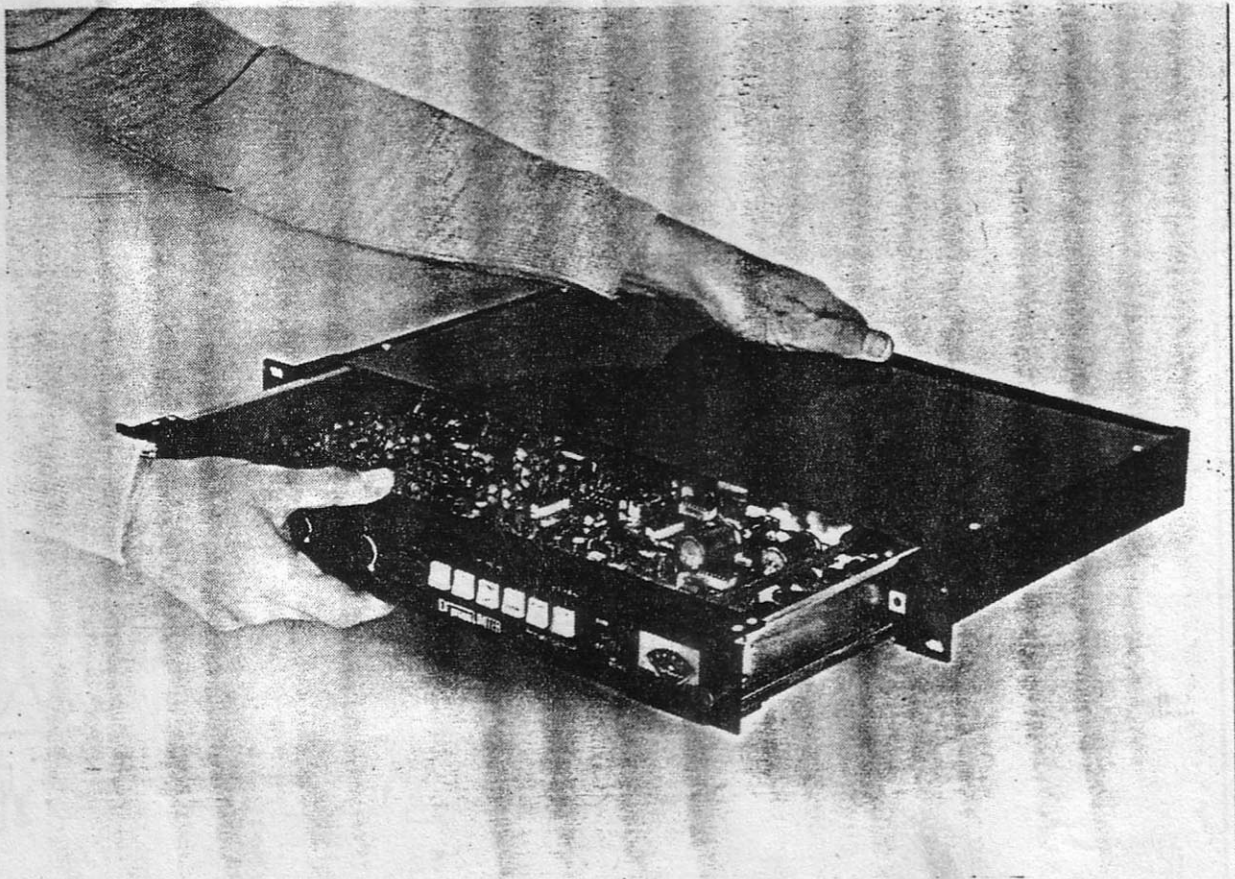
3.4.3 Factory Servicing

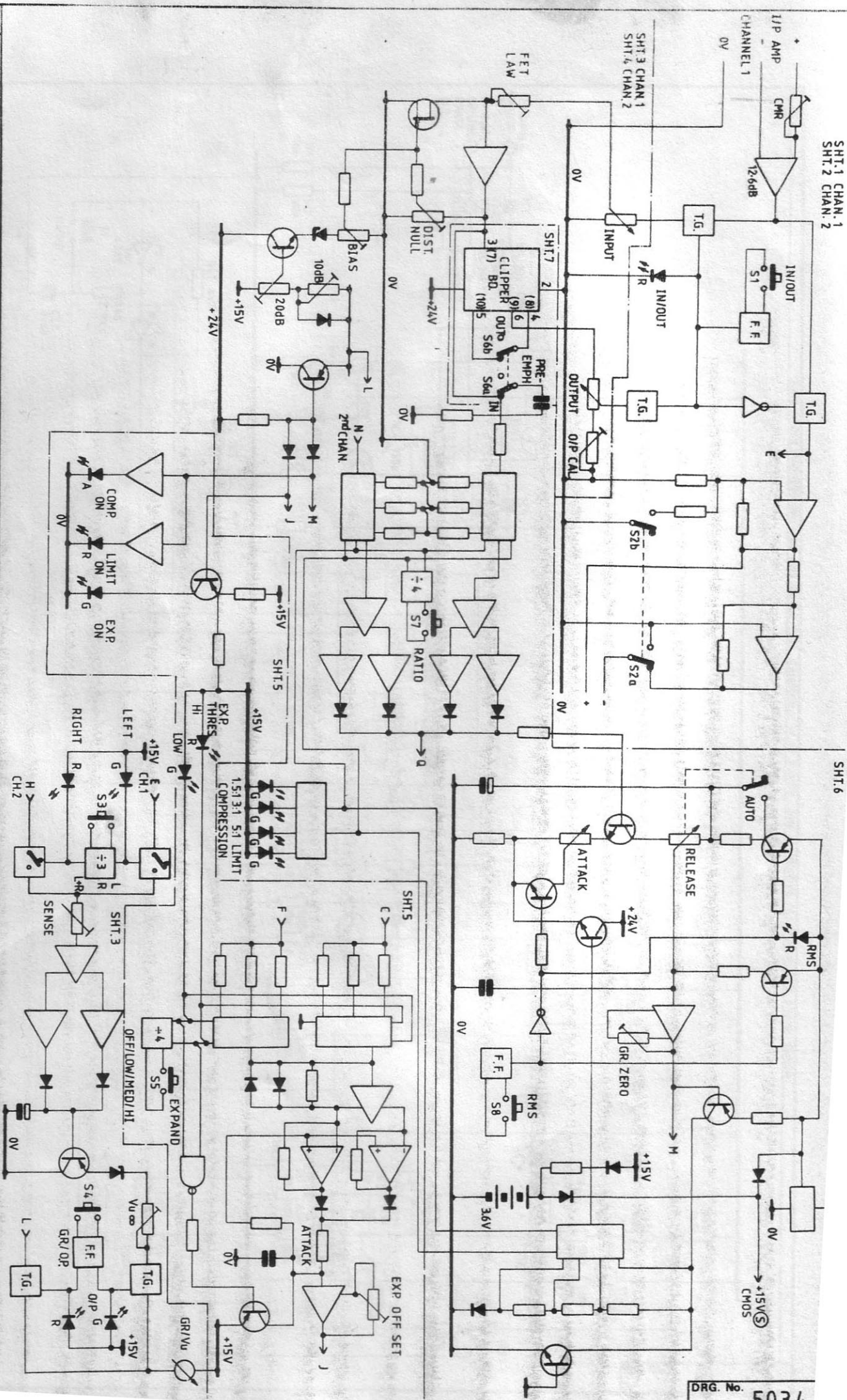
Servicing is available at any time after expiry of the warranty

(ref. 40), at a reasonable charge for parts, labour and handling. However, before returning the unit to us, it would be prudent to write or telephone, giving as much information about the fault as is to hand. Often the problem may be resolved in this fashion saving everybody time, effort and money whilst minimising your inconvenience.



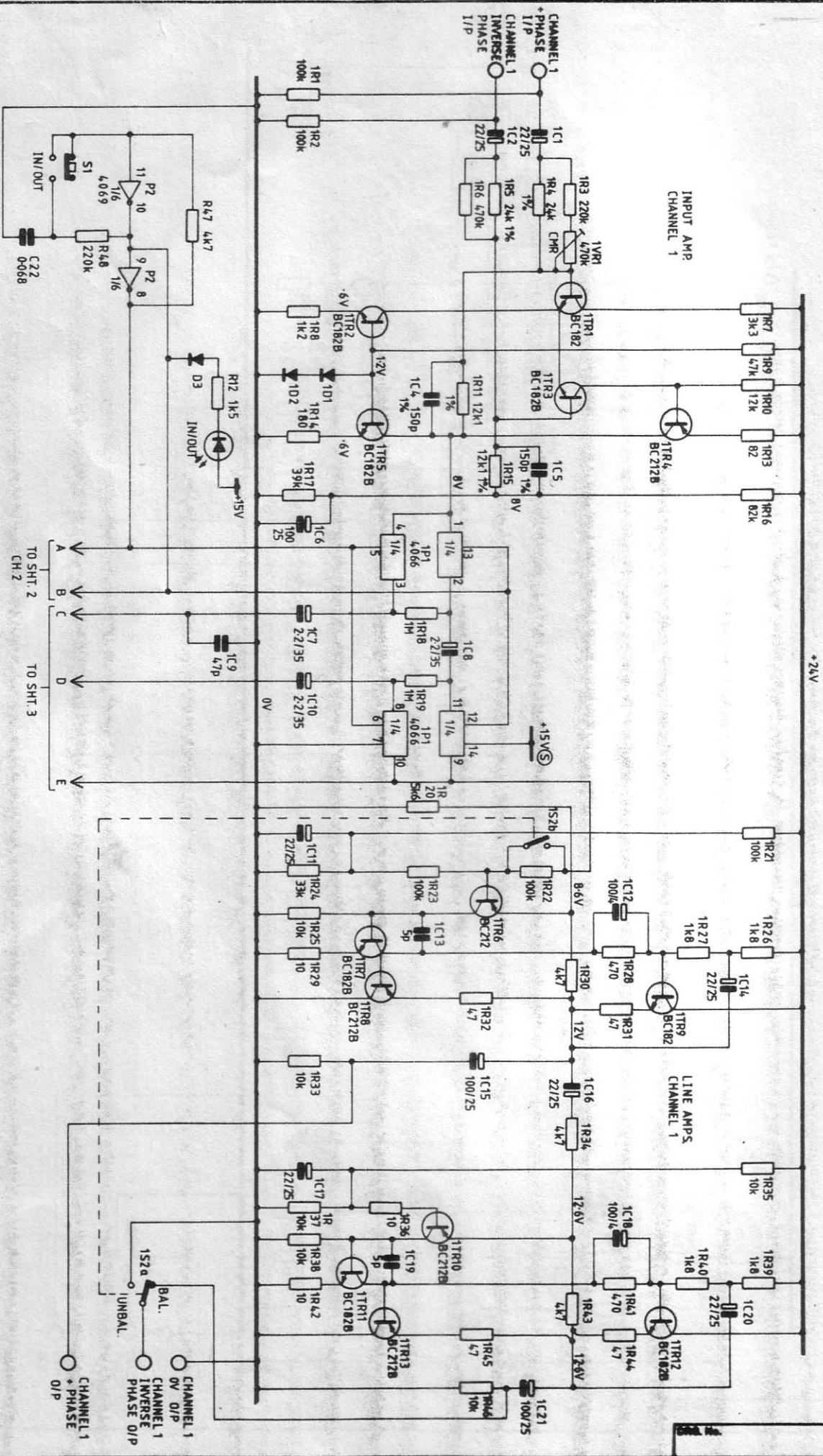
WITHDRAWING PRINTED CIRCUIT CARD FROM MAIN CASE





ISS.		ALTERATION		MATERIAL		FINISH		SCALE		TITLE	
				AUDIO & DESIGN RECORDING		CRANBOURNE ASSOCIATES		BGMILES		EXPRESS LIMITE	
				DATE		DATE		DATE		SCHEMATIC	
				SIG.		ISS.		A		DRG. No. 5034	

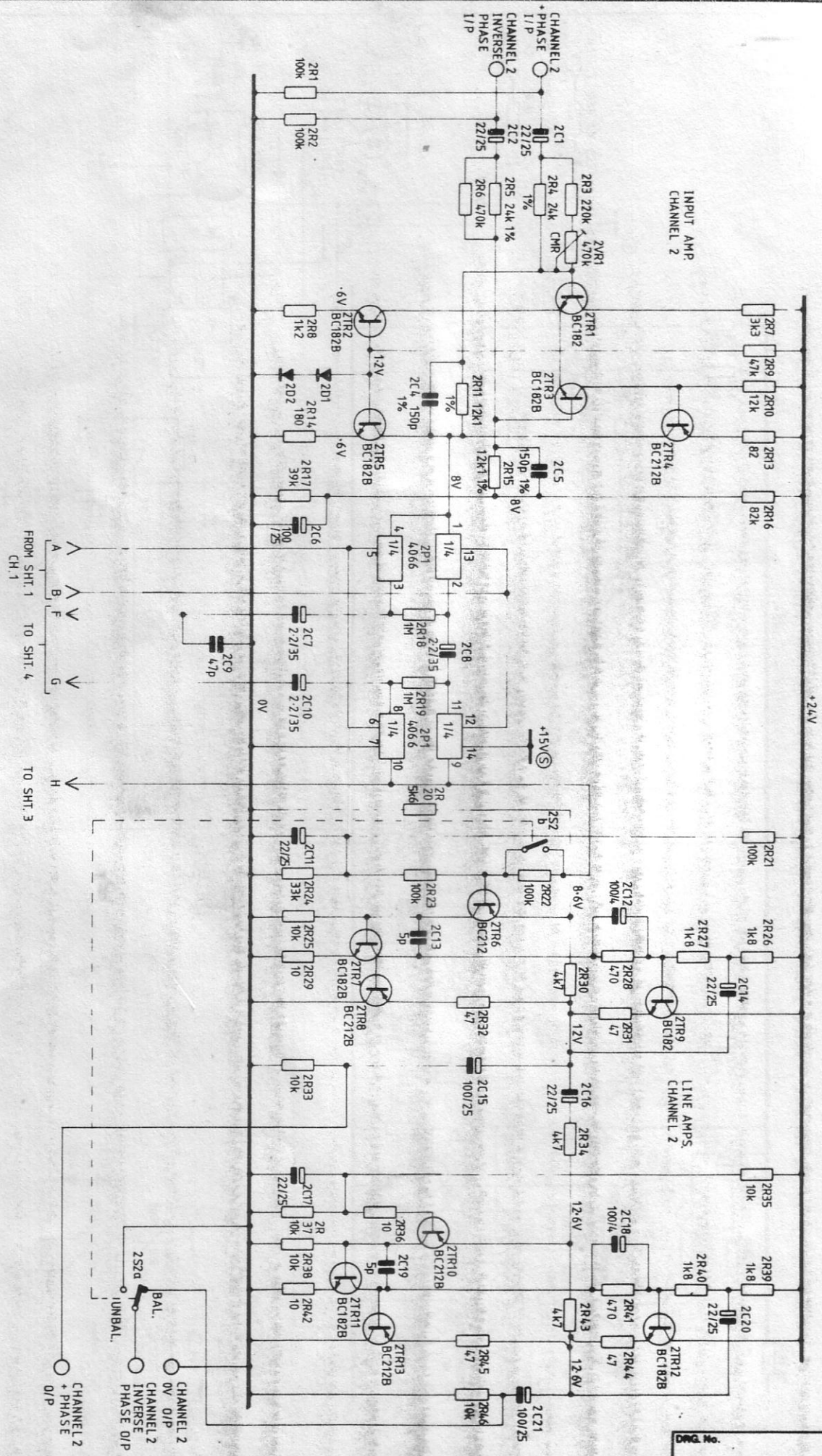
THIRD ANGLE PROJECTION. DO NOT SCALE THIS DRAWING. IF IN DOUBT ASK. REMOVE ALL BURRS AND SHARP EDGES.



CAPACITOR: IC3 NOT USED	
MATERIAL	
FINISH	
SCALE	
TITLE	

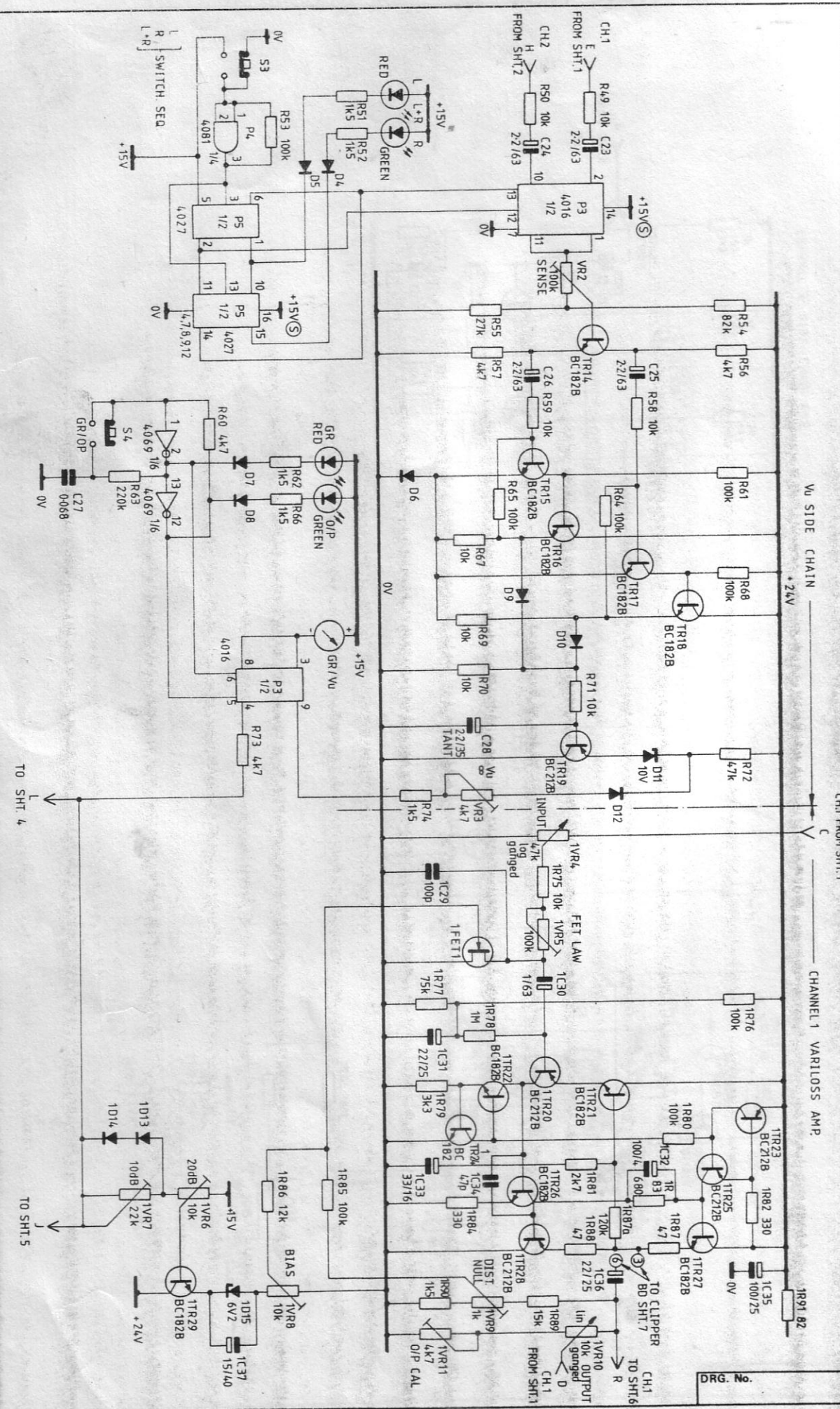
AL	ALTERATION	USED ON
AUDIO & DESIGN RECORDING		
CRANBOURNE ASSOCIATES		
DATE	SIG.	188.
CIRCUIT DIAGRAM 1A2		
SHT.1 OF 7 SHTS		

THIRD ANGLE PROJECTION. DO NOT SCALE THIS DRAWING. IF IN DOUBT ASK REMOVE ALL BURRS AND SHARP EDGES.



ISS		A		CAPACITOR: 2C3 NOT USED		MATERIAL		FINISH		SCALE		TITLE	
ALTERATION		USED ON				AUDIO & DESIGN RECORDING		CRANBOURNE ASSOCIATES		BOULEVARD		EXPRESS LIMITER	
						CIRCUIT DIAGRAM		A2		DATE		SHT. 2	

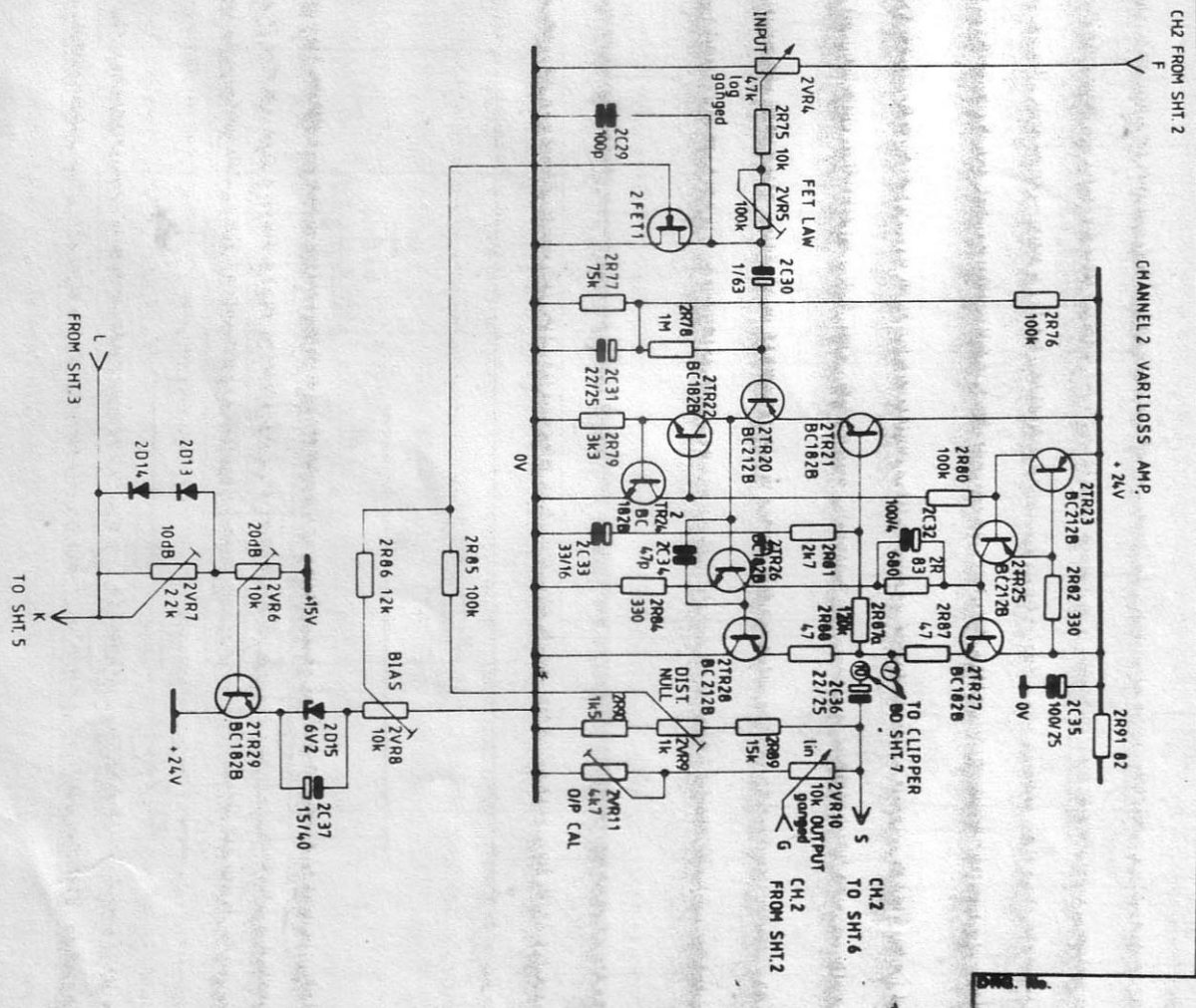
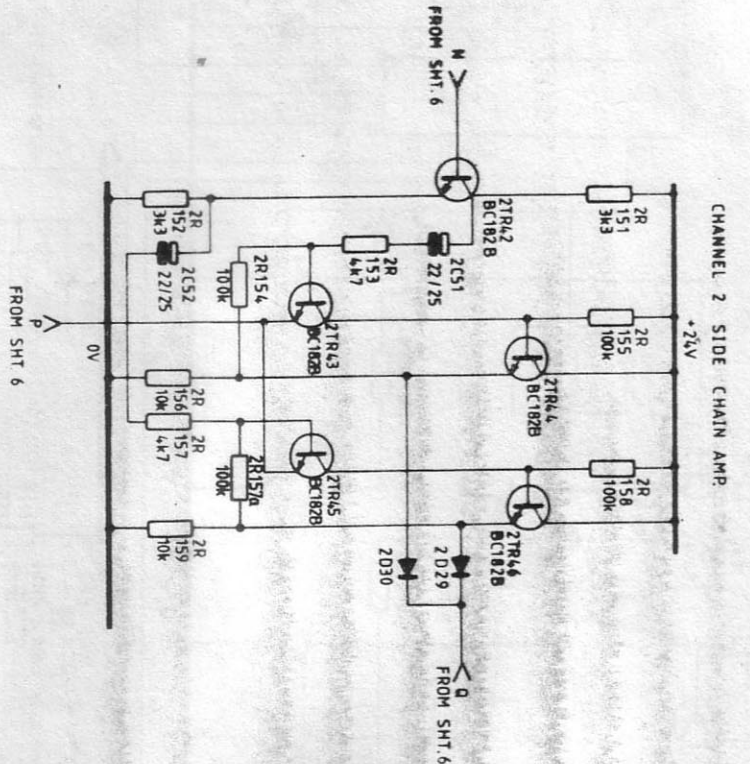
THIRD ANGLE PROJECTION DO NOT SCALE THIS DRAWING. IF IN DOUBT ASK REMOVE ALL BURRS AND SHARP EDGES



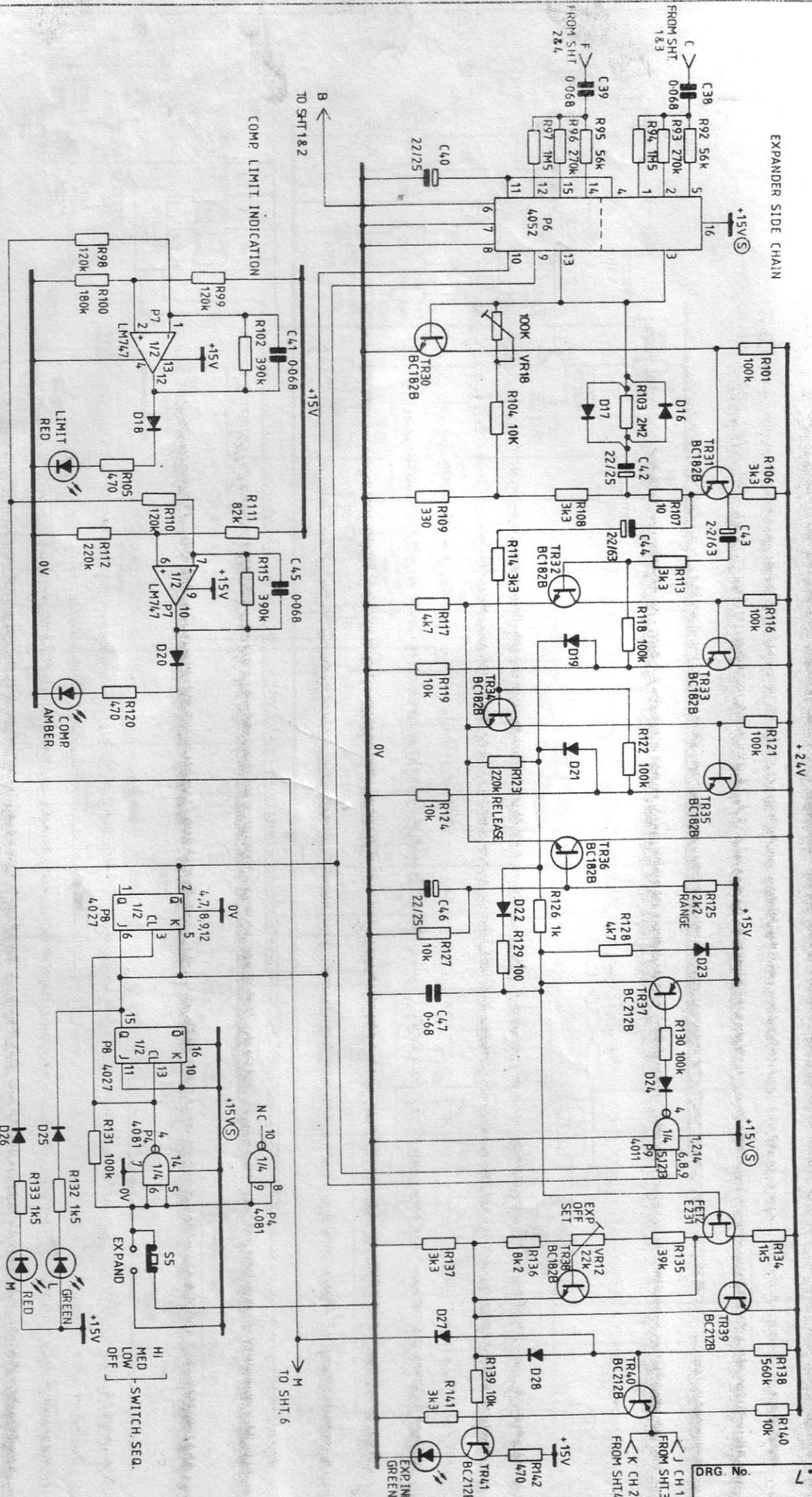
ISS		ALTERATION	
MATERIAL		FINISH	
AUDIO & DESIGN RECORDING		SCALE	
CRANBOURNE ASSOCIATES		BOARDS	
DATE	SIG.	ISS.	DRG. No.
			SHT.3
TITLE		EXPRESS LIMITER	
CIRCUIT DIAGRAM		A2	



THIRD ANGLE PROJECTION. DO NOT SCALE THIS DRAWING. IF IN DOUBT ASK. REMOVE ALL BURNS AND SHARP EDGES.



MATERIAL		FINISH		SCALE		TITLE	
				10"		EXPRESS LIMITER	
AUDIO & DESIGN RECORDING		CRANBOURNE ASSOCIATES		DATE		CIRCUIT DIAGRAM	
ALTERATION		DATE		SIG.		SHT. 4	



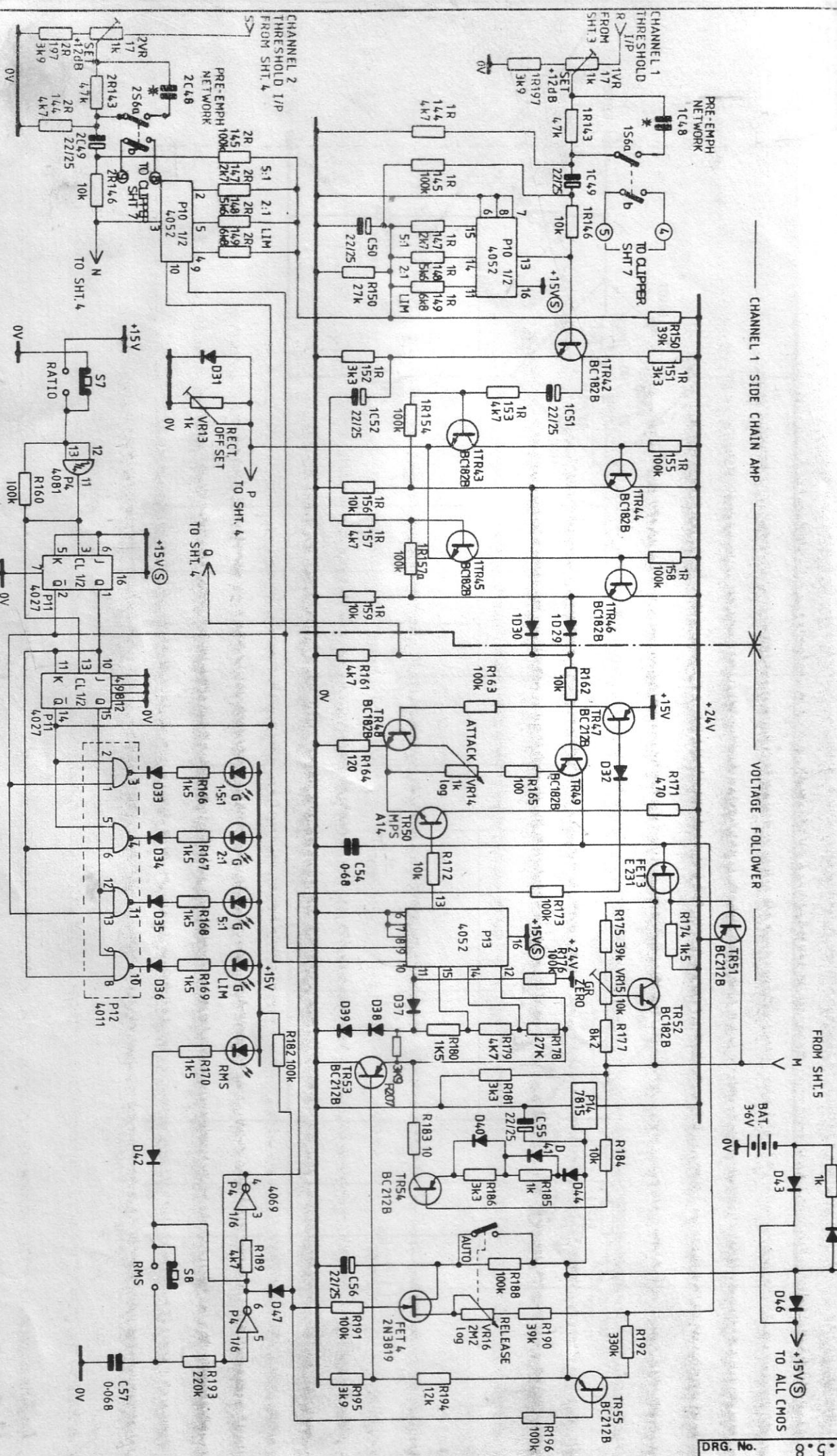
3.5.7

DRG. No.

MATERIAL		FINISH		SCALE		TITLE	
				80/100		EXPRESS LIMITER	
AUDIO & DESIGN RECORDING		GRANBOURNE ASSOCIATES		DATE		PCB ISSUE 4	
				19/7/80		CIRCUIT DIAGRAM A	
				DATE		SHT. 5	
				SIG.			
				ISS.			
				DRG. No.			

ALTERATION

ISS



CHANNEL 1 SIDE CHAIN AMP

VOLTAGE FOLLOWER

FROM SHT.5

BAT. 3.6V

TO ALL CHMS

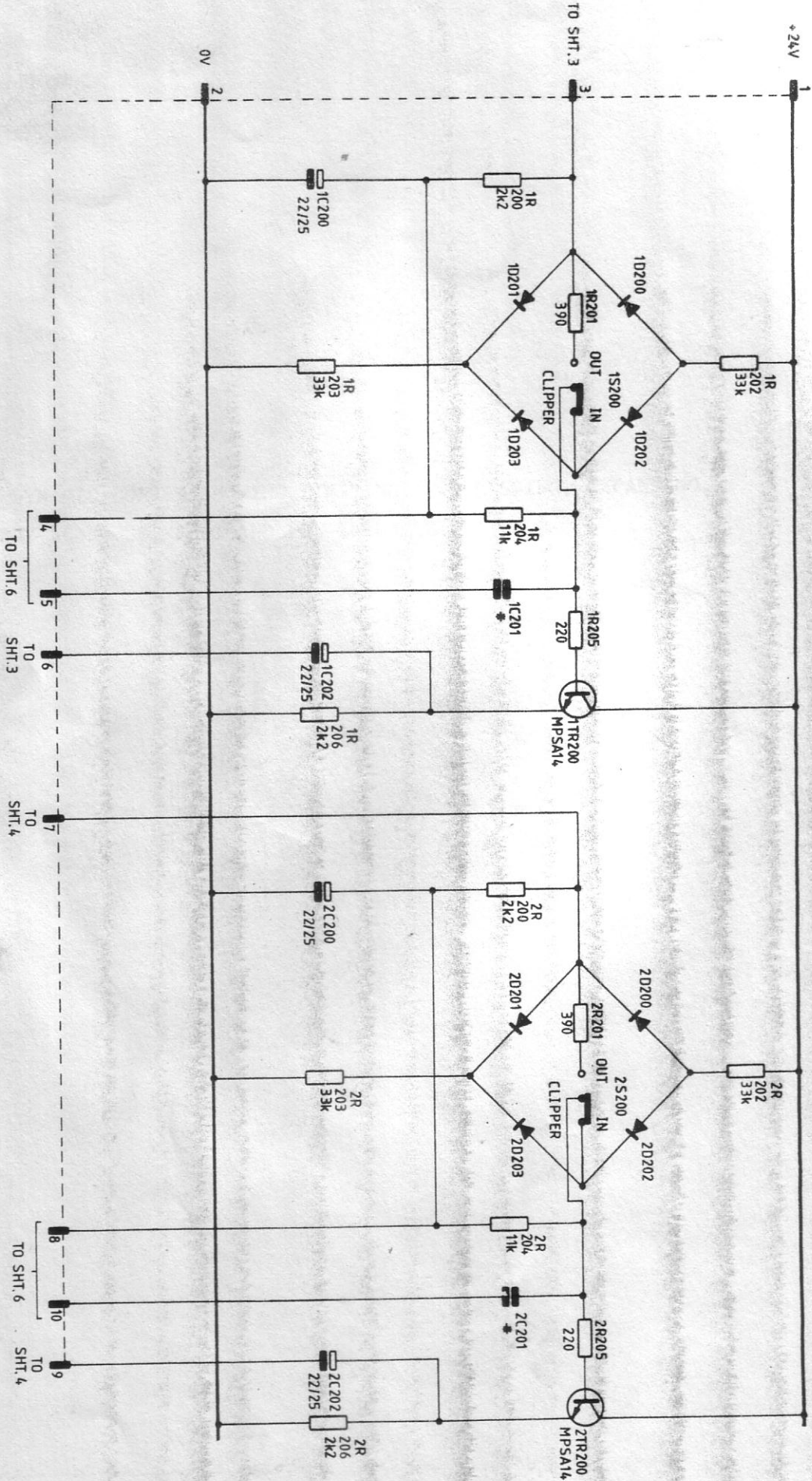
C \* SEE LIMITER PRE-EMPH TABLE

ISS.	ALTERNATION
------	-------------

LIMITER PRE-EMPH	CAPACITOR C53 NOT USED
C * = 510pF = 25µS	
C * = 1000pF = 50µS	
C * = 1500pF = 75µS	

MATERIAL	FINISH
AUDIO & DESIGN RECORDING	CIRANBOURNE ASSOCIATES

SCALE	TITLE
DRG. No.	EXPRESS LIMITER
DATE	CIRCUIT DIAGRAM A 2
DATE SIG.	SHT. 6
ISS.	PCB ISSUE 4



CLIPPER PRE-EMPH  
 C# = 2.2nF = 25μS  
 C# = 4.7nF = 50μS  
 C# = 6.8nF 75μS

ISS	ALTERNATION

MATERIAL FINISH

CRANBOURNE ASSOCIATES

SCALE	DATE	DATE	ISS.

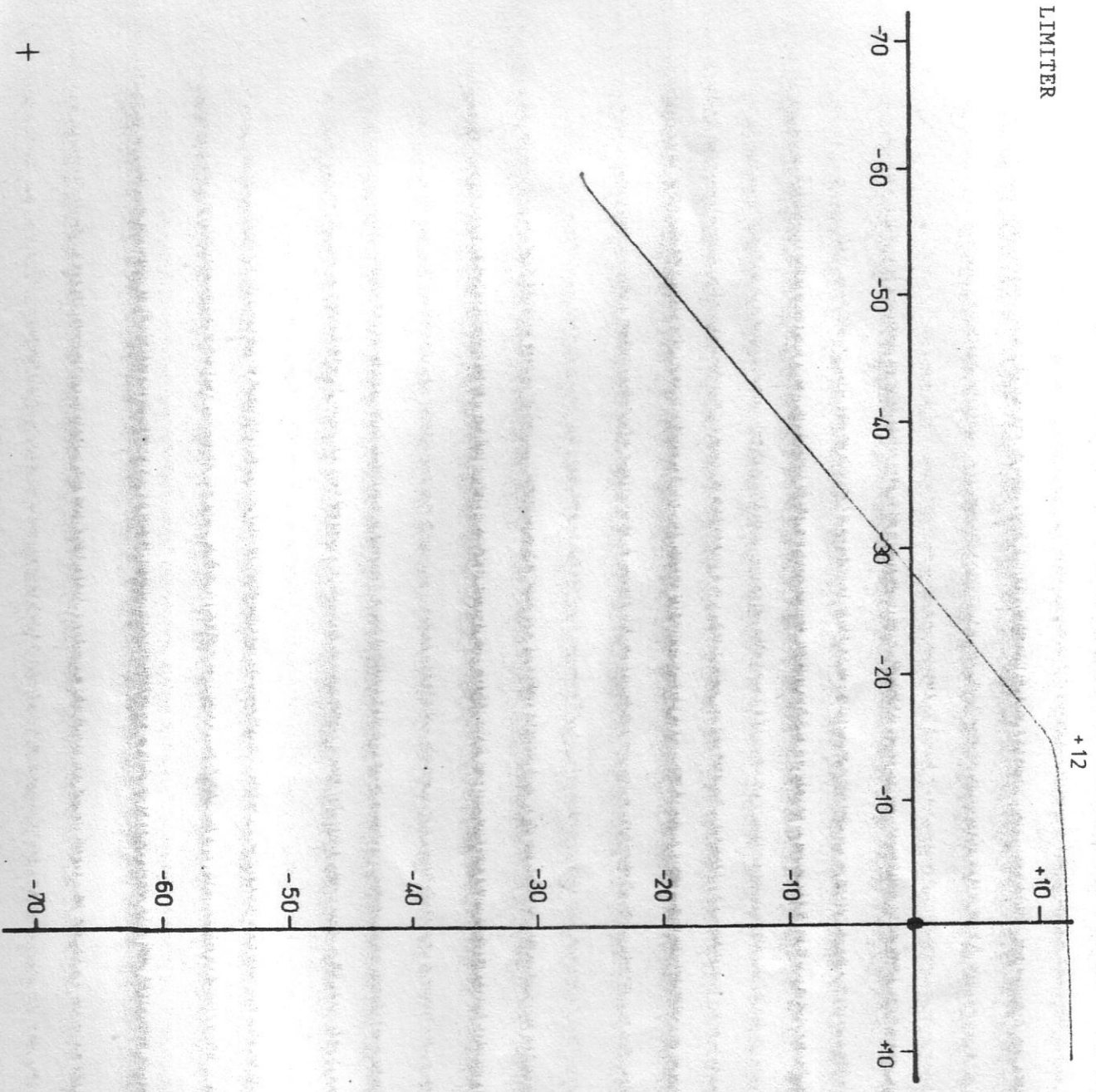
TITLE  
 EXPRESS LIMITER  
 CLIPPER BOARD  
 CIRCUIT DIAGRAM | A 2

DRG. No. SHT. 7

USEFUL DYNAMIC CURVES SHOWING LIMITING, COMPRESSING, EXPANDING,  
FREQUENCY RESPONSE, FLAT AND PRE-EMPHASIS ACTIVE.

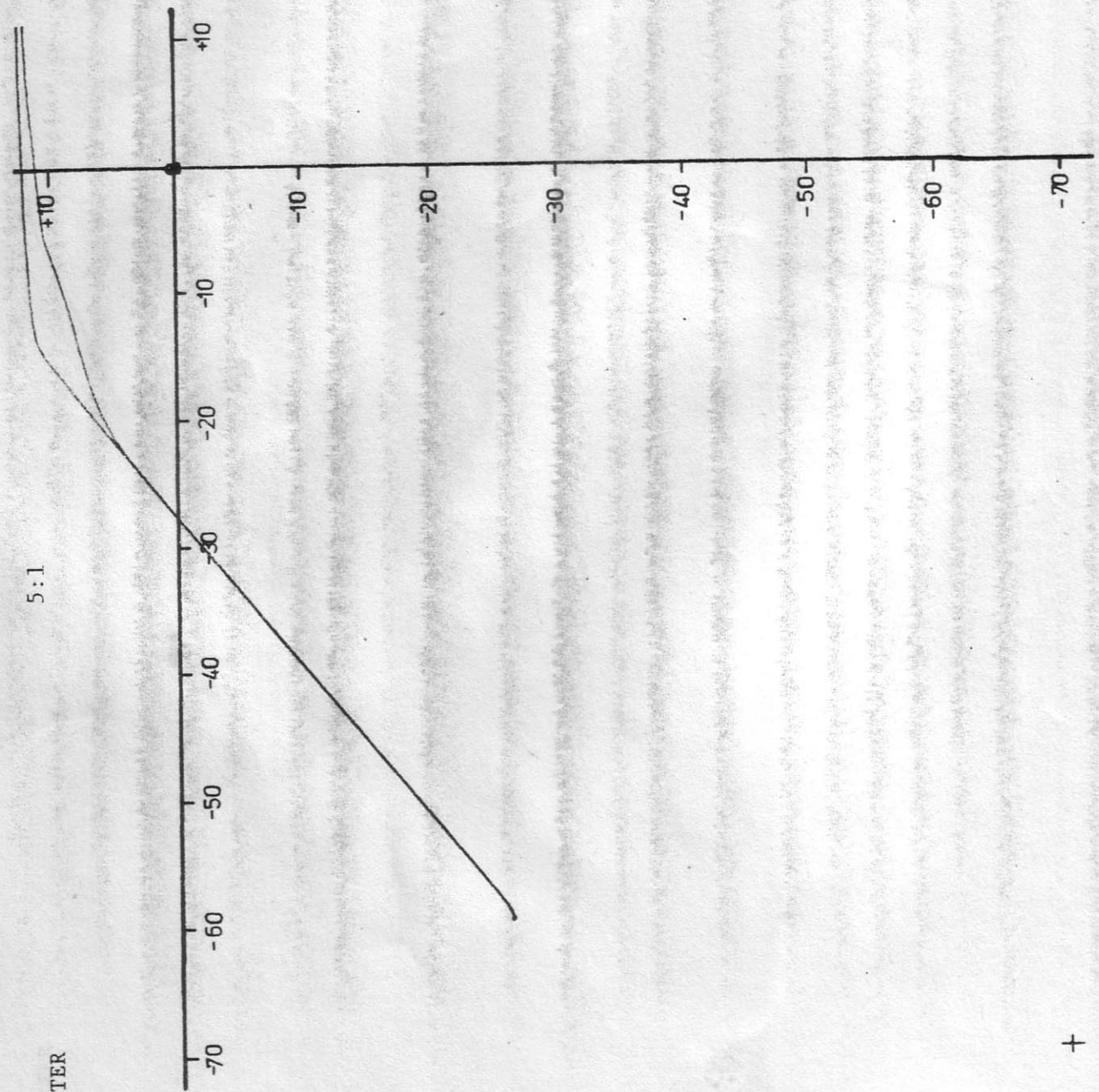
EX-PRESS LIMITER

Limit 20dB



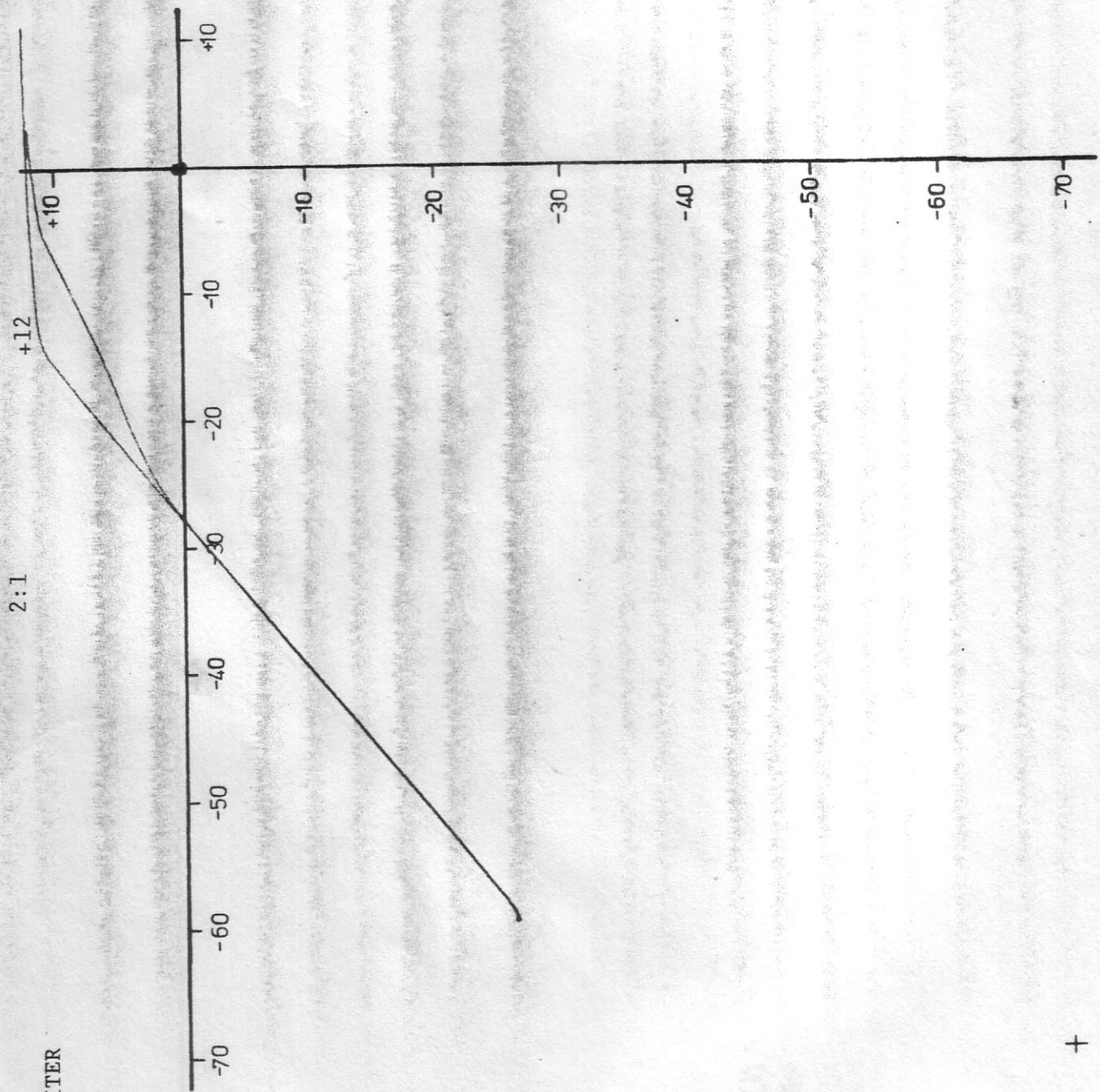
DYNAMIC PLOT SHOWING 20:1 (LIMIT)

EX-PRESS LIMITER



+

EX-PRESS LIMITER

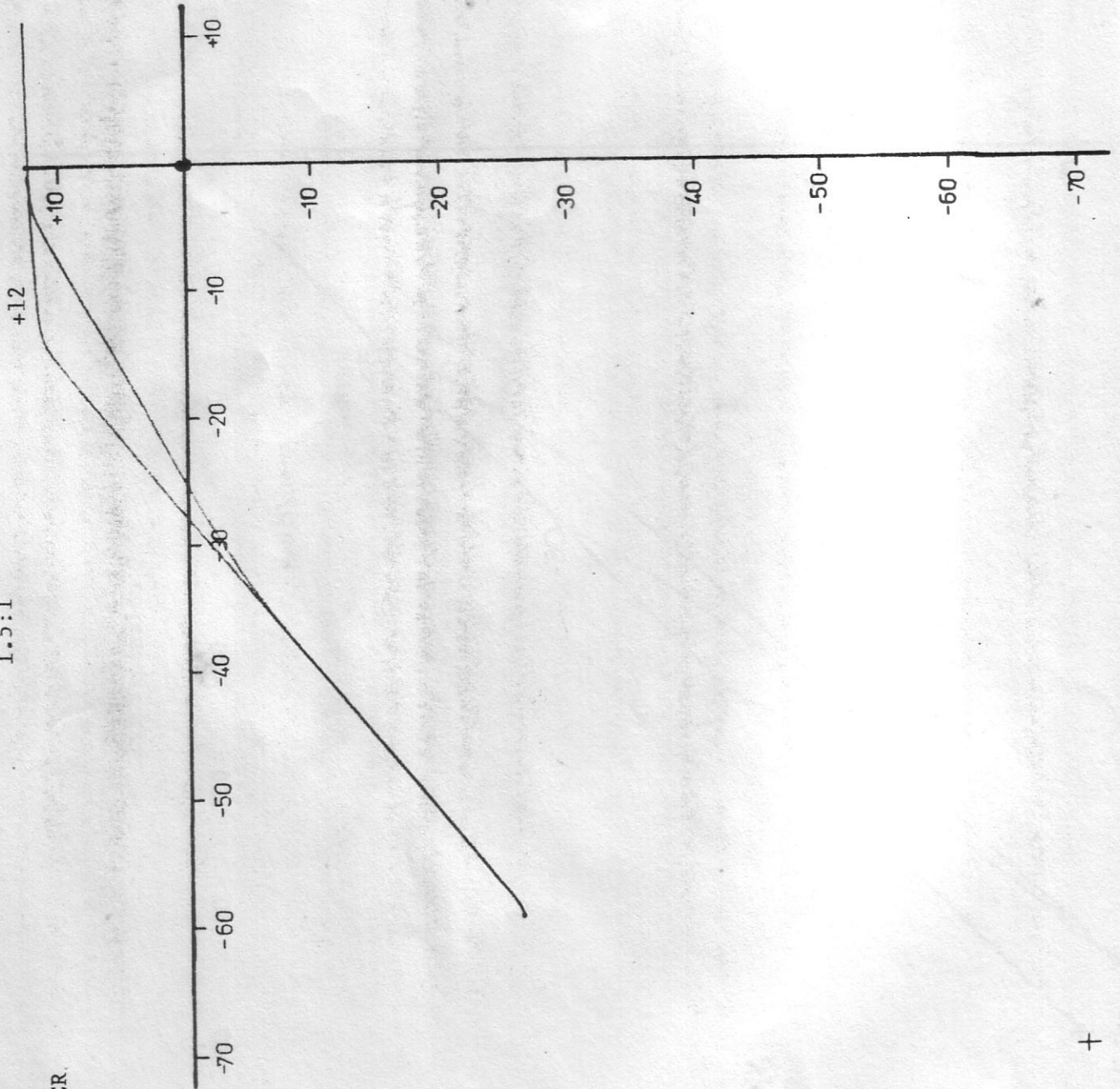


+



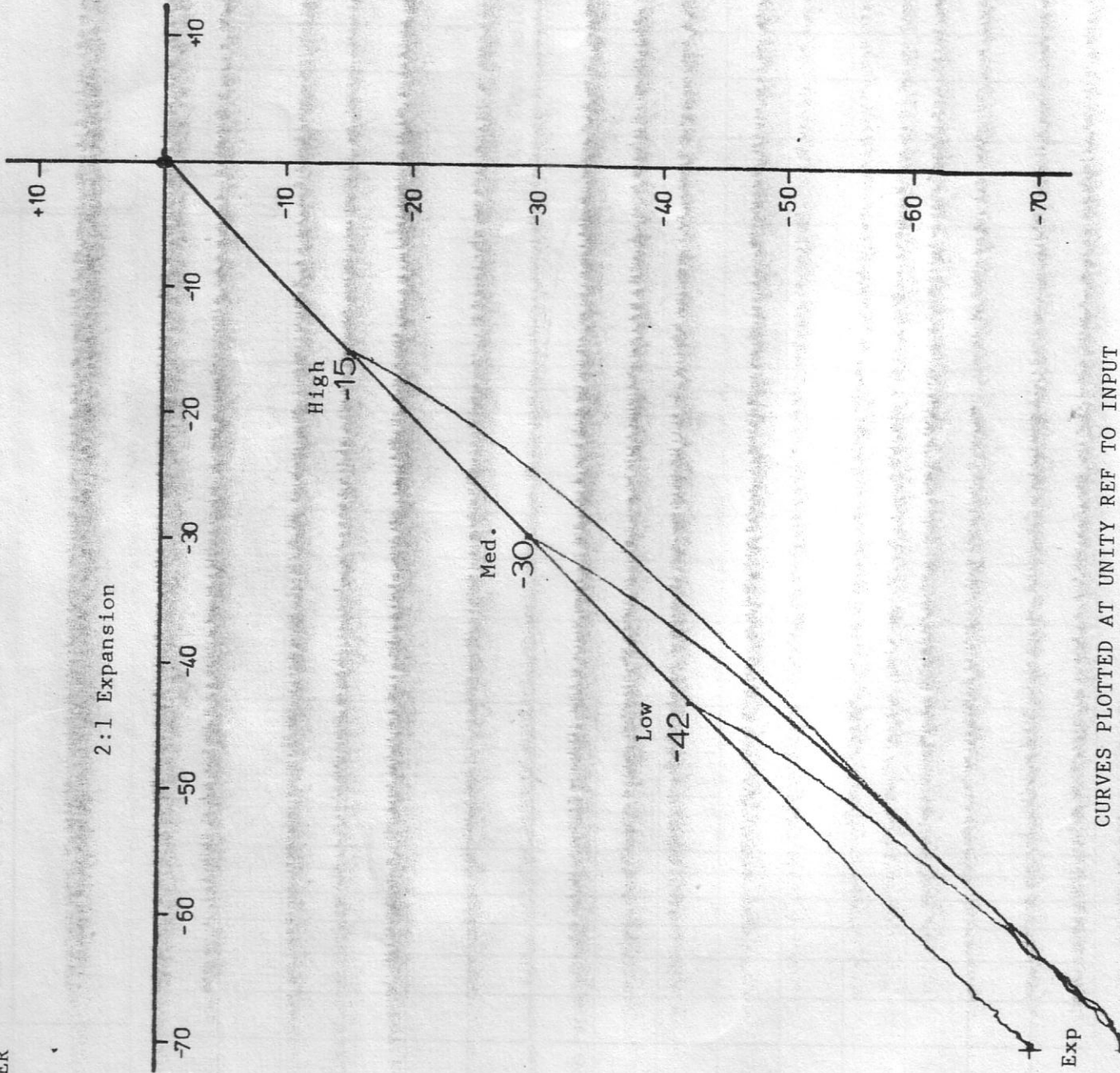
EX-PRESS LIMITER.

1.5:1



+

EX-PRESS LIMITER



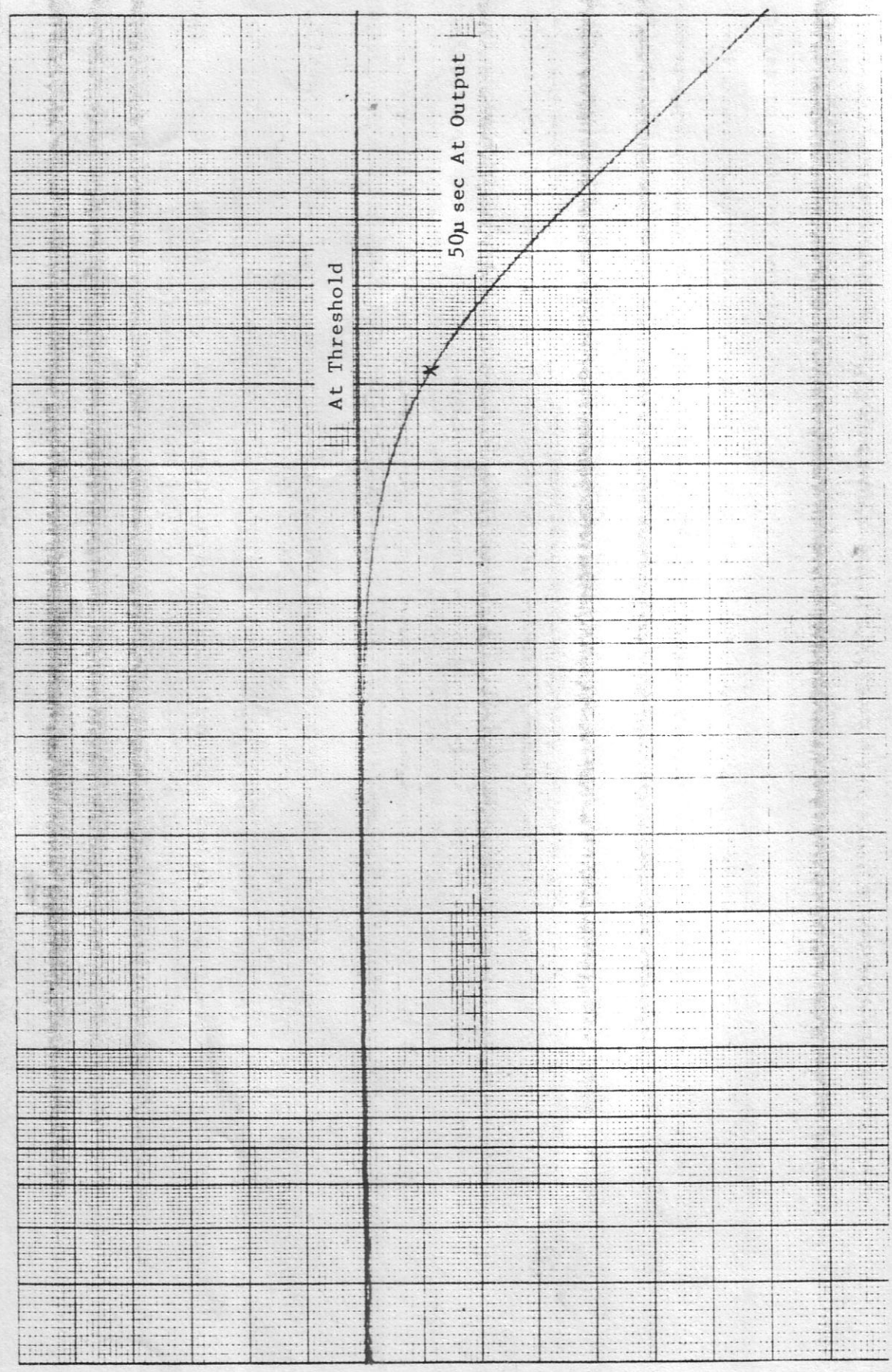
CURVES PLOTTED AT UNITY REF TO INPUT

10dB of Exp

W. JOHNSON & SONS, 1010 N. HAT COURT ROAD, WIP. OH. Ref. R.E.C.M.F.

EX-PRESS LIMITER

FREQUENCY CHECK SHOWING PRE EMPH ACTIVE SIDE CHAIN



db

Applies to embossed switches only

INSERT TOP R/H

EX-PRESS SWITCH BODY



Due to misdesign some of the switch caps may become detached from their body.

To remedy this problem, re-assembly centre rocker as shown, place over contact disc gold side down, gently bend outward the catch claws of the white cap and snap into place (claws top and bottom of the body).

On later assemblies this error has been rectified.

*All Audio & Design products are of the highest quality and designed to give long, trouble-free service. Nevertheless they are fully guaranteed for one year from the date of purchase. Provided any faulty equipment is returned, post paid, to Audio and Design or its established Agents by the original purchaser during the relevant period we will repair, or at our option replace, entirely free of all charge all breakdowns due to faulty workmanship or materials. In keeping with normal practice, breakdowns due to fair wear and tear, misuse, neglect or faulty adjustment by the user, are outside the scope of this warranty.*

#### WARNING

*All repairs are subject to serial number checking, proof of ownership may be required from second or subsequent owners. We reserve the right not to service any equipment whose serial number has, in any way, been defaced or altered.*