

**Operating
and service
information
DN500
Dual Compressor/
Limiter/Expander**

IMPORTANT:

Product registration

Please check that the product registration card is enclosed with this book. If **NOT**, immediately inform the factory quoting the unit's serial number.

Introduction

Compression, expansion, limiting and peak clipping are four of the most valuable techniques available to the sound engineer. Not only can they solve many problems that can arise in day to day work, creative possibilities exist in abundance.

The Klark Teknik DN500 Dual Compressor/Limiter/Expander integrates all of these processes into a single, compact, rack mounting unit – with two channel operation. Complete dynamic control over gain is the result, and also control over problems due to noise in the signal chain and the distortion that may be caused by excessive peak levels.

As a compressor, the DN500 can achieve almost undetectable dynamic range reduction by the use of sophisticated automatic attack and release circuitry. Or compression can be used as an effect in its own right with full manual control over Threshold, Ratio, Attack and Release. There is also a fully adjustable 'Knee' control which provides an infinite range of compression styles from Hard to Soft, 'easy' compression.

As an expander, the DN500 offers variable ratio expansion which can be used to increase subtly the dynamic range of a signal, or to act as a conventional noise gate, or offer any degree of expansion in between.

To control signal peaks, a Limiter is provided on each channel – totally independent of the Compressor, and with a fully adjustable Threshold control. For situations where absolute control over peaks is necessary, a Peak Clipper can be switched in, the threshold of which tracks the Limiter.

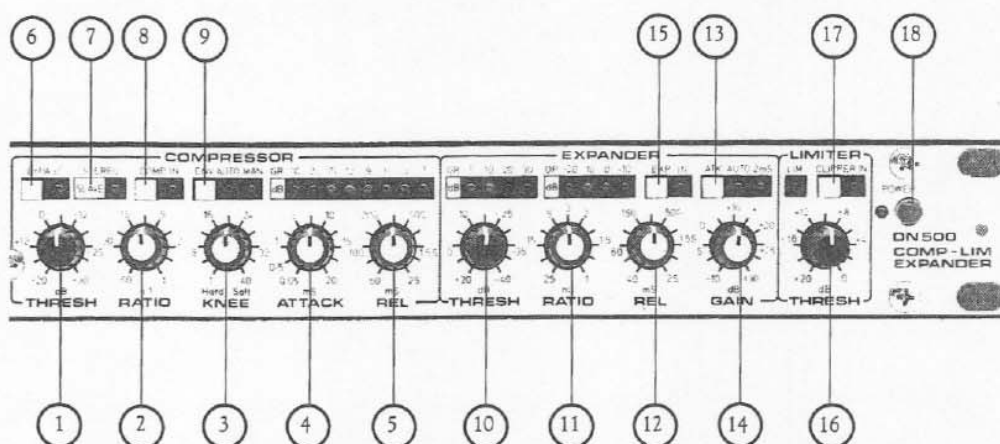
The DN500 has LED indicators for every switched audio function, and also has separate gain reduction LED bar graph meters for compression and expansion on each channel. There are also peak limiting LED indicators and output level LED bar graph meters for each channel.

Separate side chain inputs are provided for the Compressor and Expander sections. A stereo link function is available for operation of the Compression and Expansion functions of both channels of the unit from the controls of channel A.

The DN500 Dual Compressor/Limiter/Expander is built to Klark Teknik's high standards of design and construction. A well thought out aesthetic presentation is also an aid to realising full dynamic control over gain in today's complex productions.

Instrument familiarisation

Front panel controls



The DN500 Dual Compressor/Limiter/Expander consists of two identical channels, each with separate Compressor, Expander and Limiter sections.

Compressor

1. **Threshold** determines the level above which gain reduction (compression) will take place, variable from +20dBu down to -30dBu. The Gain Reduction LED bar graph meter indicates in decibels by how much the signal is compressed at any instant.
2. **Ratio** sets the degree of compression applied above the threshold level, variable from 1:1 to 50:1. A ratio of 1:1 corresponds to zero compression: Signal In = Signal Out. A ratio of 10:1 indicates that when the input signal, above the threshold, rises in level by 10dB, the output level will rise 1dB.
3. **Knee**, calibrated from 1 to 40, adjusts the 'hardness' or 'softness' of the compression effect. A hard knee means that when the input signal level rises above the threshold, it is immediately compressed at the full ratio as set. A soft knee means that compression will start below the threshold level at a low ratio and gradually attain the full ratio selected only at higher levels.
4. **Attack** sets the time taken for compression to commence after the threshold is exceeded, from 0.05 milliseconds (50 microseconds) to 20 milliseconds.
5. **Release** determines the time taken for the gain to return to normal after the signal drops below the threshold level, adjustable from 60 milliseconds to 2 seconds.
6. The **Bypass** switch selects the whole unit to be in or out of circuit.
7. **Stereo** links the two channels of the DN500 together, so that they are both operated from the controls of Channel A, apart from the Limiter sections which always work individually. In stereo mode, the unit still monitors the levels of both channels to detect when the signal is above the threshold level (on Channel B, the Stereo switch is replaced by a 'Stereo Slave' LED indicator).

8. **COMP In** selects the compression effect to be in or out.
9. **ENV** allows the setting of attack and release times to be automatic or manual. On Auto, the attack time of the input signal and the amount by which it exceeds the threshold level are assessed, and suitable Compressor attack and release values set to give an almost undetectable reduction in signal dynamic range. On Manual, the rotary Attack and Release controls come into operation.

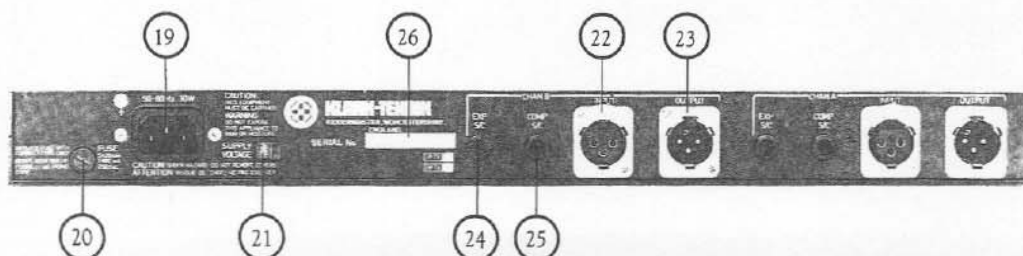
Expander

10. **Threshold** determines the level below which gain reduction will take place, variable from +20dBu down to -40dBu. Gain reduction **BELOW** a threshold level constitutes dynamic range **EXPANSION**. The Gain Reduction LED bar graph meter indicates in decibels by how much the signal is expanded at any instant.
11. **Ratio** sets the degree of expansion applied below the threshold level, variable from 1:1 to 25:1. A ratio of 1:1 corresponds to zero expansion: Signal In = Signal Out. A ratio of 10:1 indicates that when the input signal, below the threshold, falls in level by 1dB, the output level will fall 10dB.
12. **Release** determines the time taken for the gain to return to normal after the signal comes back above the threshold level, adjustable from 40 milliseconds to 2 seconds.
13. **ATK (Attack)** is a switched control offering either automatic signal-monitored setting of Expander attack time or a fixed value of 2 milliseconds.
14. **Gain** is the output level control for the entire channel, Compressor, Expander and Limiter. The output level LED bar graph meter indicates **OUTPUT** level when the channel is switched in circuit. When the channel is bypassed, the meter indicates **INPUT** level.
15. **EXP In** selects the expansion effect to be in or out.

Limiter

16. **Threshold** sets the level above which the signal will be limited (compressed at a high 25:1 ratio), adjustable from 0dBu to +20dBu.
17. **Clipper In** selects peak clipping. Clipping totally eliminates transient peaks, effectively acting as a limiter with an infinity:1 ratio and an instantaneous attack time. The Clipper threshold follows the Limiter threshold as set.
18. **Power** switches mains power on or off.

Rear Panel Functions



19. **Mains** is supplied via an IEC standard 3-pin connector. A compatible power cord is supplied with the unit.
20. The **mains fuse** is located in a fuse holder fitted to the rear panel. Always replace with the correct type and rating as indicated on the unit.
21. **Voltage selector switch.** This unit is switchable between two nominal supply voltages, 110V and 220V, via a slide switch. The switch **MUST** be set before the supply is connected. Any attempt to run the unit from a 220V supply with the switch set to 110V is liable to result in severe damage to the unit.
22. **Signal Input** is made via a female XLR type connector.
23. **Signal Output** is available on a male XLR type connector. For wiring details see page 16 of this manual.
24. **Expander Side Chain Input** is made via a 1/4 inch type A stereo jack connector.
25. **Compressor Side Chain Input** is made via a 1/4 inch type A stereo jack connector.
26. Always quote the **Serial Number** in any correspondence concerning the unit.

Reliability Control

Even with the advanced technology incorporated in this product, each instrument is given the full backing of Klark Teknik's "**reliability control**" which proves each product against a specification consistent with the highest professional standards. Only top quality components are used, and every unit is bench tested and aligned before a burn-in period and final performance test.

Options

Security cover

Transformer input */output balancing

* Input transformer balancing is non-retrofittable and has to be specified with order.

Options Ordering Information

Parts Number

Perspex security cover

SCP..... Model No.

Aluminium security cover

SCA..... Model No.

Output balancing transformer

BU37

Input balancing transformer

BN37

Using the DN500 Dual Compressor/Expander/Limiter

The natural sounds of life have an extremely wide dynamic range, from the rustle of a falling leaf to the roar of a jet engine on take off. The human ear has an automatic gain control which enables it to accommodate all of these sounds from the threshold of hearing to close to the threshold of pain, a dynamic range of approximately 120 decibels.

Even the most modern audio equipment is incapable of handling the full range that the ear can cope with. Analogue tape without noise reduction can manage almost 70 decibels dynamic range between its noise floor and the 3% distortion point. 16 bit digital audio equipment can achieve over 90dB. Still almost 30dB less than the ear's range.

Even if a 120dB dynamic range were possible in audio equipment, would it be desirable – and useful? A listener in a domestic setting enjoying the exhilarating effects of a 96dB Sound Pressure Level will almost certainly be causing his neighbour a significant amount of annoyance, if not distress! At the other end of the dynamic scale, a typical ambient noise level of at least 40dB SPL precludes the use of very quiet levels in recorded or broadcast sound media.

Almost always, it is necessary to compress the dynamic range of natural sounds to fit them into a window suitable both for the equipment and for comfortable listening.

Although the dynamic range of the programme material must fit into a 30 to 40dB window, there is another factor in the equation – noise. All the sounds that we want to listen to, whether natural or electronically processed, are accompanied by a certain amount of unwanted background noise – tape hiss, or the rustle of musicians turning the pages of the score in the studio.

Even if, in the final programme, the noise level is below the ambient noise of the listening area, it may still be heard and is therefore undesirable.

The Compressor/Limiter and the Expander are valuable tools for the control of dynamic range and reduction of noise. Compression reduces the dynamic range of any instrument or programme source. Expansion has the effect of subjectively reducing or eliminating background noise.

Compression and expansion have their artistic uses too. The sounds of instruments and voices can be altered. A mix of instruments can be compressed to give a 'tighter' dynamic effect. Or a previously over-compressed recording can have life put back into it by the subtle use of expansion.

The DN500 Dual Compressor/Limiter/Expander offers in a compact unit virtually complete control over dynamic range, for corrective and for artistic purposes.

Use of Compression

One of the principal uses of compression is the control of level in vocals. Many singers train for years to achieve the degree of breath control necessary for an even tone and expressive performance. Other vocalists rely on an instinctive voice production technique, which may need help in the studio to maintain a consistent level, and result in a vocal track which 'sits' correctly in the mix.

The level of a vocal may vary widely, and appear like the unprocessed signal in the diagram:

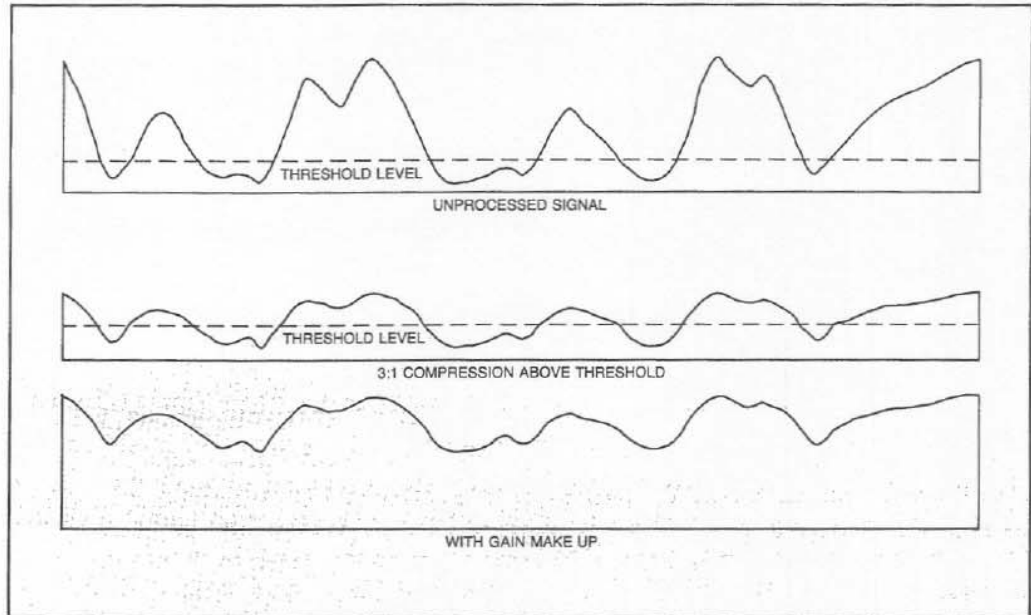


Diagram 1

The unprocessed signal has a large dynamic range between the highest and lowest levels. Applying compression reduces the highest levels, reducing the dynamic range. Because the peak level of the signal is now lower, make-up gain is added to restore the original peak level. The result is a much more controlled and useable sound.

Interface with the console

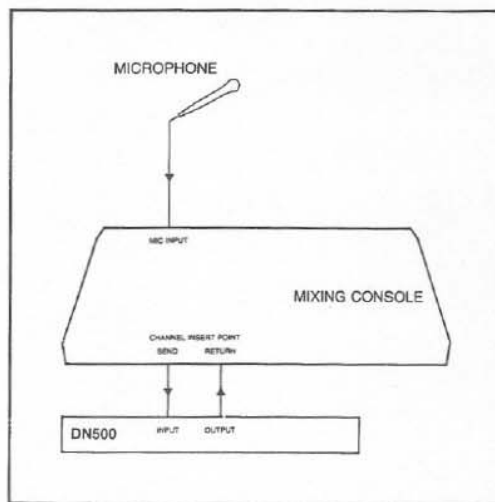


Diagram 2

The Klark Teknik DN500 Dual Compressor/Limiter/Expander is optimised for use at line level, therefore to process the signal from a microphone, the input to the DN500 has to be taken from the console – preferably from the channel insert point send. The output from the DN500 comes back to the channel insert return. By connecting the DN500 at this position in the signal chain, its operation is unaffected by the use of any of the console controls, except Input Gain.

An alternative is connection to the group insert point of the console:

This connection has two uses: The input from the microphone may be compressed post-EQ, which offers an alternative sound quality which may be desirable in some cases. Alternatively, several instruments may be compressed together in the mix to achieve a 'harder' sound.

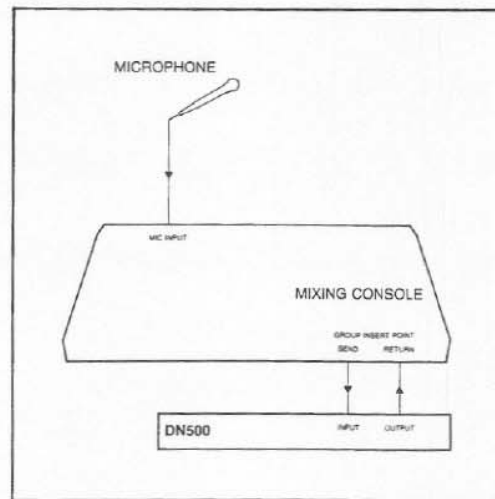
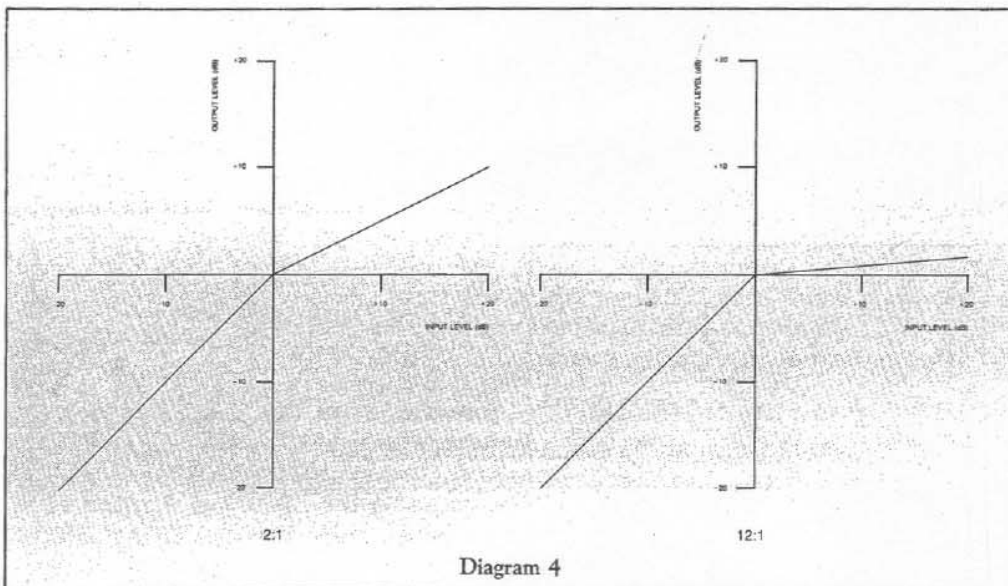


Diagram 3

Setting the Controls

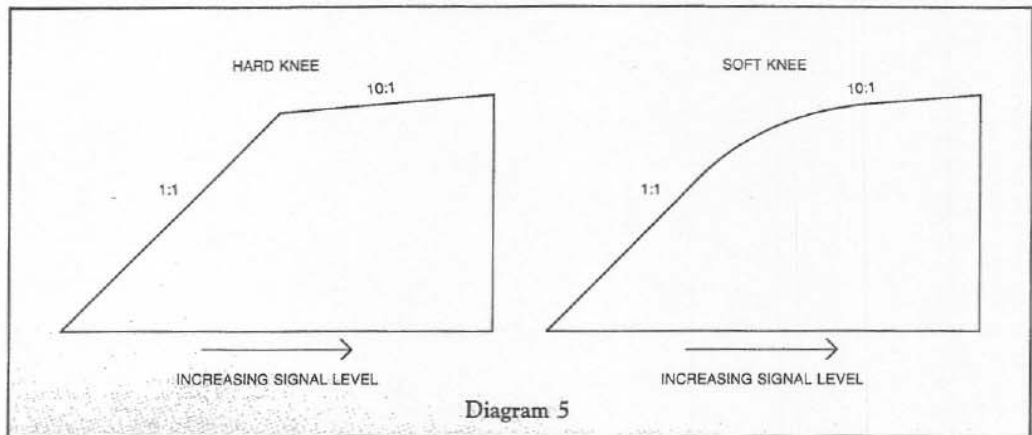
Threshold sets the level above which compression takes place. Signals below the threshold will remain unaltered. Turning the control clockwise lowers the threshold level and allows more of the signal to be compressed.

Ratio is the 'strength' of compression above the threshold level. The higher the ratio, the greater the effect.



At a compression ratio of 2:1, the effect is mild and suitable for the subtle compression of vocals or of a complete mix. At 12:1, compression is becoming stronger and more noticeable. Ratios between 3:1 and 15:1 are suitable for the 'compressor' sound, used as an effect in its own right. Higher ratios are used for the control of extremely peaky signals.

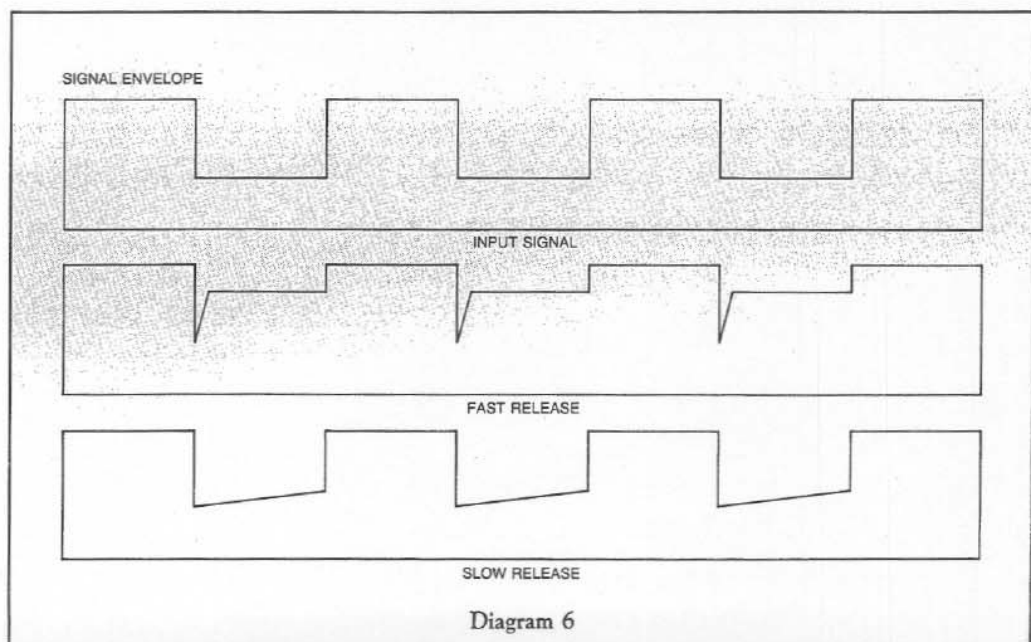
The point where the slope of the Compressor curve changes is known as the **Knee**. The DN500 has an adjustable knee, variable between 'Hard' and 'Soft':



With a soft knee, signals which only just exceed the threshold level are compressed at a low ratio, the ratio increasing the higher the signal level.

Attack sets the time the Compressor takes to respond once the threshold has been exceeded. Attack may be set so that the initial transient of the instrument passes through unaltered, or set to a faster value so that the very start of the sound is compressed. Particularly with drum sounds, careful adjustment of attack time can make the sound more 'punchy' and 'driving'.

Release time plays a very important role in compression. During periods of high signal level, gain is reduced. When the signal level falls below the threshold, the gain will increase at a rate determined by the Release control. If the release time is short, the gain will rise quickly. A long release time will mean that the gain will stay at its reduced level, only recovering gradually:



The setting of the correct release time is a compromise. If the release time is too short, background noise can cause effects often known as 'breathing' and 'pumping'. If the release time is too long, the signal will not be compressed, but simply reduced in level. For effective compression, the release time must be set to as short a value as possible before modulation of the background noise becomes too noticeable. The gain reduction bar graph meter will show how much actual compression is going on. If it stays steady, there is little active compression, just a steady-state reduction in level. The faster the bar graph moves up and down, the harder the Compressor is working.

For a natural unnoticeable compression, attack and release times may be set to Auto. The signal characteristics are continuously monitored for optimum values.

Expansion

Expansion may be used to increase the dynamic range of a signal: of a performance lacking life and vigour, or of a previously over compressed recording.

Alternatively, expansion can be used to reduce noise, either subtly and undetectably, or with the harder action of a noise gate.

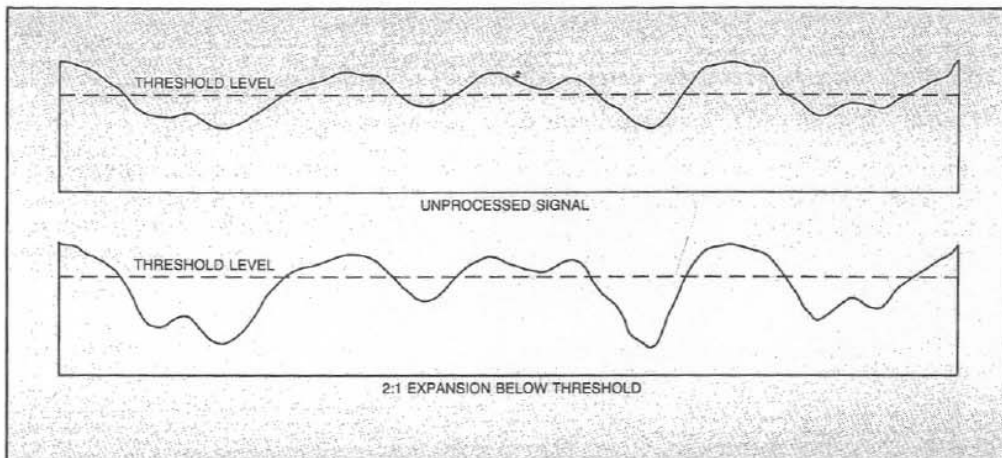


Diagram 7

The unprocessed signal has a fairly narrow dynamic range between the highest and lowest levels. Expansion makes the lower levels lower still, increasing the dynamic range.

Used as an expander, the DN500 may be connected in the signal chain in exactly the same manner as when used as a compressor.

Setting the controls

Threshold sets the level below which expansion takes place. Signals above the threshold will remain unaltered. Turning the control anticlockwise raises the threshold level and allows more of the signal to be expanded. A low threshold would be used to reduce noise, a higher threshold to increase the dynamic range of a signal.

Ratio is the 'strength' of expansion below the threshold level. The higher the ratio, the greater the effect.

At an expansion ratio of 2:1, the effect is mild and suitable for subtle noise reduction or dynamic range enhancement. At higher ratios the effect becomes harder and more like a noise gate. The LED bar graph indicates the amount of gain reduction taking place.

Attack sets the time the Expander takes to respond once the signal has passed below the threshold. This can be done automatically, the circuitry continuously analysing the signal to determine optimum attack time. Or it can be set to a fixed value of 2mS.

Release determines the time taken for the gain to return to normal after the signal comes back above the threshold level. For hard gating, this may be set to a short value. Longer release times are suitable for dynamic range enhancement or subtle noise reduction.

Gain is the output level control for the entire channel, Compressor, Expander and Limiter. The output level LED bar graph meter indicates output level when the channel is switched in circuit. When the channel is bypassed, the meter indicates INPUT level.

Limiting

The Limiter acts as a last check on signal level. If the level goes over the threshold, fast acting, high ratio compression is applied to bring it back within bounds.

If absolute control over peak levels is required, a Peak Clipper may be switched in, acting in effect as a compressor with a ratio of infinity:1 and an instantaneous attack time:

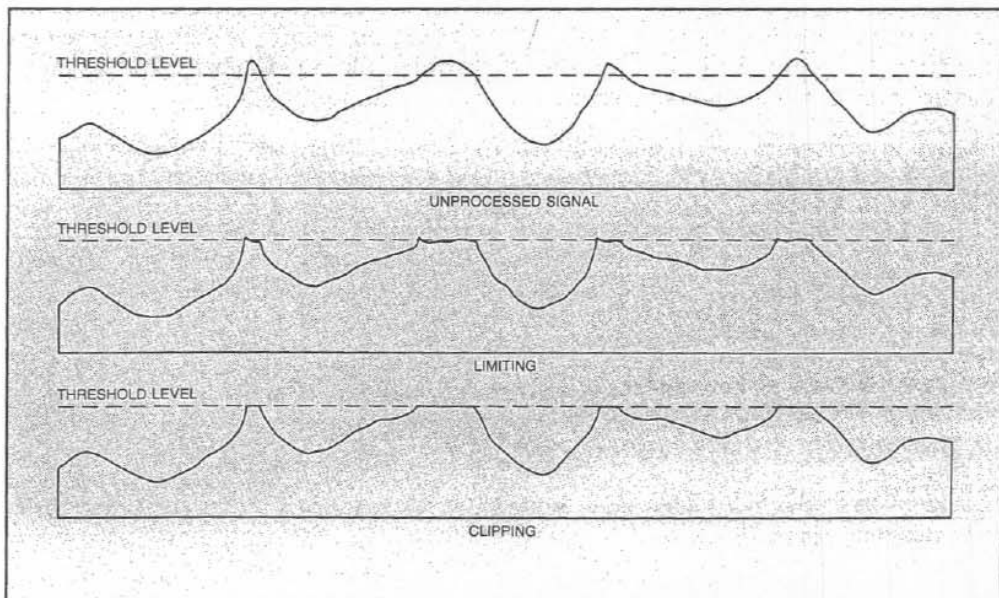


Diagram 8

Threshold sets the level above which limiting, or clipping if selected, takes place.

Compression, Expansion and Limiting together

The act of compressing a signal inevitably causes an increase in noise level. Compression reduces peak levels; gain make up restores the overall level, and in the process increases the level of any background noise that the signal contains.

Almost always, when compression is used, the Expander section of the DN500 will be used also, to clean up the signal. The Limiter/Clipper will control any unwanted peaks.

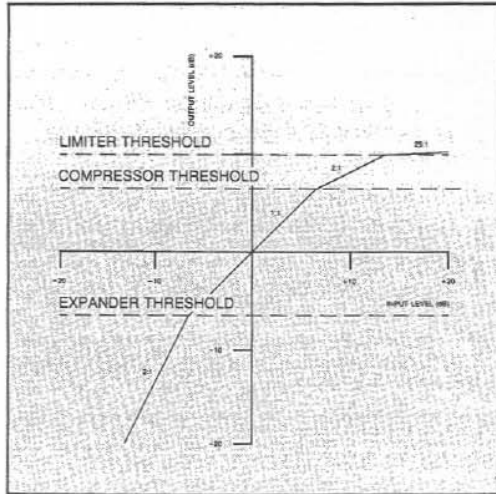


Diagram 9

The result is three-stage dynamic control over gain with three different threshold levels:

In the mid-range of levels, the signal is unaltered. Above the compression threshold, in this example, gain is reduced by a ratio of 2:1. Above the limiting threshold it is reduced by 25:1. At levels below the Expander threshold, gain is reduced by 2:1. Complete control over signal dynamics is possible.

Applications Using the Side Chain Inputs

Each channel of the DN500 has two **Side Chain** inputs, one for the Compressor and one for the Expander.

In normal use, the amount of compression or expansion is related to the dynamics of the input signal. The Side Chain allows the signal passing through the unit to be controlled by the dynamics of another separate signal.

Connection to the Side Chain input is made via the rear panel jack sockets. See 'Audio Connections', page 16.

De-Essing

De-essing is an important compression technique using the Side Chain. Many singers have high level sibilants – 'sss' sounds – which detract from their performance. Equalising the signal will reduce the sibilants, but also make the overall vocal sound dull. The sibilants can be selectively removed by compressing only when there is an excessive level of high frequencies. Here is one way to do it:

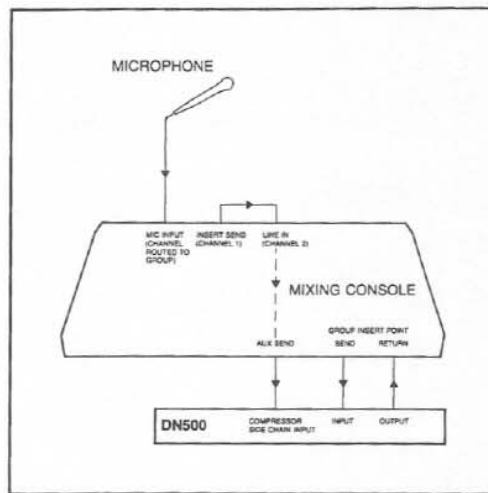


Diagram 10

The microphone channel is routed to a group with the Compressor patched into the group insert points. The microphone channel is also paralleled into another channel via the line input. The signal in the second channel is equalised so that high frequencies in the sibilant range are boosted. This channel is fed via an auxiliary output to the Compressor Side Chain input.

Now, the Compressor will react whenever there is a sibilant, reducing the gain for the duration of the sibilant and cleaning up the vocal sound.

This technique can also be used to compensate for a 'boomy' bass, or other situations where a band of frequencies is occasionally obtrusive.

The DN500 Dual Compressor/Limiter/Expander offers a unique combination of dynamic gain control processors. Engineers will find it a powerful tool in recording, broadcast and post-production studios, and in sound reinforcement systems.

Audio Connections

Input

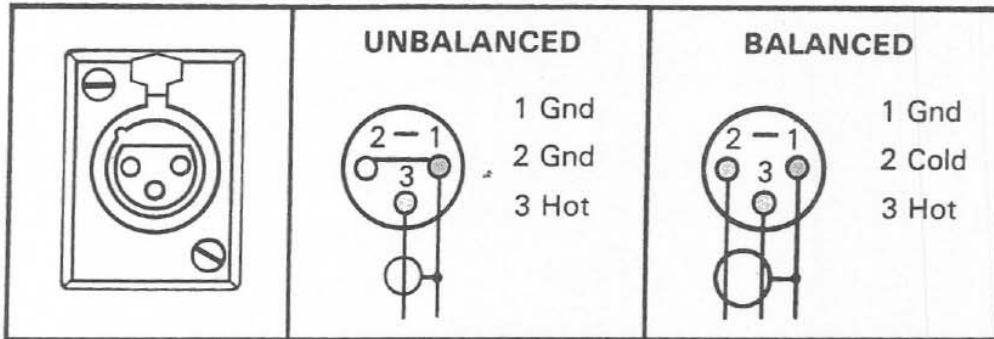
The input circuit is a transformerless, electronically balanced design which achieves a symmetry of better than -50dB from 20Hz to 10kHz .

If transformer balancing of the input is required, this must be specified at the time of order. It is not retrofittable.

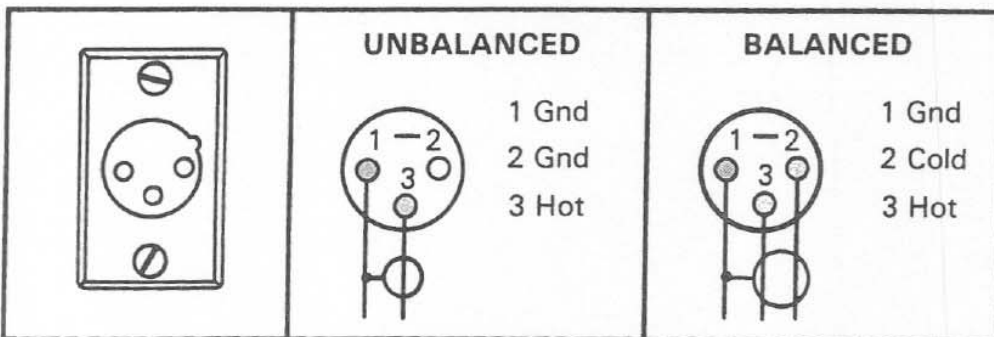
Output

The standard output is unbalanced, but balancing transformers are available and may be retrospectively fitted. The output circuitry is capable of driving a $600\ \text{ohm}$ load at a level of $+22\text{dBu}$.

Input

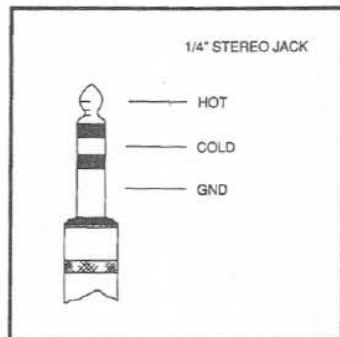


Output



Pin 2/Pin 3 Hot Operation

The unit can be quickly re-configured to accommodate either XLR wiring standard by removing the top cover and changing the orientation of 4 plug-in links per connector, as shown on the adjacent PCB legend. When using a fully balanced system, either pin 2 or pin 3 may be the HOT terminal.



Side Chain/EXT Key Inputs

The electronically balanced Side Chain inputs are on stereo quarter inch type A jack sockets, configured TIP HOT, RING COLD, SLEEVE Earth. Inserting a mono jack plug will automatically unbalance the input.

The sockets are internally normalised so that signal continuity is maintained when there is no jack plug inserted. If the unit is wired to a patchbay, then normalising must be carried out at the patchbay.

Balanced Circuits

Transformer or electronically balanced connections have the benefit of Common Mode Rejection which eliminates externally induced interference, such as mains hum etc. Balancing is especially useful when long cable runs are used between pieces of equipment.

Transformer balanced circuits have the added advantage of being fully floating, with the earth (ground) or screen being totally isolated from the signal. In installations where a difference in earth potential is likely to occur, this isolation prevents earthing problems which can, in some cases, damage the equipment.

DN500 Technical Specifications

Audio inputs	Two
Type	Electronically balanced
Impedance (ohms)	
balanced	20k
unbalanced	10k
Side chain inputs	Two Compressor + Two Expander
Type	Electronically balanced
Impedance (ohms)	
balanced	20k
unbalanced	10k
Audio outputs	Two
Type	Unbalanced
Minimum load impedance	600 ohms
Source impedance	<60 ohms
Maximum level	+21dBu
Performance	
Frequency response (20Hz – 20kHz)	±0.5dB
Distortion (at +4dBu)	<0.03% at 1kHz
Equivalent input noise (20Hz – 20kHz unweighted)	-94dBu
Compressor	
Threshold	-30dB to +20dB
Ratio	1:1 to 50:1
Knee	1dB (hard) to 40dB (soft)
Envelope	Switchable auto (attack and release controls disabled) or manual
Attack (90% capture)	0.05mS to 20mS
Release (90% recovery)	60mS to 2S
Expander	
Threshold	-40dB to +20dB
Ratio	1:1 to 25:1
Attack	Switchable auto or fixed (2mS)
Release (90% recovery)	40mS to 2S
Output gain	-10dB to +30dB
Limiter/Clipper	
Threshold	0dB to +20dB

Power requirements

Voltage 110/120/220/240V, 50/60Hz
Consumption <30VA

Weight

Nett 4kg
Shipping 6kg

Dimensions

Width 482mm (19 inch)
Depth 292mm (11½ inch)
Height 44.5mm (1¾ inch)

Terminations

Audio inputs/outputs 3 pin XLR
Side chain inputs normalled ¼ inch stereo
jack
Power 3 pin IEC

Options

Security cover
Transformer input/output
balancing*

* Input transformer balancing is non-retrofitable and has to be specified with order.

DN500 Circuit Description

(Note: only Left Channel is described, other channel is identical except where stated.)

Audio Circuits

Input Section

The input signal enters via XLR type connector XL1 and may be balanced or unbalanced (see audio connector wiring details).

The input is then fed through the Hot-Pin jumper block which allows for either Pin 2 or 3 being selected as the in phase or active pin on the input.

The signal is then connected via the first order filter network R2/C1 and R7/C2 to the differential input amplifier I1.

Common mode rejection is factory set with P1 to give maximum rejection at 100Hz; typically 85dB.

VCA Section

The output from I1 passes through the first order LF and HF filter networks C66/R22 and C9/R26 to the VCA input buffer I4b.

From there it is AC coupled to the DBX VCA I6 via C43 and to the Side Chain input jacks J1 and J2 via C57.

Preset P2 is factory set to give minimum distortion at 1kHz and +10dBm, (typically 0.003%), this adjustment also reduces control feed-through to a minimum.

Output Section

The VCA output is fed to the current to voltage converter I4a which has a high current drive capability. High frequency stability is optimised with capacitor C8.

The output of I4a is AC coupled by C64 to the Limiter THRESHold control V1a, the clip circuit and the CLIP IN switch SW1a.

From there the signal is connected via the BYPASS Switch SW6e to C6 and then to the output transformer socket TC1.

On the standard unit two plug-in links on TC1 connect signal and ground to pins 2 and 3 of the output XLR connector XL2 via the Hot-Pin jumper block.

On units with transformer balanced output the two links are removed and the transformer is connected to TC1.

Side Chain Inputs

The Gate and Compressor Side Chain input signals enter via stereo jack connectors J2 and J1 and may be balanced or unbalanced (see audio connector wiring details).

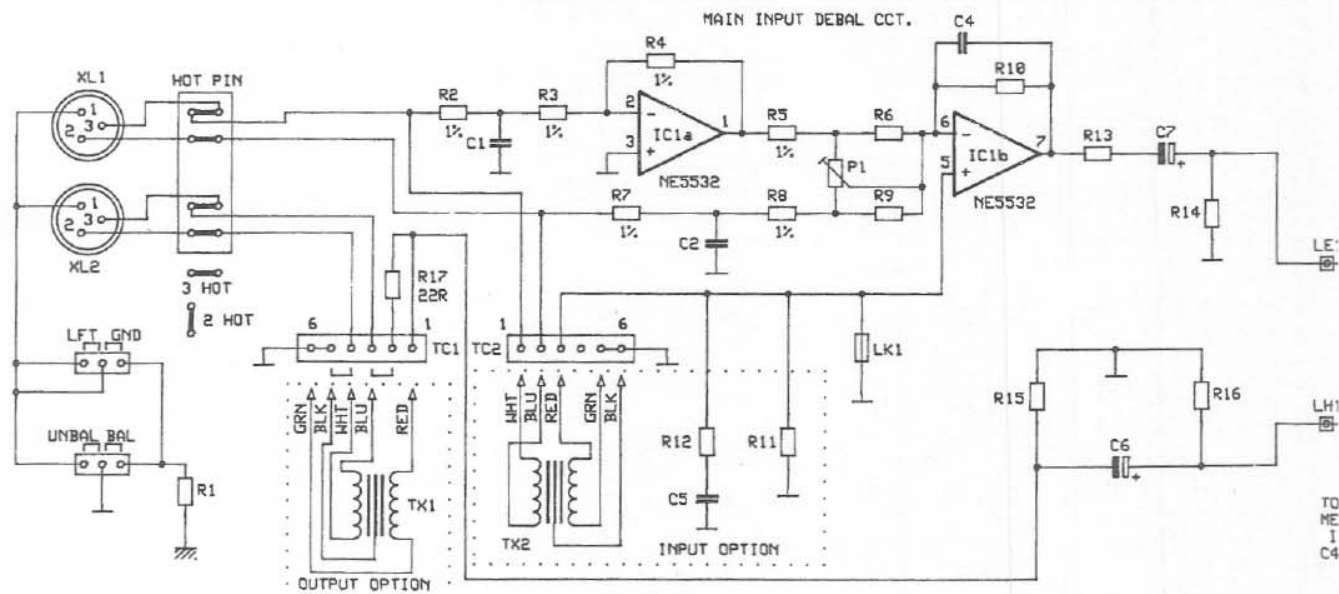
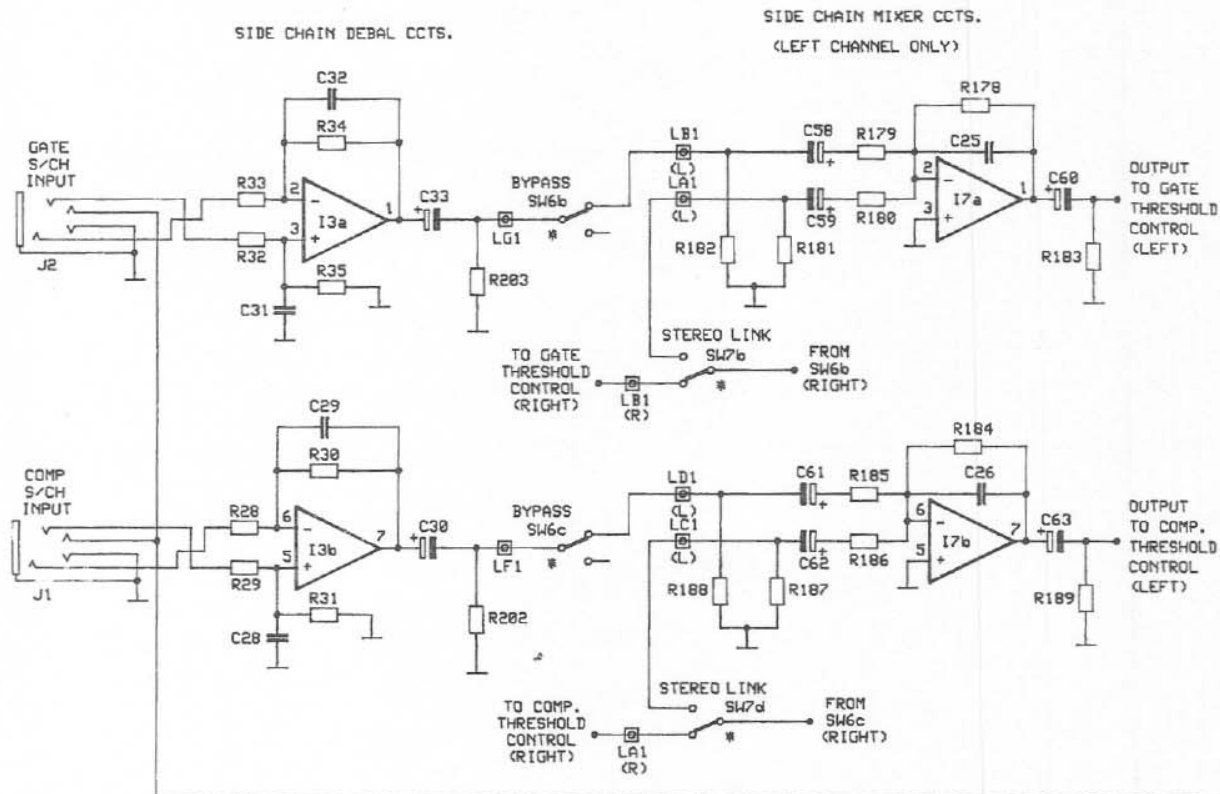
The signals then pass to the differential input amplifiers IC3a and IC3b which have first order R.F. filter networks formed by R34/C32, R35/C31 and R30/C29, R31/C28.

From IC3 outputs the signals are AC coupled to the BYPASS switch elements SW6b and SW6c by C33 and C30.

When no jacks are inserted into J1 or J2 the feed from the VCA input buffer I4b is fed via the break contacts on J1 and J2 to the Side Chain input circuits.

Side Chain Mixers

On the Left channel the signals from the BYPASS switch elements SW6b and SW6c are fed through AC coupling capacitors C58 and C61 to the inverting mixer circuits of I7a and I7b.



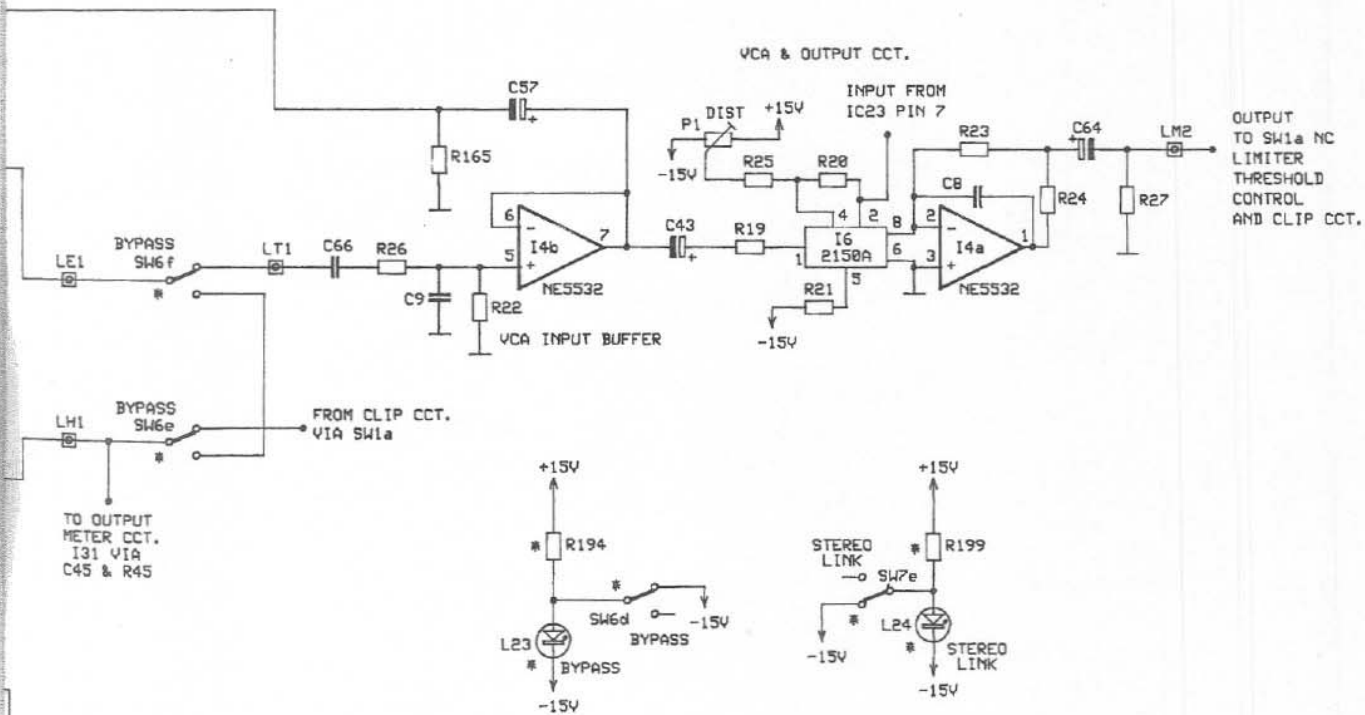
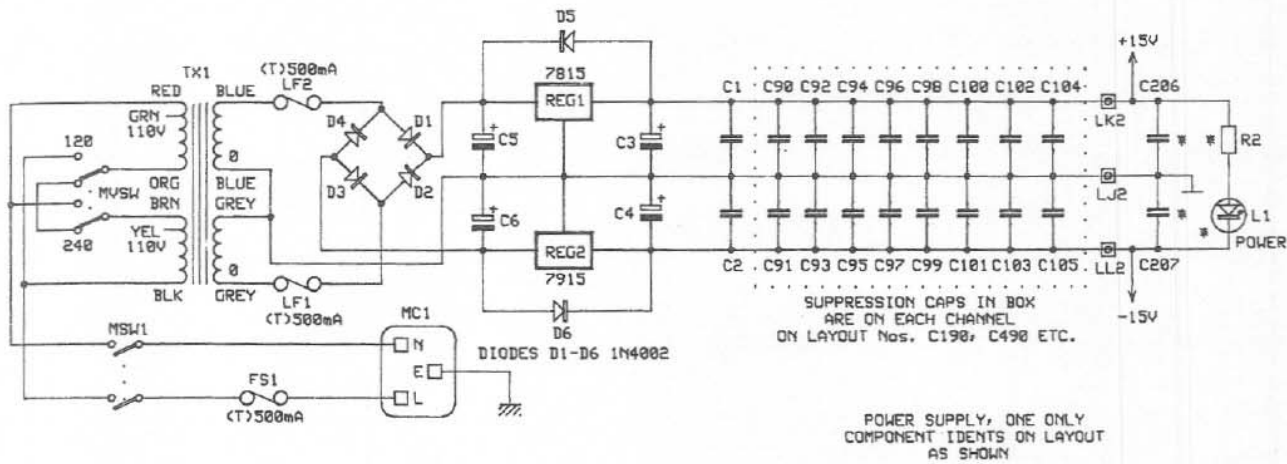
CIRCUIT FOR ONE CHANNEL ONLY
OTHER SAME EXCEPT WHERE MARKED

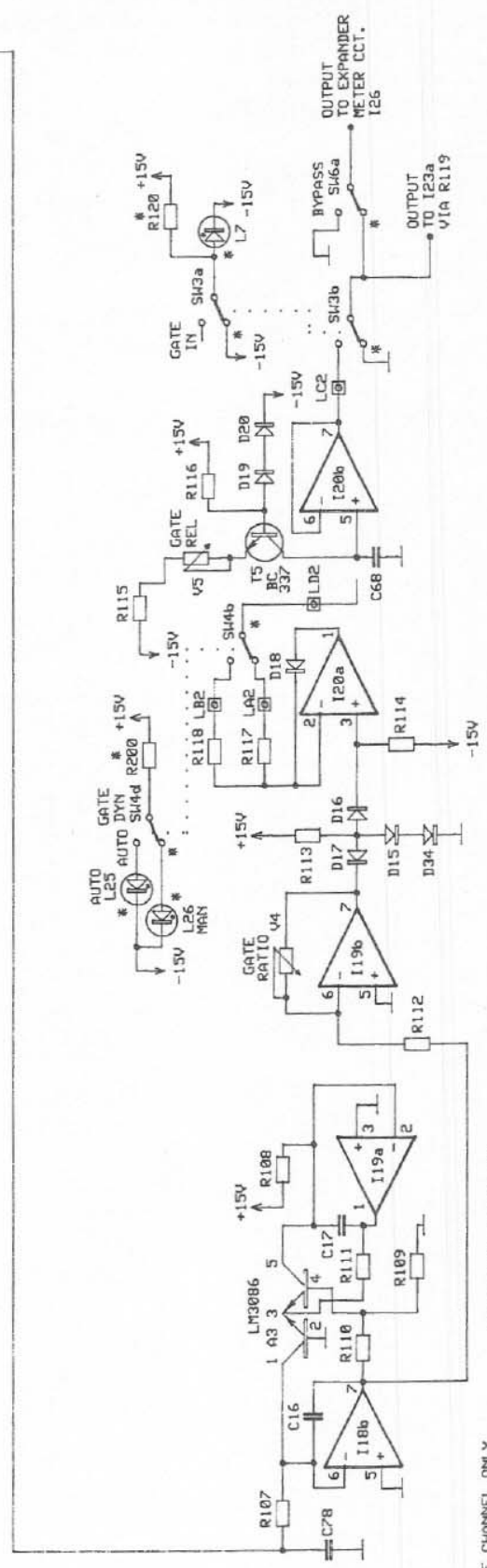
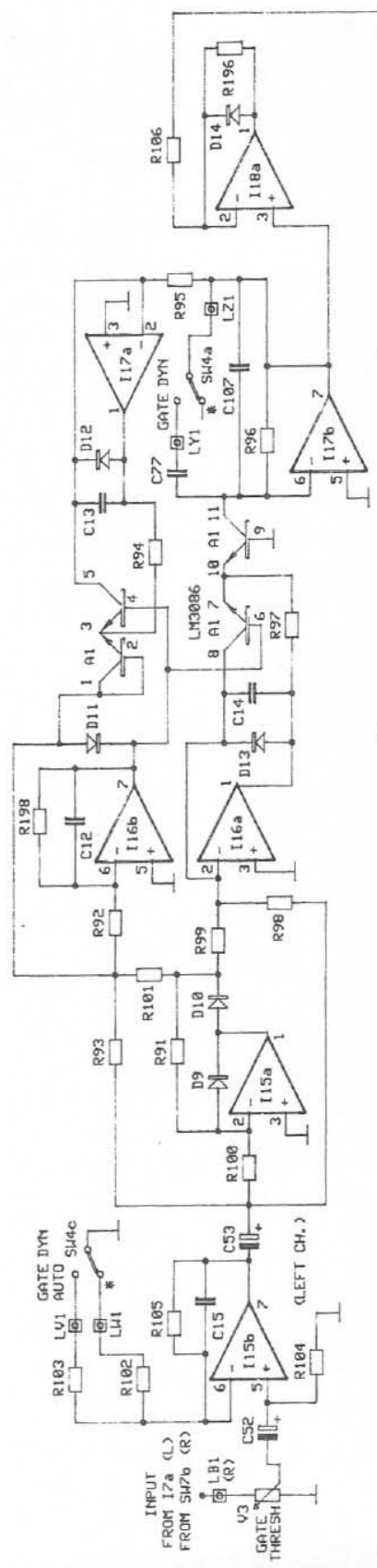
COMPONENT IDENTS ON LAYOUT
ARE NUMBERED
FROM 100 FOR CHANNEL 1,
AND 400 FOR CHANNEL 2,
EXCEPT CONNECTORS, TRANSFORMERS,
SWITCHES AND LEADS WHICH
ARE PREFIXED BY CHANNEL No.

COMPONENTS MARKED *
ARE ON DNS00S PCB.

ALL ICs LF353N UNLESS
OTHERWISE STATED
ALL DIODES 1N4148 UNLESS
OTHERWISE STATED

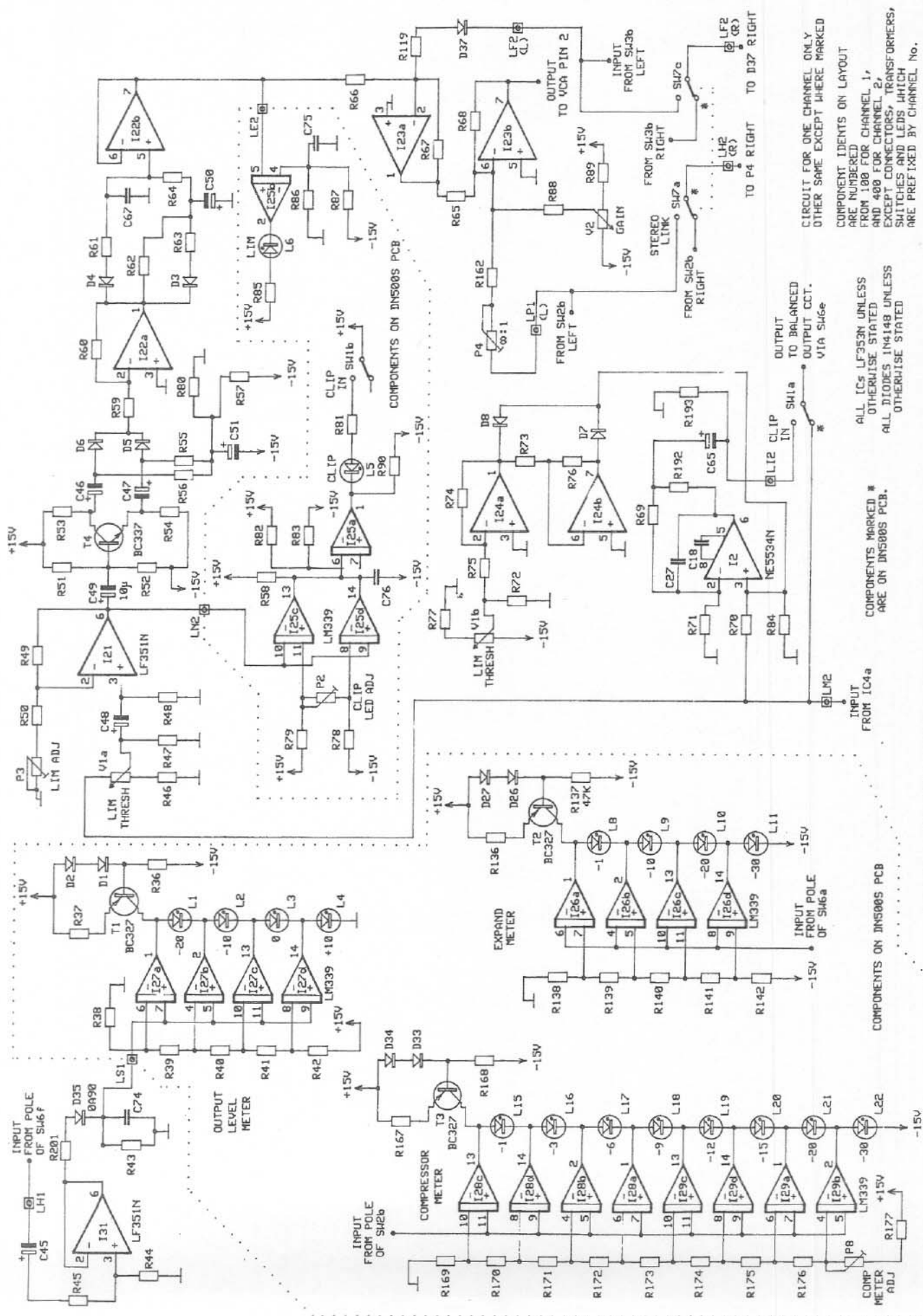
TRANSFORMER BALANCED INPUT OPTION	TRANSFORMER BALANCED OUTPUT OPTION
FACTORY OPTION TO SPECIAL ORDER ONLY COMPONENTS REMOVED: LK1, R4 R2 - R10, C1, C2 REPLACED WITH LINKS: R4, R10 COMPONENTS ADDED: R11, R12, C5	REMOVE THE TWO LINKS ON TC1 PLUG TRANSFORMER INTO TC1 SECURE TRANSFORMER WITH THE SCREW AND WASHER PROVIDED CHANGE THE LINK ON SELECTOR TO 'BAL' POSITION





CIRCUIT FOR ONE CHANNEL ONLY
 OTHER SAME EXCEPT WHERE MARKED
 COMPONENT IDENTS ON LAYOUT
 ARE NUMBERED
 FROM 100 FOR CHANNEL 1,
 AND 400 FOR CHANNEL 2,
 EXCEPT CONNECTORS, TRANSFORMERS,
 SWITCHES AND LEADS WHICH
 ARE PREFIXED BY CHANNEL NO.

COMPONENTS MARKED *
 ARE ON DN500S PCB
 ALL ICs LF353N UNLESS
 OTHERWISE STATED
 ALL DIODES 1N4148



CIRCUIT FOR ONE CHANNEL ONLY
OTHER SAME EXCEPT WHERE MARKED

COMPONENT IDENTS ON LAYOUT
ARE NUMBERED
FROM 100 FOR CHANNEL 1,
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ARE PREFIXED BY CHANNEL NO.

ALL ICs LF353N UNLESS
OTHERWISE STATED
ALL DIODES 1N4148 UNLESS
OTHERWISE STATED

COMPONENTS MARKED *
ARE ON DMS005 PCB.

OUTPUT
TO BALANCED
OUTPUT CCT.
VIA S46e

DN500

METER AND LIMITER CCTS.

BRD: DN500M

31.12.88

These mixer circuits have a loss of 6dB and high frequency stability is ensured by C25 and C26.

The outputs of the mixer circuits are fed via C60 and C63 to the Gate and Compressor THRESHold controls V3 and V6 respectively.

On the Right channel these signals pass through the STEREO LINK switch elements SW7b and SW7d instead of mixer circuits.

This arrangement causes both Left and Right audio signals to be mixed together and fed to the Left channel control circuits when the unit is Linked in Stereo.

Compressor and Gate Side Chain Control Circuits

The Compressor and Gate side chains are both feed forward control circuits allowing much more versatility of control and eliminating the overshoot problems associated with feedback circuits.

Inserting effects units into the side chains is also more straightforward with this system, although the control circuits themselves are necessarily more complicated as a result.

Note: The Compressor and Gate side chain control circuits are almost identical in operation for the first four stages and these stages will be described in detail for the Gate section only.

Any differences in the Compressor section will be stated.

Threshold Control Amplifier*

The output from the wiper of the Gate Threshold control V3 is AC coupled via C52 to the positive amplifier I15b.

The gain of I15b is changed by the ATK AUTO switch SW4c, being 36dB in the 2mS position and 39dB in AUTO.

These gains are for the Right channel circuit, the Left having 6dB more gain in both positions to allow for the loss in the Side Chain Mixer circuit on that channel.

This stage allows continuously variable selection of threshold level down to -40dBm.

The Compressor equivalent circuit of I8b has only 10dB of gain in MANual mode and 13dB in AUTO, the left channel again having 6dB more gain in both modes, and the threshold lower limit is -30dBm.

AVA and RMS section

The output of I15b is fed via C53 to the Absolute Value Amplifier and Root Mean Square circuit formed by I15a, I16a and I16b, I17a and I17b, and transistor array A1.

This circuit achieves its RMS action using the log relationship between a transistors base emitter voltage and its collector current.

The transistors in the array A1 along with their associated amplifiers form log and antilog generators which are arranged to square the input voltage, average it and then the output is fed back into the calculation to perform the square root function.

This circuit is changed between its two modes of operation by switching C107, the RMS averaging capacitor, either in or out of circuit with one pole of the ATK AUTO switch SW4a.

The time constant of the RMS circuit which affects the AUTO attack time and its low frequency response is determined by the value of C107, and the Compressor capacitor C79 is ten times the value of the Gate capacitor to give a natural sound.

Capacitors C12, C13, C14 and resistor R198 are included to ensure stability, eliminating the need for any adjustments.

Ideal Diode section

The output of I17b is directly connected to I18a which is arranged with diode D14 to form an ideal diode circuit to pass the output voltage from the RMS section accurately to the following stages.

The output from I18a is fed via a filter/storage network formed by R106 and C78 to limit the high frequencies and voltage swing reaching the next stage.

Logger section

The output of C78 is connected to the logger circuit formed by I18b, I19a and transistor array A3.

The operation of the logger circuit uses the same principles as the RMS section already described to produce an output voltage which is the log of the input voltage.

This is necessary to ensure that the VCA sees a voltage which corresponds correctly to the input signal since the VCA works on a dBs per volt, or log, law.

Capacitors C16 and C17 are included for stability.

The remainder of the Side Chain control circuits are different for the Compressor and the Gate and will be described separately.

Gate Side Chain Circuits

Gate Ratio section

The Gate RATIO control V4 acts as a feedback element around I19b creating a variable gain circuit with a maximum gain of 26dB and a minimum gain of around -40dB.

This circuit determines the relationship between the number of dBs change in input level compared to the number of dBs change in output level, i.e. the Ratio.

The output of I19b is fed via a network consisting of D15 to D17, D34, R113 and R114 which serves to only pass voltages below +0.6 volts to the next stage.

This +0.6V upper limit is set to include some Hold time in the Gate Release curve.

Attack section

The main storage capacitor C68 for the Gate dynamics is charged via either R118 or R117, depending on the position of the ATK AUTO switch, from the ideal diode circuit of I20a and D18.

This combined with the effect of the RMS section coming into circuit gives the two Attack time ranges specified.

Release section

The Release time is set using the RELease control V5 which is incorporated into a constant current circuit consisting of T5, D19 and D20, R115 and R116.

The constant current circuit causes the release to be linear in dBs per second terms, giving a natural sound.

Voltage Buffer

The voltage on the main storage capacitor C68 is buffered by the high impedance voltage follower I20b, and the output of this stage is fed to the GATE IN switch SW3b.

Compressor Side Chain Circuits

Knee section

The Knee circuit consists of a transconductance amplifier I30 and its current to voltage converter I12a, with presets P5 (20dB) and P6 (30dB) allowing for differences between particular ICs.

The circuit uses the well defined input compression characteristics of the transconductance amp to produce the desired voltage curve for the soft knee.

The KNEE control V10 selects either the input voltage to the knee section or the output of the knee circuit, or any blend in between, to set the KNEE range required.

Compressor Ratio section

The Compressor RATIO control V7 acts as a feedback element around I12b creating a variable gain circuit with a maximum gain of unity, adjusted accurately by P7 (Link Bal), and a minimum gain of around -70dB .

This circuit determines the relationship between the number of dBs change in input level compared to the number of dBs change in output level, i.e. the Ratio.

Compressor Dynamics section

The output from I12b feeds via D30 to I13a, an ideal diode circuit driving the ATTACK control V8 and the Automatic Release Circuit.

One or the other of these, dependent on the position of the ENV AUTO switch, charge the main storage capacitor C69.³

The ATTACK and RELEase controls V8 and V9 are switched in or out of circuit by the ENV AUTO switch elements SW5c and SW5d.

The ATTACK control is shorted out when in AUTO mode to stop the RMS attack time constant being interfered with, the fast attack limit in this mode is set by R161.

The RELEase control is completely switched out when in AUTO mode and the Automatic Release Circuit consisting of C56, D32, R158, R160 and R163 is switched in.

The ARC varies the release time in relation to signal burst length, increasing the release time with longer burst lengths, to achieve an almost inaudible release effect due to the masking effects produced by the ear.

Voltage Buffer

The voltage on the main storage capacitor C69 is buffered by the high impedance voltage follower I13b, and the output of this stage is fed to the COMP IN switch SW2b.

Limiter and Clipper circuits

The Limiter circuit is a feedback circuit monitoring the output of the unit and is therefore independent of the Compressor and Gate sections.

The Clipper circuit is directly linked to the Limiter circuit and its threshold tracks 1dB above the Limiter threshold.

The Clipper does not affect steady state signals and only serves to remove any overshoot allowed through by the Limiter Attack time on the start of each signal burst.

Limiter Threshold Control Amplifier

The output from the wiper of the Limiter THRESHold control V1a is AC coupled via C48 to the positive amplifier I21.

The gain of this stage is approximately 6dB and is adjusted by preset P3 (LIM ADJ) to give the correct threshold range of 0dB to +20dB.

Limiter AC to DC Convertor Section

The output of I21 is AC coupled to the base of transistor T4 which is arranged as a unity gain phase splitter biased for maximum voltage swing on its collector and emitter.

The two out of phase outputs from T4 are AC coupled by C46 and C47 to rectifier diodes D6 and D5.

These diodes are biased to 0 Volts by R59 and I22a at their cathodes and to a voltage slightly lower by R55 to R57 and R80 on their anodes.

This voltage difference sets the point at which they start to conduct and hence the level needed at T4 to start limiting, the threshold point.

Limiter Threshold Detector Amplifier

A fixed gain of 26dB is applied to the diode output voltage by amplifier I22a.

When the input signal to TR4 is above the threshold level the output of I22a will be a series of pulses the amplitude of which will depend on the amount the input signal is above the threshold level.

Limiter Automatic Release Circuit

The network formed by D3, D4, R61 to R64, C50 and C67 produces a burst length related release time for the Limiter similar to the the Compressor ARC, but with different time constants.

Voltage Buffer

The output voltage from this network is buffered by the high impedance voltage follower I22b, and the output of this stage is fed to the voltage mixer stage I23a.

Clipper Circuits

Clip Point Adjusting section

The Clip point is set by the second element of the Limiter THRESHold control V1b which is wired between the -15 volt rail and the 0 volt rail with R77 setting its maximum voltage to approximately -1.5 volts.

The output from V1b is DC coupled to inverter I24a which has a slight loss of -1.7dB and acts as a buffer for the THRESHold control.

The output of I24a is DC coupled to unity gain inverter I24b.

The outputs of I24a and I24b therefore have complimentary positive and negative voltages on them, the amplitude of which is set by V1b, and are connected via diodes D8 and D7 to the positive input of I2, the Clip Amplifier.

Clip Amplifier

When switched into circuit by the CLIP IN switch SW1a the Clip Amplifier I2 is part of the main audio path through the unit.

This amplifier is therefore a high current drive type as it has to directly drive the output of the unit when in circuit.

This stage is wired as a high impedance positive phase unity gain amplifier with HF stability optimised by capacitor C27.

Due to the connection of diodes D8 and D7 the input signal to the positive input of I2 is clamped to a maximum swing of whatever voltage is set by V1b.

Limiter LED circuit

The LIMiter LED L6 is driven by comparator I25b which is wired to switch on whenever the output of I22b goes more negative than about -0.27 volts.

This voltage corresponds to approximately 1dB of compression within the Limiter section.

Clipper LED circuit

The CLIP LED L5 is driven by comparator I25a which is wired to switch on whenever the outputs of either I25c or I25d switch low.

The positive feed to the CLIP LED is activated by the CLIP IN switch SW1b via R81. Resistor R90 ensures that the CLIP LED illuminates at about half brightness even when I25a output is high.

Comparators I25c and I25d switch low whenever the output signal from I21, the Limiter Threshold Control Amplifier, exceeds a level preset using P2 (CLIP LED ADJ).

The level set by P2 is slightly higher than the nominal steady state signal level, thereby detecting only the Limiter attack spikes.

The pulses derived from I25c and I25d are stretched by C76 and R58 to about 10mS in order to be easily visible, they would otherwise be only $250\mu\text{S}$ long.

VCA Control Voltage circuits

DC amplifiers I23a and I23b serve to mix the outputs of the Gate, Compressor and Limiter control circuits into a single voltage and reduce the 15V output swing of these sections down to the 0.54V swing required by the VCA for 90dB audio attenuation.

Preset P4 (Infinity : 1) is used to accurately match the Compressor section maximum Ratio setting to the particular VCA used, and is adjusted for constant output level at Limit.

Meter circuits

All three Meter sections, Compressor, Expander and Output are almost identical and use the same basic constant current LED drive system and comparator ICs to switch the relevant LEDs on and off.

Only the Output Meter section is described below along with any differences in the other two meters.

Transistor T1, diodes D1, D2 and resistors R36, R37 form a constant current generator producing approximately 6 milliamps of current flow into the LED diode chain which is wired to the negative supply rail.

This stops the meter circuit generating any interference on the power supply rails when the LEDs are switched on or off.

The top of each LED in the chain is connected to one output of a quad comparator I27, the positive inputs of which are all joined to the input voltage on the storage capacitor C74.

The negative inputs of the comparators are wired to the outputs of a voltage attenuator chain consisting of R38 to R42 which is connected between +15 volts and 0 volts.

This chain sets the voltages at which each comparator will switch off, the open collector output allowing its associated LED to illuminate.

The only difference in the Compressor circuit is the inclusion of preset P8 (COMP METER ADJ) which adjusts the attenuator voltages in order to calibrate the section to match the front panel markings.

In the Expand Meter circuit the LEDs are controlled with the opposite voltage swing, 0V to -15V, therefore the input voltage is wired to the comparators negative inputs and the voltage divider chain to their positive inputs.

The Output Meter section also has an AC to DC converter input stage consisting of a unity gain buffer I31 driving germanium diode D35 which in turn charges a storage capacitor C74.

Resistors R43 and R201 give this stage Attack and Release time constants similar to a PPM meter.

Power Supply

The power supply is a $\pm 15V$ design using a low noise toroidal transformer with split primary and secondary windings.

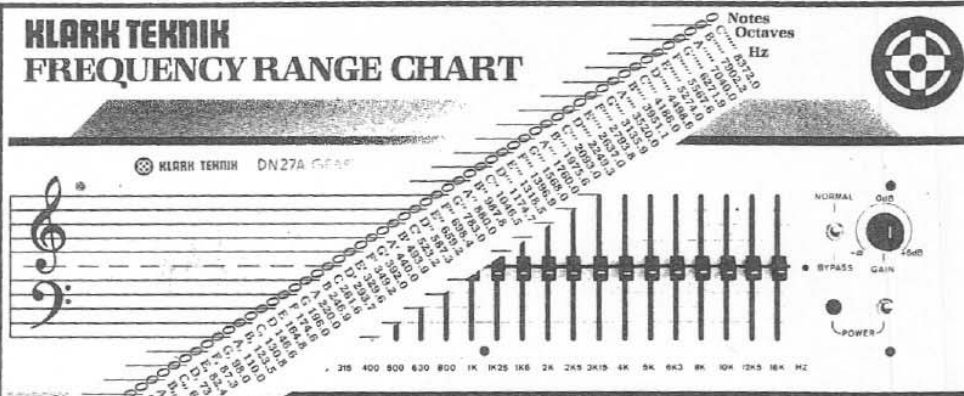
The two primaries are connected in series or in parallel by MVSW to give 220 or 110 Volt nominal operation.

The secondaries drive a full wave bridge rectifier, D1 to D4, two smoothing capacitors, C5 and C6, and integrated circuit positive and negative regulators REG1 and REG2.

Decoupling capacitors C1 and C2 at the power supply, C90 to C105 in each channel and C206, C207 on the sub board ensure low noise supply rails.

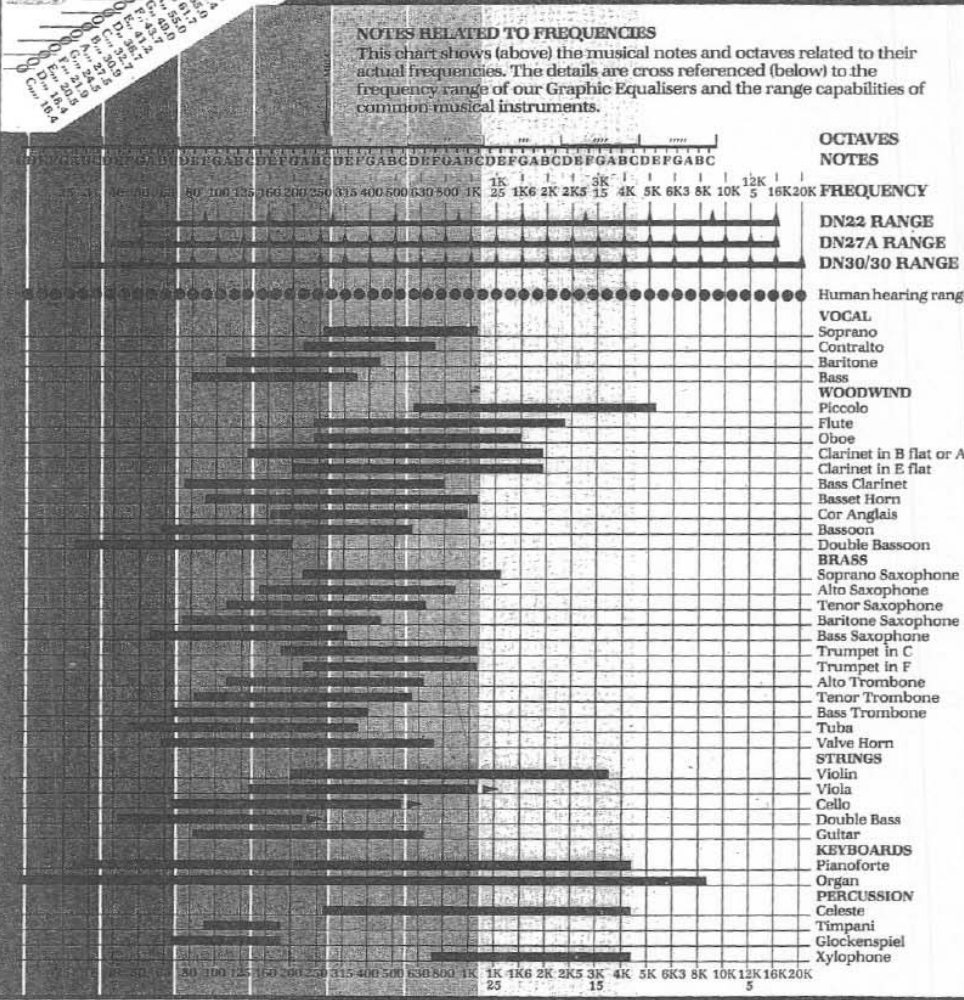
Power 'on' is indicated by LED L1 which is connected between the +15V and -15V rails via R2.

KLARK TEKNIK FREQUENCY RANGE CHART



NOTES RELATED TO FREQUENCIES

This chart shows (above) the musical notes and octaves related to their actual frequencies. The details are cross referenced (below) to the frequency range of our Graphic Equalisers and the range capabilities of common musical instruments.



Frequency Range Chart

Attention!

Cables:

This product should only be used with high quality, screened twisted pair audio cables, terminated with metal bodied 3-pin XLR connectors. The cable shield should be connected to pin 1. Any other cable type or configuration for the audio signals may result in degraded performance due to electromagnetic interference.

Electric Fields:

Should this product be used in an electromagnetic field that is amplitude modulated by an audio frequency signal (20Hz to 20KHz), the signal to noise ratio may be degraded. Degradation of up to 60dB at a frequency corresponding to the modulation signal may be experienced under extreme conditions (3V/m, 90% modulation).

No permanent damage or degradation of performance will be caused by these conditions.