FREDERICK R. VOLBE

MODEL 440
LIMITER/COMPRESSOR/DYNAMIC SIBILANCE PROCESSOR

Preliminary Operating Instructions

P.O. Box 40306 • 2817 Erica Place
Nashville, TN 37204 • (615) 383-4737

MODEL 440 LIMITER/COMPRESSOR/DYNAMIC SIBILANCE PROCESSOR

1. General Information

The Valley People Model 440 is a single channel device offering the convenience of a peak limiter, a high quality compressor/expander package, and a Dynamic Sibilance Processor section, each controlling a common VCA (voltage controlled amplifier). Sophisticated intercoupling of the control circuitry used for each function allows the device to simultaneously limit, compress, expand, and eliminate high frequency components in sibilance.

Model 440's compressor control section features continuously adjustable threshold, attack time, ratio and release time. In addition, an interactive expander control is integrated with the compressor control circuitry to reduce residual noise which would otherwise be "pumped up" or accentuated by the compression process. Special release coupling makes the transition from compression to expansion imperceptible, thus eliminating problems associated with the use of separate single-function units.

The limiter control section exhibits extremely fast attack characteristics, typically 1 µs/db or less, continuously variable threshold, a fixed 60:1 ratio, and variable release time.

Using special control intercoupling, the device operates as a compressor following a fast peak limiter. The compressor's Gain Recovery Computer maintains a preset nominal output level under varying conditions of input level, ratio, and threshold settings. In critical applications, the limiter may be linked with a safety clipper. The clipper threshold automatically tracks that of the limiter control section in order to eliminate any extremely fast transients which might escape the limiter. In the Auto mode, the compressor attack time, ratio, and release time are optimized for one-control operation. With the sophisticated control circuitry of the Auto mode engaged, the operator is allowed to obtain more or less compression by simply adjusting the threshold control.

The proprietary circuitry of the Dynamic Sibilance Processor analyzes the sibilant waveform in order to detect and cancel only the coherent and objectionable portions of the sibilant sound, such as "whistles". By cancelling these components instead of equalizing the signal chain, the DSP does not color or affect the tonal balance of the accompanying mixed program material.

The inputs of the Model 440 are balanced, and capable of handling +24 dB maximum input level. The outputs are actively balanced, with balanced-to-unbalanced gain recovery compensation which compensates for the usual 6 dB level loss normally associated with unbalancing a balanced output section. The outputs are capable of driving a 600 ohm load to +24 dBm balanced, or +21 dBm before clipping when unbalanced.

1.2 ELECTRICAL SPECIFICATIONS

Notes: 0 dB = 0.775 Vrms.
All data refers to use with "vu meters".
RMS noise measurements made unweighted in 20 Hz to 20 kHz bandwidth using 3rd order filters with -3 dB points at 20 Hz and 20 kHz.

Input Specifications	GUARANTEED	TYPCIAL	UNITS
Input Impedance, balanced:	100k	---	ohm
Input Impedance, unbalanced:	50k	---	ohm

	GUARANTEED	TYPICAL	UNITS
Maximum Input Level @ 1 kHz, balanced:	+24	---	dB
Maximum Input Level @ 1 kHz, unbalanced:	+21	---	dB
Nominal Input Level @ 1 kHz:	---	0	dB
Range of Input Levels for 0 dB Output, no compression @ 1 kHz:	±15	0	dB
Input CMR @ 50-60 Hz (ref. input):	>60	---	dB

Barrier Strip Terminations.

Output Specifications:

Output Source Impedance, balanced:	≤40	---	ohm
Output Source Impedance, unbalanced:	≤20	---	ohm
Nominal Output Level, 600 ohm balanced:	-10 to +14	---	dBm
Nominal Output Level, 600 ohm unbalanced:	-10 to +14	---	dBm
Maximum Output Level, 600 ohm balanced*:	+24	---	dBm
Maximum Output Level, 600 ohm unbalanced*:	+21	---	dBm
Static THD @ 1 kHz, 0 dBv input, unity gain RL = 600 ohm:	0.015	0.01	%

*0.1% THD into 600 ohm.

Static SMPTE IMD; 0 dB input, unity gain, RL = 600 ohm:	0.015	0.01	%
Output Noise @ unity gain, R source: 1 kohm, RL = 600 ohm:	-76	-79	dB

Power Supply:

Mains voltage, 50-60 Hz: 95-130, 190-240	Vac
Power Consumption: (12 VA)	VA

Uses standard IEC connector and cord.
RF and transient protection provided in power supply.

1.3 MECHANICAL SPECIFICATIONS

The Model 440 Limiter/Compressor/Dynamic Sibilance Processor is packaged in a 19" (482mm) rack mount, 1 unit high (1.75" or 43mm) and 8.5" deep (216mm). Weight 8 pounds (3.6kg).

1.4 APPLICATIONS AND USES

Introduction to Dynamics Processing. Dynamics processing is defined as manipulation of the dynamics of an audio signal. The most familiar of these processes are COMPRESSION, LIMITING, and EXPANSION.

COMPRESSION is a method of reducing the dynamic range of a signal by increasing the gain of the processing signal chain in the presence of signal levels below a given THRESHOLD, or "switching point", and decreasing the gain in the presence of signals above the threshold. The degree to which the gain is altered above the threshold setting is expressed as the RATIO of a signal level change at the input to the resulting signal level change at the output. In a compressor, for example, a 2 dB increase in signal level above the threshold may result in a 1 dB increase in output level, thus the COMPRESSION RATIO may be stated as being 2:1. Typical compressor transfer curves are shown in Figure 1.

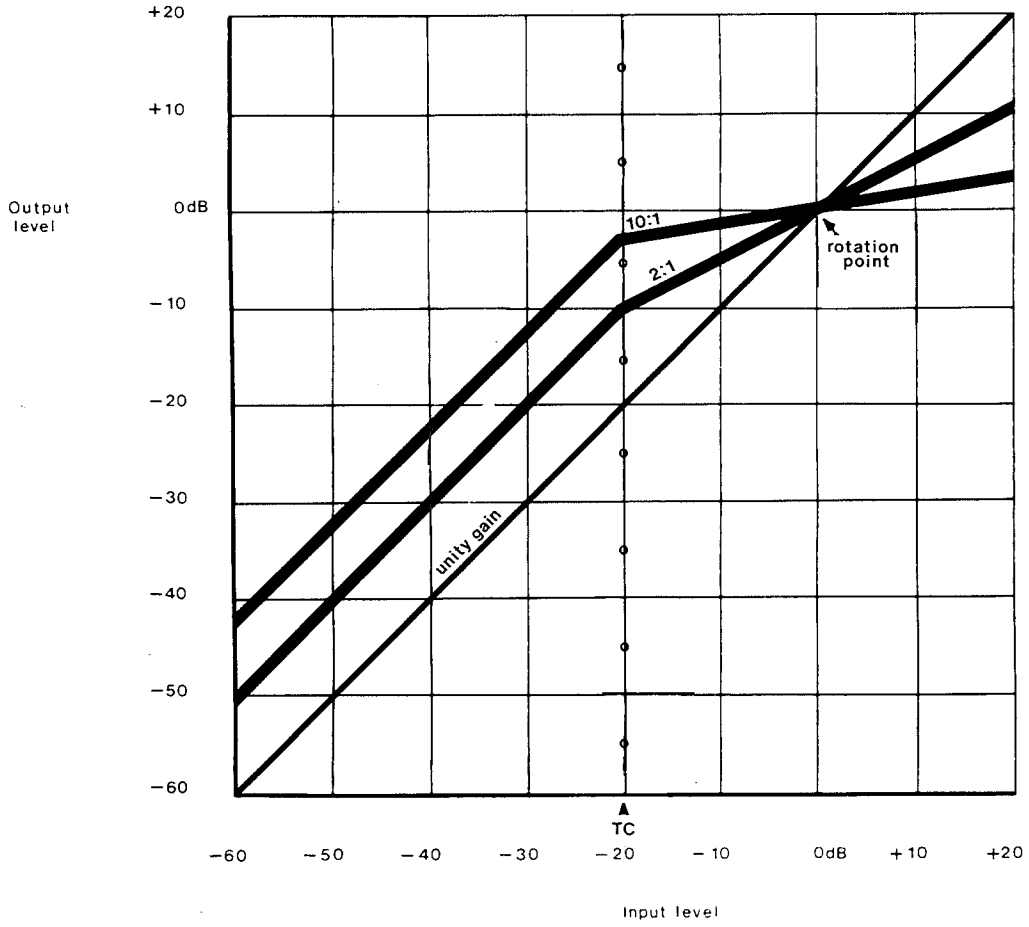
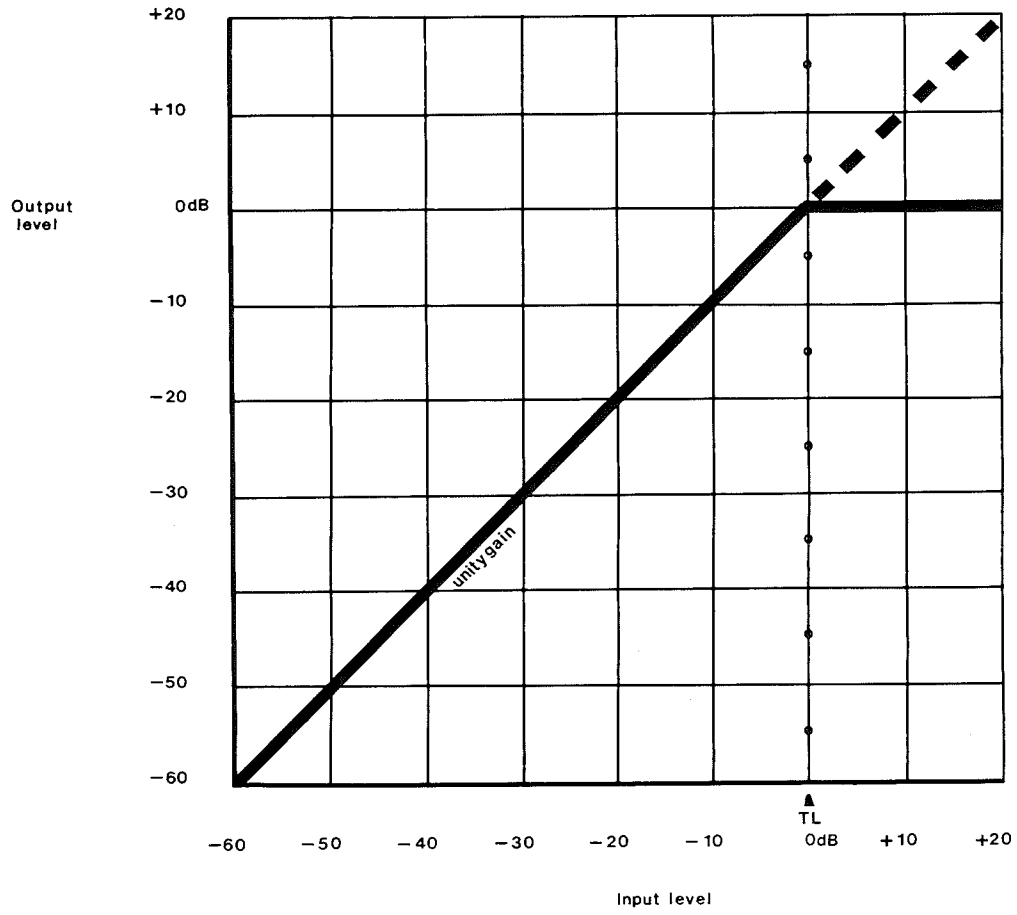


FIGURE 1

Input vs. Output Voltage Levels of a Continuous Tone Signal Through a Compressor with Threshold @ -20 dB

Note that the compressor adds gain to signals below the threshold. At the threshold, TC, the compressor begins to add less gain up to the rotation point, which is the unity gain point for the processor signal chain. As the input level exceeds the rotation point, the compressor begins to attenuate the signal.

LIMITING is a method of confining the maximum signal output level of the processor to a preset value. Although compression at high ratios is considered to constitute limiting, a limiter, in its pure form, does not add gain to signals below its threshold. A perfect limiter has a ratio of infinity to 1 (Inf:1), indicating that an infinite increase in signal level is required to produce an output level increase of 1 dB. In practice, limiters exhibit limiting ratios of 8:1 to 60:1. A typical limiter transfer curve is shown in Figure 2.



FIGUR E 2
Input vs. Output Voltage Levels of a Continuous Tone Signal
Through a Limiter with Threshold @ 0 dB

Note that the processor signal chain exhibits unity gain until the input signal level reaches the limiting threshold, TL. As the input signal exceeds the threshold, TL, the processor attenuates the signal in such a manner that the output level is not allowed to exceed the threshold setting.

EXPANSION is a method of increasing the dynamic range of a signal by automatically increasing the processor signal chain gain in response to an increase in input level. Since headroom limitations do not allow unlimited increases in gain, the reciprocal action is used in an expander, i.e., the signal chain gain is reduced in response to a reduction in input level. A typical expander transfer curve is shown in Figure 3.

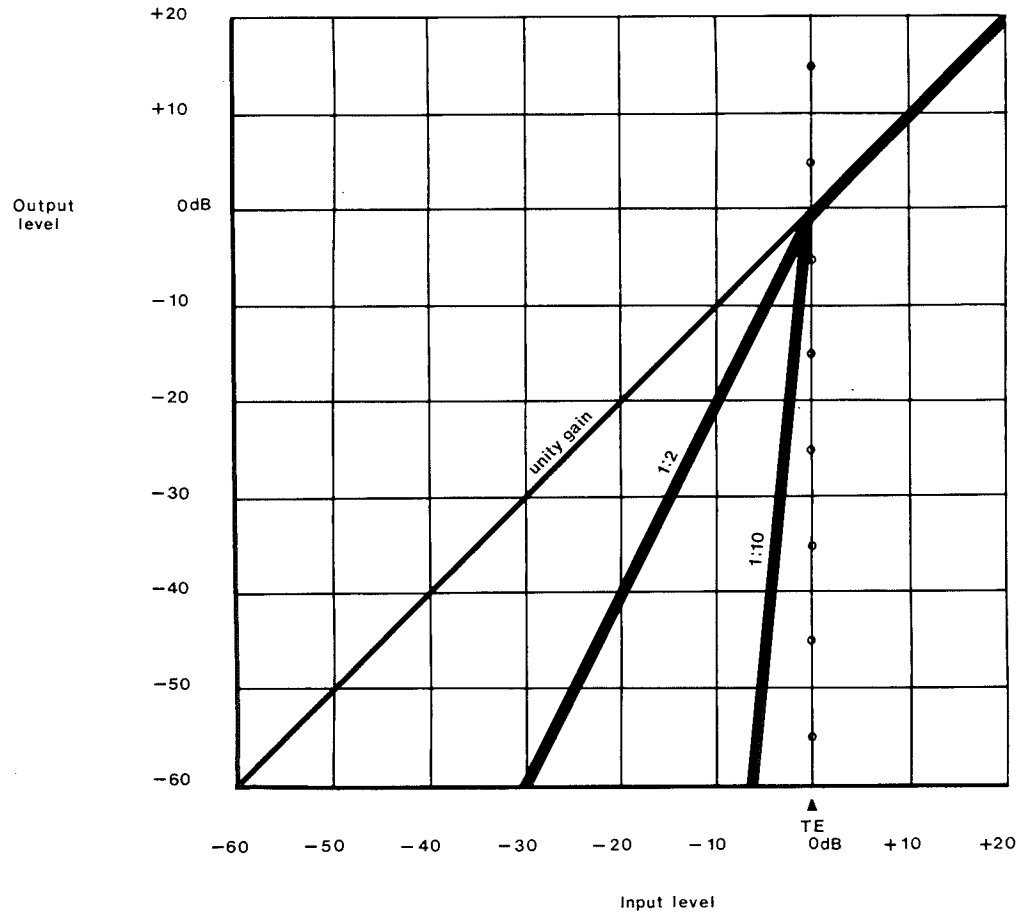


FIGURE 3
Input vs. Output Voltage Levels of a Steady State Tone
Through an Expander with Threshold @ 0 dB, Slopes of 1:2 and 1:10

Note that in the graph above, as the input signal level falls below the expansion threshold, TE, the processor gain is reduced. Each dB of drop below threshold, TE, of the input signal level causes the output level to fall 2 dB, thus the slope, or expansion ratio is 1:2. As the input signal exceeds the expansion threshold, TE, the processor recovers to unity gain. The process thus described is properly termed DOWNWARD EXPANSION. Higher expansion ratios of, for example 1:10 or 1:20 are used for a process commonly called "gating" wherein the expansion ratio, TE, is set at some point just below the level of the desired signal such as a drum. Any input level exceeding the threshold then causes the processor to rapidly recover to unity gain. Although the reduction in the unwanted signal at the output is more dramatic, the threshold setting is very critical, and the result is not as unobtrusive as expansion using a gentle slope, especially for noise reduction purposes.

Attack and Release Structures. Dynamics processors cannot be allowed to operate instantaneously, as do normal amplifiers, following exactly the input waveform; the result is operation as a non-linear gain block which creates distortion. The objective in dynamics processing is not to alter the waveform of the signal, but rather to control the envelope of the signal as shown in Figure 4.

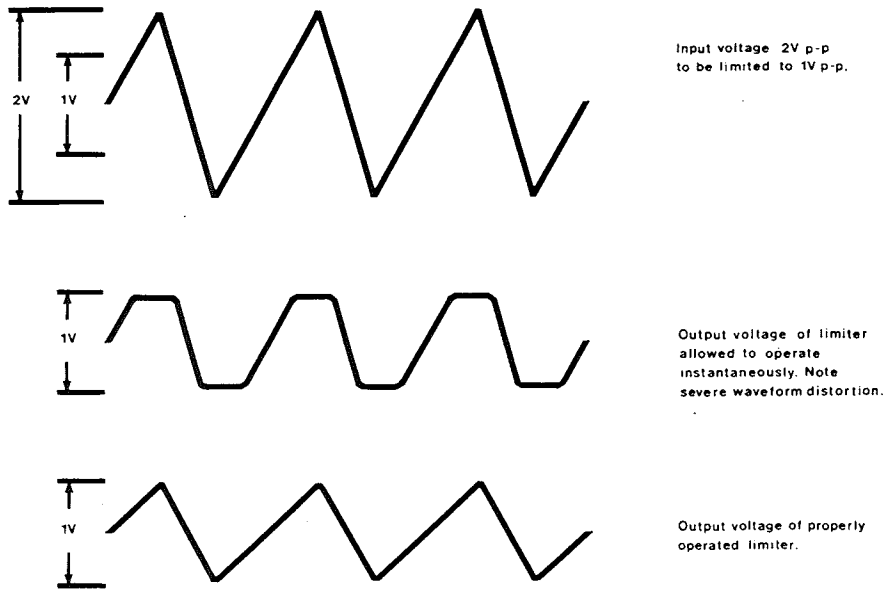


FIGURE 4
Steady-state Non-sinusoidal Tone Through Limiter Adjusted to Provide 6 dB of Limiting at Ratio of 60:1

The ideal processor should be able to distinguish the input waveform from its relatively slower envelope, and follow the envelope contour without regard to the frequency content of the waveform. This, in practice, is nearly impossible; the processor must react quickly enough to control the level of sudden bursts of high level signal and transients, thus, sometimes it must react to the waveform. The parameter which determines the processor's ability to respond to sudden bursts of high level program material and fast transients is called ATTACK TIME. The ATTACK TIME is generally characterized as the time required for a processor to alter its gain from some starting point to within a specified percentage of its required ultimate gain or attenuation. The attack time is measured starting the instant the signal causing the change in gain appears at the input of the processor. If the attack time is stated as the time required for a given amount of gain change, it must include settling time, which is the time required for the control element to recover from any overshoot or ringing and to stabilize at 100% of the specified gain change.

After the processor has "attacked" and altered its gain in order to control the signal level, it cannot be allowed to recover to its previous gain by simply following the input waveform as it falls in level. This, again, will cause waveform distortion. Some provision must be made to slow this recovery time, or RELEASE TIME. The problems associated with release times are analogous to those of attack times. The processor must follow the envelope of the input signal, but at times, must release relatively quickly.

Figure 5 illustrates attack and release characteristics of a limiter and an expander.

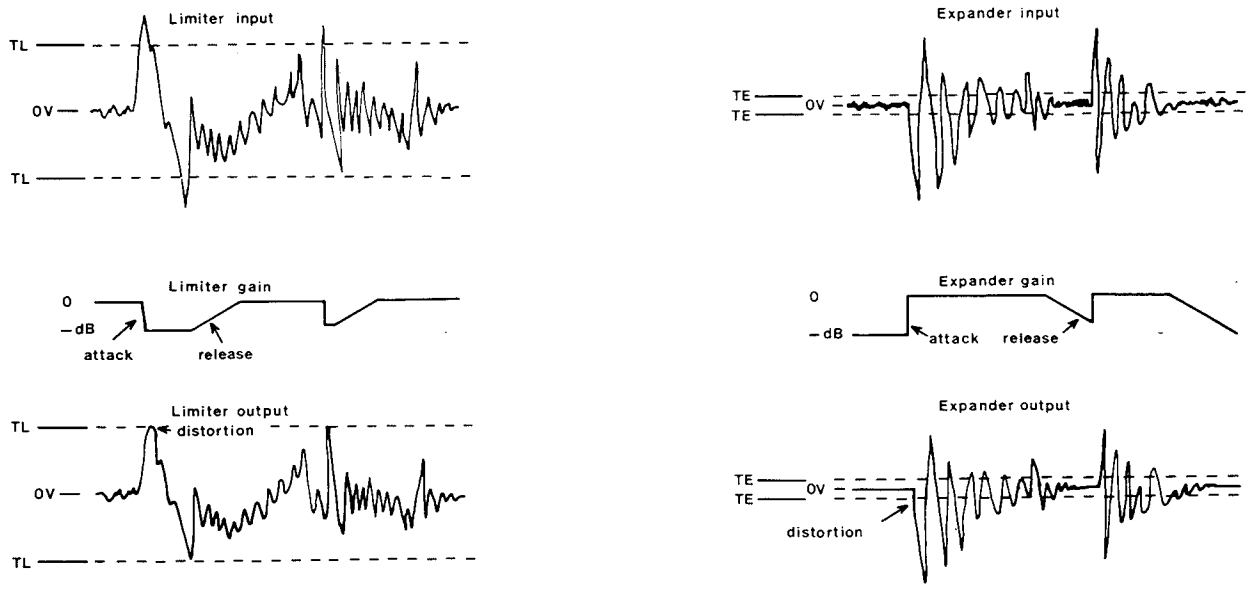


FIGURE 5
Drawing of Oscillographs Representing Musical Program Material Processed by a Limiter @ 60:1 Ratio and an Expander @ 1:20 Slope

As can be seen, a fast attacking limiter inherently causes some waveform distortion, as does a fast attacking expander. While the distortion induced in the limiter, when present in sufficient amounts, sounds like "clipping" or "fuzziness", that caused by an expander sounds like a "click", as if the signal has been turned on by a switch.

One solution to the problem of waveform distortion is to lengthen the attack time of the processor. While this approach does result in better dynamic integrity of the processed signal, it has certain drawbacks, the most serious being less dynamic control of the signal. Another approach to minimize waveform distortion is to select relatively long release times, thus not allowing the processor to recover fully before the next attack is called for. This approach suffers serious and obvious drawbacks: a limiter with a very long release time reduces the level of signals which do not require reduction, and an expander with a long release time will not attenuate unwanted signals properly. Both are forms of dynamic distortion, or unwanted, unnatural sounding gain changes. Dynamic distortion is variously described as "pumping", "breathing", "shimmering", etc. All processing devices introduce dynamic distortion in some amounts as a function of release time, however, automatic circuitry, when properly applied, can reduce dynamic distortion dramatically.

Detection Schemes. Since a dynamics processor must have a gain control element, and

since this element must be electrically controlled, usually by a voltage, the dynamics processor must also possess some means to measure the level of the input signal, compare it to the threshold setting, and generate the appropriate control voltage to adjust the gain of the controlled element. The device which performs this function is called the DETECTOR. A very simple type of detector simply measures the voltage excursions of the input waveform. Such a detector called a PEAK DETECTOR; it measures the peak excursions of either polarity of the input waveform. Peak detection is useful to prevent overloading of subsequent devices in any signal chain which may be peak level sensitive, such as in disk cutting and broadcasting. These detectors react very rapidly, typically exhibiting attack times of 10 μs to 100 μs, in order to place an absolute limit on the peak voltage at the processor output. Peak limiting is the only processing scheme which can provide protection against overmodulation in disk cutting or broadcasting.

Most contemporary use of processing equipment is no longer for protection of following stages, but for the purpose of increasing the apparent loudness of a signal within the level constraints of a transfer medium, such as a tape.

The peak voltage of a signal unfortunately bears little relationship how loud the signal sounds to a human. The human ear responds to power levels. Two waveforms of equal loudness are shown in Figure 6.

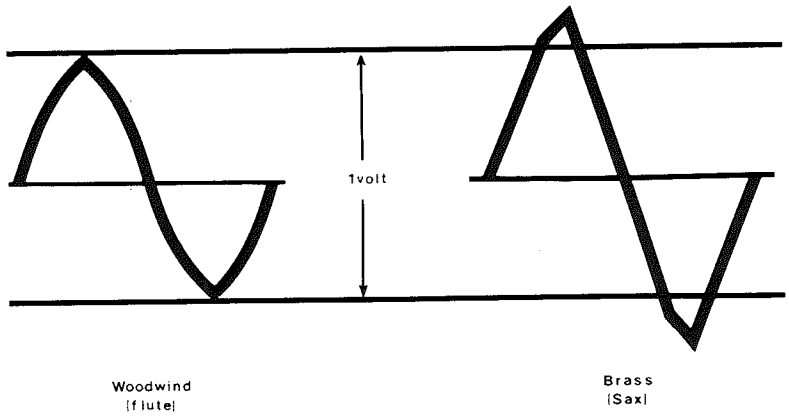


FIGURE 6
Simplified Waveforms of Same Loudness
from Woodwind and Bass Instruments

Note that the saxophone produces a more complex waveform than the flute. The two tones are of equal loudness to a human, but the peak voltage value of the saxophone waveform is much higher than that of the flute. A peak detector will cause this signal to be lower in loudness, when processed, because the peak detector reads the peak voltage level, not the power level. The more complex a waveform is, the more error exists between a peak responding processor's output and what the human ear hears as a "correct" loudness.

If the human ear responds to power levels, then some form of rms detection would seem to be in order. An rms responding detector circuit would produce an output analogous to the waveform's power level. This would correct the 10 to 14 dB discrepancy between a peak detector's indication of level and the actual power contained in a complex waveform. Although the rms detection scheme is a vast improvement over peak detection, it still suffers from some drawbacks in that it does not, in itself,

compensate for the frequency response of the human ear. Humans are woefully deficient in aural acuity both in the low frequency and high frequency portions of the audio spectrum. In the example of Figure 6, a rms detector would read the high frequency (harmonic) content of the saxophone waveform as contributing significantly to the waveform's loudness. Although the harmonic content does contribute significantly to the power level of the waveform, because the human ear is deficient in aural acuity at high frequencies, the ear does not interpret the harmonics as contributing significantly to the waveform's loudness. In order for a detection scheme to make sense to the human operator, it then must take into account the frequency response of the ear.

Sibilance Control. Certain characteristics of fricative vocal sounds are known to be difficult to reproduce electronically by equipment having limited headroom or highly equalized stages in the signal chain. A classic example is reproduction of the "s" sound, or sibilant "ss" as in the word "kiss". "Normal" frication in human speech produces random noise in a confined bandwidth having nearly equal energy per unit bandwidth, much as does Gaussian, or thermal, noise. Figure 7 represents a simplified spectrum of the fricative "ess" as a function of acoustical energy vs. frequency.

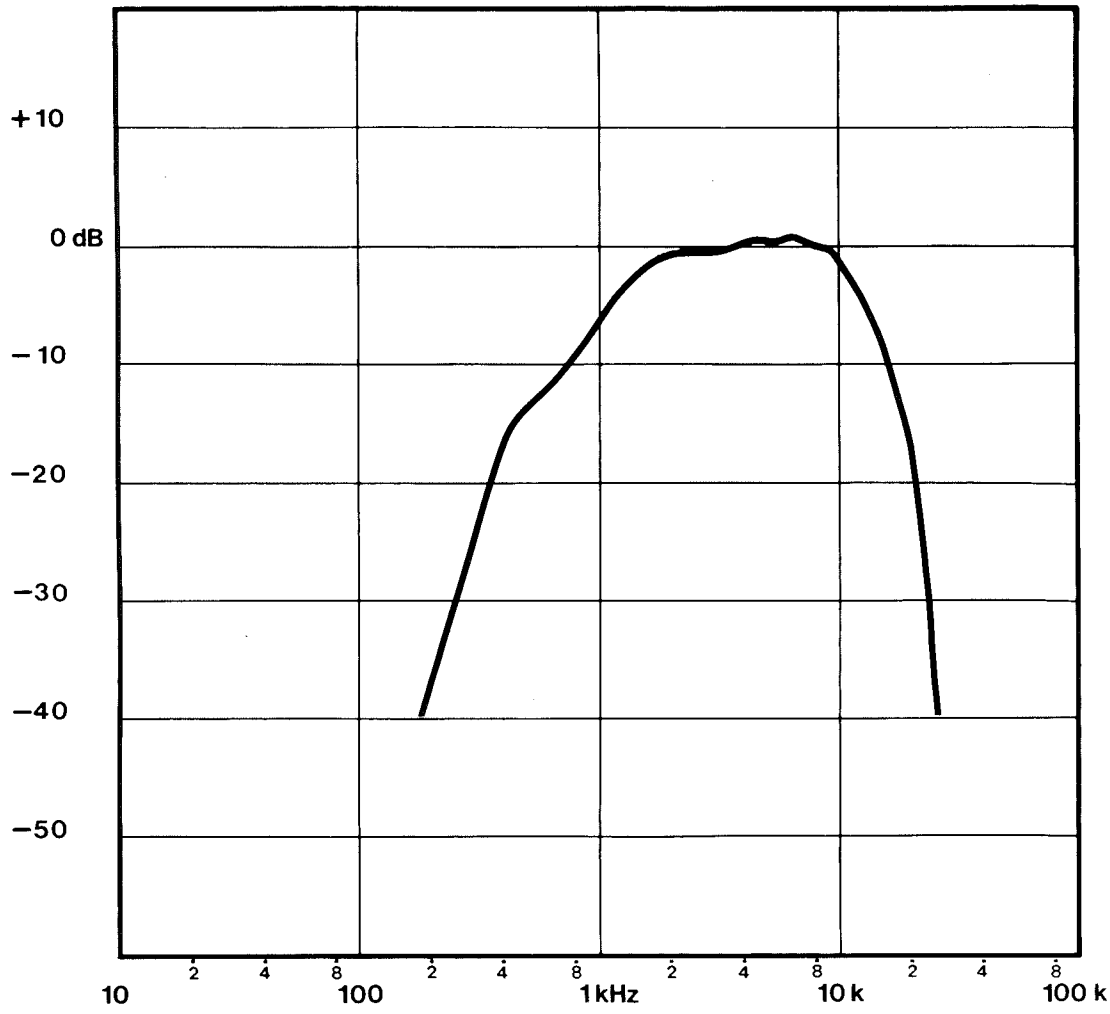


FIGURE 7
Spectral Distribution of Normal Frication

Reproduction of this sound per se is not problematic, however, individual speakers and performers, particularly those with certain common abnormalities in dentation, such as diastema, produce fricatives exhibiting pronounced peaks in the spectrum, as in Figure 8.

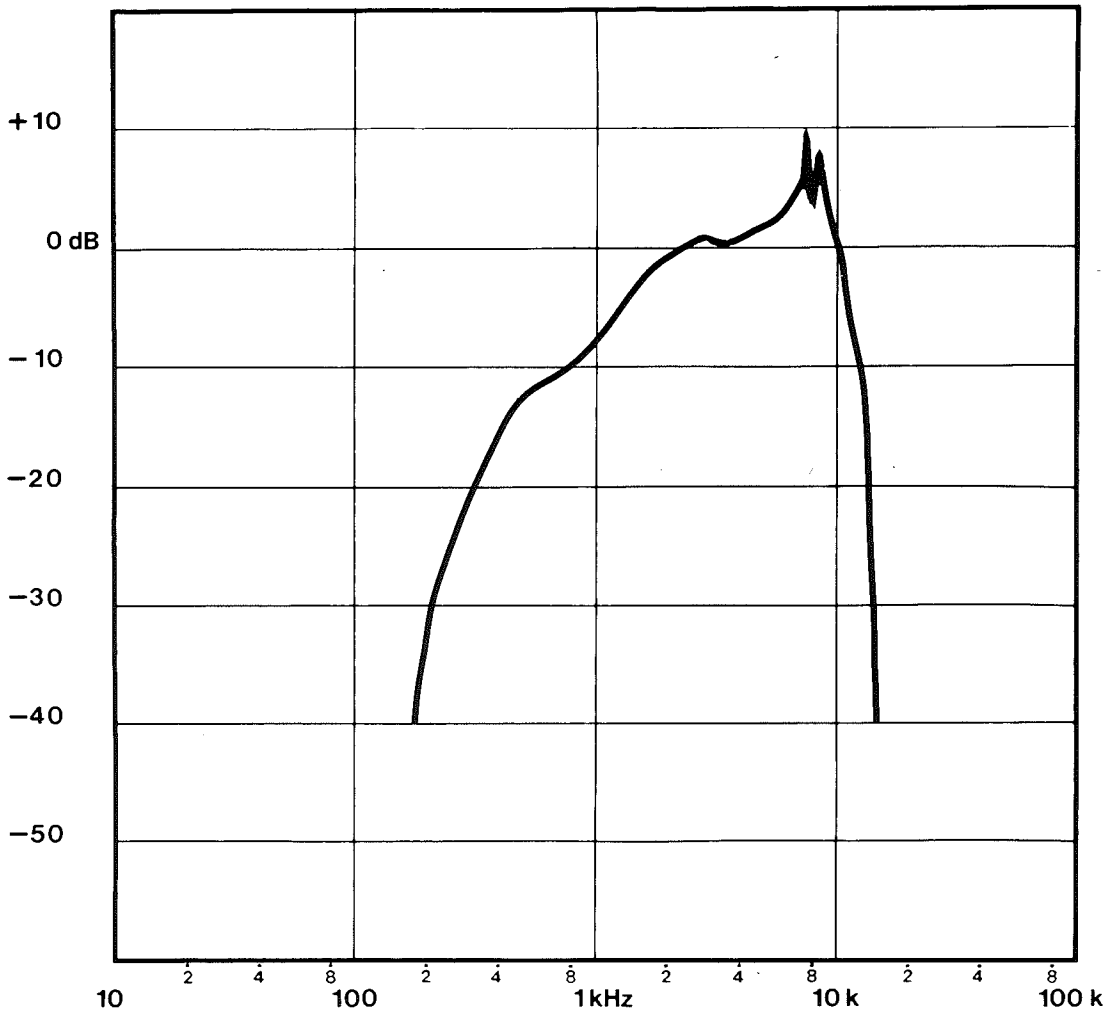


FIGURE 8
Spectral Distribution of Sibilant Frication

These peaks disclose the presence of significant acoustical energy contained in relatively narrow bandwidths, or high frequency "whistles", very nearly sinusoidal in nature. As the relative amplitude of these peaks infers, the high frequency sinusoidal content of sibilants, or the "whistles", if you will, are the components in frication which cause distortion or "splatter". Consider the following set of circumstances, wherein a problematic sibilant fricative, i.e., one containing a "whistle", is fed to a pre-emphasis network having a high frequency boost which puts its response, at 7.5 kHz, 12 dB higher than at 1.8 kHz. It can be easily seen that, if the following stage operates on standard ±15 Vdc power supply rails, and the normal signal level is +4 dB (re. 0.775) or 1.23 Vrms, the "whistle" in the region of 7 kHz exceeds the maximum output voltage swing of the circuit, resulting in distortion.

The most common scheme used to control sibilance dynamically is some form of high-frequency gain reduction. This is usually accomplished by one of two popular schemes:

split band, or multiband processing, where the audio is divided into two or more bands so that high frequencies are processed separately from the lower frequencies; and side-chain equalization, wherein the entire audio spectrum is processed in response to control signals derived from an equalized audio source, thus causing the processor to become more sensitive to high frequency information. Either of these approaches is moderately useful for sibilance control, or "de-essing" of speech, but neither is well suited to controlling sibilance dynamically on mixed program, that is, voice with accompaniment. The obvious drawback of the multiband approach is that, when active, the processor alters the high frequency content of the processed program. The side-chain equalization scheme causes pronounced, and frequently objectionable, amounts of gain reduction in the presence of "bright" passages and sibilant song or speech, but does provide somewhat less objectionable sibilance control than does the multiband approach when used on mixed program.

The Dynamic Sibilance Processor section incorporated in the Model 440 uses proprietary circuitry which "looks for" high frequency sinusoidal information and compares it to the broadband signal level. When significant amounts of "whistling" are present, the DSP removes only the very narrow band of frequencies in which the "whistle" is present without affecting the remaining broadband signal. No high frequency or broadband gain reduction occurs, thus the DSP, when operating, is free from the objectionable artifacts introduced by other "de-essing" schemes.

The Model 440's Dynamic Sibilance Processor can remove only those portions of frication in speech likely to cause overload or "splatter" without substantially altering the "ss" sound by restoring the nearly Gaussian spectral distribution produced by "normal" frication. The operation of the DSP is so subtle as to be imperceptible, and, in fact may only be verified by critical A/B listening tests under nearly ideal conditions or by comparative spectral analysis.

2. Installation

2.1 CONNECTING THE 440 TO OTHER EQUIPMENT

The Model 440 is designed to interface with all commonly used professional audio equipment which operate at nominal line levels of 0 dB to +8 dB. No provisions are made for direct connection to microphones or other equipment having nominal signal levels below - 10 dB (250 mVrms). Due to the presence of RF suppression networks at the audio input of the 440, it is recommended that the 440 be driven by devices with output source impedances less than 5 kohm.

The Model 440 may be transformer coupled at both its input and output. The device does not require termination at its output, nor does it provide termination at its input. When the 440 is fed by a device requiring low-impedance termination, the appropriate terminating resistor may be connected across the input at the 440 rear panel barrier strip connector.

The Model 440 is connected to the ac mains by means of a standard three wire cordset. The ac safety ground is connected to the metal chassis. For protection against possible shock hazard, the 440 should be powered from a three terminal grounded outlet.

If ac hum is introduced in the 440 interconnections due to ground loops, the internal jumper connecting 0 Vdc to the chassis safety ground may be removed from the power supply section of the printed circuit board (See Section 5. Maintenance). Do not remove the safety ground wire from the chassis nor the ground pin from the ac plug.

2.2 INTERCOUPLING FOR STEREO PROCESSING

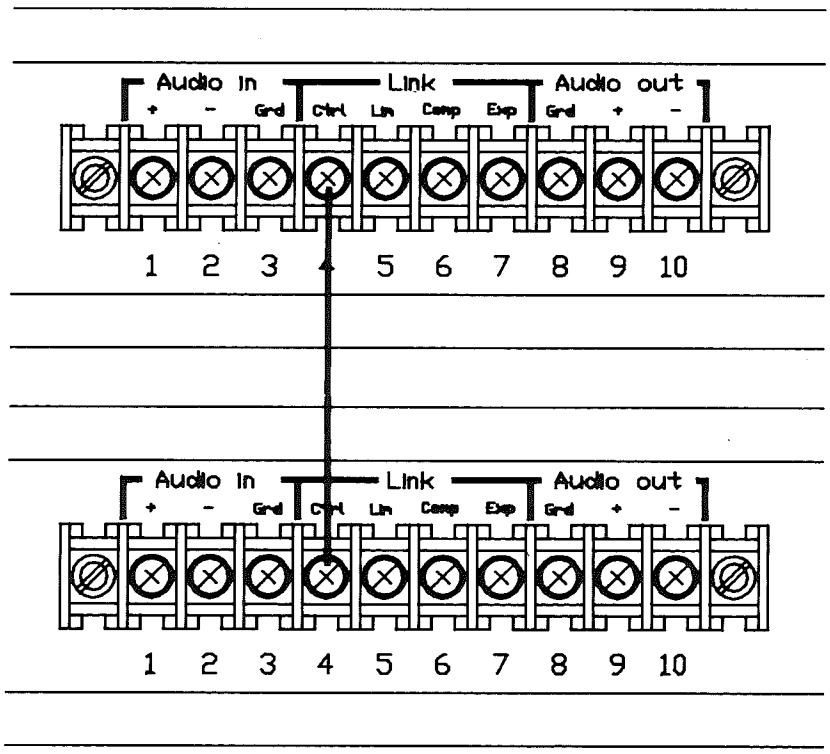


FIGURE 9a
Master/Slave Link Diagram

In the Master/Slave Link configuration, the control sections of a single Model 440 may be used to operate one or more additional 440's by connecting the control voltage link terminals as shown in Figure 9a. When using this method for stereo processing, the slave unit's control sections are defeated by selecting the "out" positions of the appropriate mode switches (Comp., Exp., Limiter). The clipper stages, DSP, and Output gain controls are not affected by the control link.

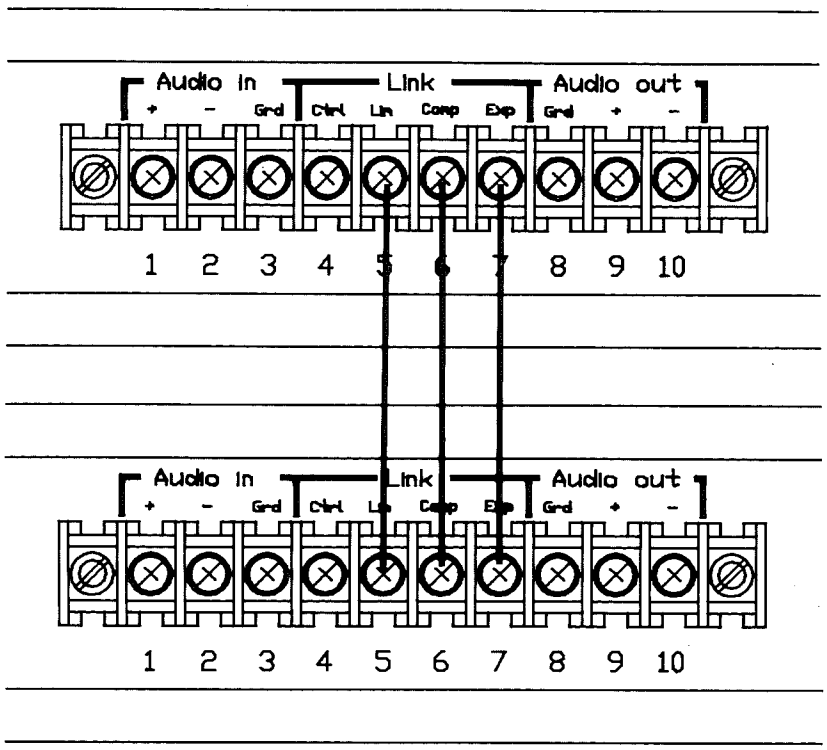


FIGURE 9b
Stereo Couple Diagram

In the Stereo Coupled mode of operation, the individual control voltages of the compressor, expander, and limiter circuits in both the A and B channels of the stereo pair are averaged prior to the control summing port of each Model 440. This configuration provides superior center image stability over that of the master/slave link configuration. The control sections of the two processors must be adjusted for nearly identical settings. The clipper stages, DSP, and Output gain controls are not affected by the control link.

3.1 EXPLANATION OF BLOCK DIAGRAM

Figure 10 illustrates a block diagram of the Model 440.

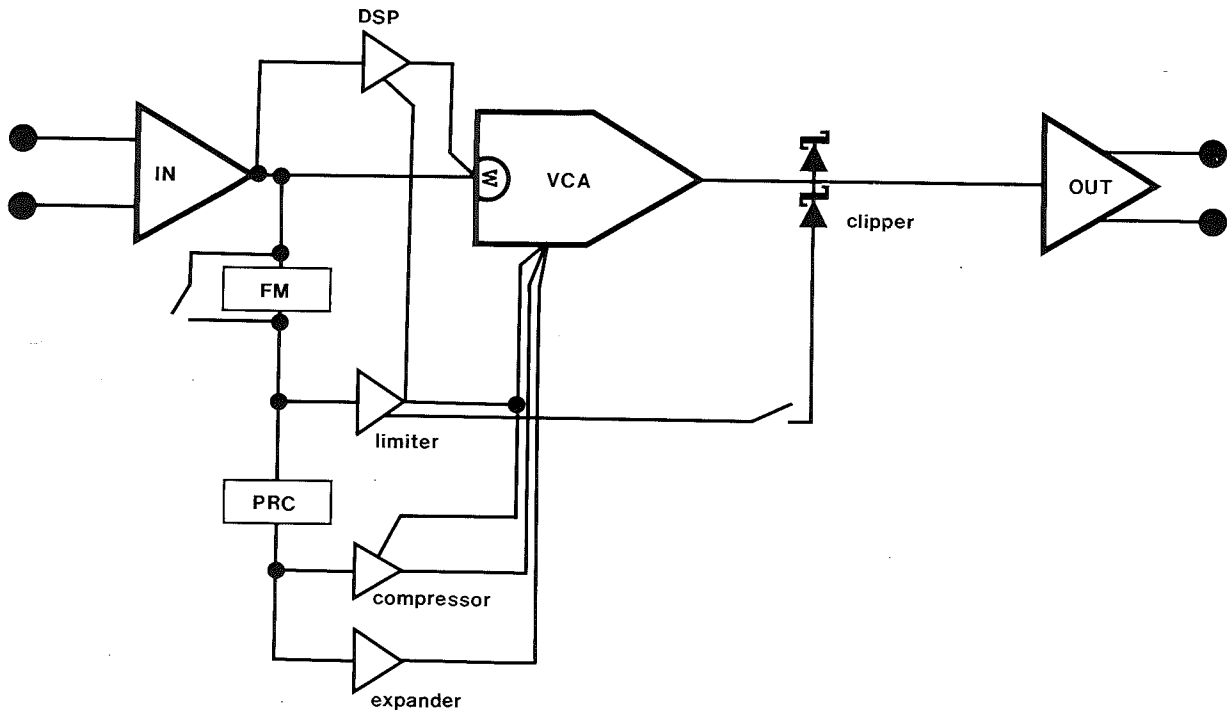


FIGURE 10
Block Diagram

The input balancing amplifier audio take-off feeds audio to the Dynamic Sibilance Processor section, DSP, and to the voltage controlled amplifier, VCA. The VCA is followed by the clipper circuit. The clipper output feeds the output balancing network and line driver amplifiers.

The control take-off, also part of the input balancing amplifier, feeds the pre-emphasis network switching section, FM. The signal is then routed to the limiter converter and control, to the compressor/expander peak reversion correction circuitry, PRC, and thence to the compressor and expander converter and their respective control sections.

Each of the control sections consists of an analogue computer which accepts voltage inputs from one or more front panel controls, from the converter preceding it, and from other control sections, and produces a voltage output which will be applied to the control ports of the VCA, thus direcing its instantaneous gain or loss.

The various output voltages of each control section also appear at the rear panel barrier terminals designated as "Link" connections.

4. Operating Instructions

4.1 A CONTROLS

COMPRESSOR THRESHOLD CONTROL: Calibrated in dB, determines the level above which compressor gain reduction begins.

COMPRESSOR RATIO CONTROL: Variable from 1:1 to 20:1, determines the compression ratio, or the voltage level increase in dB above the compressor threshold required to produce a 1 dB increase in output voltage level during compression.

COMPRESSOR ATTACK TIME CONTROL: Variable from 200 µs to 200 ms, determines the integration time of the linear integrating detector, thus effectively determining the attack time of the compressor control section. This control also affects the peak reversion correction circuitry.

COMPRESSOR MODE SWITCH: Selects the compressor control section's operating mode, compressor in, FM pre-emphasis compensated compression (and limiting) and compressor out, which disables the compressor control section.

EXPANDER THRESHOLD: Calibrated in dB, determines the input voltage level below which expander gain reduction begins.

EXPANDER IN/OUT SWITCH: Enables or disables the expander control section.

COMPRESSOR/EXPANDER RELEASE TIME CONTROL: Calibrated in seconds per 20 dB of recovery, determines the rate at which both the compressor and expander release.

AUTO/NORMAL MODE SWITCH: When in the Auto position, presets compressor attack time and release time, and places compressor ratio, expander threshold, and compressor threshold all under a control voltage derived from the setting of the compressor threshold control.

LIMITER/CLIPPER THRESHOLD CONTROL: Calibrated in dB rms, this control allows adjustment of the limiter and clipper threshold to be correlated with the compressor threshold. The actual voltage level of the limiter and clipper threshold is approximately +4 dB relative to the indicated threshold setting, or the peak to average differential of a sinewave.

LIMITER RELEASE TIME: Calibrated in seconds per 20 dB of recovery, determines the rate at which the limiter control section releases.

LIMITER MODE SWITCH: Configures the limiter control section for peak limiting (Limiter In), Automatic Gain Control (AGC), or disables the limiter control section (out).

CLIPPER IN/OUT SWITCH: Enables or defeats the clipper.

LINK SWITCH: Connects control voltages to the link/couple buss for stereo processing using two units.

DSP MODE SWITCH: Selects either of the two Dynamic Sibilance Processor modes, DS1 (low frequency) or DS2 (high frequency) or disables the DSP control section.

OUTPUT CONTROL: Calibrated in dB, allows adjustment of output level. When performing compression or limiting, the output control markings correspond to the nominal line level output in dB ref. 0.775 Vrms.

vu SELECT SWITCH: Connects the Volume Indicator (vu meter) to either the input or output of the 440.

BYPASS SWITCH: Provides a passive, hardwired connection between the input and output terminals.

POWER SWITCH: Connects ac mains to power supply transformer primary.

4.1 B THE INDICATORS

COMPRESSOR LED "Comp.": Indicates that the compressor control section is causing gain reduction.

EXPANDER LED "Exp.": Indicates that the expander control section is causing gain reduction.

LIMITER LED "Lim.": Indicates that the limiter control section is causing gain reduction.

CLIPPER LED "Clip": Indicates that the clipper stage is clipping.

COMPRESSOR GAIN REDUCTION LED DISPLAY: Indicates the amount of gain reduction, in dB, being caused by the compressor or expander control sections.

LIMITER GAIN REDUCTION LED DISPLAY: Indicates the amount of gain reduction, in dB, being caused by the limiter control section.

DS LED: Indicates dynamic sibilance processing.

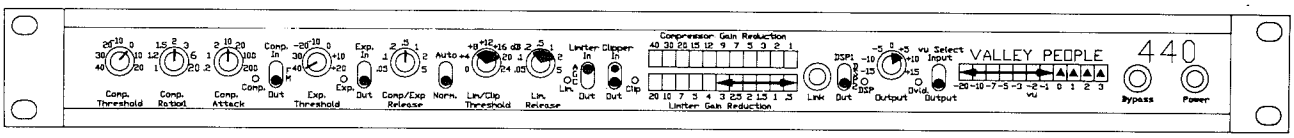
OVERLOAD LED "Ovld.": Indicates excessive signal level at the line driver stage.

VOLUME INDICATOR LED DISPLAY "vu": Indicates input or output level in volumetric units.

4.2 SAMPLE SETTINGS FOR OPERATING THE 440

A. PEAK LIMITING

Applications: Tracking instruments during recording. Limiting broadcast program feeds. Master disk cutting.



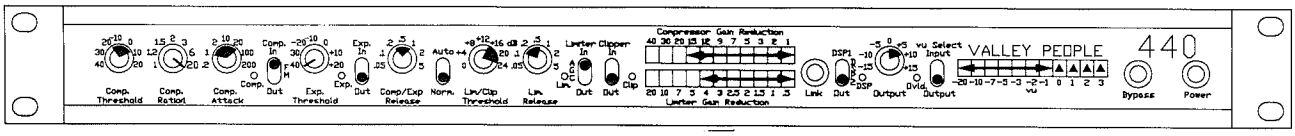
Compressor Threshold: +20 (Full cw) (not active in this mode)
Compressor Ratio: 1:1 (Full ccw) (not active in this mode)
Compressor Attack: 10 (not active in this mode)
Compressor Mode Switch: Out ; For FM pre-emphasis, FM (See Section 4.4)
Expander Threshold: -40 (not active in this mode)
Expander In/Out Switch: Out
Compressor/Expander Release: .5 (not active in this mode)
Auto/Norm: Norm.

Limiter/Clipper Threshold: maximum desired line out. See text.
Limiter Release: .5
Limiter Mode Switch: Limiter In
Clipper In/Out Switch: As required. See text.
Link Switch: As required for stereo operation.
DSP Mode Switch: Out/In as required
Output Control: 0 for unity gain
VU Select Switch: Output
Bypass Switch: No indication (normal)

By observing peak program meters, modulation monitors, etc. on device fed by the 440, adjust Limiter Threshold control for desired amount of limiting. If maximum rms input level of device is known, i.e. +24 dB, +18 dB, adjust Limiter threshold accordingly. Clipper may be enabled to clamp extremely fast transients or impulse noise (if present), but should rarely be needed. Adjust release control for least noticeable audible effect.

B. AVERAGE LIMITING WITH "PEAK STOP"

Applications: Tracking instruments or vocals during recording. Increasing apparent loudness of mixed program for broadcast feeds. "Punching up" on-air personality's voice.



Compressor Threshold: As required. Usually -10 to +10 dB
Compressor Ratio: 20:1 (full cw)
Compressor Attack: Usually 10 to 20 ms. See text.
Compressor Mode Switch: Comp. In, For FM pre-emphasis, FM (See Section4.4)
Expander Threshold: -20 to -10 as required. See text.
Expander In/Out Switch: As required. See text.
Compressor/Expander Release: .2 to 1 s/20 dB (Near center of range)
Auto/Norm: Norm.
Limiter/Clipper Threshold: Usually to +8 dB or higher. See text.
Limiter Release: As required for best sound. See text.
Limiter Mode Switch: Limiter In
Clipper In/Out Switch: Out
Link Switch: If required for stereo separation
DSP Mode Switch: Out/In as required
Output Control: As required. Usually "0" for unity gain. See text.
VU Select Switch: Output
Bypass Switch: No indication (normal)

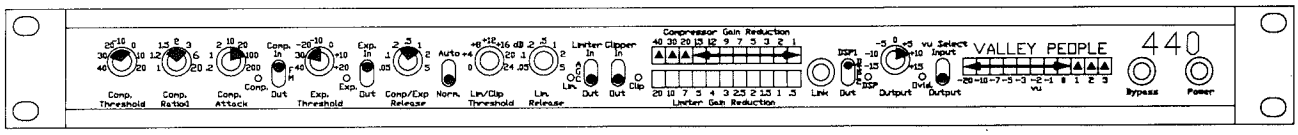
In this configuration, the output control is adjusted to the required output line level (0, +4, +8 dB). The compressor threshold control is then adjusted to reflect the desired amount of compression as indicated by the compressor gain reduction meter, usually within the 3 to 10 dB range. If compressor gain reduction greater than 10 dB is desired, and the signal sounds excessively noisy after the compressor releases to idle gain (no gain reduction), use the expander to quiet low-level passages and pauses.

Attack time of 10 ms or more for the compressor will yield a smooth, well-contoured sound but cannot cause the compressor to control transient peaks in the program.

For this reason, the limiter is used, being adjusted at least 6 to 8 dB above the compressor threshold. On material with a great deal of recurring peaks, a relatively slow limiter release may be desirable, while occasional peaks dictate the use of fast release times to eliminate pumping of the program level during passages requiring limiting in excess of 3 dB. Excessive limiting in this mode (greater than 10 dB average) will cause severe pumping due to the intercoupling circuitry in the compressor control, especially if compressor attack time is shortened.

C. INTERACTIVE EXPANDED COMPRESSION

Applications: Recording vocals, strings, mixed program. Post-production "sweetening" of mix or tracks.



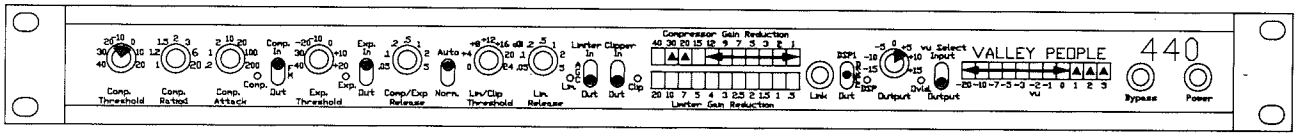
Compressor Threshold: 0 to -30 dB. See text.
Compressor Ratio: 2:1 - 6:1 typical
Compressor Attack: 10 ms to 100 ms
Compressor Mode Switch: Comp. In
Expander Threshold: -10 to -30 as required. See text.
Expander In/Out Switch: In
Compressor/Expander Release: .2 to 1 s/20 dB. See text.
Auto/Norm: Norm.
Limiter/Clipper Threshold: +24
Limiter Release: 0.5 s/20 dB (control is centered, but not active)
Limiter Mode Switch: Out
Clipper In/Out Switch: Out
Link Switch: If required for stereo operation.
DSP Mode Switch: Out/In as required
Output Control: As required; usually "0" for unity gain
VU Select Switch: Output
Bypass Switch: No indication (normal)

In general use, the 440's compressor section will be employed to subtly enhance the apparent loudness of, or to "sweeten", musical program. Since compression involves increasing the level of signals below the compressor threshold as well as decreasing the level of signals above the threshold, the compressor control directs the 440's VCA to exhibit a certain amount of no-signal gain, or "idle gain". This has the effect of "pumping up" the noise floor of the processed signal. As the compressor threshold control is adjusted to a lower threshold (toward -40) with a given ratio, this idle gain is increased. Likewise, with a given threshold, as the compression ratio is increased, the idle gain increases. This increase in idle gain, and its accompanying degradation is apparent signal-to-noise ratio may be compensated for by using the expander. During pauses and fades, the expander reduces the gain of the VCA, thus eliminating elevation of the noise floor. In order to achieve best loudness with least objectionable artifacts, the compressor threshold and ratio controls should be balanced against one another to achieve between 3 and 10 dB of gain reduction. A differential of about 10-20 dB should exist between compressor and expander thresholds, although expander thresholds below -30 are virtually useless when processing taped program.

Faster release times create a louder sound, but with the disadvantage of more objectionable artifacts such as pumping and distortion, so use moderate release times as best trade-off for smooth contour and increased loudness.

D. INTERACTIVE EXPANDED COMPRESSION, AUTO MODE

Applications: Same as Interactive Expanded Compression. Fast set-up for on-road and remote work. Simplified operation allows rapid adjustment in multi-track mix-downs, etc.



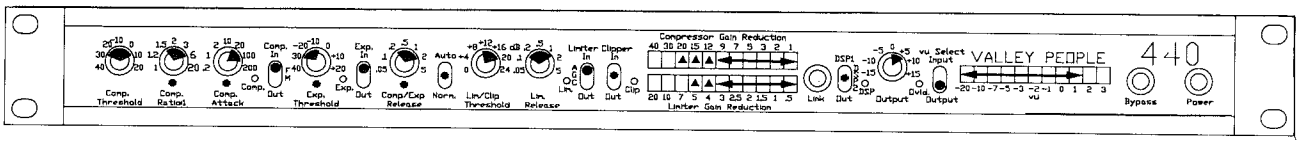
Compressor Threshold: As required. See text.
Compressor Ratio: N/A
Compressor Attack: N/A
Compressor Mode Switch: As required; In or FM. See text.
Expander Threshold: N/A
Expander In/Out Switch: In
Compressor/Expander Release: N/A
Auto/Norm: Auto
Limiter/Clipper Threshold: +24
Limiter Release: .5s (not active in this mode)
Limiter Mode Switch: Out
Clipper In/Out Switch: Out
Link Switch: If required for stereo operation.
DSP Mode Switch: As required for vocals.
Output Control: As required, usually "0" for unity gain
VU Select Switch: Output
Bypass Switch: No indication (normal)

This operational mode of the Model 440 allows the operator to obtain more or less compression by adjusting only the compressor threshold control. All other parameters of compressor and expander operation are program dependent.

To achieve more compression (denser sound) turn the compressor threshold toward -40. Since it is anticipated that auto-operation will be very useful for "punching up" on-the-air personalities and mixed program, the FM compressor mode may be used to insert the 75 µs pre-emphasis network in the processing control. This causes the compressor to become more sensitive to high frequency information, but does not equalize or alter the frequency response of the signal chain. See 4.4 FM PRE-EMPHASIS COMPENSATION.

E. INTERACTIVE EXPANDED COMPRESSION WITH LIMITING

Applications: General in-studio use. Sweetening in production, post-production, and broadcast feeds.

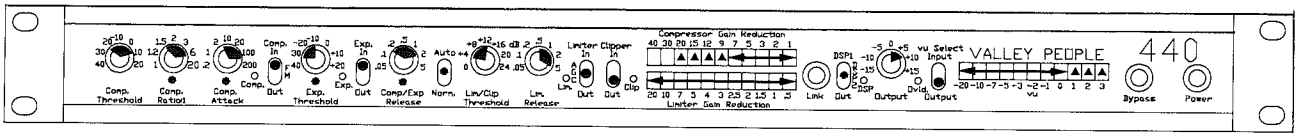


Compressor Threshold: As required, usually 0 to -30. See text.
Compressor Ratio:* As required, usually 1:1:5 to 6:1. See text.
Compressor Attack:* 10 ms to 100 ms
Compressor Mode Switch: In
Expander Threshold:* 0 to -30. See text.
Expander In/Out Switch: In
Compressor/Expander Release: .2s to 2s. See text.
Auto/Norm:* indicates settings N/A if in Auto.
Limiter/Clipper Threshold: +8 to +20. See text.
Limiter Release: .1s to 1s
Limiter Mode Switch: Limiter In
Clipper In/Out Switch: As required
Link Switch: If required for stereo operation.
DSP Mode Switch: As required for vocal de-essing
Output Control: Usually "0" for unity gain
VU Select Switch: Output
Bypass Switch: No indication (normal)

By using the compressor, expander, and limiter sections of the 440 interactively, signals may be compressed for increased loudness while the limiter controls the absolute peak voltage level out of the device, thus protecting peak sensitive devices (power amplifiers, speakers, master disk cutting systems, etc.) farther down the signal chain. The expander controls the apparent signal-to-noise degradation caused by elevated idle gain at the VCA due to compression. Best increase in loudness is usually afforded by balancing compressor threshold and ratio controls to obtain 3 to 10 dB of compression as indicated on the compressor gain reduction meter. Expander threshold is adjusted for best noise suppression without gain pumping, usually 10 dB or so below the nominal signal level. Compression/Expander release time is adjusted for best trade-off between apparent loudness and freedom from processing artifacts, usually .5 s/20 dB is optimum for most types of material. Limiter threshold is adjusted for nominal maximum line level into the following equipment or lower, as required.

F. AGC WITH COMPRESSION AND EXPANSION

Applications: Program feeds where extreme differences in level are encountered, such as commercial inserts in network programs, post-switcher audio processing or AGC in pre-modulator position at Cable TV headend, live sound reinforcement.

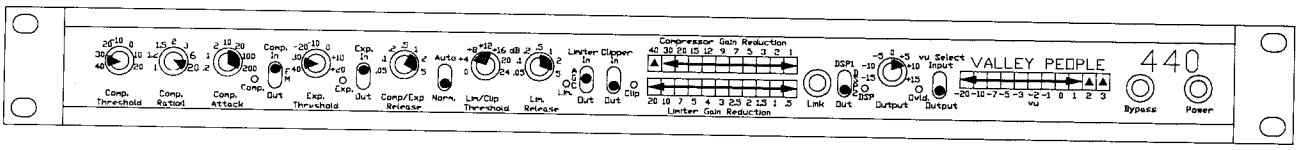


Compressor Threshold: 0 to -20
Compressor Ratio:* 2:1 or higher as required. See text.
Compressor Attack:* 10 ms or longer
Compressor Mode Switch: In
Expander Threshold:* -10 to -30
Expander In/Out Switch: In
Compressor/Expander Release: .2s to 2s
Auto/Norm:* indicates functions N/A in Auto
Limiter/Clipper Threshold: Adjust for +1 to +3 vu peaks, usually +4 to +12
Limiter Release: .5s to 5s. See text.
Limiter Mode Switch: AGC
Clipper In/Out Switch: Out
Link Switch: If required for stereo operation.
DSP Mode Switch: As required for vocals
Output Control: Usually "0" for unity gain
VU Select Switch: Output
Bypass Switch: No indication (normal)

The intended use of the AGC limiter mode is to maintain a relatively constant output vu level with signals that reach peak input levels of +24 or more. In AGC, the limiter release time is multiplied by a factor of 10. Highly transient material may require moderate release times (control at about .5), while voice announcements or "background music" may use longer release times. For normal operation (non-Auto) balance the compressor threshold and ratio from 3 to 10 dB of compression as indicated by the compressor gain reduction meter.

G. WIDE RANGE AGC

Applications: General use where very wide range of levels may be encountered, such as post-switcher audio feeds in CATV/MSO application, sound reinforcement, radio commercial insertions.



Compressor Threshold: -30 to -40
Compressor Ratio: 6:1 to 20:1
Compressor Attack: 10 to 200 ms, not critical
Compressor Mode Switch: In
Expander Threshold: -30 to -40. See text.
Expander In/Out Switch: In
Compressor/Expander Release: .5s to 5s. See text.
Auto/Norm: Norm.
Limiter/Clipper Threshold: Adjust for desired output. Usually +4 to +12. See text.
Limiter Release: .5s to 2s. See text.
Limiter Mode Switch: AGC
Clipper In/Out Switch: Out
Link Switch: If required for stereo operation.
DSP Mode Switch: Out
Output Control: Set for nominal output line level
VU Select Switch: Output
Bypass Switch: No indication (normal)

In this configuration, the 440 provides a fixed output line level for input signals ranging from -40 dB to +24 dB. The need for so wide a range of AGC is considered highly unusual, and should be verified prior to applying the 440.

In the presence of signals having very low levels, the compressor's gain recovery computation circuitry adds gain at the VCA, thus allowing signals from -40 upward to exit the device at a line level directed by the output control. Compressor release times of .5s or greater are indicated if the input level ranges into the -10 to +10 range in addition to the -40 range. The AGC as performed by the Limiter AGC mode is active only for signals above 0 dB.

The Limiter threshold is adjusted by observing the volume indicator (vu meter) while assigned to output. In the presence of high level signals, adjust the limiter threshold for peaks of +3 vu. The limiter release time is multiplied by a factor of 10 in the AGC mode. Material with a great deal of dynamic range may require a moderate release time (control at .5) while other types will require longer release times (control at 2 to 5). The expander is useful in reducing noise amplified by the compressor, but may become ineffective when fed noisy high-level signals, thus will require care in application.

4.3 USE OF THE DYNAMIC SIBILANCE PROCESSOR

The Dynamic Sibilance Processor may be used alone or in conjunction with any of the Model 440's functional modes. The two modes of the DSP operation are intended for different uses. The DS1 position will detect and remove objectionable sibilance

in the band of frequencies from 8.5 kHz to 10 kHz, while the DS2 position affects the band of frequencies from 9.8 kHz to 13 kHz. For general use, the DS1 position is preferred, while the DS2 position is preferred when using the 440 in highly equalized signal chains such as FM transmission or master disk cutting.

In normal operation, the DS LED indicator may flash during passages containing waveforms having high crest factors, such as cymbal crashes, however, the indicator will stay lit only on passages containing problem sibilance. The relative brilliance of the DS LED provides visual indication of the operation of the DSP circuitry: heavy de-essing produces an indication which appears more brilliant than light or normal de-essing.

4.4 FM PRE-EMPHASIS COMPENSATION

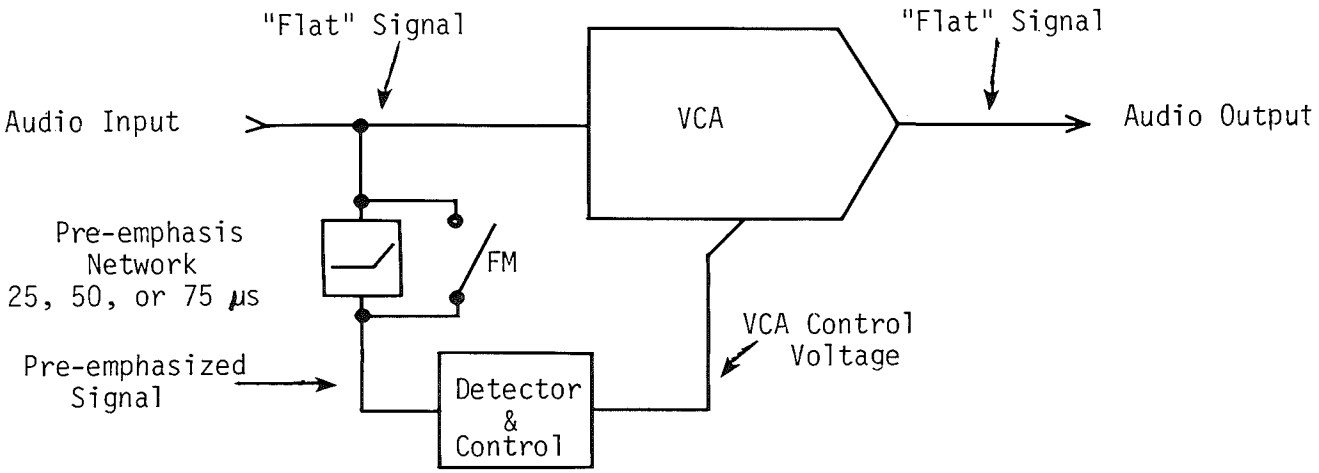


FIGURE 11
FM PRE-EMPHASIS COMPENSATION

To meet the special needs of the FM broadcaster, the Valley People 440 Limiter/Compressor/Dynamic Sibilance Processor incorporates FM pre-emphasis compensation in the control sections of the compressor, expander, and limiter.

When using a compressor in the signal chain to increase apparent loudness, or control the dynamic range of the program, the station operator faces the problem of making the compressor "aware" of the pre-emphasis network at the transmitter input, otherwise the high frequency content of the processed signal may cause frequent "hits" at the transmitter's final limiter or clipper, resulting in objectionable "coloring" or distortion of the program material.

Traditionally, the method used was to pre-emphasize the signal at the compressor input, and then to de-emphasize the signal at the compressor output before the transmitter audio feed, where it was again pre-emphasized for transmission. This was certainly necessary when using feedback limiters and compressors having "linear" gain control elements.

With the advent of the modern feed-forward compressor and limiter, the cumbersome and noisy "pre/post" equalization scheme became unnecessary. Figure 11 illustrates, in simplified form, the operation of the pre-emphasis compensation used in the Valley People Model 440.

In normal operation, with the pre-emphasis network bypassed, both the audio signal chain and the detector and control sections receive a "flat", or unequalized audio signal. When the FM position is selected using the Compressor Mode Switch, the pre-emphasis network is inserted into the control signal chain only. As a result, the audio signal chain frequency response remains "flat", and only the detector and control sections receive a pre-emphasized signal. In this configuration, the detector and control sensitivity increases at the rate of 6 dB/octave (20 dB/decade) of increasing frequency, as does the sensitivity of the transmitter's final peak limiter/clipper in its post-equalization position. The overall effect of this pre-emphasis compensation is to cause gentle, unobtrusive broadband gain reduction in the presence of predominant high frequency content and sibilance in the program material.

5. Maintenance

Due to the complexity of the Model 440, a detailed tutorial discussion of its circuit operation is beyond the scope of this manual. A schematic diagram is provided to assist users who possess sufficient techanical background to perform in-field repair. Valley People, Inc. recommends that defective units be returned to factory authorized dealers or directly the the factory for repair. The technical staff at Valley People, Inc. is available to aid technical personnel in solving maintenance problems.

5.1 ADJUSTING THE VOLUME INDICATOR

The Model 440 volume indicator (vu meter) may be calibrated by adjustment of a trimmer potentiometer accessible through the rear panel access hole marked "vu cal". Switch the vu Select Switch to input, and with power on, feed a 1 kHz tone at 0 vu (0, +4, or +8 dB) to the 440. Adjust the vu cal. potentiometer until the first red meter segment, marked "0", glows. Verify that the 440 is operating at unity gain by switching all processing front panel mode switches to their "out" positions and assigning the volume indicator to output. With the gain control at 0, the volume indicator should display 0 vu.

5.2 ADJUSTING THE VCA CONTROL REJECTION TRIM

The VCA control rejection trimmer potentiometer nulls the dc offset of the VCA by balancing the current paths in the multiplier array TA-101. Should the control rejection become badly degraded, the clipper stage will clip assymetrically, and "clicking" may be heard at the output when the peak limiter is attacking. The control rejection is somewhat temperature sensitive, thus installation of the 440 in an abnormally high ambient area, such as an enclosed rack containing other heat generating equipment having little or no ventilation, may necessitate readjustment of the control rejection trimmer. Adjustment of this trim in the field is relatively simple.

a. Disable the expander control section by selecting the out position of the Expander In/Out Switch.

b. Ensure that no signal is being fed to the input of the 440.

c. Monitor the output of the 440, either with an oscilloscope or with amplifier and speaker at high gain.

d. With the volume indicator assigned to output, rapidly turn the 440 output control through its entire range. By observing the volume indicator and monitoring the 440 output, look and listen for "thumping" corresponding to the gain change caused by the output control.

e. If thumping or scratching is apparent, rapidly rock the output control between -10 and +10, and observing the 440 output, slowly adjust the rear panel trim marked "CNTL Rej" until the thumping disappears.

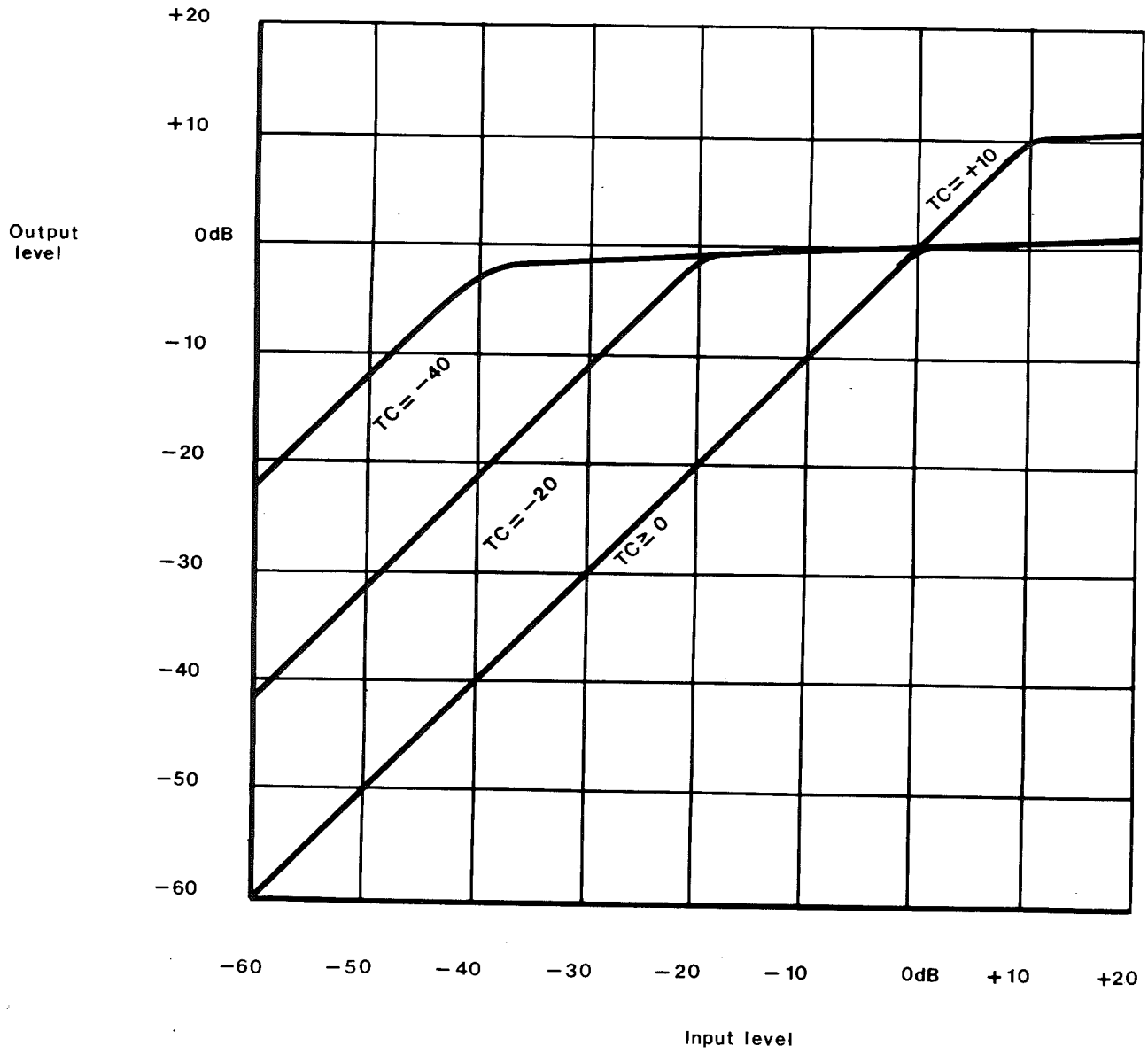
5.3 WARRANTY STATEMENT

Warranty

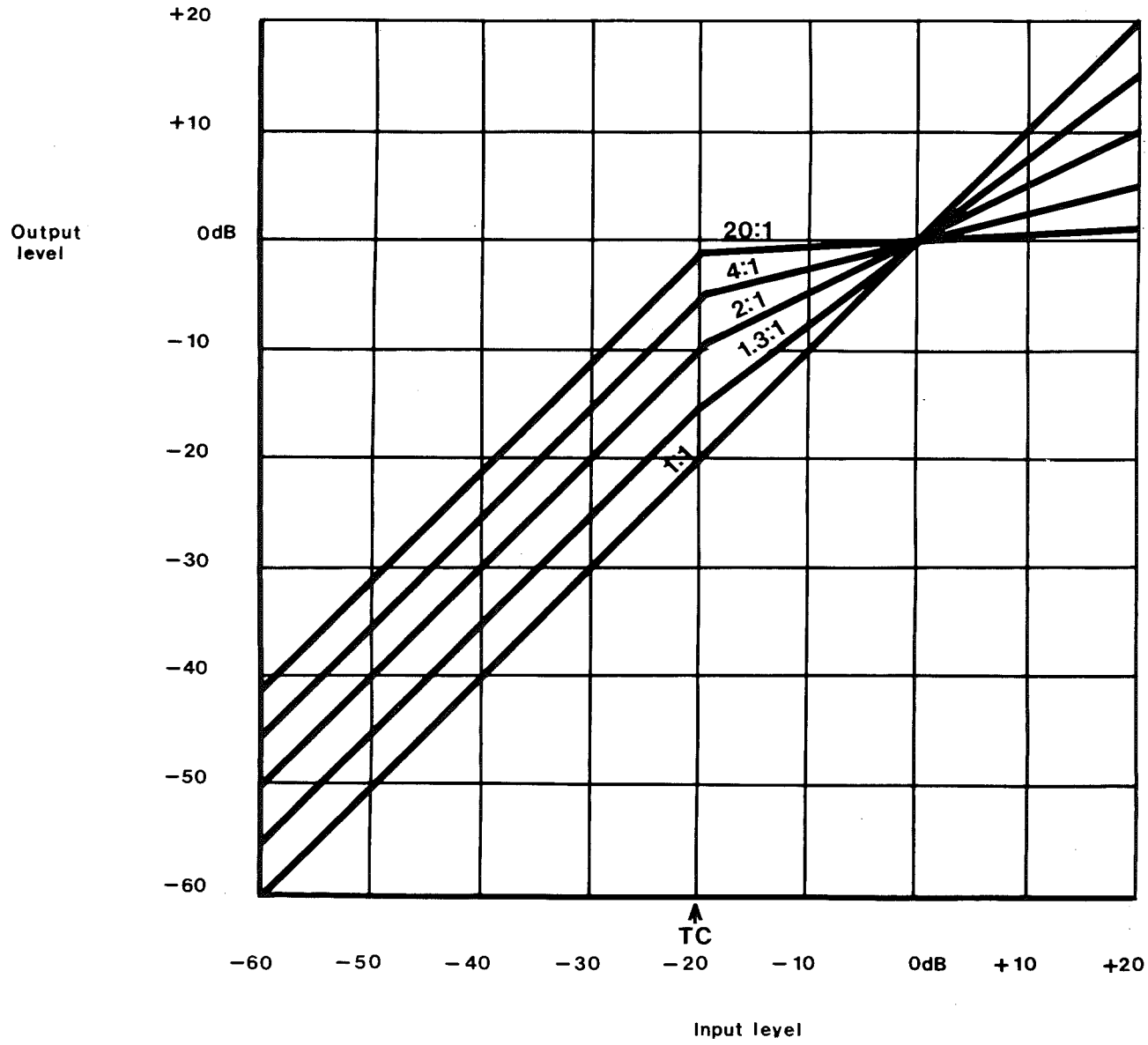
VALLEY PEOPLE, INC. warrants its products and their related enclosures and power supplies to be free from defects in workmanship and material under normal use and service. Said warranty is to extend for a period of twelve months after date of purchase. In the case that a VALLEY PEOPLE, INC. product or any of its related enclosures or power supplies is believed to be defective, same may be returned with transportation prepaid to VALLEY PEOPLE, INC., within twelve months after date of purchase, accompanied by proof of purchase. If the product is found by VALLEY PEOPLE, INC.'s inspection to be defective in workmanship or material, it will be repaired or replaced (at VALLEY PEOPLE, INC.'s election) free of charge and returned, transportation prepaid, to any point in the United States. If inspection by VALLEY PEOPLE, INC. of such products does not disclose any defect in workmanship or material, VALLEY PEOPLE, INC.'s regular charges will apply.

This warranty is expressed in lieu of any and all other warranties, whether expressed or implied, and the sole liability of VALLEY PEOPLE, INC. under this warranty is to either repair or replace (at VALLEY PEOPLE, INC.'s election) the product or its related enclosure or power supply. Any incidental damages are expressly excluded.

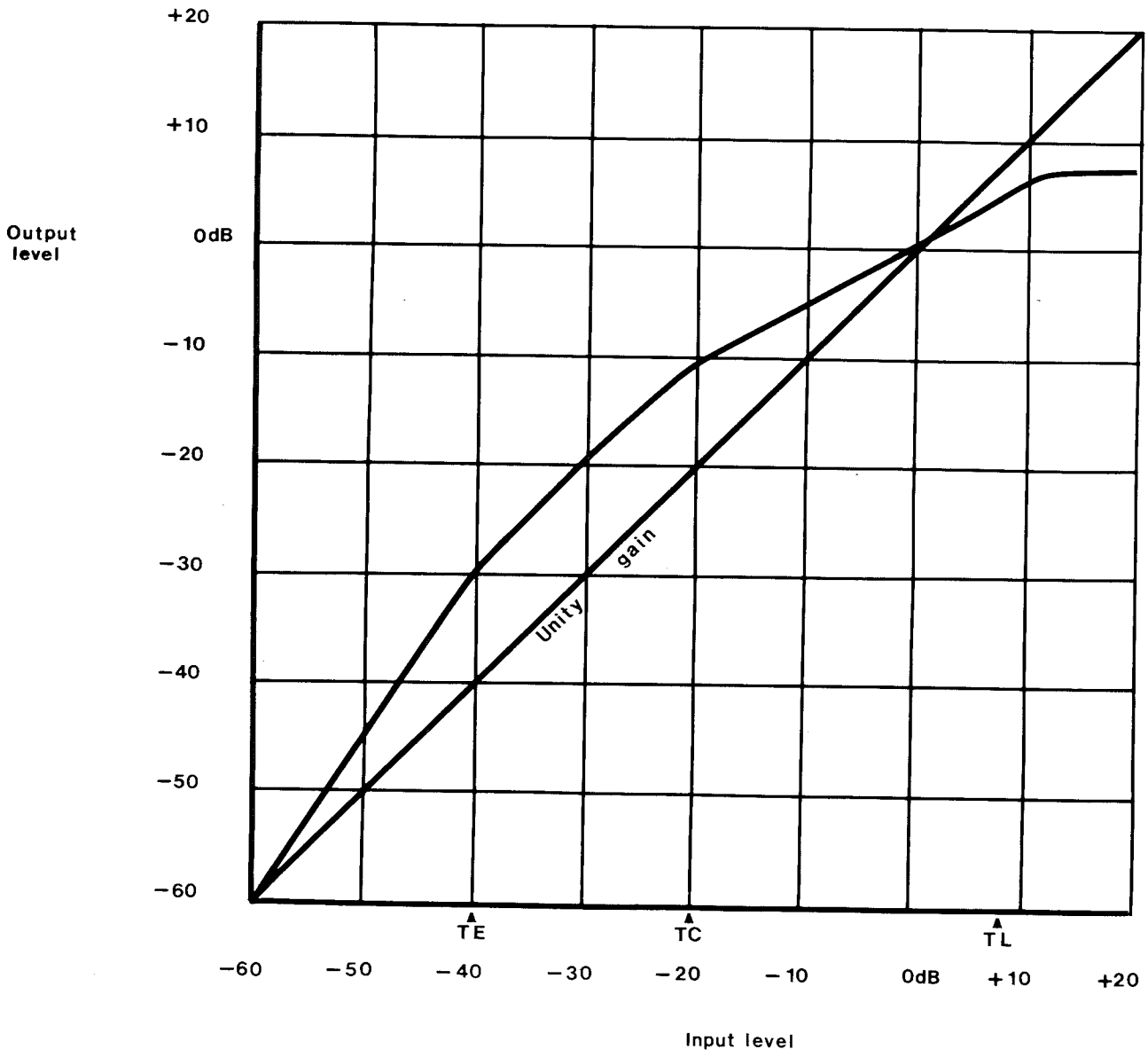
The foregoing warranty is VALLEY PEOPLE, INC.'s sole warranty, and all other warranties, expressed, implied, or statutory, are negated and excluded.



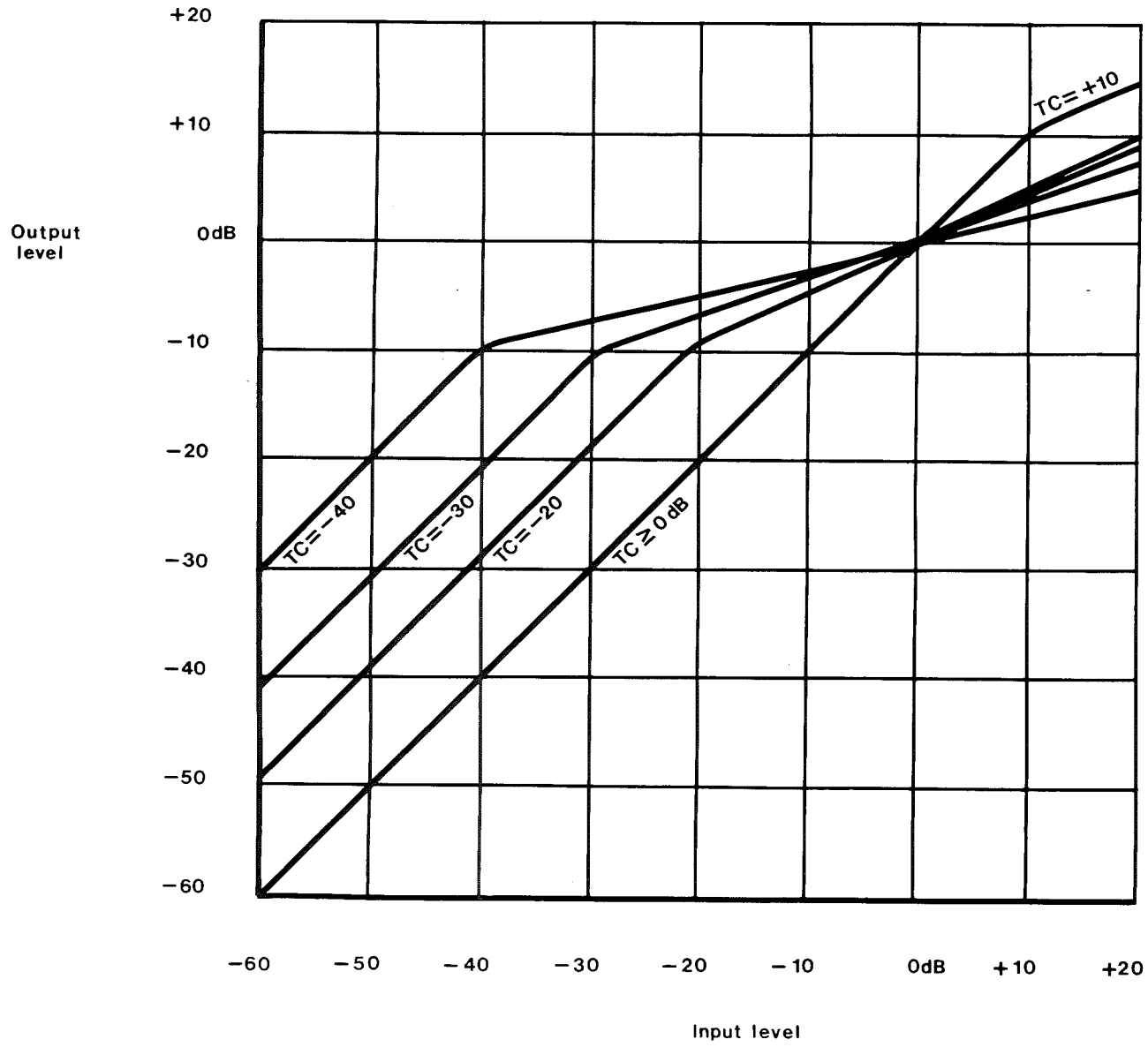
6.1 Effect of Gain Recovery Computation
Compressor in, Ratio 20:1
TC = Compressor Threshold in dB



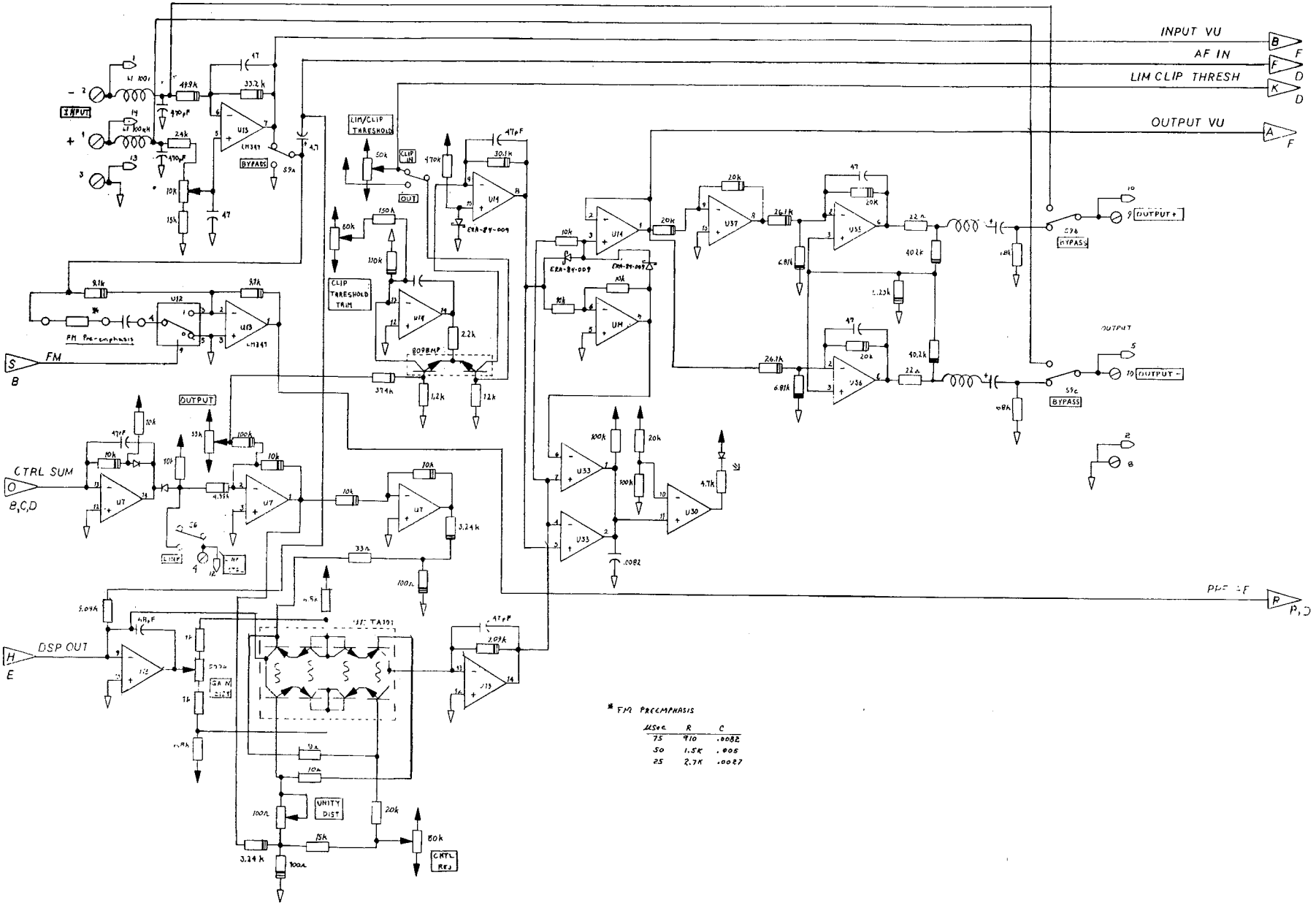
6.2 Effect of Ratio Control
Compressor in
Compressor Threshold (TC) @ -20 dB

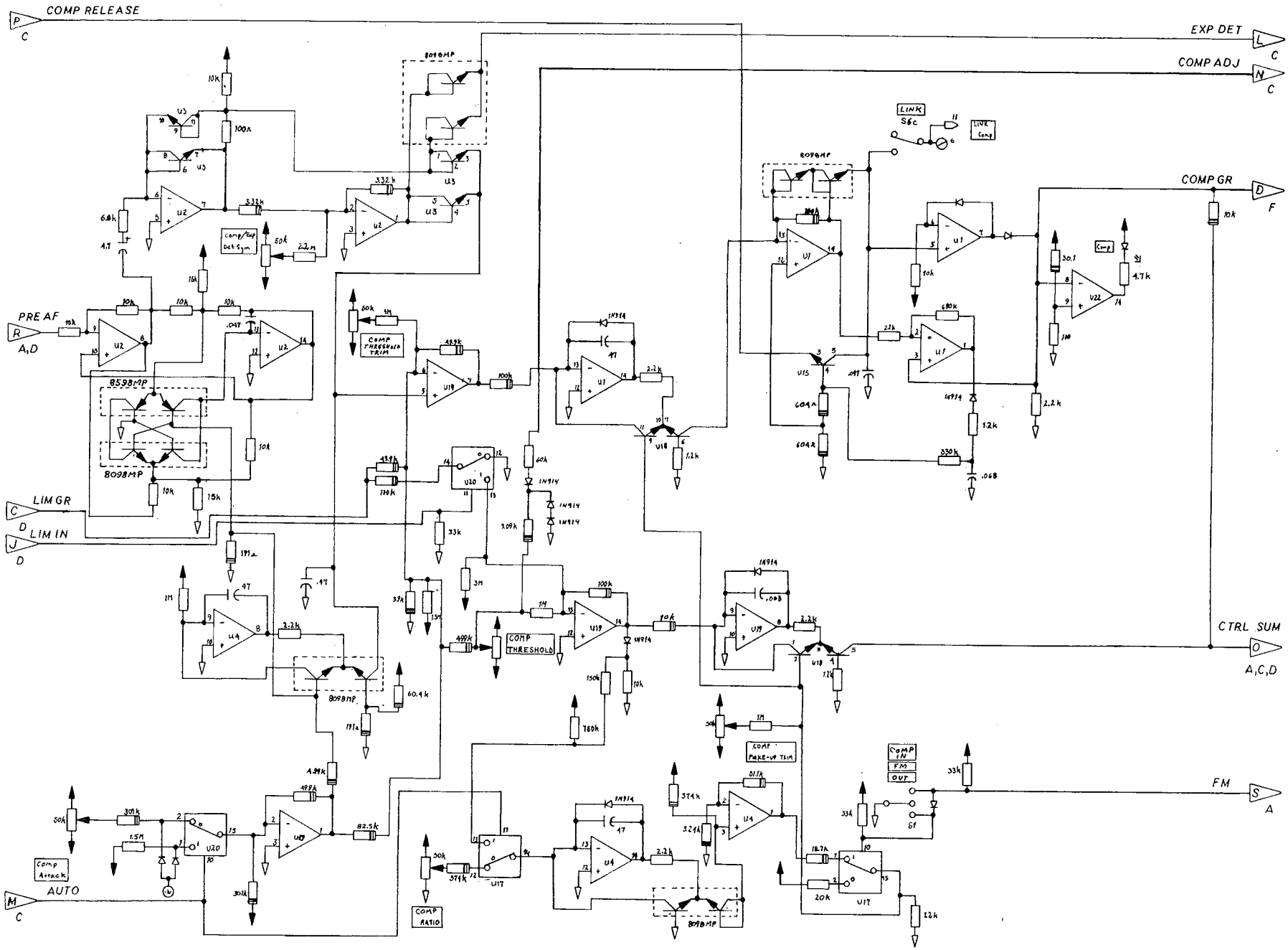


6.3 Interactive Processing:
Expanded Compression with Limiting.
Expander Threshold, TE @ -40 dB
Compressor Threshold, TC @ -20 dB
Limiter Threshold, TL @ +8 dB
Compression Ratio is 2:1

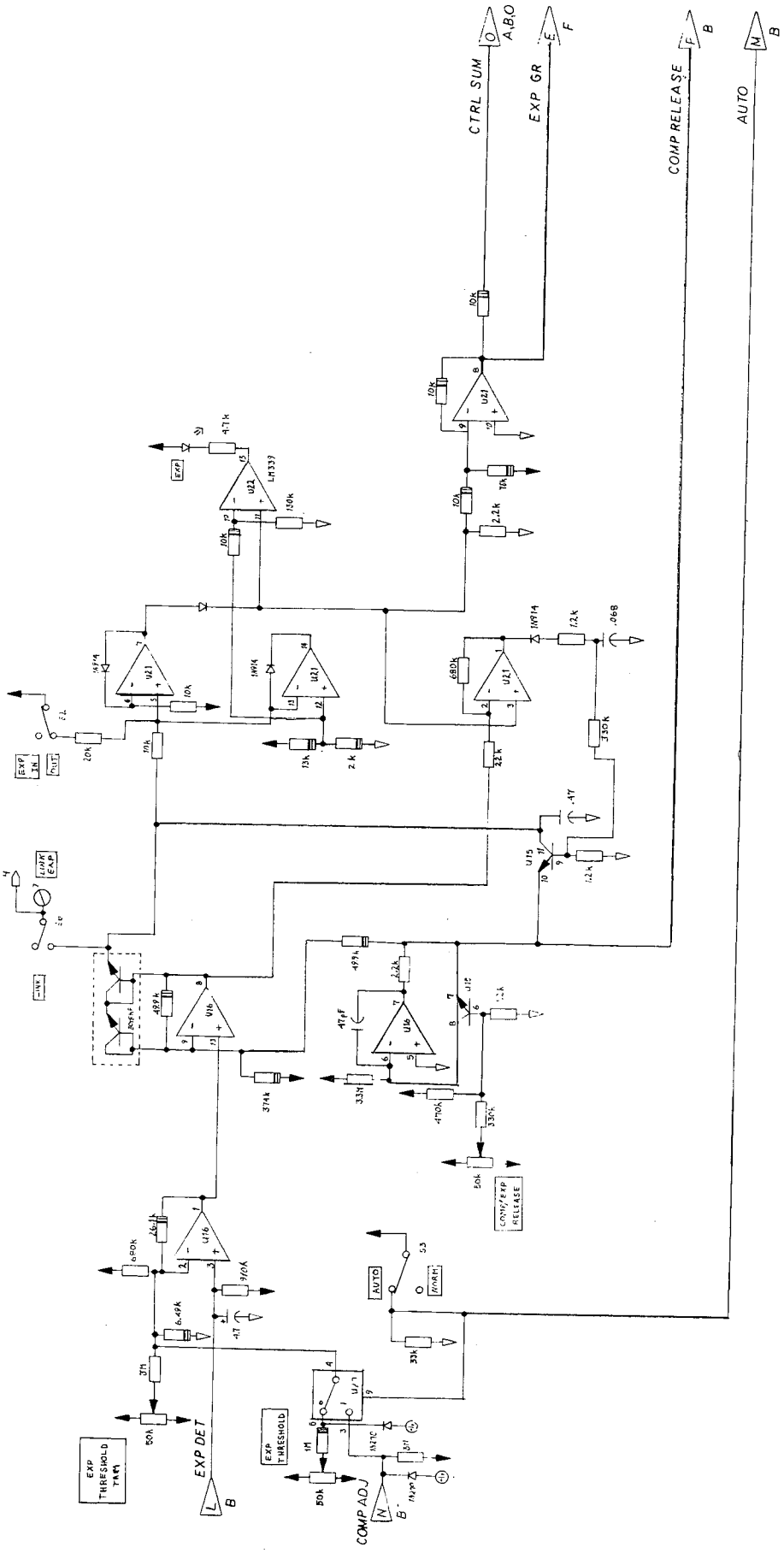


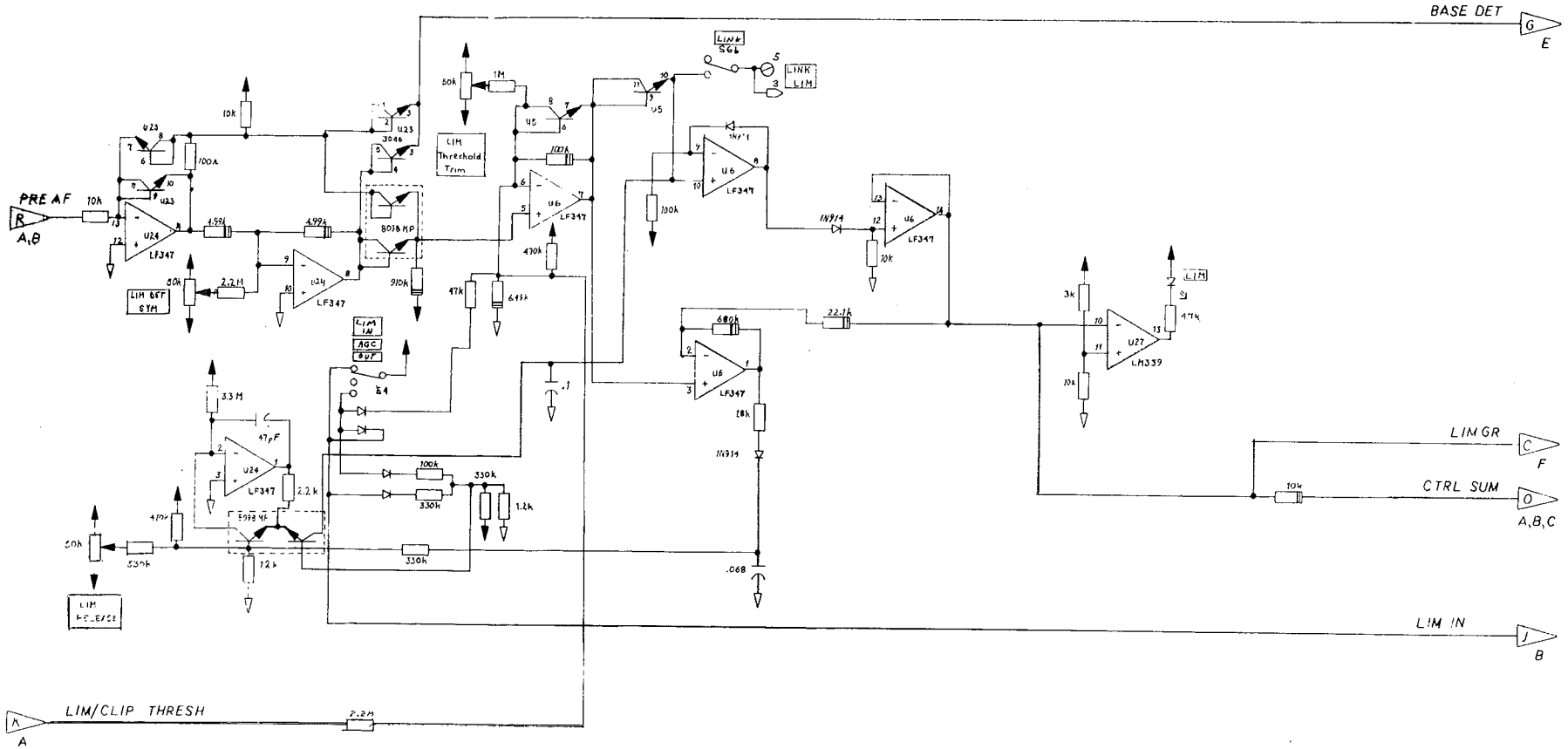
6.4 Effect of Compressor Threshold Control in Auto Mode
TC = Compressor Threshold in dB

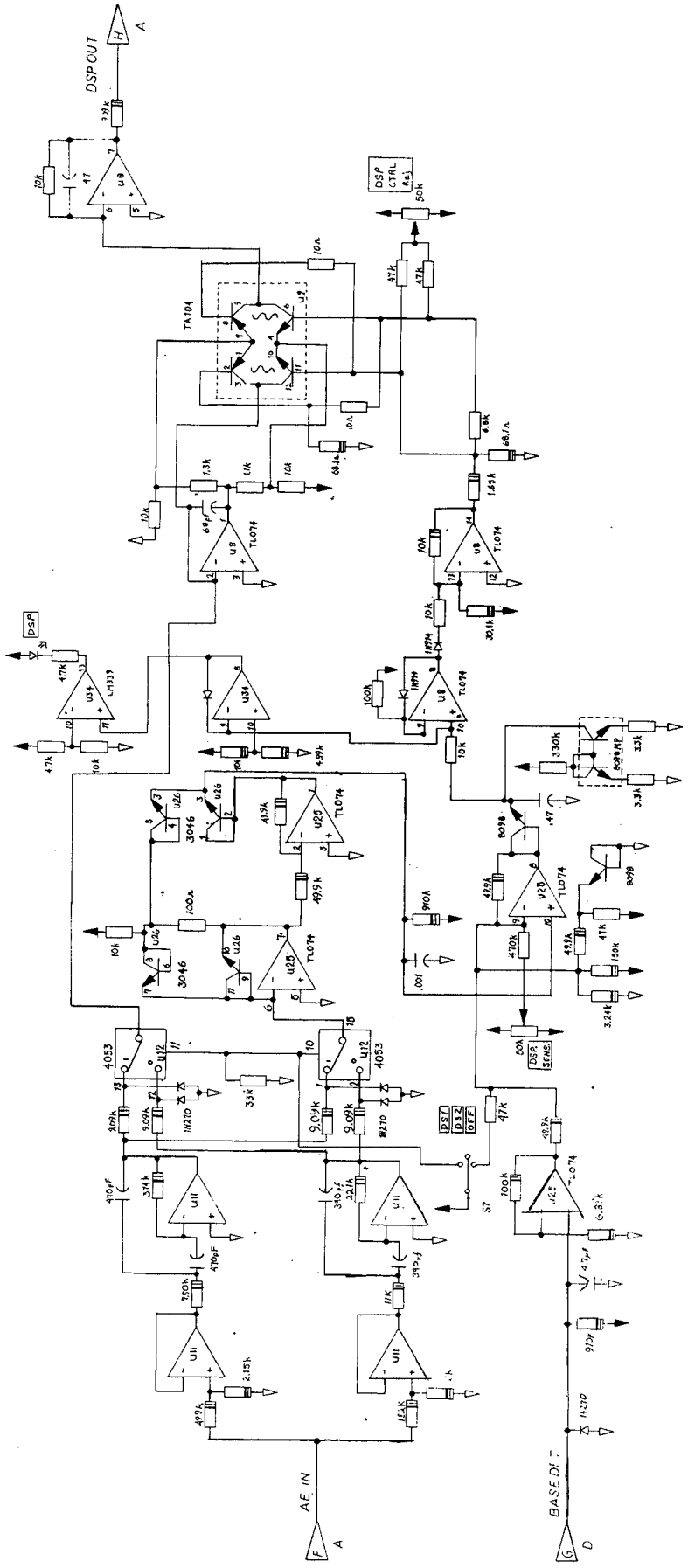

INPUT VU
AF IN
LIM CLIP THRESH
OUTPUT VU
INPUT
LIM/CLIP THRESHOLD
CLIP IN
OUT
BYPASS
CLIP THRESHOLD TRIM
FM Pre-emphasis
FM
CTRL SUM
B,C,D
DSP OUT
OUTPUT
OUTPUT+
OUTPUT-
UNITY DIST
CNTL REJ
* FM PREEMPHASIS
μSec R C
75 910 .0082
50 1.5K .005
25 2.7K .0027

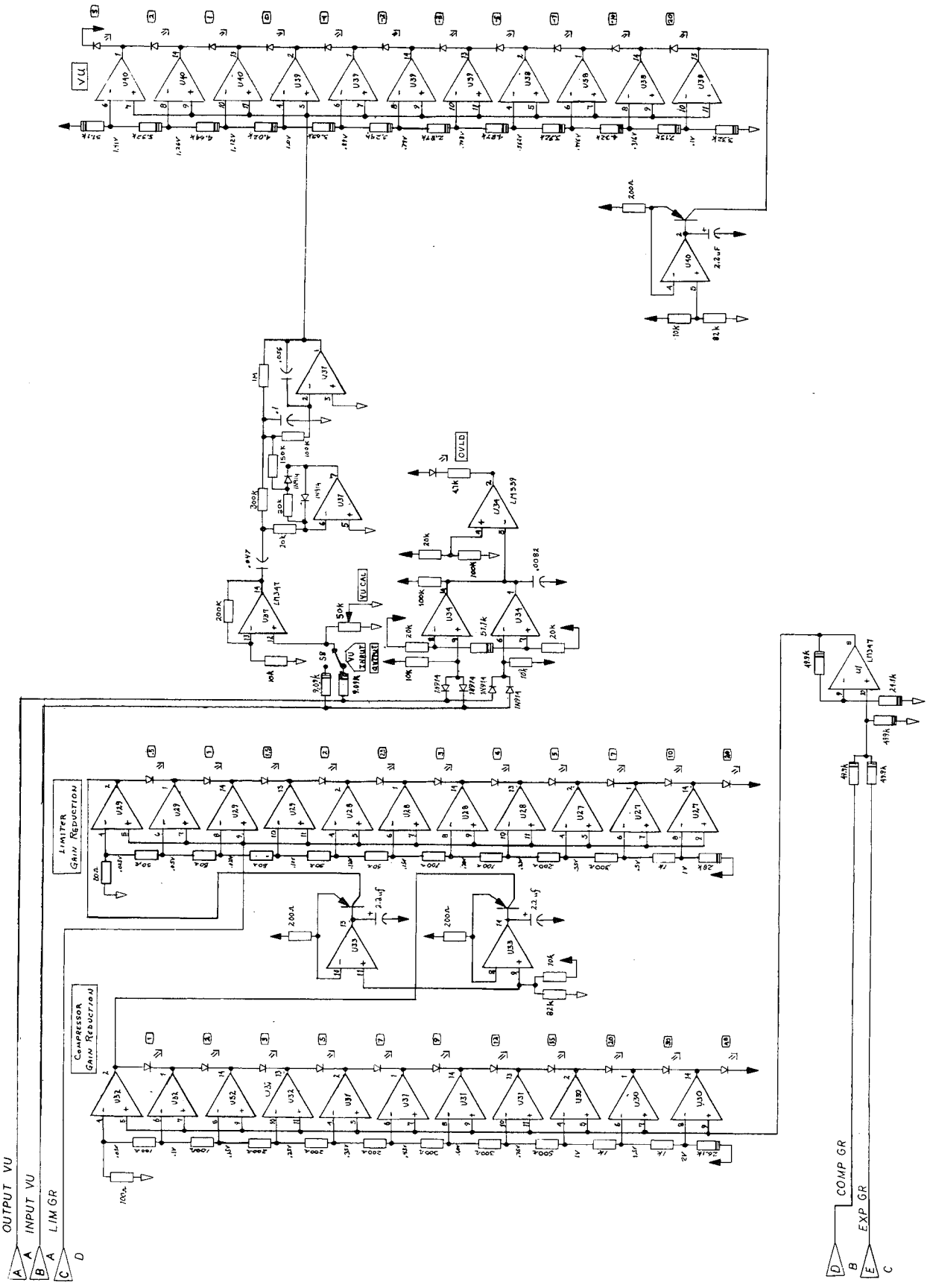

COMP RELEASE
P C
EXP DET
L C
COMP ADJ
N C
LINK
S6c
LINK Comp
COMP GR
D F
PRE AF
R A,D
LIM GR
C D
LIM IN
J D
CTRL SUM
O A,C,D
FM
S A
AUTO
M C
COMP THRESHOLD
COMP THRESHOLD TRIM
COMP RATIO
Comp Attack
COMP MAKE-UP TRIM
Comp/Exp Det Sym
8098MP
1N914

6.7 Expander Section Schematic




BASE DET
G
E
PREAF
R
A,B
LIM GR
C
F
CTRL SUM
O
A,B,C
LIM IN
J
B
LIM/CLIP THRESH
K
A
LINK SW
LINK LIM
LIM Threshold Trim
LIM OFF SYM
LIM IN AGC OUT
LIM REFERENCE
LF347
LM339
1N914
8038 MP
3046


DSP OUT
DSP CTRL
50k
TA104
TL074
LM339
3046
4053
DSP1
DSP2
OFF
DSP SENS
AE IN
BASE DT


VU
OVLD
VU CAL
LIMITER GAIN REDUCTION
COMPRESSOR GAIN REDUCTION
OUTPUT VU
INPUT VU
LIM GR
COMP GR
EXP GR

6.11 Power Supply Schematic