LA SERIES
COMPRESSOR/LIMITERS

SPECIFICATIONS

	LA-10	LA-12	LA-22
Inputs:	Active balanced bridging.	Active balanced bridging.	Active balanced bridging.
Input Impedance:	40k Ω balanced input, 20k Ω unbalanced (with detector normalled to input).	40k Ω balanced input, 20k Ω unbalanced (with detector normalled to input).	40k Ω balanced input, 20k Ω unbalanced (with detector normalled to input).
Detector Input Impedance:	100k Ω balanced input, 50k Ω unbalanced.	100k Ω balanced input, 50k Ω unbalanced.	100k Ω balanced input, 50k Ω unbalanced.
Maximum Input Level:	+24 dBu (12.3 V rms).	+24 dBu (12.3 V rms).	+24 dBu (12.3 V rms).
Gain:	±20 dB, adjustable with front panel output level controls.	±20 dB, adjustable with front panel output level controls.	±20 dB, adjustable with front panel output level controls.
Frequency Response:	20 Hz - 20 kHz ±0.2 dB	20 Hz - 20 kHz ±0.2 dB	20 Hz - 20 kHz ±0.2 dB
Dynamic Range:	< 115 dB	< 115 dB	< 115 dB
Signal To Noise Ratio:	110 dBA, 22 kHz A weighted noise bandwidth.	110 dBA, 22 kHz A weighted noise bandwidth.	110 dBA, 22 kHz A weighted noise bandwidth.
THD:	< 0.006% typical @ 1 kHz, 0.02% maximum @ +14 dBu input.	< 0.006% typical @ 1 kHz, 0.02% maximum @ +14 dBu input.	< 0.006% typical @ 1 kHz, 0.02% maximum @ +14 dBu input.
Attack Times			
Average Detectors:	1 - 50 ms	1 - 50 ms	1 - 50 ms
Peak Detectors:	≤100 µs	≤100 µs	≤100 µs
Output Peak Limiters:	50 µs	50 µs	50 µs
Release Times			
Average Detectors:	100 ms - 5 s for 10 dB of release.	100 ms - 5 s for 10 dB of release.	100 ms - 5 s for 10 dB of release.
Peak Detectors:	10 ms	10 ms	10 ms
Output Peak Limiters:	40 ms	40 ms	40 ms
Compression/Expansion Ratios:	Adjustable from 1.5:1 to ∞:1.	Adjustable from 1.5:1 to ∞:1.	Adjustable from 1.5:1 to ∞:1.
Threshold of Limiting/Expansion:	Adjustable from -40 dBu to Off.	Adjustable from -40 dBu to Off.	Adjustable from -40 dBu to Off.
Outputs:	Transformer isolated, symmetrical floating.	Transformer isolated, symmetrical floating.	Transformer isolated, symmetrical floating.
Maximum Output Level:	+24 dBm into 600 Ω	+24 dBm into 600 Ω	+24 dBm into 600 Ω
Connectors			
Inputs and Outputs:	XLR type 3 pin (pin 2 high), 6.3 mm (1/4 in) TRS phone jack.	XLR type 3 pin (pin 2 high), 6.3 mm (1/4 in) TRS phone jack.	XLR type 3 pin (pin 2 high), and barrier strip.
Limiting Detectors:	6.3 mm (1/4 in) TRS phone jack normalled to input.	6.3 mm (1/4 in) TRS phone jack normalled to input.	Barrier strip.
Link:	Barrier strip.	Barrier strip.	Barrier strip.
AC Power Requirements:	100-120/220-240 V AC, 50-60 Hz, 25 W maximum.	100-120/220-240 V AC, 50-60 Hz, 25 W maximum.	100-120/220-240 V AC, 50-60 Hz, 30 W maximum.
AC Line Cord:	Detachable, IEC type.	Detachable, IEC type.	Detachable, IEC type.
Front Panel Dimensions:	1U (44 mm x 483 mm; 1 3/4 in x 19 in).	1U (44 mm x 483 mm; 1 3/4 in x 19 in).	1U (44 mm x 483 mm; 1 3/4 in x 19 in).
Depth Behind Panel:	260 mm (10 1/4 in).	260 mm (10 1/4 in).	273 mm (10 3/4 in).
Finish:	Powdercoated black	Powdercoated black	Powdercoated black
Net Weight:	6.4 kg (14 lbs).	6.4 kg (14 lbs).	6.4 kg (14 lbs).

Standard Accessory (common to all models): Security cover, Part No. SC8

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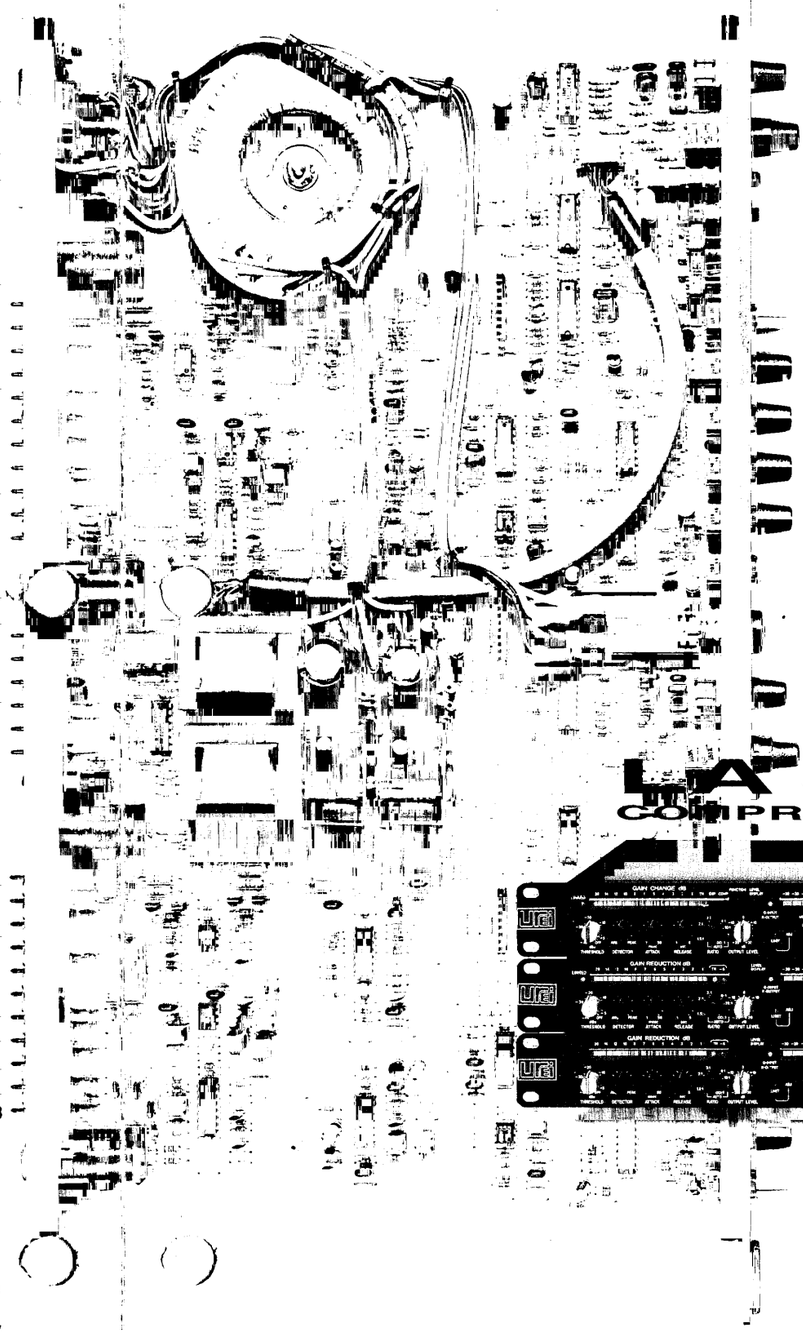
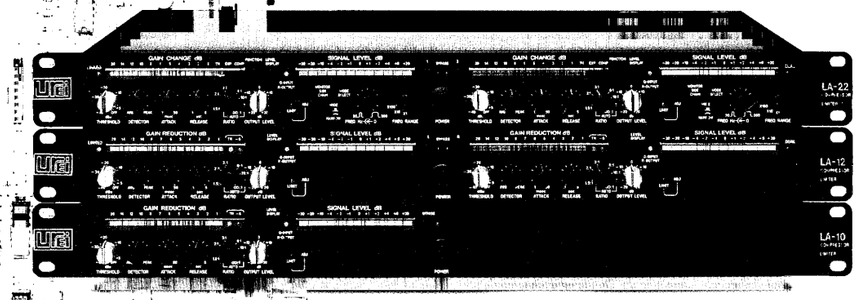
A Harman International Company

0492-20M

SIGNAL PROCESSING



LA SERIES
COMPRESSOR/LIMITERS



LA 22 Preliminary Service Manual (June 92)

LA SERIES
COMPRESSOR/LIMITERS

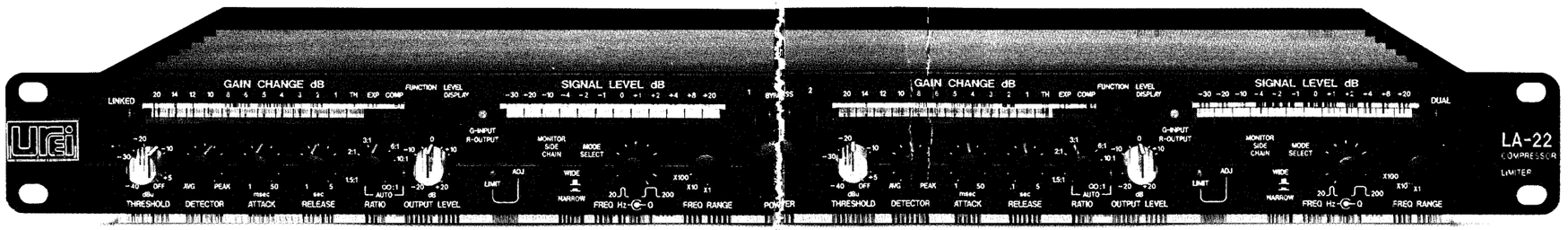
A HISTORY OF HITS.

It is virtually impossible to determine how many major recordings have been impacted by UREI products. For well over two decades, recording engineers have considered UREI Compressor/Limiters to be essential tools of the studio. Likewise, these same devices have been staples of the Live Sound and Broadcast industries, aiding engineers in achieving the desired levels of sonic performance for their respective audio needs.

Experience is the ultimate teacher and UREI engineers have been to class. Combining proven performance with modern technology, the LA Series family of Compressor/Limiters was developed to meet the needs of today's audio professional.

LA Series Compressor/Limiters deliver transparent control over audio levels, employing Smart-Slope™ compression ratios from 1.5:1 through infinity:1. Ultra low noise circuitry and intelligent feature selection make LA Series ideal for the most demanding applications, including all levels of recording, broadcast, installed sound and sound reinforcement.

The three LA Series models, LA-10, LA-12 and LA-22, all share virtually identical performance characteristics and differ only in terms of number of channels and features.



LA-22 Dual Channel Frequency Selective Compressor/Limiter/Expander

The "flagship" of the LA Series, the two channel LA-22 is truly the most flexible device of its type. This unit was designed with two key features which significantly increase its corrective and creative utility.

First, a front panel pushbutton switch converts the LA-22 from a gain "reduction" system to a dynamic gain "expander".

Secondly, the LA-22 is equipped with an onboard fully parametric filter system which can be used to "focus" the gain reduction or expansion action at a specific center frequency as narrow as 1/6 octave or as wide as 2-1/2 octaves.

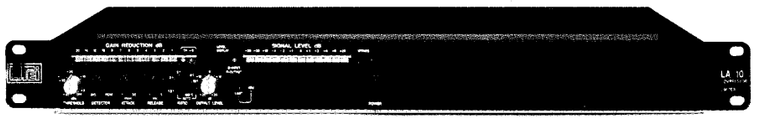
In the gain reduction mode, the "spectral agility" provided by the parametric filter (continuously variable center frequency selection from 20 Hz to 20 kHz) makes the LA-22 a particularly effective "De-esser". It can also be utilized as a very precise feedback suppressor. Its creative application is limitless.

In the expansion mode, one example of its utility would be to use the parametric filter to enhance vocal intelligibility of recordings, sound reinforcement systems or paging systems. This would be achieved by setting the parametric filter center frequency and 'Q' to expand only the range of the human voice. Once again, its creative capabilities are limited only by your imagination.

The parametric filters are fully accessible via the rear panel barrier strips and can be used as single channel independent equalizers or can be fed to the Side Chain to achieve frequency dependent control of the full bandwidth signal.

LA-12 Dual Channel Compressor/Limiter

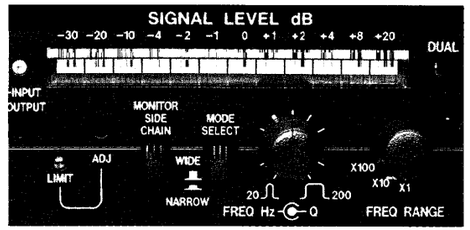
A dual channel version of the LA-10, the LA-12 packs more performance in the same size chassis. The two channels can be operated independently, linked for stereo, or linked to other units for multi-channel applications. The LA-12 offers solid gain reduction capability in a package that is ideal for the recording studio, broadcast studio or live sound reinforcement system.



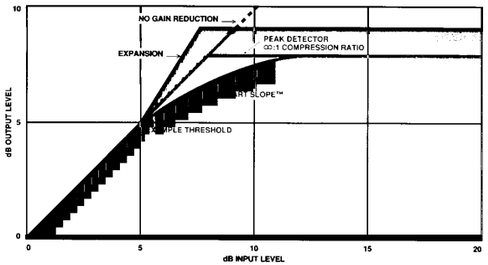
LA-10 Single Channel Compressor/Limiter

The LA-10 is a single channel device, ideal for use in sound contracting and broadcast. Its simple design makes it cost effective for use in basic systems without sacrificing performance or features. The LA-10 can be linked via a rear panel barrier strip to work in conjunction with other units for stereo or multi-channel applications.

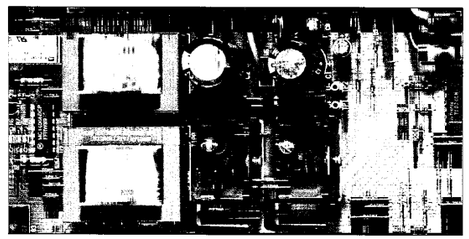
The onboard parametric filter circuit adds a degree of flexibility to the LA-22 previously unavailable in products of this type.
Center frequency selection is continuously variable from 20 Hz to 20 kHz with the 'Q' adjustable from 1/6 to 2 1/2 octaves. This enables you to gain reduce or expand within a limited range of frequencies, without effecting the remainder of the audio signal. The parametric filter can also be routed to the side chain so that full band gain reduction or expansion can occur as a result of a specific frequency(ies).



Transparent Gain Reduction or Expansion from Smart-Slope™ Compression Ratios.
Typical input vs. output level curves for LA Series Compressor/Limiters.



To achieve ideal isolation, the output stage incorporates real transformers integrated with our patented active circuit.
This combination of technologies virtually eliminates the distortion and saturation often associated with transformer output stages.



Housed in a compact 1U rack space chassis, LA Series Compressor/Limiters feature three separate gain reduction circuits: Peak, Average and Peak Output Ceiling limiting. Front panel controls allow total command over Threshold, Detector mode, Attack, Release, Ratio and Output Level. When rotated completely counter-clockwise, the Ratio control activates an "Auto" function which sets the Compression Ratio and Peak/Average to factory preset values for quick set up. Two high visibility LED displays provide visual indication of Input/Output levels and Gain Reduction.

Active Balanced Bridging circuitry on the inputs permits these units to be driven by signals in excess of +24 dBu. The output stage incorporates a real transformer to attain ideal isolation, optimized by a patented active circuit which virtually eliminates the distortion and saturation sometimes associated with transformer output stages.

These hot new tools from UREI can help you produce great hits. LA Series, a new standard from the people who have set the standards for compressor/limiters for over 20 years.

LA-22 COMPRESSOR/LIMITER THEORY OF OPERATION

12/17/91

Robert Girard

The LA-22 Compressor/Limiter is a professional performance unit providing multi-configurable function parameters. The LA-22 is a dual channel compressor/limiter with all of the capabilities and functions of the LA-12 (see LA-12 documentation for detailed explanation of the basic functions). However, the LA-22 is capable of some additional functions and features.

The first of these features is Narrow-Band limiting. A typical limiter, which controls the overall gain (full bandwidth) of the signal can also be referred to as " wide-band " limiting. In other words, the limiting response affects all frequencies equally. The LA-12 does just this type of function. Narrow-band limiting, on the other hand, only limits the signal within a narrow portion of the frequency spectrum, allowing the user to select a region of the audio spectrum to be controlled, while leaving the rest of the spectrum unaffected. This process can be thought of as dynamic equalization.

The way the LA-22 performs this function is by integrating a bandpass filter into the VCA section (detailed description of this circuit will follow in a later section). The filter (actually a typical state variable filter) can be adjusted by the user in all the typical modes; frequency sweep, frequency range, and filter bandwidth (Q). When tuning this filter for the desired frequency and bandwidth, there is a momentary switch called " Monitor Side Chain ", which allows the user to listen to just the output of the filter through the signal output channel.

The LA-22 can be configured as a wide-band limiter, or the narrow-band format just described by setting the switch called " Mode Select ", which is located next to the other filter controls just discussed.

The next function which is unique to the LA-22 is the capability of each channel to either compress or expand the VCA controlled signal via a switch marked " Function " next to the " Gain Change " LED bargraph meter. Triangular up or down LED's indicate which mode is selected (up-arrow for expand, down-arrow for compress or limit). When the expand function is selected, the expand action is an inverse of the compress action. In other words, if the modes were set to the compress/wideband modes, and 6dB of gain reduction ~~were~~ occurring as result of the present limiter control settings, when the expand mode is selected, 6dB of expansion or gain would result for the entire audio spectrum. It should be noted that the " Gain Change " meter will read the same for both conditions.

The same concept occurs with the narrow-band mode set-up. For example, if the filter center frequency is set to 1kHz, the function is set for compress, and the limiter controls are set so that the 6dB LED of the " Gain Change " meter is on, than at 1kHz, the signal will be -6dB below the unaffected region of the signal. When the expand function is selected, than at 1kHz, the signal will be 6dB above the unaffected region (see Fig. 2 for graphical depictions of these concepts and functions).

As with the LA-12 Compressor/Limiter, there is an internal link mode which connects the VCA control lines to each other, resulting in a tracking or stereo limiting system. This mode is enabled by way of a rear panel switch. One additional function unique to the LA-22 is the automatic link-mode disable circuit which prevents internal linking when the two channels are in opposite compress/expand mode states (more details on this circuit will follow in a later section). When this condition occurs, the unit disconnects the internal link line and the " dual " LED indicator (front panel) will be on. This function has the purpose of preventing incompatible mode linking, which could be confusing to the user in operation.

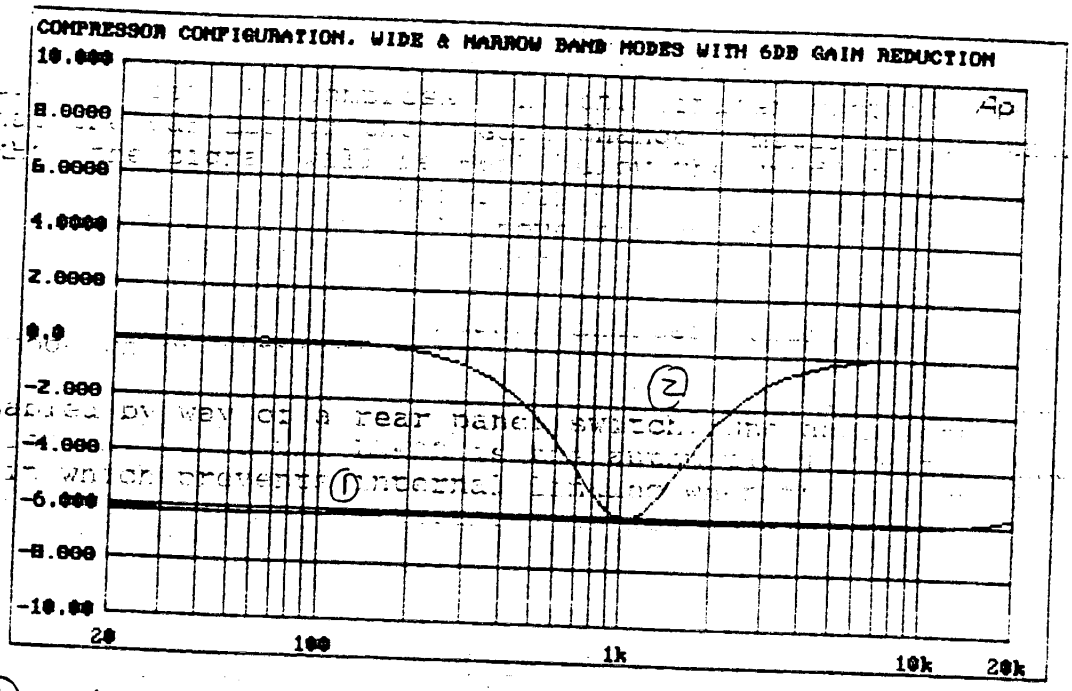
The usefulness of the LA-22 centers around the need to control audio signal levels automatically, in real-time, in order to prevent overloading of limited dynamic range equipment such as tape recorders (especially digital tape recorders), or to " compress " the wild changes in level of some vocal performances. The narrow-band mode is exceptionally useful in situations where only a certain portion the program material needs to be controlled, such as de-essing or " de-popping " vocals, or expanding a certain instrument or sound out of a mix (expand mode).
There are of course, many other uses for the compressor/limiter, too many to give attention to here.

The LA-22 system is comprised of 9 main sections (see Fig 1.)

1. Input buffer
2. VCA (voltage controlled amplifier) section
3. Parametric filter
4. Side chain (rms and peak subsections, Auto mode)
5. Output limiter (fast peak limiter)
6. Balanced transformer isolated output amplifier
7. Signal level, gain change display section
8. Automatic link mode disable circuit
9. Power supply, turn on delay

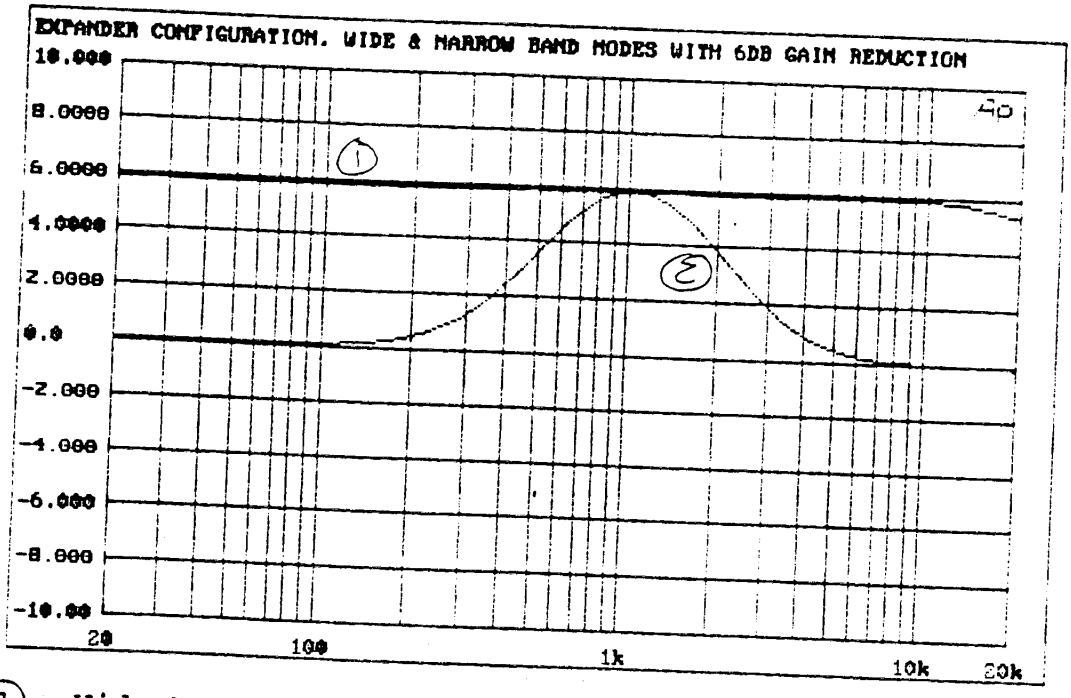
Each of these sections will be addressed in detail throughout this document, with the overall intent of providing the production test and repair technician, as well as the outside service technician valuable technical and functional information.

Regarding overall system function and specification definitions, please refer to the attached product specification document for the LA-22.



(1) Wide-band mode (2) Narrow-band mode

Fig. 2A



(1) Wide-band mode (2) Narrow-band mode

Fig. 2B

I. INPUT BUFFER/DETECTOR BUFFER SECTION:

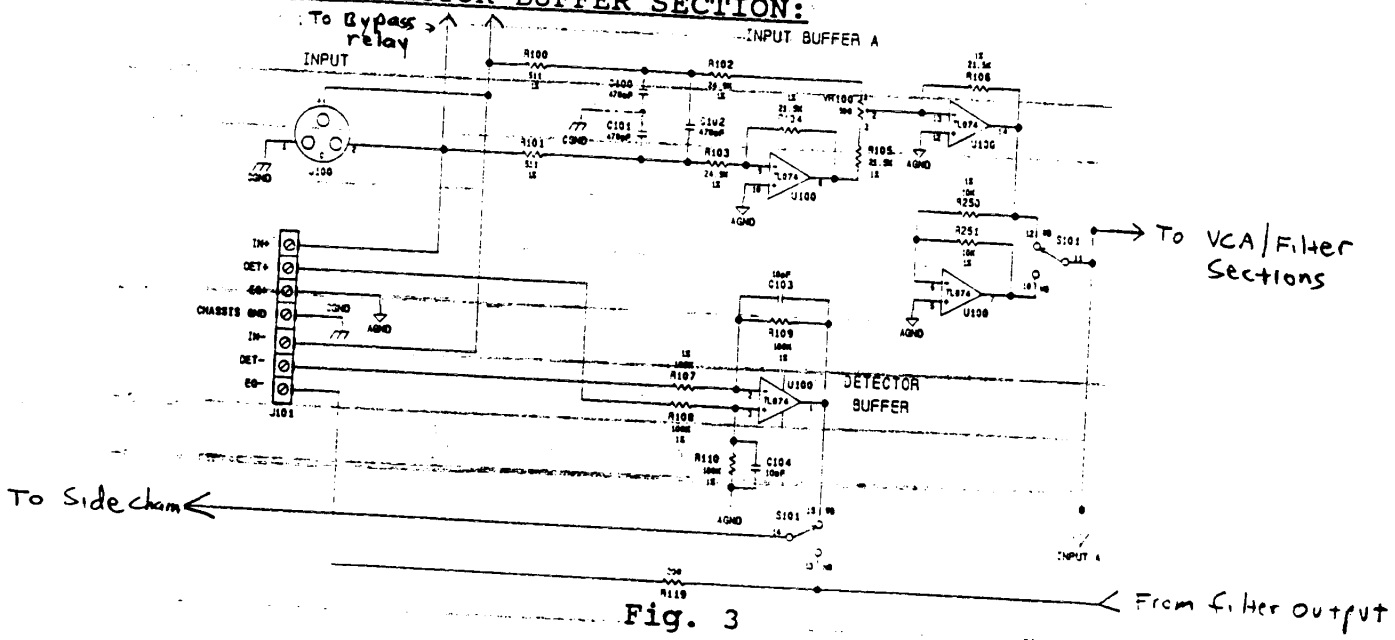


Fig. 3

This section consists of two types of balanced-to-single ended (or differential amplifier) circuits. The first type, used as the audio chain input buffer, has a trimpot adjustment for maximum common mode rejection. A typical cmrr curve for this circuit is shown in Fig.4. The gain of this stage is fixed at -1.6dBr, and THD+N at 1kHz is typically below 0.004% THD. Both XLR and barrier strip points are available for input connection, located on the rear panel. There is a phase inversion switch S101, which is part of the 6PDT switch used as the wide/narrow band mode select. The 180^{o} inversion is necessary in order to maintain correct phase for both modes. However, level does not change, as the inverting amplifier (U100 pins 5-7) is unity gain.

The second section is used as an input buffer for the control section (side chain), and is a typical differential amplifier, with a gain of unity. In normal wide-band operation, the input for the detector buffer is supplied by the main audio signal, causing the control section to react to the program material, and perform typical compress/limit functions (it should be noted that the connection from the signal input and detector input nodes is made by way of two metal straps (per channel) on the barrier strip). However, when an external source is connected to the side chain by removing these straps , the main source is disconnected from the side chain, and the side chain is driven by an audio source independent of the program material.

In the wide-band mode, a section of the switch S100 connects the output of the detector buffer to the input of the side chain (S100 contact at the " WB " position). In the narrow-band mode, the switch routes the output of the parametric bandpass filter to the side chain input (" NB " position). There is another configuration possible as well. When the mode switch is set

for wide-band (side chain connected to detector buffer), and the inputs of the detector buffer are connected to the " EQ+ " and " EQ- " barrier strip points, the detector buffer is then driven from the parametric filter, in essence looping the filter through to the side-chain, while the rest of the channel is configured as a wide-band system. This creates a narrow-band sensitive side chain which affects the entire audio spectrum.

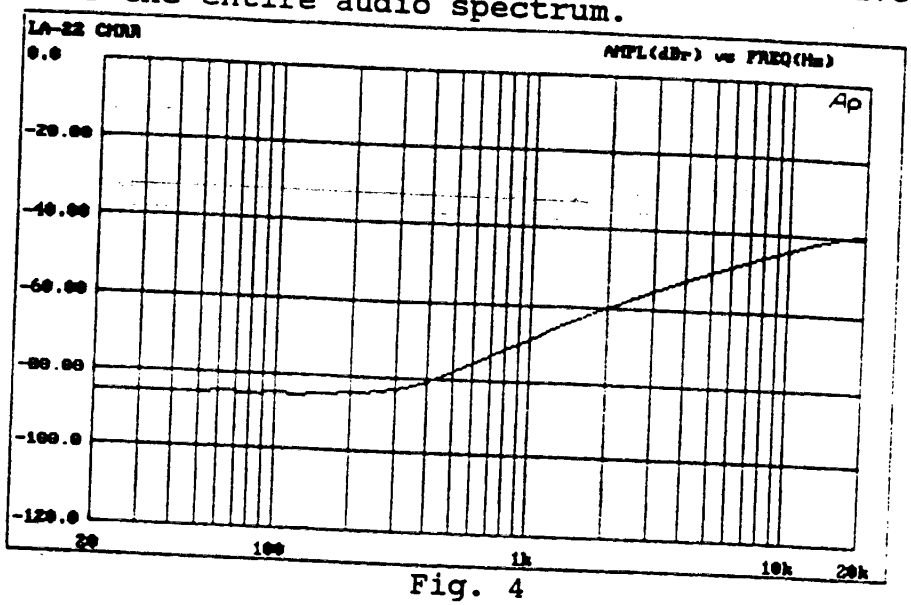


Fig. 4

II. VCA (VOLTAGE CONTROLLED AMPLIFIER) SECTION:

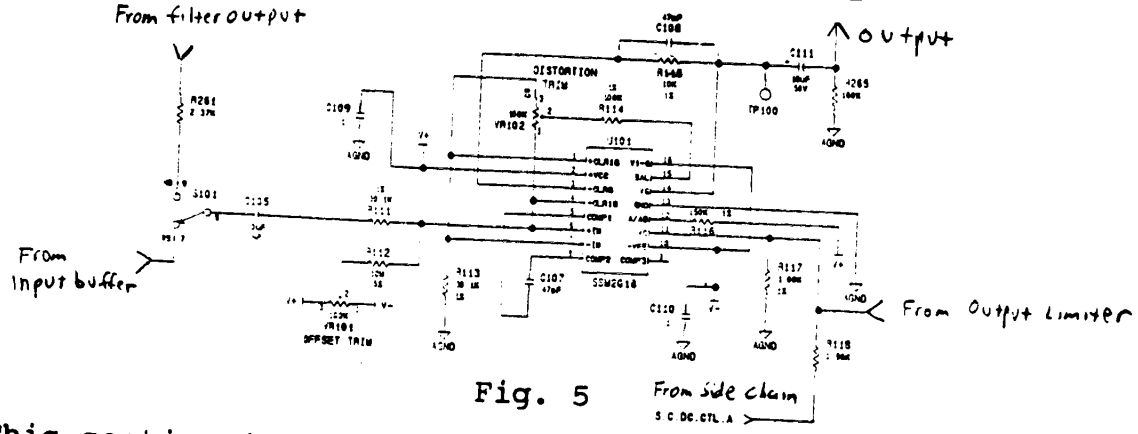


Fig. 5

This section is the heart of the LA-22 Compressor/Limiter product. The SSM2018 VCA operates as a D.C. voltage controlled gain amplifier. The control law at the control port (pin 11), is -30mV/dB. From a starting point of 0 VDC, for every increase in D.C. voltage of approx. 30mV D.C., a gain change of -1 dB results, causing a 1 dB loss through this section.

The control circuitry discussed in the following sections accesses the control port of the VCA in order to perform the various compress/limit functions characterized by the LA-22. When no limiting is occurring, and the front panel output level control is set for 0 dB, there will be approx. 0 VDC at the

control port. The nominal throughput gain (with 0 VDC at the control port) is -9.6dBr. Combined with the input buffer gain of -1.6dBr, the total output-to-unit-input gain at the VCA section output is approx -11.3dBr. There are two trimpots in this section. The first is the distortion trim, when set for minimum distortion with 0 dBu at the input to the unit, should be about .008% At 1kHz, with a 30kHz test bandwidth filter applied. The second trim minimizes D.C. offset at the VCA output. The method for doing the offset trim should be as follows:

1. Connect a DVM to test points TP100 for chan.1 and TP300 for chan. 2. Apply no audio test signal
2. Adjust trimpots for minimum DC offset
3. Verify offset to be less than 1mV D.C.

If a VCA cannot be trimmed, it should be replaced.

III. PARAMETRIC BANDPASS FILTER SECTION:

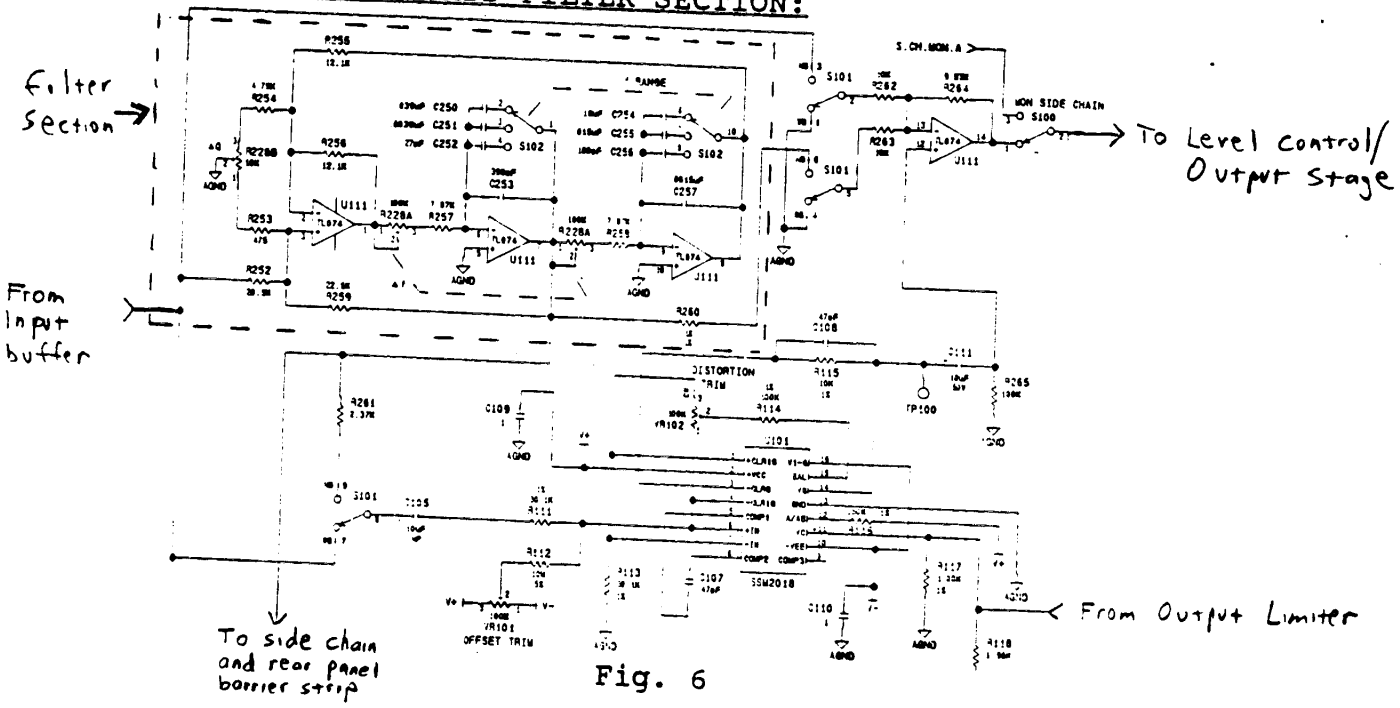


Fig. 6

This circuit is the main element used to perform the narrow-band limiting/expanding functions. When this circuit is used with the VCA section, the audio regibn defined by the filter pass-band (see Fig. 7) is either limited or expanded. The side chain section (to be defined in detail in section IV) controls the limiting/expanding functions in the same way as the wide-band mode.

The filter parameters which are user controllable are frequency sweep, frequency range, and filter bandwidth (Q). The frequency sweep is controlled by the outer section of the

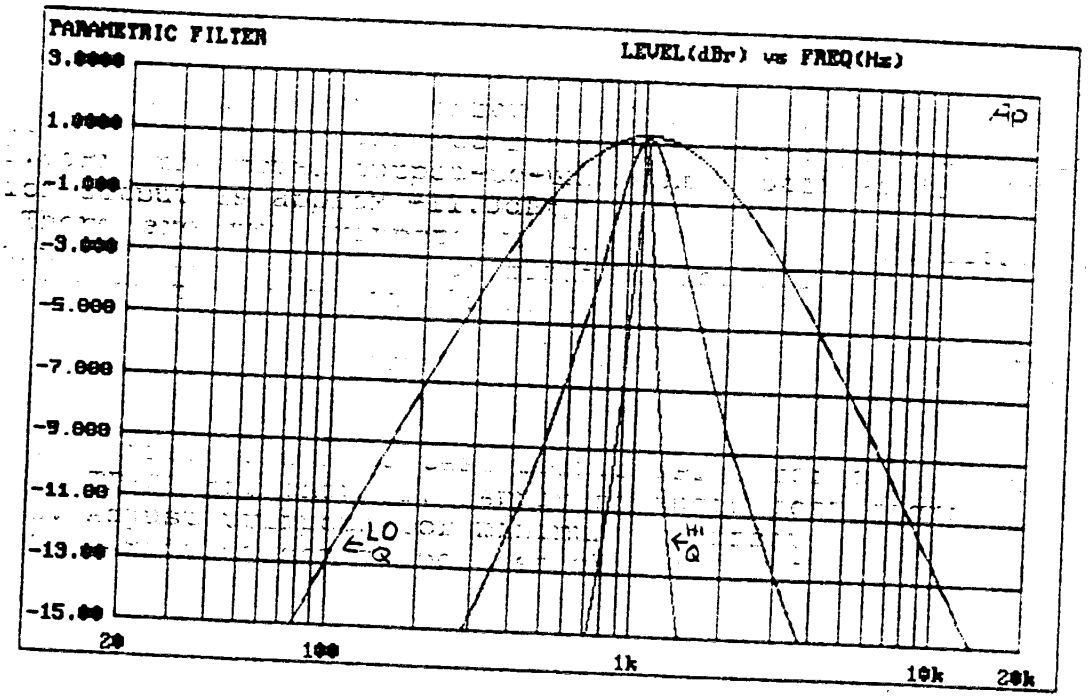


Fig. 7

concentric potentiometer R228 (R428 for chan. 2), which is dual 100K ohm. This control covers a one decade range from 20x to 200x. The " x " is the multiplication factor determined by the range control switch S102 (or S302). This switch is a dual pole switch which changes the capacitor values of the integrator sections to change the range in 1 decade increments. Combined with the frequency sweep control, any center frequency in the entire audio spectrum can be set. Since there is some overlap between the range settings, there is no gap between the endpoints of the sweep (see Fig. 8).

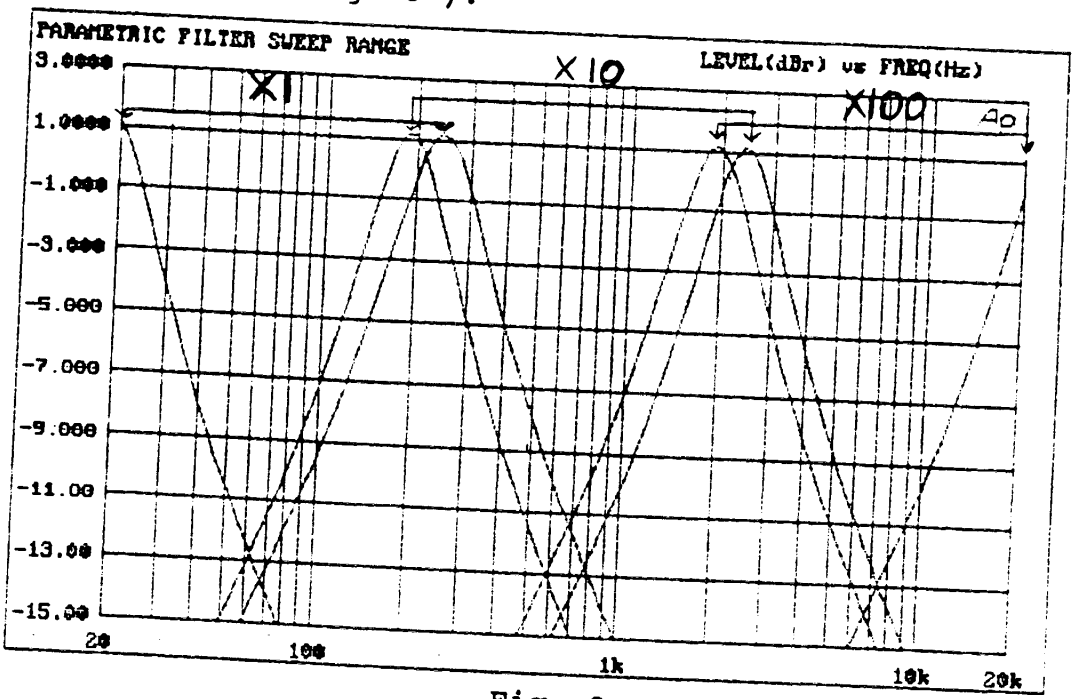


Fig. 8

The inner section of the potentiometer R228 (or R428) is the " Q " control. The range of the filter is from .12 octaves to 2.5 octaves, measured at the -3dB points (see Fig. 9).

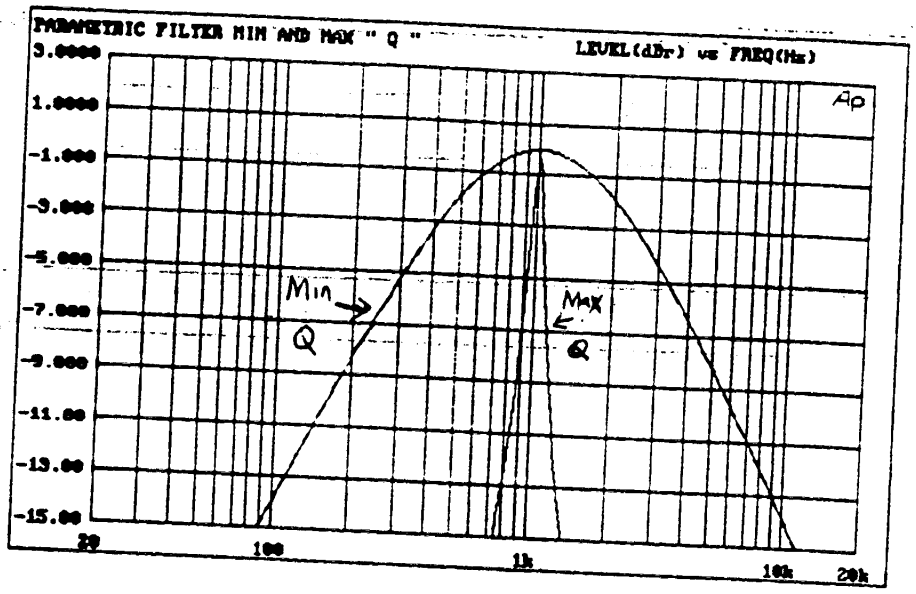


Fig. 9

The key to creating the narrow-band limiter/expander functions involves summing the bandpass filter signal 180° out of phase with the unfiltered signal, which creates a notch at the center frequency of the filter. This notch is then " filled in " by the output of the VCA, which also has as its input the filter output signal. When there is no gain change (side chain inactive), then the composite response of all the above mentioned signals is flat across the audio spectrum. An indication of a problem in one of the subsections mentioned above is non-linearity in the output signal (with no limit/expand), caused by one or more of the composite signal levels to be incorrect by some amount.

When a change in the gain of the VCA occurs due to side chain activity, then the offset in signal created will introduce a frequency dip in compress mode, or peak in expand mode. The amount of signal dip/peak at the center frequency of the filter is determined by the side chain and is shown on the " Gain Change " meter.

The associated switches in the parametric/VCA sections (S101 or S301) control the configurations for wide-band and narrow-band (see Fig. 6). The narrow-band configuration is as described in the above paragraphs. The wide-band configuration (all switch sections set to the " WB " positions) disconnects the filter from the signal path creating a direct path to and from the VCA section. This allows the limit/expand functions to be non-frequency dependent (wide-band).

The switch S100 (or S300) is a momentary switch which allows direct routing of the side chain input signal to the channel

output. In the narrow-band mode, this signal will be the filter output, which drives the side chain. In the wide-band mode, the routed signal will be that which is fed to the detector buffer through the barrier strip connections. As was mentioned earlier, this switch function is provided to allow the user an easy monitoring method for setting up the internal (or external filters). The output gain of the system at the center frequency of the filter when the monitor switch is depressed is approx. 1.1 dBr (with output level control set for 0dB).

IV. SIDE CHAIN (RMS AND PEAK SUBSECTIONS):

The main function of the side chain is the conversion of an audio signal into a D.C. control signal applied to the VCA control port to change the gain of the circuit. This basic concept is the key to compressor/limiter operation.

The LA-22 side chain consists of two main sections, with their associated subsections (see Fig. 10 for complete side chain). The first main section, the peak limiter section, is comprised of subsections D and E. The rms or " average " limiter section is comprised of subsections F, G, H, and I.

The basic difference between the peak and rms sections is twofold; the peak limiter has fixed attack and release times, whereas the rms limiter has fully adjustable attack and release times, and the peak limiter has a faster attack and release time than the rms section can achieve. There are a couple of other differences as well, and these will be explained later. For an overview of the user-adjustable controls, read the section named " controls " in the product specification sheet.

A. SIDE CHAIN INPUT AMPLIFIER, FULL-WAVE RECTIFIER:

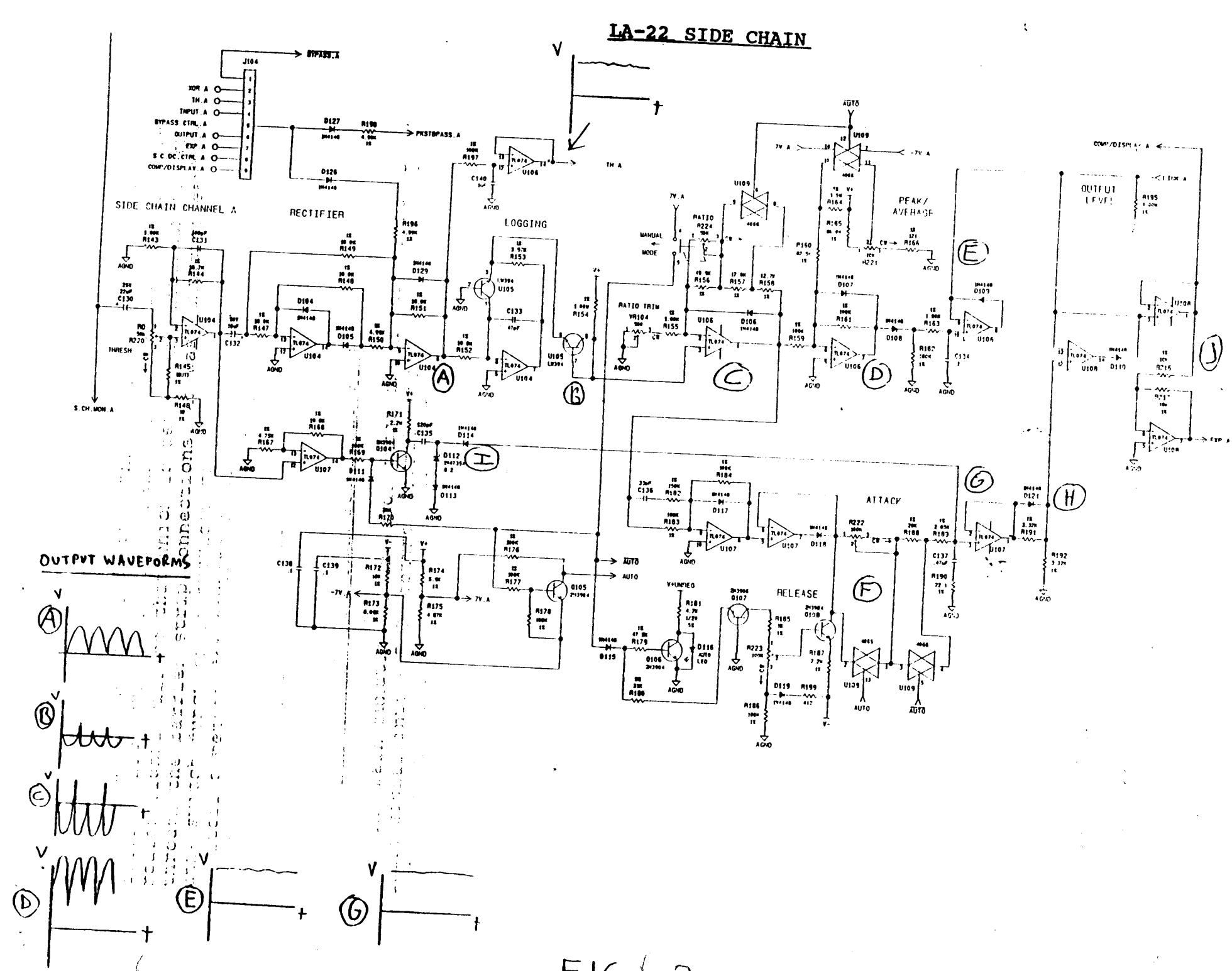
This section (see Fig. 11) performs two functions; provides an adjustable gain amplifier (threshold) for limiter function sensitivity, and full-wave rectifies the audio signal as a first step in the AC to DC conversion process. See Fig. 10 For a diagram of waveform outputs of this stage. Also included is a ripple filter for use as a signal driver for the " threshold " level LED indicators (see display board section for details).

B. LOGGING AMPLIFIER:

In order to accommodate the VCA control function (30 mVDC/dB), it is necessary to perform a log conversion of the rectified audio signal. This circuit (see Fig. 12) uses a matched transistor pair to accurately achieve the transfer function of 3.3mV/dB. In other words, for every 1 dB change in peak signal level delivered by the full-wave rectifier stage, the resultant change in peak signal output of the logging stage will be approx. 33mV.

SOUNDS INCONSISTENT

LA-22 SIDE CHAIN



OUTPUT WAVEFORMS

FIG. 5

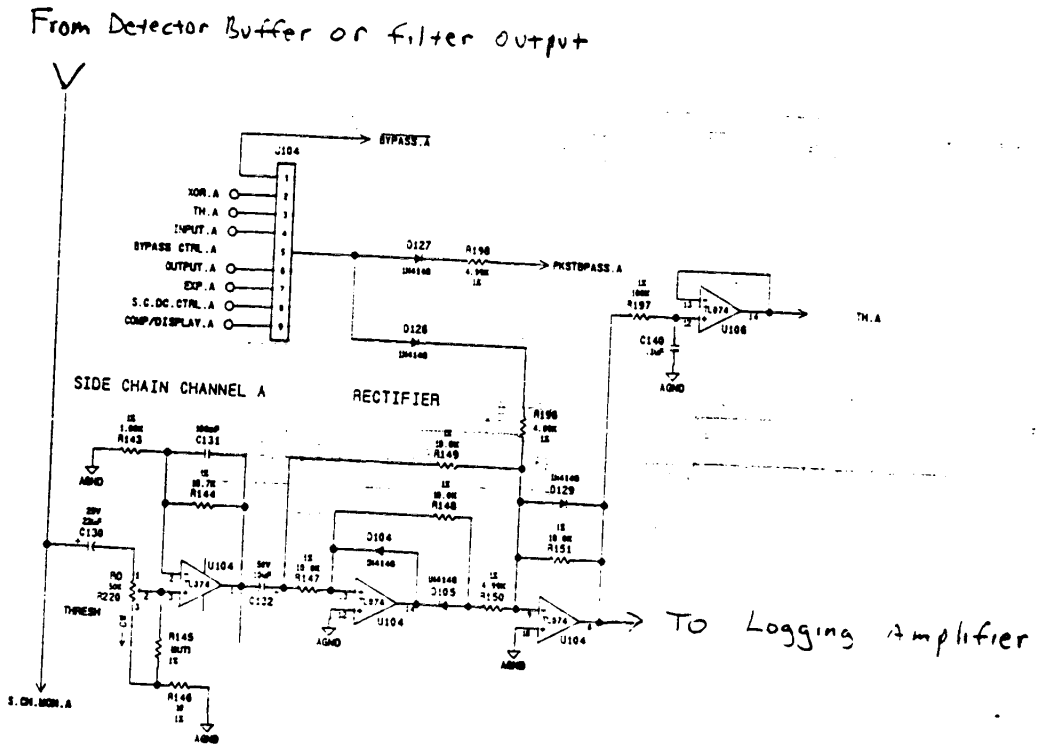

From Detector Buffer or filter output
SIDE CHAIN CHANNEL A
RECTIFIER
BYPASS.A
XOR.A
TH.A
INPUT.A
BYPASS CTRL.A
OUTPUT.A
EXP.A
S.C.DC.CTRL.A
COMP/DISPLAY.A
PKSTBPASS.A
TH.A
THRESH
S.CH.MON.A
AGND
To Logging Amplifier

Fig. 11

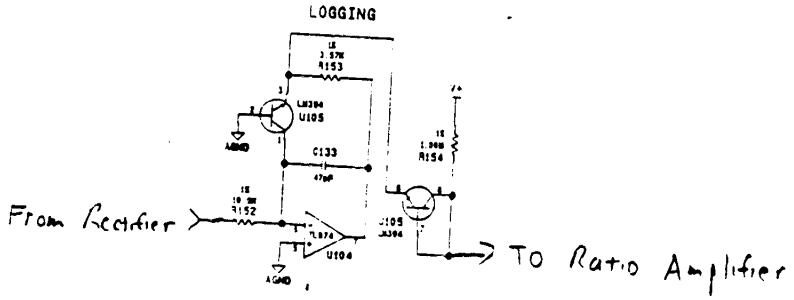

LOGGING
From Rectifier
To Ratio Amplifier
AGND

Fig. 12

C. RATIO CONTROL AMPLIFIER:

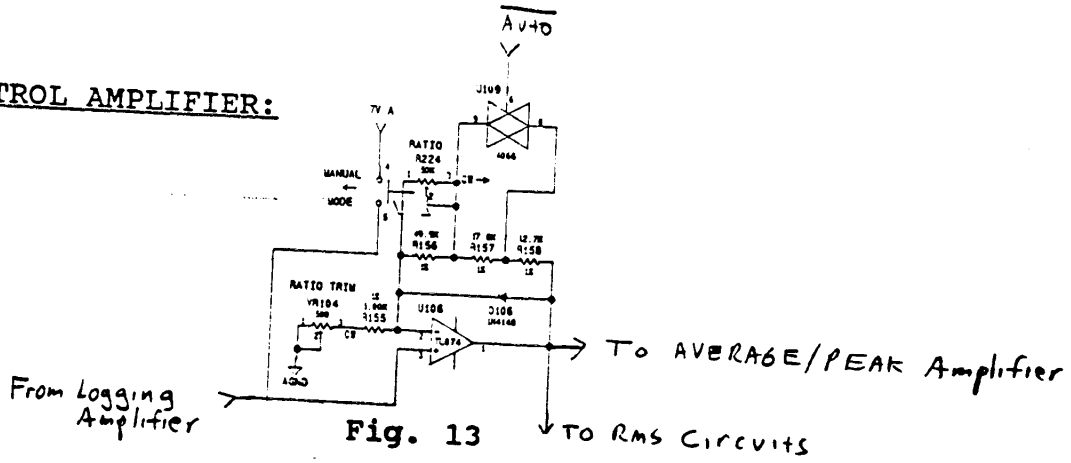


Fig. 13

This stage serves two purposes. The first is to amplify the very low level of the log converter to more useable levels. The second is to provide the user with an adjustable compression ratio (*) from 1.5:1 to ∞:1, by way of adjusting the gain of this stage. The gain is approx. 21dB at 1.5:1, and about 30dB at ∞:1. This stage is a non-inverting voltage amplifier. Included in this circuit is a trimpot which is used to trim the infinite compression ratio (∞:1 setting).

Shown in Fig. 14 is the output vs. input of an LA-22 when set to ∞:1. Note that there are 3 distinct sections of the curve. Section 1 represents the response before threshold (threshold occurs at -10dBu input level), and therefore has a 1:1 ratio, or no limiting. Section 2 is the " Smartslope " (TM) intermediate slope (more detail on this later), and section 3 is the fully active compressor/limiter region. This section is what is used to trim the ratio amplifier for accurate ∞:1 compression. Note that from 10dBu input level, to 20dBu, the output level has essentially no change (up or down). This is the correct response, and the trimpot should be adjusted to achieve this response.

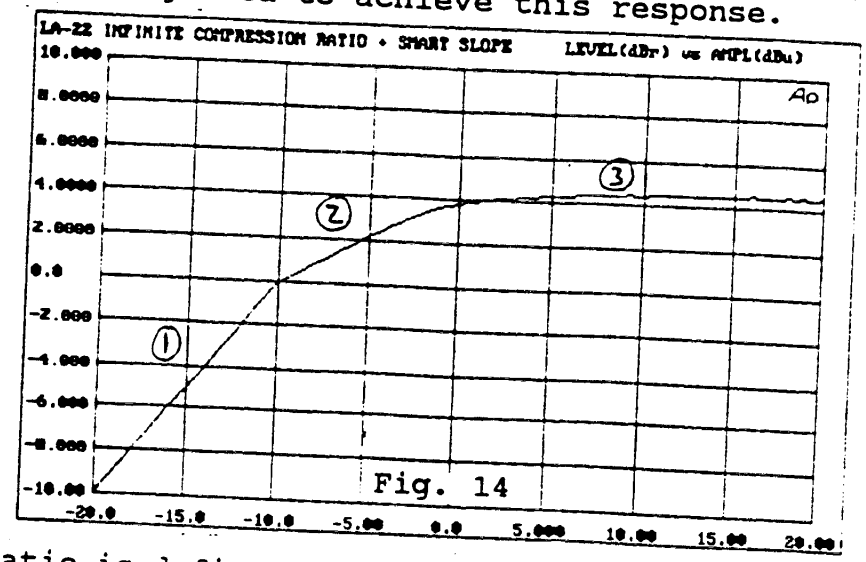


Fig. 14

(*) Note:
Compression ratio is defined as the ratio of change in input level to change in output (input change : output change).
Ex. If the compression ratio is 10:1, then for every 10 dB change in input signal level, the output will change 1dB.

D & E. AVERAGE/PEAK RESPONSE AMPLIFIER & PEAK LIMITER:

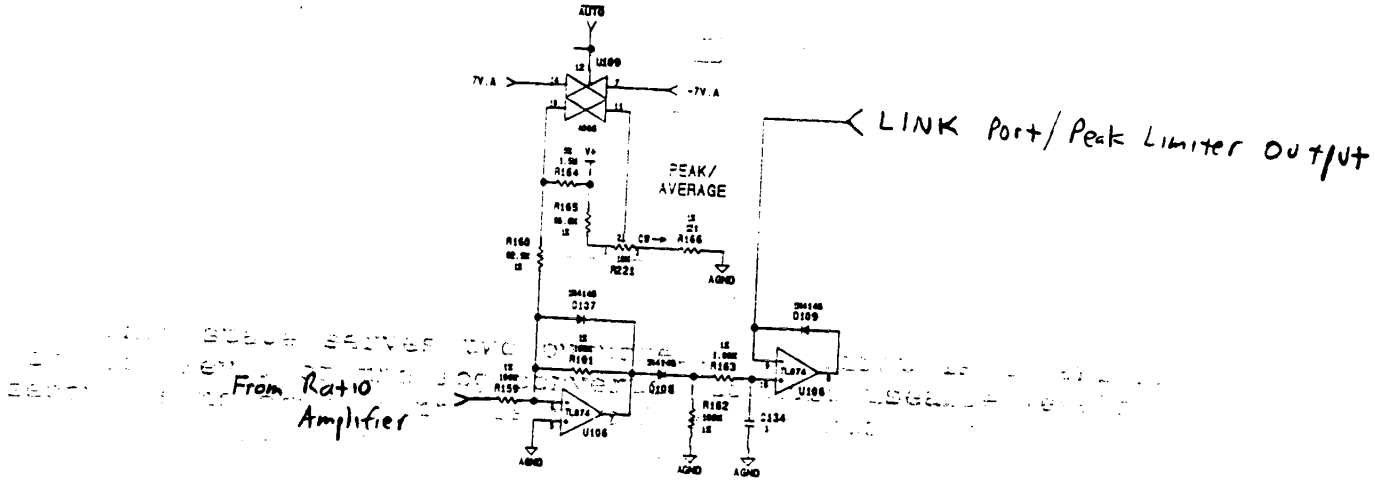


Fig. 15

The average/peak control amplifier section is a user-adjustable amplifier/driver stage which feeds the peak limiter attack/release response circuit (Fig. 10 section E). The purpose of this circuit is to allow the user to set a ratio between peak and average limiting response, by controlling how much signal is applied to the peak limiter circuit. Note that there is always a fixed drive level (from the ratio amplifier stage output) to the rms section, as the average/peak control circuit affects only the peak section.

The average/peak amplifier stage is an inverting summing voltage amplifier with a signal gain of -1 (inverting, unity), and a variable offset voltage input which is controlled by the user via the average/peak control. At full counterclockwise position (average), the offset into the amplifier is about 2 VDC, resulting in a -2V output offset. At full clockwise position (peak), the offset generated is almost 0 VDC. The offset sums with the input signal resulting in a composite output voltage contributed to by both the signal and the offset voltage. By decreasing the offset voltage (clockwise rotation), the greater ~~is~~ the overall D.C. positive magnitude into the peak limiter section.

The peak limiter section E (Fig. 15) is a simple buffered R-C charge-discharge circuit, where the attack and release times are generated by the following components:

Attack time: R163, C134 (100us)
Release time: R162, R163, and C134 (10ms).

The diode D109 and opamp section U106C combine to create an active diode, which acts as a negative voltage isolator, i.e., any voltage less than approx. 0VDC generated by the peak limiter section reverse-biases the diode circuit, preventing negative voltage feedthrough to the VCA control port.

F, G, & H. RMS (AVERAGE) LIMITER:

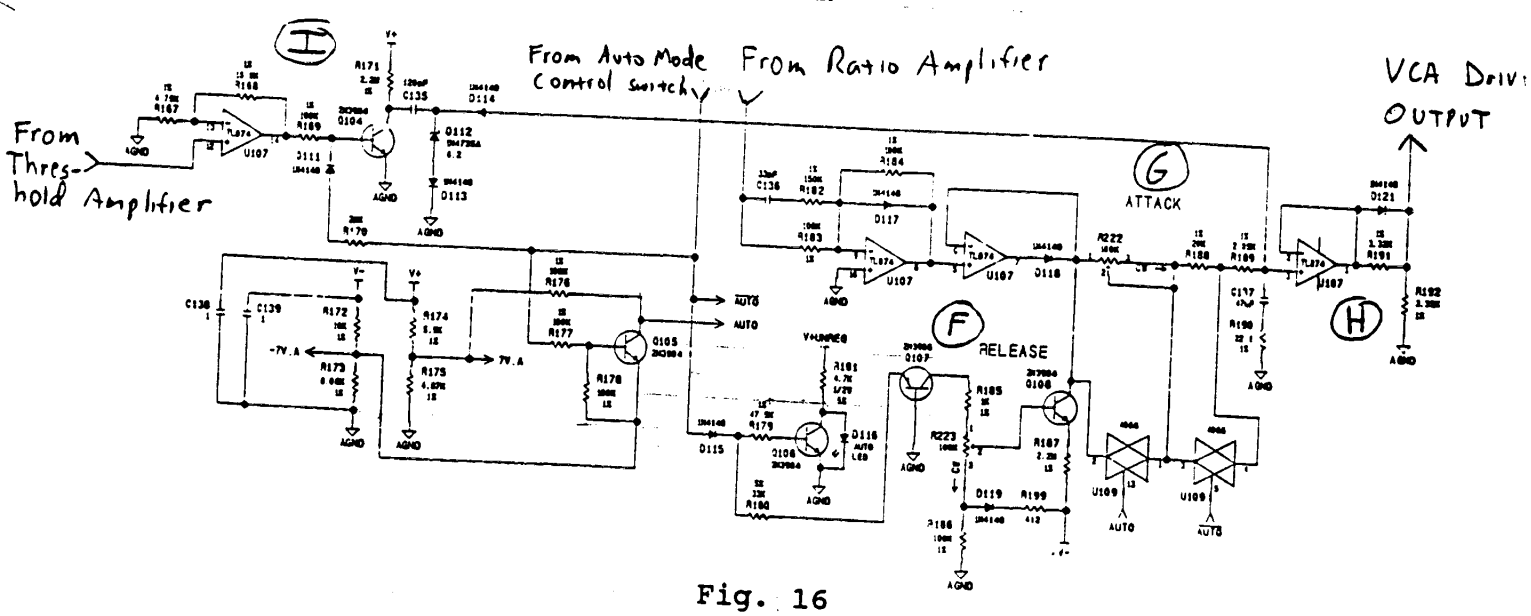


Fig. 16

The rms or average limiter control circuitry is a more user-controllable version of the peak limiter. Both attack and release times are variable by way of front panel controls. In section F, the potentiometer R222 changes the effective total resistance in combination with the capacitor C137. This allows the attack time to vary between 1ms min. to 50ms max.

Section F controls the release time through an adjustable current sink Q108, where the base voltage is adjusted by the potentiometer R223. The lower the base-to-emitter voltage of the transistor Q108, as adjusted by R223, the lower the collector current. The lower the collector or sink current, the less discharge from C137, which has the effect of lengthening the release time of the circuit. An adjustment range from 100ms to 5sec is obtained. The benefit of the use of the current sink is that a large control range is easily accomplished, and due to the constant collector current provided by the circuit to discharge the C137, a linear discharge ramp results, providing a more linear response, especially important for long release times.

Section H is known as the " Smartslope " (TM) circuit. As was briefly mentioned in section C, this circuit provides an intermediate transitional stage between no limiting action, and the full response limiting provided by the rms sections. When limiting begins, there is a positive voltage developed at the output of U107, pin 1. As this voltage begins to increase (from 0V), the diode D121 is initially not forward biased, therefore only the resistor divider composed of R191 and R192 affect the output. This divider network causes the D.C. output of the rms limiter section to be attenuated by 1/2. When a large enough drive voltage is developed, the diode D121 will eventually begin to conduct

and short out the divider network, allowing a 1 to 1 transfer to the VCA for all drive voltages above this point.

Referring back to Fig. 14, the net effect of this circuit creates a less abrupt transition at the threshold of limiting, or " soft knee ", which allows for a smoother audio response.

I. AUTO MODE, FREQUENCY CONTROLLED RELEASE:

Until now, a few components shown in the previous circuit sections have not been discussed. These are the CMOS 4066 analog switch sections attached to the ratio amp, average/peak amp, and the rms attack and release circuits. These are referenced as U109A, U109B, U109C, and U109D. Also included here are transistors Q105 and Q106 and Q107. These components act as switches, which are controlled by the mechanical rotary switch attached to the ratio control R224. When this switch is open (fully counterclockwise position of R224 after " click ") the Auto mode is enabled. This mode fixes preset values for compression ratio, average/peak ratio, and rms section attack and release times, essentially locking out the front panel controls, except for threshold and output level.

The utility of this function is that the Auto mode provides the user access to a quick and easy setup which can be used fairly successfully with many different applications. This can save time and headaches when careful adjustment of the controls is not necessary.

When the Auto mode is activated, the following conditions exist (refer to Fig. 10):

1. The control logic line AUTO goes to 8VDC, AUTO goes to -7.9VDC
2. U109D goes open, allowing R157 to be active in the feedback of the ratio amp
3. U109A goes open, disconnecting the average/peak control R221 wiper from affecting the offset voltage
4. U109B becomes active, shorting the attack control R222
5. U109C goes open, allowing R188 to become part of the attack/release time circuitry
6. Q107 goes open, causing the collector to float open, disconnecting the current path in the base bias path of the release control R223. This has the effect of fixing the base voltage of Q108 to approx. -17VDC
7. Section I becomes active

FREQUENCY CONTROLLED RELEASE CIRCUIT:

When the auto mode is enabled, the circuit designated section I (Fig. 16) becomes active. This circuit is called a " nibbler " circuit. The nibbler is basically a pulse generator which is driven by the audio signal output of the Threshold amplifier (Fig. 11), so the pulse frequency is the same as the side chain input signal.

The pulse train output of Q104 is capacitor coupled (and rectified by D114) to the attack/release charge/discharge node of the rms limiter. The pulse output of Q104 has the effect of pulling a small amount of charge out of C137 through C135 during the transitional portion of the pulse train (edge triggered). The more of these transitions that occur during any given time-frame, the more current will be pulled or " nibbled " out of C137. This causes the release time to become shorter. So then there becomes a inverse relationship between signal frequency and release time: the higher the signal frequency, the shorter the release time of the rms limiter section.

The purpose behind this function is that the release time and audio signal THD are related. The shorter the release time is, the more low frequency THD is generated by the limiting response. By having the release time controlled in part by the signal itself, the THD can be somewhat normalized for all signal frequencies, while at the same time providing a " best fit " release time for any range of signal.

Fig. 17 shows the sweep response of the limiter in Auto mode (wideband/compress modes), set for 10 dB of limiting at 1kHz.

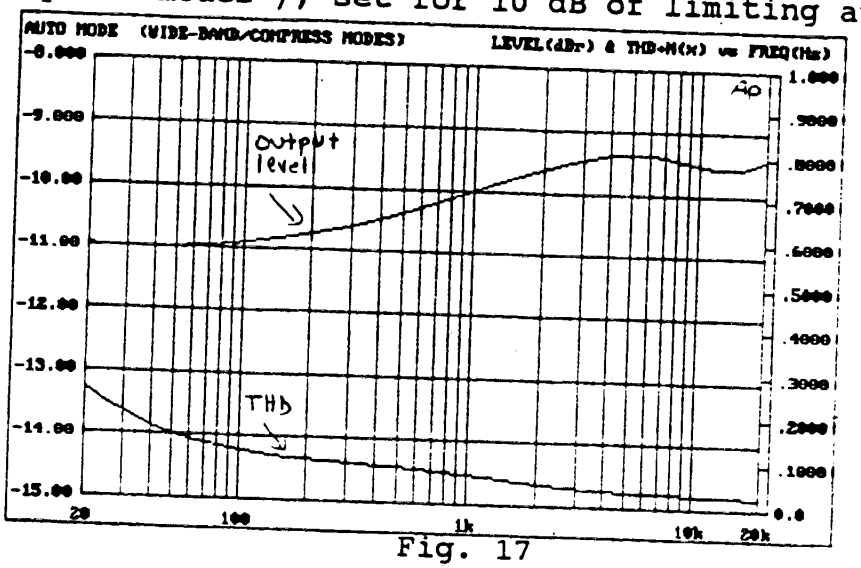


Fig. 17

J. LINK PORT, COMPRESS/EXPAND FUNCTION CIRCUITS:

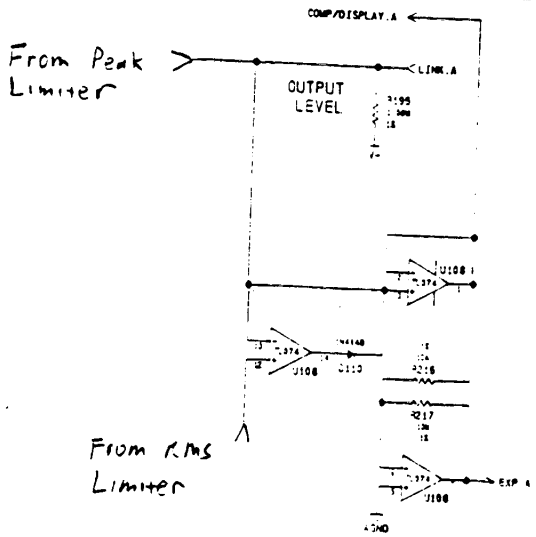


Fig. 18

This section is used as a node at which the peak and rms limiter outputs join and form the composite drive signal used to modulate the VCA gain. This node is also used as a point at which other LA-22 VCA control signals can be linked via the " LINK " port on the rear panel barrier strip. This allows any number of units hooked up in this manner to control the gain reduction of the other units. Also, by depressing the rear panel Link switch, the left and right channels become internally linked at both of the side chain outputs for the purpose of creating a stereo limiter.

The output " COMP/DISPLAY A. " is the positive D.C. control voltage used to drive the VCA control port for compressing and limiting. It is also used as the gain-change display drive signal voltage. The output " EXP.A " is the inverted, negative D.C. control voltage used to drive the VCA control port for expanding. Both of these signals are sent to the display board via J104 (J304 for channel 2) and routed to the VCA via the compress/ expand function select switches S500 or S600 (see display board circuit schematic).

V. OUTPUT LIMITER (FAST PEAK LIMITER):

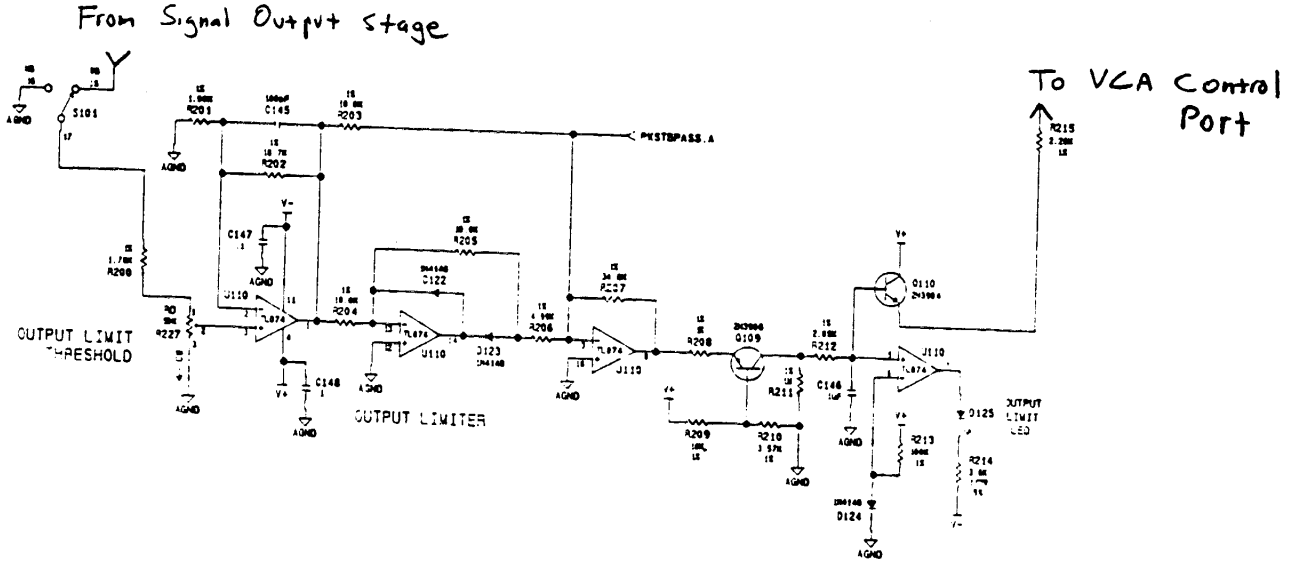


Fig. 19

The output limiter circuit serves one basic purpose. It is used to quickly suppress any signal level above its threshold to prevent potential damage to susceptible equipment such as horn drivers, which can be destroyed by severe signal peaks. Unlike the side chain previously discussed, which takes the signal from the input of the LA-22, the output limiter takes its signal from the output of the VCA itself, creating a feedback loop system useful for this purpose. The effect is that when the output limiter threshold is exceeded, it forces

a reduction in the gain of the VCA until the signal output is reduced to a level just below threshold. The net result is that once the threshold point has been reached, no increase in output level is possible, effectively clamping the output signal level. This is accomplished due to the fact that when the output limiter is triggered, it responds with a large voltage step (18VDC) output to the VCA control port. This occurs when Q110 is activated (see Fig. 19). The attack and release times are controlled by R212, R211, and C146. As with the rms and peak side chain circuitry, the DC control signal is generated by way of a full wave rectifier circuit identical to that in the side chain.

The threshold is user adjusted by a front panel screwdriver adjustable potentiometer, R227. The minimum threshold level is -10 dBu (R227 full counterclockwise position). The attack time is 50us, and release time is 40ms. An easy way to verify the functionality of this stage is to observe the steady-state response of output level and THD using a sinewave input:

1. Apply unit input level of 0 dBu, 1kHz
2. Make sure rms/peak limiter is inactive (R220 full clockwise position).
3. Turn R227 to fully counterclockwise position

The resulting output should be approx. -10 dBu, with THD at about 1%. The front panel " Limit " LED should be on.

The switch section S101 located at the input to the threshold control disconnects the peak limiter during narrow-band operation. This is done to prevent narrow-band operation of this circuit, which would not provide the wide-band peak protection necessary.

VI. TRANSFORMER ISOLATED OUTPUT STAGE:

The output stage (see Fig. 20) is an advanced ultra-low distortion, transformer coupled audio line drive circuit. It is capable of driving 24 dBm (600 ohm load) with less than .001% THD, even at 20Hz. One note of clarification is necessary here. Even though the output stage has this low THD characteristic, the rated THD spec is higher (see spec sheet for details). The reason is that the SSM2018 VCA THD is not as low as the capability of the output stage, due to existing VCA design limitations. This fact is mentioned only in that if the output stage performance for a particular unit is in question, an excellent method of analysis or troubleshooting is to isolate the VCA output from the output stage and drive the output stage directly from a high quality test signal. This can be done by lifting one lead of R120 for channel 1, and R320 for channel 2 access. The lead that should be lifted is that which is connected to U102 pin 7 (U302 pin 7 for channel 2), and connecting the lifted lead carefully to the external signal source. The result should appear as in the sweep plot in Fig. 20.

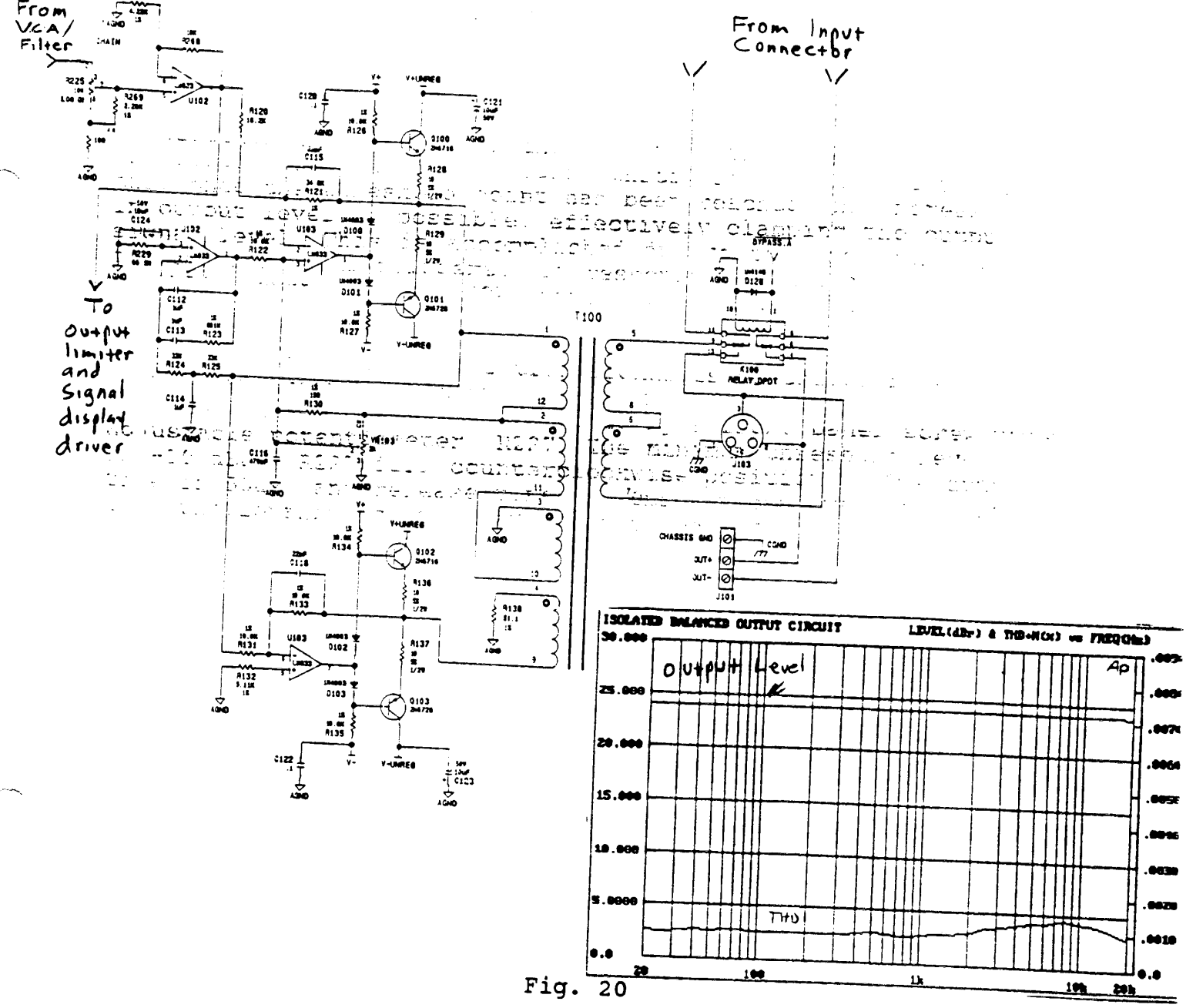


Fig. 20

Assuming the output stage performs correctly, the normal LA-22 system output sweep should appear as in Fig. 21 and 22 for wide-band mode operation, and Fig. 23 and 24 for narrow-band mode.

Integrated into the output circuit is a trimpot (VR103, VR303) used to minimize the low frequency THD. It is recommended to perform this adjustment at 0 dBu in/out at 20 Hz. Fig.21-24 show typical output performance with the low frequency trim completed. (*)

The section comprised of U102A and its associated passive components is a DC integrator circuit, which nulls the DC offset at the transformer primary inputs (T100 pins 1 and 9). In normal operation, the typical offsets will be less than +/-10mV at these pins. If not check the integrator, as well as the drive transistors and their associated temperature compensation diodes (D100-D103) for shorts or opens.

The output impedance of the circuit is approx 62 ohms.

(*)Note: Test filter bandwidth for THD measurement is 22Hz - 30kHz

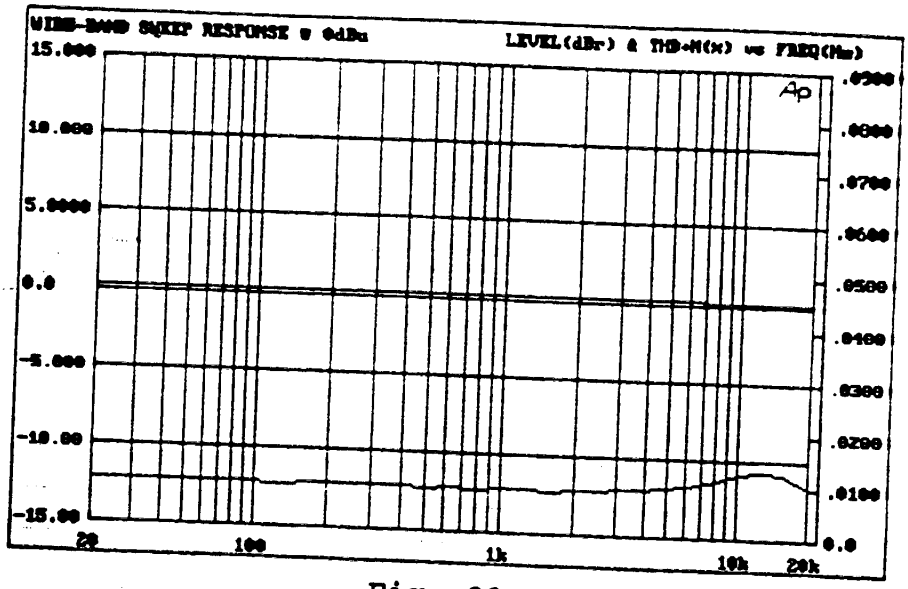


Fig. 21

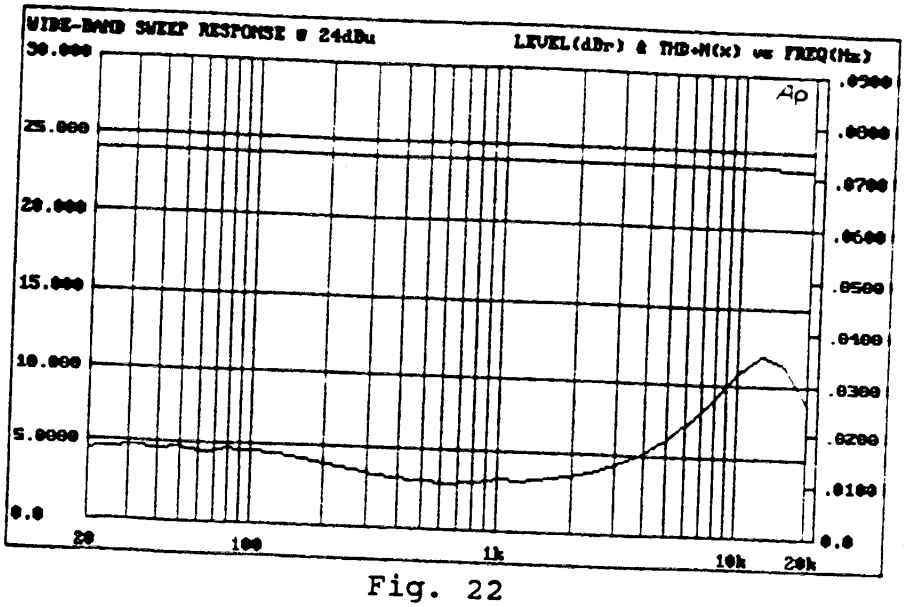


Fig. 22

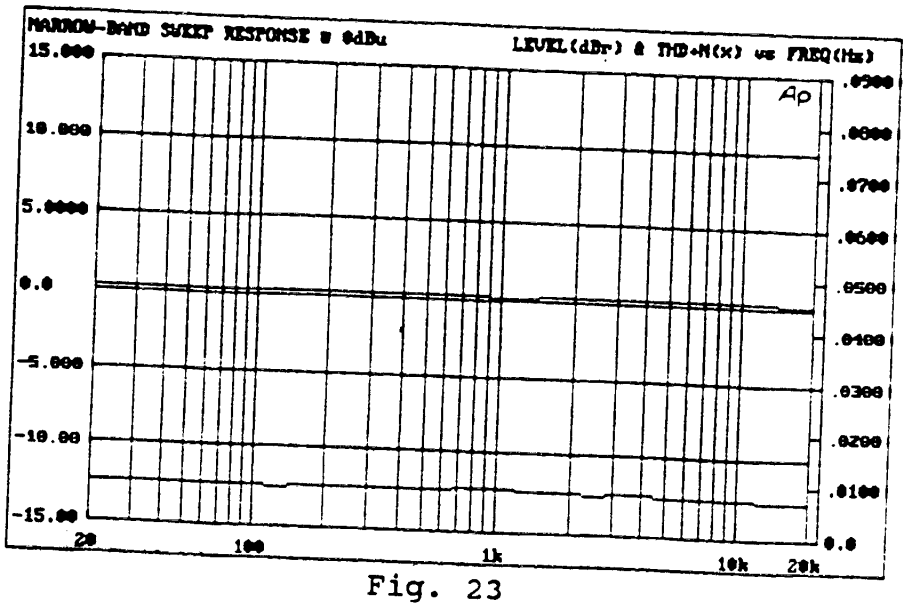


Fig. 23

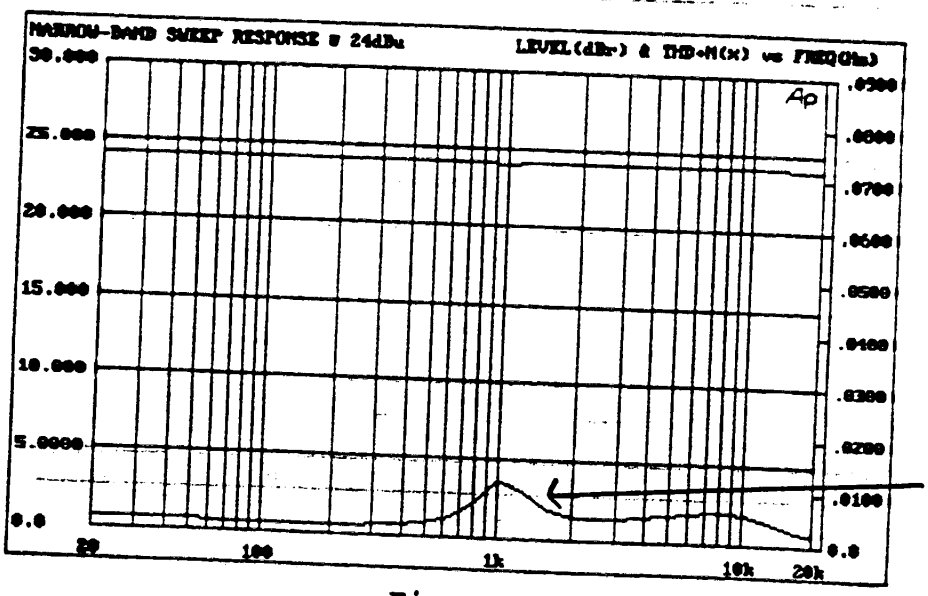


Fig. 24

The output level gain is controlled with R225 or R425 for channel 2. The control range is 40dB, or +/-20dB from center position.

The relay K100 (K300 as well for the 7112) is used to bypass the electronics either when the power is off to the unit, or if the front panel channel bypass switch is depressed when power is on. This allows for a hardwire path from the input connector to the output connector (more on bypass functions later).

VII. SIGNAL LEVEL, GAIN CHANGE DISPLAYS:

This main section can be broken down into the following sub-sections:

A. Signal level display AC-to-DC converter/driver
B. Signal level bargraph display, display drivers
C. Gain change level bargraph display, display drivers
D. Threshold display
E. Bypass control functions
F. Compress/expand control functions

A. SIGNAL LEVEL DISPLAY AC-TO-DC CONVERTER/DRIVER:

This circuit (see Fig. 25) is essentially the same as the rectifier circuits discussed earlier. The only important difference is that there is an additional capacitor (C501) added to filter the signal ripple, and to create set release time to simulate VU meter decay characteristics. The input to this circuit is a switch (S501) which routes either the input level, or output level signal to the signal display.

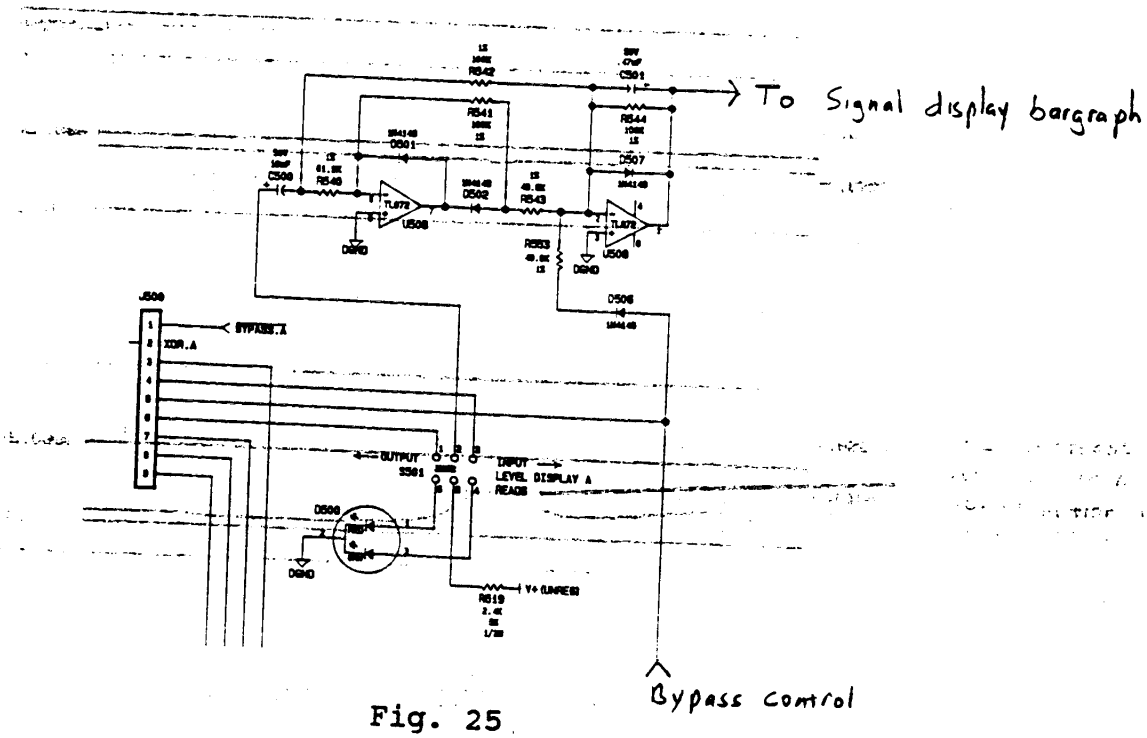


Fig. 25

B. SIGNAL LEVEL BARGRAPH DISPLAY, DISPLAY DRIVERS:

This circuit is comprised of a 12-segment LED bargraph, and its associated drivers (see Fig 26). The drivers are LM339 comparator sections, arranged in a ladder network, along with the resistor ladder used to set the individual threshold voltages. The transistors Q502 and Q503 form a constant current source to drive the LED's without changing brightness levels as more or less LED's are turned on and off. The current is determined by the value of R526 and the voltage across it. The equation for the current is i = V/R, where V is the voltage across R526, (about .68VDC) and R is the value of R526, which is 75 ohms. This results in a constant current of about 9mA to the LED's.

The method of operation is as follows. Starting from 0 signal (all LED's off), there is initially 0VDC at the comparator control line (U504 pin 5, 7, 9 etc..). At this time all of the comparator outputs are low (-18VDC), thereby prohibiting any voltage drop across any of the LED's. When a positive going voltage is driven by the output of the rectifier circuit, rising above the threshold point of the first comparator section (U504 pin 4), the output at pin 2 goes open collector (high state) allowing the current source to create a voltage across the " -30 " LED segment. This series of events continues in the same manner as a higher and higher voltage is driven by the rectifier circuit, eventually turning on all the LED's.

Integrated into this circuit block is a trimpot VR500 (VR600 as well for the 7112) which is used to trim the accuracy of the " -30 " or -30dB LED turn-on point. By adjusting this trimpot, the -30dB LED can be calibrated (*) to a turn-on level of -29.5 dBu, resulting in a turn-off point of about -31.5dBu. This

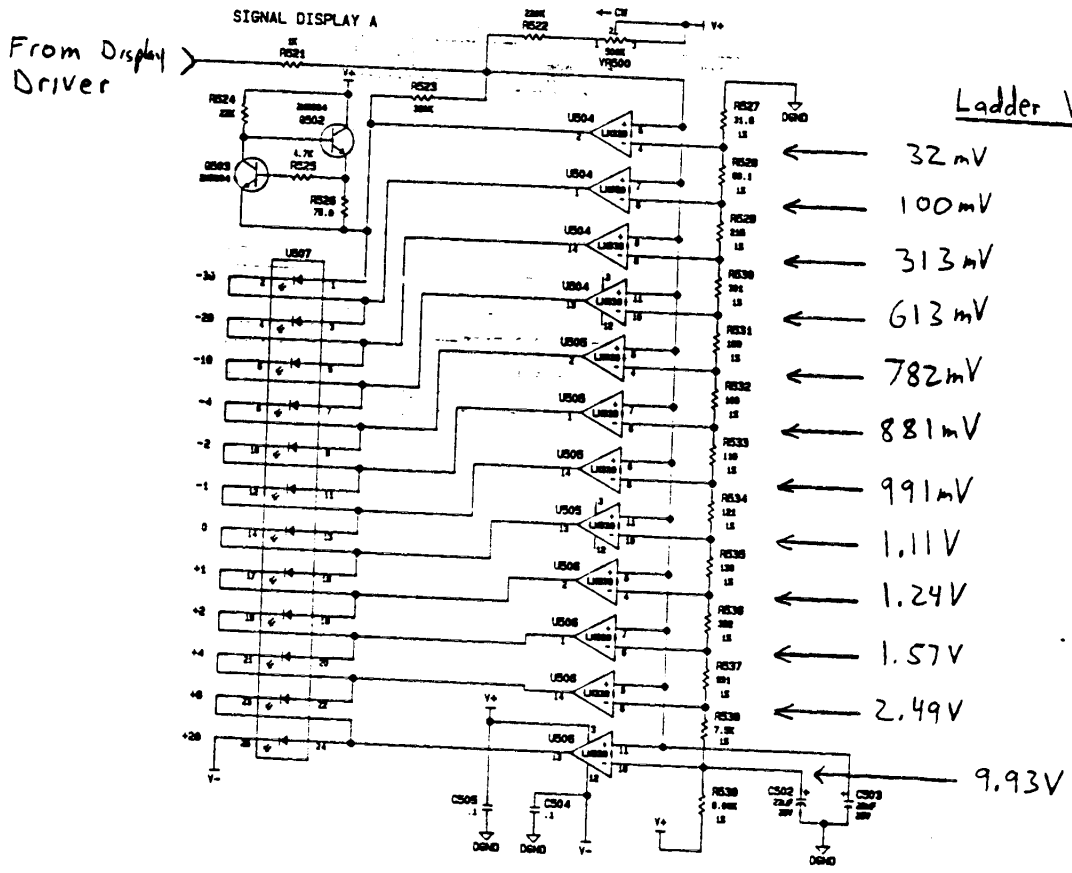


Fig. 26

difference between turn-on and turn-off levels is called " hysteresis ", basically referring to the fact that there is gap, or window between the on and off threshold, even though there is only one reference voltage generated by the resistor ladder per each comparator segment. The hysteresis is generated by the feedback resistor R523 injecting an offset to the control line every time a comparator is triggered. The result of this is that the hysteresis prevents any of the comparators from oscillating, thereby causing an LED to transition from off to a " half on , half off " or half brightness state when its associated comparator is exactly at threshold. It should be noted that the hysteresis is not a constant for all the segments in terms of a dB window. It is constant however, in terms of a comparator voltage differential. Its effect at the user level will be most detectable for the -30 LED, and almost undetectable at the +20 LED.

C. GAIN CHANGE LEVEL BARGRAPH DISPLAY, DISPLAY DRIVERS:

This section (see Fig. 27) is similar to the that discussed

in the previous section, except for having different voltage references as set by the resistor ladder, and opposite orientation of start location. Also, there is no need for an accuracy trim for this section. The function of this section is to indicate the amount of gain reduction/expansion occurring at any given moment as controlled by the side chain. This display does not indicate gain reduction caused by the output peak limiter (section V).

It should also be mentioned that unlike the signal display section, one of the LED segments of the gain change display is allocated as a threshold indicator, which is driven by a separate drive path (see next section). This design varies from the LA-10 and LA-12 in that these other models use a separate, discrete LED circuit to display threshold. With the LA-22, the discrete LED's serve the purpose of compress/expand function indicators.

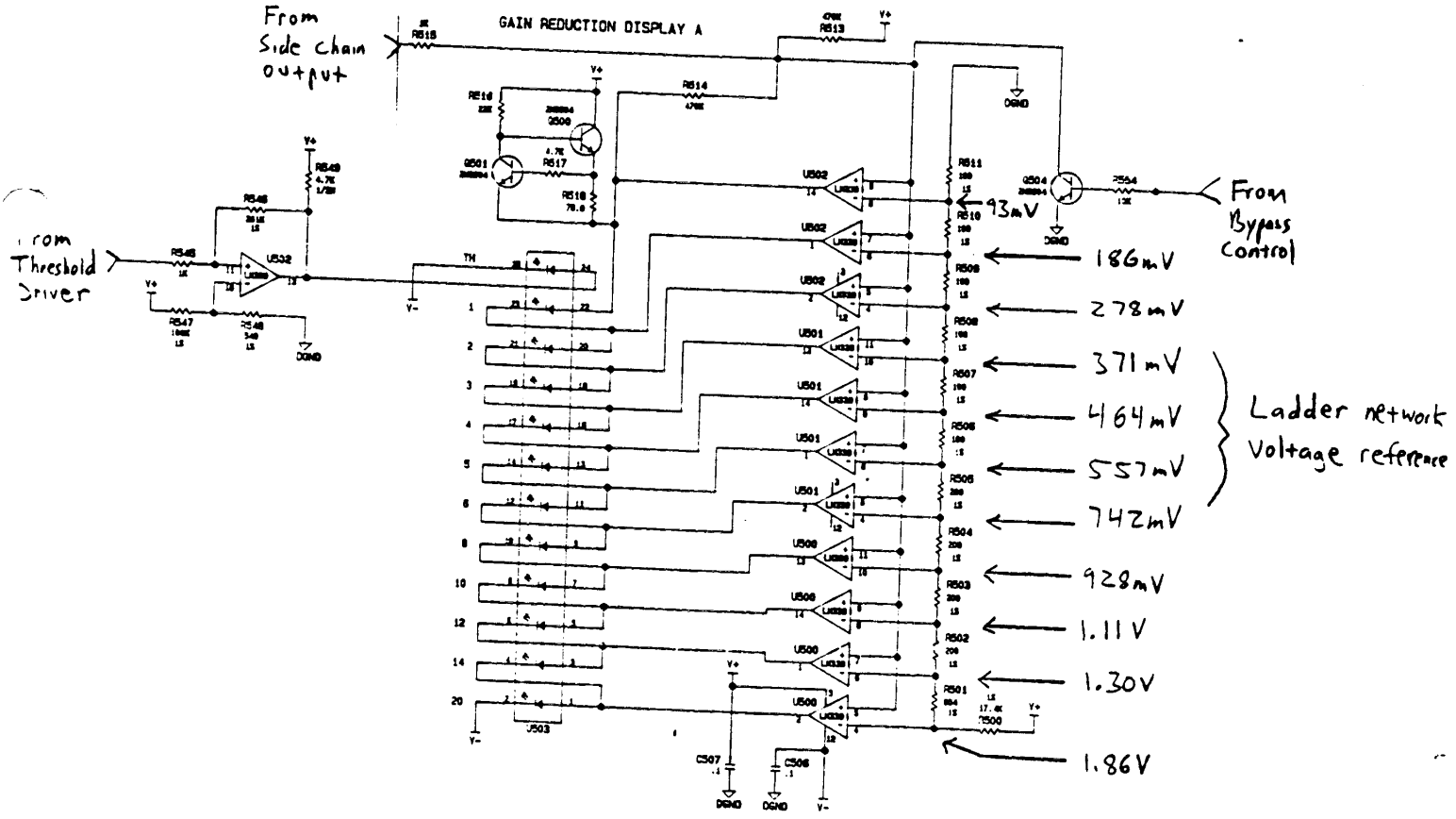


Fig. 27

(*)Note: When performing this adjustment, it is best to have the signal display input select switch set to the " input " mode, as the " output " mode is user adjustable via R226.

D. THRESHOLD DISPLAY:

This section is a mini-version of the signal/gain reduction displays already discussed (see Fig. 27). The function of this display is to indicate the threshold point of operation. It should be noted that this display is an approximation of this point, with slight errors induced depending on the settings of the side chain controls. The input drive for this display is supplied by a buffer in the side chain designated by U106D (U306D as well channel 2, see Fig. 10). The input to the buffer is the output of the side chain full wave rectified signal, with a low pass filter applied to reject ripple. This signal is then sent to the comparator section of U502 (U602 for channel 2), which drives the LED segment indicated by " TH ". compress expand function.

E. BYPASS CONTROL FUNCTIONS:

When the LA-22 unit is powered-on, if it is desired to bypass the audio chain electronics by way of the relay circuit discussed in section V, there is a front panel pushbutton switch (one per channel) which engages a number of functions which comprise the Bypass mode. The main function, controlling the audio chain relay, has already been discussed. However, in order to truly " bypass " the channel, several other conditions should exist in order to avoid confusion for the user and provide functional consistency. These conditions are defined as follows:

When the Bypass mode is engaged, the following conditions will exist:

1. Only the channel whose bypass switch has been depressed will be affected
2. The audio chain relay will be switched to hardwire the signal input of the unit to its output connector with no active or passive components in the signal path except for the relay itself
3. The side chain becomes inactive to prevent it from affecting another channel via the Link port
4. The output limiter becomes inactive, preventing its associated LED from being turned on
5. The signal level, gain reduction, and below threshold LED displays become inactive

In order to discuss the implementation of the functions defined in sections 3, 4, and 5, we will refer to the sections and associated figures previously discussed.

SECTION 3 (refer to Fig. 11):

When the bypass switch is engaged (S502 or S602), a 27VDC signal is routed from the display board down to the side chain via

the " Bypass ctrl.A " (or B for channel 2) pin of connector J104 or J304. This voltage is applied to the side chain rectifier and causes its output to go to the negative rail (-18VDC). This has the effect of disabling the side chain.

SECTION 4 (refer to Fig. 19):

The " Bypass ctrl.A " (or B) signal applies 27VDC to the output limiter rectifier, disabling it in the same manner as in section 3.

SECTION 5 (refer to Fig. 11, 25 and 27):

When the side chain becomes inactive, this prevents any signal from driving the " threshold " display.

When the bypass switch is engaged, the same 27VDC signal used to disable sections 3 and 4, also disables the signal display rectifier in the same way, also disabling the signal display LED array. This same signal also biases the base of the transistor Q504 (Fig. 27), saturating it and causing it to short to ground the control signal driving the gain reduction LED array. This prevents any signal generated by the Link port from activating this display during Bypass mode.

F. COMPRESS/EXPAND CONTROL FUNCTIONS:

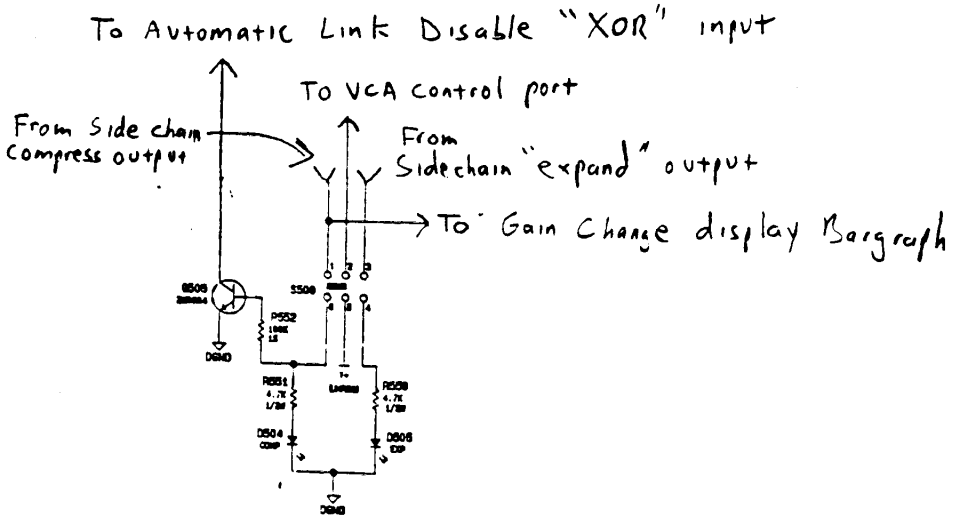


Fig. 28

In order to route the compress or expand mode side chain outputs to the VCA, switch S500 (S600 for channel 2) is used. S500 also routes the 27VDC node to the appropriate LED indicator, either D504 for compress mode, or D505 for expand mode. Also, when the switch is in the compress mode, Q505 is saturated, forcing a logic 0 (0VDC) at the " XOR.A " node. The same is true for channel 2. The purpose of this logic function will be made clear in the next section.

VIII. AUTOMATIC LINK MODE DISABLE CIRCUIT

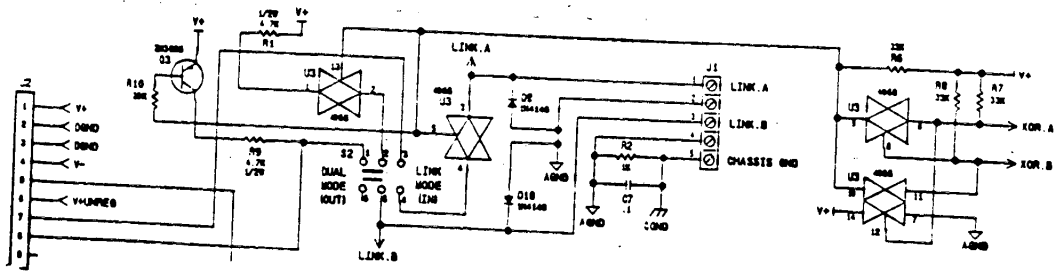


Fig. 29

In order to prevent the undesirable condition of internally linked channels with opposite compress/expand modes, the logic circuit defined by Fig. 29 is used to internally disconnect the hardwired connection made when the rear panel link switch is depressed.

The " opposite mode " condition occurs when the compress/ expand mode switches (S500 and S600) are in opposite positions. In this state, one of the associated logic transistors Q505 or Q605 (see display section F) will be saturated (logic 0 output) and the other will be off (tri-stated, or open collector logic state). These logic signals (XOR.A and XOR.B) are the condition detection lines used to engage the disable mode. Since the condition only exists when these logic lines are in opposite states, a simple exclusive OR logic circuit is used to enable the necessary circuits. This excl. OR (XOR) circuit is composed of the analog switch (U3) sections connected to these logic lines.

When an opposite state condition exists, the output of the XOR, defined by the node driven by U3 pins 9 and 10, goes " low ", actually connecting the saturated transistor (either Q505 or Q605) to this node through one of the two switch sections. When this occurs, the following results (assume link switch is depressed) :

1. analog switch section U3 at pins 3,4 and 5 goes open, breaking the internal link connection originally set by the link switch S2
2. analog switch section U3 at pins 1, 2, and 13 goes open, disconnecting the V+ voltage supply to the "Link" LED located on the display board (connected by J2 pin 7), turning off the LED
3. transistor Q3 is turned on and saturated, connecting the V+ voltage supply to the "Dual" LED located on the display board (connected by J2 pin 8), turning on the LED

It should be noted that if the Link switch is out (" Dual " mode), then this circuitry has no effect on the unit operation.

IX. POWER SUPPLY, TURN ON DELAY:

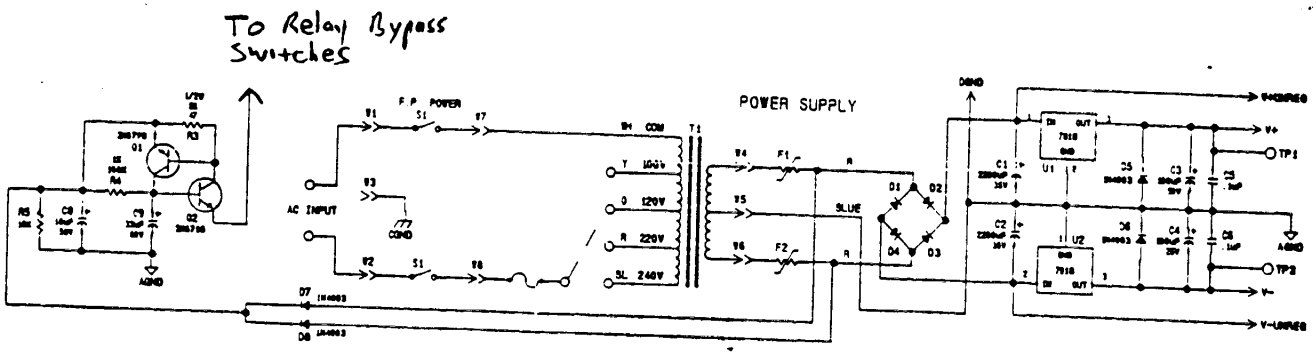


Fig. 23

The AC to DC power supply used here is capable of being driven by all the standard international voltages (100V, 120V, 220V, and 240V). By using a multi-tap torroidal power transformer and a user-configurable power connector/fuseholder, accommodating any of these voltages is a simple task. The DC voltage generated by the full wave bridge is nominally approx. +/- 27VDC. These voltages are referred to as the " V+ (unreg) " and " V- (unreg) " lines. These voltage lines are then used as inputs for the +18V and -18V regulators, which supply most of the electronics. AC ripple on the unregulated lines is typically around 500mV rms. The nominal AC operating line current is approx. 200mA rms (primary current, at 120VAC input).

The circuit comprised of Q1, Q2 and their associated components is the delayed turn-on/relay driver circuit, which powers the audio relay coils. When power-on occurs, the R-C charge-time determined by R4 (100k) and C9 (22uF) creates a delay of about 2 seconds (*), preventing turn-on transients from affecting the signal output.

I. Front Panel Controls and Features

1. Limiter Function Controls

Channels A & B

a) Threshold — Potentiometer - adjustable from -40 dBu to off.

b) Detector — Potentiometer - adjustable between average and peak.

c) Attack

Average Detector — Potentiometer - adjustable 1 ms to 50 ms.

Peak Detector — Fixed 100 us attack 10 ms release.

d) Release — Potentiometer - adjustable 100 ms to 5 seconds for 10 dB of release.

e) Ratio — Potentiometer with switch adjustable fro 1:5:1 to ∞:1. Switch engages auto circuit.

f) Auto — Auto circuit is engaged by rotating rati control fully counter clockwise to click position. This circuit presets peak/average, attack ratio controls and engages a program dependent release function.

2. Frequency Selective Limiter Mode Controls

a) Mode Select — Push-push locking switch - selects betwee wideband limiting (switch out position) and narrowband (frequency selective) limiting modes.

b) Monitor Side Chain — Momentary action pushbutton switch - wher depressed allows audio side chain input signal to be monitored via signal output. Functional in both narrow and wideband modes.

c) Frequency Range — 3-position rotary switch - sets frequency range for narrowband parametric bandpass filter center frequency:

Position: X1 - 20 Hz to 200 Hz
X10 - 200 Hz to 2 kHz
X100 - 2 kHz to 20 kHz

d) Frequency

Outer control section of concentric potentiometer - provides continuous cente frequency sweep for parametric bandpass filter. Range is one decade, from 20 (x range) to 200 (x range).

e) Q

Inner control section of concentric potentiometer - provides continuous Q control of narrowband mode parametric bypass filter. Min. Q: .47, max. Q: 9. (.12 octave to 2.5 octave).

3. Output Level

Potentiometer adjustable -20 dB to +20 dB

4. Output Meter Adjust

Front panel trim pot - sets output zero reference from -15 dBu to +4 dBu.

5. Output Limiter Adjust

Front panel trim pot - sets maximum outpu ceiling. Peak attack and release are fixed at 50 us and 40 ms. The input threshold for this circuit is taken from the absolute output level. Min. limit level -10 dBu (full CCW position) to off (full CW position). This limiter functic is non-linkable, and is disabled during narrowband modes.

6. Level Display I/O

Push-push locking switch - switches meter between input/output.

7. Function

Push-push locking pushbutton switch - switches between compressor or expander operation. Maxiumum expansion 25 dB.

8. Bypass

Push-push locking switch. Input is hard wired to output through a relay, remains connected to input section. All limiter functions bypassed.

9. Power Switch

Push-push on, off.

10. Status Indicators

Channel A, B

a) Dual

Red LED.

	Linked	Yellow LED.
b)	Input/Output	Bi color LED, lights green for input, red for output.
c)	Bypass	Red LED.
d)	Auto	Red LED.
e)	Limit	Red LED.
f)	Signal Level	12 segment bar graph. 20 dB Red LED. 8 dB Red LED. 4 dB Red LED. 2 dB Red LED. 1 dB Yellow LED. 0 dB Yellow LED. -1 dB Yellow LED. -2 dB Yellow LED. -4 dB Green LED. -10 dB Green LED. -20 dB Green LED. -30 dB Green LED.
g)	Gain Reduction	12 segment bar graph TH dB Red LED. (Threshold of limiting) 2 dB Red LED. 3 dB Red LED. 4 dB Red LED. 5 dB Red LED. 6 dB Red LED. 8 dB Red LED. 10 dB Red LED. 12 dB Red LED. 14 dB Red LED. 20 dB Red LED.
h)	Compressor Mode	Triangular Red LED.
i)	Expander Mode	Triangular Red LED.

II. Rear Panel Features, Connectors and Controls

1.	Channel A, B Input Connector	XLR D3F. pin 2 + pin 3 - pin 1 gnd.

2. Dual/Link Switch — Rear panel push lock switch for selecti dual or linked mode. Link function is automatically disabled if Channel A and compressor/expander switches are set in opposite positions. In this condition, link indicator is off, dual indicator is on, and internal link line is disconnected.

3. Channel A, B Output Connector — XLR D3M, pin 2 + pin 3 - pin 1 gnd.

4. Channel A, B Barrier Strip Connector — 10 pin:

Pin 1 parallel signal input +
Pin 2 detector (side chain) input +
Pin 3 internal narrowband filter out +
Pin 4 chassis gnd
Pin 5 parallel signal input -
Pin 6 detector (side chain) input
Pin 7 internal narrowband filter out -
Pin 8 chassis gnd
Pin 9 parallel signal out +
Pin 10 parallel signal out -

5. Center Barrier Connection Strip — 5 pin, pin 1 Channel A link, pin 2 circu gnd, pin 3 Channel B link, pin 4 circuit gnd, pin 5 chassis gnd.

6. Features

a) Parallel signal input/output barrier strip connections provide permaner installation connections.

b) Barrier strip signal input/detector input pair connections are normall strapped together with hardware straps, providing input to side chain operation of limiter.

c) Internal parametric bandpass filter output access is provided to allow wideband limiter mode operation with internal filter as side chain inpu signal.

d) Center 5-pin barrier strip provides link port access in order to connec multiple 71XX series compressor/limiter side chains together.

Power Input — 25 watts max.

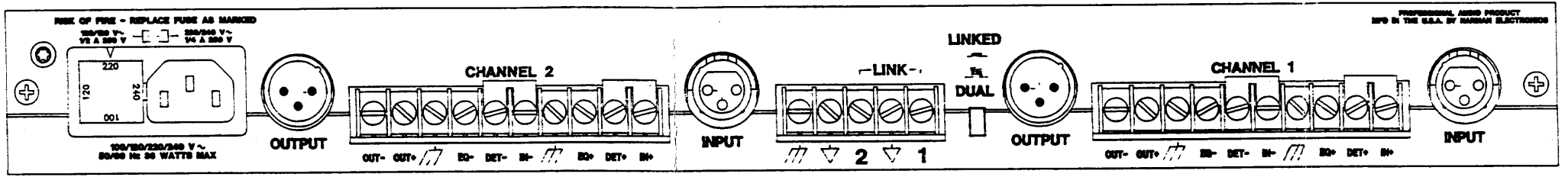
1) 50/60 Hz (All Voltages) 100V, 120V, 220V, 240V — #18 awg, 6 foot long 3 wire with IEC connector and USA cord. (Product not to be configured for any voltage when shipped).

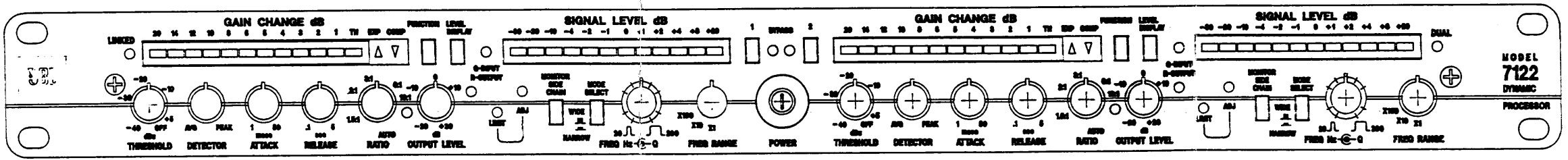
2) AC Main Protection	120V 1/2 amp fuse, slo blo type. 240V 1/4 amp fuse, slo blo type.
Accessories	Fuses, one each. Security cover screws. Rack mount screw kit. Barrier strip straps, 2 each.

III. Electrical Specifications

1.	Frequency Response	±0.2 dB, 20 Hz - 20 kHz wideband mode. ±0.5 dB, 20 Hz - 20 kHz narrowband mode.
2.	System Gain	Nominally 0 dB adjustable from +20 dB to -20 dB.
3.	Signal Input Impedance/Resistance (Input Circuit is Std. UREI Input Stage)	40 k ohms balanced. 20 k ohms unbalanced.
4.	Detector Input (Differential)	100 k ohms balanced.
5.	Maximum Input Level	+24 dBu (12.3V RMS).
6.	Signal Input Common Mode Rejection	≥ 60 dB at 1 kHz. ≥ 40 dB at 10 kHz.
7.	Channel Separation (+24 dBu In/Out)	≥ 85 dB, 1 kHz. ≥ 60 dB, 10 kHz.
8.	Output Impedance	< 75 ohms.
9.	Rated Output Level	+4 dBu (1.22 volts rms).
10.	Maximum Output Level	+24 dBu, 600 ohms.
11.	THD @ 24 dBu Input/Output (22 Hz -30 kHz test bandwidth. Output Level Control Set to 0 dB. Below Threshold)	0.05% max. @ 1 kHz.
12.	THD @ 0dBu Input, Below Threshold. 0 dB Gain Setting, 22 Hz - 30 kHz Test Bandwidth.	.02% max. @ 1 kHz.

1.	Dimensions	10.8" D x 1.719" H x 17" chassis width. Panel: 19" overall width.
2.	Depth in Rack	10.25".
3.	Overall Depth with Security Cover	11.2".
4.	Weight Net	8.6 lb.
5.	Weight Shipping	10 lb.

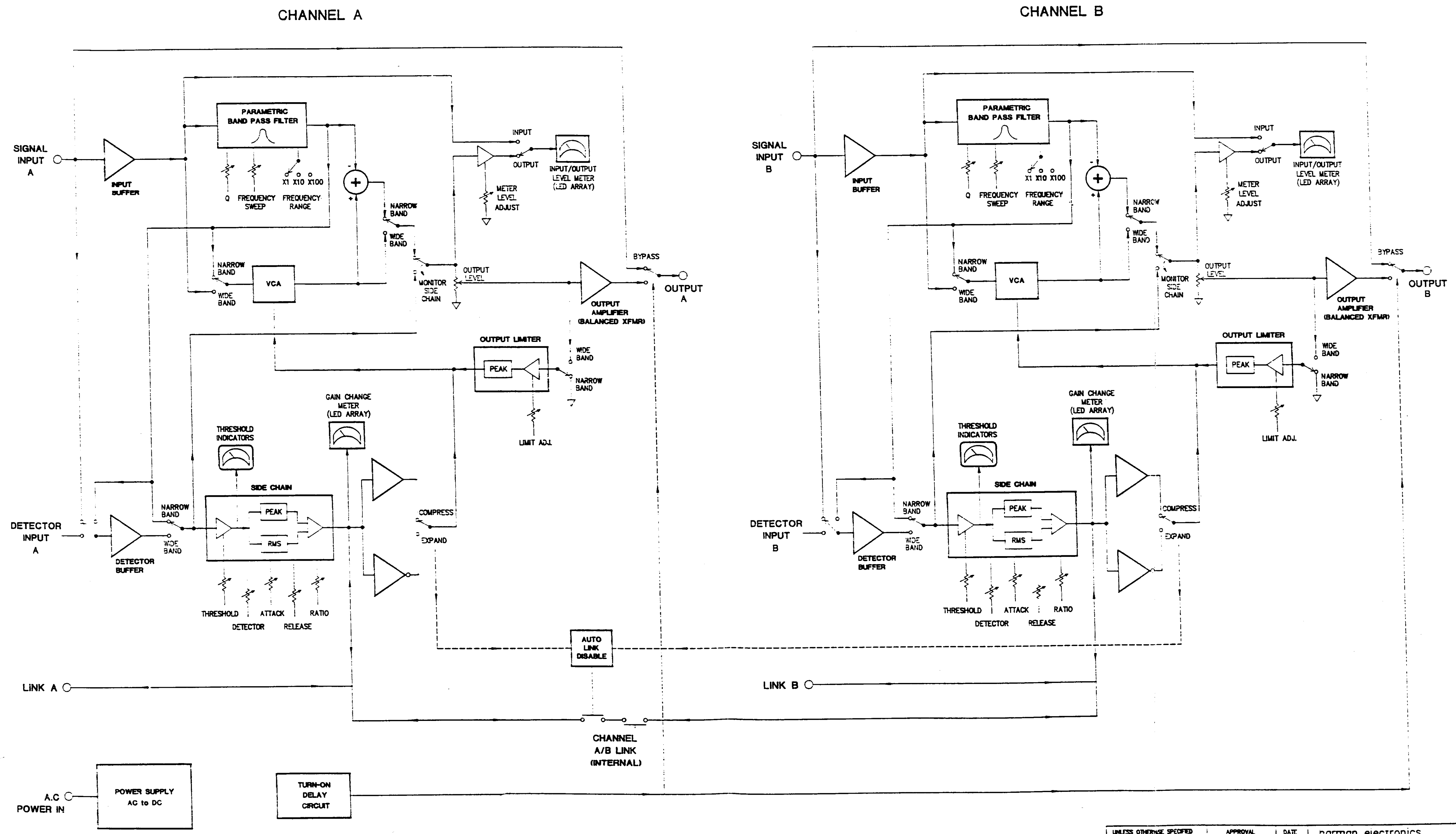

RISK OF FIRE - REPLACE FUSE AS MARKED
220
120
240
100
OUTPUT
CHANNEL 2
OUT- OUT+ EQ- DET- IN- EQ+ DET+ IN+
INPUT
LINKED
LINK
DUAL
2 1
OUTPUT
CHANNEL 1
OUT- OUT+ EQ- DET- IN- EQ+ DET+ IN+
INPUT


GAIN CHANGE dB
SIGNAL LEVEL dB
LINKED
DUAL
THRESHOLD
DETECTOR
ATTACK
RELEASE
RATIO
OUTPUT LEVEL
LIMIT
ADJ
MONITOR SIDE CHAIN
MODE SELECT
WIDE
NARROW
FREQ Hz
FREQ RANGE
POWER
MODEL
7122
DYNAMIC
PROCESSOR

DWG. NO.	SH	REV.
268109		

REVISIONS

ECO	REV.	DESCRIPTION	DATE	APPROVED
		INITIAL RELEASE		



NEXT ASSY	USED ON

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE:
FRACTIONS ± X; DECIMALS .X ± X, .XX ± X; ANGLES ± X
MATERIAL NA
FINISH NA

APPROVAL		DATE
DRAWN	M.BURCKHARDT	1/03/92
CHECKED		1/06/92
MANUFACTURING		
PRODUCT ASSURANCE		
ENGINEERING		

harman electronics
A Harman International Company
Northridge, California 91329, U.S.A.

TITLE BLOCK DIAGRAM, UREI LA-22 COMPRESSOR/LIMITER

SIZE D | DRAWING NO. 268109 | REV 01

SCALE NONE | SHEET 1 OF 1

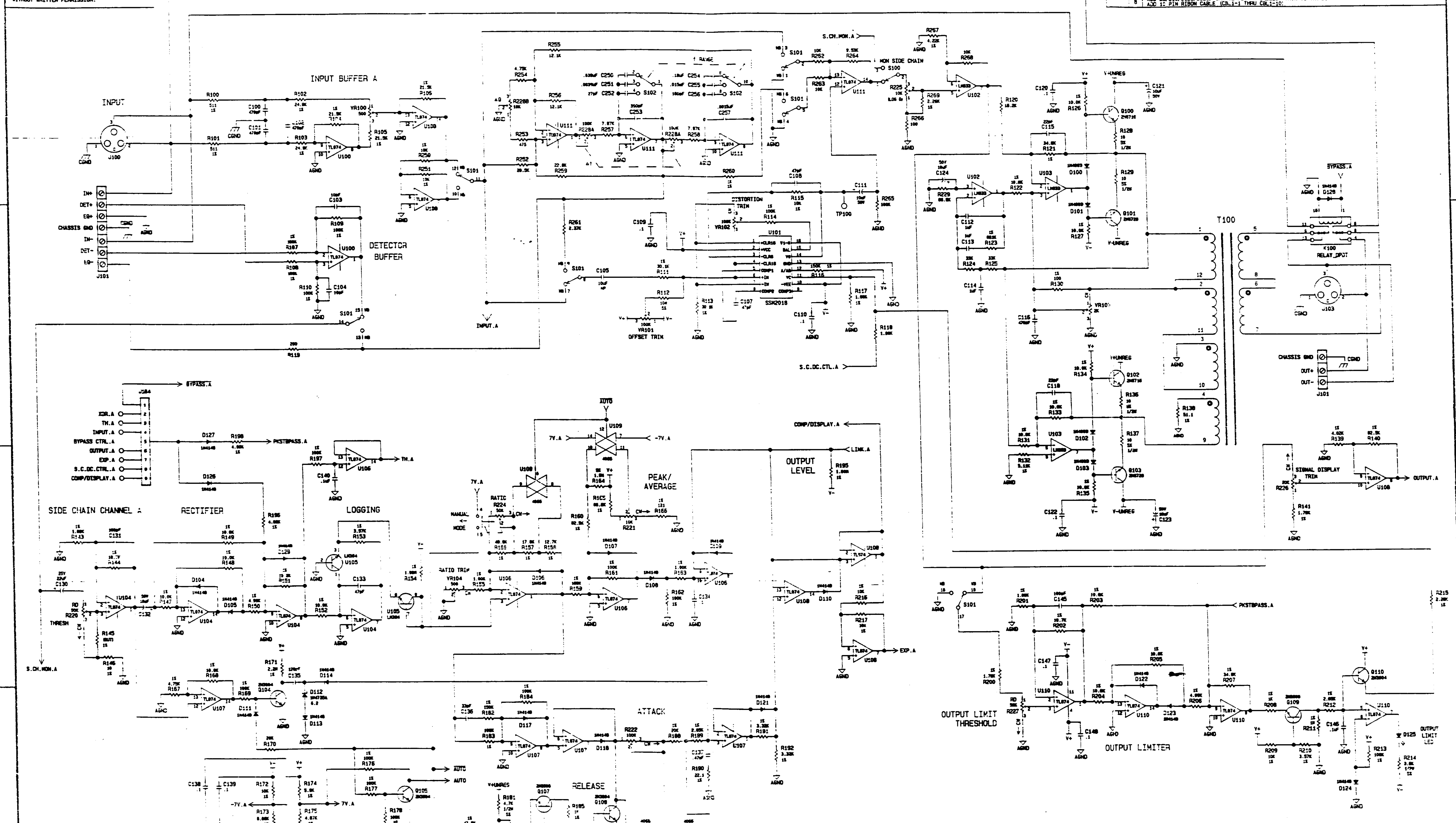
FILE: 268109.DWG | FLOPPY: YES [X] NO [ ]

Fig. 1

DWG. NO. 259212 | SH 1 | REV. 8

REVISIONS

ECO	REV	DESCRIPTION	DATE	APPROVED
11884	7	ADD R269, 469; HCF4066 TO 4066 (U109, 309); NEW VALUE (R6, 7, 8 & C1, 2)		
	8	ADD D9, D10, D129, D329; CHANGE NET NAME (BELOW TH.A TO TH.A); ADD 10 PIN RIBON CABLE (CBL1-1 THRU CBL1-10)		



UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE:	APPROVAL	DATE
FRACTIONS ± X; DECIMALS .XX ± X, .XX ± X; ANGLES ± X	DRAWN M.BURCKHARDT	1/03/92
MATERIAL NA	CHECKED	1/06/92
FINISH NA	MANUFACTURING	
	PRODUCT ASSURANCE	
	ENGINEERING	

NEXT ASSY | USED ON

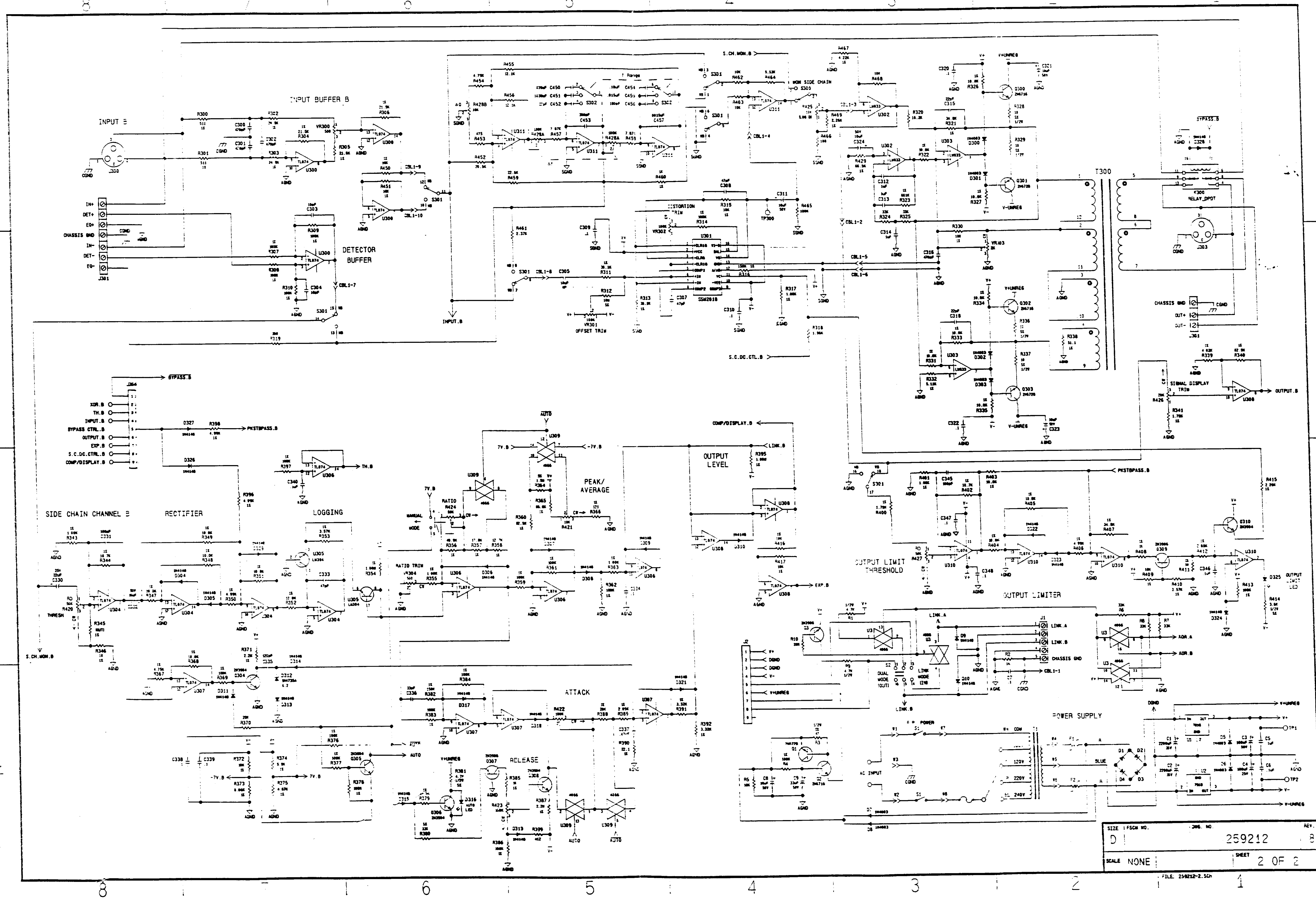
harman electronics
A Harman International Company
Northridge, California 91329, U.S.A.

TITLE: SCHEMATIC, UREI LA-22 COMPRESSOR/LIMITER

SIZE D | DRAWING NO. 259212 | REV 8

SCALE NONE | SHEET 1 OF 2

FLOPPY YES ☐ NO ☐


INPUT BUFFER B
INPUT B
DETECTOR BUFFER
DISTORTION TRIM
OFFSET TRIM
SSM2018
T300
RELAY DPDT
BYPASS.B
CHASSIS GND
OUTPUT.B
SIGNAL DISPLAY TRIM
S.C.DC.CTL.B
S.CH.MON.B
MON SIDE CHAIN
XOR.B
TH.B
INPUT.B
BYPASS CTRL.B
EXP.B
COMP/DISPLAY.B
PKSTBPASS.B
SIDE CHAIN CHANNEL B
RECTIFIER
LOGGING
RATIO
RATIO TRIM
MANUAL MODE
PEAK/ AVERAGE
OUTPUT LEVEL
LINK.B
OUTPUT LIMIT THRESHOLD
OUTPUT LIMITER
OUTPUT LIMIT LED
THRESH
ATTACK
RELEASE
AUTO
LINK.A
XOR.A
DUAL MODE (OUT)
LINK MODE (IN)
POWER SUPPLY
POWER
AC INPUT
120V
220V
240V
BLUE
V+UNREG
V-UNREG
SIZE
FSCM NO.
DWG. NO
REV.
D
259212
B
SCALE NONE
SHEET 2 OF 2
FILE: 259212-2.SCH

DWG. NO. 259223 | SH 1 | REV. 6

SIGNAL DISPLAY A

SIGNAL DISPLAY B

THRESHOLD DISPLAY B

GAIN REDUCTION DISPLAY A

THRESHOLD DISPLAY A

GAIN REDUCTION DISPLAY B

REV.	DESCRIPTION	DATE	APPROVED
6	ADD D507 & D507; TEXT 'THRESHOLD DISPLAY A & B' ADDED		

APPROVAL	DATE
DRAWN M.BURCHHARDT	1/03/92
CHECKED	1/06/92
MANUFACTURING	
PRODUCT ASSURANCE	
ENGINEERING	

harman electronics
A Harman International Company
Northridge, California 91329, U.S.A.

TITLE: SCHEMATIC, UREI LA-22 DISPLAY BOARD

SIZE D | DRAWING NO. 259223 | REV 6

SCALE NONE | SHEET 1 OF 1

JBL Incorporated, 8500 Balboa Boulevard, P. O.Box 2200, Northridge, California 91329 U.S.A.

Technical Manual

UREI LA-22

SPECIFICATIONS

- Inputs: Active balanced bridging
- Input Impedance: 40k Ω balanced input, 20k Ω unbalanced (with detector normalled to input)
- Detector Input Impedance: 100k Ω balanced input, 50k Ω unbalanced
- Maximum Input Level: +24 dBu (12.3 V rms)
- Gain: ±20 dB, adjustable with front panel output level controls
- Frequency Response: 20 Hz - 20 kHz ±0.2 dB
- Dynamic Range: <115 dB
- Signal To Noise Ratio: 110 dBA, 22 kHz A weighted noise bandwidth
- THD: <0.006% typical @ 1 kHz, 0.02% maximum @ +14 dBu input

Attack Times

- Average Detectors: 1 - 50 ms
- Peak Detectors: ≤100 μs
- Output Peak Limiters: 50 μs

Release Times

- Average Detectors: 100 ms - 5 s for 10 dB of release
- Peak Detectors: 10 ms
- Output Peak Limiters: 40 ms
- Compression/Expansion Ratios: Adjustable from 1.5:1 to ∞:1
- Threshold of Limiting/ Expansion: Adjustable from -40 dBu to Off
- Outputs: Transformer isolated, symmetrical floating
- Maximum Output Level: +24 dBm into 600 Ω

Connectors

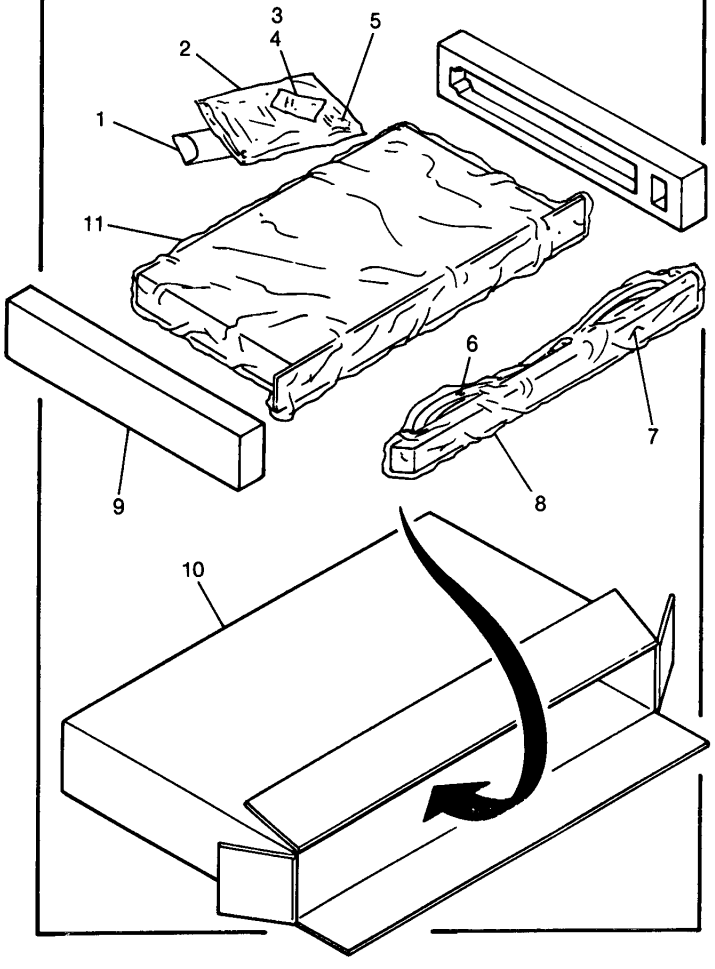
- Inputs and Outputs: XLR type 3 pin (pin 2 high), and barrier strip
- Limiting Detectors: Barrier strip
- Link: Barrier strip
- AC Power Requirements: 100-120/220-240 V AC, 50-60 Hz, 30 W maximum
- AC Line Cord: Detachable, IEC type
- Finish: Powdercoated black
- Enclosure Dimensions: See Below
- Net Weight: 14 lbs. (6.4 kg.)

WARRANTY INFORMATION:

- Refer to the Warranty Statement packed with each product.

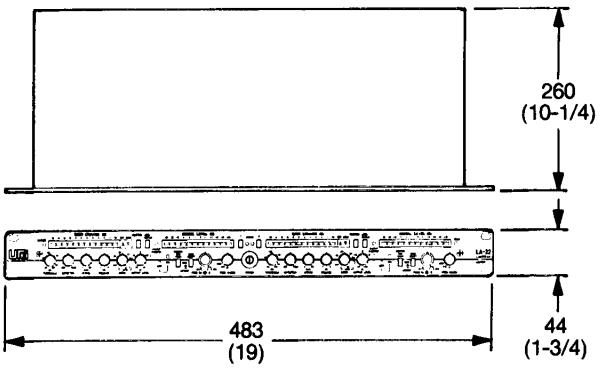
PACKAGE

Warranty 59660



COMPONENT VIEW

OVERALL DIMENSIONS
DIMENSIONS ARE mm AND (in.)



COMPONENT PARTS LIST

ITEM	PART NO.	QTY	DESCRIPTION
1	10-13788	1	KIT, RACK, SCR, BLK
2	259267	1	MNL, USER, LA-22
3	276193-001	2	FUSE, SB, 1/2A, 250V, 5 x 20, UL
4	255236	1	FUSE, SB, 1/4A, 250V, 5 x 20
5	33-0147	1	BAG, POLY, 12" x 16"
6	36-0543	1	CORD, PWR, DETCH, 3COND, 18GA
7	267151-001	1	COVR, SCRTY, LA-XX
8	33-0074	1	BAG, POLY, 5" x 22"

COMPONENT PARTS LIST

ITEM	PART NO.	QTY	DESCRIPTION
9	33-16828	2	END, PAD, FOAM
10	33-16827	1	CRTN, LA-XX/79XX
11	33-0071	1	BAG, POLY, 18" x 24"
12	25-16774	2	COVR, PNL, FAB
13	25-14284	1	LBL, WARN, ELEC-SHOCK
14	259192	1	PNL, REAR, FAB, LA-22
15	264036	1	TAPE, DBL-SIDED, ADH, 3/16 x 2
16	263437	1	CONN, PWR, W/FUHLR, LA-12
17	261108	1	SCR, 6-32 x 3/4, TRXPNH, BZ
18	274608-001	1	LBL, SER#, LA-XX
19	28-0057	2	WSHR, #6, EXT, TTH
20	H100-15199	3	NUT, 6-32, KEP
21	255104	1	WSHR, 8, 1-7/16 x 032, ALUM
22	30-0216	1	SCR, 8-32 x 1-1/4, PPH, SEMS
23			
24	25-16772	2	PNL, SIDE, FAB
25	267116-001	1	PNL, FRNT, LA-22
26	30-0057	12	SCR, 6-32 x 3/8, PPH
27	25-16781-001	6	SPCR, BSHG
28	25-12993	1	NAMEPL
29	29-17000	12	NUT, SPANNER, 7MM
30	269753-001	2	KNOB, OUTER, LA22
31	264278-001	2	KNOB, INR, 7122, BLK
32	24-16780	1	KNOB, PWR, SW
33	24-16999-001	10	KNOB, INR
34	24-16999-002	4	KNOB, INR
35			
36			

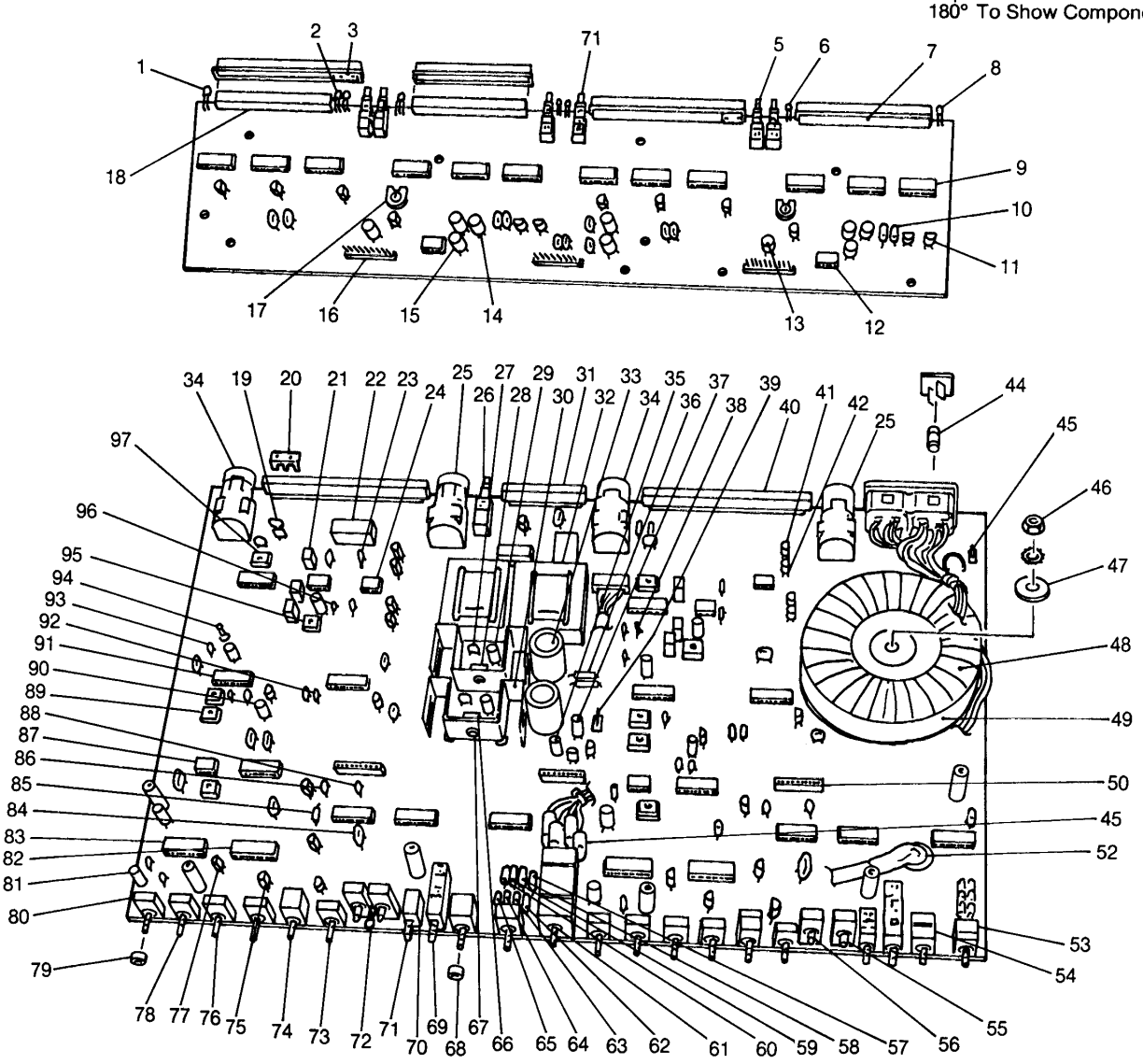
CIRCUIT BOARDS

1	13-0746	1	LED, T1, YEL
2	259815	4	LED, T1, RED, FLT-HD
3	259256	2	MASK, LED, LA-22
4			
5	15-0494	6	SW, DPDT, ALT-ACT, PCMT
6	13-0712	2	LED, GRN/RED, DICHRO
7	13-0710	2	LED, BAR-GRPHC, 12P
8	13-0744	3	LED, T1, RED
9	275009-001	12	IC, LM339AN, E-CMPRIR
10	HM14-0582	12	CAP-SF, .1UF, 5%, 50V
11	HM13-0413	12	XSTR, TO-92, NPN, 2N3904
12	13-0304	2	IC, TL072CP, OP-AMP, DUAL
13	14-0505	4	CAP-EL, 10UF, 50V, RD
14	HM14-0576	4	CAP-EL, 22, 25V, 85C
15	50911-001	2	CAP-EL, .47UF, 10%, 50V
16	27-0634	3	HDR, STR, 9POS, .1" CTR
17	15-0517	2	POT, TRIM, CF, 500K, LIN
18	13-0711	2	LED, BAR-GRAPHC, RED, 12P
19	50901-004	6	CAP-PF, 470PF, 5%, 50V, R

ITEM	PART NO.	QTY	DESCRIPTION
20	263065	4	BARR, STR, JMPR, A104210-NL-
21	14-0753	6	CAP-MP, 1UF, 10%, 63V
22	15-0400	2	RLY, 24V, DPDT
23	14-0767	4	CAP-CD, 22PF, 5%, 1KV
24	S500-1513	4	IC, LM833N
25	27-0420	2	CONN, PCMT, 3P, MALE
26	15-0494	1	SW, DPDT, ALT-ACT, PCMT
27	HM14-0582	25	CAP-SF, .1UF, 5%, 50V
28	13-0207	1	IC, 7918CT, RGTLR, 1A
29	14-0603	2	CAP-EL, 100UF, 20%, 25V, RD
30	36-0552	2	HTSK, TO220, W/MNTG, TAB
31	27-0625	1	BAR-STP, 5POS, .325" CTR
32	16-16825	2	XFMR, OUT
33	C035-2200	2	CAP, 2200UF, 35V, RL
34	27-0419	2	CONN, PCMT, 3P, FEM
35	52919-001	1	CAP, EL, 33UF, M, 35V, RD
36	278344-001	2	FUSE
37	14-0505	7	CAP-EL, 10UF, 50V, RD
38	14-0632	4	CAP-CD, 10PF, 10%, 500V
39	27-0218	3	TERM, SPADE, .250, PCMNT
40	27-0627	2	BAR-STP, 10POS, .325" CTR
41	13-0148	5	XSTR, 2N6716, NPN, 60V
42	13-0424	5	XSTR, 2N6728, PNP, 60V
43			
44			*(See Item 3 or 4 on 1st page)*
45	27-0641	5	TER, TAB, MALE, .187"
46	29-0081	1	NUT, 8, KEPS
47	255126	1	WSHR, 8, 1/2 x .03, STL
48	52921-001	1	XFMR, PWR, LA-12/22
49	269401-001	1	RING, XFMR, SHIELD, LA22
50	27-0632	3	SKT, STR, 9POS, .1" CTR
51			
52	269412-001	1	CABL, AUDIO, LA22
53	15-16766	2	SW, RTRY, 2P3T
54	263076	2	POT, 9MM, MULT, 100K/10K
55	15-16767	2	POT, TRIM, 50K, M, REVD, LOG
56	15-16769	2	POT, TRIM, 20K, M, LIN
57	50173-010	2	CAP-SF, .0015UF, 5%, 50V
58	HM14-0714	2	CAP-SF, .18UF, 5%, 50V
59	HM14-0591	2	CAP-SF, .015UF, 5%, 50V
60	HM14-0724	2	CAP-CD, 180PF, 5%, 50V
61	15-0500	1	SW, PWR, DPST, 6A, 250V
62	HM14-0681	2	CAP-SF, .039UF, 5%, 50V
63	HM14-0697	2	CAP-PF, .0039UF, 50V TEST E
64	14-0760	2	CAP-CD, 27PF, 5%, 50V
65	50901-003	2	CAP-PE, 390PF, 5%, 50V, R
66	13-0206	1	IC, 7818CT, RGLTR, 1A
67	31-0067	2	RVT, POP, .125 x .345 RADS 41

CIRCUIT BOARDS

Top PC Board Rotated
180° To Show Components



ITEM	PART NO.	QTY	DESCRIPTION
68	25-16781-002	2	SPCR, BSHG
69	15-0446	2	SW, MTK, 6U-EE
70	15-0495	2	SW, DPDT, MOM, PCMT
71	24-16779	11	KNOB, PBTN
72	13-0744	4	LED, T1, RED
73	259751	2	POT, 9MM, 10K, 10%, LOG, D
74	15-16763	2	POT, 9MM, W/SW, 50K, 10%, LIN
75	HM13-0414	5	XSTR, T092, PNP, 2N3906
76	15-16761	4	POT, 9MM, 100K, 10%, LIN
77	HM13-0413	10	XSTR, TO-92, NPN, 2N3904
78	15-16760	2	POT, 9MM, 10K, 10%, LIN
79	25-16781-001	14	SPCR, BSHG
80	52920-001	2	POT, 9MM, 50K, 10%, REV'D, "D"
81	14-0576	2	CAP-EL, 22UF, 25V
82	13-0348	3	IC, MC14066BCP

ITEM	PART NO.	QTY	DESCRIPTION
83	13-0217	14	IC, TL074, QUAD, OP-AMP
84	HM14-0752	2	CAP-SF, .47UF, 5%, 50V
85	13-0190	2	DIOD, ZR, 1N4735A, 6.2V, 5%, 1
86	14-0756	2	CAP-CD, 120PF, 10%, 100V
87	13-0514	2	XSTR, LM394CN, DUAL
88	14-0633	2	CAP-CD, 33PF, 10%, 500V
89	15-0491	4	POT, TRIM, 100K, M, HZL, MT
90	14-0863	2	CAP-EL, 10UF, 20%, 25V, RD, NP
91	13-0737	2	IC, VCA, SSM-2018
92	14-0635	4	CAP-CD, 100PF, 10%, 500V
93	HM14-0585	6	CAP-CD, 47PF, 5%, 500V, NPO
94	52924-001	4	TEST-POINT, PCMT
95	15-0481	2	POT, TRIM, 2K, M, .5W, HZ
96	14-0636	2	CAP-CD, 470PF, 10%, 500V
97	15-0496	4	POT, TRIm, 500, M, HZMT, CRMT

COMPONENT EXPLODED VIEW