

DISCRIMINATE AUDIO PROCESSOR

AGC - PEAK LIMITER

MODEL 310

Manufactured by:

DORROUGH ELECTRONICS

~~WOODLAND HILLS, CALIFORNIA~~

~~(213) 999-1132~~

818 998-4886

9021 Fullbright Ave.
Chatsworth, Cal
91311

Copyright March 1977

D O R R O U G H

DISCRIMINATE AUDIO PROCESSOR

		<u>Page #</u>
I	SPECIFICATIONS	B
II	INTRODUCTION	1
III	SIGNAL FLOW	7
IV	INSTALLATION	29
V	MAINTENANCE	40

S P E C I F I C A T I O N S

-20 Position:

Input Sensitivity: -30 dBm
Input Impedance: 600 ohms balanced

0 Position:

Input Sensitivity: -10 dBm
Input Impedance: 20 K balanced bridging

Maximum Output: +24 dBm 600 ohms balanced

Harmonic Distortion: Less than 1%

In "TEST" Position:

Frequency Response: 30 Hz to 15 kHz \pm 1 dB

Signal to Noise: Better than 65 dB 30 to 15 kHz

SPECIAL INSTRUCTIONS: Unit is designed to operate directly at the input of the transmitter.

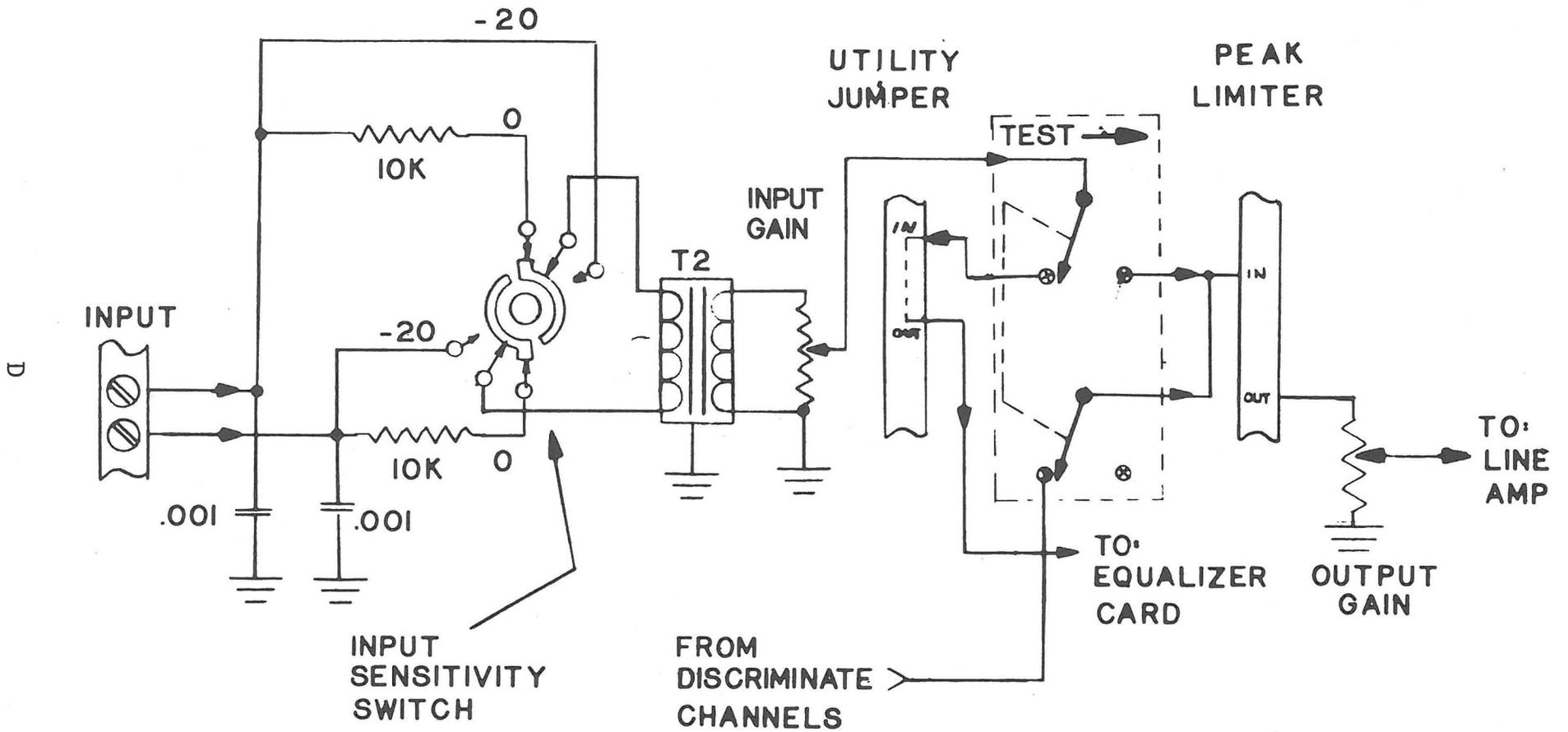
Power requirements: 117 VAC* 50-60 Hz 35 watts

*Strappable 220 VAC See page 49

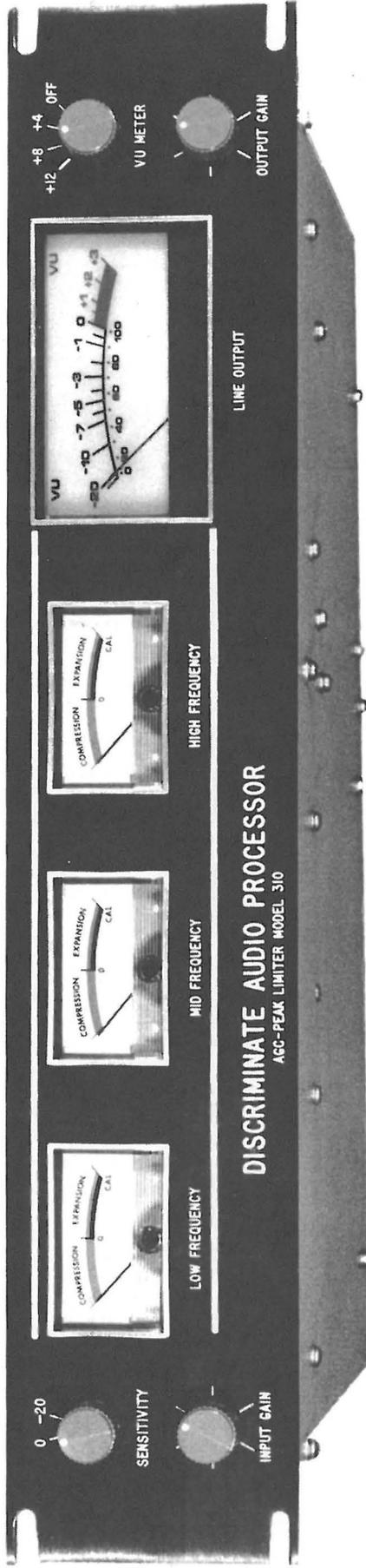
Physical Dimensions: 3-1/2 x 19 x 13"

P R O O F O F P E R F O R M A N C E

Actual proof-of-performance measurements should be conducted with the sensitivity switch in the "TEST" position. (This switch is located inside the meter compartment in units prior to Serial #021223.) This switch bypasses the parallel channels and connects the front panel control directly to the peak limiter input. Be careful not to overdrive the limiter card during measurements. Turn the output control fully open, and use the input control to control the modulation level.



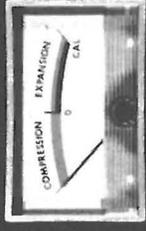
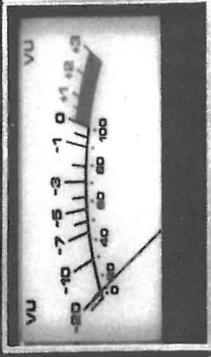
SIGNAL FLOW
 PROOF SWITCH
DAP 310



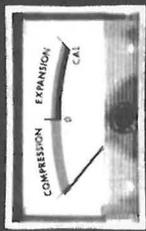
+12 +8 +4 OFF

VU METER

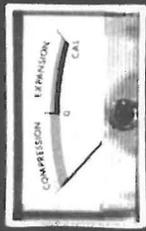
OUTPUT GAIN



HIGH FREQUENCY



MID FREQUENCY



LOW FREQUENCY

0 -20

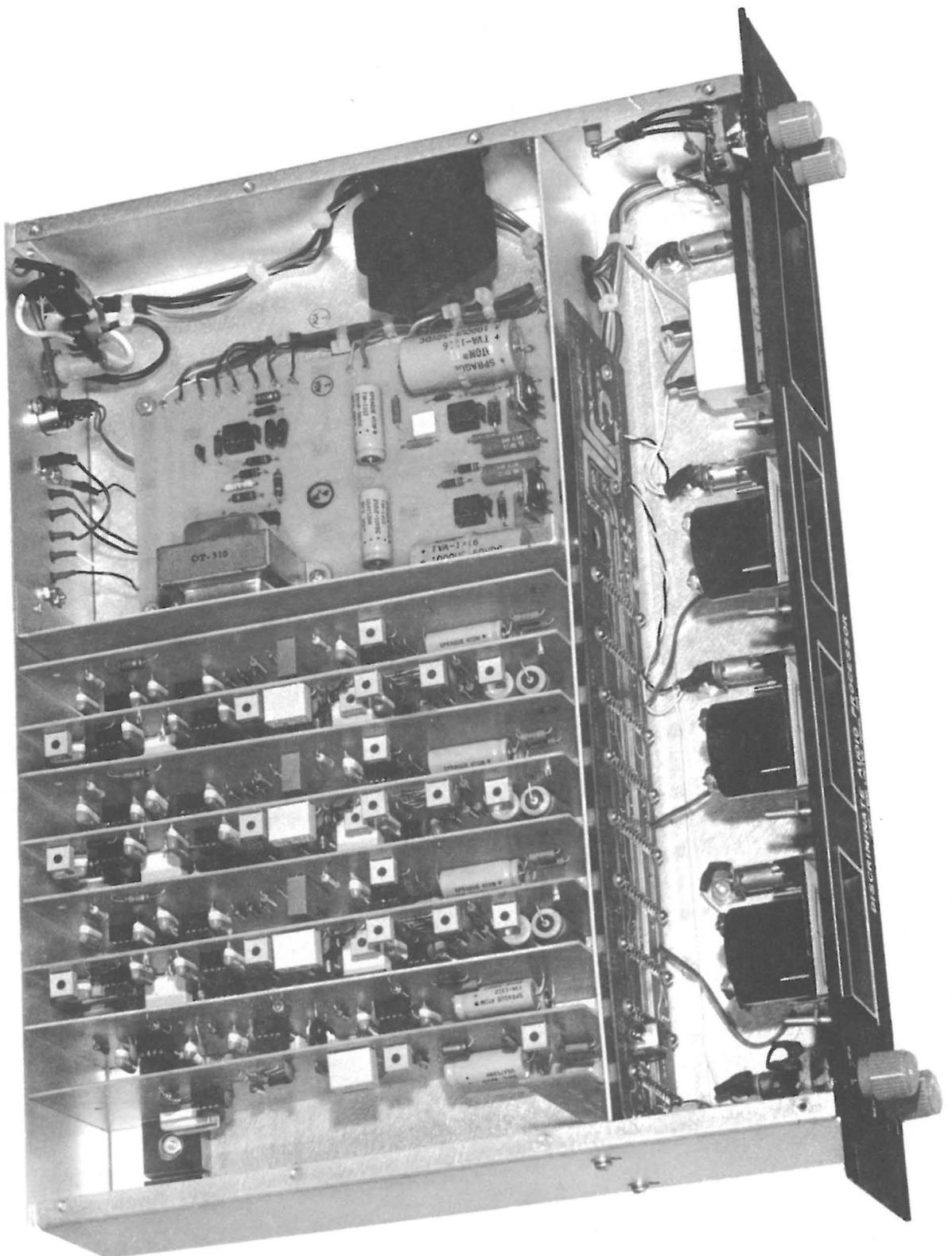
SENSITIVITY

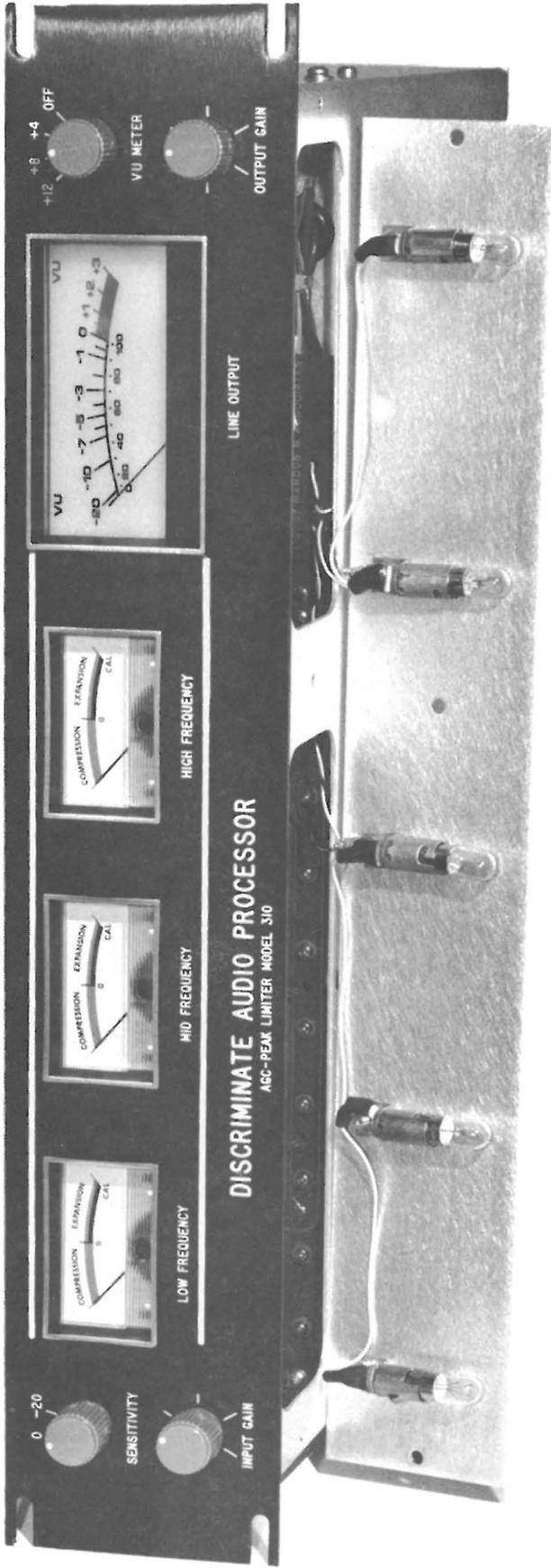
INPUT GAIN

DISCRIMINATE AUDIO PROCESSOR

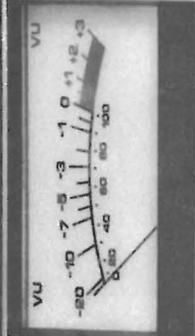
ACC-PEAK LIMITER MODEL 310

LINE OUTPUT





+12 +8 +4 OFF



VU METER

LINE OUTPUT

DISCRIMINATE AUDIO PROCESSOR
AGC-PEAK LIMITER MODEL 310

0 -20

SENSITIVITY

INPUT GAIN

LOW FREQUENCY

MID FREQUENCY

HIGH FREQUENCY

COMPRESSION EXPANSION CAL

COMPRESSION EXPANSION CAL

COMPRESSION EXPANSION CAL

OUTPUT GAIN

I N T R O D U C T I O N

I N T R O D U C T I O N

Since the advent of audio processing devices in the mid-thirties, the broadcaster has sought to raise the average energy level of the program content, while limiting peak excursions of this material at the 100% point through the use of audio processing equipment.

Although technical refinements in the design of this early approach have improved the signal to noise, attack time and distortion characteristics, the basic AGC circuit is still that of a high-class wide-band ac voltage regulator. Obviously, we have failed to consider the simple physics assigned to the problem. The basic task of the audio processor is to PROCESS ENERGY, while LIMITING peak excursions of AMPLITUDE to a preset level. Note that the term used is ENERGY, not amplitude.

ENERGY is a function of POWER. POWER is a function of AMPLITUDE AND TIME. Note that the basic AC VOLTAGE REGULATOR has an EFFECT UPON AMPLITUDE ONLY.

The design of wide-band audio processors is based on amplitude regulation only, and results in gain reduction of the entire program content during the duration of the peak, plus the release time of the device. This common effect can be illustrated, for example, when program material consisting of a sustained violin note and a periodic beat of a bass drum (exhibiting greater amplitude) are both fed into a wide-band

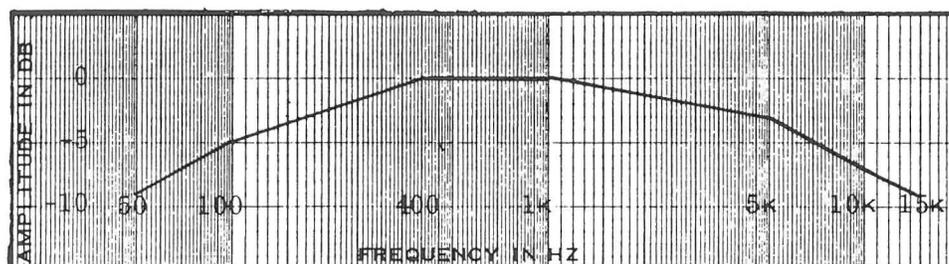
processor; the amplitude of the bass drum will cause rapid attenuation of the violin note for the duration of the beat, and for the attendant recovery time of the device.

This, in effect, "punches a hole" in the program material. This unnatural effect of modulation of the basic waveform by peak excursion is a form of intermodulation distortion and is discordant with respect to program material.

AGC amplifiers with slow recovery times reduce the basic program average. Conversely, AGC amplifiers with rapid recovery times exhibit greater energy content during the peak, confusing the control gate, producing a fluttering effect.

Also of note is that program material does not display an equal amplitude characteristic. Therefore the use of wide-band AGC circuitry acts to reduce the intelligibility of the harmonics of the program content, because the AGC action is controlled by the amplitude of the program material in the low and mid frequency ranges.

Spectrum analysis of music and speech material exhibits amplitude rolloffs at both the low and high frequency ends of the spectrum as illustrated below:



Energy content is predominant in the fundamental tone which appears in the low and mid frequency portions of the audible spectrum. This is illustrated in the preceding curve by observing that the amplitude of the mid frequencies are at maximum with the low frequencies exhibiting a gentle rolloff of approximately 3 dB/octave, in order to maintain the equal energy characteristic. A reduction in the energy content in the harmonics of fundamental tones accounts for the rolloff in amplitude at the higher frequencies.

Although modification of the audio spectrum can be made with an equalizer to increase the high frequencies into the AGC amplifier, thus giving the high frequencies equal footing as presented to the control gate, record clicks and inherent inconsistencies in high frequencies result in attenuation in overall loudness during the duration of high frequency peaks and the recovery time of the AGC amplifier. Equalization after wide-band AGC compression amplifies these uncontrolled peaks, as they are normally under threshold of the AGC amplifier, giving unknown amplitude parameters on the high frequency peaks.

Obviously we want to transfer this energy from the source to the listening area in its purest form. Therefore the logical approach is parallel processing, which has distinct advantages. Low frequencies will not attenuate high frequencies, and high frequencies will not attenuate low frequencies. The use of broad crossovers allows a certain amount of leakage between channels. This leakage serves to mask compression effects. Compression even on a single instrument such as a bass note which is being compressed in the low frequency channel would be

restricted in dynamics as we listen to just that channel. But because the bass note, although attenuated, leaks into the mid and high frequency channels under the threshold of compression, this leakage, when summed, serves to mask the restricted effect of the low end of the spectrum. Listening to musical material processed in this manner, we notice the total sound more readily than any small part of it. This is known as the psycho-acoustic masking effect.

Recognizing this information, the design of DAP incorporates parallel processing with an amplitude response curve approximating the spectral density of the program material being processed.

The audio input to the device is fed to an active three-way bandpass filter network which develops into three different outputs, as follows:

Low frequency range	20 - 120 Hz
Midrange	120 - 6.5 kHz
High frequency range	6.5 - 15 kHz

These active filters exhibit a 3 dB per octave slope, which allows the AGC action of each discriminate channel to be controlled by the peak amplitude of the filtered program material. The low phase shift of this gentle slope is a factor in the listening quality and produces no obvious effect when a gliding tone crosses over from one band to another.

The output of each bandpass filter is fed to the input of an individual processing system, each with its own independent input and output control. The control functions of each of the

three discriminate channels allows the user to boost or reduce the signal into and from each channel separately; this, in effect, shapes the spectrum to a specific energy curve, achieving a more consistent response, thus maintaining the integrity of the program material.

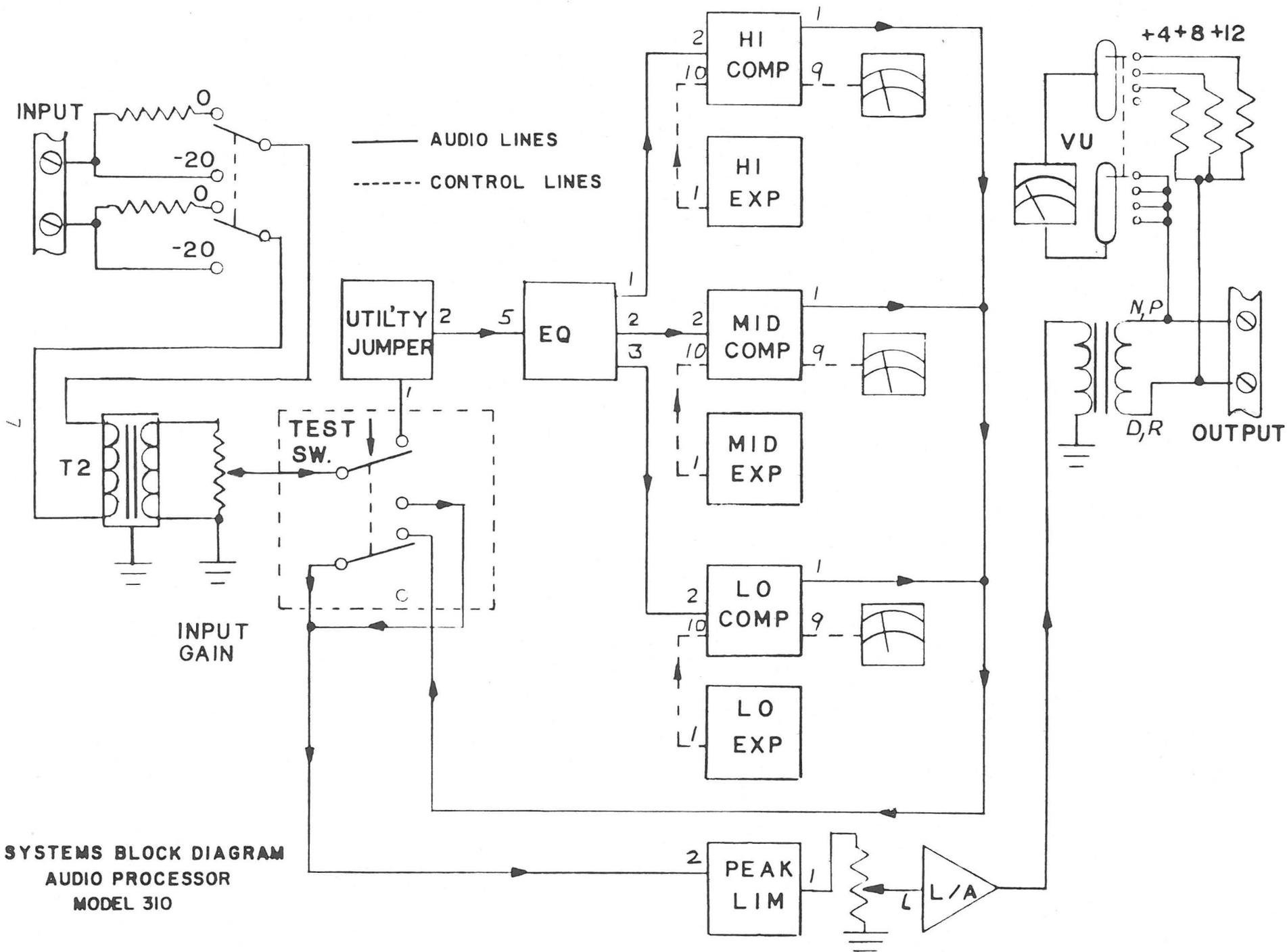
The discriminate bands are then combined and fed into a peak clipper. Contrary to popular conception, soft peak clipping is advantageous when used in the proper perspective. The basic limiting and compression in the three discriminate channels is accomplished in the individual discriminate stages, and then recombined prior to insertion into the clipper stage. However, it is possible to see peaks from the individual discriminate processors which may add in phase to produce some peaks in the order of 1 dB above the average level, thus requiring additional limiting.

Conventional wide-band limiting was not considered acceptable to the application as this 1 dB peak would reduce the level of modulation of the entire system by 1 dB for the duration of the peak, plus the recovery time of the limiter, effectively reducing modulation from 100% to 90% during recovery. This is demonstrative that maximum effectiveness of the DAP is realized in the absence of wide-band processing equipment in the broadcast chain. Instead, the use of soft limiting such as experienced in the overload of vacuum tubes is incorporated, allowing a higher level of modulation to be processed without the attendant ringing in transformers which follow.

In order to optimize the operation of the DAP, numerous controls have been provided. Slight variations from those adjustments set at the factory can be made to tailor the resultant sound to individual taste.

Therefore it is recommended that the DAP be evaluated as the only audio processor in the broadcast chain, and that the factory-adjusted controls remain undisturbed until the listening quality has been fully evaluated.

S I G N A L F L O W



SYSTEMS BLOCK DIAGRAM
AUDIO PROCESSOR
MODEL 310

EQUALIZER CARD

The equalizer card consists of three active bandpass filters designed to divide the spectrum of program material into three discriminate bands. The program is fed in parallel to all three bandpass filters.

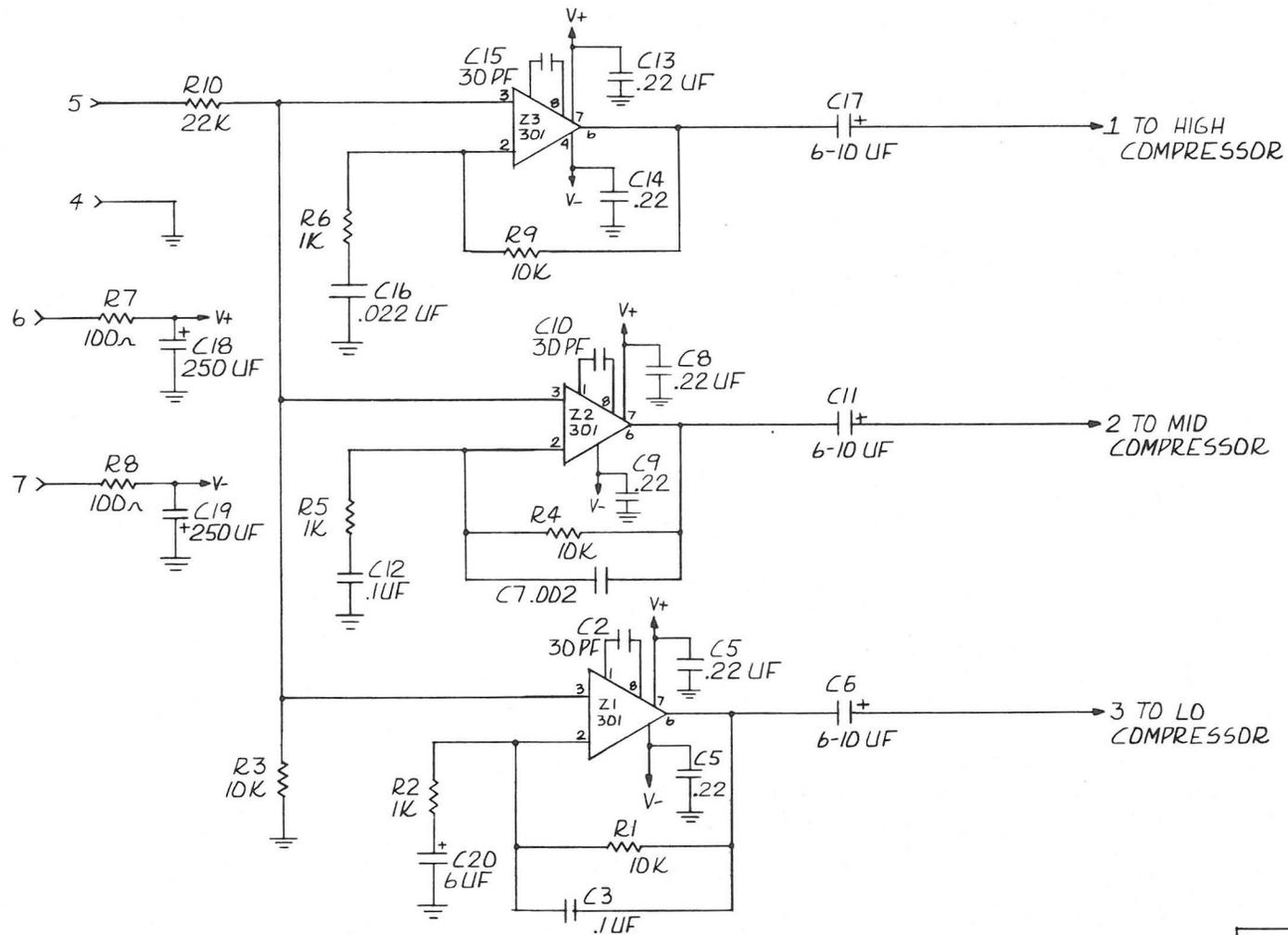
The bandpass for the low frequency filter (Z-1) is determined by feedback loop $R_1 C_3$ as fed to the inverting input determining the high frequency roll-off of this gentle 3 dB per octave 125 Hz filter. Roll-off frequencies below 15 Hz is accomplished by shunting the inverting input through $R_2 C_{20}$ to ground.

The bandpass of the mid-frequency filter (Z-2) is determined by feedback loop $R_4 C_7$ as fed to the inverting input determining the high frequency roll-off of 6.5 kHz for this 3 dB per octave filter. The low frequency 3 dB per octave roll-off of this filter is 125 Hz, and is accomplished by shunting the inverting input through $R_5 C_{12}$ to ground.

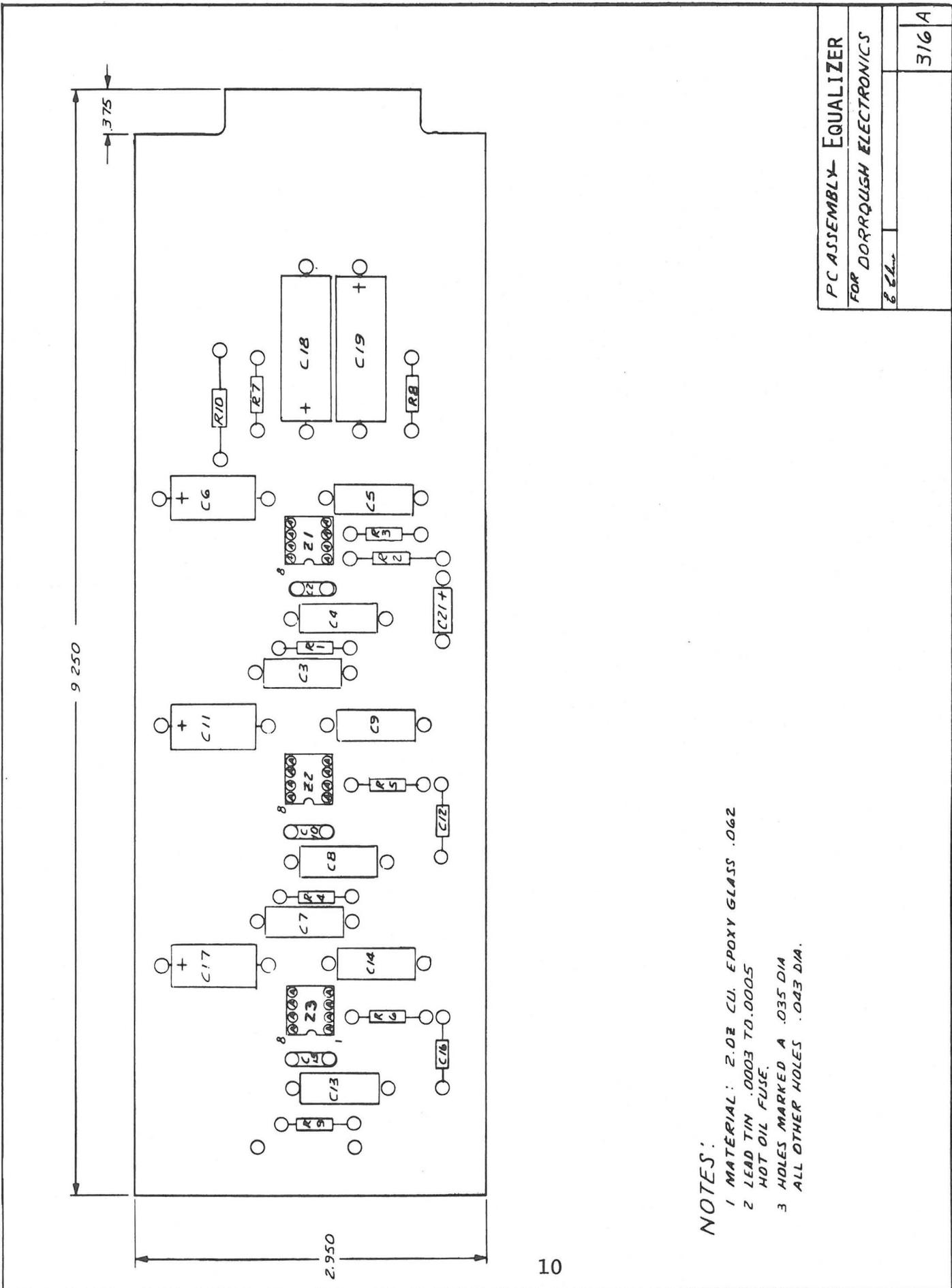
The bandpass of the high frequency filter (Z-3) is determined by feeding back to the inverting input through R_9 and shunting the low frequencies at 3 dB per octave at the roll-off frequency of 6.5 kHz through $R_6 C_{16}$ to ground.

The output of each individual filter is then fed to the corresponding compressor card.

6



EQUALIZER CIRCUIT		
MODEL NO:	REV:	DRAWN BY:
DAP-31D	B	MARCUS & ASSDC.
DORRDUUGH ELECTRONICS		



- NOTES:**
- 1 MATERIAL: 2.02 CU. EPOXY GLASS .062
 - 2 LEAD TIN .0003 TO .0005
 - 3 HOT OIL FUSE
 - 4 HOLES MARKED A .035 DIA
 - 5 ALL OTHER HOLES .043 DIA.

PC ASSEMBLY - EQUALIZER		316 A
FOR DORRQUISH ELECTRONICS		
B.C.L.		

COMPRESSOR CARD

The compressor card contains five operational amplifiers, a full wave rectifier and a voltage-controlled attenuator.

The input is applied to R_3 , the input level attenuator, and fed to both the expander card as well as the non-inverting input of Z-1. Normal gain stability of this amplifier is accomplished by feedback loop R_{14} R_{31} to the inverting input.

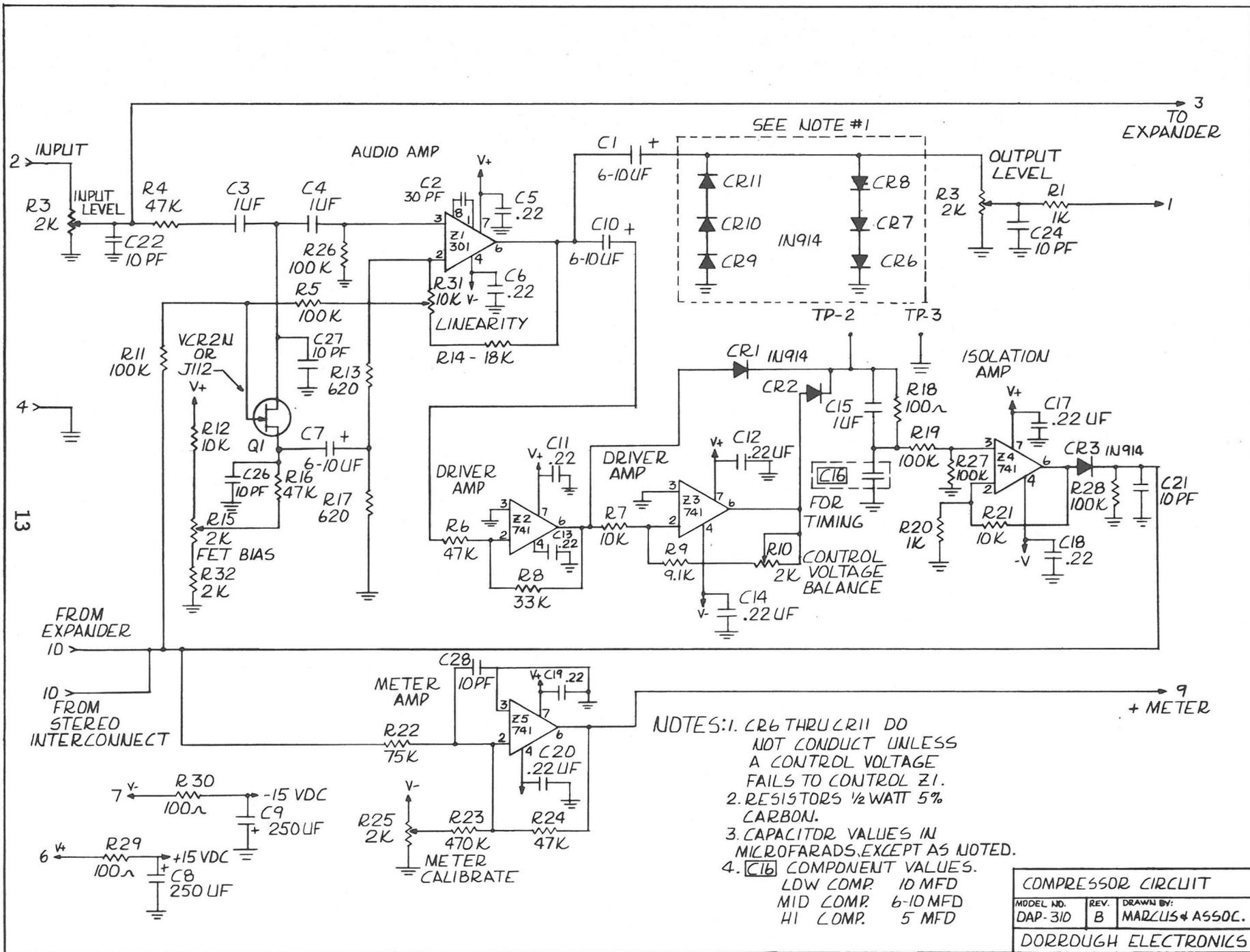
The output signal of Z-1 feeds two driver amplifiers, Z-2 and Z-3, which drive diodes CR_1 and CR_2 providing full wave rectification of the signal. Symmetry of the rectifier is accomplished by feedback loop R_{10} (ADJ) and R_9 to the inverting input of Z-3. The rectified signal is fed through R_{18} to timing capacitor C_{16} . Discharge path R_{19} and R_{27} provides the release time for capacitor C_{16} . This DC voltage is fed to the non-inverting input of Z-4, the output of which feeds through CR_3 (blocking diode) to the control buss.

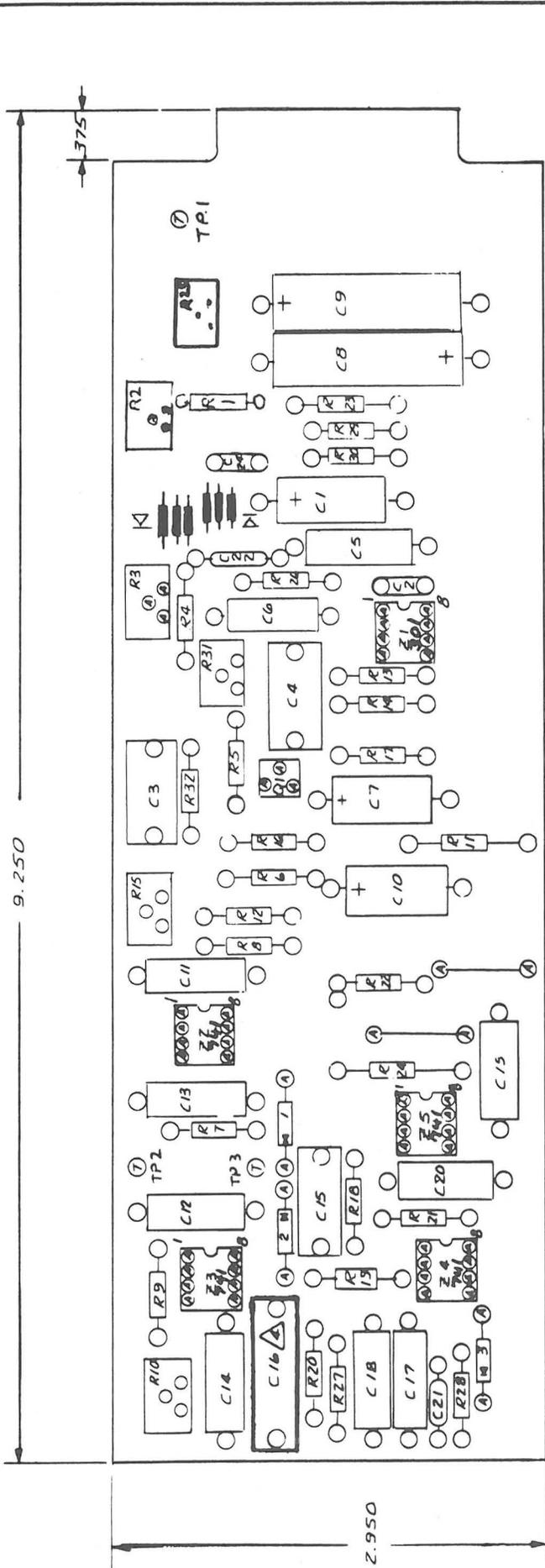
The control buss feeds the gate of the voltage-controlled attenuator Q-1, which controls the amount of input audio applied to the inverting input of Z-1, thereby limiting the gain of Z-1.

R_{15} controls the bias on Q-1 which, in turn, determines the threshold in the expansion range that the control voltage from the compressor will predominate. Proper adjustment of FET (Q-1) bias R_{15} is essential to optimum overall performance.

The output of Z-1 is fed to the output of the card for connection to the peak limiter. Diode circuitry CR₆ - CR₁₁ is a protective device and does not conduct unless the peak output level is exceeded by failure of the control voltage to control the gain of Z-1.

Z-5 is a meter amplifier for the individual compressor-expander meters. Control R₂₅ adjusts the meter to the calibrate point (see Maintenance, "Initial Adjustments").





REF DES	LO	MID	HI
C16	10UF	6.4UF	5UF

NOTES:

- 1 MATERIAL: 2 OZ CU EPOXY GLASS .062
- 2 LEAD TIN .0003 TO .0005
- 3 HOT OIL FUSE
- 4 HOLES MARKED (A) .035 DIA
- 5 HOLES MARKED (B) .067 DIA & INSTALL USECO 2001B OR EQUIV.
- 6 ALL OTHERS .043 DIA.
- 7 SELECT VALUE FROM CHART

P.C. ASSEMBLY 310

COMPRESSOR CARDS

3/5

EXPANDER CARD

The expander card consists of two operational amplifiers, a full wave rectifier, and a comparator/buffer.

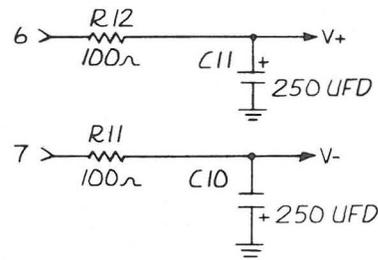
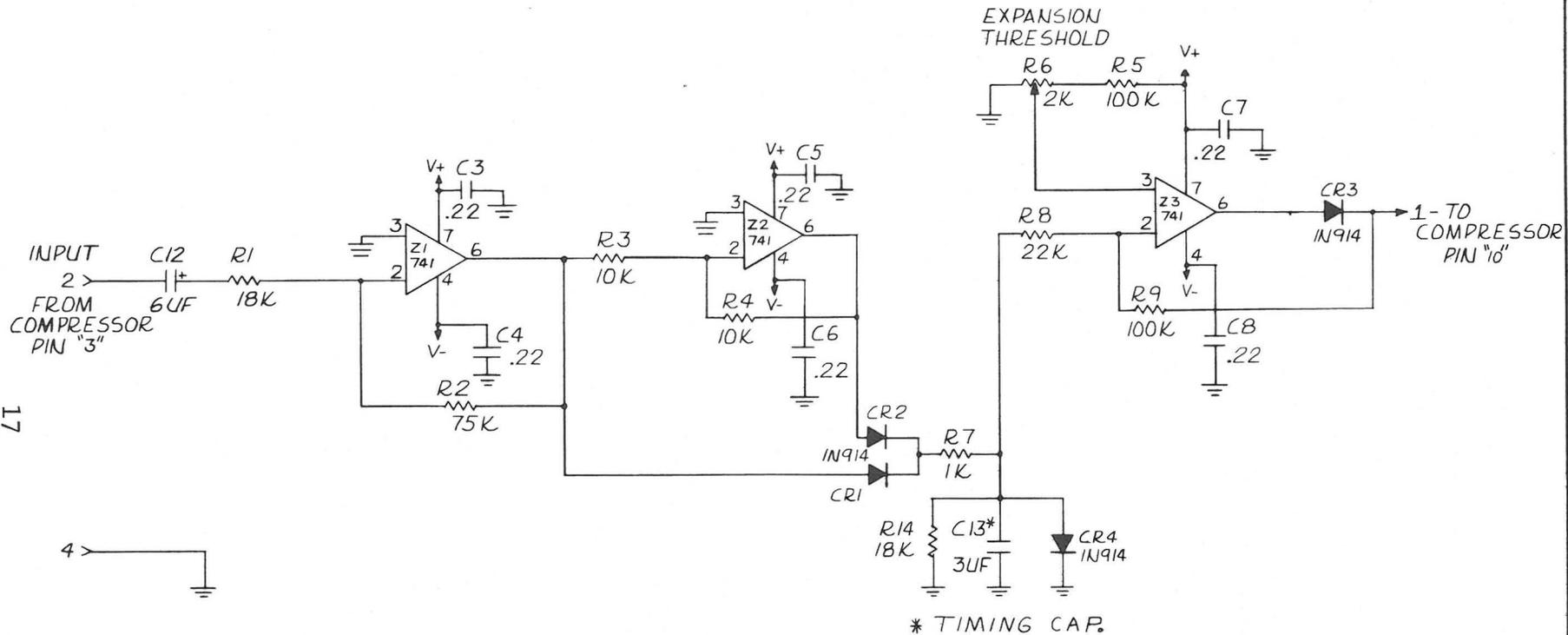
The audio input from the compressor board is fed to operational amplifier Z-1. Normal gain stability of this amplifier is accomplished by feedback resistor R_2 to the inverting input.

The output of Z-1 feeds the inverting input of Z-2 as well as CR_1 . Z-2 is a phase inverter. The output of Z-2 feeds CR_2 . CR_1 and CR_2 form a full wave rectifier. The rectified signal is fed to timing capacitor C_{13} . Discharge path R_{14} provides the release time for capacitor C_{13} . The voltage at the input of the RC circuit is limited by CR_4 and fed to the inverting input of Z-3 through R_8 . R_9 provides positive feedback to the inverting input of Z-3. Voltage divider network R_5 and R_6 provide a bias on the non-inverting input of Z-3. Adjustment of R_6 , expansion threshold control, sets the DC output voltage of Z-3 for connection to the control buss on the compressor card.

With no audio input at the input of the expander card, the expansion threshold control provides the necessary bias for Z-3 which, in turn, controls the quiescent condition of the control buss. With no audio input to the combination of the expander and compressor cards, approximately 17 dB of gain reduction is experienced. As low signal levels appear at the input of the expander card, they in turn produce a DC level at the inverting

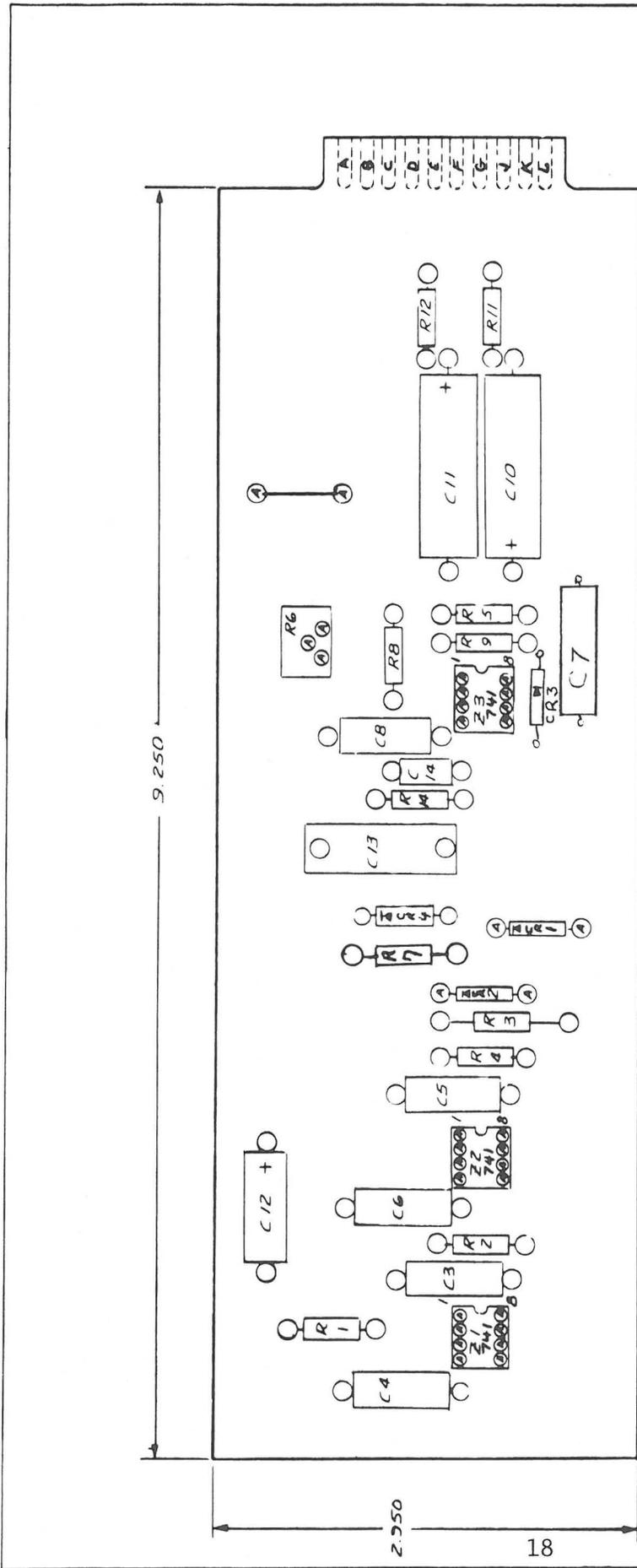
input of Z-3. Z-3 accepts this signal in opposition to the bias level as set by the expansion threshold control (R_6) reducing the DC level on the control buss, which in turn defeats quiescent attenuation, effectively providing expansion. As the input level to the expander is increased, the voltage at the output of the expander card is reduced to the crossover point, where the compressor is the dominant influence on the control buss.

17



* TIMING CAP.

EXPANDER CIRCUIT		
MODEL NO. DAP-310	REV. B	DRAWN BY: MARCLUS+ASSDC.
DORRDUUGH ELECTRONICS		



- NOTES:**
1. MATERIAL: 20Z CU. EPOXY GLASS .062.
 2. LEAD TIN .0003 TO .0005
HOT OIL FULLE.
 3. HOLES MARKED ⓐ .035 DIA.
ALL OTHERS .043 DIA.

P.C.	EXPANDER	310
FOR DORROUGH ELECTRONICS		
DATE		
		313 A

PEAK LIMITER CARD

The input to the peak limiter is fed from the combined outputs of the compressor cards. The level is controlled by R_1 and fed through an RC network $R'_x C_x$ to the inverting input of Z-1.

Network $R'_x C_x$ is chosen to meet pre-emphasis requirements where applicable.

R_2 provides for feedback to the inverting input for normal gain stability. DC bias control of the non-inverting input affects the symmetry of the output.

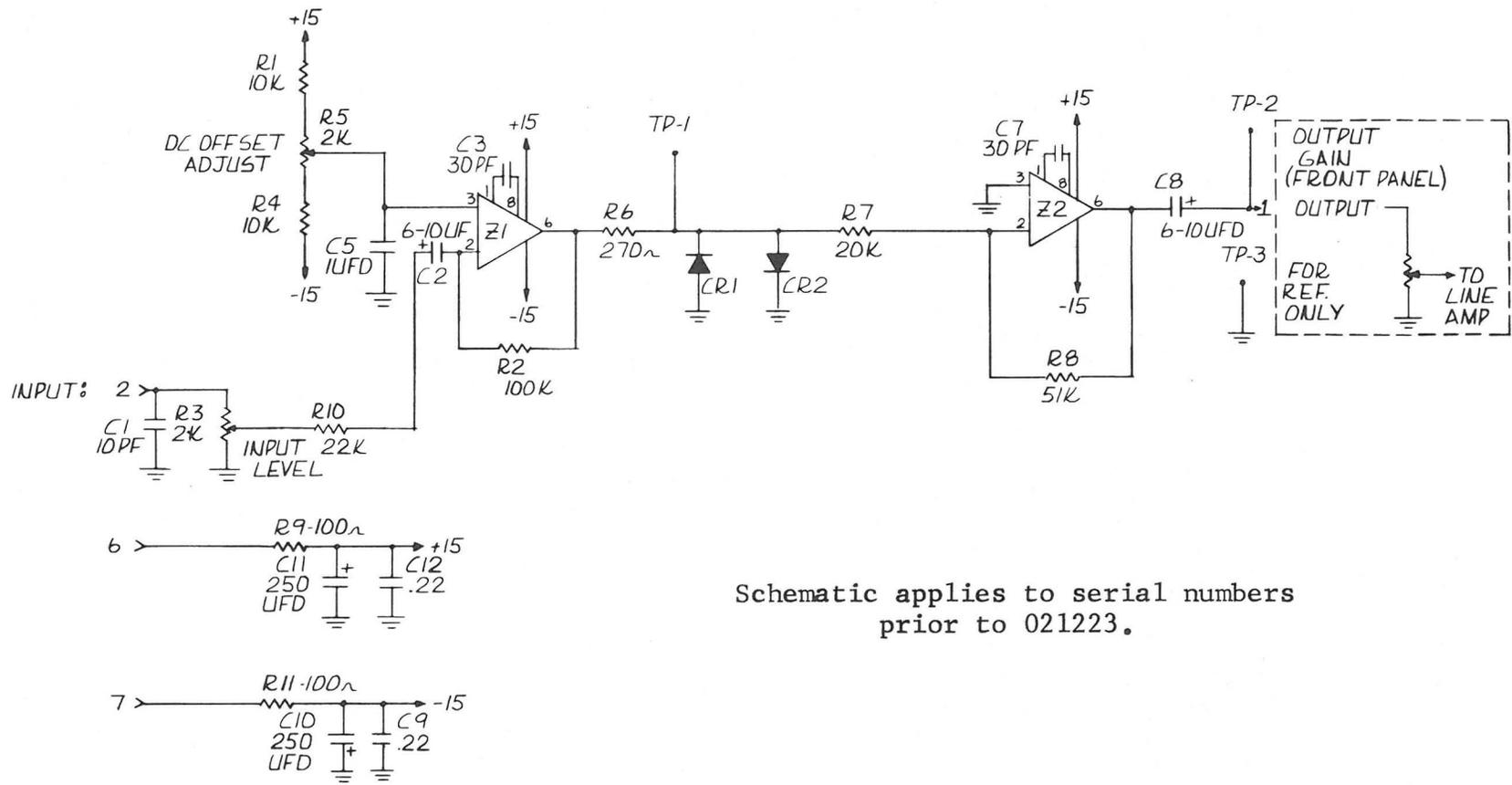
The output of Z-1 is fed through load resistor R_6 to diodes CR_1 and CR_2 . These diodes conduct upon the presence of an audio signal. The amount of current flow through these diodes is dependent upon the amount of signal and the DC bias controlled by the R_5 symmetry control. Current levels through these diodes have a negligible effect at normal levels of modulation because of square law characteristics of diodes. However, as the signal increases, the current flow increases at a more rapid rate and peak limiting is experienced. It's most important that this function is understood, as the adjustment of the input and symmetry controls plays an important role in the resultant sound quality of the final product. The output of the limiter is connected to the inverting input of Z-2 through isolation resistor R_7 .

Network $R_x C_x$ provides de-emphasis opposite to input pre-emphasis network $R'_x C_x$.

The output of Z-2 is fed through the output gain control, located on the front panel, to the line amplifier-power supply board.

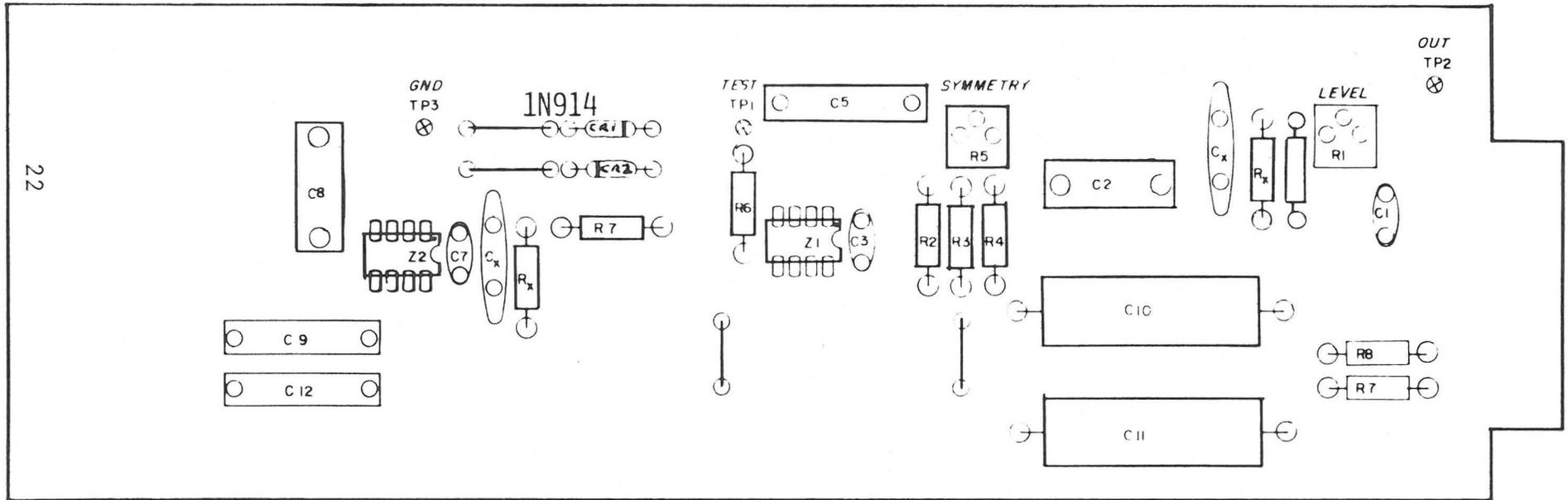
LOW PASS FILTER (FM PEAK LIMITER)

The low pass filter is designed to prevent high frequency energy from interfering with the 19 kHz pilot. This filter follows the output of the de-emphasis circuit Z-2, which also serves as a low impedance source. The filter itself is an active "twin T" tuned to 19 kHz, and is composed of R_{12} , R_{13} , C_{16} , C_{14} , C_{17} , R_{15} , R_{17} , R_{22} , C_{20} and Z-3. The circuitry surrounding Z-4 is that of a voltage follower used to provide isolation for the filter.



Schematic applies to serial numbers prior to 021223.

PEAK LIMITER CIRCUIT-AM		
MODEL NO. DAP-310	REV. B	DRAWN BY: MARCUS & ASSOC.
DORRROUGH ELECTRONICS		

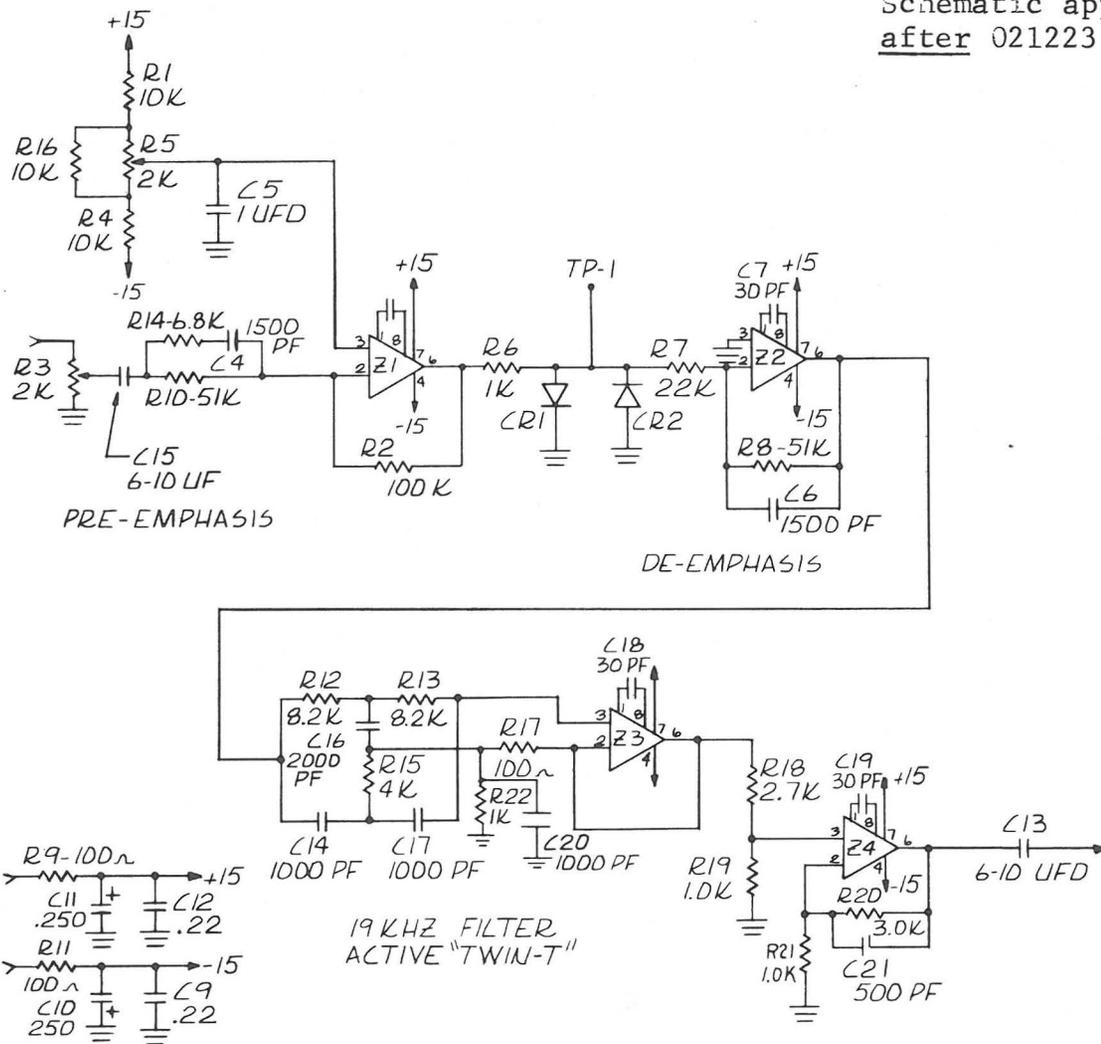


Schematic applies to serial numbers prior to 021223.

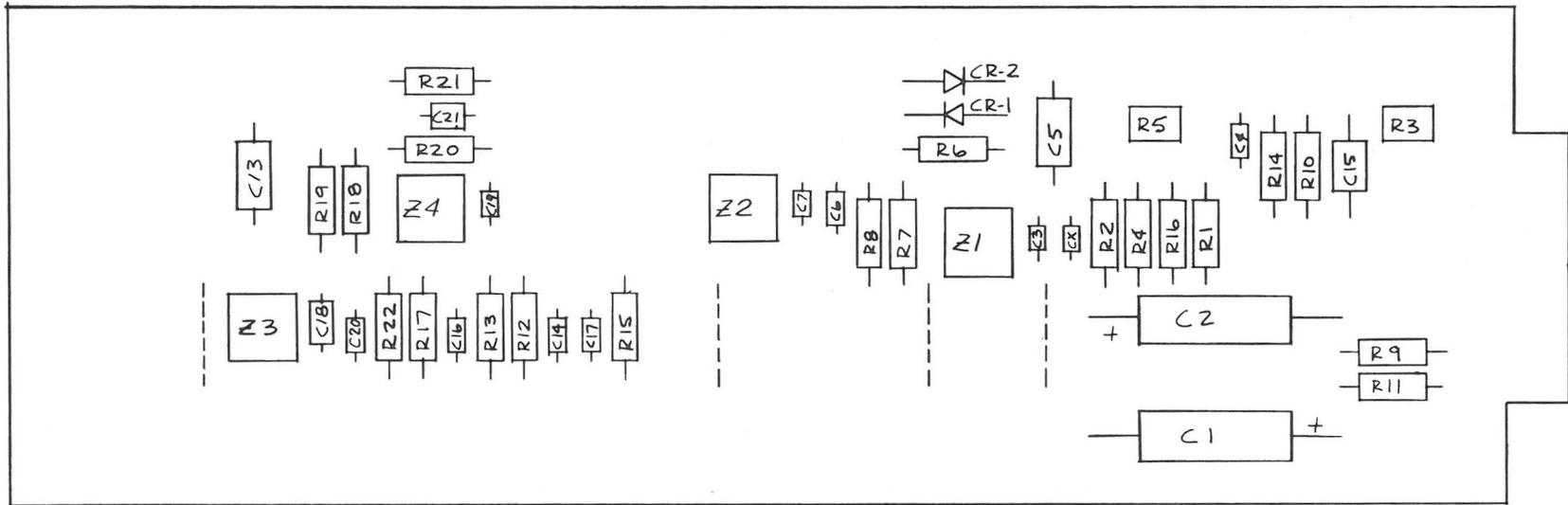
DAP-310
 OUTPUT LIMITER / PEAK LIMITER
 PC ASSEMBLY

Schematic applies to serial numbers
after 021223

23



PEAK LIMITER CIRCUIT-FM
DAP-310 C MARCUS & ASSOC.
DORROUGH ELECTRONICS



P C board applies to serial numbers after 021223

P.C. ASSEMBLY		PEAK
		LIMITER FM
DAP-310	C	MARCLUS #ASSOC
DORRROUGH ELECTRONICS		

LINE AMPLIFIER/POWER SUPPLY BOARD

LINE AMPLIFIER

The signal from the peak limiter is fed through the output gain control (front panel) to the inverting input of Z-3. Gain stability is accomplished through feedback loop $R_{20} C_{12}$.

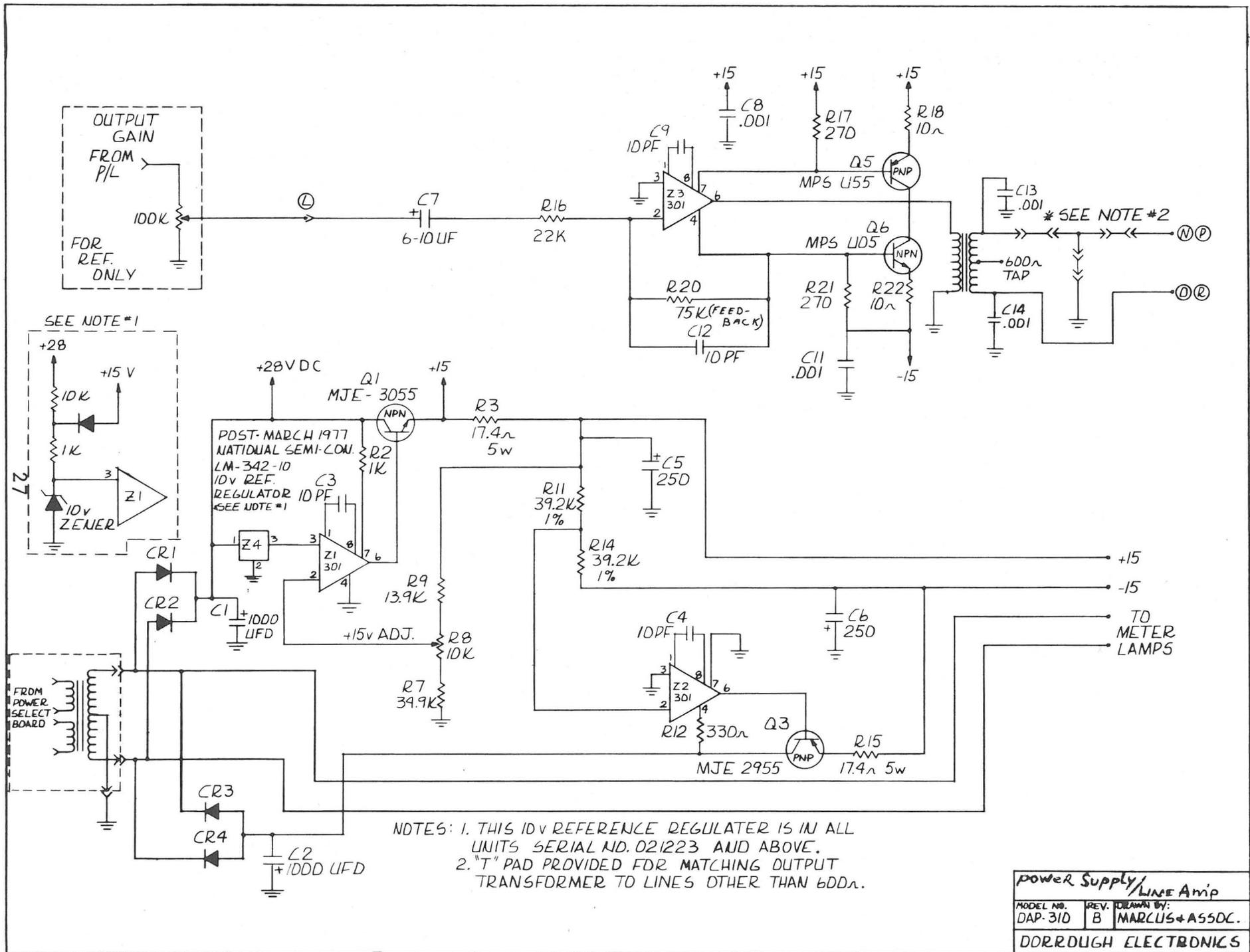
The DC power required by Z-3 from the ± 15 volt power supply is sensed by the bases of transistors of Q-5 and Q-6 forming a complementary pair amplifier which aids the output of Z-3, providing a low impedance source to the output transformer. Available output level from the line amplifier is ± 24 dBm.

A 4 to 6 dB pad may be connected at the output of the transformer to provide isolation between the output transformer of the DAP and the input transformer of the transmitter.

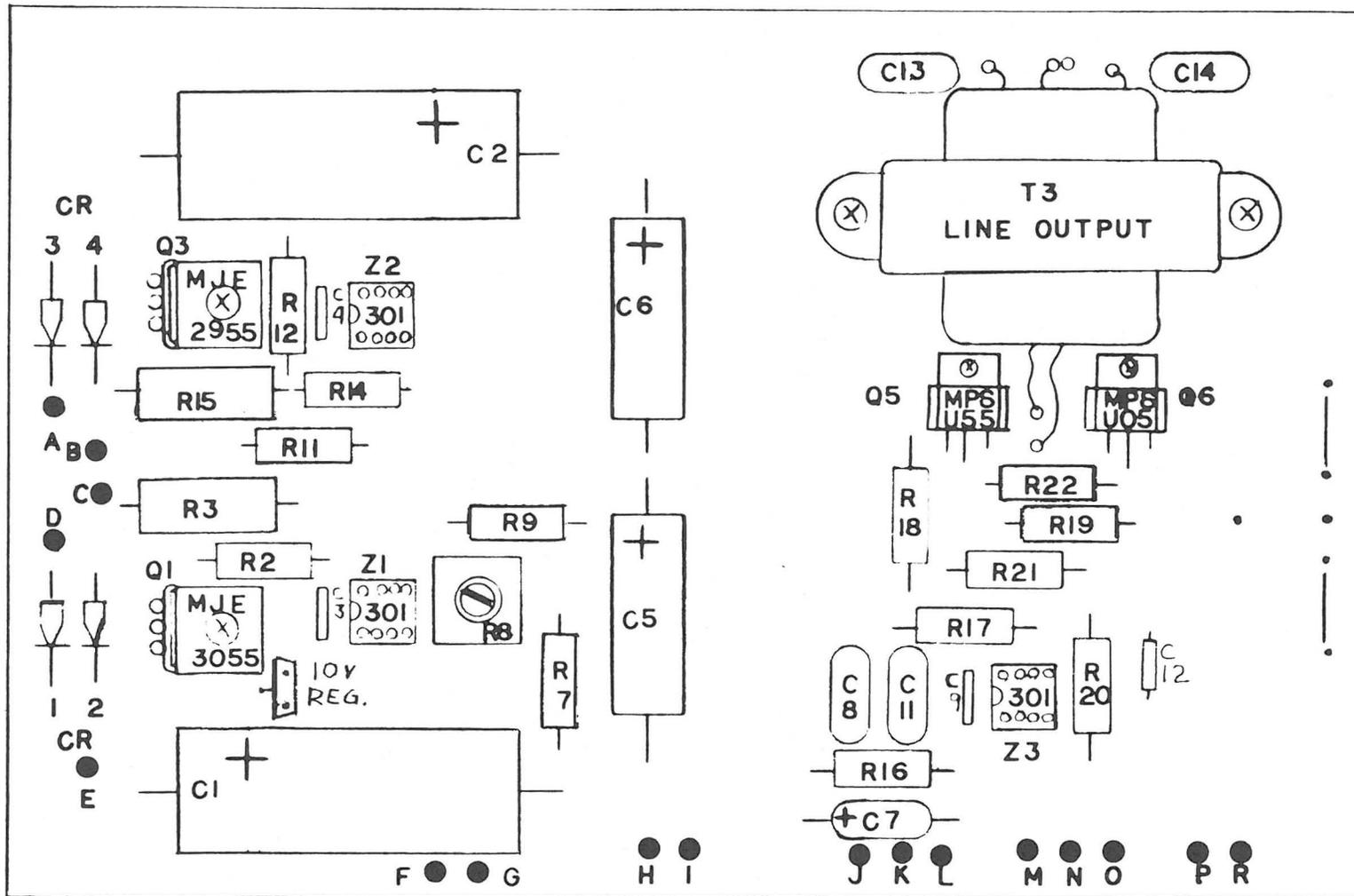
POWER SUPPLY

The power supply is a conventional full wave bridge rectifier which feeds Q-1 and Q-2 series pass regulators capable of providing currents to 2 amperes with nominal output voltages of

± 15 v. Voltage comparators Z-1 and Z-2 control the regulating action of Q-1 and Q-2. The choice of large filter capacitors and regulated voltage control produce low ripple.

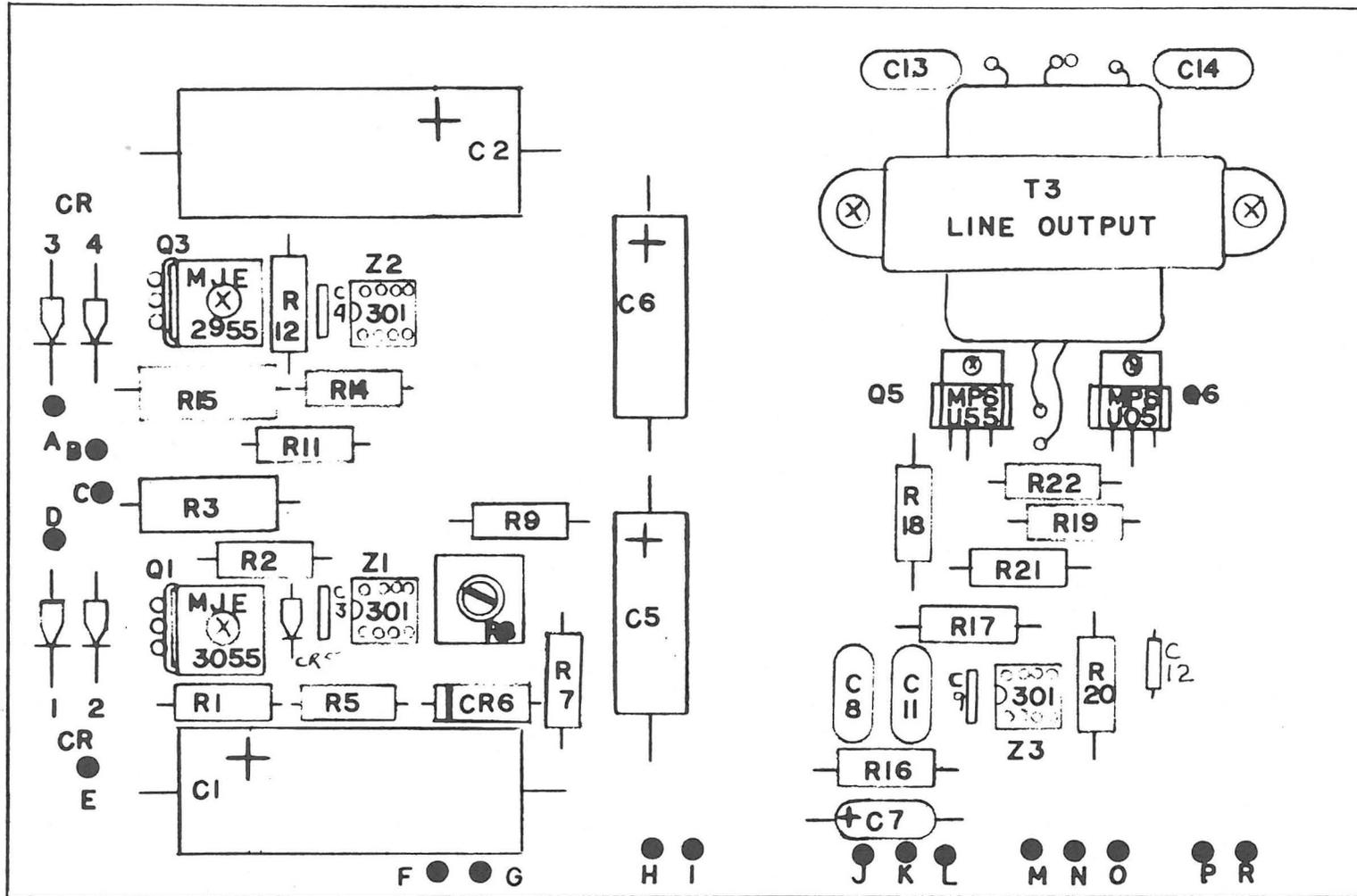


POWER SUPPLY / LINE AMP		
MODEL NO. DAP-310	REV. B	DRAWN BY: MARCLUS + ASSOC.
DORRUGH ELECTRONICS		



Parts layout applies to serial numbers after 021223.

POWER SUPPLY/LINE AMPLIFIER
PC ASSEMBLY

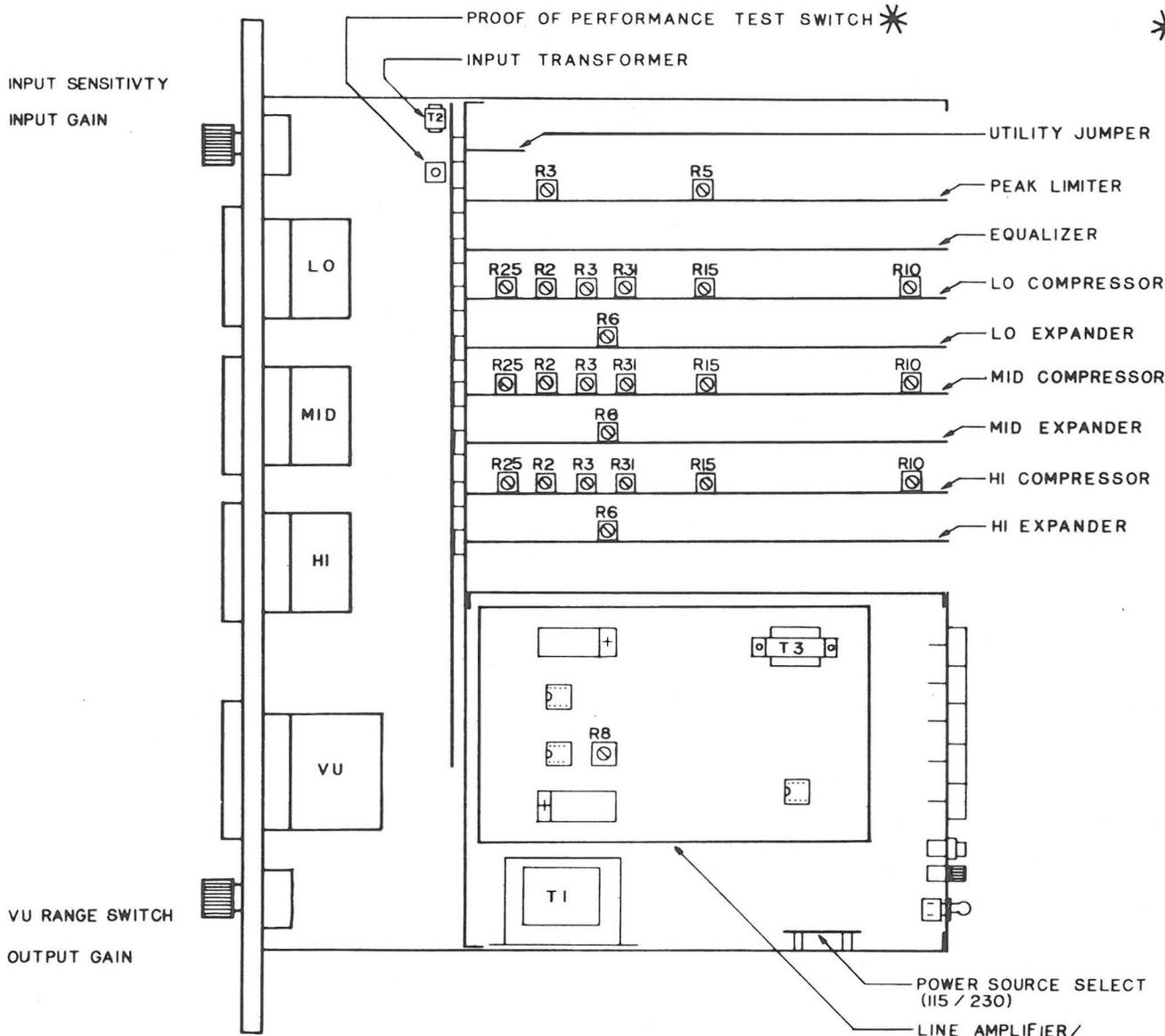


Parts layout applies to serial numbers prior to 021223.

POWER SUPPLY/LINE AMPLIFIER
PC ASSEMBLY

I N S T A L L A T I O N

A N D I N I T I A L S E T U P



* PROOF OF PERFORMANCE TEST SWITCH IS INCORPORATED INTO THE INPUT SENSITIVITY SWITCH ON ALL SYSTEMS SERIAL NO. 021223 AND ABOVE.

- ADJUSTMENT KEY**
- R2 — OUTPUT LEVEL
 - R3 — INPUT LEVEL
 - R5 — DC OFFSET
 - R6 — EXP. THRESHOLD
 - R8 — VOLTAGE ADJ.
 - R10 — SYMMETRY
 - R15 — FET BIAS
 - R25 — METER CAL
 - R31 — LINEARITY

SCALE NONE	APPROVED BY <i>M. H. ...</i>	DRAWN BY R.A.
DATE 2-2-76		REVISED C-2/2/76
PHYSICAL LAY-OUT		
DORROUGH ELECT.		310

I N S T A L L A T I O N

A N D I N I T I A L S E T U P

This processor was fully aligned prior to shipment, in accordance with the following procedure. Since the alignment procedure is relative to subjective judgment, variable adjustments allow deviation from the recommended to suit the individual taste.

Remove the top cover before installation. Mount the unit in the rack, leaving at least 3-1/2" above the unit for making adjustments.

The DAP requires a standard 3-1/2" rack height and 13" of rack depth.

The input sensitivity switch is a 20 dB fixed bridging pad at 20K ohms in the zero position. In the -20 position, the input terminals look directly into the 600 ohm input transformer.

The Processor should be terminated in 600 ohms with a 4 to 6 dB pad, and fed directly into the transmitter's input transformer. (Note: If two transmitters are to be coupled to one Processor, it should be done with a resistive splitting pad, as transformers or amplifiers tend to add overshoot to the waveform, defeating the action of the peak limiter.)

Before applying power, adjust the front panel input and output controls fully counter-clockwise. Apply power and allow the unit a few minutes to stabilize.

Inactivate the peak limiter by adjusting R_3 on the limiter card to approximately the 1/4 open position. Do not be concerned about modulation percentage at this time. Adjust R_3 on the high frequency compressor to the fully clockwise position.

Apply normal program material or, preferably, a pink noise signal, at normal operating level, to the Processor. Adjust the front panel input control clockwise, observing the small high frequency meter. During the travel of the input control, note that this meter (ignore the other two small meters for the moment) will move upward to the right, showing slight gain expansion. As the gain is increased, the meter will reach a peak and then deflect to the left as compression occurs. Continue increasing the gain until the needle fluctuates approximately 1/2 of the way into the blue region. Leave the panel input control at this setting. This assures ample headroom at the equalizer card ahead of the processing channels.

Watch the action of the mid frequency and low frequency meters. Now, if necessary, adjust the R_3 input control on the mid frequency and low frequency compressor boards until they approximate the action of the high frequency meter. Be sure to check carefully the physical layout for the correct location of these controls.

For STEREO, the signal source should be fed monophonically and in phase to each unit simultaneously (with the stereo jumper cable disconnected) as the gain is increased both units should be adjusted with the individual R_3 input controls until they track equally.

These adjustments have established the proper AGC range. The following adjustments are subjective and will allow the station to project the overall "SOUND" desired, and will be accomplished with the R_2 output adjustment of each channel. The R_2 control on the mid frequency card should be $3/4$ of the way open to establish a standard level for driving the limiter card, and will allow for subjective adjustment of the low frequency and high frequency R_2 controls.

Adjustment of the R_2 (or output) control on both the high and low frequency cards is subjective. However, an output test point is provided on each of the compressor cards (see TP-1). The output level from each of the compressor cards can be measured individually by removing the other two compressor cards and measuring with an audio voltmeter at this point.

Subjective listening tests conclude that proper adjustment with a pink noise input signal will produce an output signal on the output of the low frequency card that is 1 dB below that measured on the mid frequency output. The output of the high frequency card will be 6 dB below that measured on the mid frequency output, making the relative positions of R_2 on the low and high frequency cards to be in the approximate $3/4$ and $1/2$ open positions respectively. This concludes the adjustment of the expander-compressor cards.

SETUP OF THE OUTPUT PEAK LIMITER FOR AM USE

Place the test switch in the "TEST" position.

Feed a test signal of 1,000 Hz to the Processor.

Adjust the front panel output control, while watching the modulation monitor meter in the negative polarity position, until an average of 60% modulation is indicated. Note that if 60% modulation cannot be obtained, the input control can be adjusted to obtain the desired level.

Switch the modulation monitor to the positive polarity position, noting the differential between the negative and positive peaks. Slowly rock R_5 on the peak limiter card, while alternately watching the negative and positive readings on the modulation meter. R_5 may be adjusted for a higher level on the positive peaks than on the negative peaks. This is accomplished with the R_5 DC offset control (Asymmetry).

Because of the discriminate channels, though your transmitter may be capable of 125% modulation, it is important that the difference between the negative and positive peaks be no more than 1 dB apart for better fidelity and substantially lower intermodulation distortion. This means that even though the modulation meter will indicate less than 125% in positive peaks, the consistent density from the Processor allows greater RMS level.

Rotate both input and output controls fully counter-clockwise. Place the test switch in the opposite, or normal operating position, from "TEST."

Feed a test signal of 1,000 Hz to the Processor. Rotate the input control until this signal is observed in the compression range of all three discriminate meters. Note that the mid frequency meter will show heavy compression. This is necessary to allow all three compressor cards to contribute to the input of the peak limiter.

Adjust the peak limiter control R_3 clockwise to the point of audible distortion, then retard it slowly until it disappears. Connect a harmonic distortion meter on TP-2 of the peak limiter card. The total harmonic distortion should read approximately 2-1/2% at this point. If not, adjust R_3 so that the THD at TP-2 is 2-1/2% (note that the level at TP-2 will vary with the adjustment of R_3 , however the parameter under adjustment is THD).

Note that although the figure of 2-1/2% distortion might frighten the purist, this figure is representative of the distortion on peak excursions presented to the limiter, and not related to the general RMS amplitude normally associated with total harmonic distortion. Limiting in excess of this recommended figure will dampen the punch and depth of the program material, and will produce a "busy" sound.

Remove the 1,000 Hz tone and replace with pink noise or program material at normal operating levels. Adjust the input

control to note action on all three discriminate meters, and then adjust the output control until full modulation is achieved.

Adjustment of the Processor is now complete.

An A/B comparison between the Discriminate Audio Processor and your former processing equipment, will make the differences immediately apparent.

SETUP OF THE OUTPUT PEAK LIMITER FOR FM USE

Place the test switch in the "TEST" position.

Feed a test signal of 1,000 Hz to the processor.

With the transmitter in the stereo mode, adjust the left channel processor front panel output control until an average of 80% is indicated on the total modulation meter in the negative polarity position. Note that the stereo jumper normally connected between the two processors should not be connected at this time. Switch the modulation meter to the positive polarity position. The meter reading should be identical to the reading in the negative polarity position. If not, adjust R_5 on the peak limiter for an equal reading.

Rotate the left channel input and output controls fully counter-clockwise and follow the instructions as above for alignment of the right channel.

Place the test switch in the opposite or normal operating position from "TEST" on both left and right channel processors.

With a 1,000 Hz tone of equal amplitude and in phase, fed to both processors, rotate the input control of the left channel processor until this signal is observed in the compression range of all three discriminate meters. Note the mid frequency meter will show heavy compression. This is necessary to allow all

three compressor cards to contribute to the input of the peak limiter.

Adjust the peak limiter control R_3 clockwise to the point of audible distortion, then retard it slowly until it disappears. Connect a harmonic distortion meter on TP-2 of the peak limiter card. The total harmonic distortion should read approximately 2% at this point. If not, adjust R_3 so that the THD at TP-2 is 2%. (Note that the level at TP-2 will vary with the adjustment of R_3 , however the parameter under adjustment is THD.)

Note that although the figure of 2% distortion might frighten the purist, this figure is representative of the distortion on peak excursions presented to the limiter, and not to the general RMS amplitude normally associated with total harmonic distortion.

Limiting in excess of this recommended figure will dampen the punch and depth of the program material, and will result in listener fatigue.

Rotate the left channel input control fully counter-clockwise and follow the instructions as above for setting the peak limiter on the right channel processor.

Following the adjustment of the peak limiters on both left and right processors, remove the 1,000 Hz tone and replace with pink noise or program material fed monophonically and in phase at normal operating levels.

Adjust the input control on the left processor to note action on all three discriminate meters. Next, adjust the input control on the right processor to that observed on the left channel processor.

Next, advance the output control on each processor until full modulation is achieved on each channel. Connect the stereo jumper.

Adjustment of the Processor is now complete.

An A/B comparison between the DAP and your former processing equipment will make the differences immediately apparent.

M A I N T E N A N C E

INITIAL ADJUSTMENTS

EQUIPMENT REQUIRED

1. Low distortion audio oscillator
2. General purpose oscilloscope
3. Distortion analyzer
4. DC voltmeter

INSTRUCTIONS

Remove top cover of unit. All controls are viewed from the top. The test switch should be to the left position.

Before making any adjustments, verify power supply output at $-15\frac{1}{2}$ volts. Using a DC voltmeter, connect positive lead to chassis ground and negative lead to B- tie point (located at the junction of tie point and blue wire) on the power supply amplifier board. A $-15\frac{1}{2}$ volt reading here indicates proper operation of both sides of the supply.

Turn the expansion threshold controls R_6 on the expander boards fully counterclockwise. This will remove quiescent reduction and meters will move up to the calibrate position. Turn

R_3 on the peak limiter board fully counterclockwise and adjust R_5 to mid-position.

Set each FET bias control R_{15} fully counterclockwise on each of the discriminate channel compressor boards (low, mid and high). Set each output control R_2 and each input control R_3 to mid position.

Set linearity R_{31} on all compressor boards counterclockwise, and adjust the symmetry control R_{10} to approximately mid range position.

FET BIAS

This bias adjustment is typical for each of the compressor/expander boards.

Verify that the low/mid/high meters are all at the full scale calibrate position. If adjustment is necessary, use R_{25} (meter calibrate) on the appropriate compressor card. Note: R_{25} is first control on each compressor card as viewed from front of unit. Adjust expansion control R_6 on expander board clockwise until meter pointer deflects downscale to the blue-black junction. Leave R_6 control at this setting. This indicates the expander circuit is injecting proper quiescent gain reduction.

Set the sensitivity switch on the front panel to zero and the input gain control to the mid point.

Apply 1,000 Hz tone at approximately +8 dBm to the rear input terminals.

Slowly rotate R_3 input on each of the compressor boards clockwise, noting that the low/mid/high meter will move upscale through the expansion range. This procedure verifies that the audio tone is nullifying the quiescent gain reduction and returning the field effect transistor to full gain.

Proper adjustment of the FET bias R_{15} is essential to optimum overall performance. This control determines the point in the expansion range that the control voltage from the compressor takes over. Maximum expansion is obtained with the meter at full scale (to the right).

Slowly rotate bias control R_{15} on each compressor card clockwise until meter deflects left to the mid-compression range. Now decrease input control R_3 to the full counterclockwise position, noting that the meter will return to the blue-black junction. Again, slowly increase input control R_3 to the full counterclockwise position, noting that the meter will return to the blue-black junction. Again, slowly increase input control R_3 to point where peak expansion occurs and compressor control voltage begins to take over. Proper bias control setting will be achieved when peak expansion action causes meter to deflect halfway to the letter "E" in the word expansion. Through trial and error, continue slight clockwise rotation of the bias control

followed by rocking the input control back and forth until this degree of peak expansion is achieved.

Note: If meter fails to travel through expansion range and/or sporadically moves left into the compression range as audio is slowly applied, a condition of under-bias has occurred. In this case, slowly rotate bias control counterclockwise while rocking input control to determine proper expansion action as described above.

Once FET bias adjustment has been accomplished for each channel, the following procedure will establish an operating range in which the input control R_3 is set. Rotate the front panel input control fully counterclockwise. R_3 , high frequency input control, should be fully open. The R_3 mid frequency input control should be approximately 1/4 of the way open, and the R_3 low frequency input control should be approximately half way open. (See Installation and Initial Setup.)

The following procedure is for adjustment of the R_{31} linearity control on each compressor card for minimum distortion. Rotate R_2 output control on the high frequency compressor card half way open clockwise. Rotate output control R_2 fully open on the mid frequency compressor card and rotate R_2 output control on the low frequency compressor card 2/3 open. These settings will establish a mix from the discriminate channels.

Rotate the input control to a point where the 1,000 Hz

tone has passed through expansion threshold and indicates some amount of compression in each channel.

This may require a slight adjustment of the individual R_3 input controls.

Connect a distortion analyzer to test point 1 on any of the three individual channel compressor boards. (These test points are for factory alignment procedures. However, in actual circuit operation, they are in parallel.)

Set the distortion analyzers for a reference level. (With some analyzers, there may not be enough output to reach the "set level" point. However, any convenient reference may be used.)

Make conventional distortion measurements. Adjust R_{31} on each of the boards for lowest overall distortion.

Distortion should be checked at 100 Hz, 1,000 Hz and 10,000 Hz. As the audio generator is stepped between the three frequencies, the appropriate R_3 input control will require small adjustments to maintain overall compression threshold.

Overall distortion should be better than one per cent. Disconnect the distortion analyzer for now.

CONTROL VOLTAGE-DIODE BALANCE (SYMMETRY)

With a 1,000 Hz tone, again make sure that all three channels show slight compression.

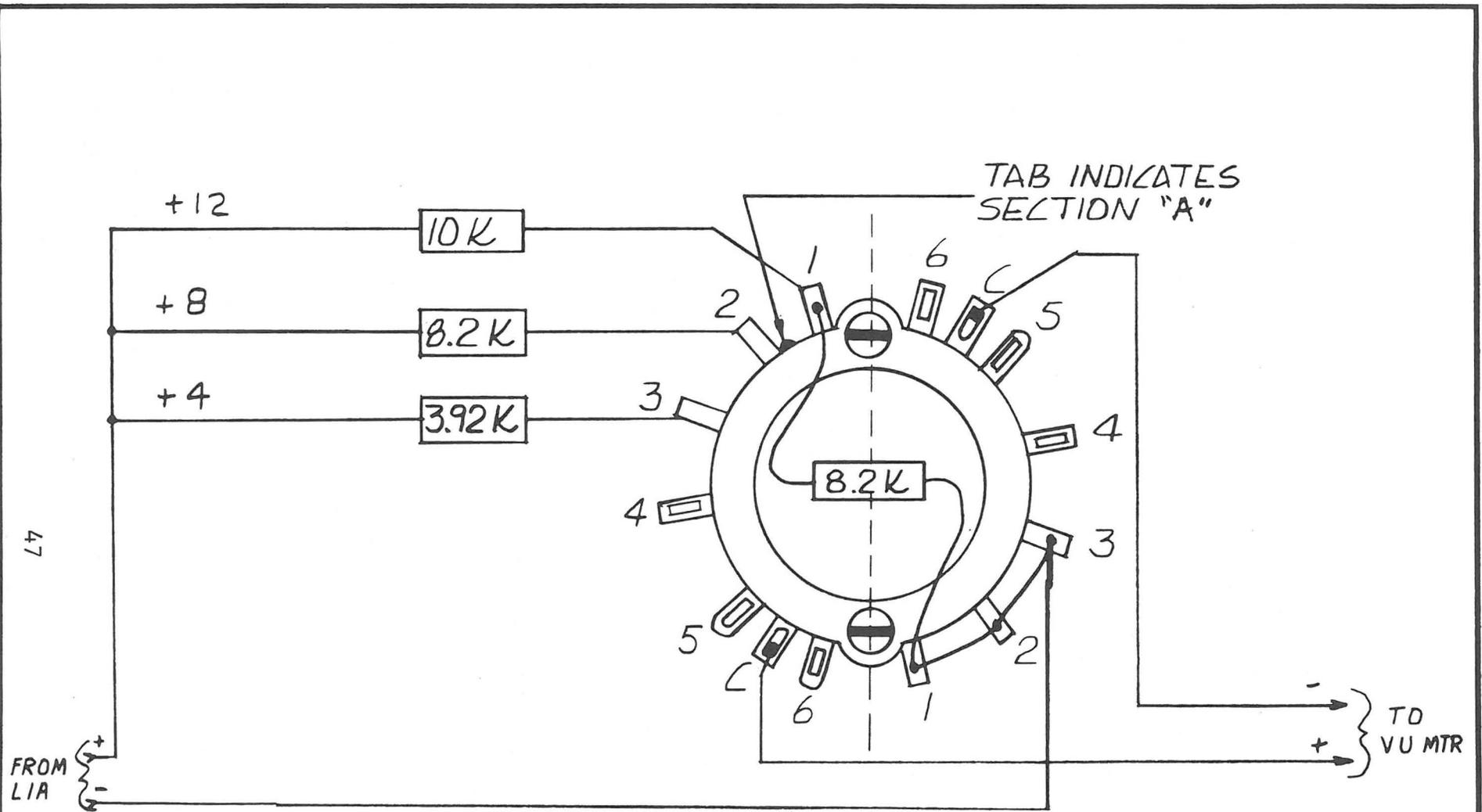
Connect an oscilloscope from test point 3 to ground. (Test point 2 is ground and is located at the top rear of the individual compressor boards.) Test point 3, for Symmetry, is located just below test point 2.

Increase the sensitivity of the scope until the waveform is easily discerned. This voltage is small. Should additional sensitivity be required to view this waveform, the use of the distortion analyzer as an amplifier provides a satisfactory solution to the problem.

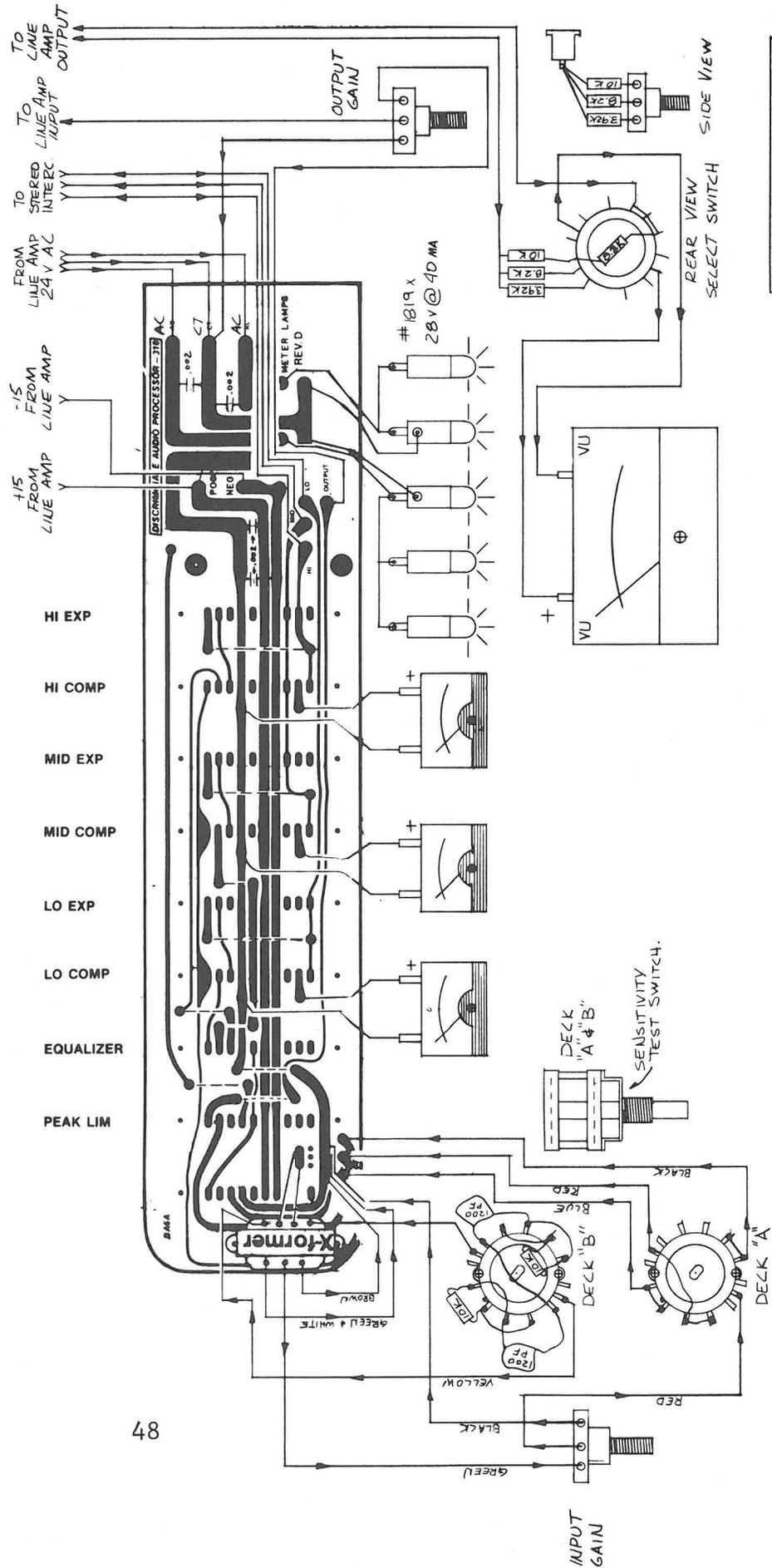
Adjust the sweep so that four cycles of sawtooth waveforms are displayed. Slowly rotate Symmetry control R_{10} throughout its entire range while carefully watching the scope, to the point the sawtooth waves will form an even pattern in height and amplitude. Both rectifiers are now switching evenly. Symmetry control R_{10} should be left in this position. Return the R_3 input controls to the settings previously marked above.

DC OFFSET ADJUSTMENT (R_5) (PEAK LIMITER CARD)

With the test switch in the "TEST" position, feed a 1,000 Hz signal to the Processor. Next, adjust the Processor front panel output control for an average of 60 to 80% on the modulation meter, with the meter in the negative polarity position. Switching the modulation meter to the positive polarity position, observe the reading. The meter reading should be identical to the reading in the negative polarity position. Adjust R_5 (DC offset) for equal readings.

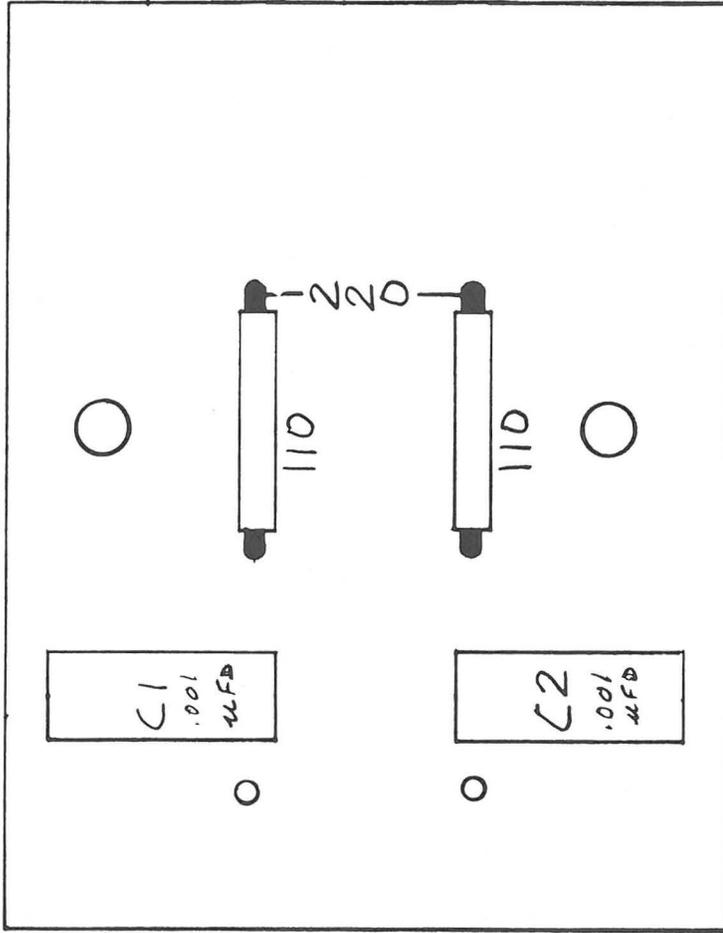


SCALE: 2x	APPROVED BY:	DRAWN BY D.J.
DATE: 1-23-77		REVISED
ASSY: VU METER SELECT SWITCH		
PROJECT: DORRDUIGH DAP-310	DRAWING NUMBER	



48

ASSY - MOTHER BOARD	
MODEL NO. DAP-310	REV. A
DATE 2-17-77	
DORROUGH ELECTRONICS	



NOTES:

FOR 110V OPERATION
 JUMPER AS SHOWN.
 FOR 220V OPERATION
 REMOVE JUMPER &
 REPLACE WITH ONE
 JUMPER IN THE 220
 POSITION

SCALE: 2 X

APPROVED BY:

M. M. J. D.

DRAWN

DATE: 1-8-77

SH. 1 OF

ASSY, POWER SEL. BOARD

PROJECT:

DORROUGH DAP-310

DRAWING NUMBER

50

POWER



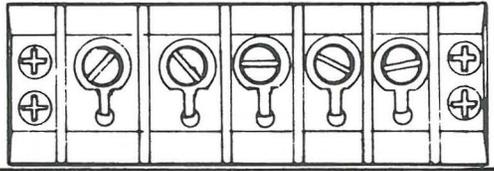
STEREO



1 AMP

GND

IN OUT
+ - + -



MODEL 310

SERIAL NO.

MFD. BY

DORROUGH ELECTRONICS

