OPERATING INSTRUCTIONS

model 1178
DUAL PEAK LIMITER

UNITED RECORDING ELECTRONICS INDUSTRIES
8460 SAN FERNANDO RD., SUN VALLEY, CALIFORNIA 91352 (818) 767-1000
a UREI company

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SECTION I

INTRODUCTION

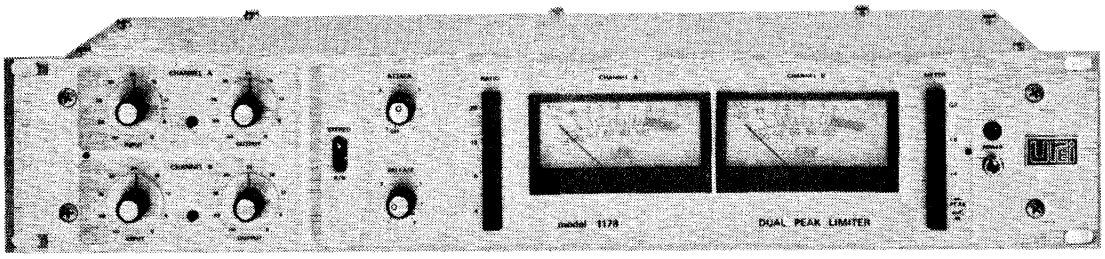

FIGURE 1-1. MODEL 1178 FRONT PANEL.

1.1 DESCRIPTION

The Model 1178 is a two channel version of the very successful 1176LN Peak Limiter used in many recording studios, broadcast stations, sound reinforcement installations, etc. around the world. The Dual Peak Limiter was designed for those applications where two channels of program material are processed, and the balance of these audio channels must be maintained. The two limiters inside the Model 1178 are matched to assure the high degree of tracking necessary for critical stereo applications.

Single adjustments of attack and release time affect both channels simultaneously, while the input and output level controls are adjusted independently. In the stereo mode, a front panel switch allows the two limiters' gain reduction amplifiers to be linked together such that the audio signal with the larger peak-to-peak amplitude causes the same amount of gain reduction in both channels. On the other hand, when switched to single mode operation, the two limiters process the signals independently. This provides the user with exceptional flexibility in operation.

The Model 1178 was designed to have performance characteristics similar to the single channel 1176LN. Limiting is accomplished by utilizing FET's as voltage variable resistors. Unique circuitry permits severe limiting without added distortion and the compression ratio may be optimized for various program materials. The gain structure throughout the Model 1178 maintains an excellent signal-to-noise ratio at normally used control setting.

Dual, backlighted front panel meters may be switched to read either the amount of gain reduction, or the output signal level referenced to +4 dBm or +8 dBm. Also switch selectable are the meter reading characteristics: either indicating average signal (VU ballistics) or peak.

1.2 SPECIFICATIONS

ELECTRICAL (Each Channel):

INPUT:	Balanced bridging, differential amplifier.
INPUT IMPEDANCE:	20 kohms, used as balanced input. 10 kohms, used as unbalanced (single-ended) input.
MAXIMUM INPUT LEVEL:	+20 dB maximum (Ref. 0.775 volts rms).
MAXIMUM GAIN:	45 dB, ±1 dB.
FREQUENCY RESPONSE:	±1 dB, 20-20,000 Hz.
OUTPUT:	Floating, transformer isolated.
OUTPUT LOAD:	150 ohms or greater.
MAXIMUM OUTPUT LEVEL:	+24 dBm into 600 ohm load (12.28 volts). +20 dB into 150 ohm load (7.75 volts).
DISTORTION:	Less than 0.5% THD, 50 Hz to 15 kHz with limiting, at 1.1 seconds release setting; (as with all limiting devices, distortion of low frequency peaks increases with faster release time).
SIGNAL TO NOISE RATIO:	Greater than 81 dB at threshold of limiting, 30 Hz to 15 kHz.
ATTACK TIME:	Less than 20 microseconds for 100% recovery; adjustable to 800 microseconds with front-panel control.
RELEASE TIME:	50 milliseconds minimum, 1.1 seconds maximum (for 63% recovery). Adjustable with front-panel control.

THRESHOLD vs OUTPUT LEVEL:

Compression Ratio Setting	Input Level at Minimum Limiting Threshold ±2 dB	Relative Output at Threshold*
20:1	-24 dB	+10 dBm
12:1	-25 dB	+9 dBm
8:1	-26 dB	+8 dBm
4:1	-30 dB	+7 dBm

*with output gain control set to provide a reserve of approximately 10 dB.

NOTE: Throughout this manual, where the expression "dB" is used to denote a signal level, it is referenced to 0 dB = 0.775 V rms.

POWER REQUIREMENTS: 100 - 125 VAC, or 200 - 250 VAC, 50/60 Hz, switch selectable, less than 10 W.

ENVIRONMENT: Operating, 0°C to +50°C; Storage, -20°C to +60°C.

1.3 FRONT PANEL CONTROLS

INPUT AND OUTPUT LEVEL: Continuously adjustable.

ATTACK : Continuously adjustable, 20 microseconds to 800 microseconds. (Fastest attack is in the maximum clockwise (CW) position.)

LIMITING ON/OFF: This switch is coupled with the Attack Time control. In the full counterclockwise position (CCW) the limiting function is disabled.

RELEASE: Continuously adjustable from 50 milliseconds to 1.1 seconds. (Fastest release in obtained in the maximumum CW position.)

A/B - STEREO SWITCH : In the A/B position the Model 1178 may be operated as two independent limiters. In the STEREO position the gain reduction amplifiers of the two channels are linked together, and the maximum limiting in one channel causes an equal amount of limiting in the other channel. (The compression ratio, attack time, and release time are always identical in both channels.)

COMPRESSION RATIO: Switch selectable with four interlocking pushbuttons.

METER FUNCTION: Three interlocked pushbuttons switch the meter to read either the amount of gain reduction or the output signal level referenced to +4 dBm or +8 dBm. The fourth pushbutton selects the response characteristic of the meter when reading the output level. "Average" is typical VU indication as selected with the +4 or +8 dBm pushbutton. In the "Peak" mode the meter reacts faster, and 0 VU corresponds to a level which is 6 dB higher than the selected output signal reference. (Gain reduction indication is always average responding.)

POWER SWITCH: Toggle switch with LED to indicate when the Model 1178 is powered.

1.4 PHYSICAL

DIMENSIONS: 483 x 89 mm rack panel. Depth behind panel 203 mm (19" x 3-1/2" x 8").

FINISH: Panel is 3.18 mm (1/8") brushed clear anodized aluminum in 2 shades. Chassis is cadmium plated steel.

WEIGHT: 5 kg (11 lb).

SHIPPING WEIGHT: 6.6 kg (14.5 lb).

ACCESSORIES: Model 301 XLR/QG Adapter for signal input and output.
Model SC-2 Security Cover.

1.5 CONNECTIONS

Rear chassis barrier strip for input and output. Power through 3 wire IEC-style connector.

SECTION II

INSPECTION AND INSTALLATION

2.1 UNPACKING AND INSPECTION

Your Model 1178 was carefully packed at the factory, and the container was designed to protect the unit from rough handling. Nevertheless, we recommend careful examination of the shipping carton and its contents for any sign of physical damage which could have occurred in transit.

If damage is evident, do not destroy any of the packing material or the carton, and immediately notify the carrier of a possible claim for damage. Shipping claims must be made by the consignee.

The shipment should include:

Model 1178 Dual Peak Limiter

UREI Instruction Manual (this book)

Two-part Warranty Card bearing the same serial number as the Model 1178.

Rack mounting hardware.

2.2 ENVIRONMENTAL CONSIDERATIONS

The system will operate satisfactorily over a range of ambient temperatures from 0°C to +50°C (+32°F to 122°F), and up to 80% non-condensing relative humidity.

If the system is installed in an equipment rack with high heat producing equipment (such as power amplifiers), adequate ventilation should be provided in order to assure longest component life. Also, while circuitry susceptible to hum pick-up is sufficiently shielded from moderate electromagnetic fields, installation should be planned to avoid mounting the system immediately adjacent to large power transformers, motors, etc.

2.3 POWERING

The 1178 may be operated from either 100 - 125 VAC or 200 - 250 VAC mains (50 Hz or 60 Hz, single phase.) As indicated in Section 2.4, the nominal line voltage may be selected with a rear panel switch. BE SURE TO VERIFY BOTH THE ACTUAL LINE VOLTAGE, AND THE SETTING OF THE VOLTAGE SELECTOR SWITCH BEFORE CONNECTING THE 1178 TO THE MAINS.

To comply with most Electrical Codes, the 1178 is supplied with a three-wire IEC style connector, the grounding pin of which is connected to the chassis. In some installations this may create ground-loop problems. Ground loops can result in hum and buzz if a significant potential difference exists between the AC conduit ground and the grounded metal enclosure in which the chassis is installed. If hum is experienced, one may check for the possibility of ground loops by using a 3-prong to 2-prong AC adapter between the power cord and the mains supply, ungrounding the AC plug temporarily. This ungrounds the Model 1178, and may cure the hum or buzz, but is not a substitute for proper system grounding. Be aware that unless the Model 1178 Dual Peak Limiter is AC grounded, a safety hazard can exist. UREI accepts no responsibility for legal actions or for direct, incidental or consequential damages that may result from violation of any electrical codes.

2.4 LINE VOLTAGE SWITCH

Unless a tag on the line cord specifies otherwise, the Model 1178 was shipped ready for operation with nominal 115 VAC power mains. In order to change this for nominal 230 V (50 Hz or 60 Hz), slide the VOLTAGE SELECTOR switch on the rear panel to the 230 position. The voltage is visible in a window next to the switch slot. Be sure to change the fuse to the correct value: 1/8-amp slo-blo when changing to 230 V operation or 1/4-amp slo-blo for 115 V operation. A small screwdriver should be used to move the recessed switch.

2.5 EXTERNAL CONNECTIONS

Permanent input and output signal wires should be shielded cable, and connected in accordance with standard wiring practice, as indicated on the rear panel barrier strip. If the XLR/QG connectors are to be used, install the accessory Model 301 according to the instructions suppplied with the adapter. (See also "Mounting Instructions," Page 9, and Section VI.)

If the Model 1178 output is connected to a high impedance circuit, we recommend shunting the "±" and "COM" output terminals with a 620 ohm, 1/2 watt resistor. This assures optimum loading. (See Section 2.6 regarding input termination).

(See Figures 2-1 and 2-2 on the following page for recommended connection procedures.)

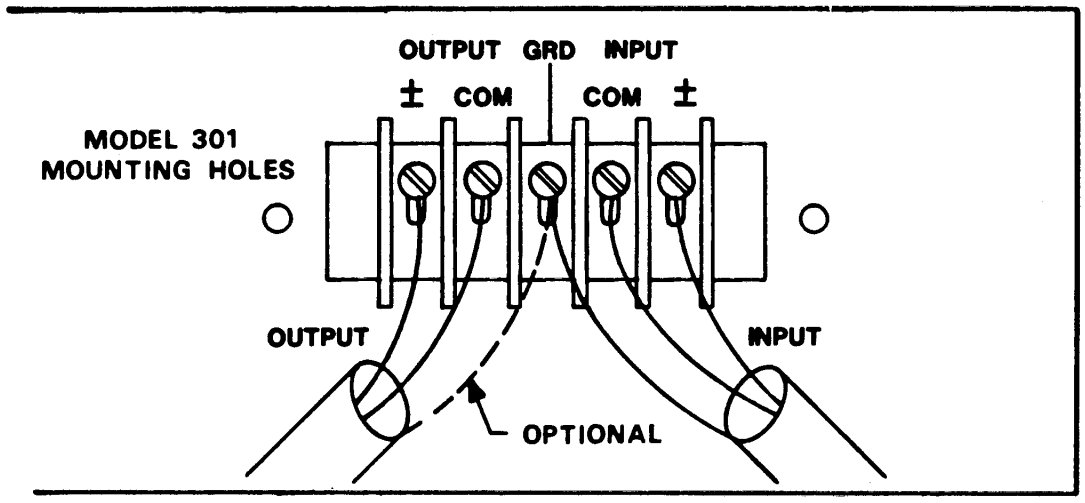

FIGURE 2-1. CONNECTING THE MODEL 1178 WITH BALANCED INPUT AND BALANCED OUTPUT CIRCUITS.*

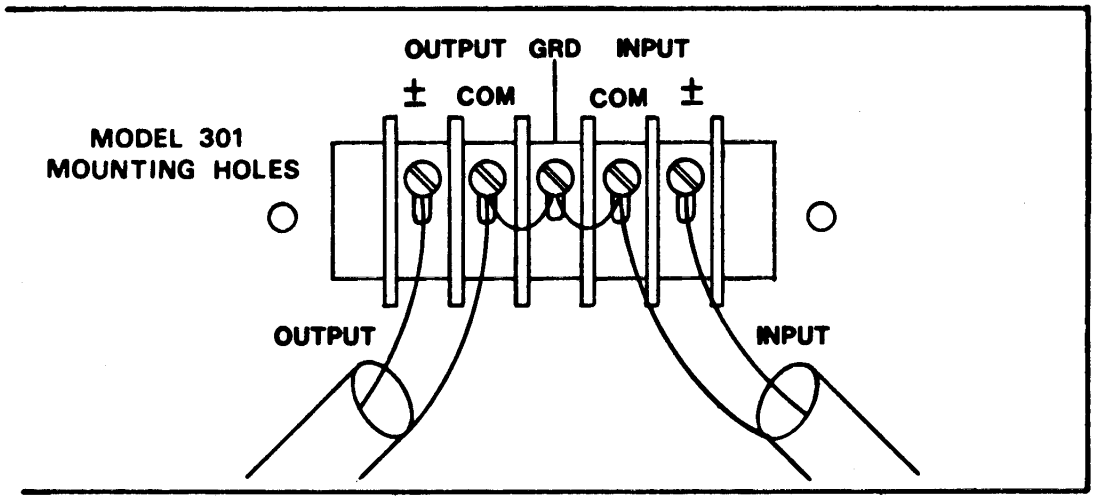

FIGURE 2-2. CONNECTING THE MODEL 1178 WITH UNBALANCED INPUT AND UNBALANCED OUTPUT CIRCUITS.*

*With a balanced input and unbalanced output, or vice-versa, use the appropriate connections suggested by each of the above diagrams. No special switching or transformers are needed.

2.6 IMPEDANCE AND TERMINATION

Audio engineering had its roots in the telephone industry, and "600 ohm circuits" (together with their predecessors, "500 ohm circuits") are carry-overs from telephone transmission practices. Long audio transmission lines, like their video counterparts, must be properly sourced from and terminated in equipment which matches their characteristic impedance, if optimum frequency response and noise rejection are to be achieved.

However, transmission line theory and techniques are not only unnecessary but impractical within modern recording studios, broadcast studios and other local audio systems where transmission circuits are seldom more than several hundred feet in length. The advent of negative feedback circuitry and solid-state electronics has spawned modern audio amplifiers and other signal processing devices having source impedances of only a few ohms. They are essentially indifferent to load impedances and by varying their output current inversely to changes in load impedance, maintain the same output voltage into any load impedance above a rated minimum, with no change in frequency response. Most new designs (all at UREI) have high input impedance to allow use with various source impedances.

Most modern audio systems, therefore, utilize amplifiers and other active devices which have very low output impedances and high (10K to 50K) input impedances. These products may thus be cascaded (operated in tandem), or many inputs may be connected to a single output of a preceeding device, without regard to impedance "matching". Switching, patching, etc. is simplified because "double loads" and "unterminated" bugaboos are essentially eliminated. "Floating" (ungrounded) transformer outputs minimize ground loop problems, and differential transformerless input circuitry (or input transformers) minimize common mode noise or interference which may be induced into the interconnecting wires or cables, or produced by different ground potentials.

Where audio must be transmitted through cables or wire pairs of more than several hundred feet in length, however, transmission line termination practices should still be observed.

The Model 1178 has an input impedances of 20,000 ohms when used in a balanced, differential input configuration, and 10,000 ohms when used unbalanced (one side grounded). This makes the device suitable for use with any normal source impedance, low or high. Only when it is used from a source which requires a low impedance termination (such as a 600-ohm transmission line or older vacuum tube equipment) is a source termination resistor required at the 1178 input.

2.7 ACCESSORIES

2.7.1 MODEL 301 ADAPTER

Two holes are provided adjacent to the ends of the IN/OUT barrier strip. This allows simple mounting of the Model 301 and adapts the limiter to signal cables fitted with XLR/QG termination.

2.7.2 SECURITY COVER SC-2

An optional Security Cover is available to cover all operating controls of the Model 1178, and to protect against any inadvertent misadjustment of critical settings.

SECTION III

OPERATING INSTRUCTIONS

3.1 GENERAL DEFINITIONS

Before operating the 1178 Peak Limiter with program material, it may be helpful to become familiar with the terminology used in this manual.

Compressors and Limiters are typically used in applications where the dynamic range of program material is too large to be processed by succeeding equipment, or where the peak-to-peak amplitude is too large for the headroom of the following equipment.

The two different names generally refer to the degree to which the dynamic range is restricted. The relationship of input level change versus output level change is called the Compression Ratio. If, for example, an increase of 8 dB input signal level should cause the output to increase by 2 dB, this would represent a 4:1 compression ratio.

Although no strict standards exist, amplifiers with compression ratios of up to 8:1 are typically considered to be Compressors, while those with ratios higher than 8:1 are called Limiters. By this definition, the following graph shows that the Model 1178 can function as a compressor or a limiter since it has compression ratios selectable from 4:1 to 20:1.

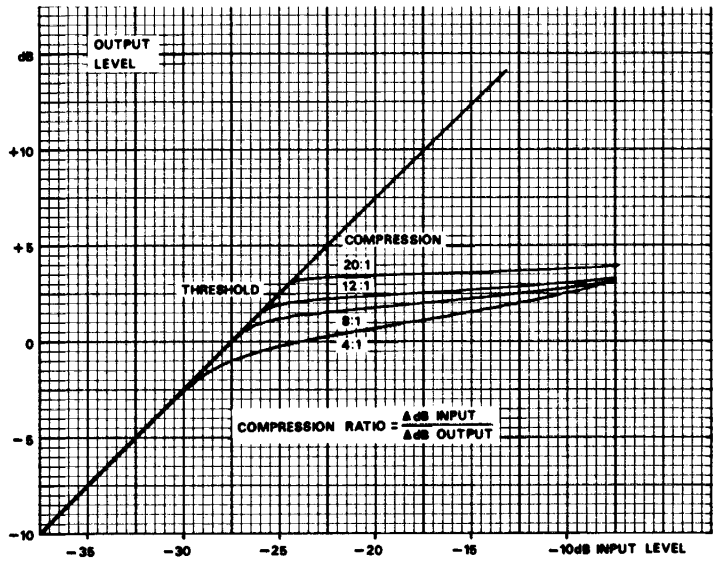

FIGURE 3-1. MODEL 1178 TRANSFER CHARACTERISTICS.

The graph also indicates the region of the Threshold. Signals at levels below the threshold will not be affected by the compression/limiting action. Higher signal levels will cause a controlled decrease in amplifier gain resulting in a change of dynamic range. The 1178 Input Level control adjusts the amount of signal to be processed above the threshold, and hence the degree of compression or limiting.

The Attack Time of the 1178 is the time it takes for the device to respond to a signal which exceeds the threshold. It is variable, and since the adjustment may have a significant effect on the sound quality of the program material, a more detailed description is given in the section on application.

The Release Time may be defined as the time for the limiter to return to its normal gain, after the signal which caused the gain reduction has dropped below threshold. The release time is variable and can also alter the sound of the program material considerably. The adjustments are discussed in more detail in the section on application.

3.2 INITIAL SET-UP

After the Model 1178 has been installed and is connected to both the signal source and the succeeding equipment according to Section II, power may be turned ON. Set the controls as follows:

Input	=	CCW
Output	=	Half rotation
Attack	=	Fully CCW, switch to OFF position
Release	=	Half rotation
Compression Ratio	=	8:1
Meter Function	=	+4 dB
Peak/Avg	=	Avg

3.3 PERFORMANCE CHECK

The following steps will verify the general performance of the limiter and indicate the operation of all functions. If the unit fails to pass these tests, malfunction is indicated. Unless otherwise indicated, these tests should be performed for both channels.

3.3.1 INPUT-OUTPUT SIGNAL LEVEL

Apply a sine wave signal with a level of approximately 0 dB (0.775 V rms) to the input terminal. Turn the Input control CW to approximately half-rotation. There should be an indication on the VU meter. Adjust the Output control until the VU meter reads "0". Measured with an external meter, the output signal will read about +4 dBm. Push the +8 dB meter function switch. The VU indication will drop by 4 dB. The actual output level will not

change. Push the +4 dB meter function switch and select the Peak characteristic. The indication on the meter will be -6 dB. Again, the actual output level does not change. Return the meter characteristic to AVG (average) reading.

3.3.2 GAIN REDUCTION CHECK (Allow 15 minutes warmup).

Push the GR meter function switch. The VU meter should read 0 VU since the limiting function is disabled [the Attack control is turned fully counterclockwise (CCW)].

Turn the Attack control ON; gain reduction should be indicated. Observe the tracking between the indicated amount of gain reduction and the actual change in output (VU) level as measured with an external meter. The tracking should be within ±1 dB.

Selecting other compression ratios of the limiter will indicate some gain reduction in each setting, however the actual amount will vary due to the different threshold sensitivities.

3.3.3 STEREO TRACKING

Apply the same signal to both inputs. Switch the meter function to GR, and, with the mode switch in the A/B position, adjust the Input controls until the same amount of GR is indicated on each VU meter -- for example -5 dB.

Select the +4 dB meter function and adjust the Output level controls for the same indication on both meters -- for example 0 VU. Switch the mode switch to STEREO and check the tracking between the two meters to remain within 1 dB.

3.4 APPLICATION

3.4.1 CONTROL SETTINGS

Since all important parameters of the Model 1178 are variable, the instrument is flexible enough to be used in virtually all phases of sound processing, from recording of a single track to reproduction of the full program material. The limiter finds application as a creative instrument during production, as well as a device for automatic level control and protection against high amplitude problems.

There is no single correct setting of the controls; rather experimentation is necessary to find the best combination of compression ratio, attack and release time, and the amount of gain reduction for the job at hand. Experience will show that the dynammic parameters (attack and release time) have a stronger effect on the character of the program material than the static parameters (compression ratio and threshold).

3.4.2 EFFECTS OF COMPRESSION RATIO

A moderate form of gain reduction is achieved with ratios up to about 8:1. The dynamic range of the program material is controlled without obvious alteration. The average signal level will be increased and the softer passages will be made louder.

A more drastic gain reduction results from compression ratios of 12:1 and 20:1. The output signal level is limited, and for practical purposes cannot exceed a preset level. Dynamic range is significantly reduced, and high level peaks are minimized.

3.4.3 EFFECTS OF THRESHOLD

Changing the relationship of the average input level to the threshold will determine the amount of gain reduction, or how much of the signal envelope is affected by the limiter action.

If only occasional large-amplitude peaks are allowed to exceed this threshold, the program material remains very much the same. However, overload problems which would be caused by these peaks are eliminated. The result can be an increase in loudness because the operator can raise the signal level without adding distortion due to headroom limitations.

When the input is adjusted so that the average signal level is above the threshold all the time, then the entire program material will be compressed. Monitoring the amount of gain reduction is made easy when the meter function is switched to the GR mode.

3.4.4 EFFECTS OF ATTACK TIME

Fast transients and high frequencies with large peak-to-peak amplitudes can only be limited or compressed if a fast attack time is chosen. Then any overshoot, and with it overload problems, are kept to a minimum. However, limiting with a fast attack time alters the musical quality of some instruments which are characterized by sharp percussive attacks.

A slow attack time will allow the first segment of fast amplitude changes to pass through the limiter unaffected. The limiter reduces gain after the initial envelope attack of the program material. Thus, slow attack maintains the "punch" of such percussive instruments as drum, bass, piano, guitar, etc. with some sacrifice of amplitude control.

The aim of the user in adjusting the limiter for the correct attack time then is to find the best setting for the task at hand. It may be a compromise between a permissible amount of initial peak-to-peak amplitude before full compression, and how much alteration of the program material is acceptable.

These general guidelines are mainly applicable when the 1178 is used for the limiting of individual signal sources. For mixed program material, a middle-of-the-range setting will usually be a good starting point for additional experimentation.

3.4.5 EFFECTS OF RELEASE TIME

This control, too, may be set to accommodate different program material requirements. The best adjustment maintains a quick response of the limiter to dynamic changes of the signal while avoiding such affects as "pumping" or "breathing." Again, let us examine the behavior with some extreme settings.

If the release time is set very short, the limiter will return the gain reduction to zero every time the signal drops below the threshold. For low frequency solo passages, such as bass and drum, this can occur between cycles or individual notes and beats. We would hear the gain come up each time, and, with it, the softer passages or background noise. Extremely short release times may even introduce harmonic distortion if the gain reduction changes between cycles.

Setting the release time to a very long duration will maintain the initial gain reduction caused by a large amplitude, and the dynamic range of the passage which follows is strongly affected. If the gain reduction continues through a soft program section, it may make this section inaudible because it, too, will be reduced in gain. Also, short dynamic changes will be ignored due to the continuous high level of gain reduction.

The most desirable release time setting for particular program material can usually be found quickly by experimentation. Here, too, the effects of varying the adjustment are more obvious with individual signals, and less apparent with a full mix. As with the Attack control, a good starting point is half rotation.

3.5 PLACEMENT OF THE 1178 LIMITER IN THE SIGNAL PATH

3.5.1 AFTER PREAMP

Small signals need to be amplified before they will cause proper operation of the 1178 Limiter. Only signal levels which are above the threshold of the limiter can cause gain reduction. For example:

> In the 4:1 compression ratio, the lowest threshold is -30 dB. If the signal applied to the input is about -20 dB, then the 1178 will provide a maximum of 10 dB compression with the Input Level control set to maximum. The sensitivity is high enough that it should not be difficult to obtain sufficient signal level from most sources which supply the audio to be processed by the 1178.

This consideration is appropriate when the limiter is patched into the signal path at a point where individual inputs are to be controlled artistically before mixing (solo tracks).

3.5.2 EQUALIZATION, BEFORE OR AFTER THE LIMITER?

In most cases, better results are obtained if one places the limiter after the equalizer. This becomes evident when one considers that the equalizer could eliminate the amplitude balance so carefully achieved with the limiter. An exception to this would be in the case of large dynamic changes in program material that are too difficult for the equalizer to handle, and that would thus result in overload or a poor signal-to-noise ratio. Then the 1178 should be used to condition the audio signal before it is applied to the equalizer or other device.

3.5.3 FULL PROGRAM MATERIAL

It is good to recall that the action of a limiter is most obvious when applied to the full program material because at this point one does not benefit from the masking that occurs when individually limited sources are mixed. Therefore, it is even more important to carefully select the dynamic parameters, like attack and release time, to achieve an optimum result. Here are some additional tips:

On live program material, the fastest attack time possible will afford the maximum protection against overload, but will cause some alteration of the sound. On pre-recorded tape, disc or film, slower attack time may be used to maintain a high average level.

For program material containing relatively little low frequency energy, the release time may be fast, thereby increasing the short interval average level. The highest apparent average level may be attained with the shortest release time before "pumping" becomes objectionable. For program material containing more than average low frequency energy, the release time must be increased to the point that no low frequency distortion is apparent. A further compromise may be made by slightly reducing the amount of limiting action in favor of slightly faster release time: the result -- a higher average level.

Adjustment of the Attack Time control also affects the amount of sibilant speech sound. These high frequency components in speech are normally at much lower level than the low frequency components, and the control voltage derived from sibilants alone is much less than from the "vowel" or low frequency sounds. In cases where attack time is extremely slow, the rise time and amplitude of the high frequency sibilants will not cause control voltage to be developed until the "vowel"

energy envelope occurs. This results in the full gain applied to the sibilants and reduced gain to the vowels, creating an exaggerated sibilant sound. Again, experimentation is the best tool.

3.5.4 PRIOR TO OUTPUT AMPLIFIER

Here the limiter fulfills mainly the function of protection. Most equipment which is fed from the low level signal path's output terminal is sensitive to amplitude overload; the power amp's peak-to-peak headroom, the saturation point of recording tape, the modulation allowed in a transmitter, the amplitude handling capability of film recording devices, etc.

If one were to summarize the ideal operation of a well adjusted limiter, one could say:

> "It should afford infallible protection against overload, while maintaining the highest level, contribute no apparent degradation to the dynamic range which might subjectively affect the artistic value of the program, and, at the same time, maintain the individual quality of all sounds, regardless of their starting transients."[1]

3.6 STEREO OPERATION

When stereo signals are processed the balance of the two audio channels is important. To maintain a good balance between channel A and channel B, the Model 1178 is simply switched into the STEREO mode. Then the audio signal with the larger peak-to-peak amplitude will cause the same amount of gain reduction in both channels.

The tracking of the GR circuitry is factory calibrated and does not need further adjustment. However, it is important to balance the signal levels with the Input controls since these determine how much signal is within the threshold of limiting. The Output level controls are used for make-up gain setting.

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1. Ref. M.T. Putnam, Audio Engineering Society paper, Spring, 1967.

SECTION IV

THEORY OF OPERATION

4.1 General

This section provides a generalized description of the 1178 circuitry and should be used in conjunction with the schematic at the end of the manual. Where used, component designations in parenthesis are those of channel B.

4.2 INPUT AMPLIFIER

The audio signal is applied through the rear panel barrier strip to a differential input amplifier IC 1, section A & B (IC 2, A & B). This input can accept either balanced or unbalanced signal sources. When used in an unbalanced mode, either the COM terminal or the "±" terminal is connected to ground, the latter causing a polarity reversal (180° out of phase) of input versus output signal. (See Installation, Section 2.5).

Common mode rejection is factory trimmed with R1 (R101), and is typically better than 60 dB.

4.3 VOLTAGE-VARIABLE RESISTOR ATENUATOR

The input signal is coupled from the differential amplifier through the Input Level control to an "L" section consisting of R3 (R103) as the series element and field-effect transistor Q7A (Q7B) as the voltage-variable shunt element. Below the threshold of limiting the FET has a very high resistance. During limiting the gain reduction amplifier causes the FET to conduct, decreasing its resistance proportionately. The Q-bias network R12, R13, R14 is adjusted to bring the FET into the region of conduction.

4.4 SIGNAL PREAMPLIFIER

This low noise amplifier stage provides approximately 28 dB of gain. Trimpot R18 (R118) in the feedback loop is used to adjust the circuit for a minimum of distortion products due to channel non-linearity in the FET. The preamplifier output signal is applied simultaneously to the Output Level control and to the ratio switch for use in the gain reduction amplifier.

4.5 LINE AMPLIFIER

The signal from the output control is coupled to the output amplifer consisting of IC 2A, Q1, Q2 (IC 4B, Q4, Q5) and associated components, and hence to the output transformer T2. This circuit

uses a special transformer designed by UREI for low phase shift, flat response, and excellent overload characteristics. The amplifier provides approximately 17 dB of gain, and an additional 3 dB is achieved in the output transformer when terminated with a 600 ohm load.

4.6 GAIN REDUCTION AMPLIFIER

The audio signal is coupled through C31 to the GR circuit IC 7D and IC 7A. Resistor R31 sets the threshold for the 4:1 compression ratio. Depending on the position of S3, different resistors are switched in parallel with R31, determining the threshold for the other compression ratios: 8:1, 12:1 or 20:1.

The audio signal is full wave rectified and a negative dc voltage is developed at the junction of diodes CR5 and CR6. This voltage is inverted in amplifier IC 7B, and then drives transistor Q3, which supplies the GR control voltage across capacitor C37.

The compression ratio is set with different resistors selected by S3. Depending on the resistor value, a current of opposing polarity is summed into the inverting input of IC 7B. Corresponding resistors are: R38 for 4:1, R39 for 20:1, voltage divider R35, R36, R37 for 8:1 and 12:1 ratios. Diode CR7 around the inverting amplifier, prevents the output voltage from assuming a negative value.

During conduction, transistor Q3 functions as a current source for the timing capacitor C37. The charging time is variable with R42, which is the Attack Control of the limiter. When transistor Q3 is turned off, the discharge of C37 occurs through the large resistance of R43. It too is variable, and is the Release Control of the limiter. During discharge the relatively small value of R42 can be neglected. The stop resistors, R44 and R45, are selected to determine the fastest attack and release time of the unit.

When the voltage across C37 is zero, no limiting occurs. With increasing positive value, the control voltage drives FET Q7A proportionately into conduction, thus providing a voltage divider for the audio signal. During STEREO operation the control voltages of the two limiter channels are connected together.

The gain reduction function is disabled with switch S5. (This is part of the Attack Control and is engaged in the full CCW position.) A sufficiently large positive current is driven into the input of IC 7, effectively overriding any negative dc voltages generated by the rectifier circuit.

4.7 METER AMPLIFIER

This circuit receives its signal from the line amplifier. Attenuator R50, R51 reduces the level, and current sense resistor R27 allows the amplifier to compensate the meter reading for differences in output loading. If switched to the average reading characteristic, the meter is driven directly from the output of IC 5A. Resistors R69 and R70 are selected to indicate 0 VU on the meter when the actual output level is +4 dBm (1.23 V) or +8 dBm (1.95 V).

The signal for the meter's peak reading characteristic is developed in rectifier circuit IC 5D and amplifier stage IC 5C and IC 5B. The gain of the circuit is designed to indicate a 6 dB lower reading when compared to the "average" characteristic. The time constant for the rise and fall of the meter is determined by components C51, R60, and R59.

When the meter is switched to gain reduction (GR), one side of it is biased with network R61 and R62 to read zero when no limiting occurs. The positive GR control voltage, buffered in IC 7C, causes a reduction in potential difference across the meter terminals, thus deflecting the needle of the meter downscale (left hand side) in proportion to the amount of limiting. Calibration (tracking) is adjusted with R65. Components R67, R68, and CR15 ensure linearity and correct meter ballistics.

4.8 POWER SUPPLY

The power supply is bipolar employing two integrated circuit voltage regulators, VR1 and VR2, to provide low-ripple, ±18 volt DC. Additional filter capacitors assure power supply stability and low noise.

The pilot LED is connected to the positive and negative sides of the power supply to indicated a power ON condition.

SECTION V

MAINTENANCE

5.1 GENERAL

The Model 1178 is an all solid-state unit, ruggedly constructed with only the highest quality components. As such, it should provide years of trouble free use with normal care. All parts used are conservatively rated for their application, and workmanship meets the rigid standards you have learned to expect in UREI products.

NO SPECIAL PREVENTIVE MAINTENANCE IS REQUIRED.

5.2 REPAIRS AND WARRANTY

This product is factory warranted to the original purchaser against defects in material and workmanship for one year after initial purchase. This limited warranty must be activated at the time of purchase by returning the registry portion of the Warranty Card to the factory. Should a malfunction ever occur, the dealer from whom the unit was purchased will be glad to handle return for factory repair. Please call or write to the factory for a Return Authorization Number which must accompany all repairs. For prompt service, ship the unit prepaid directly to the factory with the RA Number visible on the shipping label. Be sure it is well packed in a sturdy carton, with shock-absorbing material such as foam rubber, styrofoam pellets, or "bubble-pack" completely filling the remaining space. Particular attention should be paid to protecting the controls, switches, etc. Tape a note to the top of the unit describing the malfunction, and instructions for return. We will pay one-way return shipping costs on any in-warranty repair.

Because of specially selected components in this product, field repairs are not authorized during the warranty period, and attempts to perform repairs may invalidate the warranty.

Even if your unit is out of warranty, we recommend that you return it to the factory for repairs. Our experienced personnel, supported by special test equipment, will be able to find and eliminate any problem in the most efficient way.

5.3 INTERNAL SERVICE ADJUSTMENTS

These controls have been set at the factory and should not require adjustments except after service work. If recalibration is necessary, the test procedure that follows should be peformed very carefully, and adjustments performed in the exact manner and order specified.

Before attempting any calibrations, the limiter should be operated for approximately 15 minutes. This avoids subsequent drifting.

WARNING: The full AC line voltage is present at several points inside the chassis. Be careful to avoid personal shock when you work on the limiter with the covers removed.

5.3.1 POWER SUPPLY

The positive and negative voltages are most important for the correct function of the entire unit. Therefore, these should be checked first, before attempting any calibration or repair. Convenient check points are the metal tabs (collectors) of Q1 (Q4) for +18 V (±0.6 V), and Q2 (Q5) for -18 V (±0.6 V). There are no adjustments provided in the power supply.

5.3.2 Q-BIAS ADJUSTMENT

This control was factory set and should not need periodic adjustment. It is very important for correct operation of the limiter that this control be correctly set, and therefore we strongly urge you to MAKE SURE that adjustment is necessary before undertaking the procedure. This may most easily be done by applying an input signal (1 kHz, 0 dBm) with the limiting turned OFF. Turn the Output control full CW and turn the Input control up until the output reads +7 dBm on an external voltmeter. Remove Q7 from the socket on the P.C. board and observe the meter indication. It should rise to +10 dBm (±0.5 dB). If it does not so indicate, the Q-Bias adjustment should be performed. Reinsert Q7 into its socket, being careful not to bend the pins.

Initial control settings for Q-Bias adjustments are:

Input	=	full CCW
Output	=	full CW
Attack	=	full CCW (switched to OFF position)
Release	=	full CW
Ratio	=	20:1
Meter	=	+4, Avg
Mode Switch	=	A/B
Q-Bias*	=	full CCW

(*Q-Bias is set with internal trimpots R13 and R113)

Apply a 1 kHz 0 dBm signal to the input and turn the Input control full CW until the output reads +1 dBm on an external voltmter. Slowly turn the Q-Bias adjust R13 (R113) CW until the output drops 3 dB to -2 dBm.

5.3.3 GR METER ZERO AND TRACKING

Depress the GR meter pushbutton. Disable limiting by turning the Attack control full CCW to the detented OFF position. Adjust the meters to read 0 VU with trimpot R61 for Channel A, and R161 for Channel B. Apply a 1 kHz, 0 dBm input signal and adjust for 5 dB of limiting as described in the previous paragraph. Set the Output control so that the meter, switched to +4, reads 0 VU with no limiting and -5 VU with 5 dB of limiting. Switch the meter back to GR and adjust the GR Tracking control R65 (R165) to give a -5 VU reading when the unit is in limiting, and the Meter Zero pot R61 (R161) to give a 0 VU reading when no limiting is taking place.

5.3.4 COMMON MODE REJECTION

The trimpot R1 (R101) is used to adjust for maximum common mode rejection. Set the controls as follows:

Input	=	to number "18" on the front panel
Output	=	full CW
Attack	=	full CCW (switched to OFF position)
Release	=	full CW
Compression Ratio	=	20:1
Meter Mode	=	GR

Apply a signal to the input (100 Hz, -10 dB). Adjust the Input Level control to achieve +10 dB output level, measured with an external AC voltmeter. Connect the "±" and COM terminals together and feed a signal of the same input level to this connection and to the GND terminal of the limiter input. Measure the output signal level, and adjust R1 for a minimum reading, switching the external meter to more sensitive ranges as required. It should be possible to obtain a reading below 2.5 mV (60 dB down).

5.4 IN CASE OF DIFFICULTY

5.4.1 GENERAL

The overall schematic, circuit description (Section IV), and troubleshooting table (Table 5-1) can often be used to isolate a problem. Safety considerations outlined in Section II apply when working inside the device. If a problem cannot easily be solved, it is best to send the unit to the factory using the procedure described under paragraph 5-2.

5.4.2 PRECAUTIONS FOR TROUBLESHOOTING

Be cautious when testing IC and transistor circuits. Although they have almost unlimited life when used properly, they are very vulnerable to damage when accidentally shorted or connected to incorrect voltages.

Be sure not to short any terminals when making measurements. If a probe should slip, for example, and short out a bias or supply point, it will very likely damage IC's, transistors or diodes. Do not remove any components while the line cord is connected to the AC outlet.

5.4.3 VISUAL TEST

Look at wiring and connections. Check to be sure that all transistors and IC's are properly fitted into the sockets. Check for resistors which may look burned, indicating trouble in associated circuitry.

TABLE 5-1. TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSE	REMEDY
Signal does not pass through the device.	1. Power supply defective.	Check supply voltages.
	2. Device in full limiting.	Remove Q7. If signal passes, go to problem of "full limiting".
	3. Loose or broken wires between PC board and front panel controls.	Isolate and resolder.
	4. Incorrect hookup.	See Section II, Installation.
	5. Bad amplifier section.	Repair.
No limiting.	1. Limiting switched OFF.	Turn Attack control CW.
	2. Input level is below threshold.	Increase input signal level.
	3. "Q" Bias misadjusted.	Adjust (¶ 5.3.2).
	4. GR amplifier defective.	Repair.
	5. Shorted GR bus.	Check wiring.
Always in full limiting	1. "Q" Bias misadjusted.	Adjust (¶ 5.3.2).
	2. Contaminated PC board.	Clean (¶ 5.5).

TABLE 5-1. TROUBLESHOOTING (Continued)

PROBLEM	POSSIBLE CAUSE	REMEDY
Hum through output.	1. Ground Loop, etc.	See Section II, Installation.
	2. Failure to unbalance output transformer into unbalanced load.	Ground "COM" to chassis.
	3. Mounted too close to strong EMI field.	Relocate unit.
	4. Power supply.	Check filter caps.
Distortion (during no limiting mode).	1. Power supply voltage.	Repair as needed.
	2. Input level too high.	Adjust.
	3. Defective output amp.	Repair.
Distortion (during limiting).	1. "Cracking" sound on attack.	Attack set too fast or check Q-Bias (¶ 5.3.2).
	2. Low frequency distortion.	Select slower settings of Attack and/or Release controls.
VU meter reads low on +4, +8 range.	1. Bad meter.	1. Replace.
	2. Switch is in PEAK mode.	2. Switch to AVG mode.
Excess noise.	Problem in IC1, 2, 3, 4.	Replace.

5.5 PC BOARD CLEANING

Due to very high impedance circuits, it may happen that contamination on the PC board causes the limiter to perform poorly. Moisture, smoke or polutants in the air may result in slightly conductive deposits which affect the operation of Q7 due to leakage. Existence of contamination can be verified with a simple test. Supply a steady input tone and, with no limiting indicated, adjust the Input and Output controls to read 0 VU on the meter. Remove the top and bottom covers from the limiter and locate Q7. From close proximity, exhale deeply on the circuit board around Q7. The moisture in the breath will induce surface leakage, and the VU meter will indicate a drop in output level. If no contamination is on the board, the output level will return very rapidly to 0 VU (within 10 seconds or less). If contamination is on the PC board, the moisture will be retained for a longer time and cleaning of the board is necessary.

Disconnect the power cord from the AC mains. Prepare a cleaning solution by mixing equal parts of distilled water and isopropyl alcohol. Use a new tooth brush (or similar stiff bristle brush) and apply the mixture to the circuit board. Brush vigorously to thoroughly clean the top and bottom of the board and allow the board to dry completely before applying power to the limiter. In extreme cases it may be necessary to replace the socket which holds Q7. Repeat the moisture test before replacing top and bottom covers.

5.6 CLEANING THE LIMITER

The front panel of the 1178 may be cleaned with a non-abrasive cleanser such as "Formula 409" or "Fantastic" applied with a soft clean cloth. Additional protection of the anodized panel can be afforded through a light application of a spray wax preparation such as "Pledge." Never spray the panel directly, as the cleanser or wax may adversely affect controls or meter, and can contaminate circuit boards if it penetrates the chassis.

SECTION VI

APPENDIX

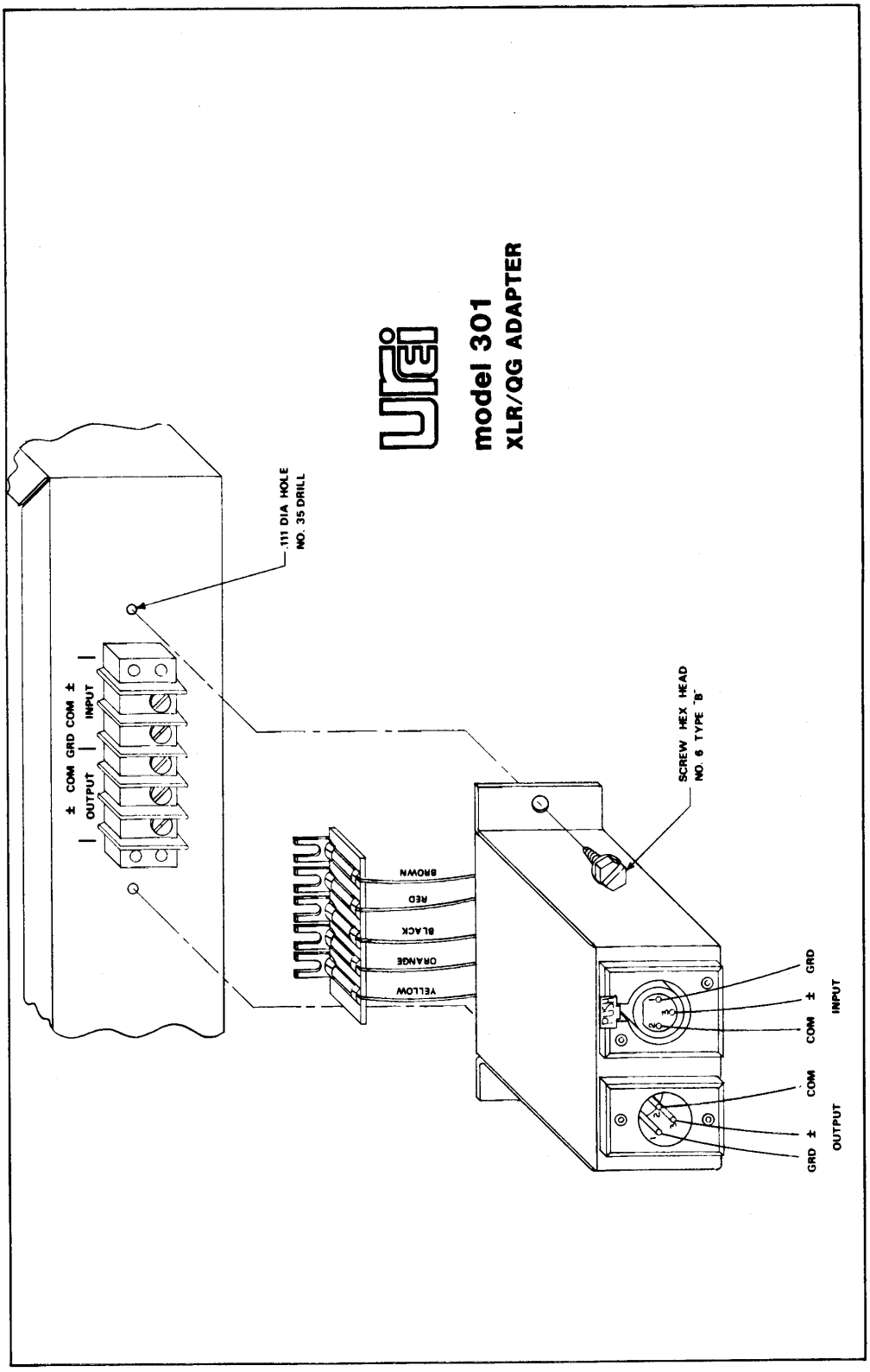
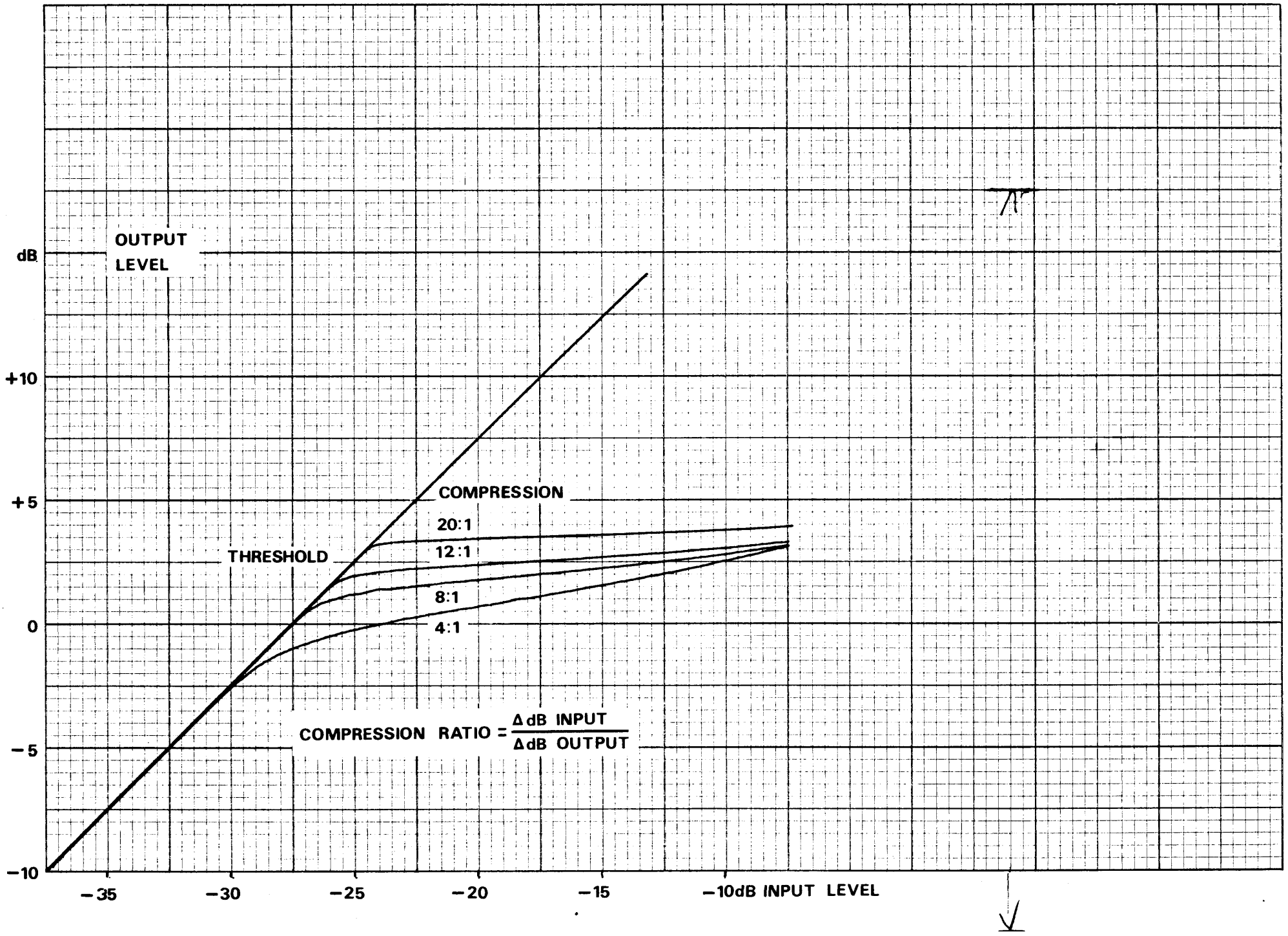
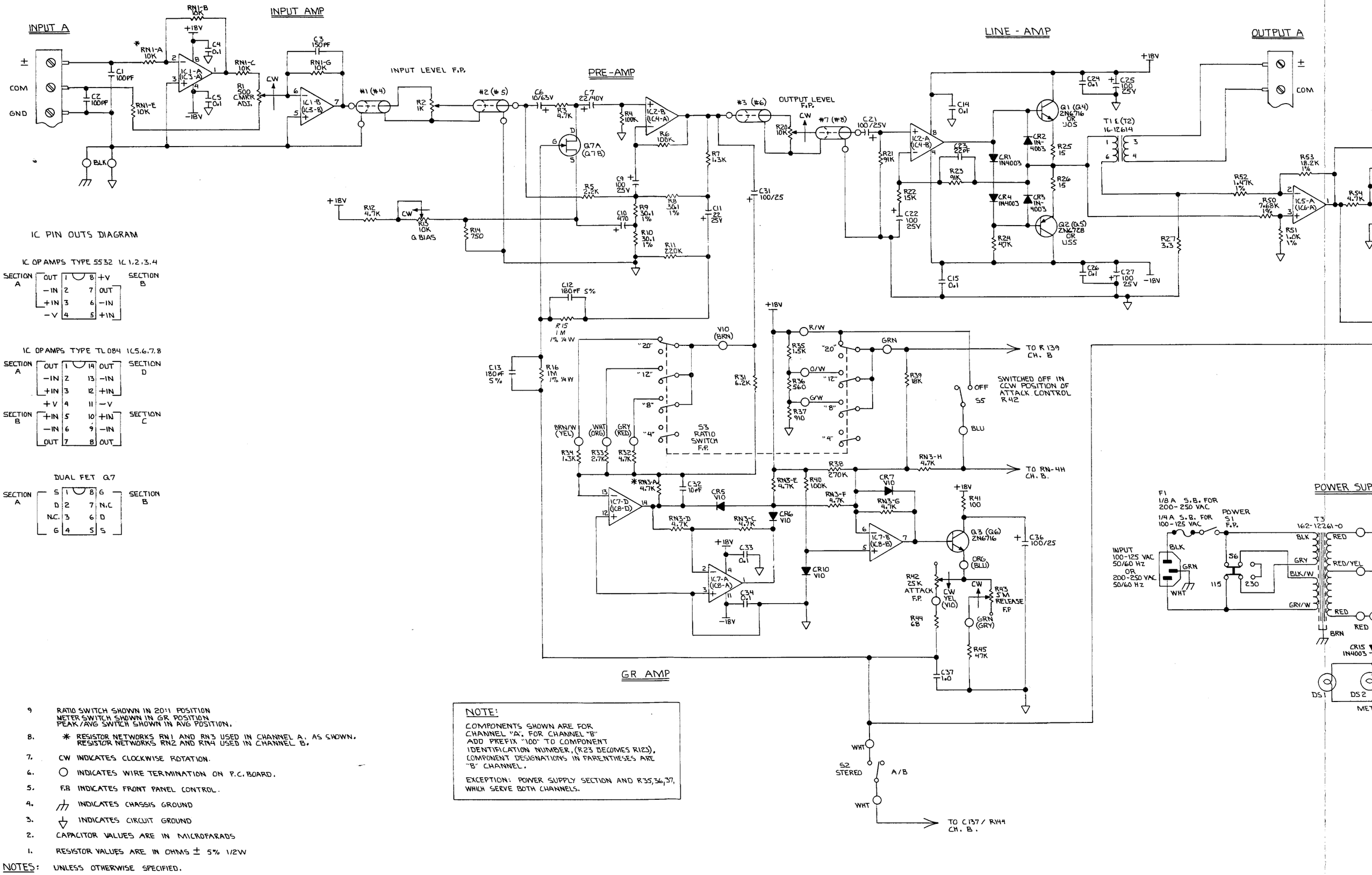


FIGURE 6-1. MOUNTING INSTRUCTIONS FOR MODEL 301.

FIGURE 6-2. MODEL 1178 DUAL PEAK LIMITER SCHEMATIC DIAGRAM.


OUTPUT
LEVEL
dB
+10
+5
0
−5
−10
COMPRESSION
20:1
12:1
8:1
4:1
THRESHOLD
COMPRESSION RATIO = Δ dB INPUT / Δ dB OUTPUT
−35
−30
−25
−20
−15
−10dB INPUT LEVEL



IC PIN OUTS DIAGRAM

IC OP AMPS TYPE 5532 IC 1,2,3,4

SECTION A				SECTION B
OUT	1	8	+V	
−IN	2	7	OUT	
+IN	3	6	−IN	
−V	4	5	+IN	

IC OP AMPS TYPE TL 084 IC 5,6,7,8

SECTION A				SECTION D
OUT	1	14	OUT	
−IN	2	13	−IN	
+IN	3	12	+IN	
+V	4	11	−V	
SECTION B				**SECTION C**
+IN	5	10	+IN	
−IN	6	9	−IN	
OUT	7	8	OUT	

DUAL FET Q7

SECTION A				SECTION B
S	1	8	G	
D	2	7	N.C	
N.C.	3	6	D	
G	4	5	S	

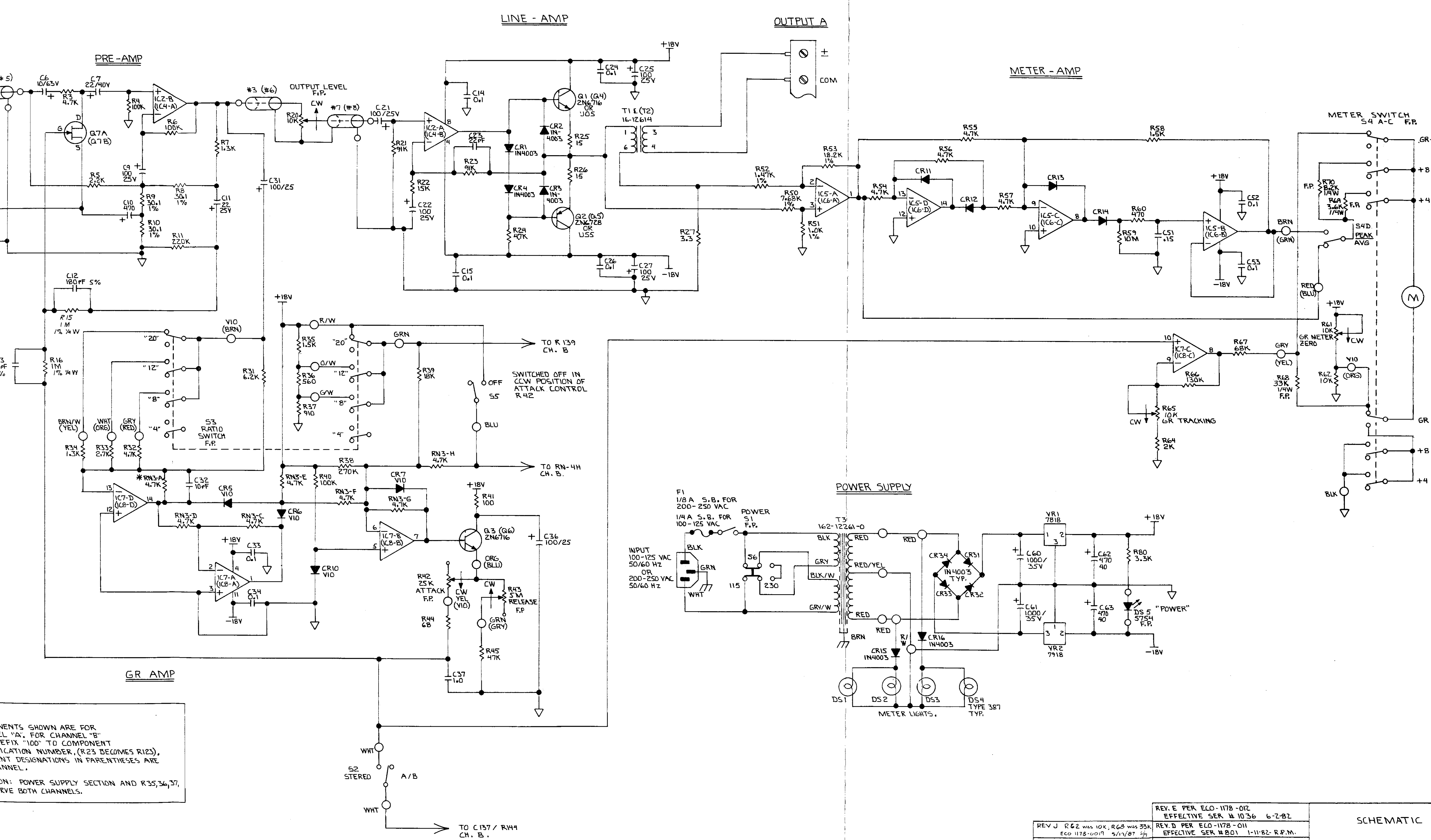
NOTE:

COMPONENTS SHOWN ARE FOR CHANNEL "A". FOR CHANNEL "B" ADD PREFIX "100" TO COMPONENT IDENTIFICATION NUMBER, (R23 BECOMES R123), COMPONENT DESIGNATIONS IN PARENTHESES ARE "B" CHANNEL.

EXCEPTION: POWER SUPPLY SECTION AND R35,36,37, WHICH SERVE BOTH CHANNELS.

9. RATIO SWITCH SHOWN IN 20:1 POSITION METER SWITCH SHOWN IN GR POSITION PEAK/AVG SWITCH SHOWN IN AVG POSITION.
8. * RESISTOR NETWORKS RN1 AND RN3 USED IN CHANNEL A, AS SHOWN. RESISTOR NETWORKS RN2 AND RN4 USED IN CHANNEL B.
7. CW INDICATES CLOCKWISE ROTATION.
6. ○ INDICATES WIRE TERMINATION ON P.C. BOARD.
5. F.P. INDICATES FRONT PANEL CONTROL.
4. ⏚ INDICATES CHASSIS GROUND
3. ⏚ INDICATES CIRCUIT GROUND
2. CAPACITOR VALUES ARE IN MICROFARADS
1. RESISTOR VALUES ARE IN OHMS ± 5% 1/2W

NOTES: UNLESS OTHERWISE SPECIFIED.



NENTS SHOWN ARE FOR
EL "A". FOR CHANNEL "B"
EFIX "100" TO COMPONENT
ICATION NUMBER, (R23 BECOMES R123).
NT DESIGNATIONS IN PARENTHESES ARE
NNEL.

ON: POWER SUPPLY SECTION AND R35,36,37,
RVE BOTH CHANNELS.

REV J R62 was 10K, R68 was 33K ECO 1178-0019 5/19/87	REV. E PER ECO-1178-012 EFFECTIVE SER # 1036 6-2-82
REV. H R15&16 R115&116 WERE 5% 1/2W MRM 11-5-86	REV. D PER ECO-1178-011 EFFECTIVE SER #801 1-11-82 R.P.M.
REV G PER ECO 1178-016 11-8-83 M.R.M.	REV. C PER ECO-1178-010 EFFECTIVE 4-7-81 R.P.M.
REV F PER ECO-1178-014 11-16-82 R.P.MARIN	REV. B PER ECO-1178-008 EFFECTIVE SER # C37 12-16-80 R.P.M.
	REV. A PER ECO-1178-006 & 007 EFFECTIVE SER # 301 7-21-80 R.P.M.

SCHEMATIC

SIZE	MODEL	DRAWING NO
R	1178	13420

DATE 5-20-80 | DR. BY R.P.MARIN