OPERATING INSTRUCTIONS

model 1176LN
PEAK LIMITER
SN # 7652 AND ABOVE

UNITED RECORDING ELECTRONICS INDUSTRIES
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SECTION I

INTRODUCTION

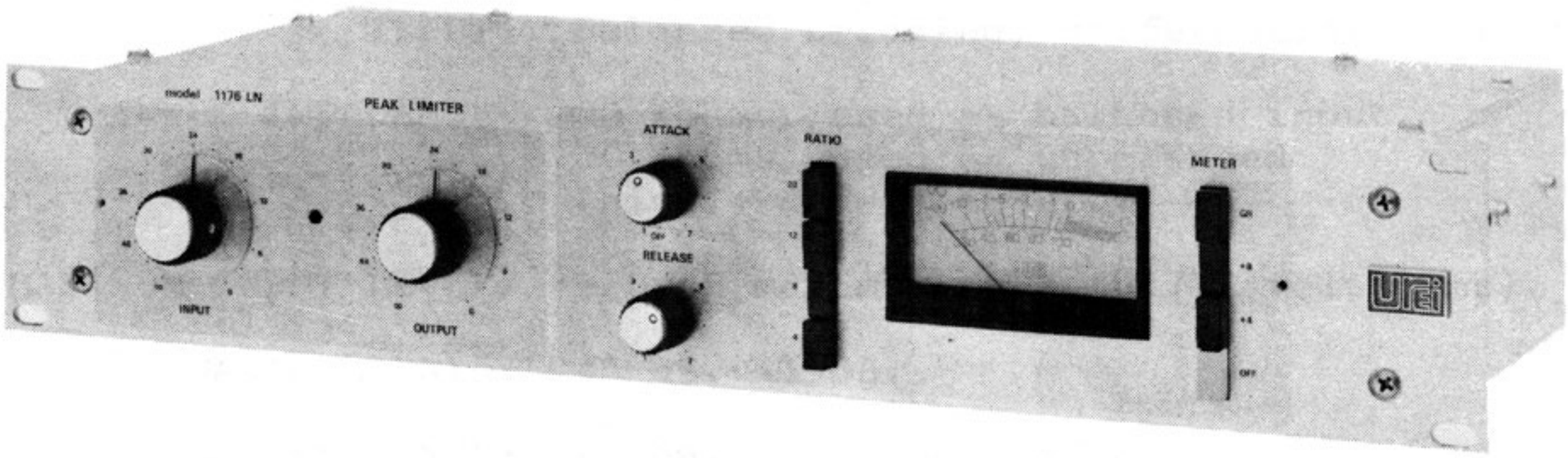


FIGURE 1-1. MODEL 1176LN FRONT PANEL.

1.1 DESCRIPTION

The Model 1176LN Peak Limiter is the most widely used device of its kind. Since its introduction in the late '60's, thousands have been for applications which require precise, automatic control of peak signal levels in recording studios, disc mastering facilities, broadcast stations, sound reinforcement installations, etc. Continuing evolutionary developments have substantially changed the inner workings of the 1176 series but,the same excellent performance is common to all units, starting with number 1.

In the 1176LN, peak limiting is accomplished by utilizing an FET as a voltage variable resistor. A unique circuit permits severe limiting without added distortion, and the compression ratio may be optimized for various program materials.

Attack time is adjustable from less than 20 microseconds to 800 microseconds. The fast attack time is independent of program peak frequency or duration. Using the tone burst method, a 50 kHz peak is fully stabilized at the limited level within 1 cycle. The release time is also continuously adjustable on the front panel from 50 milliseconds to 1.1 seconds.

The gain structure throughout the limiter also maintains an excellent signal-to-noise ratio at normally used control settings. The front panel meter may be switched to read either the amount of gain reduction or the output signal level referenced to +4 or +8 dBm.

Provision is made to interconnect two 1176LN Limiters for those applications where two channels of program material are processed, and the balance of these audio channels must be maintained. The signal with the larger peak-to-peak amplitude will cause the same amount of gain reduction in both limiters. For this mode of operation, the accessory Model 1176SA Stereo Adapter is required.

1.2 SPECIFICATIONS

ELECTRICAL:

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).
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 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 1176SA Stereo Adapter.
Model 301 XLR/QG Adapter for signal input and output.
Model SC-2 Security Cover.

1.4 FRONT PANEL CONTROLS

INPUT AND OUTPUT LEVEL: Continuously adjustable.

ATTACK TIME: 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 milli-seconds to 1.1 seconds. (Fastest release is obtained in the maximumum CW position.)

COMPRESSION RATIO: Switch selectable with four interlocking pushbuttons.

METER FUNCTION: Three interlocked pushbuttons switch the limiter ON and 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 switches the AC the power OFF.

GAIN REDUCTION
"0" ADJUST: Screwdriver adjustment accessible through a hole in the front panel (between the input and output level controls).

POWER SWITCH: Any of the meter function buttons switch the 1176LN ON. The device is switched OFF by depressing the red power switch button.

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

STEREO INTERCONNECTION: Phono jack at rear of chassis. Requires 1176SA Stereo Adapter to couple 2 limiters.

(See also Installation Instructions, Section 2.5, Figures 2-1 and 2-2.)

SECTION II

INSPECTION AND INSTALLATION

2.1 UNPACKING AND INSPECTION

Your Model 1176LN 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 1176LN Peak Limiter

UREI Instruction Manual (this book)

Two-part Warranty Card bearing the same serial number as the Model 1176LN.

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 1176LN 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 1176LN TO THE MAINS.

To comply with most Electrical Codes, the 1176LN 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 1176LN, and may cure the hum or buzz, but is not a substitute for proper system grounding. Be aware that unless the Model 1176LN 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 1176LN 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," Section VI Figure 6-1).

If the Model 1176LN 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 Figures 2-1 and 2-2 on the following page for recommended connection procedures; and Section 2.6 regarding input termination.)

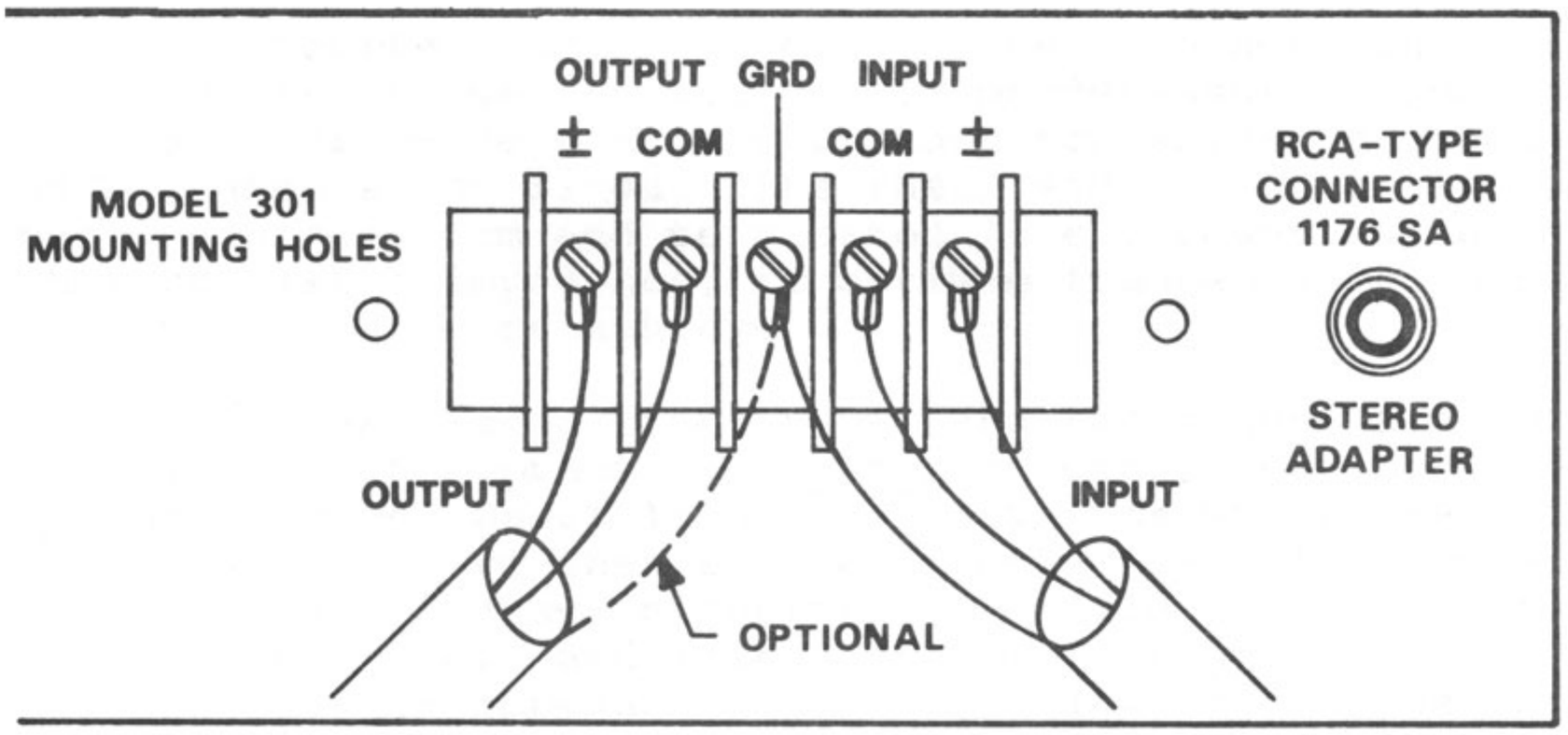


FIGURE 2-1. CONNECTING THE MODEL 1176LN WITH BALANCED INPUT AND BALANCED OUTPUT CIRCUITS.*

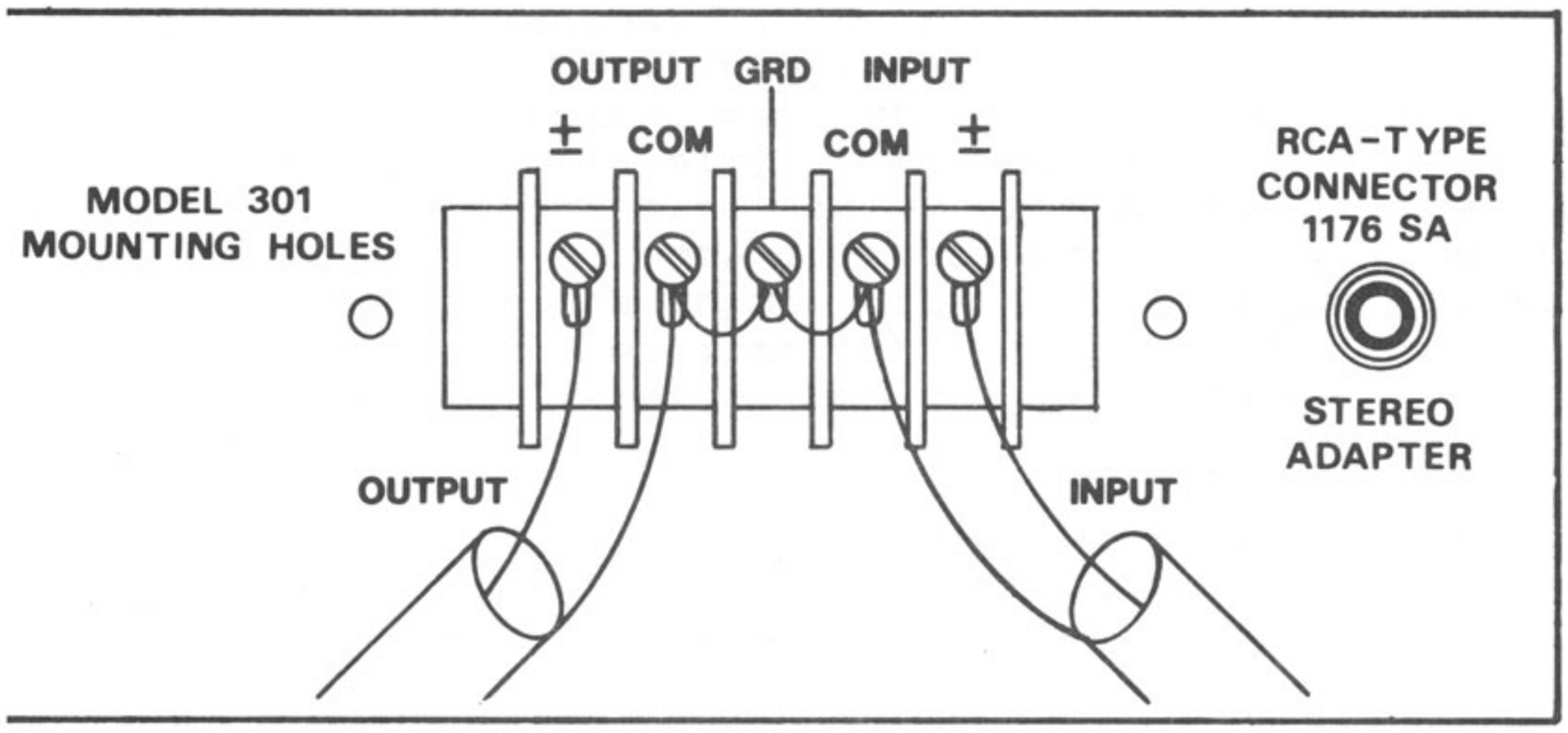


FIGURE 2-2. CONNECTING THE MODEL 1176LN WITH UNBALANCED INPUT AND UNBALANCED OUTPUT CIRCUITS.*

*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 1176LN 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 1176LN 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 be connected to signal cables fitted with XLR/QG termination.

2.7.2 STEREO ADAPTER 1176SA

The 1176SA Stereo Adapter is used to interconnect two 1176LN Limiters. The adapter is provided with an adhesive backing which allows it to be mounted on the rear chassis of the limiter or a nearby surface. Two cables are supplied with the 1176SA and are connected between the adapter and the two limiters. For calibration, see Section III, Operating Instructions, ¶ 3-6.

2.7.3 SECURITY COVER SC-2

An optional Security Cover is available to cover all operating controls of the Model 1176LN, and to protect against any inadvertent misadjustment of critical settings.

SECTION III

OPERATING INSTRUCTIONS

3.1 GENERAL DEFINITIONS

Before operating the 1176LN 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 1176LN can function as a compressor or a limiter since it has compression ratios selectable from 4:1 to 20:1.

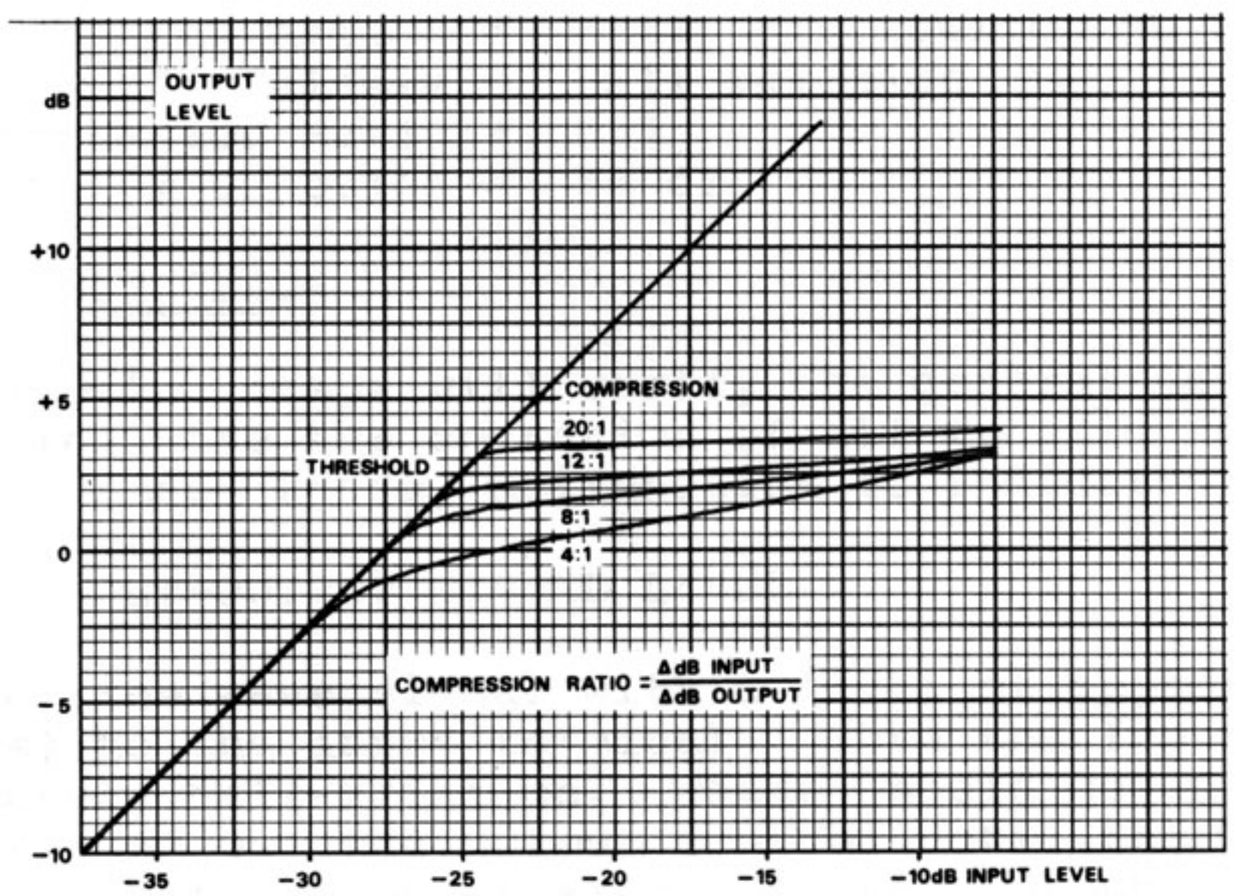


FIGURE 3-1. MODEL 1176LN TRANSFER CHARACTERISTICS.

The transfer characteristic graph (Figure 3-1) 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 1176LN 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 1176LN 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 1176LN has been installed and is connected to both the signal source and the succeeding equipment according to Section II, power may be turned ON by pushing any of the meter function switches. 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

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.

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.

3.3.2 METER ZERO ADJUST (Allow 15 minutes warmup)

Push the "GR" meter function switch. The VU meter should read "0" since the limiting function is disabled (the Attack control knob is turned OFF). If the "0" indication has drifted beyond ±1 dB, it should be adjusted. Using a small screwdriver, this may be done through the hole in the front panel located between the Input and Output level controls.

3.3.3 GAIN REDUCTION CHECK

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.

3.4 APPLICATION

3.4.1 CONTROL SETTINGS

Since all important parameters of the Model 1176LN 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 1176LN 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 1176LN LIMITER IN THE SIGNAL PATH

3.5.1 AFTER PREAMP

Small signals need to be amplified before they will cause proper operation of the 1176LN 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 1176LN 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 levels from most sources which supply the audio to be processed by the 1176LN.

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 <u>after</u> 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 1176LN should be used to condition the audio signal <u>before</u> 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 on 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 INTERCONNECTION OF TWO 1176LN UNITS

To calibrate the accessory 1176SA Stereo Adapter, first remove signals from both limiters, and disable gain reduction by rotating the Attack controls fully CCW. Connect the 1176SA to both limiters. Set the meter function switches for "GR" mode. Adjust the Meter Zero adjustment on the 1176SA until both meters read zero. If the meters cannot be zeroed, reverse the stereo interconnect cables, and the meters can then be zeroed.

The same compression ratio should be selected in both units. Also, the limiters should be set up separately for threshold and output level before being linked together for stereo operation. When two 1176LN limiters are interconnected, the Attack controls on both units will interact, as will the Release controls. Since the timing capacitors are in parallel, the fastest attack time will be double that of a single unit. Attack time on either limiter can be separately adjusted to control both units. Maximum release time is the same as that of a single unit. A good procedure would be to set the Release control on one 1176LN to maximum, and use the Release control on the other unit to control release time.

A given pair of 1176LN's will normally track properly through at least 10 dB of gain reduction. In some instances, transconductance of the two VVR FET's (Q1) will differ to the extent that equal gain reduction will not be obtained as limiting is increased. This condition is more apt to be present in 1176LN's with widely different serial numbers, as FET's within the same factory production run are normally quite well matched. Should this anomaly be observed, it will be necessary to select FET's for Q1 which match more closely in transconductance. This is better done at the factory.

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

SECTION IV

THEORY OF OPERATION

4.1 INPUT AMPLIFIER

The audio signal is applied through the rear panel barrier strip to a differential input amplifier (IC 2, Sections 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.

Common mode rejection is factory trimmed with R2, and is typically better than 60 dB.

4.2 VOLTAGE-VARIABLE RESISTOR ATENUATOR

The input signal is coupled from the differential amplifier through the Input Level control to an "L" section consisting of R6 as the series element and field-effect transistor Q1 as the voltage-variable shunt element (VVR). Below the threshold of limiting, the VVR has a high resistance due to its quiescent bias. Starting at the threshold point, the bias is reduced, causing the VVR resistance to decrease. The rate of change of bias, as well as the threshold point, is controlled by the Compression Ratio pushbutton switches.

4.3 SIGNAL PREAMPLIFIER

Transistors Q2, Q3 and Q4 comprise a low-noise preamplifier. A large amount of overall negative feedback results in low distortion and more than adequate drive capability. The preamplifier output signal is applied simultaneously to the Output Level control and to a signal voltage divider for use in the gain reduction control amplifier.

4.4 LINE AMPLIFIER

The signal from the output control is coupled to the output amplifer consisting of Q5 through Q9 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.

4.5 GAIN REDUCTION CONTROL AMPLIFIER

This amplifier receives its input signal from a voltage divider at the output of the preamplifier. The signal from the divider is selected by the Compression Ratio pushbutton switches. Transistors Q12 and Q13 make up a phase inverter and emitter-follower. The

output of Q13 is supplied to a rectifier diode CR4 and to another phase-inverter emitter-follower combination Q14 and Q15. The output of Q15 is supplied to rectifier diode CR3. Since the two signals are out-of-phase, CR3 and CR4 full wave rectify the signals. When filtered by C27, this produces a dc voltage proportional to the signal amplitude. This is a positive-going voltage which subtracts from the bias on the VVR. To create a threshold of limiting, diodes CR3 and CR4 are biased by a dc voltage divider which is ganged with the Compression Ratio pushbutton switches.

4.6 GR METER DRIVER CIRCUIT

Gain reduction is indicated on the front panel VU meter by measuring the bias on the VVR. Field-effect transistor Q11 provides an impedance transformation from the high impedance VVR bias line to the relatively low input impedance of operational amplifier IC 1. Zero gain reduction is indicated by a quiescent current through the VU meter. When limiting occurs, and the VVR bias is reduced, the current in the VU meter is reduced by an amount corresponding to the amount of gain reduction, and the needle deflects downscale.

4.7 POWER SUPPLY

Two independently regulated voltages are supplied to the circuitry of the 1176LN, +30 VDC and -10 VDC. The AC mains voltage is connected through the front panel switch assembly which also selects the meter function. The 1176LN is switched ON when any of the meter function buttons is depressed. The positive voltage is regulated through VR1, and adjusted to the correct level of 30 volts with R88. The negative voltage is regulated with a 10 volt zener diode, CR6.

SECTION V

MAINTENANCE

5.1 GENERAL

The Model 1176LN 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 DC voltage should be +30 volts (±0.5 volts). Adjustment is achieved with R88; the test point to measure the level is at the collector (metal tab) of Q8.

The level of the negative voltage supply is a fixed -10 volts (±0.5 volts), and cannot be adjusted. The test point is the metal case of IC 1.

5.3.2 "Q" BIAS ADJUSTMENT

This is a very important parameter to assure the linear operation of the limiter. Therefore, the adjustment should be performed very carefully. Set the controls as follows:

```
                Input =  full CCW
               Output =  full CW
               Attack =  full CCW (switched to OFF position)
              Release =  full CW
     Compression Ratio =  20:1
           Meter Mode =  +4 dB
       Q-Bias Adjust =  full CCW
(R81, internal trimpot)
```

Apply a signal (1 kHz, 0 dB) to the input, and turn the Input control CW until the VU meter reads +1 VU. Slowly turn the Q-Bias Adjust (R81) CW until a drop of 1 dB occurs, and the meter reads 0 VU. This places the gain reduction FET Q1 slightly into conduction.

5.3.3. GAIN REDUCTION METER TRACKING

Due to interaction of the adjustments, this procedure may have to be repeated to achieve satisfactory tracking. Set the controls as follows:

```
                Input =  mid rotation
               Output =  full CW
               Attack =  full CCW (switched to OFF position)
              Release =  full CW
     Compression Ratio =  20:1
           Meter Mode =  "GR"
                R54 =  1/4 turn from full CCW
(internal trimpot)
```

With no input signal applied, adjust the GR meter (R55) to read "0" VU. This adjustment is accessible through a small hole in the front panel between the Input and Output controls.

Apply a signal (1 kHz, -10 dB), switch the meter mode to +4 dB, and turn the Output Level control CW until the meter reads "0" VU. Turn the Attack control ON (CW) and observe the drop in the meter reading. Adjust the Input Level control until -10 dB is indicated on the VU meter. Turn the Attack control OFF (CCW) and readjust the Output Level control for "0" VU, if necessary. Repeat these last two steps until the output drops 10 dB whenever the Attack Control is turned ON.

Now, without touching the Input or Output controls, select the "GR" meter mode and turn R54 (tracking adjustment) until the GR meter reads -10 when the Attack control is ON, and adjust R55 until the GR meter reads "0" VU when the Attack control is OFF. Due to interaction of these controls, the fastest technique to adjust for best tracking is to correct only one half the error with R54 before rechecking the "0" reading with the Attack control turned OFF. Several iterations will be necessary.

5.3.4 GR METER ZERO

This adjustment is accessible through a hole in the front panel (R55) and was adjusted during calibration of GR meter tracking in Section 5.3.3. However, it may be readjusted without significantly affecting the other control settings. A small amount of drift (±1 dB) is normal in this circuit.

5.3.5 SIGNAL PREAMP LINEARITY

This control (R16) is in the feedback loop of the amplifier and affects the operation of Q1. It will never be necessary to perform any adjustment of R16 unless resistors in this section of the circuit have been replaced. If adjustment is required, set the controls as follows:

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

Apply an input signal (500 Hz, -30 dB) and measure THD of the resulting output signal. Adjust R16 until the minimum amount of distortion is achieved.

5.3.6 COMMON MODE REJECTION

The trimpot R2 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 R2 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. Remember, our technicians have tested and aligned thousands of 1176LNs, and are most qualified to repair your instrument.

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 Q1. If signal passes, go to problem of "full limiting".
	3. Loose or broken wires between PC board and front panel controls or barrier strips.	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. No compression ratio button is depressed.	Select desired ratio.
	3. Input level is below threshold.	Increase input signal level.
	4. "Q" Bias misadjusted.	Adjust (¶ 5.3.2).
	5. GR amplifier defective.	Repair.
	6. Wire from Attack control to R7 is open.	Repair.
Always in full limiting.	1. Shorted GR bus.	Check wiring; check stereo interconnect; unplug 1176SA.
	2. Negative supply voltage.	Replace zener diode and realign.
	3. "Q" Bias misadjusted.	Adjust (¶ 5.3.2).
	4. Contaminated PC board.	Clean (¶ 5.5).
Hum through output.	1. Ground Loop, etc.	See Section II, Installation.
	2. Failure to unbalance output transformer into unbalanced load.	Ground "COM" to chassis.

(Continued on next page)

TABLE 5-1. TROUBLESHOOTING (Continued)

PROBLEM	POSSIBLE CAUSE	REMEDY
(Hum through output)	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.
Release control changes the output level.	1. Contaminated PC board.	Clean (¶ 5.4.4).
	2. Diodes CR3, CR4 leaky.	Replace with Fairchild FD 333.
	3. Caps C19, C20 leaky.	Replace, 6.8 µf, 35V.
	4. Attack pot R77 faulty.	Replace, 25 kohm.
VU meter reads low on +4, +8 range.	Bad meter.	Replace.
GR meter zero control inoperative.	1. Bad connection from PC board.	Repair.
	2. Dirty switch assembly.	Clean with good contact spray through back of switch.
Excess noise.	Problem in IC2, Q2,3,4,5.	Replace.
1176SA Stereo Adapter does not work.	Dead battery.	Replace, NEDA 15 M (1.4 V). Life is normally >3 years.

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 operatoin of Q1 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 Q1. From close proximity, exhale deeply on the circuit board around Q1. 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 pure isopropyl alcohol (not rubbing 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 Q1. Repeat the moisture test before replacing top and bottom covers.

5.6 CLEANING THE LIMITER

The front panel of the 1176LN 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.

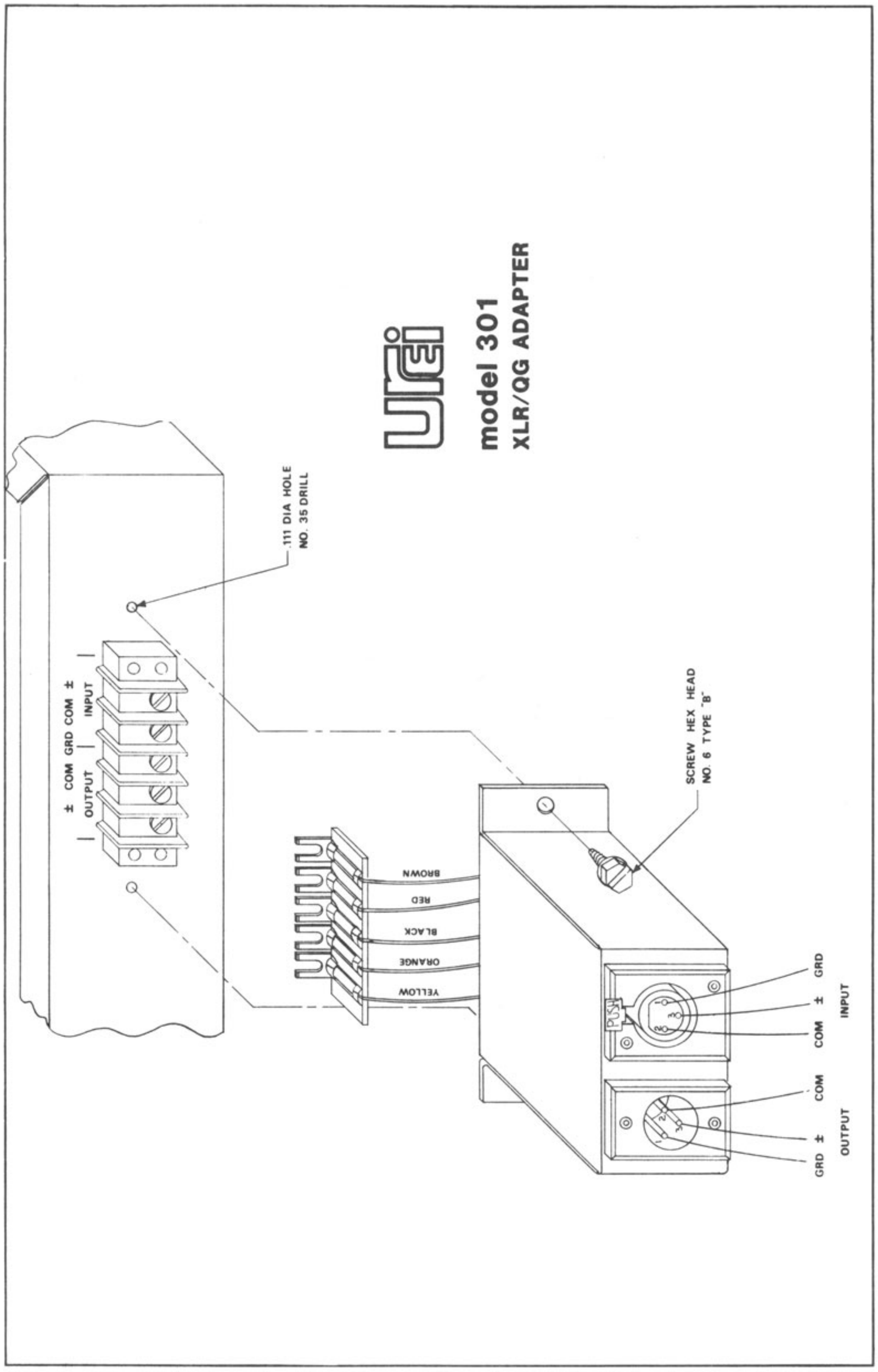


FIGURE 6-1. MOUNTING INSTRUCTIONS FOR MODEL 301.