OPERATING INSTRUCTIONS

model BL-40

MODULIMITER

Universal Audio

products of

UREI
UNITED RECORDING ELECTRONICS INDUSTRIES
8460 SAN FERNANDO RD., SUN VALLEY, CALIFORNIA 91352 (213) 767-1000
TELEX 65-1389 UREI SNVY
a UTC company

WARNING: To reduce the risk of fire or electric shock, do not expose this appliance to rain or moisture.

BEFORE PROCEEDING WITH COMPLETE UNPACKING AND SETUP,
CONSULT UNPACKING AND INSPECTION INSTRUCTIONS ON PAGE 4

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Printed in U.S.A.

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SECTION I

INTRODUCTION

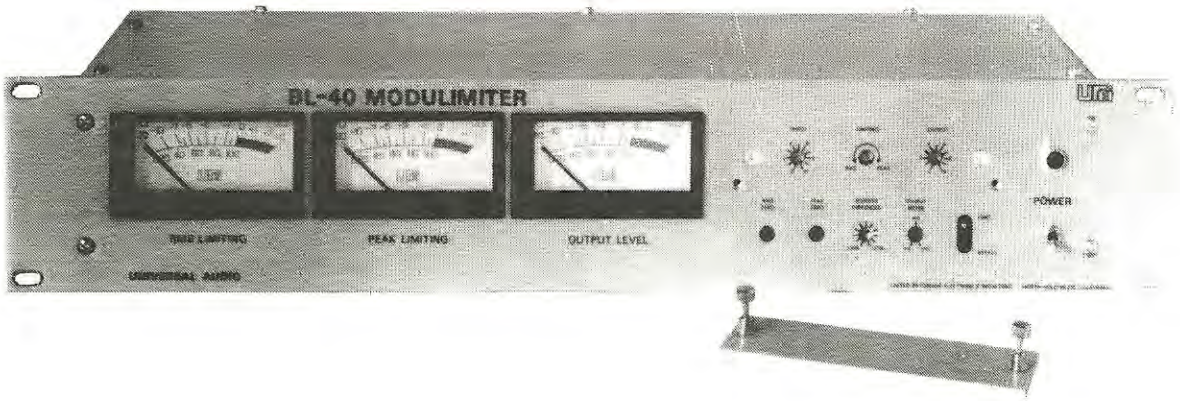

FIGURE 1. MODEL BL-40 FRONT PANEL.

1.1 DESCRIPTION

The BL-40 Modulimiter is specifically designed for AM Broadcasting, but will also find wide application in TV and CCTV audio signal processing, background music systems, and commercial sound systems.

For the AM broadcaster the BL-40 eliminates unwanted overmodulation without clipping. Independent adjustments are provided for RMS and peak limiting and variable positive overmodulation up to 125%. This permits tailoring of the modulation envelope to any program format or transmitter characteristics: constant full modulation or a more conservative approach.

The BL-40 employs UREI's patented electro-optical attenuator (T4C) for unobstrusive, smooth, true RMS limiting (U.S. Patent 3.258.707). It controls the signal level by measuring RMS content and adjusting the gain to produce a constant power output.

Additional signal conditioning is achieved through FET peak limiting which tightly controls the peak-peak amplitude. This assures absolute protection from unwanted overmodulation, with no peak clipping. Attack and release times of the limiter section are very short, allowing the largest possible average output consistent with low distortion. Attack time is typically 5 microseconds, and release time is typically 100 milliseconds. Ripple suppression is used to allow fast limiting release without low frequency distortion.

A proprietary "Phase Optimizer" circuit automatically maintains most favorable signal polarity, reversing signal polarity whenever negative peaks exceed positive peaks by a preset amount. Its action is instantaneous and silent -- no relays are used.

The indicator is a 2-color LED array. Green indicates that the input and output are in phase. Red indicates a 180° polarity reversal between input and output signals.

The results are quite beyond the performance capability of past limiting schemes, allowing excellent control, high average level and minimum waveform distortion of the output signal.

1.2 SPECIFICATIONS

ELECTRICAL:

INPUT IMPEDANCE:	600 ohms, bridged-T input control. Floating, transformer isolated.
OUTPUT LOAD IMPEDANCE:	Designed to work into 600 ohm load. Output transformer isolated.
MONITOR OUTPUT IMPEDANCE:	600 ohms, unbalanced, 10 dB below main output.
INPUT LEVEL:	-30 dBm to +25 dBm for 5dB limiting.
MAXIMUM OUTPUT LEVEL:	+27 dBm.
MONITOR OUTPUT LEVEL:	10 dB below output level.
GAIN:	70 dB with all controls at maximum.
FREQUENCY RESPONSE:	+0, -0.8 dB from 30 Hz to 15 kHz.
DISTORTION:	Less than 0.5% THD, 30 Hz to 15 kHz at +24 dBm output.
	(With 5 dB RMS, 5 dB peak limiting) Less than 3% THD at +24 dBm output.
SIGNAL TO NOISE RATIO:	Better than 70 dB at threshold of RMS limiting. Equivalent input noise less than -110 dBm.
ATTACK TIME: (RMS SECTION)	Signal dependent; 1 millisecond to 50 milliseconds for 63% correction.
(PEAK SECTION)	5 microseconds for 10 dB limiting.
RELEASE TIME: (RMS SECTION)	Signal dependent; 50 milliseconds to 2 seconds for 63% return, depending on duration of compression.
(PEAK SECTION)	100 milliseconds.

PHASE OPTIMIZER: Senses positive-negative imbalance and automatically changes signal polarity to guarantee maximum positive modulation.

PHASE INDICATOR: Front panel green-red LED indicates state of phase optimizer.

METERING: 3 separate meters for:
RMS limiting
Peak limiting
Output level.

POWER REQUIREMENTS: 100-120 V AC, 50-60 Hz, 10 W, or
220-240 V AC, 50-60 Hz, 10 W.

TEMPERATURE: Range of ambient temperatures, from 0°C to +50°C (+32°F to 122°F).

RF SUPPRESSION: Capable of operating in strong rf fields. (Field tested 150 feet from 50 kW array.)

PHYSICAL:

FINISH: Clear anodized brushed aluminum front panel. Cadmium plated steel chassis.

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

WEIGHT: (Net) 11 pounds (5.0 kg).
(Shipping) 16 pounds (7.25 kg).

NOTE: Unless otherwise noted in this manual, 0 dB is referenced to 0.775 volts RMS.

1.3 CONTROLS

All critical adjustments are located behind a removable security panel: Input Level, Output Level, Output Meter Calibration, Peak Limiting, Assymetrical Peak Limiting, Limit Bypass Switch, and Power Switch.

1.4 CONNECTIONS

All connections for the input and output are made through a barrier strip at the rear of the chassis (See Installation Instructions, Section 2.5, Figures 2 and 3).

SECTION II

INSPECTION AND INSTALLATION

2.1 UNPACKING AND INSPECTION

Your Model BL-40 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 BL-40 Modulimiter

UREI Instruction Manual (this book)

Two-part Warranty Card bearing the same serial number as the Model BL-40.

If ordered, the Accessory Spare Kit (check your packing slip and purchase order to verify this option).

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% relative humidity.

If the system is installed in an equipment rack together with high heat producing equipment (such as power amplifiers), adequate ventilation should be provided to prolong the life of components. 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 BL-40 may be operated from either 100-125 VAC or 200-250 VAC mains (50 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 BL40 TO THE MAINS.

To comply with most Electrical Codes, the BL-40 is supplied with a three-wire AC cord, the grounding pin of which is connected to the chassis. In some installations this may create ground-loop problems. Ground loops can become very evident (as 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, check for the possibility of ground loops by using a 3-prong to 2-prong AC adapter, ungrounding the AC plug temporarily. This ungrounds the Model BL-40, and will probably cure the hum or buzz, but is not a substitute for proper system grounding. Be aware that unless the Model BL-40 Modulimiter 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 BL-40 was shipped ready for operation with nominal 115 VAC power mains. In order to change this for nominal 230 V (50 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 Model BL-40 output is connected to a high impedance circuit, the "±" and "COM" output terminals must be loaded with a 620 ohm, 1/2 watt resistor. This assures optimum loading for the BL-40. (See section 2.6 regarding input sourcing).

(See Figures 2 and 3, next page.)

The monitor feed on the rear terminal strip is 600 ohms single ended. The level is 10 dB below the output if bridged, and 16 dB below the output if terminated. Termination is optional.

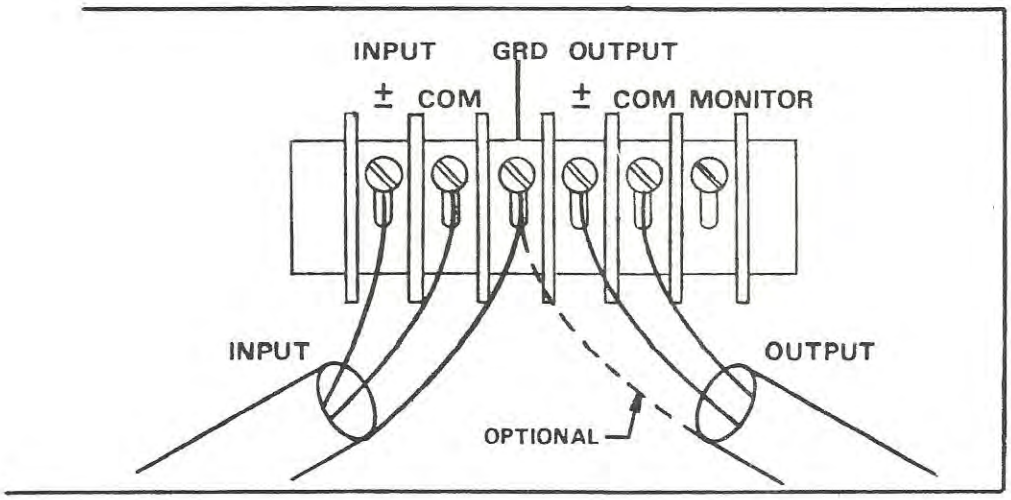

FIGURE 2. CONNECTING THE MODEL BL-40 WITH BALANCED INPUT AND BALANCED OUTPUT CIRCUITS.*

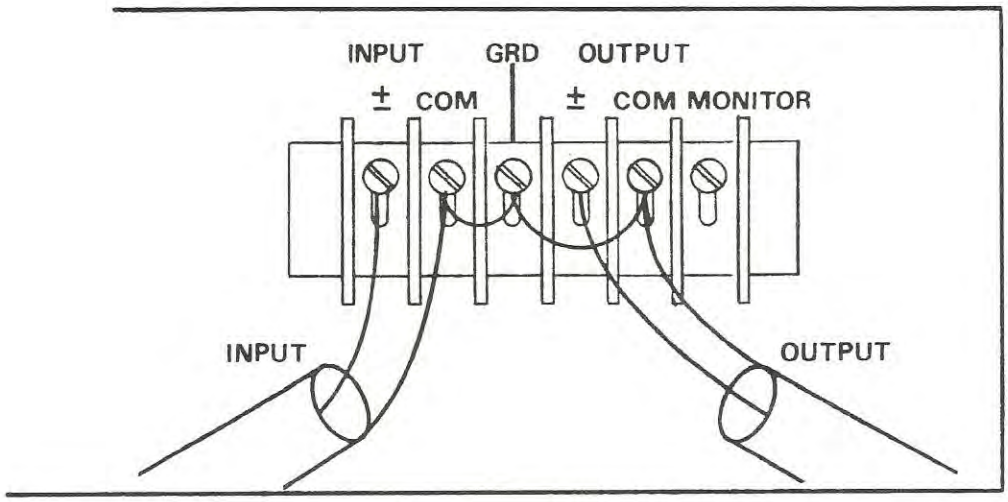

FIGURE 3. CONNECTING THE MODEL BL-40 WITH UNBALANCED INPUT AND UNBALANCED OUTPUT CIRCUITS.*

*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.

SECTION III

OPERATING INSTRUCTIONS

3.1 GENERAL

The BL-40 should be installed as the last signal processing device just before the transmitter. Other devices, such as equalizers and AGC amplifiers, etc., should precede the Modulimiter.

NOTE: The following setup procedure should be considered as a "typical" adjustment. Some experimentation will be necessary to achieve the best result for the station's format and program material. To become more familiar with the range and effects of the various controls, it is helpful to listen to a variety of settings.

As a general rule: more limiting will result in a higher average modulation with less dynamic range. However, experience has shown that gain reduction values of more than 5 to 8 dB will not increase the "loudness" appreciably.

3.2 CONTROL SETTINGS

The main operating controls are located behind a removable security cover to the right of the meters. Before applying power to the unit, all controls should be set counterclockwise, except the RMS and Peak Zero meter controls, which have been set at the factory.

3.3 METER CALIBRATION

With no signal applied, turn the power ON and check the readings on the RMS and peak meters. If necessary, adjust for accurate "0 dB" indication with the Zero controls.

3.4 INITIAL LIMITING ADJUSTMENTS

Set the Input control clockwise and apply a 1kHz input signal sufficient to cause 5 dB of RMS limiting. The input level necessary to achieve this should be -30 to -33 dBm.

No peak limiting should be indicated with the Limiting control counterclockwise, i.e., towards RMS position. Turned clockwise, i.e., towards Peak position, peak limiting of 1 to 3 dB should be achieved.

3.5 POSITIVE THRESHOLD

If asymmetry is to be used, advance the Positive Threshold control for the desired amount of positive overmodulation. (Reverse

the output leads to the transmitter if the negative modulation increases while making this adjustment.)

3.6 OUTPUT METER SENSITIVITY

The Output Meter monitors the signal level to the transmitter and may be adjusted to any reference level from +4 dB to +16 dB. A convenient setting is a zero reading on signal peaks.

3.7 PHASE OPTIMIZER

The sensitivity of your BL-40's Phase Optimizer circuit has been factory set for best operation on a wide range of program material. Should it be desired to increase or decrease sensitivity, or to completely defeat the operation of this circuit, see Section V, Maintenance, Field Modification, paragraphs 5.6.5 and 5.6.6.

3.8 PROOF OF PERFORMANCE TESTS

For proof of performance testing, the BL-40 should be left in the Limit mode to avoid bypassing circuitry within the limiter. Controls may be left set as in normal limiting operation, and the input signal level adjusted downward until no gain reduction of the test signal is indicated. Output level may then be adjusted with the Output Level control for the desired modulation percentage.

NOTE: For performance verification, follow paragraphs 5.5. ff.

SECTION IV

THEORY OF OPERATION

4.1 INPUT ATTENUATOR, INPUT AMPLIFIER, AND RMS LIMITING CIRCUIT

The input control is a standard 600 ohm bridged-T type attenuator, connected between the input terminals to the limiter and the primary winding of the input transformer. The input transformer supplies approximately 14 dB of voltage amplification ahead of the input amplifier stage. An additional 14 dB of gain is supplied by IC 1, making the total gain from input terminal to the input of the RMS limiter 28 dB. C1, C2 and C3 are in the circuit for rf suppression. The signal from IC 1 is coupled through C8, a DC blocking capacitor, and then through resistors R11 and R15 to the input of the voltage follower, IC 3.

The input of IC 3 is shunted to ground by a light dependent resistor which is part of the optical attenuator assembly (T4C). Variations in light intensity falling on the light dependent resistor control the input level to the follower. A sample of the input signal to this stage is amplified by IC 2 and transistors Q2 and Q3 and then stepped up 10:1 through transformer T2. The output of tranformer T2 drives an electro-luminescent panel which is in contact with the light dependent resistors (LDR's) in the optical attenuator. As increasing input signal tries to increase the output of the gain reduction amplifier, made up of IC 2, Q2 and Q3, the increased light level results in reduction of the resistance of the light dependent resistors. This causes increased voltage division at the input of follower IC 3 and effectively regulates the signal amplitude.

The field effect transistor Q1 drives constant current through a second light dependent resistor which is also in contact with the electro-luminescent panel. The meter which indicates the RMS limiting is connected to the junction of the second LDR and the output of the constant current source, and loads the junction with approximately 33 kohms. In this way the DC voltage developed at the end of the 50 kohm trimpot, R8, is a mirror of the AC voltage attenuation at the input of the follower. Changes in resistance of the LDR will cause a change in gain of the amplifying system and simultaneously cause a change in DC level going to the "RMS Limiting Meter." The "RMS Limiting Meter" therefore indicates the amount of limiting directly in decibels.

4.2 PHASE OPTIMIZER

The UREI Phase Optimizer operates by comparing positive and negative peaks from the output of IC 3, and reversing signal polarity as required to the input of the peak limiter. Operation is as follows:

Signal from IC 3 is amplified 1:10 by IC 11 and fed to CR2 and CR3. CR2 and C62 function as a positive peak detector. CR3 and C63 perform the same function for negative peaks. R103 and R104 combine the peak rectifier outputs and drive the input of IC 12. If imbalance between positive and negative peaks exists, the input of IC 12 is driven in the direction of the imbalance.

IC 12 is a comparator with 0 volts as a reference (through R105). Positive feedback is brought around to the input of the comparator through R107. The degree of positive feedback is adjusted by R108. The positive feedback causes the output of IC 12 to toggle immediately when the input threshold is exceeded. The output of IC 12 has two stable states: all the way positive or all the way negative, and the feedback tends to lock the output in one state or the other. For example, if the output is fully positive, it will tend to remain there unless sufficient peak detector imbalance causes it to switch. This feedback avoids "hunting" for the proper phase when the imbalance is small. At maximum sensitivity an imbalance of 1 dB will cause the output of IC 12 to change states. At minimum sensitivity an imbalance of 10 dB will be required to switch states. The control is factory set to trip at 4 dB peak imbalance. This setting is a good compromise between adequate sensitivity and unwanted hunting.

The voltage controlled phase inverter consists of Q16, IC 10 and associated components. In the non-ineverting (green) state Q16 is off because the output of IC 12 is low. Under this circumstance IC 10 functions as a unity gain follower and its output is in phase with its input. If negative signal peaks become greater than positive signal peaks, IC 12 changes state (red) and saturates Q16, grounding the non-inverting input of IC 10. IC 10 then functions as a unity gain inverter, with an output equal in amplitude, but 180° out of phase with its input. Thus the largest signal peaks are always polarized positive at the output of IC 10. The output of IC 10 drives the peak limiter.

4.3 PEAK LIMITING CIRCUIT

The output of the switchable inverter IC 10 is connected to the input of a voltage divider made up of R94, R75 and R20 which reduces the signal level to the input of the peak limiter to a value manageable by the field effect transistor Q4. Resistor R21 in combination with the FET Q4 forms a voltage controlled attenuator. The conductance of Q4 is modulated by a positive DC signal derived from the output of the peak limiting gain reduction amplifier. The signal across the FET is sampled by amplifier IC 4 and amplified approximately 36 dB before being applied to the output level control R46 and the input of the peak gain reduction amplifiers.

The peak gain reduction circuit consists of two amplifiers, IC 5 and IC 6. These amplifiers have been chosen for excellent high frequency response and stability to allow very fast attack time in the peak limiter. IC 6 is a unity gain follower with its output half-wave rectified by CR5. The output of CR6 connects through R91 and R37 in series to the emitter of Q5.

IC 5 is a unity gain inverter, the output of which is rectified by CR5 and applied through a 680 ohm resistor R38 also to the emitter of Q5. This circuit allows separate gain control of the positive and negative excursions of the input waveform. The 250 ohm potentiometer R37 can be adjusted to reduce the sensitivity of the emitter of Q5 to signals from CR6, the positive peak rectifier, allowing asymmetry, i.e., positive overmodulation.

The transistor Q5 is connected as a common base amplifier with excessive forced emitter current. The operation of this circuit is a bit unusual and will therefore be described in detail:

R43, a 2.2 kohm resistor, forces approximately 7.9 mA into the emitter of Q5. Only 4.8 mA is required to reduce the collector voltage of Q5 to 0.6 volts. In the quiescent condition the excess 3.1 mA of emitter current flows through CR19 and R39 to ground. IC 5 and IC 6 are capable of sinking excess emitter current away from Q5 through CR5, CR6, R38, R91, and R37. The values of these components are chosen so that if the peak signal amplitude exceeds +2.5 volts at the output of either IC 5 or IC 6, the transitor Q5 will be driven out of conduction, producing a positive-going voltage pulse at its collector. The gain of Q5 is quite high and a relatively large pulse will be produced with a very slight increase in signal above 2.5 volts peak. The point at which Q5 begins to be switched out of conduction by signal peaks is the threshold of peak limiting.

Transistor Q6 is connected as an emitter follower to transform the 3,900 ohm output impedance of the pulse amplifier Q5 to a low value in order to allow rapid charging of C35, the peak storage capacitor. R47 and R45 limit charging current for C35 to protect Q6 from damage. The voltage at the top of C35 is connected to the gate of Q4 through R32 and varies the conductance of Q4 to control signal amplitude. R29, R30, and R31 are a linearizing circuit which reduces signal distortion caused by non-linearity in the channel resistance of Q4. C25, C26, and C27 are speed-up capacitors to reduce delay in the correction signals to the gate of Q4.

The peak limiting release is controlled by a feed forward circuit consisting of CR7, R48, R42, R44, and C54. The voltage on C54 is nearly equal to that on C35 during limiting so the discharge resistor R44 is effectively bootstrapped out of the circuit during long term limiting of constant amplitude signals. The time constant in this part of the circuit is very short, however, and if the signal being limited drops below threshold, the limiter will

release very quickly. Use of this circuit allows fast release of limiting without distortion of low frequency signals, due to partial release between half cycles.

A meter amplifier IC 7 monitors the voltage fed to the gate of Q4 and causes an indication of the amount of peak limiting on the "Peak Limiting" meter.

4.4 OUTPUT AMPLIFIER

The complementary output amplifier utilizes feedback to the emitter of input transistor Q7. Special attention was paid to phase shift which can, if uncontrolled, undo the peak limiting of low frequency signals and allow overmodulation. The output transformer is designed to be terminated with 600 ohms. A resitor should be added across the output to load the BL-40 properly if the transmitter has an input impedance greater than 600 ohms. If the input impedance of the modulator is less than 600 ohms, build-out resistors should be added or a step-down transformer should be used.

4.5 POWER SUPPLY

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

The red-green LED phase indicator serves also as a pilot light.

SECTION V

MAINTENANCE

5.1 GENERAL

The Model B1-40 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.

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 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.

5.3.0 INTERNAL SERVICE ADJUSTMENTS

These controls have been set at the factory and should not require adjustments except after service work. If recalibration seems necessary, the test procedure below should be followed carefully and adjustments performed in the same order.

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5.3.1 INITIAL SETTINGS

From front panel:

Input Level	R3		CCW
Limiting	R75		CCW
Output	R46		CW
Positive Threshold	R37		CCW (100%)
Output Meter	R62		CCW (+4)
Mode Switch	S1	to:	Limit

Inside chassis:

T4C	Removed	
"Q"-Bias	R24	CCW
Peak Balance	R33	Mid point
Peak Meter Tracking	R67	Mid point

5.3.2 POWER SUPPLY

Connect the unit to the AC power line and connect the test cables to input and output. Switch power ON.

The pilot light should go ON in the green state.

The supply voltage should be ±18 volts and be within ±10%.

5.3.3 ZERO ADJUSTMENT OF METERS

With no input signal applied, adjust:

a. RMS-Zero (R12) until RMS meter reads "0 dB."

b. Peak-Zero (R66) until peak limiting meter reads "0 dB."

5.3.4 "Q" BIAS ADJUSTMENT

Remove IC 5, IC 6, and T4C (note that the color marking on the IC's have nothing to do with being positive or negative amplifiers).

Apply a signal to the input, 1 kHz, -30 dBm. Turn the Input control clockwise until the Output Level Meter reads "+1 dB." Adjust "Q" Bias control clockwise until the output drops to "0 dB." This sets the FET Q4 at the threshold of conduction.

5.3.5 PEAK LIMITING METER TRACKING

With IC 5, IC 6 and T4C removed, connect a high resistance (approximately 4.7 Megohms) from B+ to emitter of Q6. This will cause limiting and will be indicated on both the Peak Limiting and Output meters. Select a resistance which will give a reading of around "-5 dB" on the Output meter.

Since the adjustment of Peak-Zero (R66) and Limiting-Tracking (R67) interact, the following adjustments have to be repeated alternately several times until both Zero and Tracking are achieved.

a. With DC connected, adjust R67 until the Peak meter indicates the same reading as the Output meter.

b. Disconnect the DC and readjust R66 for a "zero" reading on Peak Limiting meter.

c. Repeat "a" and "b" until both Zero and Tracking are satisfactory.

5.3.6 PEAK BALANCE ADJUSTMENT

Replace IC 5 and IC 6. Apply a -40 dB 1 kHz signal to the input and turn the Input control clockwise until approximately 3 dB peak limiting is indicated. Connect a scope probe to the junction of R40 and CR19 and adjust the Peak Balance with R33 until all peaks are of equal amplitude at twice input frequency.

5.3.7 POSITIVE THRESHOLD CHECK

Remove the negative peak limiting amplifier (IC 5) and adjust the Input signal for a reading of "5 dB" peak limiting. Turn the Positive Threshold R37 clockwise and note the increase in output level. This should be 2.0 to 2.2 dB.

5.3.8 OUTPUT METER CHECK

If R62 is in counterclockwise position, the output level, indicating "0 dB" on the Output meter, should be +4 dBm; in the clockwise position of R62, the output level indicating "0 dB" should be +16 dBm. A deviation of ±1.0 dB is acceptable.

5.4.0 FUNCTIONAL TESTS

5.4.1 RMS TRACKING AND COMPRESSION RATIO TEST

Insert T4C and remove IC 5 and IC 6. Apply a -20 dB, 1 kHz signal to the input. Turn the Input control clockwise until 5 dB of RMS limiting is indicated. Adjust the Output Level until the meter reads "-5 dB."

Remove the T4C. Both meters should indicate "0 dB." A tracking error of 0.75 dB at the -5 dB limiting point is acceptable. Adjust R8 if the tracking error is greater than 0.75 dB.

Replace the T4C, and increase the input signal by 10 dB. The RMS Limiting meter must show 10 dB more limiting. The output should remain below -3 dB.

5.4.2 PEAK LIMITING

Check this with IC 5 and IC 6 inserted, and the T4C removed. Apply a -10 dB, 1 kHz input signal, and turn the Input control clockwise until the Peak meter indicates "-1 dB." Set the Output control to obtain a convenient output reference level. Increase the input signal by 10 dB; the Peak meter should indicate "-10 dB", ±1 dB.

Increase the input level another 10 dB, and check to see that the output signal remains within 1 dB of the reference level (compression ratio 20:1).

Reduce the input signal 20 dB to the original -10 dB level. Turn the Limiting control R75 clockwise and note that the Limiting meter indicates approximately 10 dB or more of limiting.

5.4.3 COMBINED LIMITING

Check this with T4C, IC 5 and IC 6 in their sockets. Set the Input level control for 6 dB of RMS limiting. Adjust the Peak Limiting to indicate 3 dB of peak limiting. Note the output level. Increase the input level by 20 dB; the output level should not change more than +0.3 dB.

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5.5.0 PERFORMANCE VERIFICATION

5.5.1 GAIN AND MAXIMUM OUTPUT LEVEL

Apply a -50 dBm input signal. Set the following controls clockwise: Output Meter, Input, Limiting, Output. The output should read +21 dBm, ±2 dB.

5.5.2 FREQUENCY RESPONSE

Frequency response is measured without RMS or Peak limiting. The controls should be set as in 5.5.1. Apply a -50 dBm input signal. The response at 30 Hz and 15 kHz must be within +0, -0.5 dB of the 1 kHz reference level.

5.5.3 DISTORTION

Distortion without RMS or Peak limiting is measured at spot frequencies between 30 Hz and 15 kHz. Apply a -30 dBm input signal, 1 kHz, and set the controls as follows: Input CCW, Limiting CW, Output CW. Advance the Input control clockwise until +24 dBm is measured at the output. Distortion at any frequency between 30 Hz and 15 kHz must be less than 0.5%.

Distortion with RMS and Peak limiting: advance the Input control clockwise until 6 dB of RMS limiting is indicated. Adjust the Limiting control clockwise until Peak limiting indicates 3 dB. Set the Output control for +24 dBm, and measure the distortion at 50 Hz and 15 kHz. The reading must be less than 3%.

5.5.4 THRESHOLD OF LIMITING

Set the Input control clockwise and apply a 1 kHz input signal sufficient to cause 5 dB of RMS limiting. The input level necessary to achieve this should be -30 to -33 dBm.

No peak limiting should be indicated with the Limiting control counterclockwise, i.e., towards RMS position. Turned clockwise, i.e., towards Peak position, peak limiting of 1 to 3 dB should be achieved.

5.5.5. NOISE

Terminate the input with a 600-ohm dummy load, or turn the Input control counterclockwise with no input signal applied. (Limiting and Output set clockwise.) Connect the terminated output through a filter with 15.7 kHz bandwidth to a VTVM, and read the noise level. This should be -40 dB or less, i.e., -110 dBm equivalent input noise.

5.6.0 FIELD MODIFICATIONS

5.6.1 ASYMMETRY

The F.C.C. allows a maximum of 125% positive modulation. The BL-40 may be adjusted for 125% overmodulation if the transmitter responds linearly to positive peaks. In some cases it may be desirable to achieve more than 125% peaks to compensate for modulator non-linearity. The value of R91 may be increased to a maximum of 1000 ohms to achieve a higher positive modulation.

5.6.2 TRANSFORMERLESS OUTPUT CONNECTION

In some installations it may be desired to bypass the output transformer. Simply take the output signal from the monitor output. A 10 dB reduction in gain will result. The monitor output source impedance is 600 ohms, resistive.

5.6.3 ADJUSTING RELEASE TIME OF PEAK LIMITER

The release time of the peak limiter is adjusted for a good compromise between fastest possible release and minimum waveform distortion. If some waveform distortion can be tolerated, the release time may be shortened, resulting in higher average modulation. The 1 uF capacitor C35 may be reduced in value to 0.22 uF (minimum) to decrease both attack and release times. This will result in some audible distortion, particularly on solo instrument passages.

5.6.4 RECALIBRATION OF OUTPUT METERING

Some transmitters will require more than +16 dBm to achieve 100% modulation. In this case the Output meter sensitivity may be decreased 10 dB by replacing R63 with a 330 ohm resistor.

5.6.5 ADJUSTMENT OF PHASE OPTIMIZER SENSITIVITY

The Phase Optimizer is factory set to trigger on 4 dB imbalance between positive and negative peaks. R108 on the Phase Optimizer board may be adjusted for more or less sensitivity. Turned fully clockwise, the imbalance sensitivity is about 1 dB; at full counterclokwise, about 10 dB. The factory setting produces 6.5 volts DC at the wiper of R108.

5.6.6 DEFEATING THE PHASE OPTIMIZER

If automatic polarity reversal is not desired, the BL-40 Phase Optimizer may be disabled by removing IC 11 from its socket on the Phase Optimizer board. In this configuration, the output of the BL-40 will remain in phase with its input and the LED indicator will remain green.

5.7.0 TROUBLESHOOTING

If troubleshooting the BL-40 is necessary, the following equipment should be available:

a. Oscilloscope

b. Audio Signal Generator

c. Digital Voltmeter

d. Audio Voltmeter

e. 1 each: 864 DE (LF 356), LM 318, LM 310.

5.7.1 SIGNAL PATH, GENERAL

If signal path difficulties exist, tracing the signal through the limiter with the oscilloscope is the best method for finding the problem.

A great deal of circuitry can be eliminated by checking to see if the limiter passes signal when the front panel switch is in Bypass. If the limiter passes signal in Bypass, the input and output amplifiers are OK, and the trouble lies between the output of IC 1 and the output level control. Connect the signal source to the input, set the level of the generator to around -40 dBm, and the frequency to 1 kHz. Using a scope probe, simply trace through the electronics until the point is found where the signal disappears. The signal path is described in some subsequent sections.

5.7.2 POWER SUPPLY

The most probable power supply fault would be failure of a regulator. If spare IC's are available, try substitution while monitoring supply busses.

Naturally, power buss overloading or short circuits will cause low supply voltage. Two diodes, CR16 and CR17, may be removed to unload the regulators. The regulators should put out full voltage into a 100 ohm load. If they do, a crude but effective method for finding the overload is to reconnect the diodes, turn the unit on, and see what gets hot. Be careful! IC's can get very hot.

If the smoke test is successful, you have found the problem area and should jump to the section of this procedure which is relevant.

5.7.3 INPUT AMPLIFIER

Signal passes through the input attenuator R3 to the primary of input tranformer T1. Voltage amplification through the input transformer should be 14 dB. From the secondary of T1, signal passes through IC 1, which has a gain of about 14 dB.

5.7.4 RMS LIMITER

From the output of IC 1 the signal path is through C8, R11, and R15 to the input of IC 3, which has unity gain. The output of IC 3 should be the same as the output if IC 1 if the optical attenuator T4C and IC 2 are removed. If the optical attenuator loads the input of IC 3 when IC 2 is not in the circuit, the attenuator is defective. If IC 2 loads the input of IC 3, IC 2 is defective. If signal passes to the output of IC 3, RMS limiting should operate normally, if IC 2, Q2, Q3, T2 and the optical attenuator are OK. T2 may be checked by observing the voltage step-up from the 100 uF capacitor, C16, to pin 3 of the optical attenuator socket. This step-up should be 10:1 (20 dB).

5.7.5 PHASE OPTIMIZER

This circuit consists of three major parts:

a. A set of peak rectifiers and storage capacitors.

b. A voltage comparator and switch.

c. The voltage actuated phase inverter.

IC 11 amplifies signal from IC 3 about 20 dB. The output of IC 11 drives two half-wave rectifiers, CR2 and CR3. With a sinusoidal input signal the voltages at the end of C62 and C63 should be equal but of opposite sign. Short circuiting C62 should force the comparator to the green state. In this condition, the output of IC 12 will be 12 to 18 volts negative, with respect to ground, and the front panel indicator will be GREEN. Likewise shorting C63 will drive the output of IC 12 to the high state and the LED will be RED. Sensitivity of the comparator to positive-negative imbalance may be adjusted with R108. The factory setting is ±6.5 V DC at the wiper of R108.

If R108 is clockwise, the comparator is extremely sensitive and phase reversals will occur with slight imbalance and very frequently. If fully counterclockwise, the comparator is fairly insensitive, and phase reversals will occur infrequently if at all. Normal voltage at the wiper of R108 is ±6.5 volts.

DC control voltage from the output of IC 12 drives the gate of the FET switch through R111. If the gate is driven positive (RED state) the "+" input of IC 10 is shorted to ground and IC 10 functions as a phase inverter. If the gate is driven negative (GREEN state) the FET is an open circuit and IC 10 acts as a non-inverting amplifier. In either state the amplifier has unity gain.

If it is desired to defeat the Phase Optimizer, simply remove IC 11. The power-up clear circuit, C59, R116, R117 and CR1, will guarantee the GREEN state (non-inverting).

5.7.6 PEAK LIMITER

Signal from IC 10 passes through the peak limiting control R75 then through R21, C18, and C20 to the input of IC 4. IC 4 should have a voltage amplification of about 36 dB. IC 5 and IC 6 are unity gain amplifiers. The outputs of IC 5 and IC 6 should match the output of IC 4. IC 5 is an LM 318, IC 6 an LM 310. The 846 DE or LF 356 type IC will not work properly in IC 5 or IC 6's sockets.

5.7.7 THRESHOLD AMPLIFIER

The threshold amplifier can be checked by grounding the emitter of Q5. The collector of Q5 should rise to over 16 volts and the emitter of Q6 should follow. If signal passing through the limiter drops at least 30 dB, the FET Q4 is OK.

5.7.8 OUTPUT AMPLIFIER

Signal from the output control, R46, passes through C36 and R49 to the base of Q7. The emitter of Q7 should be at around -0.5 to -0.6 volts DC. The collector of Q7 should be at about +16 volts DC. The collectors of Q8 and Q9 should be near 0 volts. The emitters of the output transistors, Q10 and Q11, should be at -1.0 to -2.0 volts DC. If these DC potentials are correct, signal should pass through the output stage.

5.8 RECOMMENDED SPARE PARTS

The following recommended spare parts may be purchased as a kit (order number 10-13096) from UREI or through your dealer at a cost of $30. The contents of the kit are listed on page 22.

MODEL BL-40 MODULIMITER KIT # 10-13096

LIST OF RECOMMENDED SPARE PARTS

QUANTITY	UREI PART #	IDENTIFICATION	DESCRIPTION
2	13-0143	846 DE (Selected from LM 301) or LF 356	Operational Amplifier
1	13-0183	LM 310 A	Operational Amplifier
1	13-0156	LM 318 A	Operational Amplifier
1	13-0027	U 2244	FET Transistor
1	13-0148	MPS U05 (or equiv.)	NPN Transistor
1	13-0149	MPS U55 (or equiv.)	PNP Transistor
1	13-0145	86-5117-2	NPN Transistor
1	13-0132	2N5087	PNP Transistor
2	13-0005	1N4003	Diode
1	13-0135	86-5037-3 or 1N914B	Diode
1	13-0206	7818	Positive Regulator IC
1	13-0207	7918	Negative Regulator IC
1	14-0187	100 uF/25 V	Electrolytic Cap.
1	14-0307	1000 uF/50 V	Electrolytic Cap.

T4C OPTICAL ATTENUATOR

This plug-in assembly is the heart of the RMS limiter section. During operation it behaves very much like a vacuum tube, i.e, it is subject to aging. The expected lifetime is 3 to 4 years, but depends also on the amount of average RMS limiting. Failure of the T4C may be gradual, resulting in less RMS limiting for a given input signal level. To minimize down time in the event of an unexpected failure, we recommend that you keep a spare T4C on hand. The price for a completely tested assembly is $36 as of the publication date of this manual (February, 1979).

PARTS LIST

TYPE OF PART	DESCRIPTION	UREI PART # (OR EQUIV.)
TRANSFORMERS	T1 Input	16-11178
	T2 Interstage	16-11184
	T3 Output	16-11148
	T4 Power	16-12261
OP AMPS	IC1, 2, 3, 4, 7, 10, 11, 12	846 DE, or LF 356
	IC 5	LM 318 A
	IC 6	LM 310 A
VOLTAGE REG.	VR1	MC 7818
	VR2	MC 7918
TRANSISTORS	Q1, 4, 16	U 2244
	Q2, 6, 10	MPS U05
	Q3, 11	MPS U55
	Q5, 7	86-5117-2
	Q8, 9	2N5087
DIODES	CR1, 2, 3, 5, 6, 7, 10, 15, 19	86-5037-3 (1N914B)
	CR8, 9, 11, 12, 13, 14, 16, 17	1N4003
	CR4 Dual Red/Green	MV 5491 or equiv.
FUSE	1/4 Amp (115 V AC)	3AG
	1/8 Amp (230 V AC)	3AG
OPTICAL ATTENUATOR	T4C Assembly	10-12273
METER	2-1/2" Modutec VU Meter w/ Bezel	40-0022
POTENTIOMETERS	R3, 600 ohm T-Pad	600 T
	R8, 67 50 K trim, flat	15-0220
	R12, 66 10 K trim, upright	15-0254
	R24 10 K trim, flat	15-0146
	R33,108 100 K trim, flat	15-0203
	R37 250 ohm trim, upright	15-0260
	R62 2 K trim, upright	15-0261
	R46 100 K audio taper	15-0007
	R75 10 K linear	15-0202

PARTS LIST (Continued)

RESISTORS
(Values in ohms, 1/2 W, 5% unless otherwise noted).

R1	47	R53	39 k
R2	47	R54	22 k
R4	3.3 k	R55	1 k
R5	2.7 k	R56	10 k
R6	12 k	R57	100
R7	33	R58	1.2 k
R9	100 k	R59	1.2 k
R10	100	R60	4.3
R11	33 k	R61	4.3
R13	1.8 k	R63	1 k
R14	33	R64	3 k
R15	2.4 k	R65	3.6 k
R16	220 k	R68	220 k
R17	150 k	R69	10 k
R18	120 k	R70	100 k
R19	220	R71	620
R20	680	R73	15 k
R21	22 k	R74	22 k
R22	4.7k	R91	680
R23	68 k	R92	15 k
R25	100 k	R93	2.2 k
R26	330 k	R94	3.3 k
R27	330	R95	Factory Select
R28	22 k	R96	10
R29	1 M	R97	10
R30	22 k	R100	100 k
R31	330	R101	10 k
R32	1 M	R102	100 k
R34	470 k	R103	180 k
R35	4.99 k, 1%, MF	R104	180 k
R36	4.99 k, 1%, MF	R105	100 k
R38	680	R106	100 k
R39	1 k	R107	1 M
R40	3.9 k	R109	10 k
R41	39	R110	10 k
R42	4.7 k	R111	10 M
R43	2.2 k	R112	10 k
R44	47 k	R113	1 k
R45	10	R114	33
R47	18	R115	33
R48	47 k	R116	100 k
R49	3.3k	R117	470 k
R50	100 k	R119	390
R51	68 k	R120	390
R52	10 k		

PARTS LIST (Continued)

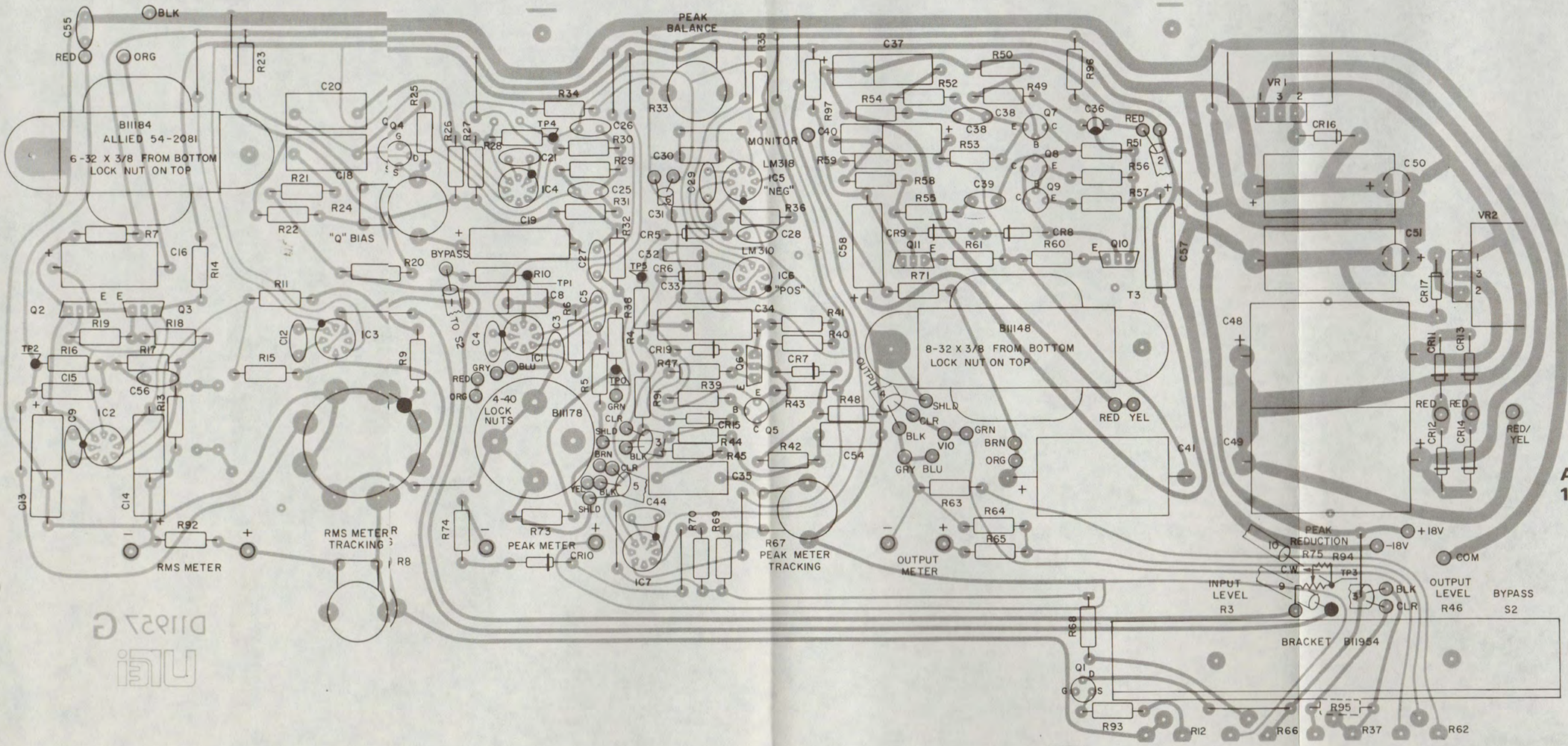
CAPACITORS
(Values in microfarads unless otherwise noted).

C1	0.001 Ceramic
C2	0.001 "
C3	33 pF "
C4	33 pF "
C5	33 pF "
C8	0.47 Mylar
C9	10 pF Ceramic
C12	33 pF "
C13	50/25 V Electrolytic
C14	50/25 V Electrolytic
C15	0.0033 Mylar
C16	100/25 V Electrolytic
C18	1.0 Mylar
C19	100/6 V Electrolytic
C20	1.0 Mylar
C21	10 pF Ceramic
C25	180 pF Silver Mica, 5%
C26	100 pF Ceramic
C27	180 pF Silver Mica, 5%
C28	3.3 pF Ceramic
C29	0.01 Mylar
C30	0.1 "
C31	0.1 "
C32	0.1 "
C33	0.1 "
C34	50/25 V Electrolytic
C35	1.0 Mylar
C36	6.8/35 V Tantalum
C37	50/25 V Electrolytic
C38	220 pF Ceramic
C39	12 pF "
C40	50/25 V Electrolytic
C41	2100/30 V "
C42	0.001 Ceramic
C43	0.001 "
C44	33 pF "
C48	1000/50 V Electrolytic
C49	1000/50 V "
C50	100/25 V "
C51	100/25 V "
C54	0.22 Mylar
C55	0.001 Ceramic
C56	33 pF "
C57	100/25 V Electrolytic
C58	100/25 V Electrolytic
C59	6.8/35 V Tantalum
C60	0.1 Mylar
C61	10 pF Ceramic
C62	6.8/35 V Tantalum
C63	6.8/35 V "
C64	10 pF Ceramic
C65	0.01 Mylar
C66	33 pF Ceramic
C67	100/25 V Electrolytic
C68	100/25 V "

SECTION VI

ILLUSTRATIONS

1. Assembly Drawing, Main PC Board, 11958.
2. Assembly Drawing, Phase Optimizer Board, 12204.
3. Schematic Diagram, Overall, 11965



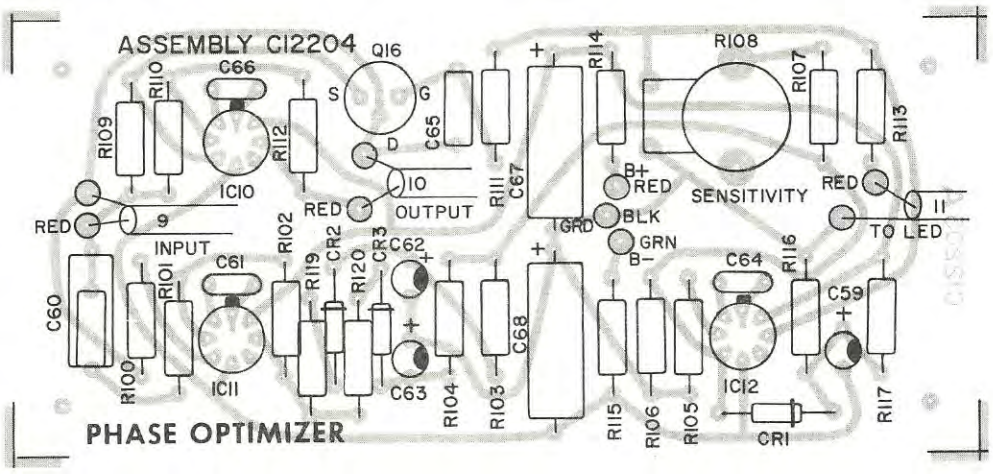
ZIERICK NO. 260
ON FAR SIDE WITH
ANGLE FACING UP

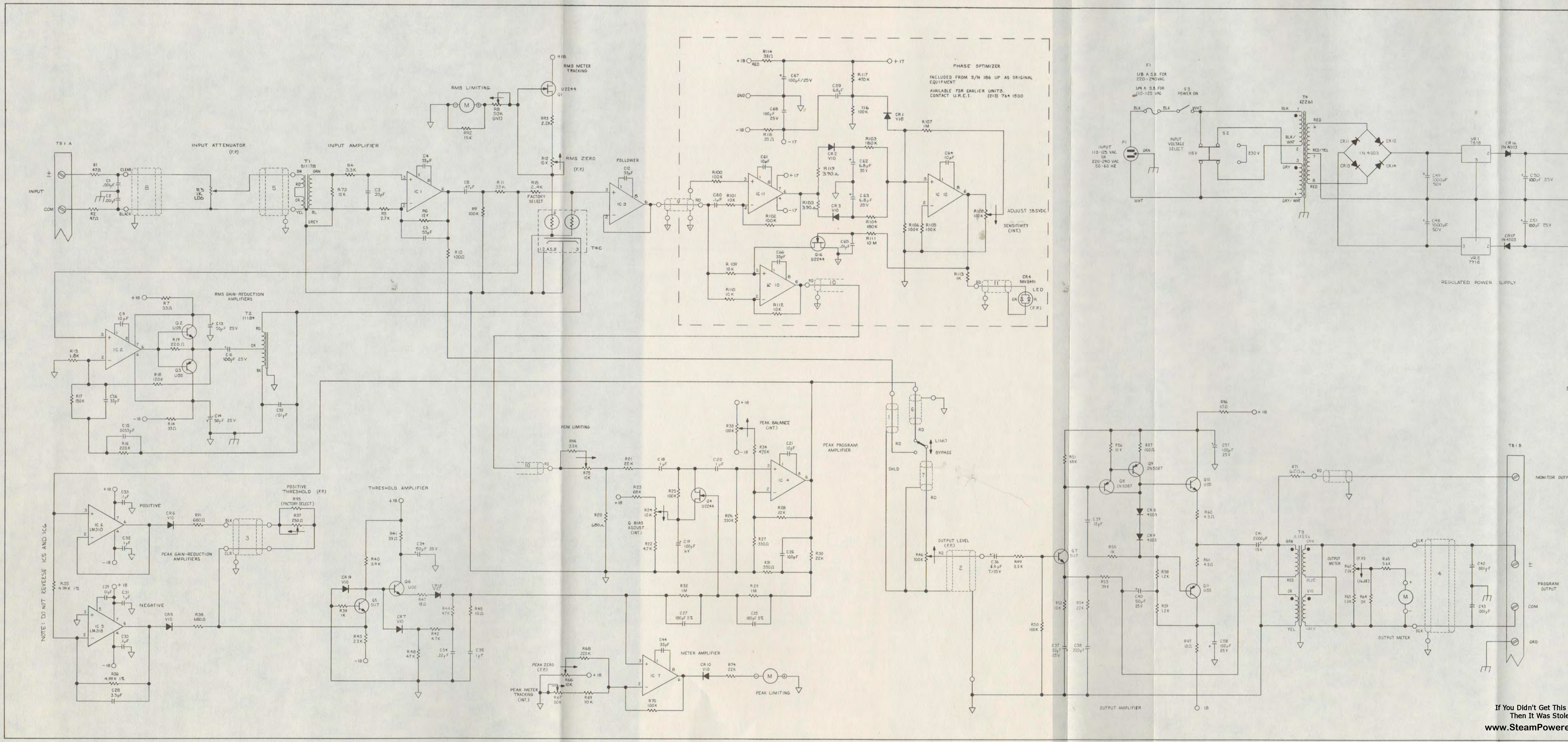
6-32 X 5/16 FROM
FAR SIDE, LOCK NUT

6 REQUIRED

urei

ASSEMBLY 11958





NOTES: UNLESS OTHERWISE SPECIFIED

1. RESISTOR VALUES ARE IN OHMS, ±5%, 1/2 W
2. ▽ INDICATES AUDIO-GROUND
3. ▽ INDICATES COMMON GROUND
4. ⏚ INDICATES CHASSIS GROUND
5. ——▶ INDICATES C.W. DIRECTION
6. INTEGRATED CIRCUIT IC 1, 2 3 4, 7, 10, 11, 12, TO BE LF356H (OR EQUIVALENT)

REV. K PER ECO-BL40-013 4-8-81 R.R.M.
REV J T3 B1114B TO A13556 ECO-BL40-012 3-9-81 SN 1304
REV I LF 356H WAS 846 DE PER ECO-BL40-011 4-23-79 SER 1153 →
REV. H CORRECT FUSE VALUE, ADD NOTE #6 2-19-79 R.P.M.
REV G PER EO 0175 7-25-77 R.P.M.
REV F PER EO 0173 7-19-77 S/N →
REV E PER EO 0151 12-17-76 S/N 652 →
REV. D PER ED 0131 7-30-76 DMM S/N →
REV C PER EO 0120 5-27-76 BDM S/N →
REV B S/N 260 → 5-19-76 BDM
REV. A PER EO 0083 L.E 9-26-74 S/N 260 →

UNITED RECORDING ELECTRONICS INDUSTRIES	BL40 SCHEMATIC	
BL 40	DATE 6-28-74	ISSUE
LOS ANGELES CALIFORNIA	CHECKED BDM	R 11965K