

**BEFORE PROCEEDING WITH COMPLETE UNPACKING AND SETUP,
READ THE SECTION ON UNPACKING AND INSPECTION**

**model 537
GRAPHIC EQUALIZER**



**UREI Incorporated
8400 BALBOA BOULEVARD
NORTHRIDGE, CA. 91325-4100 U.S.A.
PHONE: (818) 895-UREI (895-8734)
FAX: (818) 891-5475**

TABLE OF CONTENTS

	PAGE
<u>SECTION I. INTRODUCTION</u>	
1.1 DESCRIPTION	1
1.2 SPECIFICATIONS	2
1.3 CONTROLS	3
1.4 PHYSICAL	3
1.5 CONNECTIONS	3
<u>SECTION II. INSPECTION AND INSTALLATION</u>	
2.1 UNPACKING AND INSPECTION	4
2.2 ENVIRONMENTAL CONSIDERATIONS	4
2.3 POWERING	4
2.4 LINE VOLTAGE SWITCH	5
2.5 EXTERNAL CONNECTIONS	5
2.6 IMPEDANCE AND TERMINATION	7
2.7 SIGNAL LEVEL AND OVERLOAD DETECTOR	8
2.8 ACCESSORIES	8
<u>SECTION III. OPERATING INSTRUCTIONS</u>	
3.1 GENERAL	9
3.2 SYSTEM CHECK	9
3.3 EXPERIMENTATION	9
3.4 DOCUMENTATION	9
3.5 APPLICATION	9
3.6 GAIN STRUCTURE AND SIGNAL-TO-NOISE	12
3.7 INPUT LEVEL	13
3.8 OVERLOAD INDICATOR	14
<u>SECTION IV. THEORY OF OPERATION</u>	
4.1 INPUT AMPLIFIER	15
4.2 ONE-THIRD OCTAVE FILTERS	15
4.3 EQ IN-OUT SWITCH	16
4.4 OUTPUT AMPLIFIER	16
4.5 OVERLOAD DETECTOR	17
4.6 POWER SUPPLY	17
<u>SECTION V. MAINTENANCE</u>	
5.1 GENERAL	18
5.2 REPAIRS AND WARRANTY	18
5.3 SERVICE ADJUSTMENTS	18
5.4 ON OP AMPS	20
<u>SECTION VI. ILLUSTRATIONS</u>	
FIGURE 5. SCHEMATIC DIAGRAM OF UREI MODEL 537	21

SECTION I
INTRODUCTION

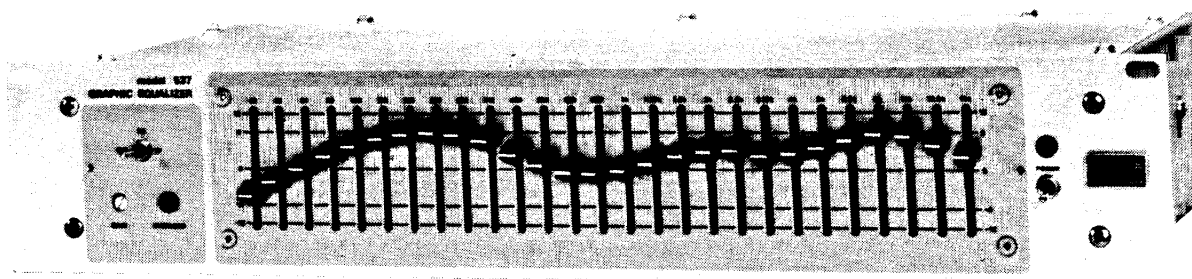


FIGURE 1. MODEL 537 FRONT PANEL.

1.1 DESCRIPTION

The Model 537 is an active filter set for general purpose frequency response adjustment of audio signals. It offers a large control range with optimum signal-to-noise ratio at any filter setting, and is therefore an ideal tool for creative equalization in professional sound recording, sound reinforcement, broadcast, motion picture and TV recording, and live performance.

The 537 provides 12 dB of boost or cut at each of its 27 frequencies, which are centered at ISO 1/3-octave increments from 40 Hz to 16 kHz. The filter characteristic has been optimized for excellent combining action with minimum phase shift. The position of the 27 control arms provides a graphic representation of the response curve selected. An adjustable front panel control provides up to 20 dB gain. An overload detection circuit monitors the signal throughout the unit. If the signal level approaches overload, a front panel LED flashes to warn the user. A bypass switch permits switching the equalization out for A-B tests. The optional security cover (SC-1) may be installed to protect all operating controls against inadvertent disturbance or tampering at fixed installations.

Due to the front panel's uncluttered and logical arrangement, operation is simple and self-explanatory. However, a thorough understanding of the Model 537 Graphic Equalizer and its application can only benefit the user, so we recommend carefully reading this manual.

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

1.2 SPECIFICATIONS

ELECTRICAL:

INPUT: Balanced bridging, differential amplifier.

INPUT IMPEDANCE: 40 kohms, used as balanced input.
20 kohms, used as unbalanced
(single-ended) input.

MAXIMUM INPUT LEVEL: +20 dB (7.75 volts).

EQUIVALENT INPUT NOISE: Less than -90 dB. Typically -94 dB;
15.7 kHz bandwidth with all controls set
flat, output terminated with 600 ohm
load.

GAIN: from unity to +20 dB, ± 1 dB.

FREQUENCY RESPONSE: ± 1 dB, 20-20,000 Hz (with no EQ).

OUTPUT: Floating, transformer isolated.

OUTPUT LOAD: 150 ohms or greater.

POWER OUTPUT: +24 dBm into 600 ohm load (12.28 volts),
+26 dBm into 150 ohm load (7.75 volts).

DISTORTION: Less than 0.5% THD, 30 Hz to 15 kHz at
maximum rated output.

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 (+32°F to +122°F);
storage -20°C to +60°C (-4°F to +140°F).

FILTER TYPE: 27 individual L-C type active filters.

FILTER BANDWIDTH: 1/3-octave at -3dB points with 8 dB
boost or cut.

CENTER FREQUENCIES: Standard ISO (Hz) 40 50 63 80 125 160 200
250 315 400 500 630 800 1K 1.25K 1.6K 2K
2.5K 3.15K 4K 5K 6.3K 8K 10K 12.5K 16K.

FREQUENCY ACCURACY: $\pm 3\%$ of center frequency.

RANGE OF BOOST AND CUT: 0 to ± 12 dB, single filter section.

CALIBRATION OF

BOOST AND CUT: Within 1 dB of indicated setting,
0 to ± 5 dB,
Within 1.5 dB of indicated setting,
 ± 5 to ± 12 dB, single filter section.

1.3 CONTROLS:

EQUALIZATION: 27 vertical slide controls, continuously variable 0 to ± 12 dB.

GAIN: Screwdriver adjustable from unity to +20 dB.

EQ IN/OUT: Front panel toggle switch.

POWER: Front panel toggle switch.

INDICATORS: LED, Power ON;
LED, Overload Condition, levels monitored at 4 circuit points;

MAINS VOLTAGE: Rear panel slide switch, 115/230 volts.

CONNECTIONS: Input and output, through rear chassis barrier strip;
Power through 3-wire power cable.

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 two shades.
Chassis is cadmium plated steel.

WEIGHT: 5.00 kg (11 pounds).

SHIPPING WEIGHT: 7.23 kg (16 pounds).

ACCESSORIES: Model SC-1 Security Cover, smoke gray transparent plastic; covers all operating controls.

1.5 CONNECTIONS:

All connections for 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 537 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 537 Graphic Equalizer

UREI Instruction Manual (this book)

Two-part Warranty Card bearing the same serial number as the Model 537.

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% 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 537 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 537 TO THE MAINS.

To comply with most Electrical Codes, the 537 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. If ground problems are experienced, check for the possibility of ground loops by using a 3-prong to 2-prong AC adapter. This ungrounds the Model 537, and will sometimes cure the problem, but is not a substitute for proper grounding. Be aware that unless the Model 537 mainframe is properly 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 537 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 may 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 537 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 of the output stage. (See section 2.6 regarding input termination).

(See Figures 2 & 3, next page)

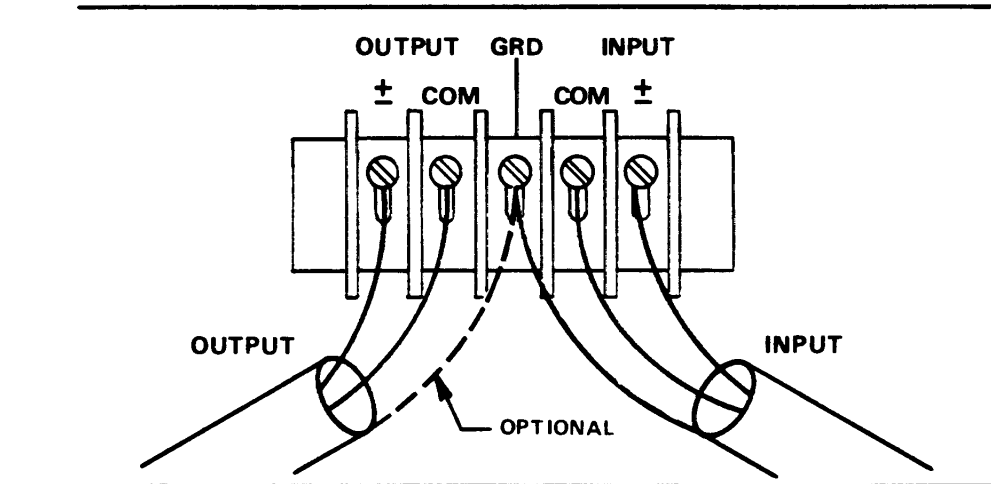


FIGURE 2. CONNECTING THE MODEL 537 WITH BALANCED INPUT AND BALANCED OUTPUT CIRCUITS.*

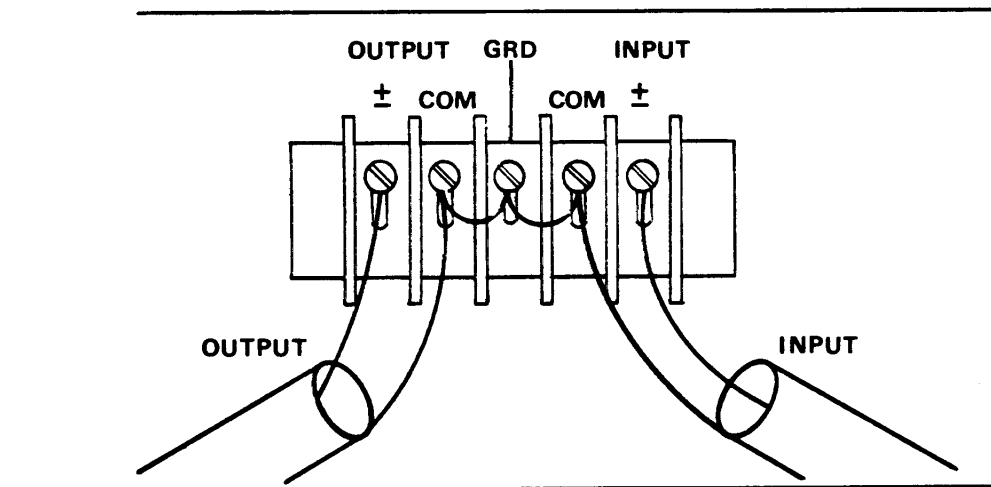


FIGURE 3. CONNECTING THE MODEL 537 WITH UNBALANCED INPUT AND UNBALANCED OUTPUT CIRCUITS.*

*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 preceding 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 537 has an input impedances of 40,000 ohms when used in a balanced, differential input configuration, and 20,000 ohms when used unbalanced (one side grounded). This makes the equalizer 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 537 input.

2.7 SIGNAL LEVEL AND OVERLOAD DETECTOR

The Model 537's differential input amplifiers are capable of being driven by signals up to a level of +20 dB (Ref. 0.775 V rms), above which clipping and distortion occurs. The overload LED turns on when peak signals exceed the clipping level, and it will remain on long enough to be seen even if the excess signal is only a brief transient. To avoid audible distortion, when the LED indicator flashes more than occasionally, either lower the output level of the source feeding the equalizer, or use an external attenuation pad.

Because of the possible combination of control settings, the overload is monitored at several points in the circuit:

1. Input amplifier (maximum signal level +20 dB, ref. 0.775 V rms).
2. Filter amplifiers, which could be driven into clipping as a result of boost equalization.
3. Output amplifier, which is capable of delivering +24 dBm into a 600-ohm load (12.3 V rms), or +26 dBm into a 150-ohm load (7.75 V rms).

2.8 ACCESSORIES

A security cover may be installed over the 537 front panel. This protects all controls from unwanted adjustments. Only the power switch remains accessible. The smoke gray plexiglas cover is transparent enough to allow viewing of the control settings.

SECTION III

OPERATING INSTRUCTIONS

3.1 GENERAL

After the Model 537 Graphic Equalizer has been installed and is connected to both the signal source and the succeeding equipment according to Section II, power may be switched ON. Set all controls to a minimum, i.e.:

Gain Control -- Counterclockwise, which is unity gain.

All Frequency Controls -- To the zero line of the front panel, producing no effect on the frequency response.

3.2 SYSTEM CHECK

Apply program material and monitor the output signal while the EQ switch is in the OUT position. The signal should be passed through the Model 537 without loss or gain in amplitude, or frequency alteration. No change should be noticeable when the EQ switch is set to the IN position.

3.3 EXPERIMENTATION

To become familiar with the range and effect of the individual filters and their almost unlimited number of combinations, it is helpful to "play" with the controls and listen to the change in some familiar program material. The EQ switch is very useful to make an instant A-B comparison while altering adjustments.

3.4 DOCUMENTATION

The very nature of a 27 1/3-octave graphic equalizer will result in many different control settings. For later duplication of a certain sound, or of a corrective filter shape, it is necessary to document the position of the controls (frequency, boost and/or cut, and gain). This is made convenient by the graphic layout of the Model 537's front panel and its calibrated markings. In addition, a frequency curve may be drawn with a suitable sweep generator and X-Y recorder system, such as the UREI Model 200/2000.

3.5 APPLICATION

It will be helpful to study the editorial in the following paragraphs. Although the section is not intended to be a complete textbook, it shares some of the experiences we have gained during

the years our equalizers have been in use. Also, it should serve as a stimulant to experiment with the instrument. We believe that it is of primary importance for the user to know and understand the equipment and its capabilities. Some sections may not be of interest at this time, however it is beneficial to read through the entire text.

As in any other field, "practice is the key to success." Just as it is not reasonable to expect to get beautiful music out of a musical instrument the first time you play on it, it is also not reasonable to expect to immediately master the techniques necessary to adjust the Model 537 for the desired sound the first time you work with it.

3.5.1. OBJECTIVE MEASUREMENTS vs. SUBJECTIVE HEARING

Since the hearing process is subjective, each individual will have a different opinion of what constitutes "good sound" or "bad sound". Until science has found all the answers about the phenomenon of hearing, we will have to use the available tools to modify sound with a certain imprecision. This lack of ability to quantify the relationship which exists between the subjective response of the listener, and the objective measurements of amplitude-vs-frequency response, phase, distortion, etc., need not be a barrier to our efforts to "improve" the sounds that we hear.

We have a most sophisticated quality assessment mechanism which is specifically suited to do this job...the human ear. Therefore, the educated listener with good hearing will probably always be the standard of reference to decide if a sound has been accurately reproduced. However, accurate faithful reproduction is not always the goal, and in many circumstances it may not even be possible or desirable.

3.5.2. ADDITIONAL HINTS

The Model 537 Graphic Equalizer is a powerful tool for the audio engineer to modify, adjust, alter, enhance, destroy or reclaim the audio signal. The extreme result would be a sound that never existed before. In such instances, there are very few rules for what to do and what not to do with the equalizer controls...in creative equalization whatever works is right.

It is good to begin the work in a controlled environment where there is enough time to experiment, and the freedom to do it "wrong" without offending someone else. Doing it the wrong way means to know what does not work! Start out with simple program material of various types and try to make it sound "better." Different program material will require different control settings.

Extreme filter settings are generally to be avoided. Of course special effects and corrective equalization of program material which must be saved may require such settings. The important thing is to avoid creating a new problem while correcting another.

Whenever a big notch in the frequency response of the filter is selected, it can cause important parts of the program material to be removed. It is possible to make adjacent notes on the musical scale differ considerably in level. If that's what is desired, fine. However, if you are trying to correct for problems which would better be dealt with by choice of microphone, microphone positioning, acoustic control, etc., you may run into trouble. The 537 (or any other such device) is not a lifesaver in an ocean of problems.

3.5.3. SPECTRAL DISTRIBUTION IN THE AUDIO SIGNAL

It may seem obvious, but we'll point it out anyway; a major advantage of a graphic equalizer is to be able to see at a glance what the instrument is doing. The shape of the filter response is apparent immediately from the positions of the slide controls. This information, together with the knowledge of the spectral distribution of the program material, is very advantageous in arriving at a desired frequency response.

NOTE: The UREI Model 970 Vidigraf™ is an especially useful tool to view the program spectrum in a recording studio situation. It allows the operator to monitor the signal from a program source and to determine visually the relative levels of frequency bands.

We can arbitrarily divide the audible frequency spectrum into four sections: bass, lower midrange, upper midrange, and high frequencies. When we are concerned with wide bandwidth program material, we should remember that each of these frequency bands is important for its contribution to a full and balanced sound. Lack of bass frequencies will make the sound thin, while too much will make it boom. The lower midrange, which provides much of the rich and mellow texture to music, may make the program material sound muffled if too abundant. The upper midrange is necessary for clarity and articulation, but gives the program a "canned" quality if overused. The high frequencies in excess create a harsh sound, but if balanced, give the audio program a spaciousness which it would not otherwise have.

3.5.4. EQ SYSTEMS AND LIMITERS

The use of a compressor or limiter in the audio chain is frequently dictated by the system's headroom restraint, the dynamic range of program material, or aesthetic reasons. The question then arises, "do I put the limiter before or after the equalizer?"

The answer is that generally the equalizer should be ahead of the limiter in the chain.

The equalizer, by its very nature, changes the frequency balance and harmonic relationship of the input signal. Frequencies that were greatest in amplitude at the input may not be so at the output. Conversely, some frequencies may be at a high level at the output due to the equalizer's action. The limiter, which is actuated by the level of the signal, should see the equalized or balanced signal.

The use of the equalizer prior to the limiter offers a further advantage, i.e., the program material may be equalized to optimize the limiter output by adjusting the input signal to the limiter. As an example, if a recording has a large dynamic range and an excess of low frequencies, the equalizer would be able to reduce the level of the low frequencies fed to the limiter, thereby reducing the amount of limiting needed. It also enables the user to select a faster attack and release time on the limiter if needed for peak limiting. The excessive low frequencies would have restricted the speed at which the limiter could operate and still achieve the desired low distortion.

There are a few instances where the equalizer might be placed after the limiter, and that would be in a system where extreme uncontrollable dynamics are expected. These might otherwise overload the Model 537. However, these cases are very rare, and the exceptionally wide dynamic range of the 537 makes this situation even more unlikely.

3.5.5. ROOM EQUALIZATION

Just a short note on the use of the Model 537 in corrective room equalization. If applied judiciously and with caution, the equalizer may prove to be successful in these applications. For example, a thorough analysis of the room's frequency response is necessary, boost of frequencies and extreme filter settings must be avoided, etc. Instead of the Model 537, we recommend a dedicated instrument such as a UREI Model 539 Room Equalizer when working with acoustic problems.

3.6 GAIN STRUCTURE AND SIGNAL-TO-NOISE

Only the correct gain structure throughout the entire audio system will enable the user to take advantage of the optimum signal-to-noise ratio built into the individual components. In this discussion, the matching between the equalizer and a following power amplifier is considered.

The Model 537 was designed for an average signal level at its input of approximately 0 dB (Ref. 0.775 V rms). This guarantees 20 dB of headroom; that is, peaks may be 20 dB above the average level before any clipping could occur. Residual output noise from the Model 537 is 90 dB below the average signal level, or 110 dB below maximum output level, and therefore inaudible.

The specification of the power amplifier may state an input sensitivity of 0.775 volts (0 dB) for maximum output power. This means that any signal level which is greater than 0 dB causes overload of the amplifier. As stated before, the maximum output level from the equalizer may have peak values of approximately +20 dB. Obviously, the equipment is not properly matched!

Two solutions shall be discussed:

- (1) We reduce the input level to the equalizer to -20 dB. Since it is a unity gain device, its output is also -20 dB average signal level. This value is safe to provide us with 20 dB of headroom in the power amplifier. At the same time, however, we reduce our signal-to-noise ratio. As was mentioned before, the residual noise from the equalizer is 90 dB below a 0 dB reference level. If our average signal level is -20 dB, only 70 dB of signal-to-noise ratio remains, which may be adequate, but is a limitation.
- (2) A better solution would be to leave the average signal level through the equalizer at the optimum level of 0 dB, but add a 20 dB attenuator between its output and the power amplifier's input. This reduces the average signal level and the residual noise from the equalizer (and other possible sources). The original 90 dB below average signals or 110 dB below peak signals is maintained. In many cases the gain control of the power amplifier may be used as the suggested attenuator (so long as an input stage in the power amplifier will not be overdriven).

3.7 INPUT LEVEL

If the equalization controls are in the flat position or attenuated, no special care is necessary with regard to input signal level other than keeping it below +20 dB (Ref. 0.775 V rms). However, if any of the controls are adjusted for boost, then it must be remembered that at the frequencies affected by that control the gain of the amplifier is greater than unity, and the maximum input signal level which is allowable at those frequencies is reduced by the amount of boost at those frequencies.

For example, if the 400 Hz control is set for 5 dB of boost, an input signal level of +15 dB at 400 Hz would result in an output signal level of +20 dB. Because +20 dB is the maximum capability of the filter amplifier, the maximum input level permissible at 400 Hz without overload has become +15 dB. At moderate amounts of boost, this should not present a problem, but if, for example, all controls are in full boost, some frequencies will be boosted as much as 15 to 16 dB due to the combining effect of adjacent filters. This would bring the maximum input level down to +4 or +5 dB, and under such circumstances, the input level should be reduced to a safe level to avoid overload.

3.8 OVERLOAD INDICATOR

Overload conditions are monitored throughout the equalizer. The LED flashes ON when peak signals exceed the clipping level in any part of the circuit. It will remain ON long enough to be seen even if the excess signal is only a brief transient. To avoid audible distortion, when the LED indicator flashes more than occasionally, the signal level must be lowered.

A listening test may show that the LED flashes before noticeable distortion is audible. This may be due to high amplitude, short duration transients, and you may never hear the resulting overload, depending on program material, listening conditions, and yes, even your own ears. Therefore the overload LED, like all such indicators, should not be ignored.

SECTION IV

THEORY OF OPERATION

4.1 INPUT AMPLIFIER

The signal is applied to a differential input amplifier (IC-1, sections A and B). The input accepts either balanced or unbalanced sources (see also Installation 2.5 and 2.6). Common mode rejection is typically better than 60 dB.

The factory set offset adjustment of R-3 assures that no DC voltage is at the output of the following amplifier stage, thus preventing audible clicks when operating the EQ IN-OUT switch. The gain of the input amplifier is -6 dB.

4.2 ONE-THIRD OCTAVE FILTERS

There are 27 individual L-C networks in the equalizer. They are divided into four groups. Two groups each are designed to be the feedback/feedforward circuit around amplifiers IC-2, sections C and D. Figure 4 (next page) shows a simplified schematic of the circuit.

Since resistors R_d and R_e are of equal value, the op amp functions as a unity gain inverting amplifier. The boost-cut potentiometer is shown as two separate resistors, R_a and R_b , with point "M" denoting the electrical midpoint of the pot.

The potentiometer is fed by two signals which are equal in amplitude but 180° out of phase. Therefore the voltage at point "M" is zero. The wiper of the potentiometer is connected to the series resonant circuit consisting of R_c , C, and L. When the wiper is at point "M", no signal flows through the series circuit. This is the 0 dB position of the 1/3-octave control on the front panel.

Referring to Figure 4 (next page), as the wiper is moved to the right, increasing negative feedback is applied to the op amp for those frequencies which are passing through the tuned circuit, selectively reducing the gain of the amplifier. The result is the desired attenuation in the equalizer's frequency response. Conversely, if the wiper is moved to the left, more input signal is selectively fed to the op amp, increasing the gain at the resonant frequency of the tuned circuit. Adjacent filter sections combine smoothly without unwanted characteristics (excessive ripple, phase shift, etc.) The potentiometers are fed through isolating buffer amplifiers (IC-3 and IC-4). In addition, phase correcting networks (R-42,43, C-25, etc.) ensure excellent loop stability and good transient response.

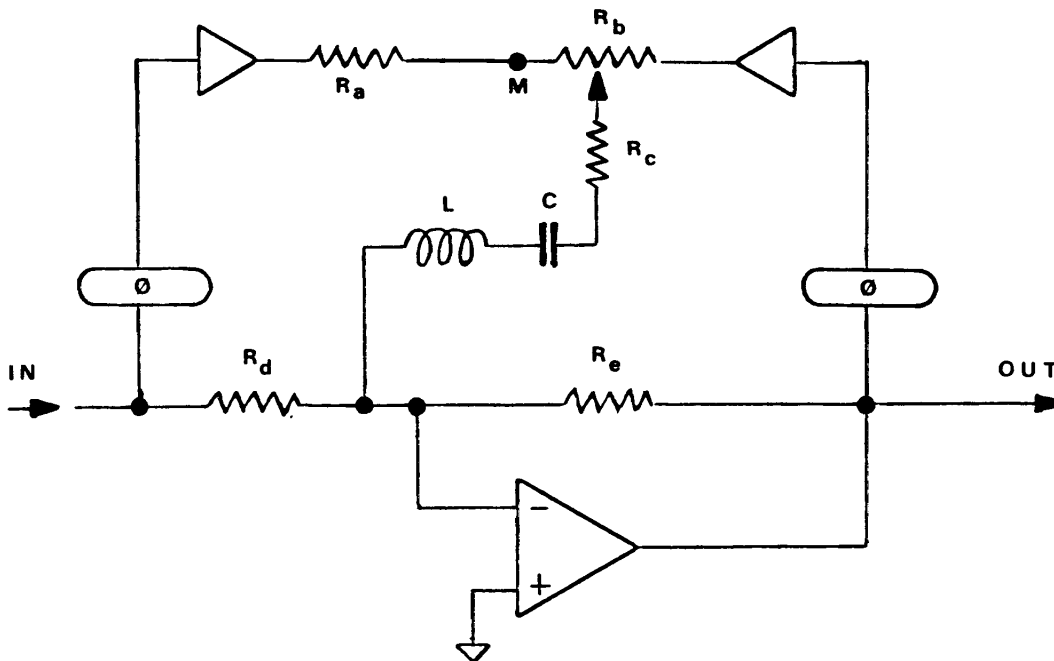


FIGURE 4. SIMPLIFIED 1/3-OCTAVE FILTER SECTION.

4.3 EQ IN-OUT SWITCH

A loss pad of 4.26 dB at the output of the filter section matches the signal level to the output of the isolation amplifier (IC-1-C). The result is that no level change occurs when switching the equalizer section IN or OUT if none of the frequency controls are adjusted for boost or cut. In the EQ IN position, the signal is coupled through C-14 and R-24 into the output amplifier. In the EQ OUT position, the output of the isolation amplifier (IC-1-C) is also connected to the output amplifier. However, since the output impedance of IC-1-C is very low, the signal from the filter section is effectively short circuited.

4.4 OUTPUT AMPLIFIER

The output stage is a high performance op amp (IC-5) which drives a complementary pair of output transistors. The gain is adjustable between +1 dB and +21 dB, depending on the ratio of R-26, 27 & 28. The output transformer has a gain of 3 dB when terminated with a 600 ohm load, thus restoring unity gain through the entire Model 537 Equalizer, when the gain is set to minimum.

4.5 OVERLOAD DETECTOR

Under normal signal level conditions, the output of IC-2-B is positive due to the negative bias at its inverting input. Thus, the LED is turned OFF. If the signal levels from the input amplifier through diode CR-10, from IC-2-C through CR-13 and R-36, from IC-2-D through CR-14 and R-36, or from the output amplifier through CR-11 and R-36 exceed the threshold set by the ratio of R-35 and R-37, the overload detector amplifier changes its output state for approximately 0.1 seconds, and the LED indicates the overload condition.

The pulse-stretching network included in the positive feedback loop of the amplifier ensures that the LED remains ON long enough to be observed, even though the overload may have been caused by a very short duration signal peak.

4.6 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 side of the power supply to indicate power ON condition.

SECTION V

MAINTENANCE

5.1 GENERAL

The Model 537 is an all solid-state unit, ruggedly constructed of only the highest quality components, and 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 & WARRANTY

This product is factory warranted to the original purchaser against defects in material and workmanship for one year after initial purchase. Save your sales slip for proof of warranty if it should be necessary. 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 SERVICE ADJUSTMENTS

These controls have been carefully set at the factory and should not require adjustments except after service work.

5.3.1 OFFSET ADJUSTMENT

The internal trimpot R-3 affects this adjustment. It should only be necessary to change the factory setting if IC-1 is replaced. The adjustment is correct when the DC output of IC-1-C is 0 VDC. Since there is no offset voltage at the input of IC-5, no "click" will be generated when the EQ switch is operated.

NOTE: If the offset control is severely misadjusted, large voltage pulses are generated in the equalizer when the EQ switch is operated. This could overload or damage unprotected equipment which may be connected to the output of the Model 537. UREI cannot be responsible for consequential damages due to misadjustment of this control.

PREFERRED METHOD

Adjust R-3 for 0 VDC at the output of IC-1-C (yellow wire at the EQ switch).

ALTERNATE METHOD

Connect the output terminals of the Model 537 to a high gain amplifier and loudspeaker. With no input signal applied switch the EQ In and OUT.

Listen to the loudspeakers and adjust R-3 for minimum audible "click" while operating the EQ switch.

5.3.2 CLEANING

The front panel of the 537 may be cleaned with a non-abrasive cleaner 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 the lubrication of the slide pots.

5.4 ON OP AMPS

The Model 537 Graphic Equalizer has been designed making extensive use of integrated circuit operational amplifiers (IC op amps). During the last several years, much research and development work has been done by the semi-conductor manufacturers to improve their products, and more is anticipated. We expect that better op amps at lower cost will be available as this development work continues. At the time of the design of the Model 537, we anticipated this and have made every effort to design the circuit so that as improved parts become available they may be incorporated into the Model 537 with little, if any, modification. We also realize that occasionally an IC will fail. For this reason, the table below lists a number of different operational amplifiers which will function as direct, pin-for-pin replacements for the op amps in the 537. For one reason or another, they may not function as well as the op amps originally supplied with this unit, but for emergency repairs, if the original types are not available, these will get the instrument back into service.

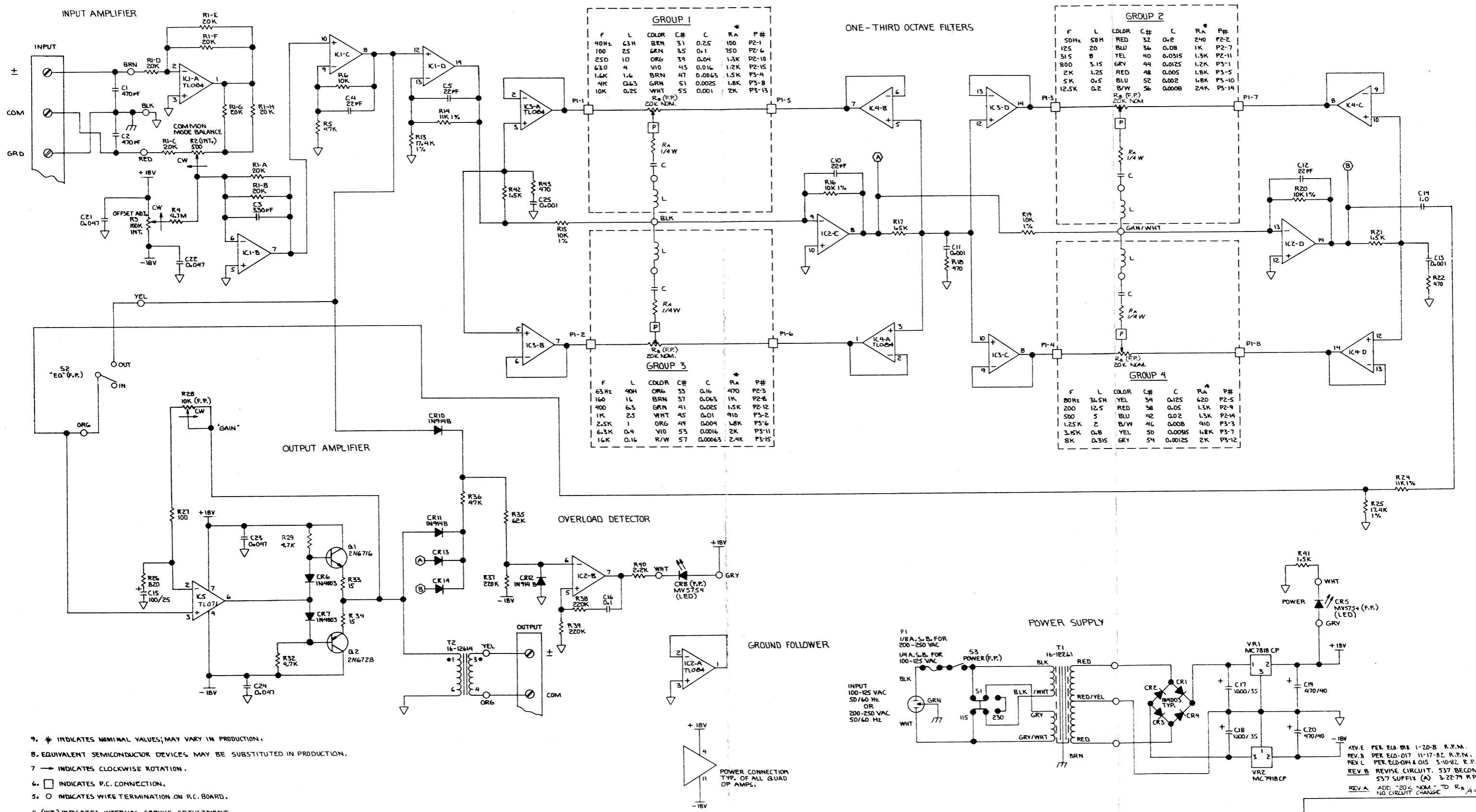
	<u>MODEL or TYPE</u>	<u>MANUFACTURER</u>
<u>IC-1 THROUGH 4</u>		
ORIGINAL . . .	HA 4741-5 . . .	HARRIS
REPLACEMENTS . . .	HA 4741-5 . . .	RAYTHEON
	TL 074 . . .	TEXAS INSTRUMENTS
	TL 084 . . .	TEXAS INSTRUMENTS
	LM 347 . . .	NATIONAL SEMICONDUCTOR
<u>IC-5</u>		
ORIGINAL . . .	TL 071 CP . . .	NATIONAL SEMICONDUCTOR
REPLACEMENTS . . .	LM 301 J* . . .	NATIONAL SEMICONDUCTOR
	LF 351 N . . .	NATIONAL SEMICONDUCTOR
	TL 080 CL* . . .	TEXAS INSTRUMENTS
	TL 081 CL . . .	TEXAS INSTRUMENTS
	TL 070 CL* . . .	TEXAS INSTRUMENTS

All of the above "replacement" op amps should be considered interim replacements until the correct "original" device can be obtained and substituted. IC 3 and 4 must be of the same type.

*Requires addition of a 30 pf compensation capacitor between pins 1 & 8. Space is available on the PC board.

SECTION VI

SCHEMATIC: Figure 5.



- 9. * INDICATES NOMINAL VALUES; MAY VARY IN PRODUCTION.
- 8. EQUIVALENT SEMICONDUCTOR DEVICES MAY BE SUBSTITUTED IN PRODUCTION.
- 7. → INDICATES CLOCKWISE ROTATION.
- 6. □ INDICATES P.C. CONNECTION.
- 5. ○ INDICATES WIRE TERMINATION ON P.C. BOARD.
- 4. (INT.) INDICATES INTERNAL SERVICE ADJUSTMENT.
- 3. (F.P.) INDICATES FRONT PANEL CONTROL.
- 2. CAPACITOR VALUES ARE IN MICROFARADS.
- 1. RESISTOR VALUES ARE IN OHMS ± 5%, 1/2W.

NOTES: (UNLESS OTHERWISE SPECIFIED),

THIS SCHEMATIC APPLIES TO UNITS WITH SERIAL NUMBER SUFFIX "B"

REV. E PER ECO-018 1-20-8 R.P.M.
 REV. D PER ECO-017 11-17-82 R.P.M.
 REV. C PER ECO-014 015 3-10-82 R.P.M.
 REV. B REVISE CIRCUIT. 537 BECOMES 537 SUFFIX (A) 3-22-79 R.P.M.
 REV. A ADD -20C NOM. TO R₈ 4-5-78
 NO CIRCUIT CHANGE

SCHEMATIC GRAPHIC EQUALIZER		
SIZE R	MODEL NO. 537	DRAWING NO. 12987 J
DATE 6-5-78		DR: BY: R.P. MARIN SHEET 1 OF 1

REV. J: TLO04 IC WERE 41471, 08-07-02 M
 REV. H PER ECO-002 2-25-86 M
 REV. G PER ECO-003 6-3-85 M