Instructional MANUAL

PACIFIC RECORDERS AND ENGINEERING CORPORATION
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MULTIMAX

AGC and Processing Amplifier

OPERATING AND SERVICE MANUAL

MODEL MX-AM

FILTER 260Hz/3KHz

SERIAL NUMBER F-2069

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Printed June 1977

SECTION I

GENERAL INFORMATION

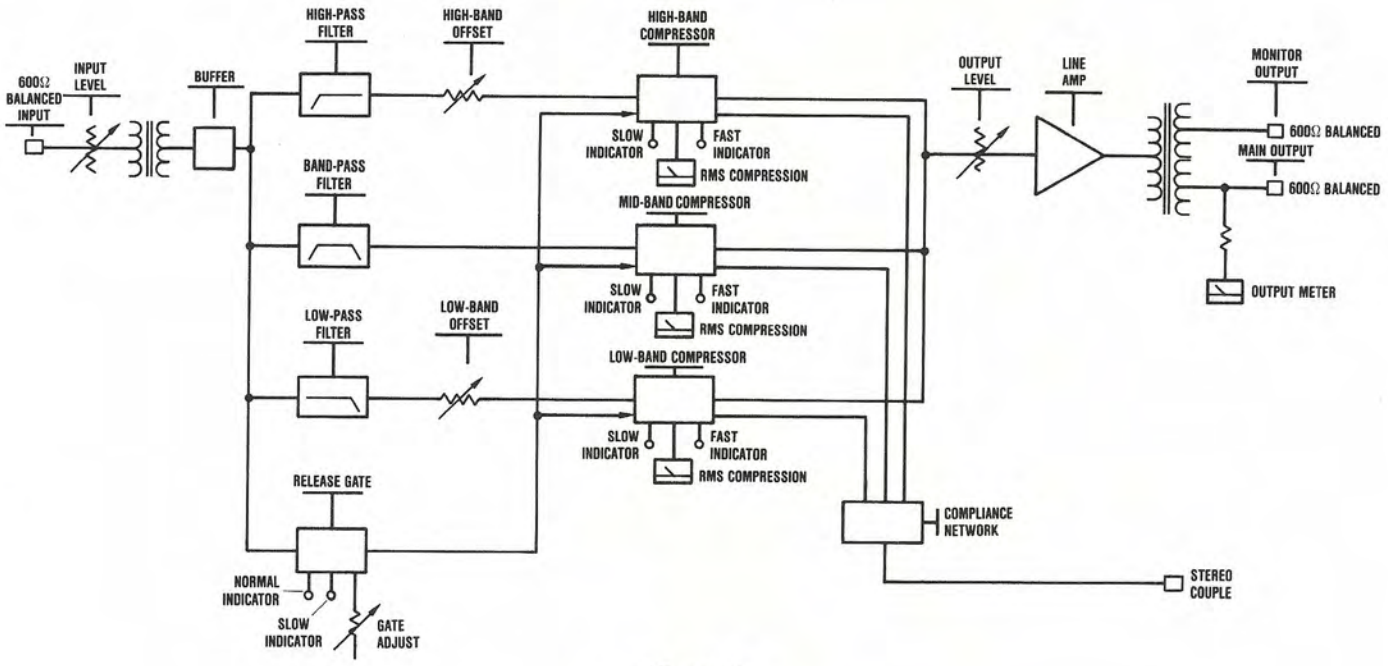


Figure 1
Multimax Block Diagram

The Multimax tri-band audio processor/AGC amplifier combines control of the full range of audio frequencies and an extremely wide range of volume levels. The three audio processing bands result in excellent processing control performance with a variety of music and speech structures. The gated gain control precisely regulates the release time of the three band compressors to prevent "gain rush" during music rests or speech pauses. The result is smooth wide-range gain control with far

more input headroom than has previously been available.

Front panel low and high-band AGC offset controls permit precise tuning for the spectral balance the particular format requires. Although the Multimax was designed to mate with Pacific Recorders' Multilimiter, Multimax will perform superbly with other modern day broadcast limiters.

The equipment design is free of secret circuits and magic boxes. Complete schematics and parts lists are included in this manual. The signal processing is accomplished in four separate function modules.

The tri-band filter and gate module divides the program into low, mid and high frequency bands and provides the release gate control signal to the band compressor amplifiers. The specially designed band-splitting filters result in excellent phase, passband, frequency and transient response, with splitting frequencies selected on the basis of psychoacoustics and the natural energy distribution in music and speech. Butterworth filters provide third-order, 18 dB/octave slopes to insure band control isolation and precision band summing. Two filter systems are available to meet the needs of both the AM and FM broadcaster. The 390 Hz/6 KHz filter is recommended for FM and other "wide-band" applications; the 260 Hz/3 KHz filter is recommended for AM and other "narrow-band" applications. The frequencies of these filters have been specifically determined to provide clearly defined control of bass, rhythm, leads, voice characteristics, overtones, and percussives.

The three band gain control amplifier modules are unique in several respects. First, the control results from rectifying

and integrating the total audio signal to produce an analog control relative to program energy, not peak voltage values. Second, each amplifier has two discrete gain control circuits, one with a long-time constant to control gain for the long-term signal envelope, the other with a short-time constant to respond to short-term signal energy. These control signals are derived ahead of the control element to provide open-loop gain control. The results are no control overshoot and low-distortion performance over a dynamic range exceeding 25 dB. While such a wide range is not ordinarily used in "normal" operation, it does provide an extreme amount of control headroom. Finally, a Delta-configured compliance coupling circuit interconnects the long-time constant sections of the three band compressors, limiting the long-term gain variations between them to 6 dB. This provides wide-range gain tracking, yet prevents excessive single-band compression of monotonic program material.

The main chassis and printed circuit motherboard contain the input, output, and power supply circuitry for the function modules. All of the components used in the unit are conservatively rated and designed to provide extended full-time operational life.

SECTION II

TECHNICAL SPECIFICATIONS

Metering:	Four separate meters for: Low-band compression Mid-band compression High-band compression Output level
Controls:	Input level Output level Low-band offset High-band offset Test-Operate switch
Input Impedance:	600 ohms, floating, bridged-H input control, transformer isolated
Output Load Impedance:	Designed to work into 600 ohm load. Output is transformer isolated.
Input Sensitivity:	-20 dBm minimum for 6 dB mid-band gain reduction
Maximum Output Level:	Main output +24 dBm Monitor output +18 dBm Main output in series with monitor output +27 dBm
Frequency Response:	High and Low Offset controls set flat, no band compression or in test mode; +0 dB, -0.5 dB 30 Hz to 15 KHz ref: 1 KHz

Distortion:	Less than 0.2% THD, 50 Hz to 15 KHz @ +24 dBm output level. Less than 0.2% IM, 4:1 ratio.
Signal to Noise Ratio:	Better than 72 dB below +4 dBm output. level ref: 6 dBm compression @ 1 KHz.
Band Filters:	18 dB/octave, Butterworth type. Division frequencies: FM applications - 390 Hz/6 KHz AM applications - 260 Hz/3 KHz Other frequencies available on special order.
Compressors:	Attack time, Fast section, 100 Milliseconds. Attack time, Slow section, 500 Milliseconds. Release time, Fast section, 200 Milliseconds. Release time, Slow section, 1 Second. Release time, Gated, 5 Seconds.
Power Requirements:	110-120 VAC, 50-60 Hz, 12 Watts
Weight:	10 pounds
Shipping Weight:	14 pounds

SECTION III

INSTALLATION

3.1. UNPACKING AND INSPECTION

Carefully examine the unit for any sign of physical damage which could have occurred in transit. The unit was carefully packed in a container designed to protect the unit through rough handling. However, accidents do happen.

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

Besides the unit itself, you should verify that the shipment included the following:

a. This instruction manual;
b. A warranty card, bearing the same serial number as the unit; and
c. If ordered, the accessory spares kit and/or stereo-couple cable.

3.2. ENVIRONMENTAL CONSIDERATIONS

The unit will operate satisfactorily over a wide range of ambient temperatures. (From 0°C to 50°C/32°F to 122°F.) If installed in an equipment rack with high heat-producing equipment, adequate ventilation should be provided to prolong component life.

The input transformer and other circuitry are adequately shielded from moderate electromagnetic fields; the installation

should be planned to avoid mounting the unit immediately adjacent to large power transformers, etc.

To comply with existing electrical codes, the unit is provided with a three-wire AC power cord. In some installations, this may create a ground-loop problem if a significant potential difference exists between the mounting enclosure and the AC conduit ground. If hum is experienced, check for the differential by using a 3-wire to 2-wire adapter at the power recepticle.

3.3. POWER

The unit is designed to be operated from 110-120 VAC main supply, 50-60 Hz single phase. Verify this voltage before applying power to the unit. The AC fuse should be ¼ Amp, "Slo-Blo" type.

3.4. EXTERNAL CONNECTIONS

During intial setup the INPUT and OUTPUT controls should be set to minimum (counter-clockwise). Input and output signal pair wires should be connected as indicated above the terminal strip on the rear chassis, following standard practices. The unit has a second transformer-coupled output on the rear panel labeled MONITOR. This 600 ohm output was provided for feeding either a local monitor amplifier/speaker, or a return line for line monitor on the control consoles, engineering shop, etc. If the main OUTPUT is to be connected to a high-impedance circuit, a 620 ohm resistor should be shunted across the output terminals. Termination of the MONITOR output is not required.

3.5. STEREO COUPLING

Traditionally, it has been assumed that the gain control systems of transmitter limiters and compressors must be coupled to prevent "center image shift." Unfortunately, if the faster control systems are coupled, fast dynamic material in one channel can cause severe amplitude modulation of program material in the other. For this reason, the Multimax system is designed to be coupled at only the slow RMS gain control stages.

At this time, most contemporary and popular music is mastered to disc with most of the bass information in the center. The main reasons are to minimize the chance of cutter "lift" during mastering and to share the energy required to reproduce bass between the two amplifier/loudspeakers. With these formats, the broadcaster may find the sound slightly "louder" and less "restricted" appearing when the units are not coupled. Classical music is usually not recorded or mastered in this manner and coupling of the units is recommended. The coupling cable should be a one foot BNC-to-BNC coaxial cable similar to Pomona Electronics No. 2249-C-12.

SECTION IV

OPERATION

4.1. GENERAL

The Multimax has been designed with simplicity of operation in mind. Before applying power, set the front panel controls as follows:

INPUT	Counter-Clockwise
OUTPUT	Counter-Clockwise
OFFSET, LOW BAND	12 o'clock
OFFSET, HIGH BAND	12 o'clock
TEST/OPERATE	OPERATE

Apply power and check zero readings on the three BAND COMPRESSION meters. A "cold" reading of $\pm\frac{1}{2}$ dB is within tolerance. Refer to Section VI for adjustment procedure if required.

Apply "average" program material at normal level and advance INPUT control clockwise until MID-BAND COMPRESSION meter indicates an average of 5 to 7 dB gain reduction. The LOW and HIGH BAND COMPRESSION meters will be indicating some degree of gain reduction dependent upon the program content. In a stereo installation use monaural program material and set both units alike. Advance the OUTPUT control to obtain the desired output level as shown on the front panel VU meter. At this time the transmitter limiter input level should be checked and adjusted if necessary.

The LOW and HIGH BAND OFFSET controls should be adjusted with the resident "Golden Ear" in attendance. These controls set the input levels to the high and low band compressors from the tri-band filter. In the 12 o'clock position, the Multimax is statically "FLAT." Clockwise rotation of either offset

control increases the compressor input drive by up to 5 dB maximum. Counter-clockwise rotation decreases the band compressor input by up to 2 dB.

It is suggested that the broadcaster "Listen" to programming with the controls set "flat" for some period of time to become accustomed to the sound. Then the offset controls may be set to provide the desired emphasis or de-emphasis in the program spectral balance.

It must be pointed out that no amount of audio processing will "clean up" distorted, noisy, or otherwise poor quality program material. In fact, quality problems often become more apparent with processing. Also, it is important for the broadcaster to feel free to adjust the input level control for more or less overall gain control action as the format dictates. The recording industry has an old rule about processing, "When it sounds right it is right, when it sounds wrong it is wrong." Translation: tune to suit, there are no scientific or, for that matter, magic settings.

4.2. PROOF OF PERFORMANCE TEST

Proof of performance tests should be run with the OPERATE/TEST switch in the TEST position, and the low- and high-band offset controls in the 12 o'clock position. All of the audio circuitry remains in the signal line as the test switch defeats only the gain control circuitry. The Input control may be turned down to compensate for the additional gain realized from defeating the control circuitry.

SECTION V

THEORY OF OPERATION

5.1. INPUT SECTION

The Multimax is designed to be directly connected to 600 balanced or unbalanced program sources with a maximum sensitivity of -20 dBm for 6 dB gain reduction at 1 KHz. Input transformer (T1) and compensation network (R1, R2, C1) are designed for flat response coupling from 40 Hz to well above 20 KHz with virtually no transient overshoot. Buffer amplifier (IC1) is used to match the high impedance transformer to the subsequent stages.

5.2. TRI-BAND FILTER AND GATE

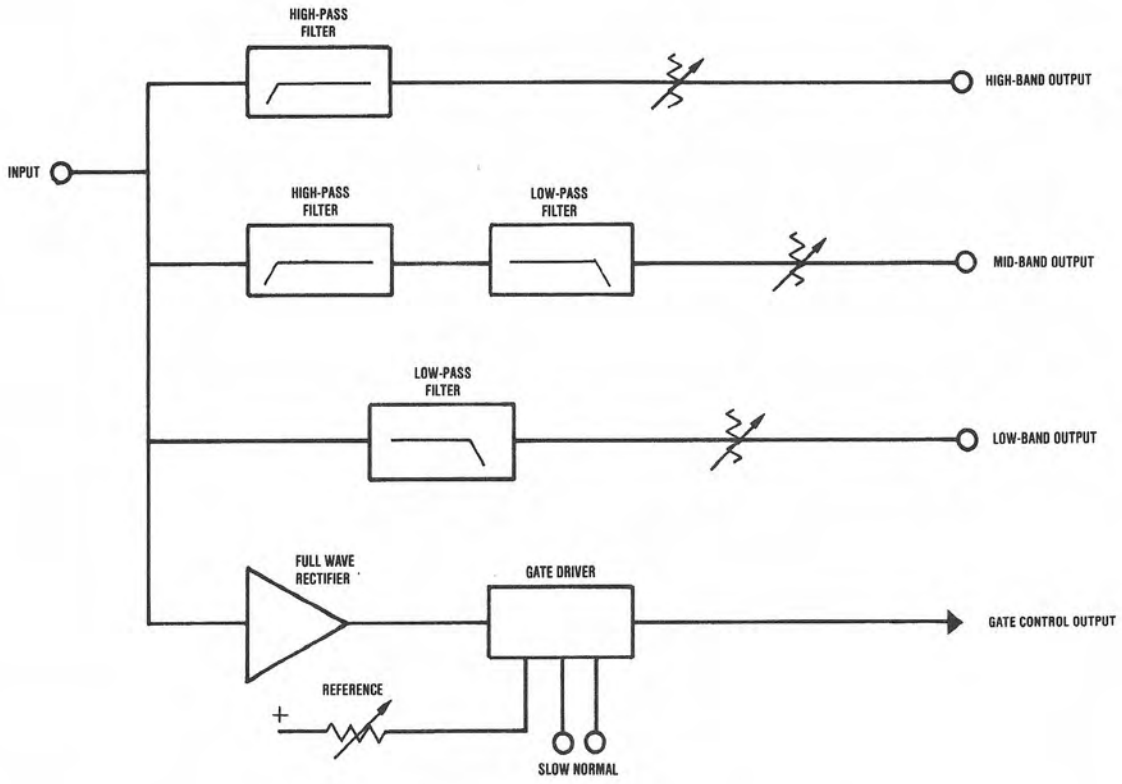


Figure 2
Tri-Band Filter and Gate Module

The band filters are constant-K type, 3-pole, Butterworth characteristic designs. Operational Amplifiers (IC3, IC4, IC5, IC6) are employed as active elements and unity gain buffers in each filter. The mid-band filter is a band-pass design realized by following a low frequency high-pass filter (IC5) with a high frequency low-pass filter (IC4).

The gating circuit compares the input program level against a threshold reference to determine normal or slow compressor release. Voltage follower (IC2A) drives positive and negative rectifiers (IC1A, IC2B) which convert the audio program to a DC voltage on filter capacitor C16 and the non-inverting input of IC1B. Trimpot (R15) sets the gate threshold voltage to the inverting input of IC1B. Whenever the DC voltage on C16 is below the threshold voltage, the output of IC1B will be forced negative, a higher voltage will cause a positive output. A negative output is blocked by D5; a positive output is coupled to the compressors by R22 and filtered by C30.

The NORMAL and SLOW front panel LED indicators are switched by transistor Q1. Resistor R21 limits the current to the LEDs. When Q1 is off, current passes through D5 to the SLOW indicator. When Q1 is on, the collector is below the voltage threshold voltage of the SLOW indicator with the current passing through the NORMAL indicator.

5.3. RMS COMPRESSOR

The RMS Compressor employs a feed-forward, open-loop control design. The gain control module (GCM) employed is capable of 25 dB of linear control with fast response characteristics. The control signal for the GCM is obtained by combining fast responding and slow responding control voltages. The time

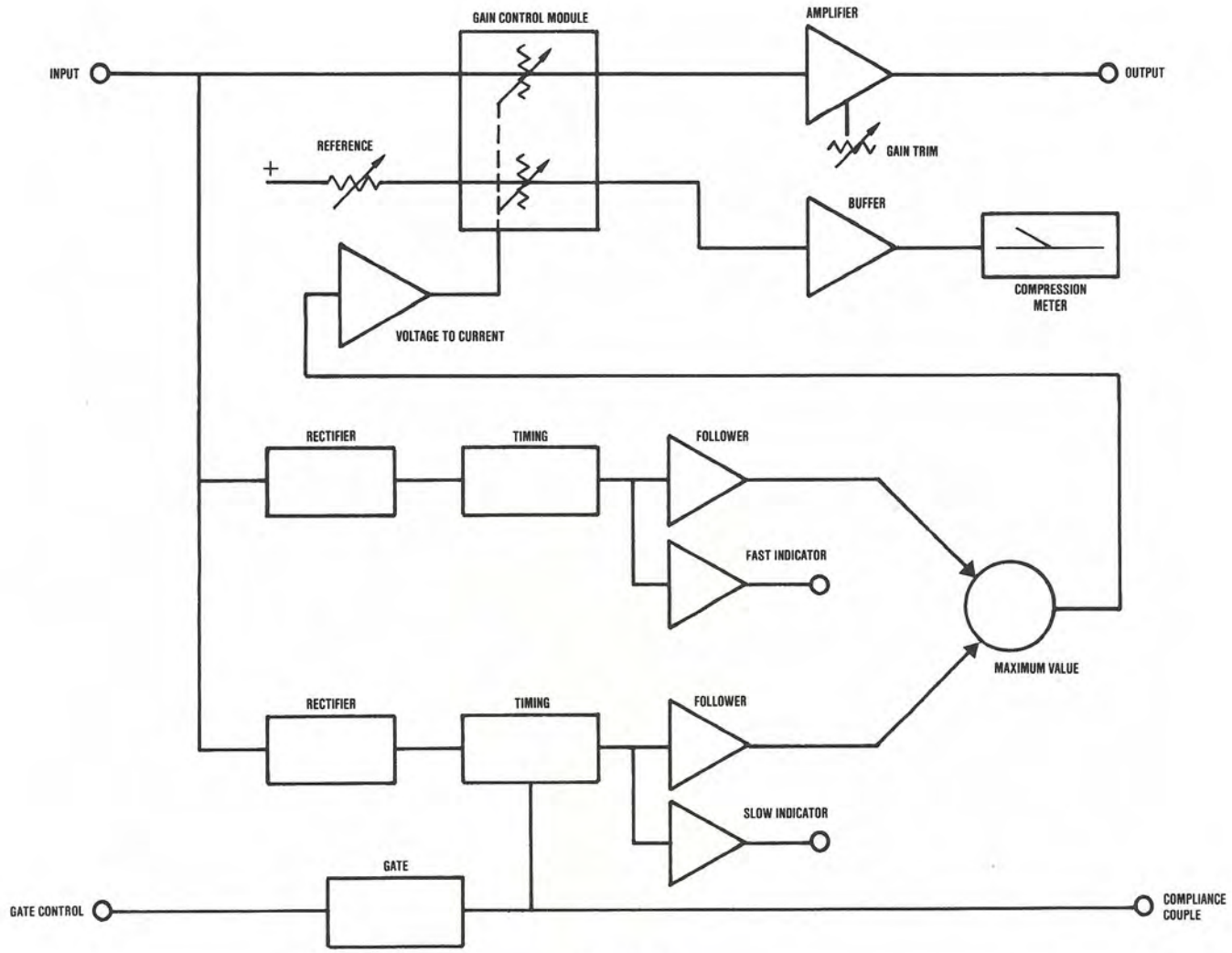


Figure 3
RMS Compressor

response character of these controls being 100 milliseconds and 500 milliseconds. The control circuit is designed such that short duration energy information contributes little to long term gain reduction and the long term audio envelope information provides an overall gain reduction platform.

The fast section consists of rectifier amplifier, IC4, processed by time constant circuit R8, R9, R10, R15 and C2. This voltage is then buffered by IC2 and used for the fast response LED indicator. The slow section consists of rectifier amplifier, IC3, coupled via D5 and D8 to attack time-constant circuit R18 and C3. The gated release circuit

employs a transistor as a shunt switch such that normal release is R16 via the transistor when on, via R17 when off. The control voltage on C3 is buffered by IC1 and used for the slow response LED indicator. IC1B and IC2B are connected such that the greater of the two control signals appear at Test Point #1. IC5A is a voltage to current amplifier providing the current drive to the Gain Control Module.

Note that the current to the GCM is proportional to the audio input at Test Point #3. Since the resistance of the photo resistor in the GCM is inversely proportional to the current supplied to the LED, it can be shown that the output of the audio voltage divider consisting of R_A and R_a will have a constant average level.

1) $$R_a = \frac{C1}{I_{LED}}$$

2) and $$I_{LED} = C2 \cdot V_{IN}$$

C1, C2 determined by circuit

also $$V_{out} = V_{in} \cdot \frac{Ra}{R_a + R_A}$$

for $$R_A >> R_a$$

3) $$V_{out} = V_{in} \cdot \frac{R_a}{R_A}$$

Combining 1, 2, 3:

$$V_{out} = \frac{V_{in} \cdot C1}{R_A \cdot I_{LED}} = \frac{V_{in} \cdot C1}{R_A \cdot C2 \cdot V_{in}} = \frac{C1}{R_A \cdot C2} = \text{Constant}$$

IC6 is used to buffer the high impedance of the GCM attenuator and amplify the audio signal for re-mixing with the other bands. The gain of this amplifier is set by adjusting amplifier feedback with trimpot R21.

IC5B is used in the metering circuit. Trimpot R4, using R2 and DS1 as a reference voltage supply, sets the VU meter to zero with no gain reduction. R_M and R_a form an identical circuit with R_m and R_a, respectively.

The operating threshold level is determined by the voltage divider R38 and R39 ahead of the fast and slow signal rectifiers.

The compressors work with program audio of three different octave spreads which requires their thresholds be compensated accordingly to ensure equal gain reduction for equal energy.

5.4. OUTPUT AMPLIFIER

The output amplifier is designed to amplify the combined band signals to a line level, transformer-coupled output. IC2 provides a high gain element coupled into current-pair transistors Q1 and Q2 by C13, C14, D1 and D3. R13 and R14 bias both transistors on against D1 and D3 respectively. R8, C9 and R9 form the feedback network to IC2. Output current limiting and protection are provided by R15, R16, D2 and D4. D.C. offset is eliminated by C18. Two transformer outputs are provided. One, the MAIN output is monitored by the front panel meter. The second, or MONITOR output is 6 dB below the first.

5.5 POWER SUPPLY

Power is switched by a DPST switch on the rear panel and is fused at ¼ amp. The power transformer secondary current is rectified by a full wave bridge (FWC100) and applied to filter capacitors C19 and C22. Voltage regulation is provided by IC3 and IC4. D5 and D6 protect the regulators from being back biased by the removal and insertion of function modules with the power on. The lumped sum of the supply capacitors on each module and the output amplifier stabilize the voltages for each circuit.

5.6. TEST SWITCHING

The front panel test switch disables gain reduction by opening R1, the feedback path for current amplifier IC5, in each of the three band compressors.

SECTION VI

CHECKOUT AND ALIGNMENT

6.1. TEST EQUIPMENT

1) Audio Oscillator: 30 Hz to 20 KHz, less than 0.1% total harmonic distortion, calibrated output attenuator, 600 ohm source impedance. Recommended model: Hewlett Packard 204D.

2) Distortion Analyzer: Measure to 0.1% THD, 50 Hz to 20 KHz. Measure AC signal -60 dBm to +30 dBm, 20 Hz to 20 KHz. Recommended model: Hewlett Packard 334.

3) AC Voltmeter: Average responding, -60 dBm to +30 dBm, 30 Hz to 20 KHz, 100 KHz low-pass filter switch. Recommended model: Hewlett Packard 400F.

4) DC Voltmeter: 3½ digit ±1 count accuracy, 20 volt range. Recommended model: Fluke 8030A.

6.2. INITIAL TESTS

1) Connect audio oscillator and AC voltmeter to INPUT terminals.

2) Connect distortion analyzer and 600 ohm termination to OUTPUT terminals.

3) Set front panel controls as follows:

Input	Full counter-clockwise
Output	Full counter-clockwise
Low Band Offset	12 o'clock
High Band Offset	12 o'clock
TEST/OPERATE	TEST

4) Turn power switch ON and measure output of the power supply regulators at Test Points #4 and #5. Should be ±15 vdc within ½ volt.

5) Allow 5 minute "warm up," then check band compression meters for "O" VU reading. Adjust trimpot, R4, on the respective compressor board for meter zero as required.

6) Set TEST/OPERATE switch to OPERATE. Compression meter zero should not change.

6.3. 390 Hz/6 KHz TRI-BAND FILTER AND GATE MODULE

1) Set output trimpots R23, R24, and R25 and gate threshold trimpot R15 full counter-clockwise.

2) Set audio oscillator to 1 KHz, at a level of exactly -20 dBm. Set INPUT control full clockwise.

3) Turn mid-band trimpot, R24, clockwise to obtain -6 dB gain reduction on the mid-band compression meter.

4) Switch the audio oscillator to 100 Hz, maintain level at -20 dBm.

5) Turn low-band trimpot, R24, clockwise to obtain -6 dB gain reduction on the low-band compression meter.

6) Switch the audio oscillator to 10 KHz, and decrease the level to exactly -28 dBm.

7) Turn the high-band trimpot, R23, clockwise to obtain -6dB gain reduction on the low-band compression meter.

(NOTE: The compliance coupling relationship of the three band compressors may be easily seen during these adjustments, by observing the action of the stop-band meter readings.)

8) Reset the audio oscillator to 1 KHz and set the level to exactly -30 dBm.

9) Adjust the gate threshold trimpot, R15, clockwise while observing the front panel RELEASE GATE indicators. The control should be set to the point that -30 dBm input illuminates the NORMAL indicator and -31 dBm illuminates the SLOW indicator.

6.3.1. 260 Hz/3 KHz TRI-BAND FILTER AND GATE MODULE

1) Set output trimpots R23, R24, and R25 and gate threshold trimpot R15 full counter-clockwise.

2) Set audio oscillator to 1 KHz, at a level of exactly -20 dBm. Set INPUT control full clockwise.

3) Turn mid-band trimpot clockwise to obtain -6 dB gain reduction on the mid-band compression meter.

4) Switch the audio oscillator to 100 Hz, and set level to exactly -22 dBm.

5) Turn low-band trimpot, R25, clockwise to obtain -6 dB gain reduction on the low-band compression meter.

6) Switch the audio oscillator to 10 KHz, and decrease the level to exactly -23 dBm.

7) Turn the high-band trimpot, R23, clockwise to obtain -6 dB gain reduction on the low-band compression meter.

NOTE: The compliance coupling relationship of the three band compressors may be easily seen during these adjustments, by observing the action of the stop-band meter readings.

8) Reset the audio oscillator to 1 KHz and set the level to exactly -30 dBm.

9) Adjust the gate threshold trimpot, R15, clockwise while observing the front panel RELEASE GATE indicators. The control should be set to the point that -30 dBm input illuminates the NORMAL indicator and -31 dBm illuminates the SLOW indicator.

6.4. RMS COMPRESSOR MODULES

1) Set the gain trim adjust pots, R21, on each compressor module counter-clockwise. Set the front panel OUTPUT control full clockwise.

2) Check to insure that the audio oscillator is set at 1 KHz, level at -20 dBm, and that the mid-band compression meter indicates -6 dB of gain reduction.

3) Adjust gain trim, R21, on the mid-band compressor clockwise to obtain a reading of +8 dBm on the distortion analyzer/voltmeter.

4) Set OPERATE/TEST switch to TEST; adjust OUTPUT control to obtain a reading of +10 dBm on the distortion analyzer/voltmeter.

5) Switch the audio oscillator to 100 Hz while maintaining -20 dBm level.

6) Adjust gain trim, R21, on the low-band compressor clockwise to obtain a reading of +10 dBm on the distortion analyzer/voltmeter.

7) Set the audio oscillator to 10 KHz, again maintaining the -20 dBm level.

8) Adjust gain trim, R21, on the high-band compressor clockwise to obtain a reading of +10 dBm on the distortion analyzer/voltmeter.

6.5. OVERALL CHECKOUT AND PERFORMANCE MEASUREMENTS

1) Set distortion analyzer/voltmeter to +30 dBm range. Place shorting clip lead across OUTPUT METER terminals to guard against meter damage.

2) Set OUTPUT control full clockwise. Set OPERATE/TEST switch to TEST.

3) Switch the oscillator to 1 KHz and increase the oscillator level to obtain a +24 dBm reading on the distortion analyzer/voltmeter.

4) Measure distortion, should be less than 0.1% THD.

5) Switch oscillator to 50 Hz, check to insure all levels are maintained. Measure distortion, should be less than 0.2% THD.

6) Switch oscillator to 15 KHz and measure distortion, should be less than 0.1% THD.

7) Reset oscillator to 1 KHz and reduce level to -20 dBm.

8) Set OPERATE/TEST switch to OPERATE and remove shorting clip lead from OUTPUT METER terminals.

9) Adjust OUTPUT control to obtain "0" VU on OUTPUT METER which corresponds to +4 dBm on distortion analyzer/ voltmeter.

10) Disconnect audio oscillator from INPUT terminals, do not disturb any controls on the Multimax.

11) Measure residual noise with AC voltmeter using 100 KHz low-pass filter. Noise should be below -68 dBm.

12) Reconnect audio oscillator, set OPERATE/TEST switch to TEST and adjust OUTPUT control to obtain "0" VU on output meter.

13) Hold oscillator level constant and perform frequency response sweep from 30 Hz to 15 KHz. Response should be within +0 dB, -0.5 dB, referenced to 1 KHz.

14) Reset OPERATE/TEST switch to OPERATE.

15) Disconnect test equipment, unit is ready for operation.

SECTION VII

FIELD MODIFICATIONS

7.1. RELEASE GATE THRESHOLD

The release gate threshold is continuously adjustable and therefore can be set higher or lower than the alignment procedure, at the broadcaster's discretion. Simply turn trimpot R15 fully counter-clockwise if it is desired to effectively defeat the circuit altogether.

7.2. INCREASED OUTPUT LEVEL CAPABILITY

The Multimax's output transformer has three identical secondaries; two are connected in series for the MAIN OUTPUT and the third is connected to the MONITOR OUTPUT. The overall output capability and level may be increased by 3 dB by connecting the MAIN and MONITOR outputs in series. DO NOT CONNECT IN PARALLEL! The output transformer was designed for the flexibility of driving 600 ohm loads from either setup. The output meter is connected across the MAIN OUTPUT; therefore, "0" VU will be +7 dBm with series output.

SECTION VIII

MAJOR PARTS LIST

8.1. MAIN FRAME

Description	Reference	Part Number
Transformers	T1	* 49-102
	T2	* 48-104
	T3	* 49-303
Integrated Circuits	IC1, IC2	HA-2505
	IC3	LM-340T-15
	IC4	LM-320T-15
Transistors	Q1	MJE-180
	Q2	MJE-170
Diodes	Bridge Rectifier	FWC-100
	D1 - D4	1N914
	D5, D6	1N4003
Potentiometers	Input	* 22-601-BHS
	Output	* 21-103-CWAS
	Low & High Offset	* 21-103-CWLS
Switch	TEST	* 26-103
Meters	Compression (3)	* 47-003
	OUTPUT LEVEL	* 47-003

* Pacific Recorders and Engineering Part Number.

8.2. TRI-BAND FILTER AND GATE

Description	Reference	Part Number
Integrated Circuits	IC1, IC2	1458
	IC3-IC6	HA-2505
Transistors	Q1	2N3642
Diodes	D1-D6	1N914
Trimpots	R15, R23-R25	* 24-102V

8.3. RMS COMPRESSORS

Description	Reference	Part Number
Integrated Circuits	IC1, IC2	TL 082
	IC3-IC5	4558
	IC6	HA-2505
	IC7 (attenuator)	* 101-018
Transistors	Q1-Q3	2N3642
Diodes	D1-D14	1N914
	LED DS1	TIL-209A
Trimpots	R4	* 24-102V
	R21	* 24-103V

* Pacific Recorders and Engineering Part Number.

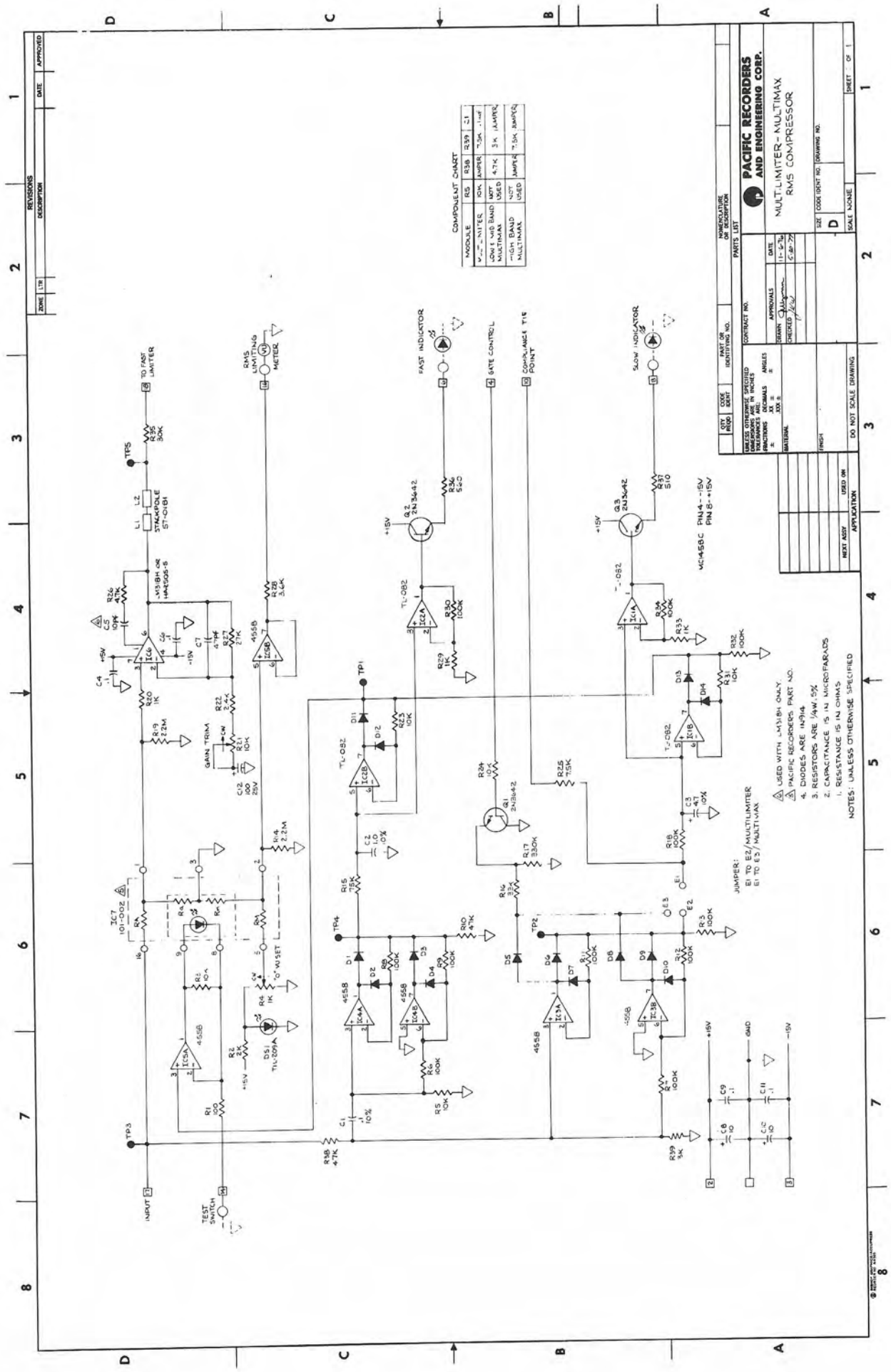
SECTION IX

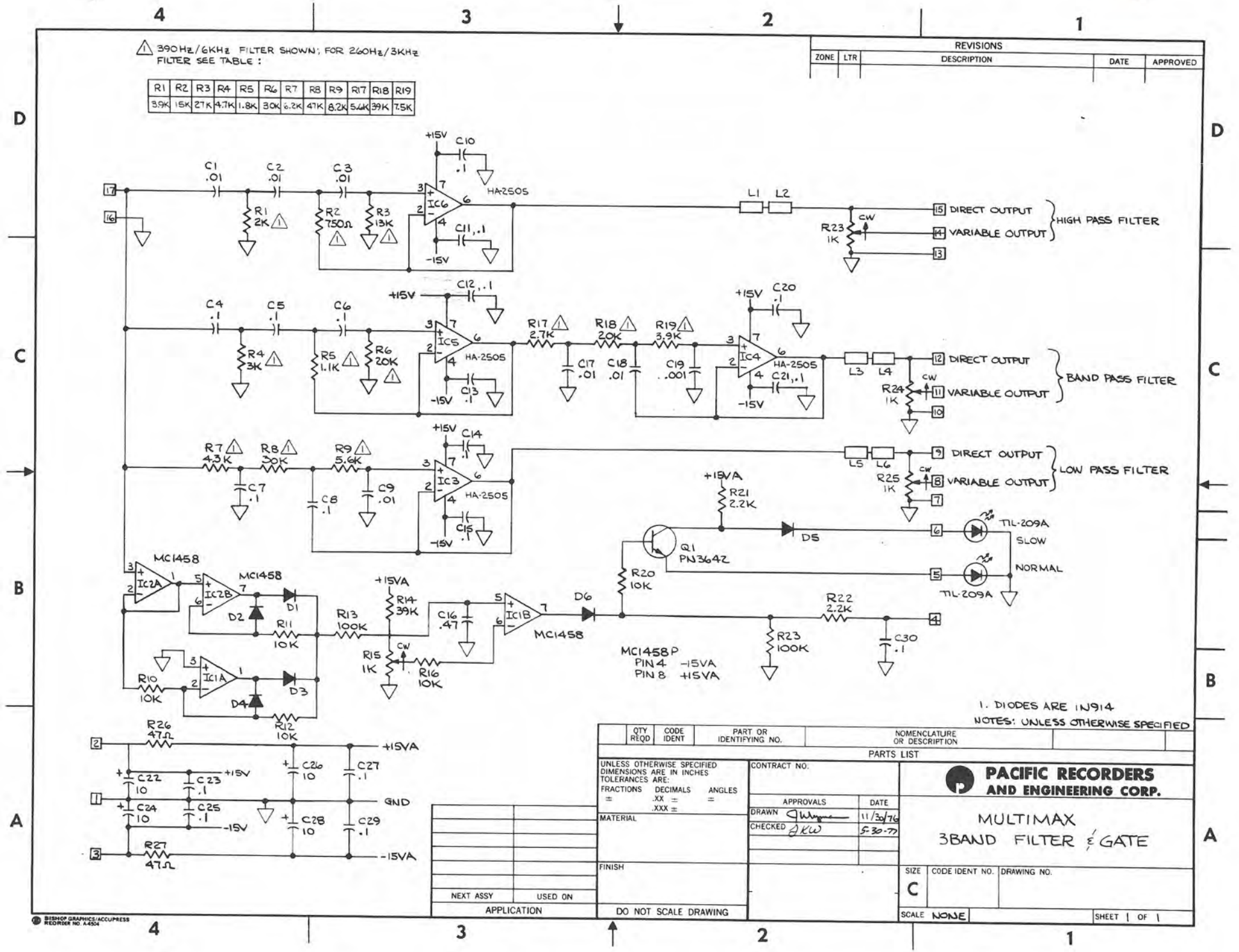
RECOMMENDED SPARE PARTS

The following parts are suggested for field service of the Multimax:

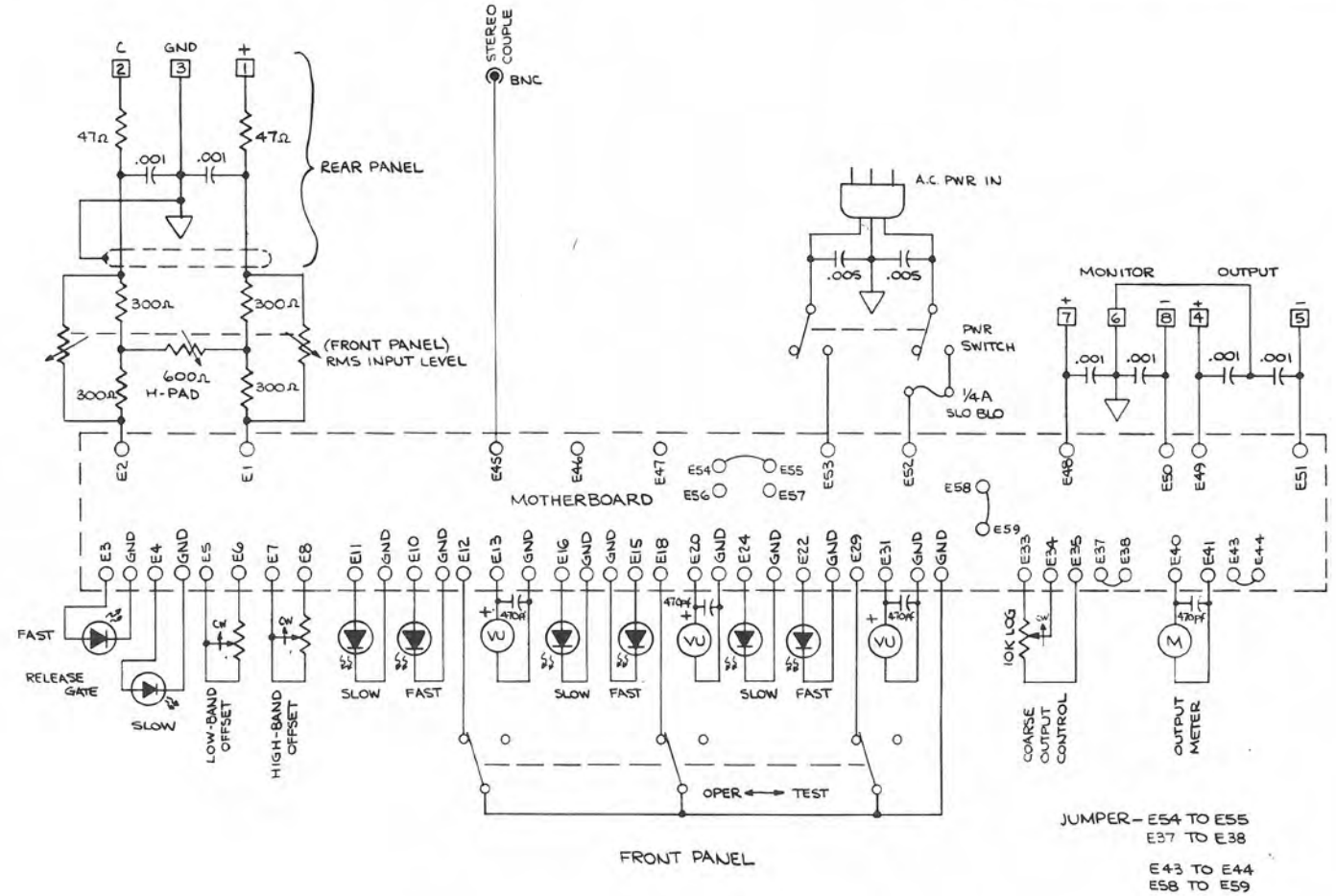
Description	Part Number	Quantity
Operational Amplifiers	HA-2505	3
	1458	2
	4558	3
	TL082	3
Transistors	2N3642	2
	MJE-170	1
	MJE-180	1
Diodes	FWC-100 Bridge	1
	TIL-209A, LED	2
	1N914	4
	1N4003	2
Gain Control Module	* 101-018	1

* Pacific Recorders and Engineering Part Number.





REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED



QTY REQD	CODE IDENT	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION

PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
FRACTIONS ± DECIMALS .XX ± .XXX ± ANGLES ±

MATERIAL

FINISH

NEXT ASSY | USED ON

APPLICATION

DO NOT SCALE DRAWING

CONTRACT NO.

APPROVALS	DATE
DRAWN	12-16-76
CHECKED JKW	5-30-77

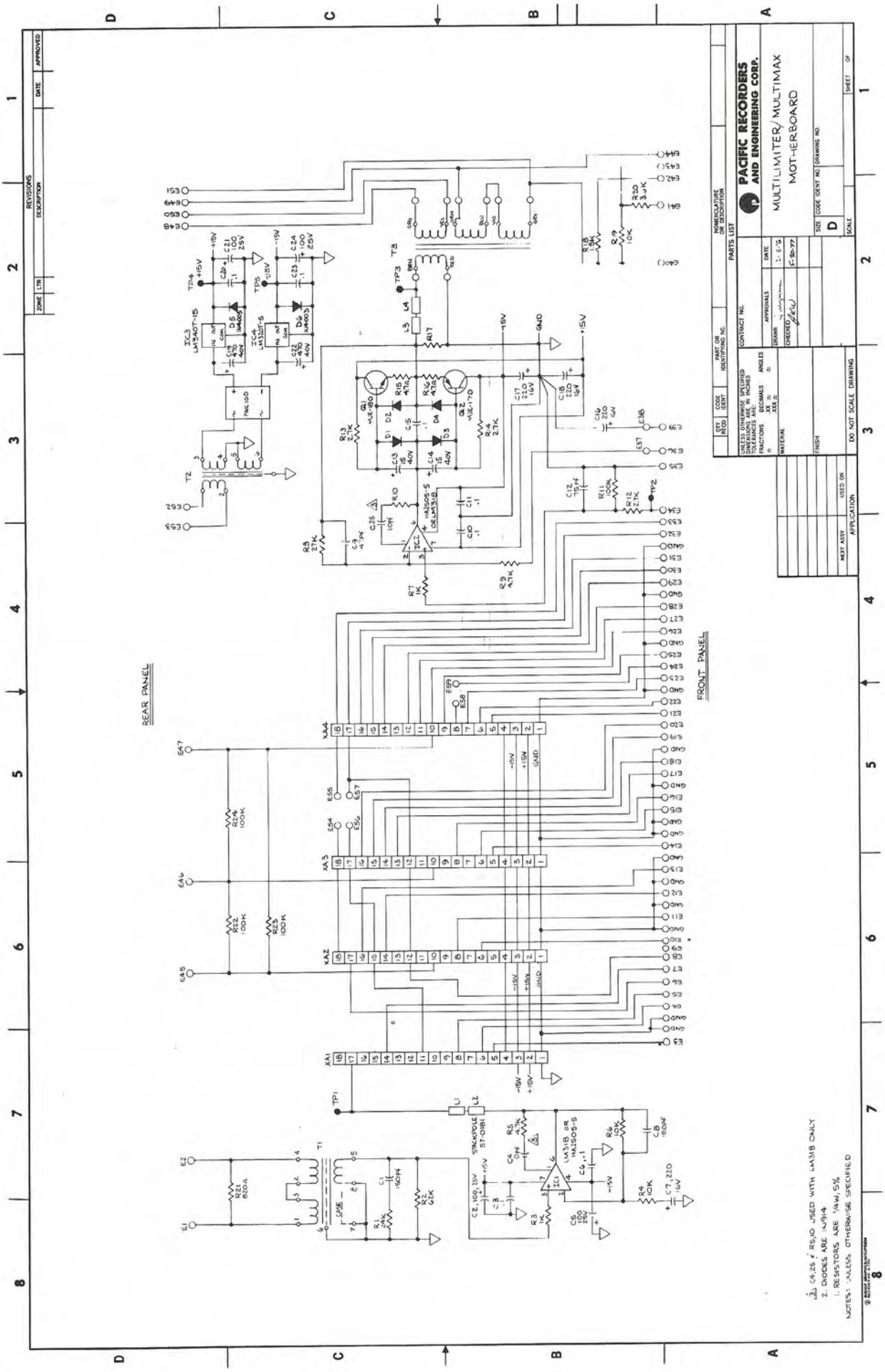
PACIFIC RECORDERS AND ENGINEERING CORP.

INTERCONNECT-
MULTIMAX

SIZE C | CODE IDENT NO. | DRAWING NO.

SCALE | SHEET OF

BISHOP GRAPHICS: ACCUPRESS REORDER NO. A-4504



SECTION XI

FACTORY SERVICE

The Multimax contains all solid-state circuits which have been designed for extended maintenance-free operation. Plug-in operational amplifiers have been used extensively to further simplify field service. However, Pacific Recorders and Engineering maintains a factory service facility should a failure or operating problem arise which cannot be corrected in the field. The user should contact the Service Manager in San Diego to discuss the problem. Often, simple field repairs can be made after this consultation.

The Service Manager might suggest that return of the unit would be the fastest and most efficient method of repair. No units will be accepted for factory repair unless a Return Authorization accompanies it so the unit can be processed speedily.

SECTION XII

WARRANTY

LIMITED WARRANTY

(a) Except as expressly excluded hereinafter, Pacific Recorders and Engineering Corporation ("Seller") warrants equipment of its own manufacture against faulty workmanship or the use of defective materials for a period of one (1) year from date of shipment to Buyer. The liability of Seller under this Warranty is limited to replacing, repairing or issuing credit (at the Seller's discretion) for any equipment, provided that (i) Seller is promptly notified in writing within five (5) days upon discovery of such defects by Buyer, (ii) Seller's examination of such equipment shall disclose to its satisfaction that such defects existed at the time shipment was originally made by Seller, and (iii) Buyer returns the defective equipment to Seller's place of business in San Diego, California, packaging and transportage prepaid, with return packaging and transportage guaranteed.

(b) Equipment furnished by Seller but manufactured by another shall be warranted only to the extent provided by the other manufacturer.

(c) The warranty period on equipment or parts repaired or replaced under warranty shall expire upon the expiration of the period of the original warranty.

(d) This warranty is void for equipment which has been subject to (1) abuse, (2) improper installation,

(3) improper application, (4) improper or omitted maintenance, (5) alteration, (6) accident, (7) negligence in use, storage, transportation or handling, (8) operation not in accordance with Seller's operation and service instructions, or (9) operation outside of the environmental conditions specified by Seller.

(e) This warranty is the only warranty made by Seller, and is in lieu of all other warranties, including merchantability and fitness for a particular purpose, whether expressed or implied, except as to title and to the expressed specifications contained in this manual. Seller's sole liability for any equipment failure or any breach of this Warranty is as set forth in subparagraph (a) above; and Seller shall not be liable or responsible for any business loss or interruption, or other consequential damages of any nature whatsoever, resulting from any equipment failure or defect or breach of this Warranty.

PACIFIC RECORDERS AND ENGINEERING CORPORATION
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