TECHNICAL MANUAL

HARRIS

COMMUNICATIONS AND INFORMATION HANDLING

TECHNICAL MANUAL

VOLUME I

MSP-100

AUDIO PROCESSOR SYSTEM

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HARRIS CORPORATION

Broadcast Products Division

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CAUTIONARY NOTICE

Always disconnect power before opening covers, doors, enclosures, gates, panels or shields. Always use grounding sticks and short out high voltage points before servicing. Never make internal adjustments, perform maintenance or service when alone or when tired.

Never remove, short-circuit or tamper with interlock switches on access covers, doors, enclosures, gates, panels or shields. Keep away from live circuits, know your equipment and don't take chances. Proper training of experienced personnel and observing the above guidelines will help assure safe and continued operation of this equipment.

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VOLUME I

SECTION I

GENERAL DESCRIPTION

1-1. INTRODUCTION.

1-2. SCOPE AND PURPOSE.

1-3. This technical manual consists of two volume containing the information necessary to install, operate, maintain, and service the MSP 100 Audio Processor system. Volume I which includes the system operating instructions, discusses the overall system and its various subsystems. Volume II contains individual technical manuals for the main frame and each of the modules with detailed parts lists, principles of operation, and maintenance. The various sections of each volume provide the following information.

a. SECTION I, GENERAL DESCRIPTION, provides a description of the equipment, identifies the major components, lists operating parameters and specifications, and describes other pertinent features of the equipment such as optional capabilities.

b. SECTION II, INSTALLATION, provides information relative to incoming inspection, power requirements, input/output connections, and component mounting instructions.

c. SECTION III, OPERATION, provides identification and functions of panel or component mounted controls and indicators, along with information necessary to set up and operate the system.

d. SECTION IV, PRINCIPLES OF OPERATION, provides description and functional circuits within the system beginning with a general, overall block diagram discussion and proceeding through subsystem block diagram discussions.

e. SECTION V, MAINTENANCE, provides information pertaining to preventive and corrective maintenance, along with the applicable performance schedules.

f. SECTION VI, PARTS LIST, provides information for ordering replacement electrical components and assemblies together with selected mechanical parts.

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1-4. EQUIPMENT PURPOSE.

1-5. The MSP 100 Audio Processor System, shown in figure 1-1, is a flexible audio control package employing a tri-band AGC and broadband peak limiter. This system provides the user with a wide variation of adjustments to tailor the "sound" to individual station requirements.

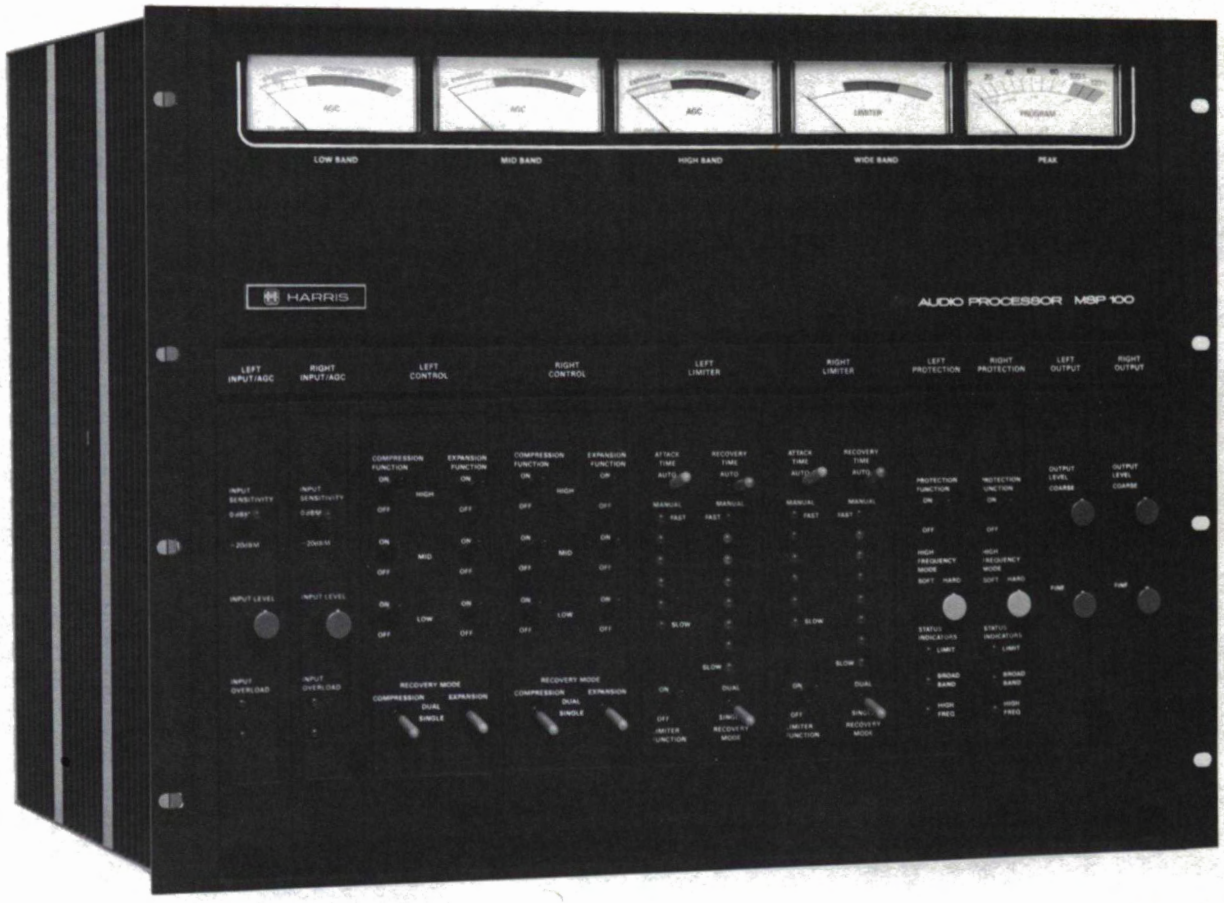

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Figure 1-1. MSP 100 Audio Processor System

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WARNING: Disconnect primary power prior to servicing.

1-6. Modular construction is used throughout the system to permit flexibility in initial installation and provisions for future additions. The system may be configured for either monaural or stereo operation by simply adding or removing modules.

1-7. PHYSICAL DESCRIPTION.

1-8. MSP 100 AUDIO PROCESSOR.

1-9. The MSP 100 Audio Processor shown in figure 1-2 consists of a main frame, constructed of assembled aluminum extrusions, a mother board contained within the main frame, ten plug-in modules, and five removable meter modules.

1-10. The ten plug-in modules consist of one or two printed circuit boards attached to an aluminum shielding tray and a front panel. The plug-in modules mate with edge-connector receptacles on the mother board, and are held in position laterally by guides. The front panels contain an over-the-center latching mechanism that secures the module in the frame, and is used to extract the module for removal.

1-11. Each meter module consists of a formed aluminum sub-chassis containing one or two printed circuit cards, a meter, controls, and indicators. The meter modules connect, through ribbon cable, to receptacles on the mother board, and are secured to the main frame by screws extending through the bottom of the sub-chassis.

1-12. The mother board, which is mounted vertically in the main frame, provides interconnection among the modules and provides input and output, connectors.

1-13. The back panel of the main frame has the audio input/output card and power supply card mounted on it.

1-14. The power supply transformer and filter capacitors are mounted on an aluminum panel extending horizontally across the main frame. This panel also provides the mounting point for the meter modules.

1-15. FUNCTIONAL DESCRIPTION.

1-16. GENERAL.

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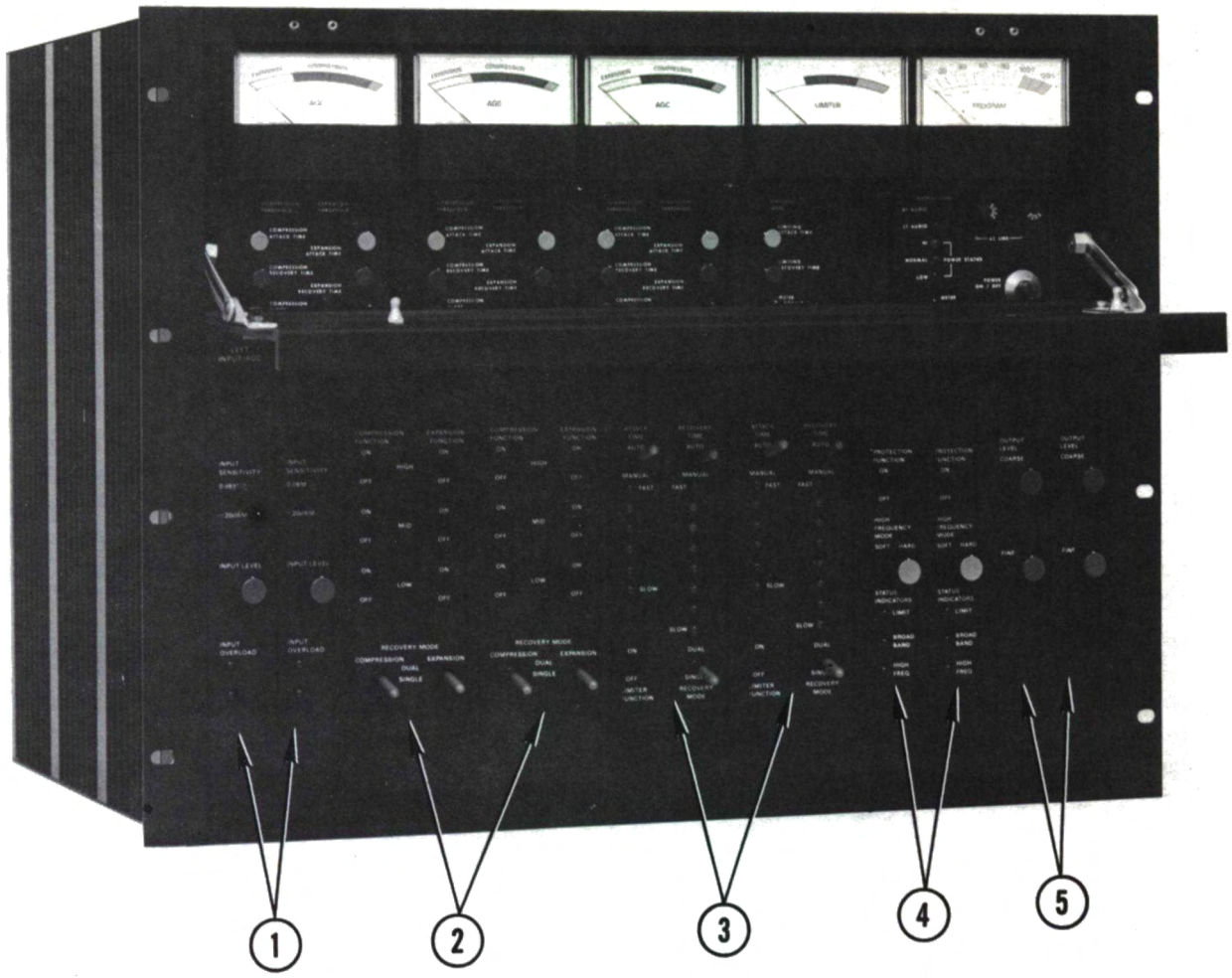
1-17. A simplified block diagram of the MSP 100 Audio Processor System is shown in figure 1-3. Since the system is composed of identical left and right channels, only the function of the left channel will be discussed.

1-18. INPUT SECITON. An active instrumentation-type input circuit permits balanced or unbalanced input mode without modification. An input sensitivity switch (20 dB) and a further fine adjustment range of 20 dB allow control of input level to the AGC section over a 40 dB range.



LEGEND

1. INPUT AGC MODULE
2. CONTROL MODULE
2. LIMITER MODULE
4. PROTECTION MODULE
5. OUTPUT MODULE
6. POWER SUPPLY REGULATORS
7. AC POWER CONNECTOR
8. INPUT/OUTPUT RFI FILTER
9. POWER SUPPLY P.C. BOARD
10. INPUT/OUTPUT TERMINAL STRIP
11. PROGRAM METER MODULE
12. LIMITER METER MODULE
13. AGC METER MODULES

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Figure 1-2. MSP 100 Audio Processor Components (Sheet 1 of 2)

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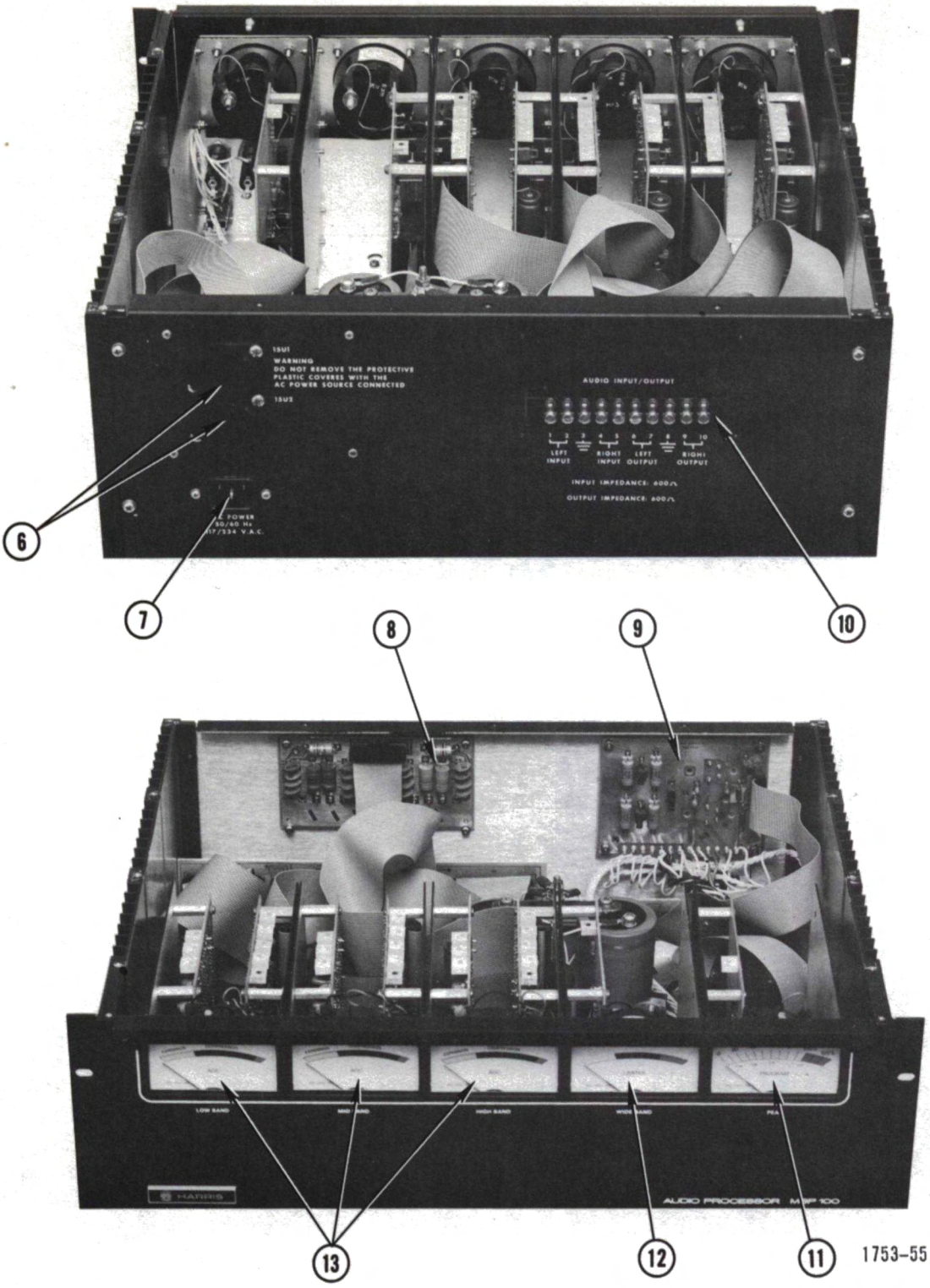

Figure 1-2. MSP 100 Audio Processor Components (Sheet 2 of 2)

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1-19. AGC SECTION.

1-20. Three independent AGC circuits process three segments of the audio spectrum independently. Operational parameters are variable to user tastes in each band. Variation of parameters dierectly affects the output spectral distribution; the characteristic "sound" of the processed signal. Use as a gentle AGC, spectral consistency equalizer, fast parallel split-band limiter, or anything in between is quickly selected.

1-21. Confusion in operational adjustment is minimized by the extensive use of selector switches rather than potentiometers. High and low crossover frequencies are adjustable to any one of seven frequencies each. Attack and recovery times of expansion and compression have five different periods each per band. The dual recovery mode expands the range of recovery independently in each band. Expansion and compression thresholds may be adjusted independently in each band.

1-22. The gain controlling element is a monolithic four-quadrant multiplier operating in the two-quadrant mode assuring optimum noise and distortion performance. Exact tracking between bands and between left and right stereo channels is inherent in the circuits used.

1-23. Metering modules are located above the main signal card frame and contain most operating parameter adjustment swithces. One module is used per band. Meter circuitry can be switched to monitor left or right band control signal or the greater of the two. In stereo operation, the greater of left or right controls the gain of both sections.

1-24. LIMITER SECTION.

1-25. A broadband fast limiter controls transient peaks and summation error present in the output of the tri-band AGC. Automatic attack time selection minimizes transient intermodulation of reconstructed broadband signals during limiting. Automatic recovery time selection optmizes the degree of dynamic range reduction to the nature of the program signal.

1-26. A two-quadrant multiplication technique similar to that employed in the AGC section is used to control limiter gain. Automatic attack circuitry analyzes the signal density in six separate frequency bands and selects attack time faster for significant high frequency energy. Automatic recovery is based on the detection of syllabic rate. Recovery time is selected by a limited bandwidth pulse counter to eliminate extreme recovery selection errors on extremely rapid pulses such as drum rolls.

1-27. Attack and recovery times are monitored by LED status indicators. Manual selection of attack and recovery times is available over a range of five values for each, with dual recovery available in both manual and automatic modes. Stereo strapping of limiters is easily connected and disconnected. An expanded scale meter indicates limiting over a 12 dB range; it can be switched to monitor left limiting, right limiting, or the greater of the two.

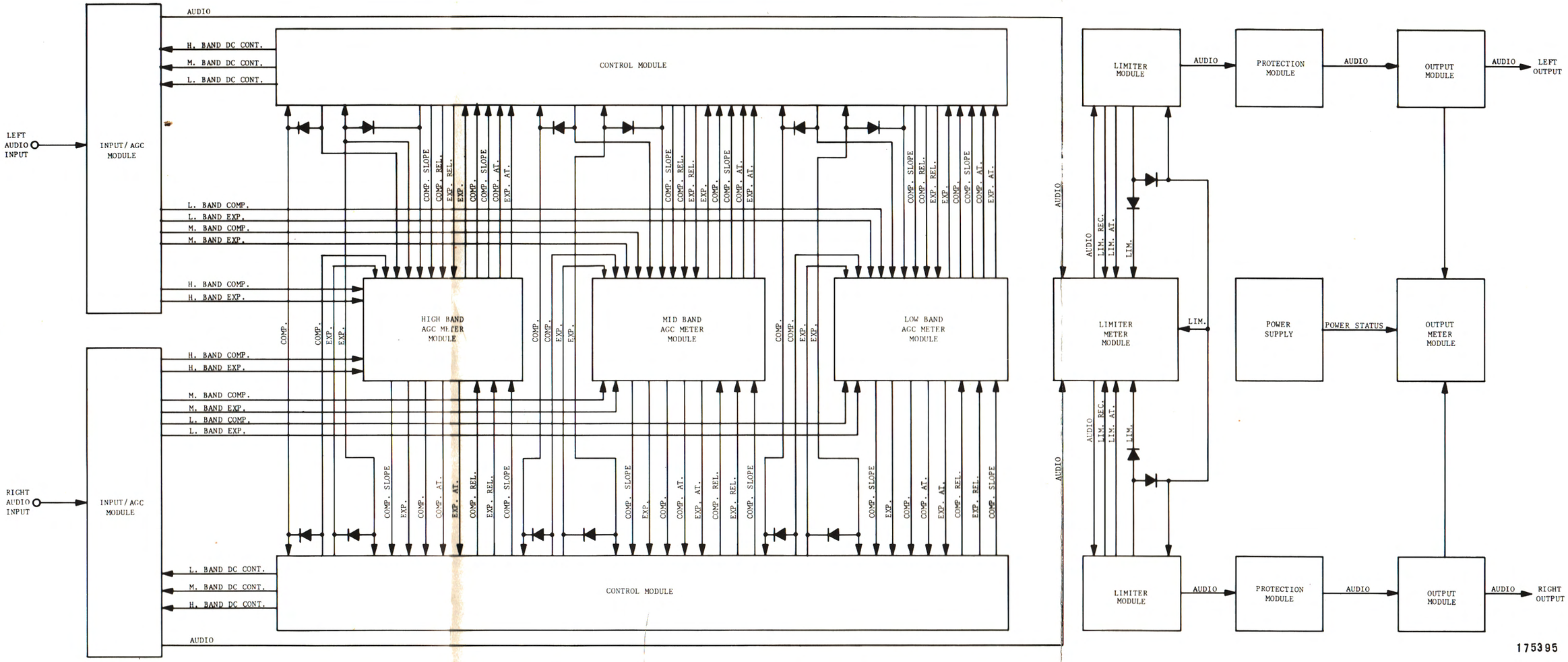

FIGURE 1-3.
MSP-100 AUDIO PROCESSOR
SYSTEM BLOCK DIAGRAM

1-28. PROTECTION SUBSYSTEM.

1-29. FM PROTECTION. High frequency energy can cause significant overdrive conditions in pre-emphasized systems such as FM, TV, SCA broadcasting, and tape recording. Modification of the signal is required to eliminate instantaneous overdrive when high frequencies are present.

1-30. Input signal from the limiter is pre-emphasized and split into two bands above and below 450 Hz. The high frequency bands feed a parallel clipper and fast limiter. The output signal may be adjusted to combine any combination of limited or clipped signal with the unprocessed low frequency signal. Final broadband clipping controls transient peaks and summation errors. De-emphasis after the clipper sections minimizes audible harmonic distortion.

1-31. Relative operational action can be ascertained through front-panel LED indications of high frequency limiting, clipping, and broadband clipping.

1-32. AM PROTECTION. Asymmetrical modulation on naturally asymmetric waveforms is advantageous in AM broadcasting. A limiter for AM broadcast must maintain proper signal polarity to allow full modulation and establish a means of controlling the degree of asymmetry allowed.

1-33. The AM Protection module inserts a polarity reversal circuit ahead of the limiter module input to maintain uniform signal asymmetry sense. It also monitors limiter module output and generates a control signal which regulates gain of the limiter in accordance with the selected degree of asymmetry. Transient clippers are provided to prevent transmitter overmodulation when slow limiter attack times are selected.

1-34. Front-panel LEDs which indicate module audio polarity and program meter display of positive or negative peaks are provided.

1-35. OUTPUT AMPLIFIER.

1-36. The output amplifier does not use any transformers or transistors whatsoever in providing a 600 ohm balanced output capable of delivering +18 dBm. Integrated circuits are used exclusively. Both coarse and fine output level adjustments are provided.

1-37. Output metering circuitry permits observation of peak signal levels both with and without pre-emphasis. Meter sensitivity can easily be changed in precise 2 dB increments. As in the AGC metering modules, left output, right output, or the greater of the two can be switched to the meter by the user.

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1-38. POWER SUPPLY.

1-39. The power supply is fully regulated using a double regulation scheme. A failure of any module would not necessarily cause the entire

unit to cease operation. Simple integrated-circuit regulators are employed for ease in troubleshooting. A unique power status monitor indicates deviations in the output of the primary regulators.

1-40. RFI PROTECTION.

1-41. Since the processor will be located near the transmitter in most installations, special attention has been paid to RFI considerations. Each plug-in module is shielded by a protective cover and flat support panel. Grounding of circuitry has been given special attention and use of ground planes on PC boards has been mode. The AC power input, audio inputs, and audio outputs all pass through low pass filters located at their connectors.

1-42. MECHANICAL.

1-43. Modular construction allows easy access to all circuit elements. All plug-in modules are easily serviced through the use of an extender card. Metering modules lift out for accessibility and the power supply is easily accessed by removing the top cover. Gating diodes are the only devices present on the mother board, minimizing the need for service to the mother board. Most maintneance and service is easily performed without removing the unit from its rack.

1-44. TECHNICAL CHARACTERISTICS.

1-45. ELECTRICAL CHARACTERISTICS.

1-46. Table 1-1 lists the electrical operating characteristics and parameters of the MSP 100 Audio Processor System.

1-47. MECHANICAL/ENVIRONMENTAL CHARACTERISTICS.

1-48. Table 1-2 lists the mechanical/environmental operating characteristics and parameters of the MSP 100 Audio Processor System.

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Table 1-1. Electrical Characteristics and Parameters

FUNCTION	CHARACTERISTIC/PARAMETER
Frequency Response:	30 Hz to 15 kHz, ±1 dB of 1 kHz value at +10 dBm output, control functions disabled.
Harmonic Distortion (Total):	0.25% or less 20 Hz to 15 kHz at +10 dBm output with control functions disabled; 1.0% or less 30 Hz to 16 kHz at +10 dBm output, 10 dB compression or less, with medium recovery times selector.
Intermodulation Distortion:	0.50% or less, 60 Hz and 7 kHz mixed 4:1 at +10 dBm output with control functions disabled.
Noies:	65 dB below +10 dBm output over a 30 Hz to 15 kHz bandwidth for 0 dBm input with control functions disabled.
Gain:	Switch selected, 23 dB or 43 dB, ±2 dB (Input and output controls allow finer adjustment).
Maximum Output Level:	+18 dBm.
Source Load Impedance:	600 ohms, balanced or unbalanced.
AC Input Power:	115/230 volts, 50/60 Hz, single phase, 40 watts.
AGC SECTION:	
Crossover Frequencies:	Switch selectable, ±10%
Low:	75 Hz, 95 Hz, 105 Hz, 135 Hz, 160 Hz, 230 Hz, 320 Hz
High:	1.68 kHz, 2.18 kHz, 2.45 kHz, 3.06 kHz, 3.7 kHz, 5.3 kHz, 7.20 kHz

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WARNING: Disconnect primary power prior to servicing.

Table 1-1. Electrical Characteristics and Parameters (Continued

FUNCTION	CHARACTERISTIC/PARAMETER
AGC SECTION (cont'd) NOTE The following is applicable to each of the three bands.	
Attack Time:	Compression or expansion; switch selected 0.25, 0.8, 2.5, 8, 25 milliseconds.
Recovery Time:	Compression or expansion; switch selected 0.4 to 6 seconds; dual recovery mode (when used) dynamically increases period recovery time up to 11 times selected period
Compression Ratio:	Switch selected; 12:4, 12:2, 12:1, 12:.5 (dB/dB) at center of range
Expansion Ratio:	Fixed, 12:24 dB/dB
Compression Threshold:	Adjustable over 12 dB range
Expansion Threshold:	-30 dB relative, adjustable $\pm$12 dB
Expansion Range:	12 dB
Compression Range:	24 dB
LIMITER SECTION	
Attack Time:	Automatic mode, 40 microsecond to 3.6 millisecond determined by program signal; manual mode, 40, 100, 400, 1200, 3600 microseconds.
Recovery Time:	Automatic mode, 40 milliseconds to 10 seconds determined by program signal; manual mode, 0.4, 0.75, 1.4, 3.0, 6.5 seconds; dual recovery mode (when used) dynamically increases recovery time up to eleven times selected period in either mode.

Table 1-1. Electrical Characteristics and Parameters (Continued)

FUNCTION	CHARACTERISTIC/PARAMETER
LIMITER SECTION (cont'd)	
Limiting Ratio:	12:0.5 (dB/dB)
Limiting Range:	12 dB
FM PROTECTION SECTION	
Compensation Curves:	Flat, 25, 50 and 75 microsecond
Attack Time, H.F. Limiter:	100 microseconds
Recovery Time, H.F. Limiter:	100 milliseconds
Operational Mode:	Parallel split-band with H.F. control only
Crossover Frequency:	450 Hz
High Frequency Control:	Infinitely variable from full clipping to full gain-reduction limiting
AM PROTECTION SECTION	
Attack and Reocvery Times:	See Limiter Section
Positive Peak Limit:	100% to 133%
Polarity Switch Time:	1 microsecond, maximum
Asymmetry Sensitivity:	5%
Phase Detector Sensitivity:	-10 dB, -20 dB, -30 dB, DIP switch selected

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Table 1-2. Mechanical/Environmental Characteristics

FUNCTION	CHARACTERISTIC
Dimensions	
Height:	14 inches (355 mm)
Width:	17.6 inches (447.5 mm)
Depth:	15.1 inches (384 mm)
Weight:	
Humidity Range:	Non-condensing, 5% to 95% relative humidity
Temperature Range:	Operating, 0°C to 55°C Storage, -40°C to +85°C
Altitude Range:	0 to 10,000 feet A.M.S.L.

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SECTION II

INSTALLATION

2-1. GENERAL.

2-2. The MSP 100 Audio Prpcessor System has been tested and inspected before being shipped, and is ready for operation after installation.

2-3. UNPACKING AND INSPECTION.

2-4. Inspect each item received against the shipping list and for evidence of possible shipping damage. If there is evidence of shipping damage, notify the carrier. Claims for damaged equipment must be filed against the carrier within ten days of delivery or the carrier will not accept the claim. When the equipment is delivered to the carrier by Harris Corporation, Broadcast Products Division, it becomes the property of the customer. If there is a shipping error or if, because of damage, replacement equipment must be ordered, notify the Harris Corporation, Broadcast Products Division representative.

2-5. MECHANICAL INSTALLATION.

2-6. The MSP 100 Audio Processor System is designed to be mounted in a standard 19-inch equipment rack. The unit is secured to the rack by eight screws (four on each side). When the unit is mounted, ensure that the louvered cooling air openings are not obstructed. Do not mount the system in the rack until the preparatory checks of paragraph 2-15 have been completed.

2-7. ELECTRICAL INSTALLATION.

2-8. Electrical installation of the MSP 100 Audio Processor System consists of connecting the audio input lines, the audio output lines, checking the ac power input connections, and initial control setup.

2-9. POWER INPUT CONNECTIONS.

2-10. Before the ac power is connected, the power transformer in the MSP 100 must be connected for the ac line voltage in use. For 117 vac power, the factory connections are used. If 234 vac power is used it will be necessary to change the power connections. To do this, the top cover must be removed. Locate primary power supply board, A13, and change the connections as shown in figure 2-1.

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2-11. AUDIO INPUT CONNECTIONS.

2-12. Input leads from an audio signal source impedance no greater than 600 ohms should be connected to the terminal strip on the rear of the chassis as shown in figure 2-2. Input lead shields should be terminated only at the MSP 100, not at the signal source. If the source is designed to feed a load of 150 ohms, a 200 ohm, 1/2-watt, 5% resistor should be connected across the input terminals to provide a 150-ohm load.

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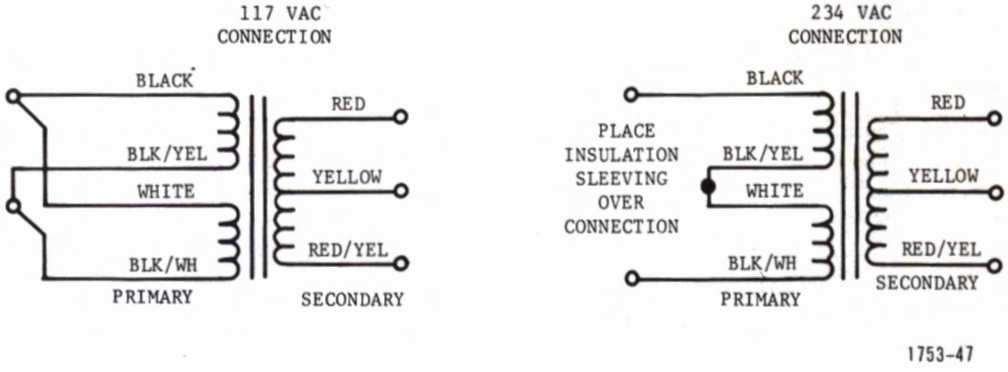

Figure 2-1. AC Power Input Connections

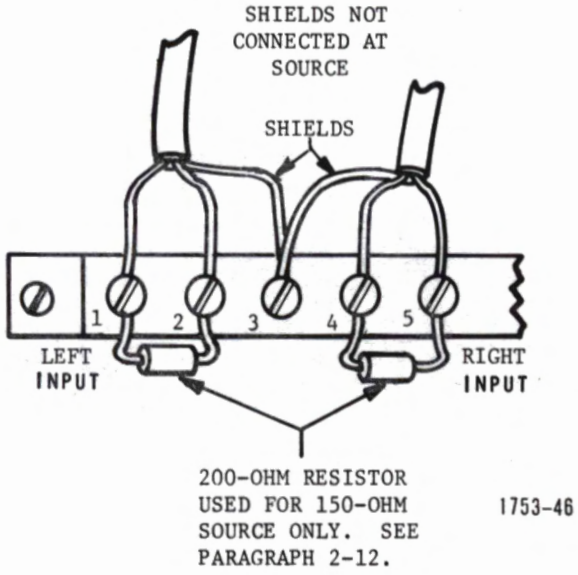

Figure 2-2. Audio Input Connections

WARNING: Disconnect primary power prior to servicing.

2-13. AUDIO OUTPUT CONNECTIONS.

2-14. When feeding a balanced load, output connections should be made to the terminal strip as shown in figure 2-3(a). Output lead shields should not be connected at the MSP 100; they should be connected only at the transmitter or other load. If the load is unbalanced, the hot leads should be connected to terminals 6 and 9 and the common leads to terminal 8 as shown in figure 2-3(b). Polarity may be reversed by removing the hot leads from terminals 6 and 9, and connecting them to terminals 7 and 10.

2-15. PREPARATORY CHECKS.

2-16. Before applying ac power to the unit, the following should be checked.

AC POWER INPUT: Make certain that the power transformer primary leads are connected properly as described in paragraph 2-9.

AUDIO INPUT/ OUTPUT LEADS: Make certain that the proper connections have been made for the particular installation as described in paragraphs 2-11 and 2-13.

2-17. INITIAL CONTROL SETTINGS.

2-18. Set the module controls to the positions given in table 2-1. FM Units are normally shipped with pre-emphasis set for 75 microseconds. This is accomplished by opening and closing the elements of 6S1 and 6S3 on the limiter circuit board (see Section III, table 3-6). If pre-emphasis other than 75 microseconds is desired, it may be set up in accordance with table 3-6. If pre-emphasis is performed in the transmitter, the elements of 6S3 must be set identical to those of 6S1. If pre-emphasis is to be performed by the MSP 100, all elements of 6S3 must be open.

NOTE

In the following table, where reference is made to a control located on a circuit board, the module cover must be removed. Remove 8 cross-recessed screws and lift the cover off. Replace the cover before installing the module.

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2-19. INITIAL OPERATION.

2-20. Connect primary ac power and depress POWER ON/OFF switch (11S2) on the program meter module. The NORMAL indicator (green) should glow. If the red or yellow (HI or LOW) LED's glow, refer to the power subsystem troubleshooting chart in Volume II. If no indicators glow, check primary power connections and fuses, 11F1 and 11F2. All three AGC meter pointers should rest

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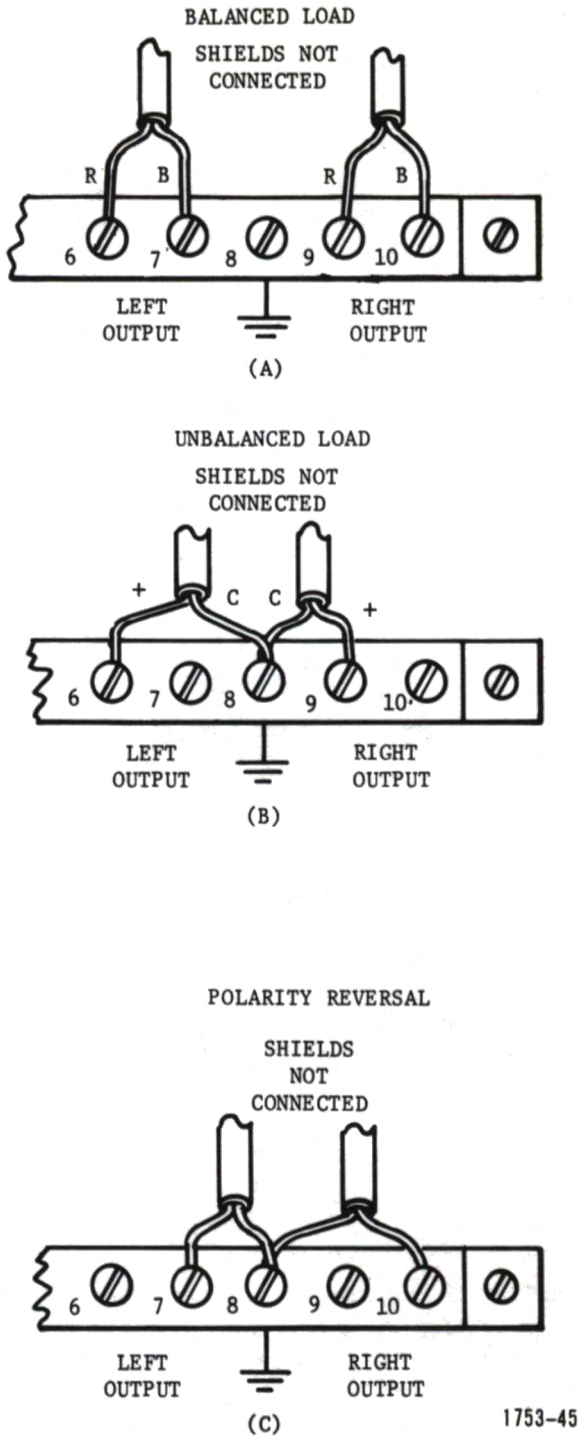

Figure 2-3. Audio Output Connections

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Table 2-1. Initial Control Settings

MODULE	CONTROL	POSITION
AGC METER (ALL)	COMPRESSION ATTACK TIME (8S2)	Position 3
	COMPRESSION RECOVERY TIME (8S1)	Position 3
	COMPRESSION SLOPE (8S3)	Fully CW
	EXPANSION ATTACK TIME (9S2)	Position 3
	EXPANSION RECOVERY TIME (9S1)	Position 3
	METER/L BOTH R	BOTH
	COMPRESSION THRESHOLD (8R20)	Factory Set
	EXPANSION THRESHOLD (9R30)	Factory Set
LIMITER METER	LIMITING THRESHOLD (10R1)	Factory Set
	LIMITING ATTACK TIME (10S2)	Position 3
	LIMITING RECOVERY TIME (10S1)	Position 3
	METER/L BOTH R (10S3)	BOTH
PROGRAM METER	METER/L BOTH R (11S1)	BOTH
INPUT/AGC	INPUT SENSITIVITY (1S1)	0 dBm
	INPUT LEVEL (1R104)	Fully CCW
	LOW FREQUENCY CROSS-OVER (1S3 on circuit board)	Element 3 closed

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Table 2-1. Initial Control Settings (Continued)

MODULE	CONTROL	POSITION
INPUT/AGC (Cont'd)	HIGH FREQUENCY CROSS-OVER (1S2 on circuit board)	Elements 3 and 4 closed
CONTROL	COMPRESSION FUNCTION/ HIGH (2S2)	OFF
	COMPRESSION FUNCTION/ MID (2S3)	OFF
	COMPRESSION FUNCTION/ LOW (2S1)	OFF
	RECOVERY MODE/COMPRES-SION/DUAL/SINGLE	SINGLE
	EXPANSION FUNCTION/ HIGH (3S2)	OFF
	EXPANSION FUNCTION/ MID (3S3)	OFF
	EXPANSION FUNCTION/ LOW (3S1)	OFF
	RECOVERY MODE/EXPAN-SION/DUAL/SINGLE (3S4)	SINGLE
LIMITER	ATTACK TIME/AUTO/ MANUAL (4S2)	MANUAL
	LIMITER FUNCTION (4S1)	OFF
	DUAL/SINGLE/RECOVERY MODE	SINGLE
FM PROTECTION	PROTECTION FUNCTION (6S2)	OFF
	PRE-EMPHASIS (6S1, 6S3 on circuit board)	See paragraph 2-18

WARNING: Disconnect primary power prior to servicing.

Table 2-1. Initial Control Settings (Continued)

MODULE	CONTROL	POSITION
AM PROTECTION	POLARITY	
	POSITIVE/AUTO/ NEGATIVE (6S2)	AUTO
	MODE (6S1)	OFF
	+ PEAKS (6R1)	100%
OUTPUT	OUTPUT LEVEL/COARSE (7R50)	Fully CCW
	OUTPUT LEVEL/FINE (7R49)	Fully CCW
	JUMPER PLUG (7P2 on circuit board)	Connecting J1 and J2
	METER SENSITIVITY (7S1 on circuit board)	Position 3 closed

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in the small black region that separates compression and expansion. As the control modules' EXPANSION FUNCTION switches are set to ON, the meter pointers should drop to the left scale limit.

NOTE

In stereo units, the meter pointers will not drop unless the switches on both control modules are set the same.

2-21. At this point, the only indicator that should be illuminated is the green POWER STATUS/NORMAL indicator on the program meter module. If any other indicators are on, a fault in the particular module is indicated; refer to the troubleshooting procedures of Section V.

2-22. SIGNAL OPERATION.

2-23. Audio program input at normal operating levels can now be applied using the following procedure:

a. Set all COMPRESSION FUNCTION, EXPANSION FUNCTION, LIMITER FUNCTION, and PROTECTION FUNCTION switches to ON. Rotate the INPUT LEVEL control on the left channel input/AGC module until the AGC meter pointers rise through the yellow EXPANSION region, half way into the first division of the compression region.

RESULT: The limiter meter should read up scale and the protection module indicators should flash.

b. With the left channel OUTPUT LEVEL/FINE control at mid position, adjust the OUTPUT LEVEL/COARSE control until the transmitter modulation monitor indicates 90% modulation. Then adjust the OUTPUT LEVEL/FINE control until legal modulation is obtained.

CAUTION

Some transmitters require special audio calibration procedures. Refer to the transmitter technical manual for further information.

NOTE

For AM operation, refer to paragraph 2-25.

c. To set up the right channel to match the left, refer to figure 2-4. Set the signal generator output at 700 Hz and increase the output until 12 dB (mid scale) compression is indicated on the MID AGC meter.

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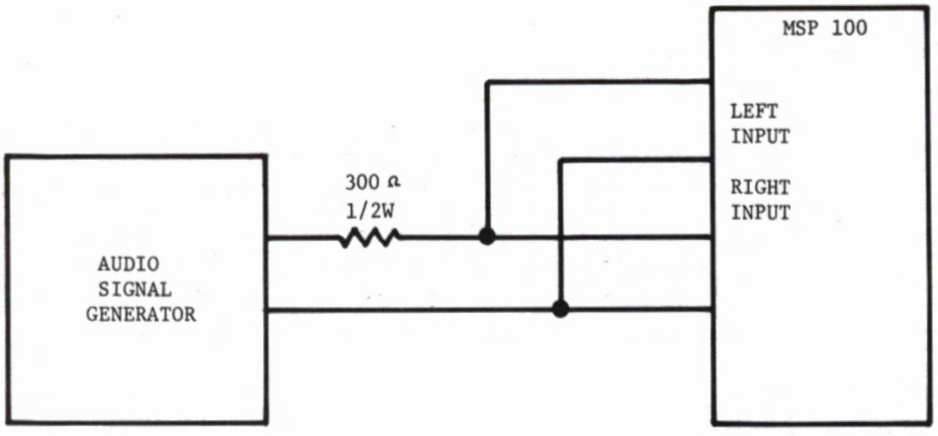

Figure 2-4. Test Equipment Setup

d. Alternately switch the METER/L BOTH R switch on the MID AGC meter module from L to R while adjusting the INPUT LEVEL control on the right channel input/AGC module CW until both right and left compression are equal.

RESULT: Compression indication on the MID AGC meter is the same with the METER/L BOTH R switch in either the L or R position.

e. Lower the audio input, using the signal generator level control, as much as possible. Set the COMPRESSION FUNCTION and EXPANSION FUNCTION switches on both control modules to OFF.

f. Change the signal generator frequency to 100 Hz and increase the generator output level until a mid scale reading is displayed on the limiter meter.

g. Adjust the OUTPUT LEVEL/FINE control on the right channel output module to the same position as the OUTPUT LEVEL/FINE control on the left channel output module.

h. Adjust the OUTPUT LEVEL/COARSE control on the right channel output module until an approximate left - right null is indicated on the station modulation monitor.

i. Adjust the OUTPUT LEVEL/FINE control on the right channel output module until a precise null is indicated on the station modulation monitor.

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j. Disconnect the signal generator and reconnect the program source.

k. Set the COMPRESSION FUNCTION and EXPANSION FUNCTION switches on both control modules to ON.

RESULT: Full modulation in both channels should now be possible. If overmodulation occurs, output level must be reduced. To preserve the left-right balance, it is recommended that the left output be reduced and the right channel balance procedure (steps c. through k.) be repeated. This procedure must be repeated until legal modulation level is achieved.

2-24. AM INSTALLATION.

2-25. Input and output polarity are important in AM applications. After completion of step b. of paragraph 2-23. rotate the + PEAKS control on the AM protection module to 130% while observing negative peaks on the modulation monitor. If the negative peaks increase appreciably with no increase in positive peaks, either the output leads on the MSP 100 or the input leads to the transmitter must be reversed. Do not change the shield connection. Proper asymmetrical modulation should now be possible. + PEAKS control should be adjusted to prevent modulation over 125% positive when negative peaks are held just below 100%. Illumination of the polarity indicator should be noted when the program source is the station's primary announce microphone. If the NEGATIVE indicator (DS2) glows, the input leads to the MSP 100 should be reversed. The POSITIVE indicator should now glow.

2-26. OPERATIONAL PARAMETER ADJUSTMENT.

2-27. Refer to Section III, paragraph 3-5 for information on suggested operational parameter settings. Detailed discussions on the affects of adjusting each parameter are contained in paragraphs 3-39 through 3-65. Once a group of parameter setting has been established, the control positions should be recorded on a log sheet and retained in a safe place to assure repeatability should the MSP 100 be subject to unauthorized tampering.

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SECTION III

OPERATION

3-1. GENERAL.

3-2. Since the object of the audio processor is to allow the tailoring of sound to the user's own requirements, and because of the versatility of the system, there is no set operating procedure delineated in this manual. Instead, a description of each of the controls and indicators is given in tables 3-1 through 3-11 followed by a brief discussion of the general procedures that usually should be followed when setting up the system.

3-3. CONTROLS AND INDICATORS.

3-4. All of the controls and indicators are mounted on the individual modules. Figures 3-1 and 3-9 show the location of the controls and indicators on each module and tables 3-1 through 3-11 describe their functions.

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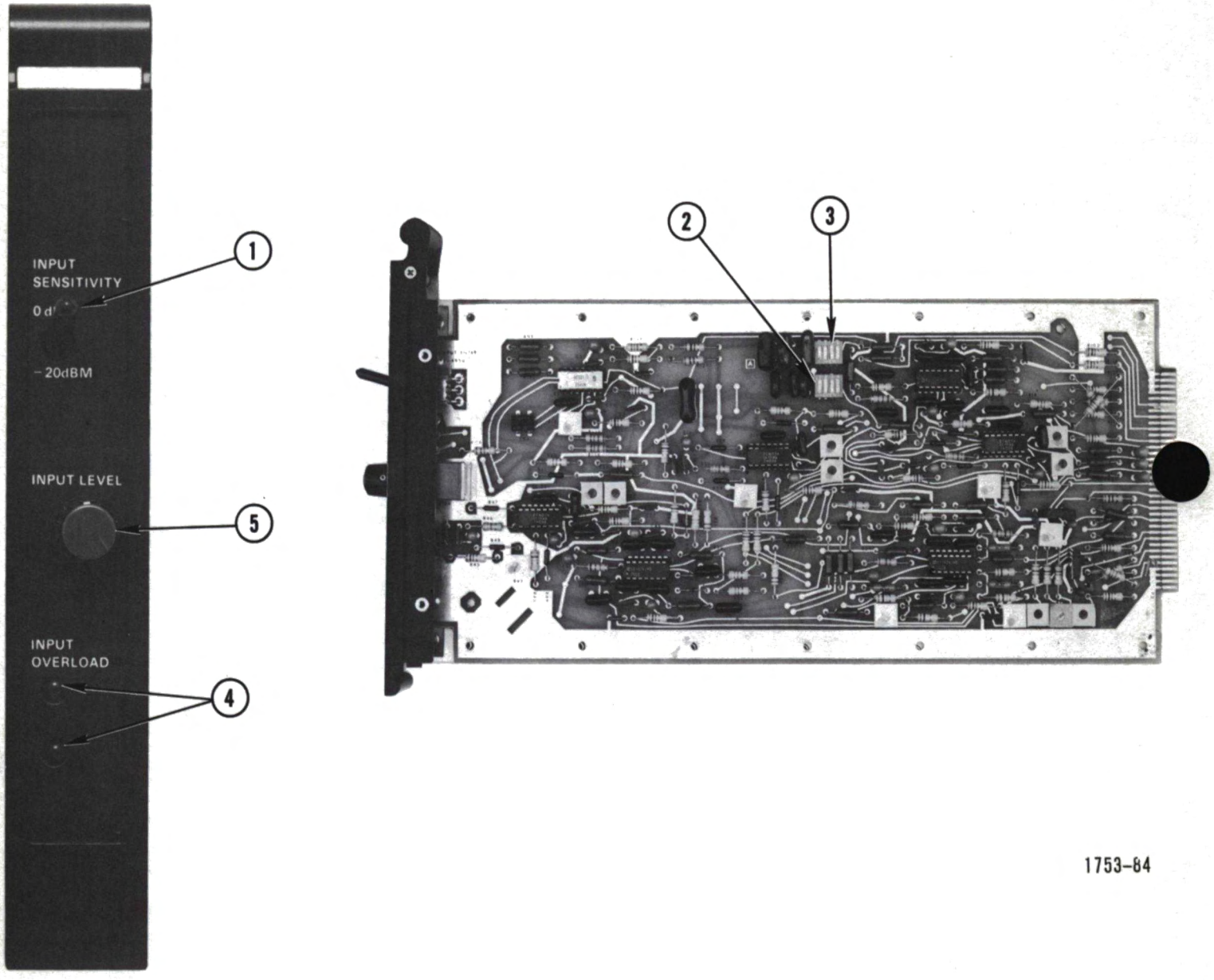

Figure 3-1. Input/AGC Module Controls and Indicators

WARNING: Disconnect primary power prior to servicing.

Table 3-1. Input/AGC Module Controls and Indicators

REF.	CONTROL/INDICATOR	FUNCTION
1	INPUT SENSITIVITY, 1S1	Selects the range of acceptable input levels for the AGC section.
	0 dBM	Accepts signals from -5 dBm to +15 dBm without distortion.
	-20 dBM	Accepts signals from -25 dBm to -5 dBm.
2	HIGH FREQUENCY CROSSOVER, 1S2	Selects the lower limit of the high frequency band and the upper limit of the mid frequency band. (See table 3-3.)
3	LOW FREQUENCY CROSSOVER, 1S3	Selects the upper limit of the low frequency AGC band and the lower limit of mid frequency AGC band. (See table 3-2.)
4	INPUT OVERLOAD, 1DS1/1DS2	Indicates that the input signal is excessive enough to damage internal circuitry if sustained.
5	INPUT LEVEL, 1R104	Adjusts the drive to the AGC section, directly effecting the amount of compression and expansion.

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Table 3-2. Low-to-Mid Frequency Crossover Section

1S3 SECTION				FREQUENCY (HZ)
1	2	3	4	
Closed	Either	Either	Either	0
Open	Closed	Closed	Closed	75
Open	Closed	Closed	Open	95
Open	Closed	Open	Closed	105
Open	Open	Closed	Closed	135
Open	Closed	Open	Open	160
Open	Open	Closed	Open	230
Open	Open	Open	Closed	320

Table 3-3. Mid-to-High Frequency Crossover Selection

1S2 SECTION				FREQUENCY (HZ)
1	2	3	4	
Open	Closed	Closed	Closed	1680
Open	Open	Closed	Closed	2180
Open	Closed	Open	Closed	2450
Open	Closed	Closed	Open	3060
Open	Open	Open	Closed	3700
Open	Open	Closed	Open	5300
Open	Closed	Open	Open	7200
Closed	Either	Either	Either	∞

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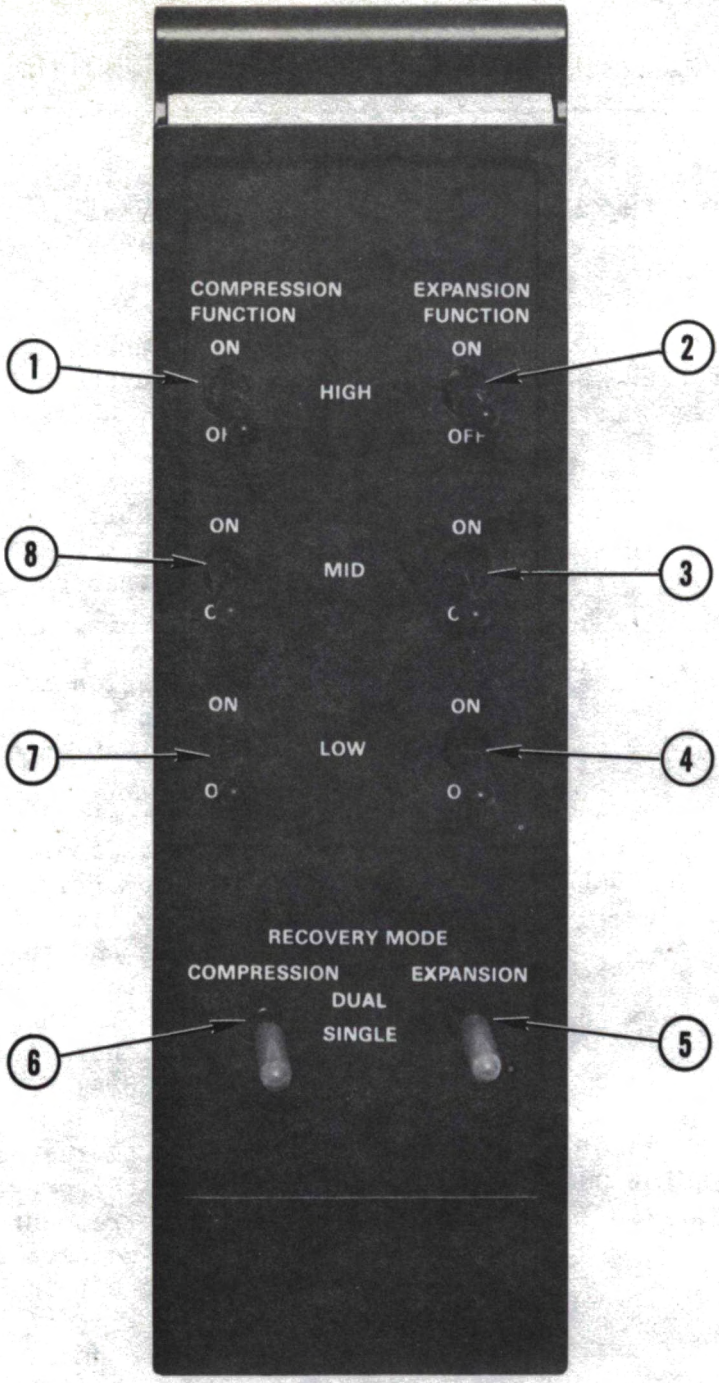

Figure 3-2. Control Module Controls and Indicators

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WARNING: Disconnect primary power prior to servicing.

Table 3-4. Control Module Controls and Indicators

REF.	CONTROL/INDICATOR	FUNCTION
1	COMPRESSION FUNCTION ON/OFF HIGH, 2S2	ON Position: Enables high frequency band compression in the AGC section. OFF Position: Disables the compression function.
2	EXPANSION FUNCTION ON/OFF HIGH, 3S2	ON Position: Enables high frequency band expansion in the AGC section. OFF Position: Disables the expansion function.
3	ON/OFF MID, 3S3	ON Position: Enables mid frequency band expansion in the AGC section. OFF Position: Disables the expansion function.
4	ON/OFF LOW, 3S1	ON Position: Enables low frequency band expansion in the AGC section. OFF Position: Disables the expansion function.
5	RECOVERY MODE/ EXPANSION/DUAL/ SINGLE, 3S4	DUAL Position: Expansion recovery time varies with the program signal as determined by recovery time circuits in the AGC meter modules and the dual recovery time circuits in the control module. SINGLE Position: Expansion recovery time is fixed by the switch settings on the AGC meter modules.
6	RECOVERY MODE/ COMPRESSION DUAL/ SINGLE, 2S4	DUAL Position: Compression recovery time varies with the program signal as determined by the recovery time circuits in the AGC meter modules and the dual recovery time circuit in the control module. SINGLE Position: Compression recovery time is fixed by the switch settings on the AGC meter modules.
7	COMPRESSION FUNCTION ON/OFF LOW, 2S1	ON Position: Enables low frequency band compression in the AGC section. OFF Position: Disables the compression function.

WARNING: Disconnect primary power prior to servicing.

Table 3-4. Control Module Controls and Indicators (Continued)

REF.	CONTROL/INDICATOR	FUNCTION
8	COMPRESSION FUNCTION ON/OFF MID, 2S3	ON Position: Enables mid frequency band compression in the AGC section. OFF Position: Disables the compression function.

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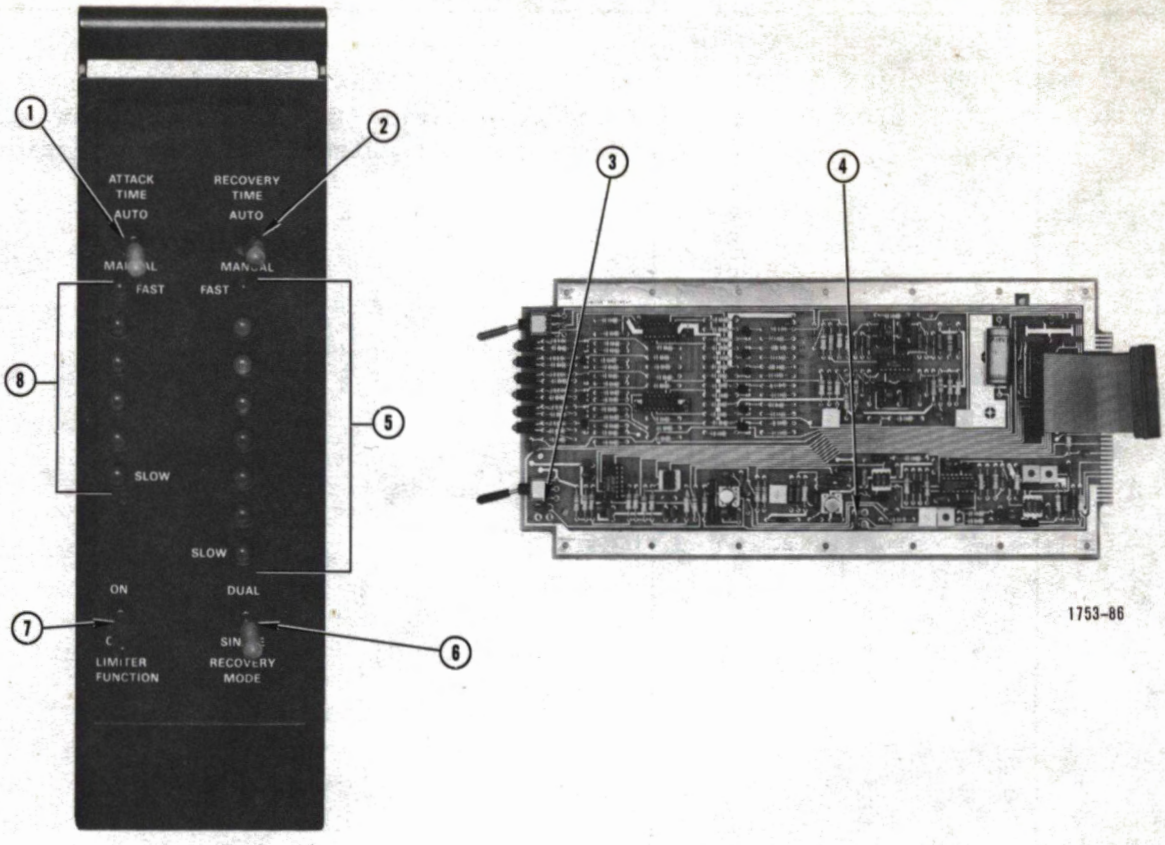

Figure 3-3. Limiter Module Controls and Indicators

WARNING: Disconnect primary power prior to servicing.

Table 3-5. Limiter Module Controls and Indicators

REF.	CONTROL/INDICATOR	FUNCTION
1	ATTACK TIME AUTO/ MANUAL, 4S2	AUTO Position: Limiting attack time is automatically varied (fast to slow) by the different frequency components of the signal. MANUAL Position: Limiting attack time is fixed by the switch settings on the limiter meter module.
2	RECOVERY TIME AUTO/ MANUAL, 5S2	AUTO Position: Limiting recovery time is automatically varied (fast or slow) according to the rate of signal peaks in audio envelope. MANUAL Position: Limiting recovery time is fixed by the switch setting on the limiter meter module.
3	JUMPER PLUG, 4P3	Selects either the limiter multiplier signal or an external signal as limiting source. Connecting J5 to J6 selects the external signal. Connecting J4 to J3 selects the multiplier output.
4	JUMPER PLUG, 4P2	Straps the left and right limiter control signals. Connecting J1 to J3 connects the two control outputs through gating diodes CR3 and CR4 on the motherboard allowing the greater control signal to control both limiters. Connecting J2 and J4 allows independent control.
5	RECOVERY TIME FAST/ SLOW, 5DS1 through 5DS8	LED indicators illuminate and display the recovery time automatically selected by the limiter auto recovery circuits as follows: LED — RECOVERY TIME 5DS1 (FAST) — 40 mSec 5DS2 — 75 mSec 5DS3 — 150 mSec 5DS4 — 300 mSec 5DS5 — 400 mSec 5DS6 — 1.2 Sec 5DS7 — 2.5 Sec 5DS8 (SLOW) — 5 Sec

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WARNING: Disconnect primary power prior to servicing.

Table 3-5. Limiter Module Controls and Indicators

REF.	CONTROL/INDICATOR	FUNCTION
6	DUAL/SINGLE RECOVERY MODE 5S1	DUAL Position: Provides a fast recovery rate for transient limiting and average recovery rate for slower limiting as determined by the program signal. SINGLE Position: One recovery rate is selected either by the automatic circuits in the limiter or by thr RECOVERY TIME switch on the limiter meter modjle.
7	ON/OFF LIMITER FUNCTION, 4S1	ON Position: Enables limiting. OFF Position: Disables limiting NOTE Except during performance measurements, this switch should be left in the ON position.
8	ATTACK TIME FAST/ SLOW, 4DS1 through 4DS6	LED indicators illuminate and display the attack time automatically selected by the limiter auto attack circuits as follows: LED — ATTACK TIME 4DS1 (SLOW) — 3.6 mSec 4DS2 — 1.2 mSec 4DS3 — 400 uSec 4DS4 — 100 uSec 4DS5 — 40 uSec 4DS6 (FAST) — 25 uSec

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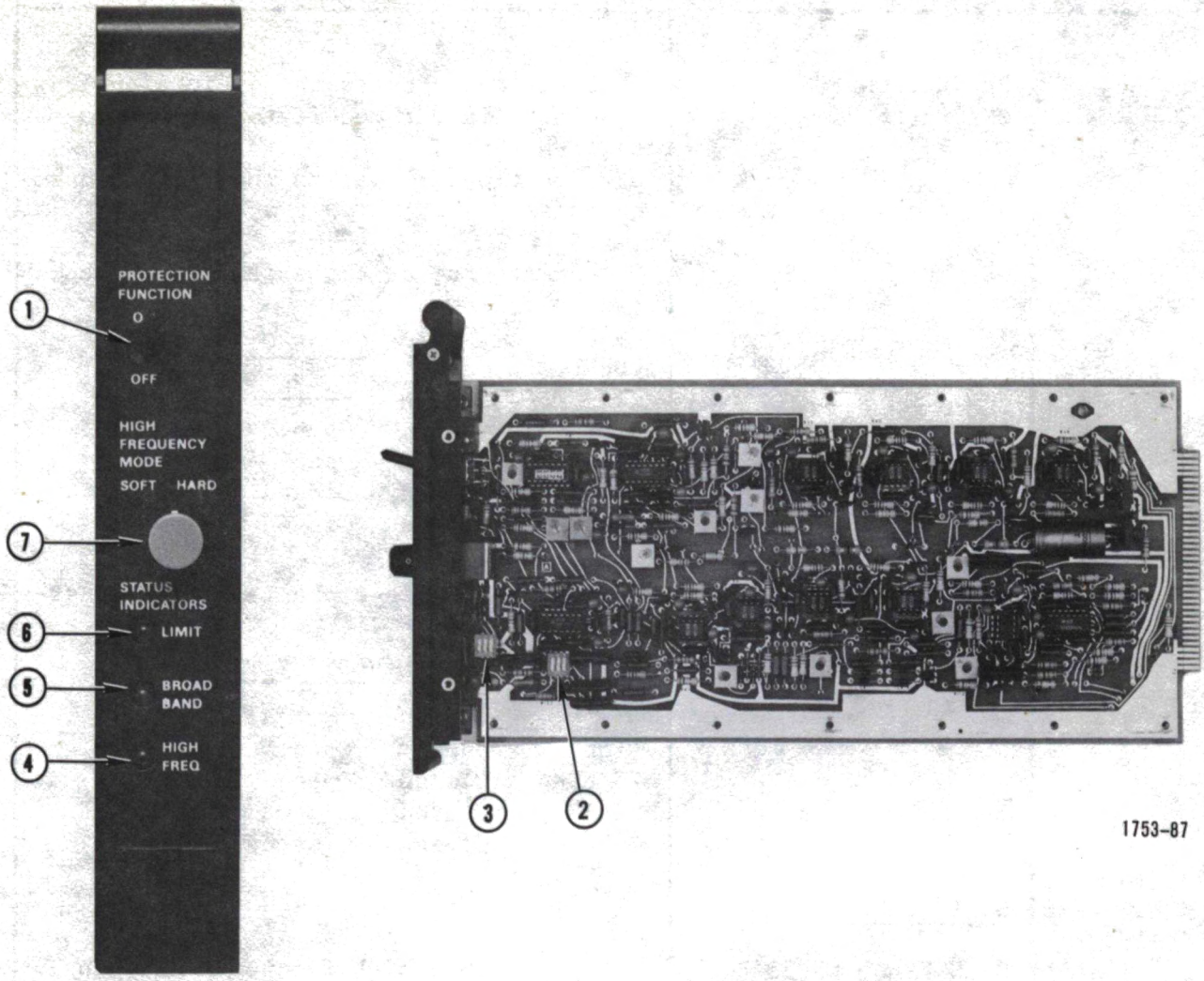

Figure 3-4. FM Protection Module Controls and Indicators

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WARNING: Disconnect primary power prior to servicing.

Table 3-6. FM Protection Module Controls and Indicators

REF.	CONTROL/INDICATOR	FUNCTION
1	PROTECTION FUNCTION ON/OFF, 6S2	ON Position: Routes the audio signal from the limiter module to the FM protection circuits. OFF Position: Bypasses the protection circuits.
2	DE-EMPHASIS, 6S3	Determines the de-emphasis curve selected as follows: 6S3 SECTION CURVE / 1 / 2 / 3 Flat / Open / Open / Open 25 uSec / Closed / Open / Open 50 uSec / Closed / Closed / Open 75 uSec / Closed / Closed / Closed
3	PRE-EMPHASIS, 6S1	Determine the pre-emphasis curve selected as follows: 6S1 SECTION CURVE / 1 / 2 / 3 Flat / Open / Open / Open 25 uSec / Closed / Open / Open 50 uSec / Closed / Closed / Open 75 uSec / Closed / Closed / Closed
	STATUS INDICATORS	
4	HIGH FREQ, 6DS51	LED glows when high frequency clipping occurs.
5	BROAD BAND, 6DS52	LED glows when broadband clipping occurs.
6	LIMIT, 6DS53	LED glows when high frequency limiting occurs.
7	HIGH FREQUENCY MODE/ SOFT/HARD, 6R96	Determines the proportions of high frequency distortion and rolloff. CCW rotation (SOFT) provides minimum distortion with significant high frequency rolloff. CW rotation (HARD) provides minimized high frequency rolloff at the expense of increased distortion.

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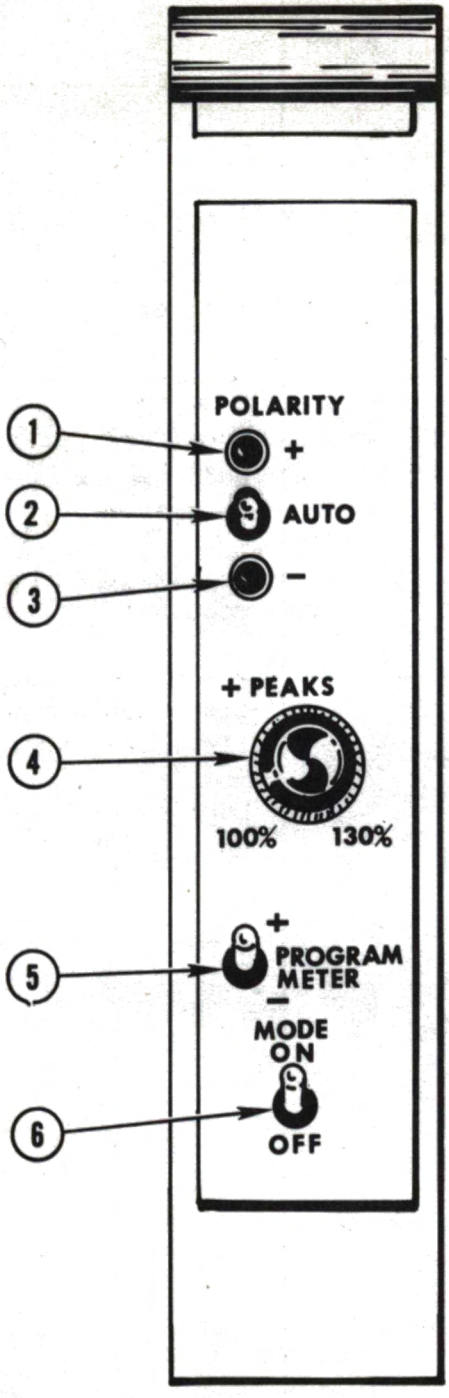

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Figure 3-5. AM Protection Module Controls and Indicators

WARNING: Disconnect primary power prior to servicing.

Table 3-7. AM Protection Module Controls and Indicators

REF.	CONTROL/INDICATOR	FUNCTION
1	POLARITY +	LED indicates AM protection and limiter modules are operating in the noninverting mode.
2	POLARITY switch	Allows selection of AM protection and limiter modules signal polarity either manually or automatically by the polarity reversal circuit.
3	POLARITY -	LED indicates AM protection and limiter modules are operating in the signal inverting mode.
4	+ PEAKS	Adjusts the degree of asymmetrical modulation.
5	PROGRAM METER +/-	Permits program meter display of relative modulation due to positive or negative peaks as selected.
6	MODE ON/OFF	Enables or disables the AM protection and limiter modules.

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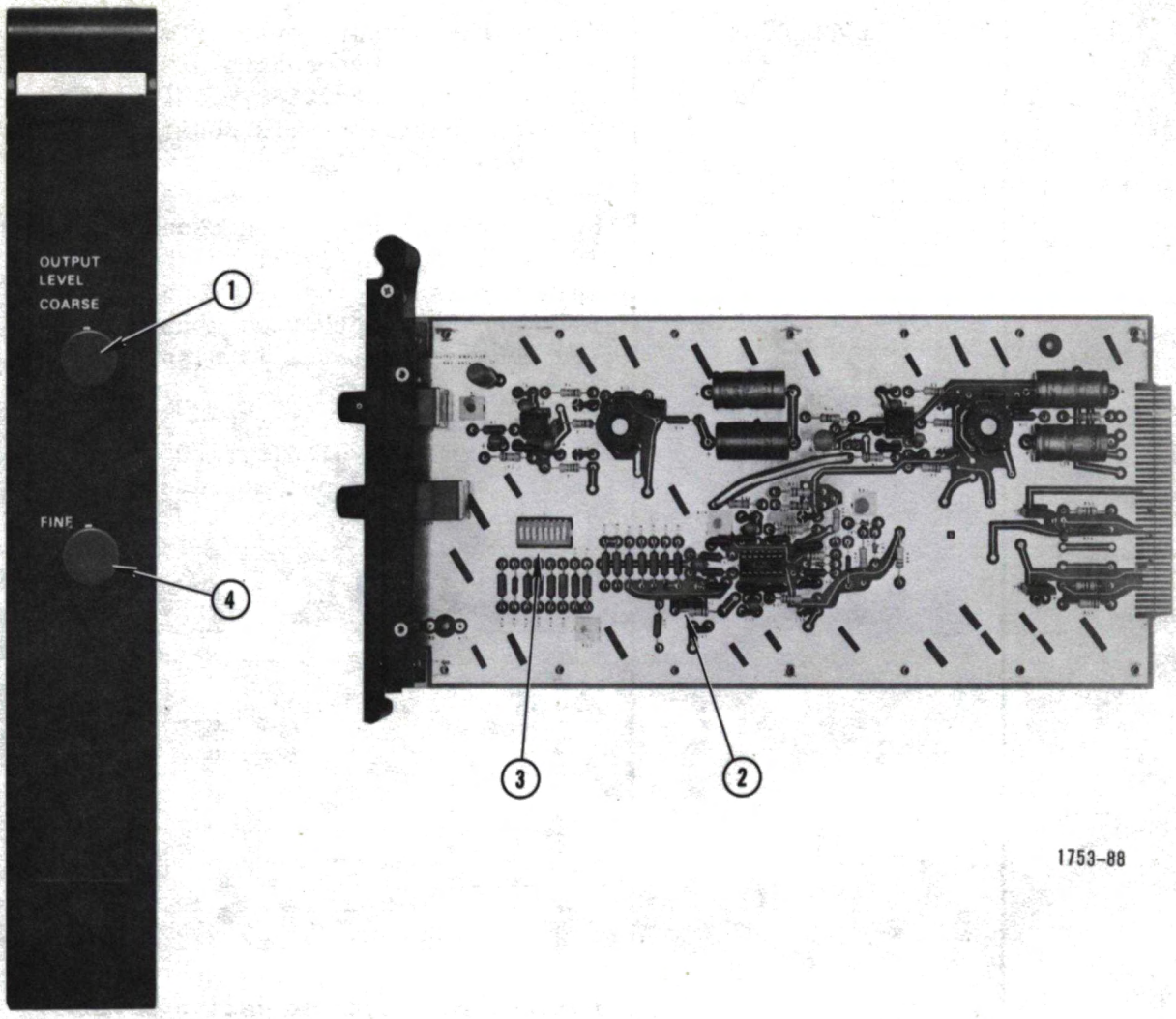

Figure 3-6. Output Module Controls and Indicators

WARNING: Disconnect primarypower prior to servicing.

Table 3-8. Output Module Controls and Indicators

REF.	CONTROL/INDICATOR	FUNCTION
1	OUTPUT LEVEL COARSE, 7R50	Adjusts the output level from zero to full output. This control is normally set for 90% transmitter modulation with the FINE control at mid position.
2	JUMPER PLUG, 7P2	Determine the source of signal feeding the program meter. When connected to J1 and J2, output level of the output amplifier is displayed. When J2 and J3 are connected protection module relative modulation level is displayed.
3	METER SENSITIVITY, 7S1	Selects sensitivity for the program meter which will display 100% modulation for the specified output level (dBm) as follows: CLOSED POSITION — dBm OUTPUT FOR 100% MODULATION 1 — +4 2 — +8 3 — +10 4 — +12 5 — +14 6 — +16 7 — +18 When 7P2 connects J2 and J3, position 8 is closed and all others are opened to indicate relative modulation level.
4	FINE, 7R49	Adjusts output level over a 2 dB range. Once modulation percentage is set approximately with the COARSE control, the FINE control trims the level to the exact value required.

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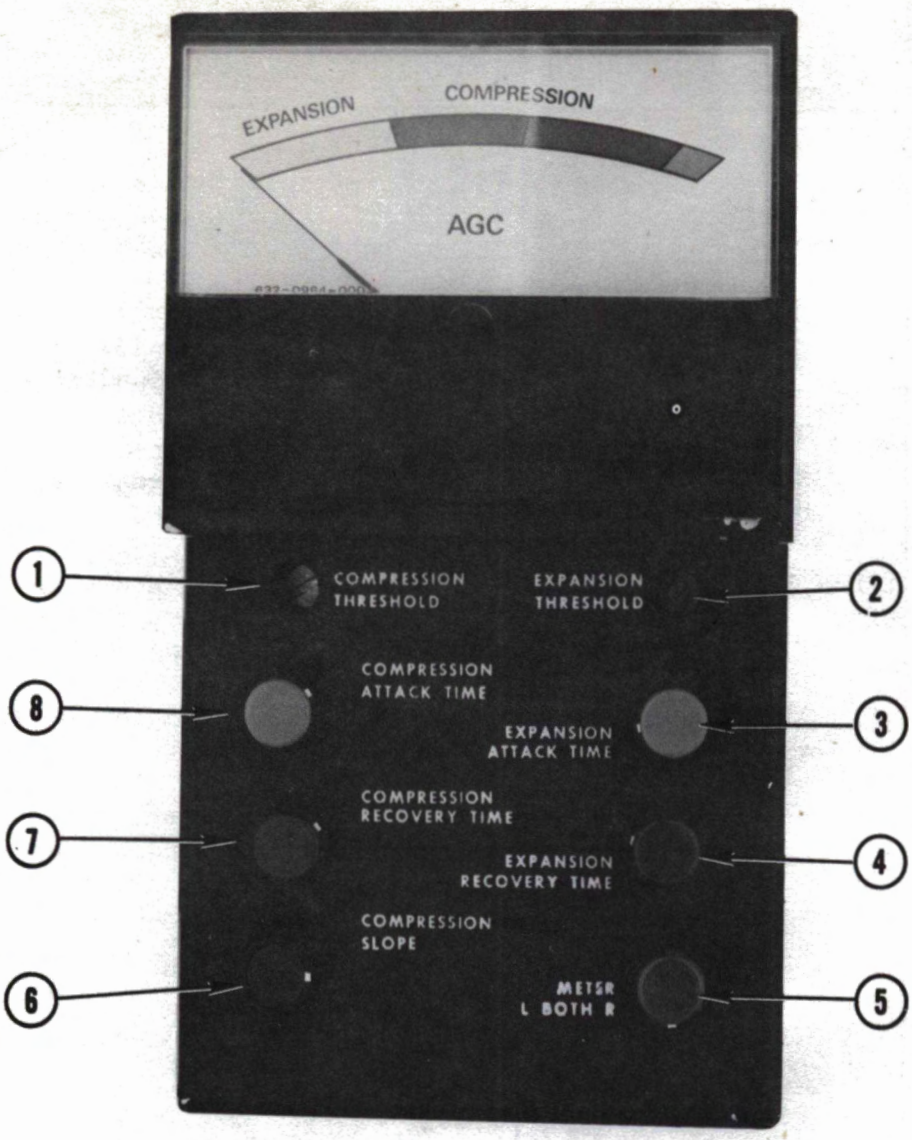

Figure 3-7. AGC Meter Module Controls and Indicators

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WARNING: Disconnect primary power prior to servicing.

Table 3-9. AGC Meter Module Controls and Indicators

REF.	CONTROL/INDICATOR	FUNCTION
	M1	The AGC meter indicates the amount and rate of AGC compression and expansion in the band controlled by the particular module.
1	COMPRESSION THRESHOLD, 8R20	Recessed to prevent inadvertent adjustment. Sets the AGC output level at which compression begins. Precisely controls the output level of the frequency band, provided the input signal level is sufficient to cause compression.
2	EXPANSION THRESHOLD, 9R30	Recessed to prevent inadvertent adjustment. Sets the AGC output level at which expansion begins. Approximately controls the output level of the frequency band provided the input signal level is sufficient to cause expansion.
3	EXPANSION ATTACK TIME, 9S2	Determines approximately the time the signal level must exceed the expansion threshold before expansion begins as follows: SWITCH POSITION — ATTACK TIME 1 (CCW) — 220 uSec 2 — 800 uSec 3 — 2.4 mSec 4 — 8 mSec 5 (CW) — 24 mSec
4	EXPANSION RECOVERY TIME, 9S1	Determine approximately the time delay after the signal level drops before the gain increases, as follows: SWITCH POSITION — RECOVERY SINGLE TIME 1 (CCW) — 0.4 Sec 2 — 0.8 Sec 3 — 1.5 Sec 4 — 3.0 Sec 5 (CW) — 6.2 Sec

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WARNING: Disconnect primary power prior to servicing.

Table 3-9. AGC Meter Module Controls and Indicators (Continued)

REF.	CONTROL/INDICATOR	FUNCTION
		In the dual recovery mode, this switch scales the recovery time in five ranges proportional to the single recovery settings.
5	METER/L BOTH R, 9S3	Selects the signal to be monitored by the module meter. L Position: Meter displays the compression or expansion taking place in the left channel. BOTH position: Meter displays the compression or expansion taking place in both channels. In this position, the meter indicates proportional to the greater control signal of the two channels, since the greater signal controls both channels. R Position: Meter displays the compression or expansion taking place in the right channel. NOTE This switch should normally be left in the BOTH position.
6	COMPRESSION SLOPE, 8S3	Selects the amount of output increase for a given input increase above the compression threshold. For example, assuming an input increase of 12 dB, the output increase would be as follows: SWITCH POSITION — OUTPUT INCREASE 1 (CCW) — 4 dB 2 — 2 dB 3 — 1 dB 4 (CW) — 0.5 dB
7	COMPRESSION RECOVERY TIME, 8S1	Determines approximately the delay after the signal drops before AGC gain is fully restored, as follows:

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Table 3-9. AGC Meter Module Controls and Indicators (Continued)

REF.	CONTROL/INDICATOR	FUNCTION
		SWITCH POSITION — RECOVERY SINGLE TIME 1 (CCW) — 0.4 Sec 2 — 0.75 Sec 3 — 1.5 Sec 4 — 3.0 Sec 5 (CW) — 6.2 Sec In the dual recovery mode, this switch scales the recovery time over five ranges proportional to the single recovery settings.
8	COMPRESSION ATTACK TIME, 8S2	Determines approximately the amount of time the signal must exceed the compression threshold before AGC gain reduction beings, as follows: SWITCH POSITION — ATTACK TIME 1 (CCW) — 250 uSec 2 — 800 uSec 3 — 2.5 mSec 4 — 8 mSec 5 (CW) — 25 mSec

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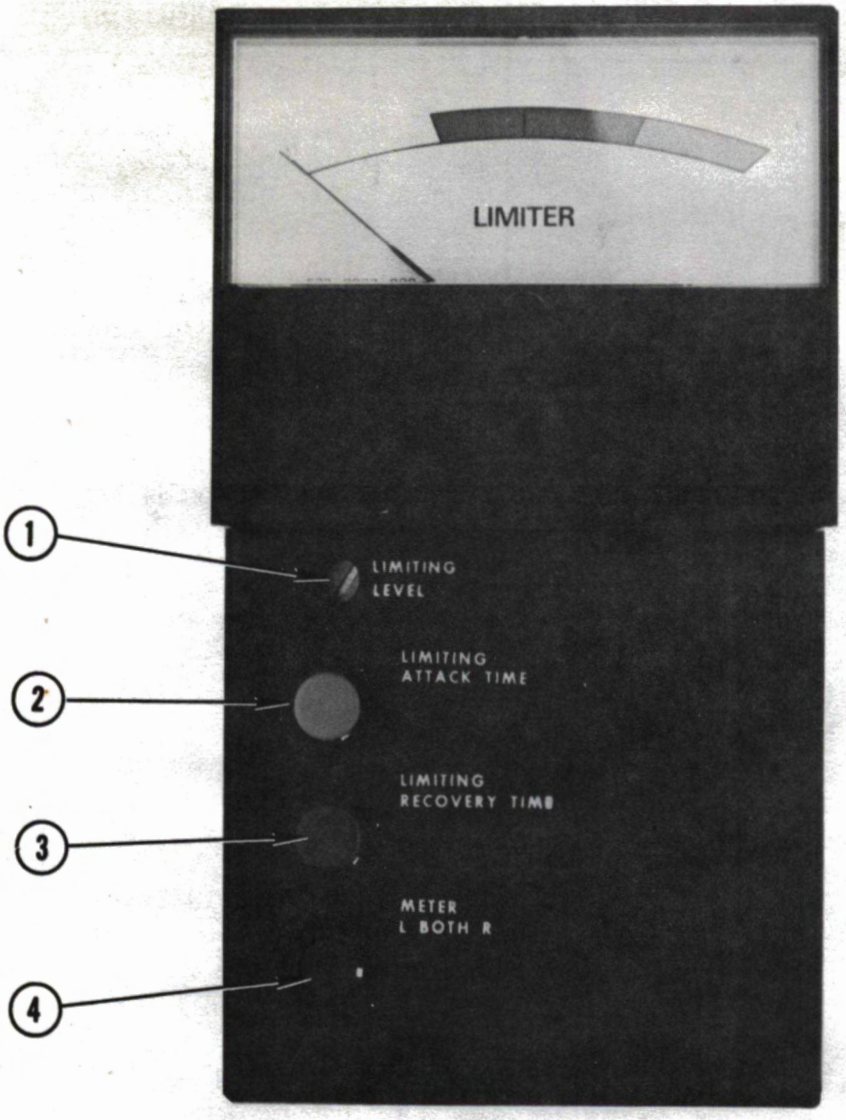

Figure 3-8. Limiter Meter Module Controls and Indicators

WARNING: Disconnect primary power prior to servicing.

Table 3-10. Limiter Meter Module Controls and Indicators

REF.	CONTROL/INDICATOR	FUNCTION
	M1	The limiter meter displays the approximate amount and rate of gain reduction taking place during broadband peak control.
1	LIMITING LEVEL, 10R1	Adjusts the input level to the limiter which determines the amount of limiting taking place.
2	LIMITING ATTACK TIME, 10S2	Determines approximately the time after the limiting threshold is exceeded that proper gain reduction begins as follows: SWITCH POSITION — ATTACK TIME 1 (CCW) — 40 uSec 2 — 100 uSec 3 — 400 uSec 4 — 1.2 mSec 5 (CW) — 3.6 mSec
3	LIMITING RECOVERY TIME, 10S1	Determines approximately the time delay after the signal level drops below limiting threshold before limiter gain returns to its quiescent value as follows: SWITCH POSITION — RECOVERY SINGLE TIME 1 (CCW) — .4 Sec 2 — .75 Sec 3 — 1.5 Sec 4 — 3.0 Sec 5 (CW) — 6.2 Sec In the dual recovery mode this switch scales the recovery time over five ranges corresponding to the single mode settings.
4	METER/L BOTH R, 10S3	Selects the signal to be monitored by the limiter meter. L Position: Displays the control signal from the left channel limiter.

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WARNING: Disconnect primary power prior to servicing.

Table 3-10. Limiter Meter Module Controls and Indicators (Continued)

REF.	CONTROL/INDICATOR	FUNCTION
		BOTH Position: Displays the limiting taking place in both channels, simultaneously, when the left and right limiters are strapped. In this position, the channel with the greater control signal controls the gain of both channels. NOTE This switch should normally be left in the BOTH position. R Position: Displays the control signal from the right channel limiter.

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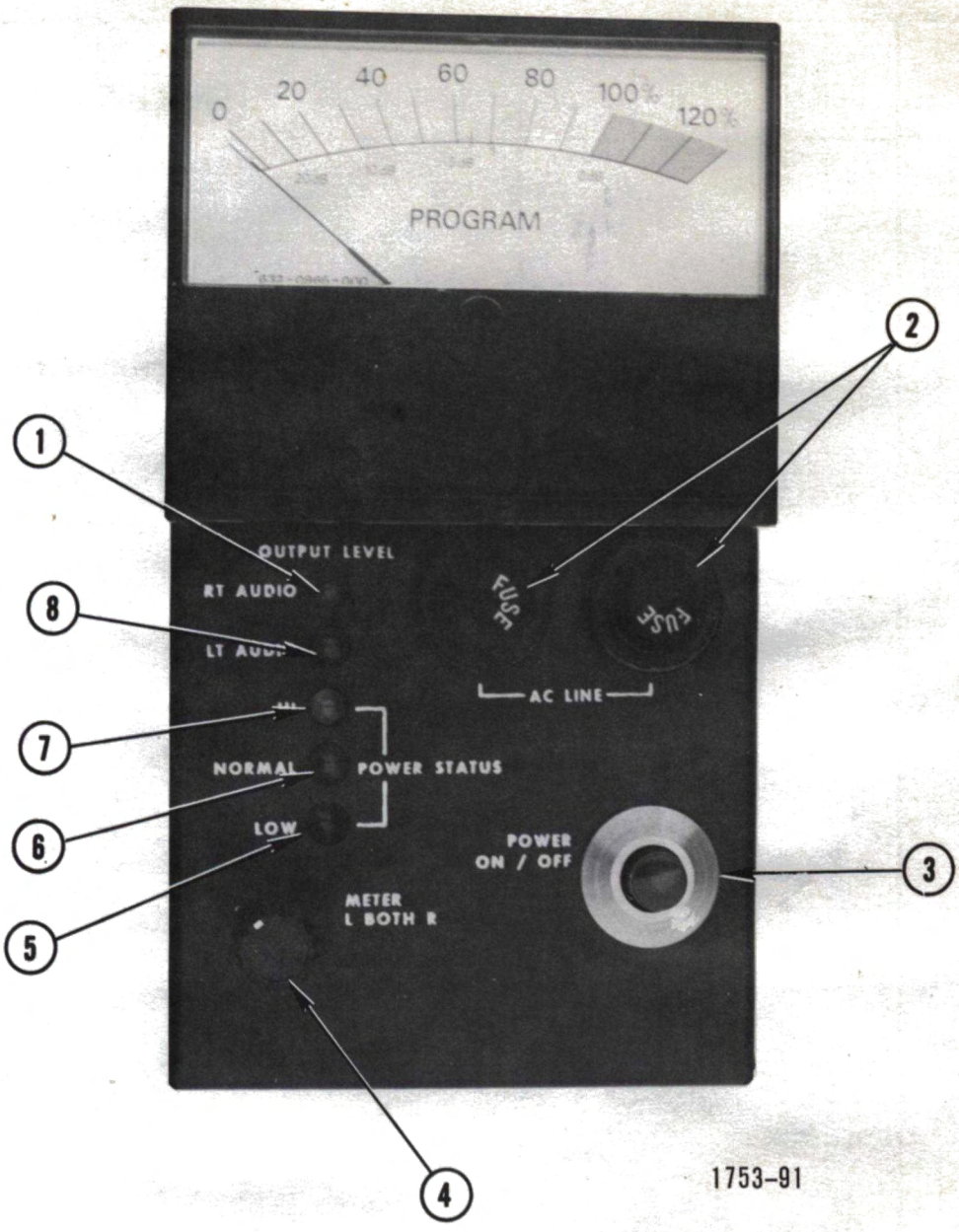

Figure 3-9. Program Meter Module Controls and Indicators

WARNING: Disconnect primary power prior to servicing.

Table 3-11. Program Meter Module Controls and Indicators

REF.	CONTROL/INDICATOR	FUNCTION
1	OUTPUT LEVEL/RT AUDIO, 11DS2	LED indicates presence of significant left channel output when illuminated.
2	AC LINE FUSE, 11F1, 11F2	Fuses for the ac line input to the primary power supply.
3	POWER ON/OFF, 11S2	Pushbutton switch, turns on primary power.
4	METER L/BOTH/R, 11S1	Selects the signal to be monitored by the program meter. L Position: Displays the left channel audio output. BOTH Position: Displays the greater of the left and right channel output. R Position: Displays the right channel output.
5	POWER STATUS/LOW, 11DS5	LED glows when the primary power supply voltage drops below 90% of its rated value.
6	POWER STATUS/NORMAL, 11DS4	LED glows when the primary power supply voltage is within 10% of its rated value.
7	POWER STATUS/HI, 11DS3	LED glows when the primary power supply voltage exceeds 110% of its rated value.
8	OUTPUT LEVEL/LT AUDIO, 11DS1	LED indicates presence of significant right channel output when illuminated.

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WARNING: Disconnect primary power prior to servicing.

3-5. OPERATIONAL ADJUSTMENT.

3-6. The MSP 100 offers nearly unlimited choices of operational parameter adjustment. Such flexibility also allows possibilities of error in parameter setup. For this reason, it is suggested that the user thoroughly familiarize himself with the controls and indicators of the unit as outlined in paragraphs 3-30 through 3-66 and the effects of adjustment of these parameters. Typical control settings for station programming several different formats are presented in tables 3-12 through 3-17. These settings are intended as a starting point for the user to create his own unique set of adjustments, depending on competition, market preferences, and program format.

3-7. The knob-operated controls should be used for most unit adjustments. It is best to leave the COMPRESSION and EXPANSION THRESHOLD controls at factory settings unless a pink noise generator and a real-time 1/3 octave spectrum analyzer are available. Most static effects can be produced dynamically through careful adjustment of AGC operating parameters. If adjustment of compression and expansion threshold is desired, the user is advised to read carefully paragraphs 3-67 through 3-73, which explain adjustment affects, consideration, and setup procedures. After initially setting the AGC and limiter parameters, the HIGH FREQUENCY MODE control (FM) or the + PEAKS control (AM) should be approximately set for the transmitter used and for the best subjective distortion compromise.

NOTE

In tables 3-12 through 3-17, switch positions are counted CW. Position one is fully CCW.

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Table 3-12. Parameter Setting for Highly Competetive Contemporary, MOR/Top 40/Disco Program Format

PARAMETER SWITCH	SWITCH POSITION					
	CONTROL MODULE	AGC METER MODULE			LIMITER MODULE	LIMITER METER MODULE
		LOW	MID	HIGH		
COMPRESSION ATTACK TIME		2	5	5		2
COMPRESSION RECOVERY TIME		4	3	3(2*)		1
COMPRESSION SLOPE		3	4	4(3*)		
RECOVERY MODE/COMPRESSION/DUAL/SINGLE	SINGLE				DUAL	
EXPANSION ATTACK TIME		3	3	3		
EXPANSION RECOVERY TIME		4	2	2		
RECOVERY MODE/EXPANSION/DUAL/SINGLE	SINGLE				SINGLE	

CROSSOVER FREQUENCIES (1S2 AND 1S2 ON INPUT/AGC CIRCUIT BOARD): LOW 230 Hz, HIGH 2450 Hz

*SWITCH POSITION FOR AM MSP 100 ONLY.

Table 3-13. Parameter Settings for Top 40/Contemporary MOR/ Modern C & W/R & B Program Format

PARAMETER SWITCH	SWITCH POSITION					
	CONTROL MODULE	AGC METER MODULE			LIMITER MODULE	LIMITER METER MODULE
		LOW	MID	HIGH		
COMPRESSION ATTACK TIME		4	5	4		1
COMPRESSION RECOVERY TIME		4	3	4(2*)		2
COMPRESSION SLOPE		3	3	3		
RECOVERY MODE/COMPRESSION/DUAL/SINGLE	SINGLE				SINGLE	
EXPANSION ATTACK TIME		3	3	3		
EXPANSION RECOVERY TIME		4	2	2		
RECOVERY MODE/EXPANSION/DUAL/SINGLE	SINGLE				SINGLE	

CROSSOVER FREQUENCIES (1S2 AND 1S3 ON INPUT/AGC CIRCUIT BOARD): LOW 230 Hz, HIGH 2180 Hz

*SWITCH POSITION FOR AM MSP 100 ONLY.

Table 3-14. Parameter Settings for Variety Program Format

PARAMETER SWITCH	SWITCH POSITION					
	CONTROL MODULE	AGC METER MODULE			LIMITER MODULE	LIMITER METER MODULE
		LOW	MID	HIGH		
COMPRESSION ATTACK TIME		2	4	4		(*2)
COMPRESSION RECOVERY TIME		3	3	3		(*3)
COMPRESSION SLOPE		3	2	3		
RECOVERY MODE/COMPRESSION/DUAL/SINGLE	DUAL				(*SINGLE) DUAL	
EXPANSION ATTACK TIME		4	2	2		
EXPANSION RECOVERY TIME		2	2	2		
RECOVERY MODE/EXPANSION/DUAL/SINGLE	SINGLE				SINGLE	

CROSSOVER FREQUENCIES (1S2 AND 1S3 ON INPUT/AGC CIRCUIT BOARD): LOW 230 Hz, HIGH 2180 Hz

*ATTACK AND RECOVERY TIME/AUTO RECOMMENDED.

Table 3-15. Parameter Settings for Talk/News Program Format

PARAMETER SWITCH	SWITCH POSITION					
	CONTROL MODULE	AGC METER MODULE			LIMITER MODULE	LIMITER METER MODULE
		LOW	MID	HIGH		
COMPRESSION ATTACK TIME		1	5	4		(*4)
COMPRESSION RECOVERY TIME		4	2	2		(*2)
COMPRESSION SLOPE		4	2	3		
RECOVERY MODE/COMPRESSION/DUAL/SINGLE	SINGLE				SINGLE	
EXPANSION ATTACK TIME		4	2	2		
EXPANSION RECOVERY TIME		2	2	2		
RECOVERY MODE/EXPANSION/DUAL/SINGLE	SINGLE				SINGLE	
CROSSOVER FREQUENCIES (1S2 AND 1S3 ON INPUT/AGC CIRCUIT BOARD): LOW 105 Hz, HIGH 2450 Hz						
*ATTACK AND RECOVERY TIME/AUTO RECOMMENDED						

Table 3-16. Parameter Settings for AOR/Jazz/Album Oriented Popular Program Format

PARAMETER SWITCH	SWITCH POSITION					
	CONTROL MODULE	AGC METER MODULE			LIMITER MODULE	LIMITER METER MODULE
		LOW	MID	HIGH		
COMPRESSION ATTACK TIME		4	5	5		(*3)
COMPRESSION RECOVERY TIME		3	2	3		(*2)
COMPRESSION SLOPE		3	2	2		
RECOVERY MODE/COMPRESSION/DUAL/SINGLE	DUAL				(*SINGLE) DUAL	
EXPANSION ATTACK TIME		2	3	3		
EXPANSION RECOVERY TIME		2	2	2		
RECOVERY MODE/EXPANSION/DUAL/SINGLE	DUAL				DUAL	

CROSSOVER FREQUENCIES (1S2 AND 1S3 ON INPUT/AGC CIRCUIT BOARD): LOW 230 Hz, HIGH 2180 Hz

*ATTACK AND RECOVERY TIME/AUTO RECOMMENDED

Table 3-17. Parameter Settings for Beautiful Music/Serious/Classical Program Format

PARAMETER SWITCH	SWITCH POSITION					
	CONTROL MODULE	AGC METER MODULE			LIMITER MODULE	LIMITER METER MODULE
		LOW	MID	HIGH		
COMPRESSION ATTACK TIME		3	5	3		(*2)
COMPRESSION RECOVERY TIME		4	4	4		(*3)
COMPRESSION SLOPE		2	2	2		
RECOVERY MODE/COMPRESSION/DUAL/SINGLE	DUAL				DUAL	
EXPANSION ATTACK TIME		4	4	4		
EXPANSION RECOVERY TIME		4	4	4		
RECOVERY MODE/EXPANSION/DUAL/SINGLE	SINGLE				SINGLE	
CROSSOVER FREQUENCIES (1S2 AND 1S3 ON INPUT/AGC CIRCUIT BOARD): LOW 230 Hz, HIGH 1680 Hz						
*ATTACK AND RECOVERY TIME/AUTO RECOMMENDED						

3-8. ADJUSTMENT OF INPUT LEVEL.

3-9. The final setting of 1R104, the INPUT LEVEL control, depends upon the desired use of the MSP 100; that is, station format and market preferences. Some generalized statements can be made, however. As long as the AGC meter pointers stay below the black mark in the center of the green portion of the meter scale, expansion and compression will cancel each other during program pauses, maintaining the signal to noise ratio. If the pointers travel into the leftmost green portion of the scale, gain reduction will be almost unnoticeable. The greater the travel into the green region, the greater will be the gain reduction.

3-10. The program formats illustrated in tables 3-13, 3-14, and 3-15 would imply operation such that the AGC meter pointers travel no further than the half way mark into the green region. For the formats illustrated in tabels 3-16 and 3-17, the pointers would travel just slightly into the green region occasionally, if at all. Operation such that the AGC meter pointers occasionally exceed the half way point of the green region would be typical of settings with the format illustrated in table 3-12.

NOTE

When setting input level, the left channel should be adjusted first, then the right channel adjusted to match, using the procedure of Section II, paragraph 2-22.

3-11. ADJUSTMENT OF LIMITING LEVEL.

3-12. The LIMITING LEVEL control has been adjusted at the factory, and in most installations, should not require adjustment. If adjustment is required, it is recommended that the control be adjusted so that the limiter meter indicates slightly upscale with a 700 Hz tone at sufficient level to cause 12 dB (mid-scale) compression in mid band applied. Adjustment for greater limiting will result in the limiter control effects dominating over AGC.

3-13. DEGREE OF COMPRESSION.

3-14. This characteristic is a function of three variables. Input level, compression recovery time, and compression slope primarily determine the dynamic range reduction. The farther the AGC meter pointers swing through the green region and the faster they move, the greater the compression. Because of the split band nature of the MSP 100, it is not necessary to employ quite as much compression in order to achieve the same sound intensity as with conventional broadband AGC units.

3-15. SOUND INTENSITY.

3-16. This characteristic is primarily a function of compression recovery time, although it is affected by input level and compression slope.

Greater intensity is obtained when input level is adjusted to cause greater AGC meter deflection into the green range, compression slope is set to a higher (CW) value, and most important, compression recovery time is set faster (CCW).

3-17. PUNCH.

3-18. This characteristic can be described as the ability of a signal burst in one part of the spectrum to temporarily domoniate MSP 100 output to emphasize the importance of that portion of the spectrum without doing so on a steady state basis. This is accomplished by setting the compression slope lower and the compression recovery slower in the band to be emphasized.

3-19. BRIGHTNESS.

3-20. Emphasis of high frequencies contributes to brightness. Adjustment of the high band AGC will primarily affect brightness in AM application, although adjustment of the mid band and low band to give the high band dominance will achieve the same effect. In FM application, it may be desireable to adjust the high band AGC for slight attenuation of high frequencies. This will result in less high frequency input to the protection module and a significant reduction in intermodulation distortion which can reduce brightness significantly.

3-21. INTERACTION OF OPERATIONAL PARAMETERS.

3-22. Due to the wide range of operational parameter adjustments possible in the MSP 100, a given effect may be caused by variation of any one of several different parameters. This section identifies common effects of parameter adjustment and associates certain control effects with certain parameters or combinations thereof.

3-23. COMMON EFFECTS.

3-24. INCREASE IN OUTPUT LEVEL. Variation of the following parameter control as indicated will increase output from a particular AGC band or from the limiter:

INPUT LEVEL - CW

COMPRESSION ATTACK TIME - CW (slower)

LIMITING ATTACK TIME - CW (slower)

COMPRESSION RECOVERY TIME - CCW (faster)

LIMITING RECOVERY TIME - CCW (faster)

COMPRESSION SLOPE - CCW (lower)

EXPANSION ATTACK TIME - CCW (faster)

EXPANSION RECOVERY TIME - CW (slower)

3-25. DECREASE IN OUTPUT LEVEL. Perform the inverse action with the controls listed in paragraph 3-24.

3-26. INCREASE IN SYSTEM DISTORTION. Total MSP 100 distortion will be increased by parameter control variations as follows:

INPUT LEVEL - CW

COMPRESSION ATTACK TIME - CCW (faster)

LIMITING RECOVERY TIME - CCW (faster)

COMPRESSION RECOVERY TIME - CCW (faster)

COMPRESSION SLOPE - CCW (lower)

EXPANSION ATTACK TIME - CCW (faster)

EXPANSION RECOVERY TIME - CCW (faster)

LIMITING ATTACK TIME - CW and CCW extremes

PROTECTION MODULE - Improper transmitter match settings

3-27. DECREASE IN SYSTEM DISTORTION. Perform the inverse action with the control listed in paragraph 3-26.

3-28. SIGNAL DROPOUTS OR HOLES FOLLOWING PEAKS. Coincidental adjustment of some or all of the following parameter controls will result in audible dynamic signal degradation:

COMPRESSION ATTACK TIME - mid position

COMPRESSION RECOVERY TIME - 3 CW positions

EXPANSION RECOVERY TIME - CCW (faster)

LIMITER ATTACK TIME - CCW (faster)

LIMITER RECOVERY TIME - CW (slower)

3-29. TRI-BAND AGC OFFSET. Several dynamic effects are possible by offsetting AGC parameters with respect to each other.

a. Time Constants. Smooth, identical band action will occur when all time constants (attack and recovery) are set symmetrically in all

three bands. This condition insures consistent spectral distribution. Dynamically, the density of signal in each band is largely a function of compressor recovery time. Offset of recovery time permits density variation from band to band; the bands set faster having greater density. Sensitivity of AGC to small signal transients being set by the attack time control, it is sometimes advantageous to offset attack times so that a signal peak in one band does not result in as much broadband limiting as an equal peak in another band. The band with the slower attack time will be the emphasized band.

b. Compression Slope. As with time constants, equal ratio assures smooth and identical action. If the compression ratio is offset lower (CCW) in one band than the others, the output of that band increases and will exhibit slight domination over others in the processor output. In some applications, it may be desirable to allow a different amount of compression tightness (input vs output) in each band to permit a band to sound tighter or more free than others. These characteristics all are shaped by offset of compression ratio.

c. Frequency Response. The static (steady-state) response of the tri-band AGC is set at the factory to exhibit flat output spectral distribution for most compression levels. Tone sweep tests will reveal varying responses for different amounts of expansion and compression even though the pink noise - real-time analyzer response plot will show no response variations. The dynamic modifications of the signal possible through adjustment of time constants for both compression and expansion and compression ratio will accomplish the same effects dynamically as a change in static frequency response. All that is necessary is that the parameters be varied in the affected bands as outlined in paragraph 3-72.

3-30. EFFECTS OF INDIVIDUAL CONTROL ADJUSTMENT.

3-31. INPUT SENSITIVITY SWITCH (1S1).

3-32. The input sensitivity switch should be set to the nominal input level used. If it is only set so that the AGC meters do not pin, it is possible to overdrive the input stage. A good general rule is to set the switch so the INPUT LEVEL control is in the right-hand half of its rotation with normal signal conditions.

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3-33. LOW FREQUENCY CROSSOVER SWITCH (1S2).

3-34. The range of frequencies over which the low AGC acts is set by this switch. Also, the lower limit of the mid band is selected. It may be set to include 20% to 40% of the total audio spectrum or none at all. The dynamic enhancement/attenuation characteristics provided by adjustment of AGC parameters will be effective over the portion of the spectrum selected. With the switches set for 95 Hz, the low AGC band would be effective only on the "deepest" bass and a significant amount of low frequency material would be processed by the mid band AGC. A switch setting of 320 Hz would assure processing of all bass by the low band AGC as well as the lower part of the midrange.

3-35. HIGH FREQUENCY CROSSOVER SWITCH (1S3).

3-36. The range of frequencies over which the high frequency band AGC acts is set by this switch. The high band AGC can cover 15% to 35% of the audio spectrum. The dynamic enhancement/attenuation characteristics provided by adjustment of high band AGC operating parameters will be effective over the portion of the spectrum selected. A setting of 7200 Hz would result in the high band AGC processing mostly overtones and percussives and would have little effect on voice. The presence range, three to five hilohertz, would be regarded as midrange and processed by the mid band AGC. Selection of 2450 Hz as the high frequency crossover would allow significant presence range processing.

3-37. COMPRESSION, EXPANSION, AND LIMITER FUNCTION SWITCHES (2S3, 3S2, 4S1).

3-38. These switches will normally remain in the ON position except when the unit is undergoing performance measurements. They are intended to aid in maintenance and troubleshooting. Left and right control module switches must be set identically. If this is not done, 12 dB errors in AGC meter indication and control confusion will result.

3-39. COMPRESSION, EXPANSION, AND LIMITING RECOVERY MODE SWITCHES (2S4, 3S4, 5S1).

3-40. In the single mode, the recovery time is set to a constant value selected by the RECOVERY TIME control on the appropriate meter module. In the dual mode, it is not possible to specify a value for the recovery time. Fast transient peaks will cause very rapid recovery (in milliseconds), but long sustained signal averages will increase the recovery time up to eleven times the selected single value. The recovery time varies with the nature of the program signal. AGC and limiter action is not significantly audible on fast transients and is slower and non-violent on signal averages. The result is a sound less "self-modulated" by transients. Due to stereo gating, these switches must be set identically. in left and right channels for proper stereo operation.

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3-41. COMPRESSION THRESHOLD CONTROL (8R20).

3-42. The cut-in level of AGC output to cause compression is set by this control. Since compression slope may be set to any one of four values, it does not define a single input-output relationship. It does, however determine the point at which that ratio departs from linear, as shown in figure 3-10.

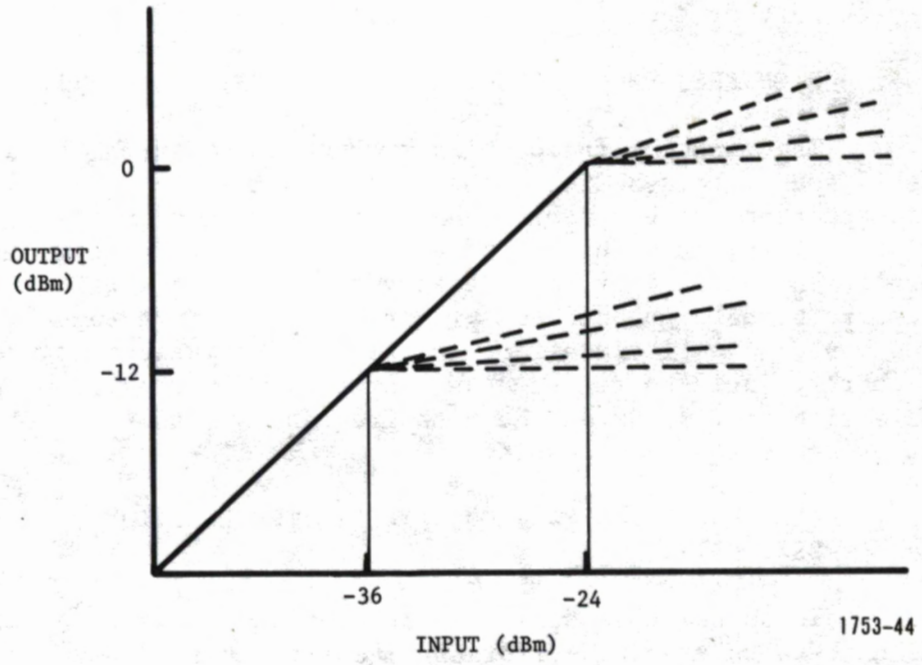

Figure 3-10. Cut-In Level of COMPRESSION THRESHOLD Control

At maximum CW, compression starts at an input level of -36 dBm: at maximum CCW it starts at -24 dBm. Interaction exists between expansion and compression thresholds. If expansion threshold is about 30% CCW and compression threshold is maximum CW, the expansion cut-out level corresponds to an input level of -30 dBm and the compression cut-in level starts at an input level of -30 dBm. There is no "dead spot" of linear gain separating expansion and compression and the expansion range is reduced and pre-empted by compression; only 6 dB expansion occurs before compression. Significant AGC meter errors will occur under this condition, and it is recommended that thresholds be adjusted carefully so as to ensure full 12 dB expansion range before compression.

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3-43. EXPANSION THRESHOLD CONTROL (9R30).

3-44. Since this control adjusts the point at which expansion beings, its setting affects the input-output relationship as shown in figure 3-11.

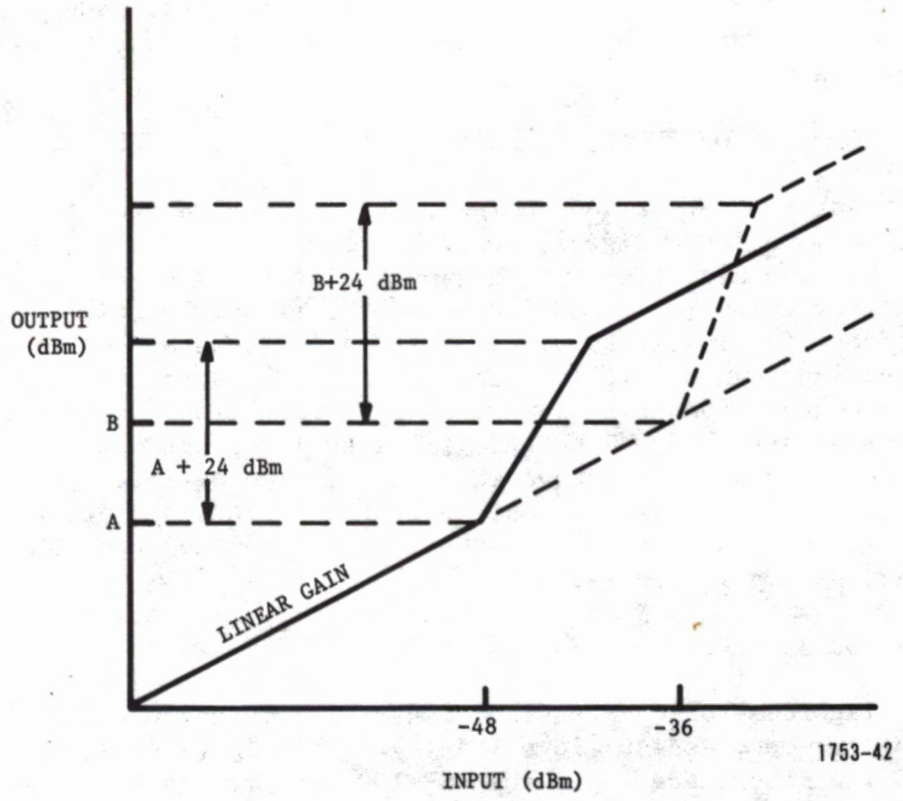

Figure 3-11. Effect of EXPANSION THRESHOLD Control Adjustment

At maximum CW position, expansion starts at an input level of -48 dBm and ceases at -36 dBm. As the threshold is increased by CCW rotation, these points move upward. The greater the expansion, the greater the drive to the compression section and the higher the signal output level. In some applications it is desired to adjust expansion threshold and compression threhsold to provide a dead spot of linear gain between compression and expansion. This results in a natural sound with mid-level expansion and top-level compression. In other applications, anything near or above the compression threshold may be regarded as significant and all other signals regarded as noise, in this case, where maximum loudness and processing is desired, the expansion threshold will be adjusted so that expansion range upper limit coincides with the threshold of compression.

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3-45. COMPRESSION ATTACK TIME SWITCH (8S2).

3-46. The compressor's characteristic sound and interaction with the limiter is to a large extent a function of its attack time. Interaction

with the limiter is minimized in the slowest and fastest positions. However, fast attack can cause transient intermodulation of some limited-bandwidth signals. Given the split-band AGC system, it is possible for slow attack times to force the limiter and protection modules to work harder, to a degree defeating the smooth control characteristics of the parallel-split-band system. On the other hand, fast AGC attack may significantly reduce one band's gain when the amplitude of the others is such that the resultant sum would not cause broadband limiting.

3-47. COMPRESSION AND LIMITING RECOVERY TIME SWITCHES (8S1, 10S1).

3-48. Fast recovery allows quick gain restoration from a compression condition for a more dense signal, sometimes referred to as louder or tighter compression. It can also result in harmonic distortion due to partial recovery on half-cycles or self-modulation of the signal by itself. This self-modulation effect is similar to vibrato with a non-constant repetition rate. Slow recovery times can result in significant excess attenuation (dropouts or holes) following strong signal-induced gain reduction, particularly when fast attack times are used. RECOVERY TIME also interacts with the amount of compression. For a given change in gain and time period, one time constant is defined at 6 dB compression, another at 12 dB, and yet another at 18 dB. Recovery time should be adjusted to match nominal compression, becoming longer as compression increases.

3-49. COMPRESSION SLOPE SWITCH (8S3).

3-50. Tightness of compression or dynamic range reduction is largely influenced by the compression slope (ratio). This is very significant once 3 dB compression is exceeded. In the MSP 100, the ratios given for the various switch positions are valid from 6 dB to 18 dB compression. Outside this window, the ratio will approximate but not exactly match specified ratios due to circuit nonlinearities. The audibility of compression is least at position 1 (12:4) and greatest at position 4 (12:0.5). The amount of control required in the limiter module to prevent overmodulation is increased in the low ratio position, given a constant setting of the LIMITING LEVEL control. The COMPRESSION SLOPE control can be looked on as setting either the degree of dynamic range reduction (assuming gentle limiting) or the amount of punch a significant pulse in one band will have over signals from other bands at the limiter output.

3-51. EXPANSION ATTACK TIME SWITCH (9S2).

3-52. In the fastest position, short transients will enable expansion and cause a 2 dB output increase in the AGC for every 1 dB input increase. Slower attack assures that signal averages will activate expansion.

3-53. EXPANSION RECOVERY TIME SWITCH (9S1).

3-54. The fast positions provide rapid gain reduction when signal drops, in some cases sufficiently fast to cause audible dropouts as some

program material makes quick changes in level. Slow recovery results in slow gain reduction after input level drops. Some program material will exhibit significant swish-up in background noise if slow recovery is used. A good rule of thumb is to set expansion recovery equal to compression recovery. When input disappears, expansion and compression recovery will decay at the same rate and maintain signal-to-noise ratio provided that average compression does not exceed 12 dB.

3-55. METER SWITCH (AGC AND LIMITER METER MODULES) (9S3, 10S3).

3-56. The signal monitored in L or R positions is the gain-control signal derived from that channel (left or right). Due to stereo gating (optional in the limiter), the signal observed will not always be the signal that controls AGC action. The greater of the two control signals always controls gain of both left and right channels with stereo gating connected. Special caution should be used in interpreting left-right action during normal program conditions. If the signal is significantly higher in one channel than in the other, gain in the lower level channel may be reduced far enough (by stereo gating) to keep the signal in that channel below the compression threshold, resulting in no meter indication in that channel when the METER SWITCH selects its control signal for monitoring. Gain control still occurs due to the dominating influence of the stronger channel. For this reason, it is strongly recommended that the METER SWITCH be left in the BOTH position under normal program conditions.

3-57. LIMITER ATTACK TIME AUTO/MANUAL SWITCH (4S2).

3-58. In the automatic mode, attack time is based on the spectral distribution of the signal, the presence of higher audio frequencies causing faster attack. Operation in the AUTO mode will eliminate transient intermodulation of limited bandwidth signals but retain fast attack on wideband signals, reducing the transient output to the instant peak control circuits in the protection module.

3-59. LIMITER RECOVERY TIME/AUTO/MANUAL SWITCH.

3-60. In the AUTO mode, recovery time is based on the rate of change in the audio signal envelope. Pulsing signals (voice) select faster recovery times while smooth signals (symphonic music) select slower times. This recovery is conditioned to the nature of the input signal as it changes. This feature does not insure maximum loudness under all program conditions, but rather insures a consistent loudness level as signal type changes.

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3-61. LIMITING ATTACK TIME (LIMITER METER MODULE - 10S2).

3-62. The amount of control of broadband signal by the Protection Module is largely determined by limiter attack time. Slow settings require significant peak control in the protection module, but fast settings assure minimum requirement for protection module broadband action. Fast attack, however, can cause transient intermodulation of some limited-bandwidth signals, and may significantly reduce one channel's gain due to a short peak in the other when stereo gating is employed.

3-63. HIGH FREQUENCY MODE/SOFT/HARD (6R96) (FM).

3-64. The nature of high frequency control is determined by the position of this control. In the SOFT position, high frequency-caused overmodulation is prevented by a gain-reduction circuit acting on high frequencies. Minimum distortion results but the high frequency signal amplitude will be significantly reduced. The HARD mode relies only on clipping circuits to prevent overmodulation. This technique assures maximum high frequency response, but at the expense of some distortion. The Mode control allows the user to compromise the two extremes to his taste. If transmitters not equipped with overshoot-compensated filters, best performance will be obtained in the SOFT position.

3-65. + PEAKS CONTROL (AM).

3-66. The positive peak level, with respect to negative peak level, is established by this control. In situations where regulations permit asymmetrical modulation, the positive peak level may be set to any value up to 130%. However, the control should not be set to any level beyond the capabilities of the transmitter. If the transmitter is only capable of 115%, positive peak input in excess of 115% will only cause wasted power consumption, distortion, and distirbance of negative peak linearity by modulation transformers and reactors. No loudness increase will result.

3-67. RESPONSE CALIBRATION.

3-68. The MSP 100 compression and expansion thresholds are factory adjusted for flat frequency response across the audio spectrum using data obtained by real-time analysis. Since few stations possess a real-time 1/3 octave audio spectrum analyzer and pink noise source, a table of settings obtainable with common test equipment is provided. Table 3-18 is based on real-time analysis adjustment of an MSP 100 and tabulation of single-tone conditions which are present when the MSP 100 is adjusted for given real-time conditions. This table was derived with all MSP 100 AGC parameter selectors in the center of their range and the compression slope at 12:1. If thresholds are adjusted, these parameter conditions should be duplicated during measurements. Crossover frequencies must be at 230 and 2180 Hz. Required test equipment is a low-distortion audio oscillator with metered output, and an accurate voltmeter with dB scale. The oscillator is connected to the left channel input, voltmeter to left output, and the LIMITER FUNCTION and PROTECTION FUNCTION switches set to OFF.

3-69.. FLAT RESPONSE.

3-70. Adjust the oscillator output to the reference (REF) frequency given in table 3-18 at an output level that produces the voltmeter indication specified. The AGC meter pointer (in the appropriate band) should rest between the E and S in the word COMPRESSION printed on the meter face, indicating 12 dB compression. Chante the oscillator frequency to each of the other two frequencies, holding the input level constant, and for each frequency, adjust the COMPRESSION THRESHOLD control on the AGC meter module for that frequency band to obtain the specified voltmeter reading. Alternatively, adjust the COMPRESSION THRESHOLD control for the specified meter reading.

Table 3-18. Flat Response Calibration

OSCILLATOR FREQUENCY	AGC METER (COMPRESSION)	VOLTMETER INDICATION
20 Hz (REF)	E ↑ S	-1 dB
630 Hz	S ↑ S	0 dB
20 kHz	R ↑ E	0 dB
	(EXPANSION)	
20 Hz	S I ↑ O	+1 dB
630 Hz (REF)	A ↑ N	0 dB
20 kHz	A ↑ N	+1 dB

3-71. Adjust the EXPANSION THRESHOLD control in the same manner using the frequencies and levels given in table 3-18.

NOTE

The AGC meter column in the table gives the approximate resting position for the AGC meter pointers with respect to the letters in the word COMPRESSION (or EXPANSION) printed on the meter face.

3-72. NONFLAT RESPONSES.

3-73. Settings for response calibration other than flat are given in table 3-19. The procedure is the same as for flat response except that levels are different and the EXPANSION THRESHOLD control is not involved.

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Table 3-19. Response Calibration for Varying Responses

BOOST/CUT BAND	OSCILLATOR FREQUENCY	AGC METER (COMPRESSION)	VOLTMETER INDICATION
6 dB Cut Low Frequency	20 Hz (REF) 630 Hz 20 kHz	E ↑ S C ↑ ↑ C	-6 dB 0 dB 0 dB
3 dB Cut Low Frequency	20 Hz (REF) 630 Hz 20 kHz	E ↑ S P ↑ R 0 ↑ M	-3 dB 0 dB -0.3 dB
3 dB Boost Low Frequency	20 Hz 630 kHz (REF) 20 kHz	0 ↑ M E ↑ S M P R ↑	0 dB -2 dB -3.5 dB
6 dB Boost Low Frequency	20 Hz 630 Hz (REF) 20 kHz	↑ C E ↑ S P ↑ R	0 dB -4 dB -5 dB
5 dB Cut Mid Frequency	20 Hz 630 Hz (REF) 20 kHz	Approx. 3 dB E ↑ S Approx. 3 dB	0 dB -5 dB -1 dB
3 dB Cut Mid Frequency	20 Hz 630 Hz (REF) 20 kHz	C ↑ 0 E ↑ S ↑C	0 dB -3 dB -1 dB
3 dB Boost Mid Frequency	20 Hz (REF) 630 Hz 20 kHz	E ↑ S 0 ↑ M R ↑ E	-4 dB 0 dB -4 dB

WARNING: Disconnect primary power prior to servicing.

Table 3-19. Response Calibration for Varying Responses

BOOST/CUT BAND	OSCILLATOR FREQUENCY	AGC METER (COMPRESSION)	VOLTMETER INDICATION
6 dB Boost	20 Hz (REF)	E S	-7 dB
Mid Frequency	630 Hz	Approx. 3 dB	0 dB
	20 kHz	P	-4 dB
6 dB Cut	20 Hz	C	-1 dB
High Frequency	630 Hz	O M	0 dB
	20 kHz (REF)	E S	-6 dB
3 dB Cut	20 Hz	P	-1 dB
High Frequency	630 Hz	P R	0 dB
	20 kHz (REF)	E S	-3 dB
3 dB Boost	20 Hz (REF)	E S	-3.5 dB
High Frequency	630 Hz	E	-1.5 dB
	20 kHz	C	0 dB
6 dB Boost	20 Hz (REF)	E S	-5.5 dB
High Frequency	630 Hz	S S	-4 dB
	20 kHz	C	0 dB

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WARNING: Disconnect primary power prior to servicing.

SECTION IV

PRINCIPLES OF OPERATION

4-1. GENERAL.

4-2. This section provides the principles of operation for the MSP 100 Audio Processor System and of the individual subsystems formed by the overall module configuration. The theory of operation is presented at two levels. The first level explains the basic operation using a functional block diagram, and the second level discusses subsystem operation from more detailed block diagrams of the circuits forming the subsystem.

4-3. FUNCTIONAL BLOCK DIAGRAM DISCUSSION.

4-4. The MSP 100 Audio Processor System (figure 4-1) is composed of an aluminum chassis containing ten plug-in modules.

4-5. The ten plug-in modules are as follows:

Left Input/AGC Module A1

Right Input/AGC Module A1

Left Control Module A2/A3

Right Control Module A2/A3

Left Limiter Module A4/A5

Right Limiter Module A4/A5

Left Protection Module A6

Right Protection Module A6

Left Output Module A7

Right Output Module A7

4-6. The five removable meter modules are as follows:

AGC Low Band Meter Module A8/A9

AGC Mid Band Meter Module A8/A9

AGC High Band Meter Module A8/A9

Limiter Meter Module A10

Program Meter Module A11

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WARNING: Disconnect primary power prior to servicing.

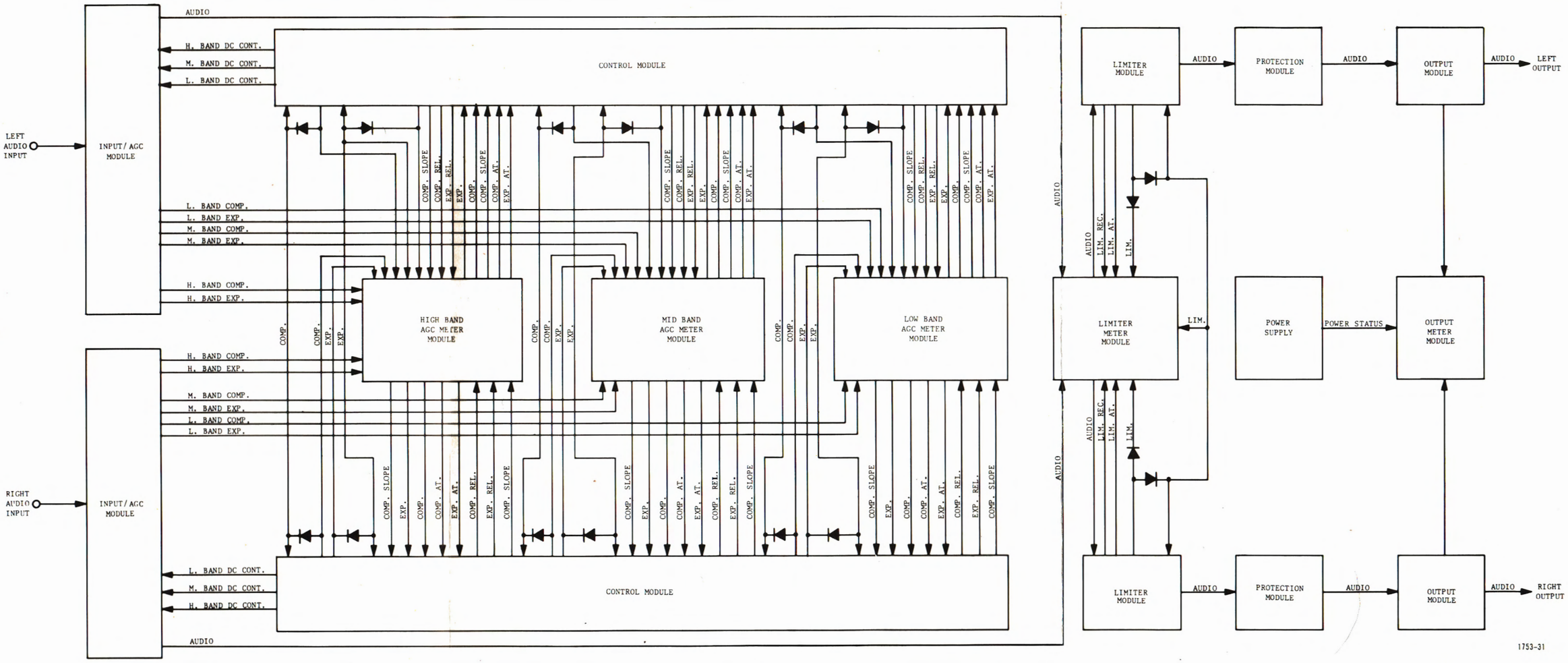

FIGURE 4-1.
MSP-100 AUDIO PROCESSOR
SYSTEM BLOCK DIAGRAM

4-7. INPUT AGC MODULE.

4-8. This module contains all of the audio program signal circuitry used in the AGC section of the system. The sensing and control circuitry controlling the input AGC module is contained in the control and metering moduels.

4-9. The input section of the input AGC module contains an instrumentation amplifier, a buffer and band-splitting filters. The AGC section of this module contains three linear two-quadrant multipliers that control the gain of the three bands, and a summing amplifier in which the three bands are summed. Thus the four outputs of this module are the three bands and their sum.

4-10. CONTROL MODULE.

4-11. The pulse and dc control circuits used to control the AGC section of the system are contained in this module. The module contains two printed circuit boards, one that controls the expansion function, and one that controls the compression function. These boards contain threshold amplifiers, rectifiers, and signal summers that sample the audio and provide control voltage to vary the gain of the AGC to effect expansion or compression.

4-12. LIMITER MODULE.

4-13. The limiter module contains two printed circuit boards, one that controls attack time and one that controls recovery time. This module contains a broadband gain-reduction type peak limiter employing automatic attack and recovery time selection.

4-14. An analog two-quadrant multiplier circuit controls limiter gain. Digital comparators and pulse counters determine time constants.

4-15. FM PROTECTION MODULE.

4-16. The FM protection module contains circuitry that protects the FM exciter from instantaneous overmodulation. This is accomplished by pre-emphasizing the input, splitting it into two bands, limiting the high band, summing the bands, and correcting summation errors.

4-17. AM PROTECTION MODULE.

4-18. The AM protection module performs essentially the same function for AM systems as does the FM protection module, the primary purpose being the prevention of overmodulation. Automatic polarity reversal circuitry is provided to maintain positive asymmetry.

4-19. OUTPUT MODULE.

4-20. The output module contains voltage amplifiers and current boosters to provide a 600 ohm balanced audio output. In addition, this module contains the amplifier circuits that operate the peak program meter.

WARNING: Disconnect primary power prior to servicing.

4-21. AGC METER MODULES.

4-22. The three AGC meter modules (low band, mid band and high band) each contain the circuitry that drives the EXPANSION/COMPRESSION meter mounted on the front of the module. Each module contains two printed circuit cards, one for expansion and one for compression. Controls on the front panel enable control of compression threshold, attack, recovery and slope; and expansion threshold, attack and recovery. A selector switch allows selection of left, right, or both channels for metering.

4-23. LIMITER METER MODULE.

4-24. The Limiter meter module contains switching and adjustment circuitry that controls the LIMITER meter on the front of the module to enable monitoring of limiting level (0 to 12 dB). Controls enable adjustment of limiting level, attack, and recovery. A selector switch allows selection of left, right or both channels for metering.

4-25. PROGRAM METER MODULE.

4-26. The program meter module contains meter driving circuitry that drives the PEAK PROGRAM METER on the front panel of the module, to indicate the output level of the system (expressed in %). A selector switch allows selection of left, right, or both channels for monitoring. In addition, this module contains LED indicators to indicate the status (low, normal or high) of the ±20 vdc power bus.

4-27. FUNCTIONAL SUBSYSTEMS.

4-28. The modules making up the MSP 100 Audio Processor System form five functional subsystems. These are:

a. AGC Control Subsystem

b. Limiting Subsystem

c. Protection Subsystem

d. Output Subsystem

e. Power Subsystem

4-29. AGC CONTROL SUBSYSTEM.

4-30. Five modules comprise the AGC control subsystem (seven for stereo) as shown in figure 4-2. The input/AGC module accepts the audio signal, transforms it, splits it into three frequency bands, and performs compression and expansion by utilizing control signals from the control module. The control module's output is a dc control voltage, for each of the three bands, which is proportional tó the signal amplitude in accordance with a compression factor and expansion factor. In addition, the control voltage is proportional to attack time, recovery time, and the degree of compression being imposed on the signal. The AGC meter modules (one for each frequency band)

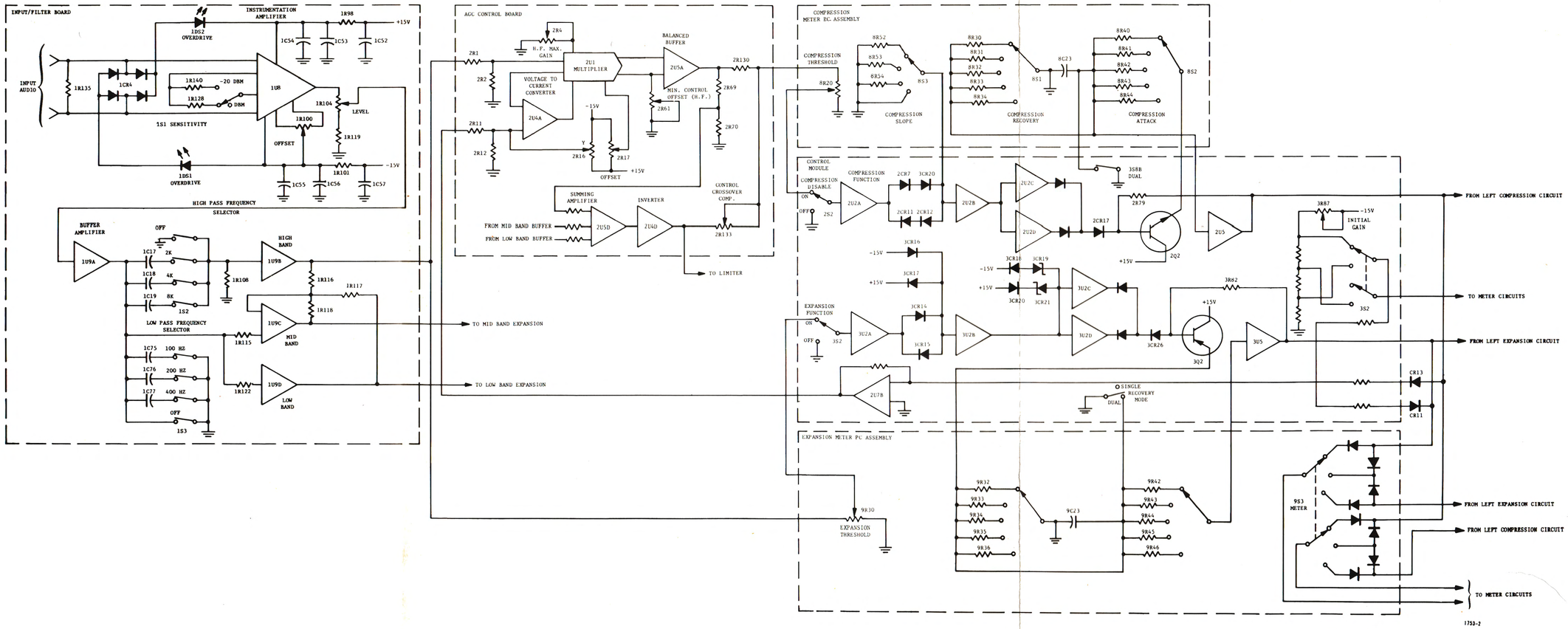

FIGURE 4-2.
AGC CONTROL SUBSYSTEM
BLOCK DIAGRAM

monitor the control module output and display the amount and rate of expansion and compression which is taking place. They also contain the circuit elements which control attack time, recovery time, and threshold controls for both compression and expansion and the compression slope, or compression ratio, controls.

4-31. INPUT FILTER SECTION. The input to the MSP 100 is an instrumentation amplifier, 1U8, buffered by an operational amplifier, 1U9A. 1U8 is a differential input amplifier with input impedance set by external circuit elements at 600 ohms. The input configuration allows either balanced or unbalanced operation with no changes in input elements. The output of 1U9A is fed simultaneously to a high pass filter, 1U9B, and a low pass filter, 1U9D. Rolloff of these filters is 6 dB/octave with corner frequencies selected by DIP switches, 1S2 and 1S3. The mid band is derived by taking a portion of the broadband signal and subtracting from it the sum of the high band and low band signals; this function is performed in 1U9C.

4-32. MULTIPLIER GAIN CONTROLLER SECTION. The multiplier gain controllers perform compression and expansion in response to the control signals from the control module. These devices are monolitihic four-quadrant integrated circuit multipliers which are connected in the two quadrant mode to minimize distortion. The program signal is fed to the Y input and the control voltage is fed to the X input of the multipliers. The resultant output is the product of the two inputs; thus the gain is directly proportional to the control voltage. The control voltages are not used directly; instead they are converted to currents by 1U4A, B, and C. The outputs of the multipliers, 1U1, 1U2, and 1U3, are fed through differential buffer amplifiers, 1U5A, B, and C, to the AGC meter module compression and expansion threshold controls.

4-33. BROAD BAND SUMMER. The outputs of buffers, 1U5A, B, and C, are also fed to the broad band summing amplifier, 1U5D, where they are summed to reconstruct the broad band signal which is buffered by 1U9D. In the output 1f 1U9D are three potentiometers which are used to inject a small amount of each of the three frequency band signals to eliminate dips in the response near the crossover frequencies.

4-34. COMPRESSION AND EXPANSION CONTROL. In figure 4-2, only the low frequency band is shown since the other two bands are identical. The compression and expansion threshold controls set the levels at which compression and expansion begin. The signal enters the control module through buffers, 2U3A and 3U3A. The signal is then amplified by 2U2B and 3U3B. 2U3B also controls the compression slope (the unit output increase for each unit input increase). The expansion signal is clipped (high peaks) before being applied to precision rectifiers 2U3 and 3U3. The outputs of 2U3 and 3U3 charge time constant circuits in the AGC meter modules which control attack and recovery time of both signals. The outputs of the time constant circuits are fed to high input impedance buffers, 2U6 and 3U6, and then to summing amplifier, 2U7A. Here, the compression control signal, twice the expansion control signal, and a negative bias voltage are all summed. The output of 2U7A is routed back to the input/AGC module where it precisely controls the gain of 1U3.

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4-35. LIMITING SUBSYSTEM.

4-36. The primary purpose of the limiting subsystem is to eliminate high peaks in the broad band signal which would cause overmodulation.

4-37. MULTIPLIER GAIN CONTROLLER. Input to the limiter is taken from the LIMITING LEVEL control (located in the limiter meter module) and routed to the Y input of four-quadrant multiplier, 4U2. The multiplier circuit is virtually identical to the AGC control subsystem gain controller. Output of the multiplier is buffered by 4U3 and routed through the LIMITER FUNCTION switch, 4S1, to the peak detector circuit (figure 4-3).

4-38. PEAK DETECTOR CIRCUIT. The peak detector circuit consisting of 4U9A and 4U9B is a symmetrical detector which passes only the positive and negative signal peaks which exceed 5.3 volts in amplitude. The amplitude of these pulses is dependent upon the setting of the LIMITING LEVEL control. The pulses are rectified by a full wave detector consisting of 4U9C and 4U9D and fed to ATTACK TIME switch, 4S2, where either manual attack or automatic attack is selected.

4-39. AUTO ATTACK TIME CIRCUITS. The program signal is routed through LIMITER FUNCTION switch 4S1, to the filter circuits consisting of a low pass filter with cutoff frequency at 1 kHz, four band pass filters centered at 2, 3, 4, and 5 kHz, and a high pass filter with cutoff frequency at 6 kHz. Each filter is followed by a half wave rectifier, a one-second time constant circuit, and a comparator. Whenever the signal component in any band is high enough to trigger its comparator, the LED indicator (4DS1 through 4DS6) for that band illuminates and the comparator output triggers one of the bilateral switches in 4U4 or 4U5, charging the attack time capacitor 4C61. Thus, this circuit provides attack time which is dependent on signal frequency components and at the same time shows visually which frequencies are controlling limiting.

4-40. AUTO RECOVERY TIME CIRCUITS. The program signal is applied directly to full wave rectifier, 5U5A and 5U5B, followed by low pass filter, 5U5C. Since the cutoff frequency of this filter is 10 Hz, its output is a replica of the signal envelope. 5U5D is a zero crossing detector. Every time the output of 5U5C goes positive or negative, 5U5D generates a positive or negative pulse which triggers one shot 5U4. Every time 5U4 is triggered, a 55 millisecond pulse is generated. These pulses are integrated and applied to comparators in 5U6 and 5U7 whose thresholds are set by a ladder network. As the repetition rate of the pulses from 5U4 increases, the voltage from the integrator rises and a comparator is turned on, it adds resistance across the discharge path of 4C61 which speeds up the discharge rate, since the resistances are in parallel. Thus, the recovery time is adjusted automatically to the signal envelope peak rate. As each comparator is turned on, its corresponding LED indicator (5DS1 through 5DS8) is also turned on providing a visual indication of recovery time.

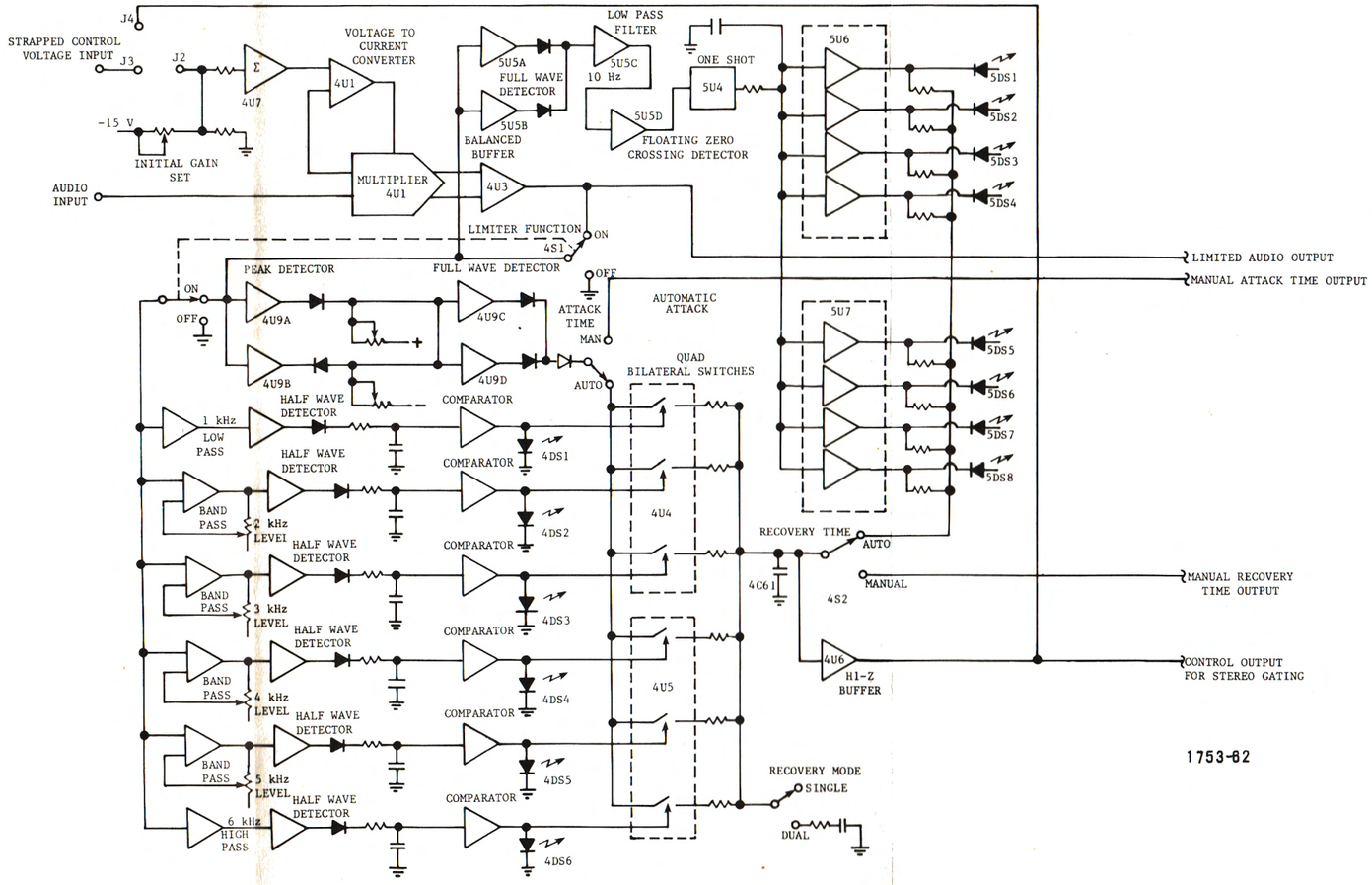

FIGURE 4-3.
LIMITING SUBSYSTEM
BLOCK DIAGRAM

4-41. SUMMING AMPLIFIER. The voltage across 4C61 is applied to 4U6, a high input impedance voltage follower, to prevent leakage currents from disturbing the attack and recovery time circuits. A negative bias voltage is fed to the summing junction of 4U7. The INITIAL GAIN SET control adjusts this bias which in turn determines the output voltage (the control voltage applied to multiplier 4U2) of 4U7 with no limiting taking place. Jumper plug 4P2 selects independent limiter operation or strapped (left and right) operation. With 4P2 connecting J2 and J4, the output of 4U6 is summed with the negative bias voltage. With 4P2 connecting J1 and J3, both limiter outputs are routed to stereo gating diodes on the mother board and the greater control voltage controls both limiters.

4-42. LIMITER METER MODULE. In addition to providing a meter readout (taken from the output of 4U7) of the amount of limiting taking palce, the limiter meter module contains the manual attack time and recovery time circuits, the LIMITING LEVEL control, and a switch which selects either left channel, right channel, or both channels for monitoring.

4-43. OUTPUT SUBSYSTEM.

4-44. AUDIO AMPLIFIER. The audio signal from the protection module is applied to noninverting amplifier, 7U1, and inverting amplifier, 7U3 through the COARSE and FINE OUTPUT LEVEL controls (figure 4-4). Current boosters, 7U2 and 7U4, are included in the feedback loops of 7U1 and 7U3 to provide the low impedance drive required for the output. Capacitor pairs, 7C24, 7C25 and 7C26, 7C27 provide nonpolarized ac coupling for the output circuit.

4-45. METER AMPLIFIER. The output signal is attenuated and applied to differential amplifier, 7U5A. Jumper plug, 7P2, selects either the output signal or a signal from the protection module for monitoring. Sensitivity of the program meter (located on the program meter module) is determined by the gain of 7U5B. Closing the proper element of 7S1, causes the meter to indicate 100% modulation for a given output level in dBm. Element 8 of the switch is used when the protection module signal is being monitored. The output of 7U5B is rectified by 7U5C, amplified by 7U5D and finally fed to the remainder of the meter amplifier located in the program meter module.

4-46. POWER SUBSYSTEM.

4-47. PRIMARY POWER SUPPLY. The power subsystem of the MSP 100 uses a dual regulation scheme to prevent loss of the entire system if a module should fail. As shown in figure 4-5, the primary power supply provides +20 and -20 vdc to all the modules except the meter modules. (The ±20 vdc used in the program meter module is for the power status indicating circuit.) The components are located on the main frame chassis, the power supply PC assembly, and in the program meter module.

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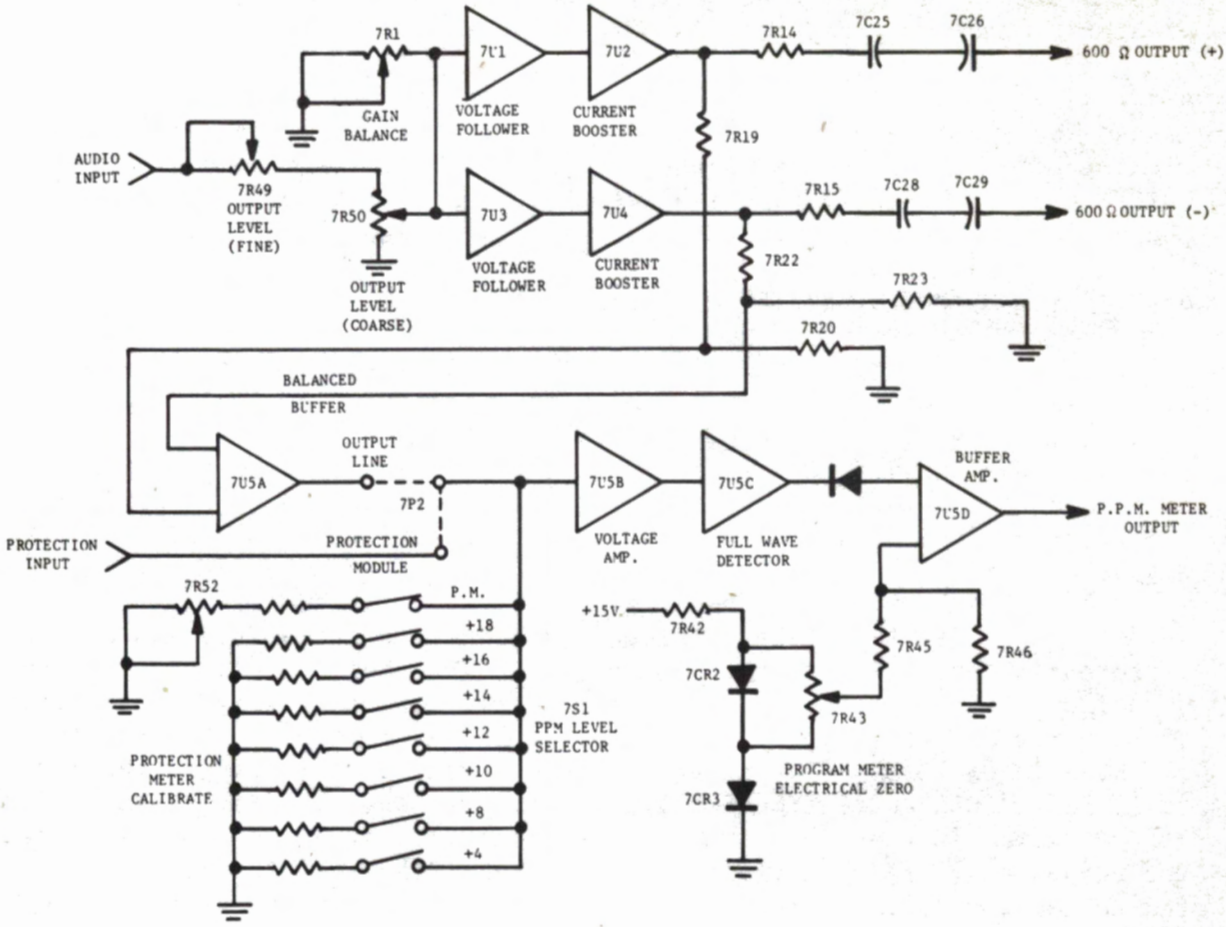

Figure 4-4. Output Subsystem, Block Diagram

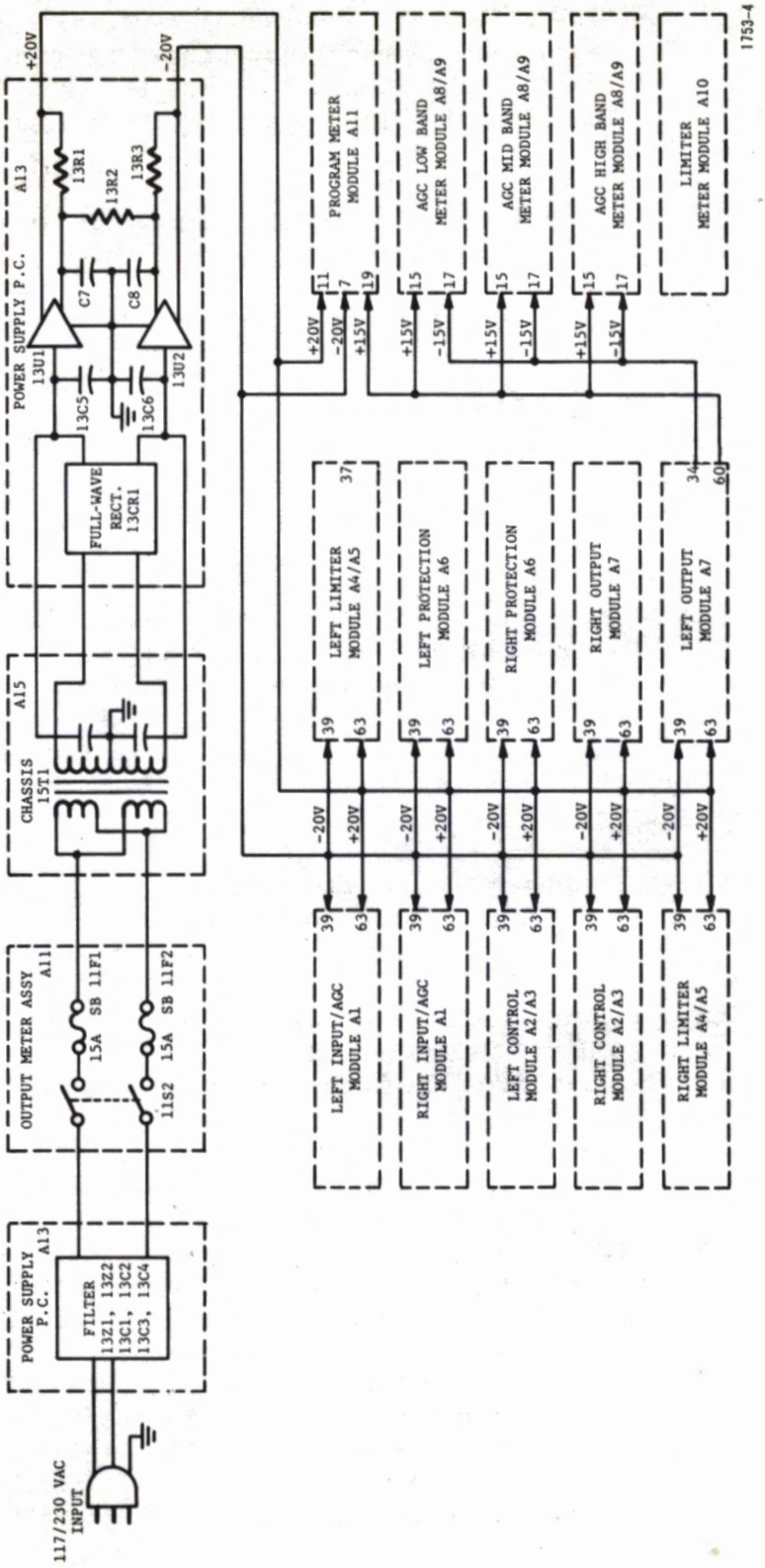

Figure 4-5. Power Subsystem, Block Diagram

WARNING: Disconnect primary power prior to servicing.

4-48. SECONDARY POWER SUPPLY. The secondary power consists of the +15 and -15 vdc regulators used in each (except meter) module and the +8 and -8 vdc regulators used in the limiter. Input to the ±15 vdc regulators comes from the the primary supply; input to the ±8 vdc regulators is from the ±15 vdc regulators.

4-49. POWER STATUS INDICATING CIRCUIT. The power status indicating circuit is contained in the program meter module. Under normal conditions, the NORMAL indicator LED (green) is lit. If the primary supply voltage increases, the HI (yellow) LED will light, and under low voltage conditions, the LOW (red) LED will light.

4-50. PROTECTION SUBSYSTEM.

4-51. FM PROTECTION. The FM protection subsystem limits the high frequency components in the audio signal to prevent instantaneous over-modulation of the transmitter.

4-52. The broadband signal from the limiter module is applied to input amplifier, 6U7D, through INPUT LEVEL control, 6R127, as shown in figure 4-6. Switch, 6S1, is provided for pre-emphasing the response, if required. A 25, 50, or 75 micorsecond curve may be selected by closing sections of this switch. From 6U7D, the signal is routed simultaneously to high pass filter, 6U7C, and low pass filter, 6U7A. The crossover frequency is set at 450 Hz.

4-53. The high frequency signal from 6U7C is further divided into two paths; one to a limiter, and the other to a clipper. The limiter is a four-quadrant multiplier which operates in essentially the same manner as the gain controllers in the AGC control and limiting subsystems. When the control voltage output of 6U2A reaches a level sufficient to cause limiting, comparator, 6U15A, is triggered and LIMIT indicator, 6DS3, glows providing a visual indication of limiting action.

4-54. The high frequency clipper, 6U8, will clip all peaks above a given level which is set by H.F. CLAMP 6R91 control. This control adjusts the zener voltage on the gate of a programmable zener diode causing it to conduct at the set level. The limited and clipped signals are summed in summing amplifier, 6U10, through HIGH FREQUENCY MODE control, 6U96. The output of 6U10 (the high frequency signal) is then summed with the low frequency signal through H.F./L.F. BALANCE 6R101 control in 6U11. On the output of 6U11 is another clipping circuit similar to the high frequency clipper. Its purpose is to eliminate any peaks in the broadband signal cuase by the summation process. Both of the clipping circuits route signals to comparators in 6U14. When the signal level reaches clipping amplitude, the comparators switch states, and HIGH FREQ (6DS1) and BROAD BAND (6DS2) indicators glow.

4-55. PROTECTION FUNCTION switch, 6S2, selects either the protected signal or the unprotected signal from 6U7D and routes it to de-emphasis amplifier, 6U7B. De-emphasis switch, 6S3, is identical to 6S1; however,

the circuit configuration has low pass rather than high pass characteristics. Therefore, if the two switches are set identically, each will exactly cancel the effects of the other. If pre-emphasis is to be performed in the MSP 100, all sections of 6S3 should be open. If pre-emphasis is performed in the transmitter, 6S1 and 6S3 should both be set the same.

4-56. AM PROTECTION. Refer to paragraph 1-34 for a description of the AM protection subsystem.

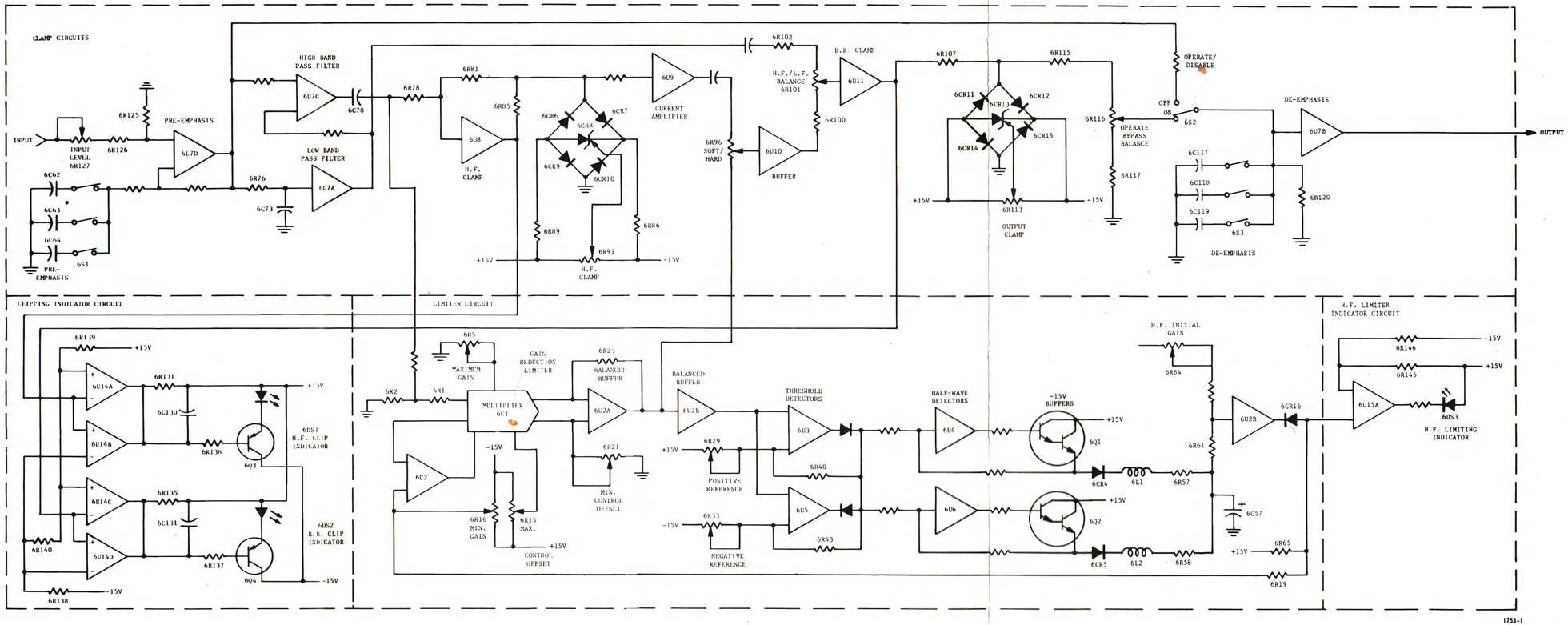

FIGURE 4-6.
FM PROTECTION
BLOCK DIAGRAM

SECTION V

MAINTENANCE

5-1. SCOPE.

5-2. This section contains information regarding periodic preventive maintenance, troubleshooting, adjustment procedures and minor repair and replacement of components and parts.

5-3. PREVENTIVE MAINTENANCE.

5-4. GENERAL.

5-5. Preventive maintenance (PM) consists of regularly performed system checks which are used to detect malfunctions or degradation of performance of the system.

5-6. PERIODIC CHECKS.

5-7. The following checks should be performed every six months. If a malfunction is detected during performance of these checks, refer to the troubleshooting section, paragraph 5-11.

a. Depress POWER ON/OFF switch, 11S2, and measure power supply output voltages at power supply PC board connector P1 pins 1, 2, and 3 (positive) and 7, 9, and 10 (negative) with respect to ground (pins 4, 5, 6, and 8). The voltages should be +20 $\pm$1 vdc and -20 $\pm$1 vdc (see figure 5-1).

b. Depress POWER ON/OFF switch, 11S2, to turn power off. As this is done, observe the POWER STATUS indicators, The red indicator (LOW) should wink as power is removed. If it does not, a status indicator problem should be suspected.

c. With no audio input, set all three EXPANSION FUNCTION switches on the left control module to OFF. The AGC meter pointers should rise to the black mark dividing expansion and compression. Set the three EXPANSION FUNCTION switches to ON, and the meter pointers should fall back to their original positions.

d. Repeat paragraph c., above, for the right channel control module. The AGC meter pointers should rise and fall as before. If they do not, refer to the troubleshooting section, paragraph 5-11.

e. Connect an audio signal generator to the left input. Sweep the signal from 20 Hz to 20 kHz at sufficient level to produce 12 dB compression at 20 Hz. The compression action in each band should be indicated on its respective AGC meter. The pointer should rise as the signal enters the band and fall as it leaves the band.

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WARNING: Disconnect primary power prior to servicing.

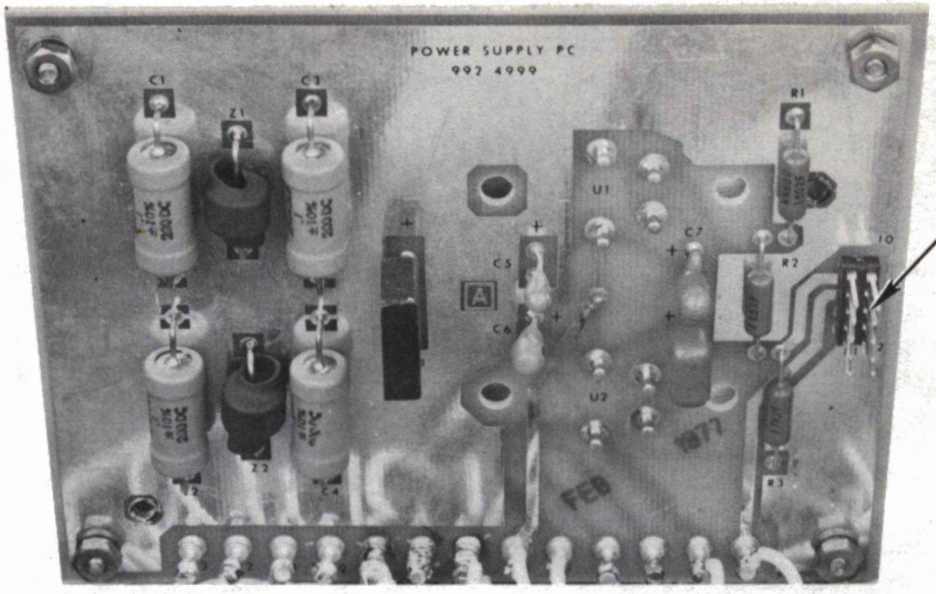

Figure 5-1. Primary Power Supply Parts Layout

WARNING: Disconnect primary power prior to servicing.

NOTE

12 dB compression is indicated when the AGC meter pointer rests between the E and S in the word COMPRESSION printed on the meter face.

f. With the left limiter ATTACK TIME switch, 4S3, in the AUTO position, carefully sweep the signal generator frequency from 1000 Hz to 7000 Hz. Sequential illumination of the limiter ATTACK TIME indicators (from LOW to HIGH) should occur. It is possible for more than one indicator to glow at once.

g. Return the signal frequency to 1000 Hz and connect a switch or telegraph key between the signal generator output and the MSP 100 input. Set the limiter RECOVERY TIME switch, 5S2, to AUTO. Key or switch the input signal on and off. As the keying rate is increased, more RECOVERY TIME indicators should glow. As keying rate is decreased, less indicators should glow.

h. Repeat f. and g. for the right limiter.

i. Audio input and output should be balanced as outlined in paragraph 2-11 and 2-13.

5-8. CORRECTIVE MAINTENANCE.

5-9. GENERAL.

5-10. Corrective maintenance consists of those troubleshooting procedures necessary to isolate a malfunction, and the repair or adjustment necessary to return the system to an acceptable level of performance.

5-11. TROUBLESHOOTING.

5-12. GENERAL PHILOSOPHY. Most problems in the MSP 100 can be traced to a specific module witnout test equipment. This is especially true in stereo units. Two important items must be remembered:

a. Always keep track of any interchanged modules; it is best to mark them with small strips of tape as they are moved. Remember that the AGC meter modules are set slightly differently in each band and will not perform identically when interchanged.

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b. Use caution and work slowly. With the vast array of controls on the MSP 100, it is easy to spot problems caused by improperly set controls and improperly identify them as module defects when working hastily.

5-13. SPECIFIC SUGGESTIONS. When any malfunction in the MSP 100 is suspected and its cause is not immediately obvious, first check the position of all operational controls against the values in your MSP 100 Control Log

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sheet. If no errors are found and trouble persists, disconnect input from one channel at a time and see whether left, right, or both are at fault. Remember that stereo gating will allow one channel's errors to affect the other when both have input. Next, disable modules one at a time on the side of the unit that appears bad. The other channel should have no audio input at the time. You should be able to determine whether the problem is in the AGC, Limiter, Protection, or Output section. Once isolated, consult the specific module troubleshooting chart in Volume II for further information.

5-14. CABLES. If a problem is encountered after the unit has been received or after maintenance or repair, check all ribbon-wire cables for proper plug orientation at each end. The red stripe on the cable should be oriented to the side of the connector labeled 1 on the PC board.

5-15. EMERGENCY OPERATION.

5-16. Should the AGC fail, it is possible to operate the limiter and protection functions only. Place all AGC Function switches in the OFF position and adjust input levels to keep limiting indication around 6 dB (mid-scale) on the Limiter Meter. In case of limiter failure, the AGC may feed the protection module with the LIMITER FUNCTION switch in the OFF position. However, it will be necessary to rotate the Limiting Level control counterclockwise so the Protection Module status indicators do not remain illuminated continuously and wink moderatley. Failure of the Protection module will cause overmodulation. Operation without the Protection Module (that is, with the PROTECTION FUCNTION switch in the OFF position) is possible provided that the output level is reduced to keep modulation legal and the high band AGC is adjusted for significant high-frequency attenuation. See paragraph 3-72.

5-18. RECOMMENDED TEST EQUIPMENT.

5-19. Whenever test equipment is required in any adjustment or troubleshooting procedure, the following are recommended as a minimum:

Low Distortion Audio Oscillator, with Output Meter, Hewlett Packard, Model 654A, or equivalent

AC Voltmeter, with dB Scale, Hewlett Packard, Model 334A, or equivalent

Digital VOM, John Fluke, Model 8000A, or equivalent

Dual Trace Oscilloscope, Tektronix, Model 465, T935, or equivalent

5-20. MAINTENANCE PRACTICES.

5-21. Maintenance of the system should be accomplished following good shop practices. Some practices that have proven to be of value are presented in the following paragraphs.

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5-22. VISUAL INSPECTION.

5-23. The System should be inspected regularly for loose or frayed connections, bent connection pins, and broken insulation. In addition, check for overheating, or heat damaged parts, since overheating is normally a symptom of trouble. Before replacing a heat-damaged component, ensure that the cause of the heat is determined and repaired.

5-24. CLEANING.

5-25. The individual equipment items making up the system are enclosed to protect from dust and dirt. Some dust will accumulate in the enclosure. To remove the accumulated dust, use a vacuum cleaner and a soft bristle brush. The brush is used to dislodge the dust with the vacuum nozzle held close to the surface being cleaned. Care should be exercised when working near parts which could be damaged by the brush. In addition, a soft cloth can be used to wipe clean the interior surfaces of the enclosure.

5-26. PRINTED CIRCUIT MODULES.

5-27. Perform the procedures listed below to ensure reliability and performance of printed circuit modules.

5-28. CARE AND STORAGE. Keep spare printed-circuit modules in plastic bags and stored in cardboard boxes before being used. Before installation, protect the boards with insulating coating on both sides.

5-29. INSULATION. On printed-circuit modules with conductive patterns on both sides, observe the following suggestions:

a. Both connections must be soldered when a component pigtail enters a pad on one side of a board and terminates at a pad or other connection point on the other side.

b. Pigtails should have a minimum clearance of 1/16 inch between bend and component body. When making the minimum bend, support the end seal of the component with wire-bending pliers.

c. Avoid extremely sharp 90-degree pigtail bends. Make all bends with a gradual curve.

d. The radius of the bend should be equal to, or greater than, twice the lead diameter.

e. Extend component pigtails through printed-circuit modules to a minimum of 1/16-inch to a maximum of 1/8 inch and clinch them flush with the circuit. The bend or clinch should be in the same direction as the conductive line to which the pigtail is attached.

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f. Component leads that cannot be bent or clinched flush with the circuit must be properly cleaned and cut to a length that permits the lead to extend 1/32-inch above the solder pad. Components mounted in this way should be secured rigidly to the board with a suitable mounting clamp or approved epoxy resin. To minimize the need for this type of connection, use components designed for printed circuit application when obtainable.

g. With electrolytic capacitors and other components that have welded leads, measure the bend from the weld rather than from the component body.

5-30. HANDLING. Whenever practicable, avoid handling printed circuit pads, terminals, component leads, etc. When handling is unavoidable, use finger tabs or white gloves.

5-31. COMPONENT MOUNTING. Mount components flush with the printed circuit board unless potted or supported by a suitable retaining clamp.

5-32. CLEANING. The following materials must be available to perform cleaning and oxide prevention procedures on the edge clad of a printed-circuit module and mating socket.

a. Cramolin R

b. Lint-free cloth

c. Aluminum socket cleaning tool

d. Rubber band

5-33. The following procedure must be adhered to if maximum reliability of board/socket connections is to be maintained.

a. Ensure that each board and socket is accurately identified.

b. If any greasy or oily contact treatment has been used, the socket and edge connection portion of the board should be cleaned with alcohol or freon spray.

c. Dampen a piece of lint-free cloth with Cramolin R and firmly wipe the edge connection portion of the board. Discard the cloth when it becomes badly discolored and dampen another. When all contact edges of the boards are coated with Cramolin, wipe the edges firmly with a dry cloth.

d. Fold a piece of lint-free cloth over one end of the aluminum socket cleaning tool. Only one piece of cloth can be used or the overall thickness cannot be inserted into the socket. Secure the cloth to the cleaning tool with a rubber band. Dampen the cloth covered end of the tool with Cramolin and insert it into the board socket. Insert the tool at least three times in the same area until the complete socket is treated. Inspect the cloth after each set of insertions and replace it when it appears contaminated.

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NOTE

Recleaning may be required after 6 to 12 months in an extreme smoggy or dirty atmosphere.

e. Repetition of the cleaning and coating process should not be required unless a board is removed and reinserted more than 10 to 15 times or, if a new board or socket is used.

5-34. SOLDERING. Careful selection of the correct, size, shape, and wattage iron is a prerequisite for reliable soldering.

a. Use the correct size and shape of iron and tip to permit soldering with maximum ease and minimum danger of damaging surrounding areas.

b. The tip should rapidly heat the joint to soldering temperature with only a negligible change in temperature of the soldering tip.

c. A variable voltage supply is recommended for controlling iron temperature when soldering printed circuits. It can be advantageous in many other soldering applications. By proper selection of tips and correct voltage adjustments, a single 50-watt, pencil-type iron can be used for soldering miniature printed circuits or relatively large terminals.

d. Do not use soldering aids or similar tools to exert force on wires or components for testing security. The quality of a properly soldered connection can be determined by visual inspection. The practice of bending or pulling wires or components to ascertain the security of the connection can present a serious reliability hazard.

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SECTION VI

PARTS LIST

6-1. INTRODUCTION.

6-2. This section contains a listing of all of the subassemblies of the MSP 100 Audio Processor System and their part numbers. Detailed listings of replaceable parts for the subassemblies can be found in Volume II of this manual, in the Technical Manual referenced in Table 6-1.

6-3. REPLACEABLE PARTS SERVICE.

6-4. Replacement parts are available 24 hours a day, seven days a week from the Harris Service Parts Department. Telephone 217/222-8200 to contact the Service Parts Department or address correspondence to Service Parts Department, Harris Broadcast Products Division, Harris Corporation, P.O. Box 4290, Quincy, Illinois, 62301.

6-5. TECHNICAL ASSISTANCE.

6-6. Technical assistance and troubleshooting recommendations are available from Harris Field Service Parts Department during normal working hours. Emergency technical service is available 24 hours a day. Telephone 217/222-8200 to contact the Field Service Department or address correspondence to Field Service Department, Harris Broadcast Products Division, Harris Corporation, P.O. Box 4290, Quincy, Illinois, 62301. The Harris factory may also be contacted through a TWX facility (910-246-3312) or a TELEX service (40-4347).

WARNING: Disconnect primary power prior to servicing.

Table 6-1. MSP 100 Audio Processor System Subassemblies

PART NO.	NOMENCLATURE	QTY	VOLUME II TECHNICAL MANUAL
992 4958 001	Main Frame	1	888 1753 100
994 7971 001	Input/AGC Module	2	888 1753 200
994 7973 001	Control Module	2	888 1753 300
994 7975 001	Limiter Module	2	888 1753 400
994 7977 001	FM Protection Module	2	888 1753 500
994 8159 001	AM Protection Module	2	888 1753 501
994 7979 001	Output Module	2	888 1753 600
992 4955 001	AGC Meter Module	3	888 1753 700
992 4956 001	Limiter Meter Module	1	888 1753 800
992 4967 001	Program Meter Module	1	888 1753 900

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