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TECHNICAL MANUAL

for

MULTIPLE SIDEBAND ADAPTER MODEL MSA-1

THE TECHNICAL MATERIEL CORPORATION
MAMARONECK, N.Y. OTTAWA, CANADA

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THE TECHNICAL MATERIEL CORPORATION

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COMMUNICATIONS ENGINEERS
700 FENIMORE ROAD MAMARONECK, N. Y.

Warranty

The Technical Materiel Corporation, hereinafter referred to as TMC, warrants the equipment (except electron tubes,* fuses, lamps, batteries and articles made of glass or other fragile or other expendable materials) purchased hereunder to be free from defect in materials and workmanship under normal use and service, when used for the purposes for which the same is designed, for a period of one year from the date of delivery F.O.B. factory. TMC further warrants that the equipment will perform in a manner equal to or better than published technical specifications as amended by any additions or corrections thereto accompanying the formal equipment offer.

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2. That the defect is not the result of damage incurred in shipment from or to the factory.
3. That the equipment has not been altered in any way either as to design or use whether by replacement parts not supplied or approved by TMC, or otherwise.
4. That any equipment or accessories furnished but not manufactured by TMC, or not of TMC design shall be subject only to such adjustments as TMC may obtain from the supplier thereof.

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*Electron tubes also include semi-conductor devices.

PROCEDURE FOR RETURN OF MATERIAL OR EQUIPMENT

Should it be necessary to return equipment or material for repair or replacement, whether within warranty or otherwise, a return authorization must be obtained from TMC prior to shipment. The request for return authorization should include the following information:

1. Model Number of Equipment.
2. Serial Number of Equipment.
3. TMC Part Number.
4. Nature of defect or cause of failure.
5. The contract or purchase order under which equipment was delivered.

PROCEDURE FOR ORDERING REPLACEMENT PARTS

When ordering replacement parts, the following information must be included in the order as applicable:

1. Quantity Required.
2. TMC Part Number.
3. Equipment in which used by TMC or Military Model Number.
4. Brief Description of the Item.
5. The *Crystal Frequency* if the order includes crystals.

PROCEDURE IN THE EVENT OF DAMAGE INCURRED IN SHIPMENT

TMC's Warranty specifically excludes damage incurred in shipment to or from the factory. In the event equipment is received in damaged condition, the carrier should be notified immediately. Claims for such damage should be filed with the carrier involved and not with TMC.

All correspondence pertaining to Warranty Claims, return, repair, or replacement and all material or equipment returned for repair or replacement, within Warranty or otherwise, should be addressed as follows:

THE TECHNICAL MATERIEL CORPORATION
Engineering Services Department
700 Fenimore Road
Mamaroneck, New York

RECORD OF CORRECTIONS MADE

Change No.	Date of Change	Date Entered	Entered By

CHANGE NO. 1 MSA-1

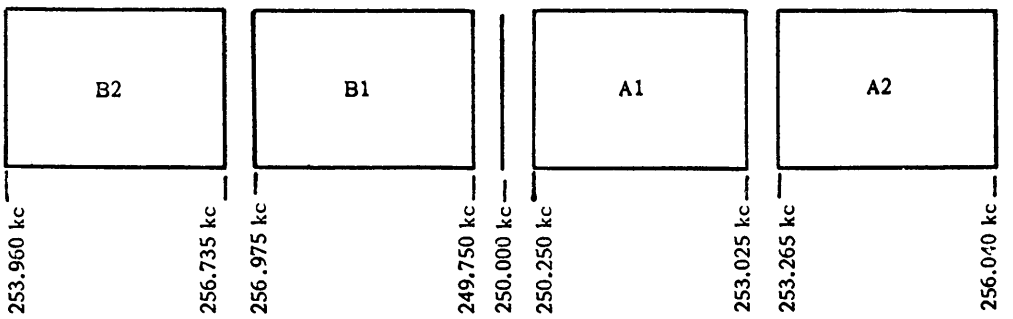
INSTRUCTION BOOK CHANGE NOTICE

Date August 30, 1965

Manual affected: Multiple Sideband Adapter, Model MSA-1 IN -4004A

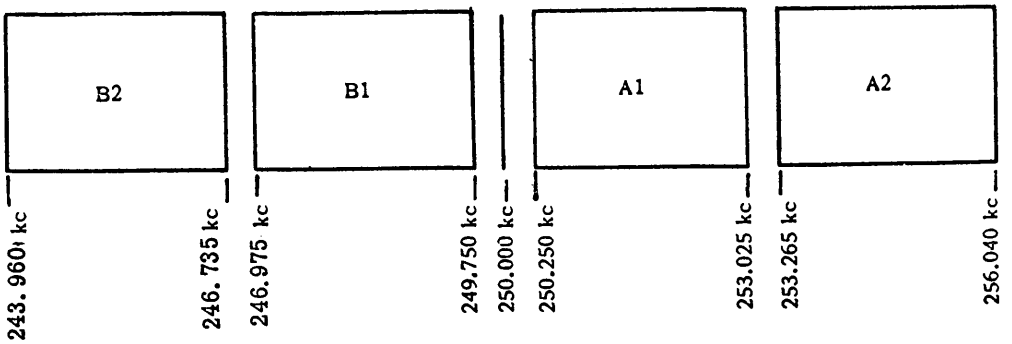
Page 4-5, figure 4-2, change channel B1 and B2 frequencies as shown below.

Change from:



SECOND I-F SPECTRUM

Change to:



SECOND I-F SPECTRUM

SHOULD ADDITIONAL COPIES OF THIS CHANGE NOTICE BE REQUIRED, PLEASE CONTACT:

THE TECHNICAL MATERIEL CORP., 700 Fenim re Road, Mamaroneck, New York

Attn.: Direct r f Eng. Services.

CHANGE NO. 2 MSA-1

INSTRUCTION BOOK CHANGE NOTICE

Date Dec. 28, 1965

Manual affected: Multiple Sideband Adapter Model MSA-1 **IN** - 4004A

Page 5-2.

e. AGC COMPARATOR.

In steps (2) and (3), change R6532 to R6531.

SHOULD ADDITIONAL COPIES OF THIS CHANGE NOTICE BE REQUIRED, PLEASE CONTACT:

THE TECHNICAL MATERIEL CORP., 700 Fenimore Road, Mamaroneck, New Y rk

Attn.: Direct r f Eng. Services.

CHANGE NO. 3

INSTRUCTION BOOK CHANGE NOTICE

Date January 23, 1969

Manual affected: Multiple Sideband Adapter, Model MSA-1 **IN** 4004A

1 The MSA-1 may be adapted to several Conversion Oscillator and 1-F inputs, such as 2MC, and 1.75MC.

a Page 7-3/7-4 Figure 7-1, (sheet 1 of 3) change input to jack J6501 to read Conversion Oscillator input.
Delete 2MC input.

b Change input to jack J6502 to read I-F input.
Delete 1.75MC input.

c Change Audio module note for channels B2, B1, A1 and A2 to read (see CK709)

d Change 1-F module note for channels B2, B1, A1, A2 to read (see CK519)

2 Page 7-7/7-8, Figure 7-1. (sheet 3of3). Reverse position of capacitor C211, with resistor R232.

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THE TECHNICAL MATERIEL CORP., 700 Fenimore R ad, Mamaroneck, New York

Attn.: Director f Eng. Services.

CHANGE NO. 4

INSTRUCTION BOOK CHANGE NOTICE

Date October 5, 1970

Manual affected: Multiple Sideband Adapter, Model MSA-1 IN 4004A

Page 6-3, Plug-In IF Amplifier

Change the Part Numbers of Z101 Bandpass Filters as follows:

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
Z101	FILTER BANDPASS: 2.7 Kc. (Used on Channel A1, I.F. Module.)	FX183
Z101	FILTER BANDPASS: 2.7 Kc. (Used on Channel A2, I.F. Module.)	FX182
Z101	FILTER BANDPASS: 2.7 Kc. (Used on Channel B1, I.F. Module.)	FX184
Z101	FILTER BANDPASS: 2.7 Kc. (Used on Channel B2, I.F. Module.)	FX185

SHOULD ADDITIONAL COPIES OF THIS CHANGE NOTICE BE REQUIRED, PLEASE CONTACT:

THE TECHNICAL MATERIEL CORP., 700 Fenimore Road, Mamaroneck, New York

Attn.: Director of Eng. Services.

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Figure 1-1. Multiple Sideband Adapter, Model MSA-1

SECTION 1
GENERAL INFORMATION

1-1. DESCRIPTION.

Multiple Sideband Adapter, Model MSA-1 (figure 1-1) is a combined demultiplexer and ISB detector that converts a 1.75 mc composite i-f signal to four independent audio output channels (A1, A2, B1, and B2). Demultiplexing of each independent signal is accomplished with the aid of a 2 mc i-f translation frequency and carrier injection frequencies of 243.71 or 243.75 kc*, 250 kc, and 256.29 or 256.25 kc* provided by associated equipment such as TMC's Mux Carrier Generator MCG. The MSA requires input power of +200 vdc, -105 vdc, and 6.3 vac (balanced and unbalanced) from an external power supply.

Rear-panel mounted jacks provide the means to connect each channel to associated i-f and audio filters (such as TMC Models MNF and MAF respectively) that may be used with the MSA to eliminate interference. Front-panel meters and lamps indicate channel activity and output level. Each channel has a squelch circuit, controllable from the front panel, that cuts off the channel audio amplifier in the absence of an i-f signal. A front-panel monitoring jack and switch enable the operator to monitor the audio output signal of any one of the four channels. Technical specifications for the MSA are given in paragraph 1-3.

1-2. TUBE AND DIODE COMPLEMENT.

The tube and diode complement for the MSA is given in table 1-1.

Table 1-1. Tube and Diode Complement

QUANTITY	REFERENCE SYMBOL	TYPE	FUNCTION
4	V101	6BA6	1st i-f Amplifier
4	V102	6CE5	2nd i-f Amplifier
4	V103	6CE5	AGC i-f Amplifier
4	V201	5814	Product Detector
4	V202	6EU8	Squelch
4	V203	5814	Cathode Follower; 1st Audio Amplifier
4	V204	5814	2nd Audio Amplifier Phase Inverter
4	V205	5814	Power Amplifier
1	V6501	6CM7	Converter
1 each	V6502 V6503 V6504 V6505	6BA6	Preamplifier
1 each	V6506 V6507	12AT7	AGC Amplifier

*243.71 and 256.29 kc are compatible with National Standard translation frequencies.
243.75 and 256.25 kc are compatible with CCIR translation frequencies.

Table 1-1. Tube and Diode Complement (Cont)

QUANTITY	REFERENCE SYMBOL	TYPE	FUNCTION
1	V6508	5814	Monitor Amplifier Cathode Follower
4 each	CR101 CR102	1N463	AGC Detector
4	CR103	1N463	Clamp
1 each	CR6501 CR6504 CR6505 CR6508	1N463	Clamp
1 each	CR6502 CR6503 CR6506 CR6507	1N463	AGC Comparator

1-3. TECHNICAL SPECIFICATIONS.

I-F Input Signal:	1.75 mc or 455 kc composite i-f signal (approximately 12 kc bandwidth) at a level of 0-3 to 300 millivolts.
Carrier Injection Inputs:	243.71- or 243.75-kc, 250.00 kc, 250.00 kc, 256.29- or 256.25-kc, at a level of 1 volt.
I-F Translating Signal Input:	2 mc or 705 kc at a level of 1 volt.
Input Impedance:	50 ohms.
Number of Channels:	Four (A1, A2, B1, and B2).
Channel I-F Bandwidth:	2775 cps.
Overall Response:	Within ±1.5 db from: 250- to 3025-cps for A1 and B1 channels; 250- to 3025-cps or 210- to 2985-cps for A2 and B2 channels.
Intermodulation:	Intermodulation products at least 60 db below maximum output in desired channel for two signals in the undesired channel.
Distortion:	Intermodulation products at least 50 db below full output with two signals in the desired channel.
Output:	Up to 10 milliwatts from each channel for balanced 600-ohm load.
AGC Characteristics:	Four independent AGC circuits: fast attack, decay variable from 1 to 10 seconds. Comparator routes strongest agc signal to associated tuner.
Monitoring:	Headset monitoring of any channel without affecting the output circuits.
Sideband Rejection:	Undesired sideband removed more than 250 cycles from the carrier suppressed a minimum of 60 db.
Adjacent Channel Rejection:	Modulating tone of 2700 cps or less in the undesired channel suppressed at least 60 db; modulating tone of 3000 cps in the undesired channel suppressed a minimum of 30 db.
Hum Level:	50 db below full audio output.
Environment:	Designed for continuous duty within a temperature range of 0 to 50°C with up to 90% relative humidity.
Input Power:	+200 vdc, -105 vdc, 6.3 vac (4 balanced and 1 unbalanced inputs), 115/230 vac. Total dissipation approximately 220 watts.
Dimensions:	Approximately 7" high x 19" wide x 17" deep.
Weight:	Approximately 30 lbs.

SECTION 2
INSTALLATION

2-1. INITIAL INSPECTION.

The MSA unit is calibrated and tested at the factory prior to shipment. When it arrives at the operating site, inspect the packing case and contents for possible damage. Inspect all packing material for parts that may have been shipped as "loose items." With respect to damage to the equipment for which the carrier is liable, the Technical Material Corporation will assist in describing methods of repair and the furnishing of replacement parts. The MSA is shipped with all tubes installed; check to make sure that all tubes are seated in their sockets.

2-2. POWER REQUIREMENTS.

The MSA requires operating voltages of 115/230 volts a-c, 50 to 60 cps, single-phase; +200 volts dc; -105 volts dc, and 6.3 vac. Refer to paragraph 2-3 for connection of power to the MSA. Unless otherwise specified, the MSA is factory-wired for 115 vac operation. If the unit is to be operated from 230 vac primary power, the jumper across resistor R6577 must be removed.

2-3. INSTALLATION.

a. MECHANICAL. - The MSA is designed for both cabinet and rack installation. In either case, the MSA requires adequate ventilation, sufficient space for servicing, and sufficient clearance in back for access to rear-panel connections. The MSA is equipped with a standard 19-inch wide front panel, and is 7 inches high and approximately 17 inches deep.

When intended for rack installation, the MSA is equipped with slide mechanisms. To install the MSA in a rack, proceed as follows:

(1) Set the MSA chassis slide mechanisms in tracks.

(2) Slide chassis in tracks until rearward release finger engages holes in track.

(3) Press forward release fingers and slide chassis into cabinet; secure front panel of MSA to rack with screws.

(4) Make the necessary cable and electrical connections as described in paragraph b.

b. ELECTRICAL. - All external connections are made at the rear panel of the MSA. Refer to figures 2-1 and 2-2 and table 2-1, and make connections as indicated.

2-4. INITIAL ADJUSTMENTS.

Before the MSA is shipped, it is aligned and thoroughly checked against the manufacturer's specifications. Initial adjustments are therefore not required.

Table 2-1. Rear Panel Connections

ITEM NO. (Figure 2-2)	REAR PANEL DESIGNATION	FUNCTION
1	NOTCH FILTER A2, J6503 OUT	Normally connected by coaxial cable to jack J6504. Permits connection of Channel A2 preamplifier output to external notch filter equipment.
2	A2, J6504 IN	Normally connected by coaxial cable to jack J6503. Permits connection of external notch filter equipment to the input circuit of the Channel A2 i-f module.
3	A1, J6505 OUT	Same as item 1 except: normally connected to jack J6506; used in Channel A1.
4	A1, J6506 IN	Same as item 2 except: normally connected to jack J6505; used in Channel A1.

Table 2-1. Rear Panel Connections (Cont)

ITEM NO. (Figure 2-2)	REAR PANEL DESIGNATION	FUNCTION
5	B1, J6507 OUT	Same as item 1 except: normally connected to jack J6508; used in Channel B1.
6	B1, J6508 IN	Same as item 2 except: normally connected to jack J6507; used in Channel B1.
7	B2, J6509 OUT	Same as item 1 except: normally connected to jack J6510; used in Channel B2.
8	B2, J6510 IN	Same as item 2 except: normally connected to jack J6509; used in Channel B2.
9	DEMUX A2, J6543	Connects 256.29* or 256.25** kilocycle carrier signal from external carrier equipment to Channel A2 audio module.
10	A1, J6541	Same as item 9 except: frequency is 250 kilocycles; used in Channel A1.
11	B1, J6539	Same as item 9 except: frequency is 250 kilocycles; used in Channel B1.
12	B2, J6537	Same as item 9 except: frequency is 243.71* (or 243.75) kilocycles: used in Channel B2.
13	AUDIO FILTER B2, J6519 IN	Normally connected by coaxial cable to jack J6518. Permits connection of external audio filter equipment to the input circuit of the Channel B2 first audio amplifier.
14	AUDIO FILTER B2, J6518 OUT	Normally connected by coaxial cable to jack J6519. Permits connection of Channel B2 product detector external audio filter equipment.
15	B1, J6521 OUT	Same as item 14 except: normally connected to jack J6522; used in Channel B1.
16	B1, J6522 IN	Same as item 13 except: normally connected to jack J6521; used in Channel B1.
17	A1, J6524 OUT	Same as item 14 except: normally connected to jack J6525; used in Channel A1.

* National Standard translation frequency.
**CCIR translation frequency.

Table 2-1. Rear Panel Connections (Cont)

ITEM NO. (Figure 2-2)	REAR PANEL DESIGNATION	FUNCTION
18	A1, J6525 IN	Same as item 13 except: normally connected to jack J6524; used in Channel A1.
19	A2, J6527 OUT	Same as item 14 except: normally connected to jack J6528; used in Channel A2.
20	A2, J6528 IN	Same as item 13 except: normally connected to jack J6527; used in Channel A2.
21	IF, J6502	Input jack for 1.75 mc composite i-f signal from associated tuner.
22	LOCAL OSC. J6501	Input jack for 2 mc i-f translating signal.
23	J6515	Permits power connections from external power supply; connects MSA agc signal to external receiver.
24	TERMINAL BOARD E6501 (no rear panel designation)	(a) Terminal 1; AGC output to associated tuner. (b) Terminals 2, 3, and 4; ground connection for external lines. (c) Terminals 5 and 6; channel A2 600-ohm balanced audio output. (d) Terminals 7 and 8; channel A1 600-ohm balanced audio output. (e) Terminals 9 and 10; channel B1 600-ohm balanced audio output. (f) Terminals 11 and 12, channel B2 600-ohm balanced audio output.

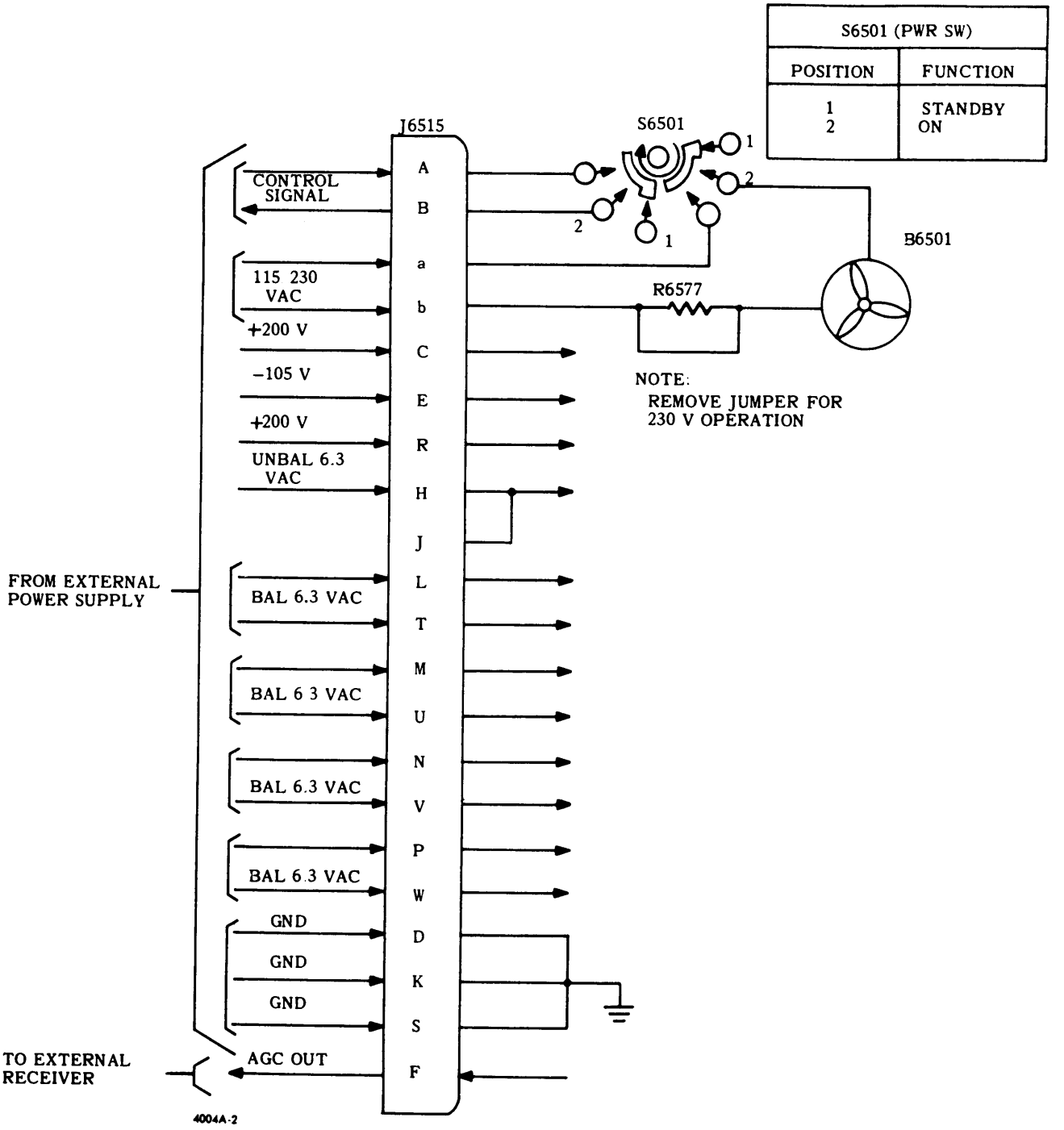

Figure 2-1. External Power and AGC Connections, J6515

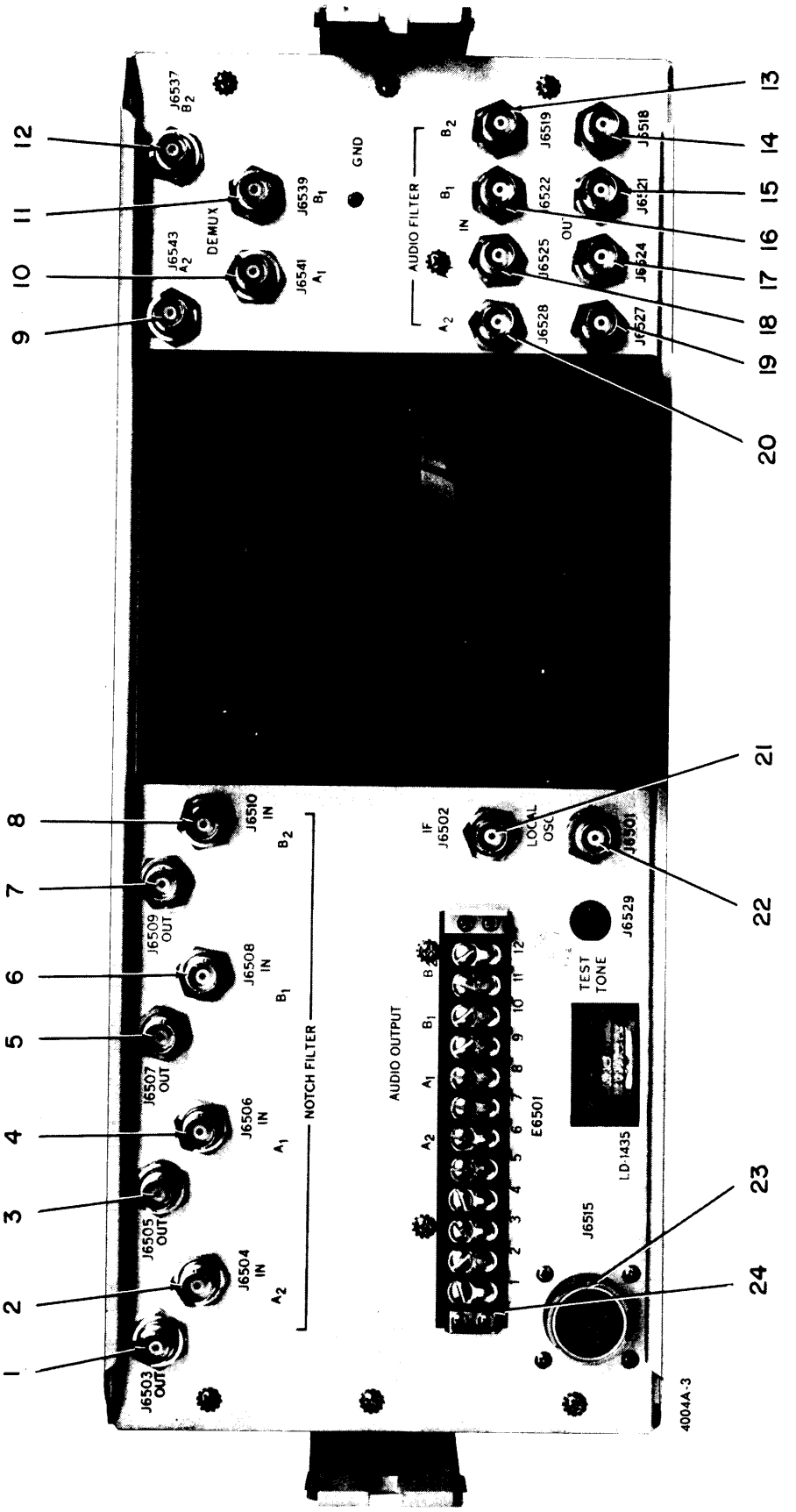

Figure 2-2. Rear Panel, MSA

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SECTION 3
OPERATOR'S SECTION

3-1. CONTROLS AND INDICATORS.

The controls and indicators for each of the four channels (A1, A2, B1, and B2) are identical, as illustrated in figure 3-1. Therefore, only the controls and indicators of Channel A1 in addition to the monitoring controls are listed in table 3-1.

3-2. OPERATING PROCEDURE.

a. GENERAL. - Prior to applying power to the MSA ensure that the unit is installed in accordance with the instructions contained in section 2.

b. STARTING. - Proceed as outlined in step (1) or (2). In both cases, with power applied to the MSA, the active channel indicator lamps should light; the associated channel meters should indicate upscale. The inactive channel meters should not indicate.

(1) If MSA is connected to an external power supply such as the TMC Model HFP, merely set MSA power switch at ON.

(2) If MSA is connected to a power supply that is not controlled by MSA power switch:

(a) Set MSA power switch at ON. This applies 115 volts to the ventilating fan.

(b) Set power switch of external power supply at ON.

c. CHANNEL RECEPTION.

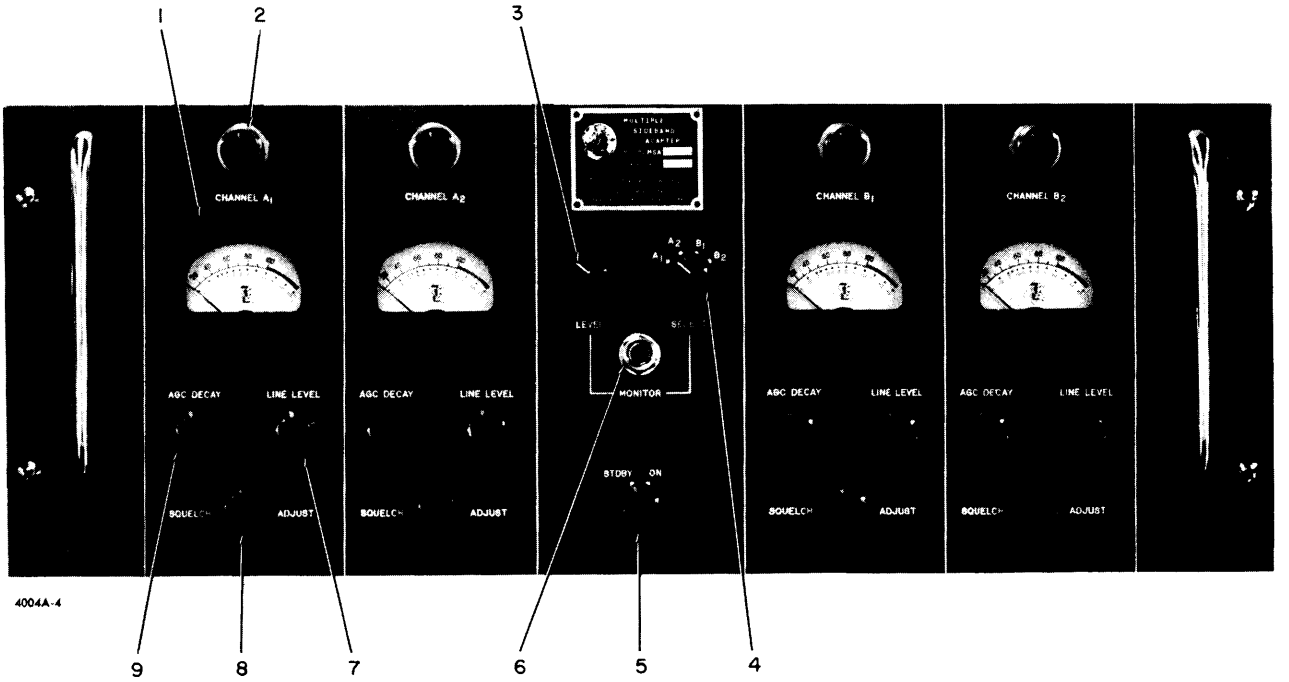
(1) Set MSA controls as follows:

CONTROL	SETTING
LINE LEVEL (each channel)	Mid-range
AGC DECAY (each channel)	Fully counterclockwise
SQUELCH ADJUST (each channel)	Fully counterclockwise
MONITOR LEVEL	Mid-range

(2) For each active channel, adjust LINE LEVEL control until channel meter indicates 0 dbm.

(3) For each inactive channel, rotate the SQUELCH ADJUST control clockwise just until the channel indicator lamp goes off.

(4) Insert 600-ohm headset into MONITOR jack. Adjust MONITOR LEVEL control for proper headset audio level.



63 10.25-1

Figure 3-1. Front Panel Controls and Indicators, MSA

(5) Set MONITOR SELECT switch to an active channel. Adjust selected channel AGC DECAY control for time constant best suited for the incoming signal.

(6) Repeat step 5 for remaining active channels.

d. STOPPING. - To stop the MSA, proceed as follows:

(1) If MSA is connected to an external power supply, merely set the MSA power switch at STANDBY.

(2) If MSA is connected to a power supply that is not controlled by the MSA power switch:

(a) Set the power switch on the external power supply at OFF.

(b) Set MSA power switch at STANDBY; this removes 115 volts from the ventilating fan.

3-3. OPERATOR'S MAINTENANCE.

The operator should observe that all controls, indicator lamps, and meters are in good condition and functioning properly (see figure 3-1 and table 3-1). Any noticeable irregularity could be an indication of trouble.

The MSA does not contain any power fuses. However, the fuses associated with the MSA circuits should be located in the associated, external power supply. Refer to the service manual for the external power supply for fuse locations.

CAUTION

Never replace a fuse with one of a higher rating. If a fuse burns out immediately after replacement, do not replace it a second time until the trouble has been located and corrected.

Table 3-1. Controls and Indicators

REFERENCE DESIGNATION (Figure 3-1)	FRONT PANEL DESIGNATION	FUNCTION
1	CHANNEL A1 meter	Indicates level in db of channel audio output signal as set by the LINE LEVEL control (item 7).
2	CHANNEL A1 indicator lamp	Lights to indicate that channel is active. Goes off when channel is inactive as controlled by setting of SQUELCH ADJUST control (item 8).
3	MONITOR LEVEL control	Controls the amplitude of audio signal available at MONITOR jack (item 6).
4	MONITOR SELECT switch	Selects any one of four channel (A1, A2, B1, or B2) audio output signals to be monitored.
5	STANDBY-ON power switch	A 2-position switch. ON position controls the application of operating power from an external power supply to the MSA unit. STANDBY position removes operating power from the MSA unit.
6	MONITOR jack	Permits headset monitoring of any one of four audio output channels as selected by the MONITOR SELECT (item 4).
7	LINE LEVEL control	Adjusts the level of the channel audio output level as indicated by CHANNEL A1 front-panel meter.

Table 3-1. Controls and Indicators (Cont)

REFERENCE DESIGNATION (Figure 3-1)	FRONT PANEL DESIGNATION	FUNCTION
8	SQUELCH ADJUST control	Selects input signal level required to enable channel audio amplifier. Normally adjusted when the channel is inactive by setting the control to a point where the CHANNEL A1 indicator lamp goes off.
9	AGC DECAY control	Adjusts the decay time of the channel AGC signal.

SECTION 4
PRINCIPLES OF OPERATION

4-1. BLOCK DIAGRAM ANALYSIS.

Refer to figure 4-1. The MSA consists of a converter stage; four independent i-f amplifiers, detectors, and audio amplifier channel circuits; an AGC comparator; and a monitoring circuit.

The MSA accepts a 1.75-mc i-f output of an associated r-f tuner, a 2 mc translating signal from an external multiplex carrier generator such as TMC's Model MCG. The 1.75-mc i-f signal is converted to a lower intermediate frequency, 250 kc (see figure 4-2).

The 250-kc composite i-f signal is divided into its four separate intelligence channels by highly selective bandpass filters. The resultant narrow band i-f signals are each amplified independently and applied to associated product detectors. The carrier injection signals for these product detectors are supplied from the external multiplex carrier generator.

The outputs of the product detectors are replicas of the audio signals that were originally multiplexed. The audio amplifiers raise the product detector output to a level of 10 mw.

Each channel has its own AGC circuit, so that level variations in one channel will have minimal effect on the other three channels. Also, each channel has its own squelch circuit that disables the audio amplifier circuit for that particular channel during no-traffic periods.

The AGC comparator circuit supplies an AGC signal that is proportional to the highest of the individual channel envelope levels; this AGC signal is applied to the associated r-f tuner.

4-2. CONVERTER AND PREAMPLIFIER, CIRCUIT ANALYSIS.

The converter V6501B (see figure 7-1, Sheet 1) receives the composite 1.75-mc i-f signal from jack J6502 and a 2-mc i-f translating signal from jack J6501 through amplifier V6501A. The output signal of the converter, centered at 250 kc, is the difference product of the 2-mc i-f translating signal and the input i-f signal. This 250-kc composite i-f signal consists of the upper sideband of a suppressed 243.71-kc carrier (B2 channel), independent lower and upper sidebands of a reduced or suppressed 250-kc carrier (B1 and A1 channels respectively), and the lower sideband of a suppressed 256.29 kc carrier (A2 channel).

The 250-kc composite i-f signal is applied to the inputs of four preamplifiers (V6502, V6503, V6504, and V6505) in parallel. The output circuits of the preamplifiers are tuned so each amplifier passes one of the channel sidebands. The preamplifier tuning is: V6505 (A2 channel), 254.65 kc; V6504 (A1 channel), 251.64 kc; V6503 (B1 channel), 248.36 kc; V6502 (B2 channel), 245.35 kc. The outputs of the preamplifiers are routed to the associated channel i-f modules. This routing includes two rear-panel jacks in each channel circuit (J6503 through J6510) that permit interposing an i-f notch filter between the preamplifiers and i-f modules. If a notch filter is not used, the preamplifier output signal is routed to the i-f module via jumper cables. The gain of each preamplifier is controlled by an AGC voltage supplied by the associated channel i-f module.

4-3. I-F MODULE, CIRCUIT ANALYSIS. (See Figure 7-1, Sheet 2)

Each of the four i-f modules are similar, differing only in amplifier tuning and filter bandpass. The channel filter bandpasses are: channel A2, 253.265- to 256.04 kc; channel A1, 250.250- to 253.025 kc; channel B1, 246.975- to 249.750 kc; channel B2, 243.960- to 246.735 kc. The i-f signal from the channel preamplifier is routed to first i-f amplifier V101 through filter Z101. The filter passes the desired channel sideband signals, and rejects adjacent channel signals and any accompanying carrier signal. The gain of V101 is controlled by the AGC voltage that is developed in that particular module (see paragraph 4-4). The output of V101 is coupled to second i-f amplifier V102; the amplified output of V102 is routed to the channel audio module, and to AGC i-f amplifier V103.

The output of V103 is connected to AGC detector CR101 and CR102. Diode CR102 is reverse biased by positive voltage from the voltage divider consisting of resistor R115 and delay adjustment potentiometer R116. This reverse bias is set so that CR102 will conduct only after a predetermined signal level has been reached. Diode CR103 prevents the possible generation of positive d-c voltage in the AGC circuit. The output of the AGC detector is routed to i-f amplifier V101, the associated channel preamplifier, and to one of the AGC amplifiers associated with the AGC comparator (V6506 and V6507).

4-4. AUDIO MODULE, CIRCUIT ANALYSIS. (See Figure 7-1, Sheet 3)

NOTE

Carrier injection frequencies of 256.25 or 256.29 and 243.75 or 243.71 kc may be employed in channel A2 and B2 product detector circuits for operation with CCIR or National Standard translation systems. For simplicity and brevity, the following explanation refers to carrier injection frequencies for operation with a National Standard translation system only.

Each of the four audio modules are identical; however, the carrier injection signals supplied to the audio modules are different. The carrier injection signal frequencies are: channel A2, 256.29 kilocycles; channels A1 and B1, 250.00 kilocycles; and channel B2, 243.71 kilocycles. Each of the carrier injection signals is routed to the respective carrier amplifier V201B.

A narrow band i-f signal from the associated channel i-f module is routed to product detector V201A. Product detector V201A also receives a carrier injection signal of the proper frequency from carrier amplifier V201B. The output of the product detector is the difference of the channel i-f signal and the carrier injection signal.

EXAMPLE: The channel A2 i-f signal is between 253.265 kilocycles and 256.04 kilocycles. The channel A2 carrier injection signal frequency is 256.27 kilocycles. The product detector output is an audio spectrum between 250 cps and 3025 cps.

The audio output of the product detector is applied to cathode follower V203A; the output of V203A is then routed to first audio amplifier V203B. This routing includes two rear-panel jacks in each channel circuit (J6518 and J6519, J6521 and J6522, J6524 and J6525, J6527 and J6528) that permit interposing an audio filter between V203A and V203B. If an audio filter is not used, the output of V203A is routed to amplifier V203B via jumper cables. The control grid of V203B is also connected to squelch relay K201.

The channel AGC signal from the associated i-f module is applied to the grid of squelch tube V202A. The AGC signal is a negative voltage proportional to the peak envelope voltage of the channel i-f signal. Therefore, as the signal level increases, AGC voltage goes negative and V202A conduction decreases. The positive going signal at the plate of V202A is coupled to the grid of V202B; as the signal level increases, V202B conduction increases and energizes K201. When K201 is energized, the grid of first audio amplifier V203B is ungrounded, permitting the amplifier to operate, and ground return is supplied to the associated channel activity lamp (DS6501, DS6502, DS6503, or DS6504). When the signal level decreases, AGC voltage decreases, V202A conduction increases, V202B conduction decreases, and K201 is de-energized. With K201 de-energized, the grid of V203B is grounded, disabling the audio amplifier chain, and the ground return of the associated channel activity lamp is opened. Additional bias for V202B is taken from the -105 vdc supply through the associated SQUELCH ADJUST rheostat (R6556, R6558, R6560, or R6562). Therefore, the signal level required to activate K202 is determined by the setting of the associated SQUELCH ADJUST control.

The output of first audio amplifier V203B is routed to second audio amplifier V204A through the associated LINE LEVEL potentiometer (R6557, R6559, R6561, or R6563). The amplified output of V204A is supplied to phase inverter V204B. Phase inverter V204B provides two outputs (one from the plate and one from the cathode) that are 180 degrees out of phase with each other; these outputs are applied to the two control grids of push-pull power amplifier V205. The output of V205 is then coupled through transformer T202 to terminals of terminal board E6501, and to the associated output level meter (M6501, M6502, M6503, or M6504). Also, a sample of each audio output signal is routed to monitor switch S6502 through an isolating resistor (R6552, R6553, R6554, or R6555).

4-5. MONITOR CIRCUIT ANALYSIS. (See Figure 7-1, Sheet 1)

A sample of one of the audio-output signals is selected by MONITOR SELECT switch S6502 and applied to amplifier V6508B through MONITOR LEVEL potentiometer R6551. The amplified output of V6508B is coupled to MONITOR jack J6516 through cathode follower V6508A, an impedance matching stage.

4-6. AGC COMPARATOR CIRCUIT ANALYSIS. (See Figure 7-1, Sheet 1)

Each of the channel AGC signals is routed to its associated AGC amplifier (V6506A, V6506B, V6507A, or V6507B). The AGC amplifiers are bootstrap amplifiers; i.e., the output load is in the cathode circuit, in each case. AGC amplifier operation is similar to that of a cathode follower in that the output signal voltage change is of the same polarity as the input signal voltage change. The output of each AGC amplifier is connected to the anode of its associated comparator diode (CR6502, CR6503, CR6506, or CR6507). Comparator AGC delay potentiometers (R6531, R6533, R6539 and R6541) are adjusted so that the anode of the associated comparator diode is at ground potential with no AGC voltage supplied from the associated i-f module. The cathodes of all the comparator diodes are connected in common to pin F of jack J6515 and to terminal 1 of terminal board E6501, the AGC output. The AGC output point will assume a voltage equal to the most negative anode of all the comparator diodes. Therefore, the AGC output signal is instantaneously proportional to the highest level channel i-f signal.

4-7. POWER DISTRIBUTION AND FAN CIRCUIT. (See Figure 7-1, Sheet 1)

Power (115 vac) for fan B6501, is supplied directly from pin b of jack J6515 and through STDBY/ON switch S6501 from pin a. Additionally, pin A and B of J6515 are connected to S6501 so that the switch may be

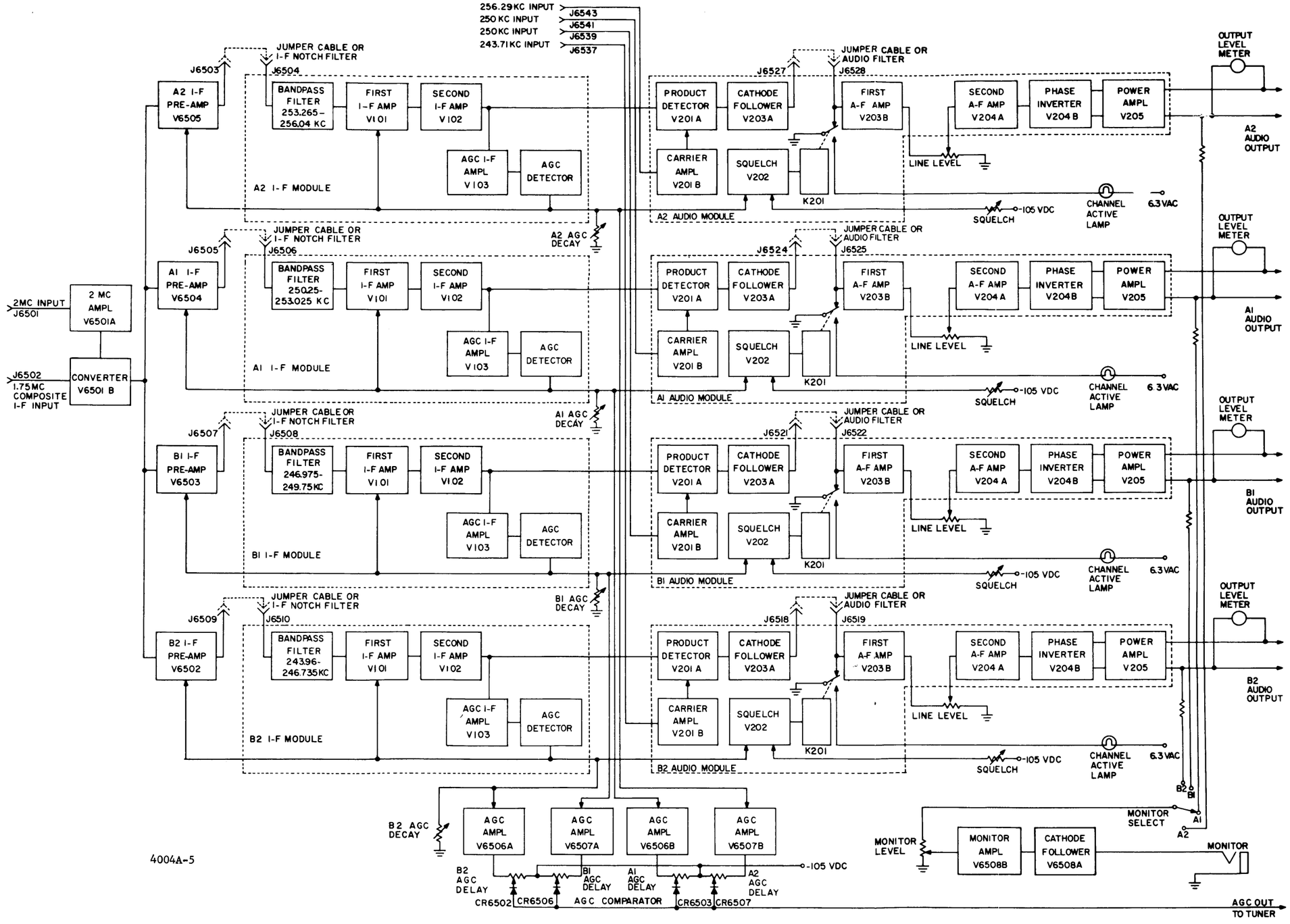


Figure 4-1. Block Diagram. Multiple Sideband Adapter MSA

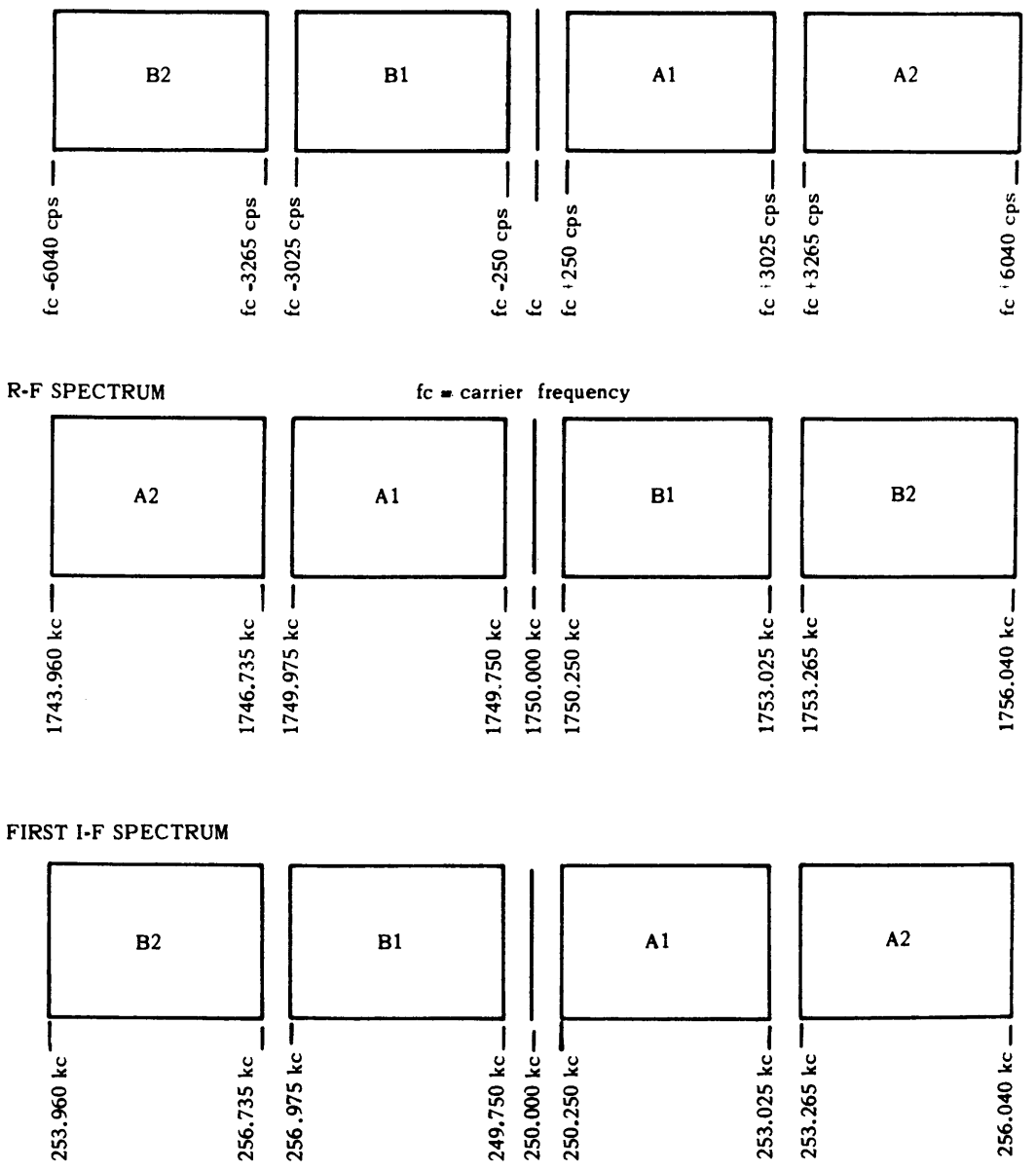


Figure 4-2. Idealized Composite Signal Spectra

used to control primary-power application to the associated external power supply.

Positive 200 vdc is supplied via pin C of J6515 to all tubes in the main chassis assembly and the four i-f modules. Positive 200 vdc for the audio modules is supplied via pin R. This B+ supply has additional filtering (in the associated external power supply) for improved decoupling since the audio modules operate at higher power levels than the remainder of the unit. Unbalanced 6.3 vac is supplied via pins H and J of J6515 for the filaments of all tubes on the main chassis assembly, the four i-f modules, and the squelch tubes (V202) in the audio modules. Independent, balanced 6.3 vac supplies are provided for each of the audio product detector/carrier amplifier and audio amplifier chains. These independent balanced filament circuits minimize hum in the audio amplifiers.

SECTION 5
MAINTENANCE

5-1. PREVENTIVE MAINTENANCE.

a. The MSA has been designed to provide long-term, trouble-free operation under continuous duty conditions. However, in order to prevent failure of the unit due to tube failure, corrosion, dust, or other destructive elements, it is suggested that a schedule of preventive maintenance be set up and adhered to.

b. At periodic intervals, the unit should be removed from its mounting for cleaning and inspection. All accessible covers should be removed and the wiring and all components inspected for dirt, corrosion, charring, discoloring or grease. Remove dust with a soft brush or vacuum cleaner. Remove dirt or grease from other parts with any suitable cleaning solvent. Use of carbon tetrachloride should be avoided due to its highly toxic effects. Trichlorethylene or methyl chloroform may be used, providing the necessary precautions are observed.

WARNING

When using toxic solvents, make certain that adequate ventilation exists. Avoid prolonged or repeated breathing of the vapor. Avoid prolonged or repeated contact with skin. Flammable solvents shall not be used on energized equipment or near any equipment from which a spark may be received. Smoking, "hot work", etc. is prohibited in the immediate area.

CAUTION

When using trichlorethylene, avoid contact with painted surfaces due to its paint removing effects.

5-2. TROUBLESHOOTING.

a. GENERAL. - In many instances, trouble in the MSA may be localized to a particular module by use of the operator's controls and front-panel indicators. If all four channels are inoperative, the trouble most likely lies in the converter stage or associated power supply. Refer to table 5-2 for voltage and resistance measurements. Table 5-1 lists the test equipment required for detailed troubleshooting and alignment. Refer to figures 5-1 and 5-2 for location of major components.

b. QUICK TESTS USING FRONT-PANEL CONTROLS. - If one or more, but not all channels are operating normally, check the operation of the squelch control with a signal applied to the unoperative channel. If the channel activity lamp lights with a normal signal applied, but no audio output is obtained, the trouble probably lies in the product detector or amplifier stages. If the channel activity lamp does not light with a normal signal applied and the SQUELCH ADJUST control at its normal setting, the trouble probably lies in the preamplifier or i-f module.

Table 5-1. Test Equipment Required

TYPE	MANUFACTURER AND MODEL NUMBER
Volt-ohm-milliometer	Simpson Model 260, or equivalent.
R-F signal generator	Hewlett-Packard Model 606A, or equivalent.
Mux Carrier Generator	T.M.C. Model MCA-1, or additional r-f signal generator as described above.
Vacuum-tube-voltmeter	Hewlett-Packard Model 410B, or equivalent.
Oscilloscope	Tektronix Type 454A, or equivalent.

c. CONVERTER AND PREAMPLIFIER STAGES.

(1) Disconnect all external wiring, except power supply input, from rear of unit.

(2) Connect co-axial jumper cables between J6503 and J6504, between J6505 and J6506, between J6507 and J6508, and between J6509 and J6510. Remove i-f modules.

(3) Connect an r-f signal generator to J6502. Adjust generator to deliver 245.3 kc at 20 mv; use frequency counter to determine that frequency of signal generator output is accurate.

(4) Measure signal level at pin 2 of J6511; level should be 0.3 v (300 mv) or higher. If this signal level is not obtained, check channel B2 preamplifier V6502.

(5) Adjust signal generator to deliver 248.4 kc; check frequency as in step (3) above.

(6) Measure signal level at pin 2 of J6512; level should be 0.3 v or higher. If this signal level is not obtained, check channel B1 preamplifier V6503.

(7) Adjust signal generator to deliver 251.6 kc; check frequency as in step (3) above.

(8) Measure signal level at pin 2 of J6513; level should be 0.3v or higher. If this level is not obtained, check channel A1 preamplifier V6504.

(9) Adjust signal generator to deliver 254.7 kc; check frequency as in step (3) above

(10) Measure signal level at pin 2 of J6514; level should be 0.3v or higher. If this level is not obtained, check channel A2 preamplifier V6505.

(11) If none of the above tests were successful, check voltages, resistances, and alignment of convertor stage V6501.

d. I-F MODULE.

(1) Disconnect all external wiring, except power supply input, from rear of unit.

(2) Connect r-f signal generator to J6510; adjust signal generator to deliver 245.3 kc at 5 mv.

NOTE

Audio modules must be installed so that the i-f modules are properly loaded.

(3) Measure signal level at J102 on B2 i-f module; level should be approximately 0.2v rms. If this level is not obtained, check tube voltages and i-f module alignment.

(4) Connect signal generator to J6508. Adjust signal generator to deliver 248.4 kc at 5 mv.

(5) Measure signal level at J102 on B1 i-f module; level should be approximately 0.2v rms. If this level is not obtained, check tube voltages and i-f module alignment.

(6) The channel A1 and channel A2 i-f modules may be tested similarly to the B2 and B1 tests outlined above. To check channel A1 i-f module gain, connect signal generator to J6506, and use 251.6 kc as test frequency. To check channel A2 i-f module gain, connect signal generator to J6504, and use 254.7 kc as test frequency.

e. AUDIO MODULE.

(1) Disconnect all external wiring from terminal board E6501.

(2) Connect associated multiplex carrier generator or similar equipment to jacks J6537, J6539, J6541, and J6543. Check that the following inputs are present.

(a) At J6537; 243.71 kilocycles at 1v rms.

(b) At J6539; 250.00 kilocycles at 1v rms.

(c) At J6541; 250.00 kilocycles at 1v rms.

(d) At J6543; 256.29 kilocycles at 1v rms.

(3) Terminate each channel audio output with a 600 ohm resistor across channel output terminals.

(a) Channel A2; terminals 5 and 6, E6501.

(b) Channel A1; terminals 7 and 8, E6501.

(c) Channel B1; terminals 9 and 10, E6501.

(d) Channel B2; terminals 11 and 12, E6501.

(4) Rotate all LINE LEVEL controls fully clockwise.

(5) Rotate all SQUELCH ADJUST controls fully counter clockwise. All channel indicator lamps should be lit.

(6) Connect an a-c voltmeter across channel B2 load resistor.

(7) Connect r-f voltmeter to J201 on channel B2 audio module. Adjust generator to deliver 245.3 kc at 15 mv.

(8) Audio signal at channel B2 output should be at least 0.78v rms. If this level is not obtained, check tube voltages in the applicable audio module.

(9) Channels B1, A1 and A2 audio modules may be tested similarly to the channel B2 test described above. The applicable test frequencies are:

(a) Channel B1; 248.4 kilocycles.

(b) Channel A1; 251.6 kilocycles.

(c) Channel A2; 254.7 kilocycles.

5-3. ALIGNMENT.

a. CONVERTER.

(1) Disconnect all external wiring except power supply input from rear of unit.

(2) Connect signal generator to J6502. Adjust generator to deliver 250.00 kilocycles at 50 mv.

(3) Ground secondary (green terminal) of T6502.

(4) Connect VTVM to plate (pin 1) of V6501. Use 100k ohm isolating resistor to prevent loading of circuit.

(5) Tune primary (top slug) of T6502 to obtain maximum r-f voltage at plate of V6501.

(6) Remove ground connection from secondary of T6502. Tune secondary (bottom slug) of T6502 to obtain minimum r-f voltage at plate of V6501.

(7) This completes alignment of converter stage.

b. PREAMPLIFIERS.

(1) Disconnect all external wiring except power supply input from rear of unit.

(2) Remove the i-f modules. Connect co-axial jumper cables between J6503 and J6504, between J6505 and J6506, between J6507 and J6508, and between J6509 and J6510.

(3) Connect r-f signal generator to J6502. Adjust generator to deliver 245.3 kc at 20 mv.

(4) Ground secondary (green terminal) of T6503.

(5) Connect VTVM to plate (pin 5) of V6502. Use 100k ohm isolating resistor to prevent loading the circuit.

(6) Tune primary (top slug) of T6503 to obtain maximum r-f voltage at plate of V6502.

(7) Remove ground connection from secondary of T6503. Tune secondary (bottom slug) of T6503 to obtain minimum voltage at plate of V6502.

(8) Align remainder of preamplifiers in a similar manner.

TEST FREQUENCY	TUBE	TRANSFORMER
248.4 kc	V6503	T6504
251.6 kc	V6504	T6505
254.7 kc	V6505	T6506

(9) Replace i-f modules at completion of preamplifier alignment.

c. I-F MODULES.

(1) Disconnect all external wiring except power supply input from rear of unit.

NOTE

Audio modules must be installed so that the i-f modules are properly loaded.

(2) Ground terminal 5 of jack J6511.

(3) Connect r-f signal generator to J6510. Adjust generator to deliver 245.3 kilocycles at 5 mv.

(4) Ground secondary (green terminal) of T102 on channel B2 i-f module.

(5) Connect VTVM to plate (pin 5) of V101.

(6) Adjust top slug of T102 to obtain maximum indication on VTVM.

(7) Connect VTVM to output winding (yellow terminal) of T103. Remove ground from T102.

(8) Adjust bottom slug of T102 and top slug of T103 for maximum indication on VTVM.

(9) Remove ground from pin 5 of J6511. Adjust L101 to obtain minimum indication on VTVM.

(10) Adjust R116 until VTVM indicates 0-2 rms at output of module. (yellow terminal of T102).

(11) Adjust channels B1, A1, and A2 i-f modules in a similar manner. The applicalbe test frequencies are: channel B1, 248.4 kilocycles; channel A1, 251.6 kilocycles; and channel A2, 254.7 kilocycles. The channel AGC output must be grounded during the first part of each module alignment. The most convenient point to ground appropriate AGC circuits are: channel B1, pin 5 of J6512; channel A1, pin 5 of J6513; and channel A2, pin 5 of J6514.

d. AUDIO MODULES.

(1) Disconnect i-f signal input from unit.

(2) Check that the following carrier injection signals are applied.

(a) At J6537; 243.71 kilocycles at 1v rms.

(b) At J6539; 250.00 kilocycles at 1v rms.

(c) At J6541; 250.00 kilocycles at 1v rms.

(d) At J6543; 256.29 kilocycles at 1v rms.

(3) Connect VTVM to pin 1 of V201 on channel B2 audio modules.

(4) Adjust L201 to obtain minimum r-f voltage at plate of V201.

(5) Align remainder of audio modules in same manner.

e. AGC COMPARATOR.

(1) Disconnect all external wiring, except power supply input, from unit.

(2) Connect d-c voltmeter to arm of R6532. Adjust R6532 to obtain 0 vdc.

(3) Rotate channel B2 AGC DECAY ADJUST control fully clockwise and fully counter clockwise. Voltage at arm of R6532 must not be more than ±0.1 vdc. If necessary, readjust R6532 so that output voltage remains essentially at ground potential when the AGC DECAY ADJUST control is rotated.

(4) Adjust channels B1, A1, and A2 controls in similar manner. The applicable AGC delay controls are: channel B1, R6539; channel A1, R6533; and channel A2, R6541.

Table 5-2. Typical Voltage and Resistance Measurements

TUBE	MEASUREMENT	PINS								
		1	2	3	4	5	6	7	8	9
V6501	DC	192	146	2.5	Fil	0	146	0	0	9.6
	Ohms	7K	7K	330	0	0	8K	100	47	4K
V6502	DC	0	3	Fil	0	173	100	3		
	Ohms	250K	470	0	0	7K	15K	470		
V6503	DC	0	3	Fil	0	173	100	3		
	Ohms	250K	470	0	0	7K	15K	470		
V6504	DC	0	3	Fil	0	173	100	0		
	Ohms	250K	470	0	0	7K	15K	470		
V6505	DC	0	3	Fil	0	173	100	3		
	Ohms	250K	470	0	0	7K	15K	470		
V6506	DC	200	*4 & 3 4	*3 0	Fil	Fil	200	*3 -.1	*3 3.4	0
	Ohms	3K	800	*5 120K	0	0	3K	600	*3 130K	0
V6507	DC	200	*3 0	*3 3.3	Fil	Fil	200	*3 -.05	*3 3	0
	Ohms	3K	650	*3 120K	0	0	3K	600	*3 120K	0
V6508	DC	105	0	3.5	FK	FK	87	*3 .15	3.7	0
	Ohms	1.1K	0	0	70K	2K	0	0	35K	1 meg
V101	DC	0	1.25	FK	0	165	100	1.25		
	Ohms	850K	68	0	0	6K	30K	68		
V102	DC	0	NC	Fil	0	165	140	1.2		
	Ohms	60	100	6K	25K	6K	25K	100		
V103	DC	0	1.3	Fil	0	160	160	1.3		
	Ohms	7	470	0	0	5.8K	10K	470		
V201	DC	125	0	6.5	*4 Fil	*4 Fil	175	0	6.5	*4 Fil
	Ohms	30K	47							
V202	DC	85	0	115	Fil	0	.62	5.2	5.5	93
	Ohms	12K	650	170K	0	0	1K	350K	390	30K
V203	DC	175	6	12	*4 Fil	*4 Fil	77	0	3	*4 Fil
	Ohms	4K	1 meg	3K	INF	INF	70K	0	2.2K	INF

Table 5-2. Typical Voltage and Resistance Measurements (Cont)

TUBE	MEASUREMENT	PINS								
		1	2	3	4	5	6	7	8	9
V204	DC	73	0	3.2	*4 Fil	*4 Fil	165	0	7.8	*4 Fil
	Ohms	100K	4	3.3K	INF	INF	7K	1 meg	4.7K	INF
V205	DC	195	0	6	*4 Fil	*4 Fil	195	0	0	Fil
	Ohms	3.5K	470K	1K	INF	INF	3.5K	470K	1K	INF

*Notes

1. All voltage measurements are d-c measured to ground unless specified otherwise. A Hewlett Packard 410B VTVM was used. All front panel controls on MSA-1 except power switch are fully counterclockwise.
2. All resistance measurements are taken with respect to ground with a Simpson 260 VOM. The LINE LEVEL and AGC DECAY controls are turned fully counterclockwise, the MONITOR LEVEL control fully counterclockwise, SQUELCH ADJUST fully clockwise, and power switch at STDBY.
3. These voltages may fluctuate greatly.
4. Pins 4 and 5 measured to pin 9. Pin 9 measured to pins 4 and 5.
5. These readings will vary with adjustment of potentiometers R6531, R6533.
6. These readings will vary with adjustment of potentiometers R6539, R6541.

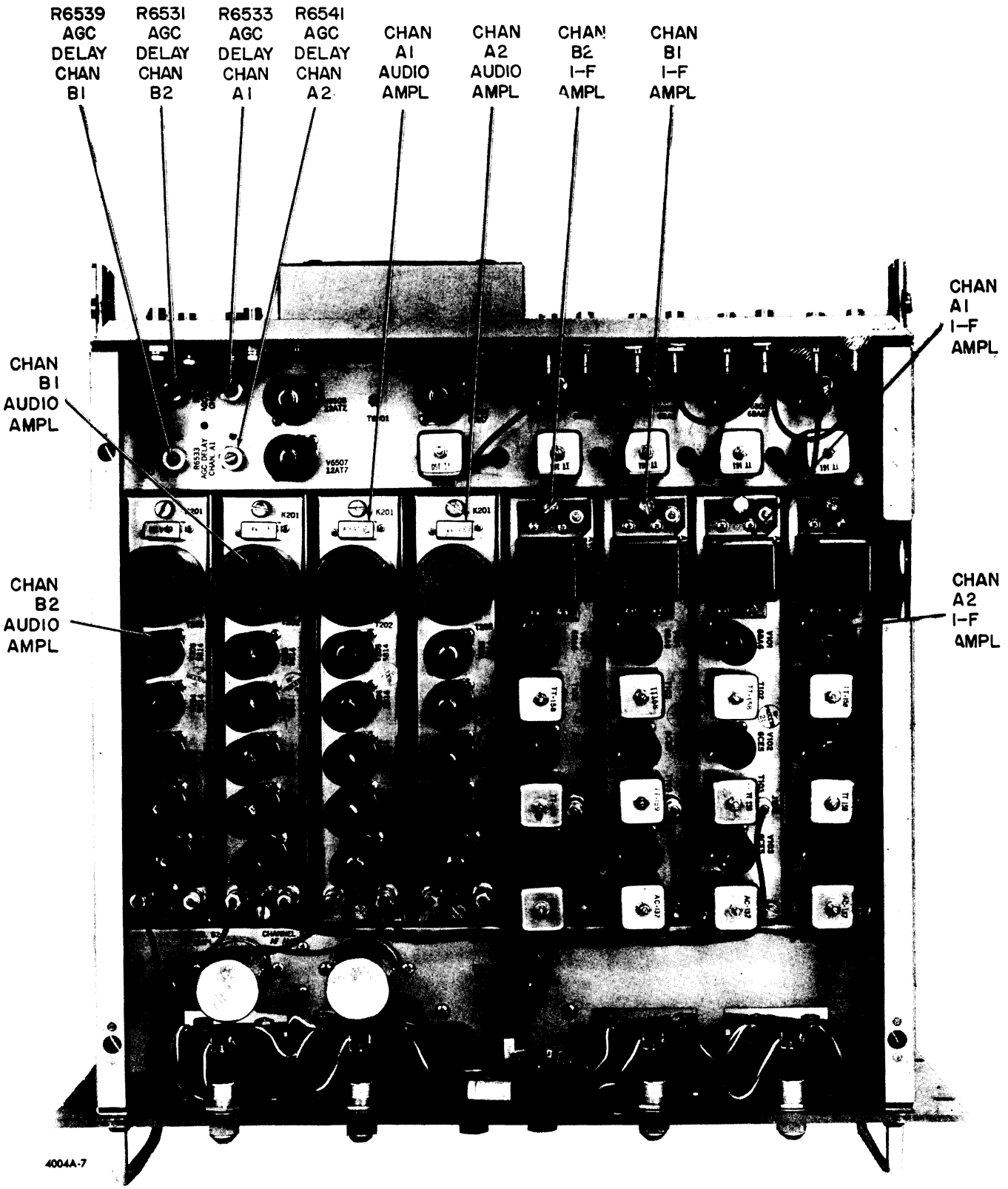


Figure 5-1. Top View, MSA

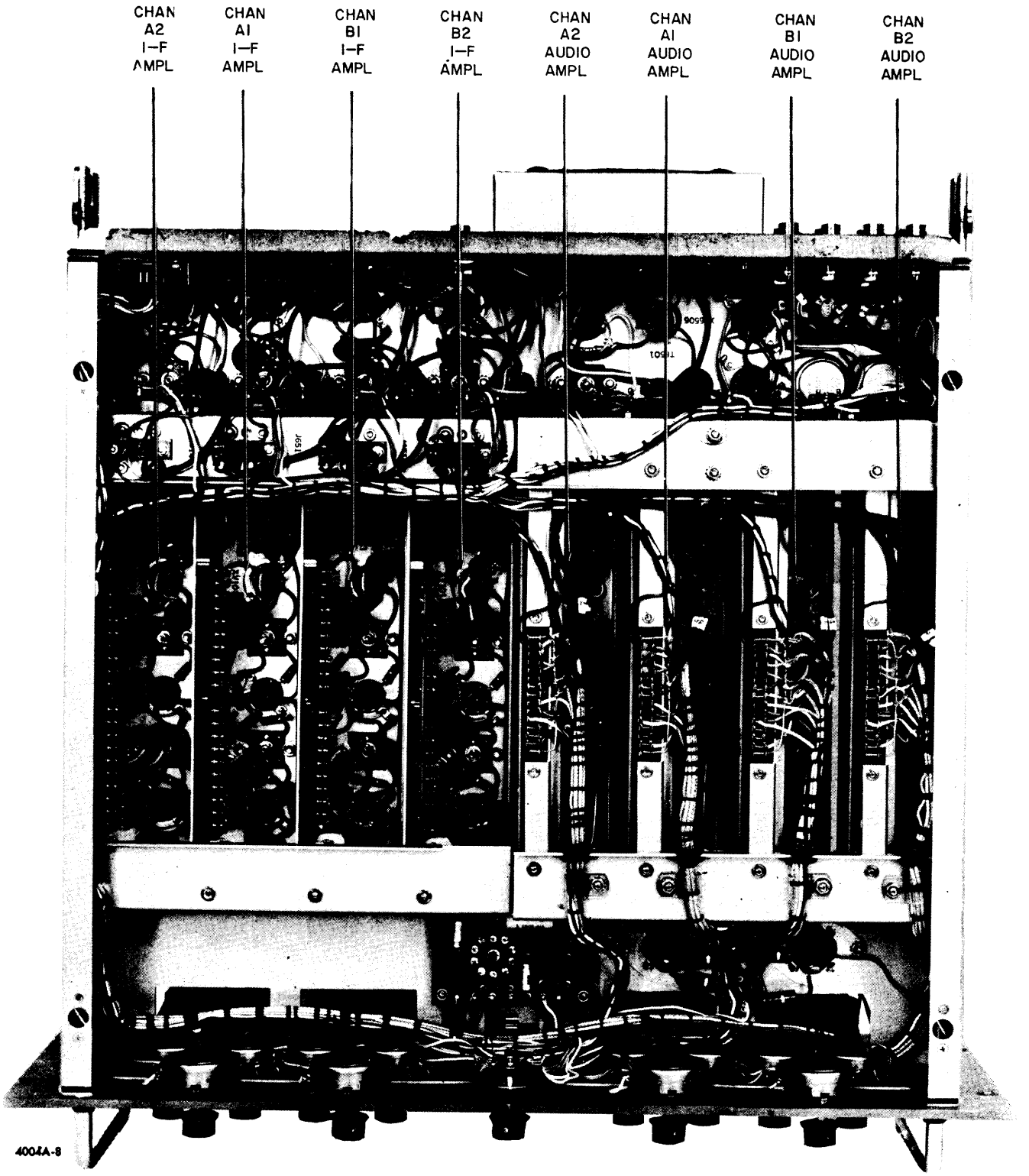


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Figure 5-2. Bottom View, MSA

SECTION 6
PARTS LIST

6-1. INTRODUCTION. Reference designations have been assigned to identify all electrical parts of the equipment. These designations are used for marking the equipment (adjacent to the part they identify) and are included on drawings, diagrams and the parts list. The letters of a reference designation indicate the kind of part (generic group), such as resistor, capacitor, transistor, etc. The number differentiates between parts of the same generic group. Sockets associated with a particular plug-in device, such as transistor or fuse, are identified by a reference designation which includes the reference designation of the plug-in device. For example, the socket for fuse F101 is designated XF101. To expedite delivery, when ordering replacement parts, specify the TMC part number and the model number of the equipment.

PLUG-IN IF AMPLIFIER

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C101	NOT USED	
C102	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 20,000 uuf, +80% -20%; 500 WVDC.	CC100-24
C103	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 200,000 uuf, +80% -20%; 25 WVDC.	CC100-33
C104	Same as C102.	
C105	Same as C103.	
C106	Same as C102.	
C107	Same as C102.	
C108	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 100,000 uuf, +80% -20%; 500 WVDC.	CC100-32
C109	Same as C102.	
C110	Same as C102.	
C111	CAPACITOR, FIXED, PLASTIC DIELECTRIC: 1.0 uf, ±10%; 200 WVDC.	CN112A105K2
C112	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 100,000 uuf, +80% -20%; 100 WVDC.	CC100-28
C113	Same as C103.	
C114	Same as C108.	
C115	CAPACITOR, FIXED, MICA DIELECTRIC: 560 uuf, ±5%; 500WVDC.	CM20C561J
CR101	SEMICONDUCTOR DEVICE, DIODE: silicon; max. peak inverse voltage 175 volts; max. RMS voltage 125 volts; 30 ma at 25°C and 15 ma at 150°C; peak recurrent 120 ma; max. surge current 0.5 amps.	1N463
CR102	Same as CR101	
CR103	Same as CR101.	
EV101	SHIELD, ELECTRON TUBE: 1-3/4" lg. x 0.930" dia.; tension spring, twist lock.	TS102U02

PLUG-IN IF AMPLIFIER

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
EV102	Same as EV101.	
EV103	Same as EV101.	
J101	CONNECTOR, RECEPTACLE, ELECTRICAL: 7 round #16 male contacts; straight type.	JJ245
J102	CONNECTOR, RECEPTACLE, ELECTRICAL: 1 round male contact; teflon insulation; miniature BNC series.	JJ211
L101	COIL, INTERMEDIATE FREQUENCY: tuned; operating frequency 250 KC; consists of two capacitors, one 220 uuf and one 2,000 uuf, one resistor 10,000 ohms.	AC137
R101 thru R103	NOT USED	
R104	RESISTOR, FIXED, COMPOSITION: 100 ohms, ±10%; 1/2 watt.	RC20GF101K
R105	RESISTOR, FIXED, COMPOSITION: 27,000 ohms, ±10%; 1/2 watt.	RC20GF273K
R106	RESISTOR, FIXED, COMPOSITION: 3,300 ohms, ±10%; 1/2 watt.	RC20GF332K
R107	RESISTOR, FIXED, COMPOSITION: 47 ohms, ±10%; 1/2 watt.	RC20GF470K
R108	Same as R104.	
R109	RESISTOR, FIXED, COMPOSITION: 22,000 ohms, ±10%; 1/2 watt.	RC20GF223K
R110	Same as R106.	
R111	RESISTOR, FIXED, COMPOSITION: 470 ohms, ±10%; 1/2 watt.	RC20GF471K
R112	RESISTOR, FIXED, COMPOSITION: .22 megohms, ±10%; 1/2 watt.	RC20GF224K
R113	RESISTOR, FIXED, COMPOSITION: 10,000 ohms, ±10%; 1/2 watt.	RC20GF103K
R114	Same as R106.	
R115	Same as R109.	
R116	RESISTOR, VARIABLE, COMPOSITION: 50,000 ohms, ±10%; 1/2 watt.	RV106UX10C503A
R117	RESISTOR, FIXED, COMPOSITION: 560 ohms, ±10%; 1/2 watt.	RC20GF561K
R118	RESISTOR, FIXED, COMPOSITION: 330 ohms, ±10%; 1/2 watt.	RC20GF331K
R119	RESISTOR, FIXED, COMPOSITION: 1 megohm, ±10%; 1/2 watt.	RC20GF105K
R120	Same as R107.	
T101	NOT USED	
T102	TRANSFORMER, INTERMEDIATE FREQUENCY: tuned; operating frequency 250 KC; consists of two capacitors, one 470 uuf and one 320 uuf.	TT158
T103	TRANSFORMER, INTERMEDIATE FREQUENCY: tuned; operating frequency 250 KC; consists of one, 1000 uuf capacitor.	TT159
TB101	TERMINAL BOARD, FINAL ASSEMBLY.	A2170-4

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
V101	TUBE, ELECTRON: remote cutoff pentode; 7 pin miniature.	6BA6
V102	TUBE, ELECTRON: sharp cutoff pentode; 7 pin miniature.	6CE5
V103	Same as V102.	
XV101	SOCKET, ELECTRON TUBE: 7 pin miniature.	TS102P01
XV102	Same as XV101.	
XV103	Same as XV101.	
Z101	FILTER, BANDPASS: 2.7 KC. (Used on channel A1, IF Module)	FX186
Z101	FILTER, BANDPASS: 2.7 KC. (Used on channel A2, IF Module)	FX187
Z101	FILTER, BANDPASS: 2.7 KC. (Used on channel B1, IF Module)	FX188
Z101	FILTER, BANDPASS: 2.7 KC. (Used on channel B2, IF Module)	FX189

AF AMPLIFIER

C201	CAPACITOR, FIXED, MICA DIELECTRIC: 470uuf, ±10%; 500 WVDC.	CM15C471K
C202	CAPACITOR, FIXED, MICA DIELECTRIC: 100 uuf, ±5%; 500 WVDC; char. C.	CM15C101J
C203	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 20,000 uuf, +60% -40%; 150 WVDC.	CC100-35
C204	NOT USED	
C205	CAPACITOR, FIXED, MICA DIELECTRIC: 820 uuf, ±5%; 500 WVDC; char. C.	CM20C821J
C206	CAPACITOR, FIXED, ELECTROLYTIC: 1 uf, -10% +150% at 120 cps at 25°C; 25 WVDC; polarized; insulated tubular case.	CE105-1-25
C207	CAPACITOR, FIXED, PAPER DIELECTRIC: 1,000 uuf, +60% to -20%; 600 WVDC.	CN100-9
C208 thru C210	Same as C207.	
C211	CAPACITOR, FIXED, METALIZED PLASTIC: 0.25 uf, ±20%; 100 WVDC.	CN112A254M1
EV201	SHIELD, ELECTRON TUBE: heat dissipating; 2-1/8" high x 1" sq.; with finger shields and black cadmium plated insert liner.	TS128-5
EV202 thru EV205	Same as EV201.	
J201	CONNECTOR, RECEPTACLE, ELECTRICAL: RF; 1 round male contact; straight type; series BNC to BNC.	JJ211
J202	Same as J201.	

AF AMPLIFIER

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
K201	RELAY, ARMATURE: coil operating voltage 110 VDC; coil resistance 9100 ohms DC; current rating 26.5 VDC; 3 amps, non-inductive; double pole, double throw.	RL143-1
L201	COIL, RADIO FREQUENCY: adjustable; 440-800 uh, ±10%; 11 ohms DC resistance; perma-torq slug lock type.	CL283-10
R201	RESISTOR, FIXED, COMPOSITION: 27,000 ohms, ±5%; 1/2 watt.	RC20GF273J
R202	RESISTOR, FIXED, COMPOSITION: 47 ohms, ±5%; 1/2 watt.	RC20GF470J
R203	NOT USED.	
R204	RESISTOR, FIXED, COMPOSITION: 100,000 ohms, ±5%; 1/2 watt.	RC20GF104J
R205	RESISTOR, FIXED, COMPOSITION: 820 ohms, ±5%; 1/2 watt.	RC20GF821J
R206	NOT USED.	
R207	NOT USED.	
R208	RESISTOR, FIXED, COMPOSITION: 4,700 ohms, ±5%; 1/2 watt.	RC20GF472J
R209	NOT USED.	
R210	RESISTOR, FIXED, COMPOSITION: 220,000 ohms, ±5%; 1/2 watt.	RC20GF224J
R211	RESISTOR, FIXED, COMPOSITION: 1 megohm, ±5%; 1/2 watt.	RC20GF105J
R212	RESISTOR, FIXED, COMPOSITION: 22,000 ohms, ±5%; 1/2 watt.	RC20GF223J
R213	RESISTOR, FIXED, COMPOSITION: 1,000 ohms, ±5%; 1/2 watt.	RC20GF102J
R214	RESISTOR, FIXED, COMPOSITION: 470,000 ohms, ±5%; 1/2 watt.	RC20GF474J
R215	RESISTOR, FIXED, COMPOSITION: 390 ohms, ±5%; 1/2 watt.	RC20GF391J
R216	Same as R211.	
R217	RESISTOR, FIXED, COMPOSITION: 1,500 ohms, ±5%; 1/2 watt.	RC20GF152J
R218	Same as R217.	
R219	RESISTOR, FIXED, COMPOSITION: 68,000 ohms, ±5%; 1/2 watt.	RC20GF683J
R220	Same as R213.	
R221	RESISTOR, FIXED, COMPOSITION: 2,200 ohms, ±5%; 1/2 watt.	RC20GF222J
R222	Same as R204.	
R223	Same as R211.	
R224	RESISTOR, FIXED, COMPOSITION: 3,300 ohms, ±5%; 1/2 watt.	RC20GF332J
R225	Same as R211.	
R226	Same as R208.	
R227	Same as R208.	

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R228	Same as R214.	
R229	Same as R213.	
R230	Same as R214.	
R231	Same as R213.	
R232	Same as R219.	
T201	TRANSFORMER, RADIO FREQUENCY: primary resistance 50 ohms; secondary resistance 5,000 ohms; frequency response 200 KC to 2 MC within 3 db; black case.	TZ107
T202	TRANSFORMER, AUDIO: hum bucking coil and core; primary resistance 600 ohms; secondary resistance 60,000 ohms, CT.	TF132
V201	TUBE, ELECTRON: medium-mu twin triode; 9 pin miniature.	5814
V202	TUBE, ELECTRON: triode pentode; 9 pin miniature.	6EU8
V203 thru V205	Same as V201.	
XV201	SOCKET, ELECTRON TUBE: 9 pin miniature.	TS103P01
XV202 thru XV205	Same as XV201.	

MAIN CHASSIS

B6501	FAN, AXIAL: 115 V, 50/60 cps; 14 watts; 100 cfm; blade dia. 4-1/2"; o/a dim., 1-5/8" x 5-5/32" x 6-1/8"; with grill cover and mounting clips.	BL106-3
C6501	CAPACITOR, FIXED, MICA DIELECTRIC: 110 uuf, ±5%; 500 WVDC; char. C.	CM15C111J
C6502	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 100,000 uuf, +80% -20%; 100 WVDC.	CC100-28
C6503	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 100,000 uuf, +80% -20%; 300 WVDC.	CC100-37
C6504	Same as C6502.	
C6505	NOT USED.	
C6506 thru C6509	Same as C6503.	
C6510	CAPACITOR, FIXED, METALIZED PLASTIC: 1.00 uf, ±10%; 200 WVDC.	CN112A105K2
C6511	CAPACITOR, FIXED, ELECTROLYTIC: 10 uf, -10% +150% at 120 cps at 25°C; 15 WVDC; polarized; insulated tubular case.	CE105-10-15

MAIN CHASSIS

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C6512	Same as C6503.	
C6513	Same as C6511.	
C6514	CAPACITOR, FIXED, METALIZED PLASTIC: 1.00 uf, ±20%; 200 WVDC.	CN112A105M2
C6515	CAPACITOR, FIXED, ELECTROLYTIC: dual unit; 40 uf each section; 450 WVDC.	CE102-1
C6516	Same as C6515.	
C6517	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 10,000 uuf, GMV; 500 WVDC.	CC100-16
C6518	Same as C6502.	
C6519	Same as C6517.	
C6520	Same as C6502.	
C6521	Same as C6517.	
C6522	Same as C6502.	
C6523	Same as C6517.	
C6524	Same as C6502.	
C6525	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 20,000 uuf, +80% -20%; 500 WVDC.	CC100-24
C6526 thru C6529	Same as C6525.	
C6530	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 200,000 uuf, +80% -20%; 25 WVDC.	CC100-33
C6531 thru C6533	Same as C6530.	
CR6501	SEMICONDUCTOR DEVICE, DIODE: silicon; 175 V max. peak inverse voltage; 30 ma at 25°C and 15 ma at 150°C; two axial wire lead type terminals; hermetically sealed glass case.	1N463
CR6502 thru CR6508	Same as CR6501.	
DS6501	LAMP, INCANDESCENT: 6-8 volts, 0.15 amp; miniature bayonet base T-3-1/4 bulb.	BI101-47
DS6502 thru DS6504	Same as DS6501.	
E6501	TERMINAL BOARD, BARRIER: 12 terminals; 6-32 thd. x 1/4" lg. binder head screws; phenolic black bakelite.	TM100-12

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
EV6501	SHIELD, ELECTRON TUBE: heat dissipating; type D; 2-5/8" height; black cadmium plated.	TS128-6
EV6502	SHIELD, ELECTRON TUBE: heat dissipating; type C; black cadmium plated.	TS128-2
EV6503	Same as EV6502.	
EV6504	Same as EV6502.	
EV6505	Same as EV6502.	
EV6506	SHIELD, ELECTRON TUBE: heat dissipating; type D; 2-1/16" height; black cadmium plated.	TS128-5
EV6507	Same as EV6506.	
EV6508	Same as EV6506.	
J6501	CONNECTOR, RECEPTACLE, ELECTRICAL: 1 round female contact; straight type; series BNC to BNC. Part of W6501.	JJ172
J6502	Same as J6501. Part of W6502.	
J6503	Same as J6501. Part of W6503.	
J6504	Same as J6501. Part of W6504.	
J6505	Same as J6501. Part of W6505.	
J6506	Same as J6501. Part of W6506.	
J6507	Same as J6501. Part of W6507.	
J6508	Same as J6501. Part of W6508.	
J6509	Same as J6501. Part of W6509.	
J6510	Same as J6501. Part of W6510.	
J6511	CONNECTOR, RECEPTACLE, ELECTRICAL: 7 round #16 female contacts; straight type.	JJ216
J6512 thru J6514	Same as J6511.	
J6515	CONNECTOR, RECEPTACLE, ELECTRICAL: panel mount; 24 #20 male pin type contacts, rated for 7.5 amperes, 500 V RMS.	JJ200-4
J6516	JACK: telephone.	JJ034
J6517	CONNECTOR, RECEPTACLE, ELECTRICAL: 30 female, flat solid face contacts; 5 amps continuous current rating, 1800 V RMS.	JJ293-15D
J6518	Same as J6501. Part of W6512.	
J6519	Same as J6501. Part of W6512.	
J6520	Same as J6517.	

MAIN CHASSIS

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
J6521	Same as J6501. Part of W6512.	
J6522	Same as J6501. Part of W6512.	
J6523	Same as J6517.	
J6524	Same as J6501. Part of W6512.	
J6525	Same as J6501. Part of W6512.	
J6526	Same as J6517.	
J6527	Same as J6501. Part of W6512.	
J6528	Same as J6501. Part of W6512.	
J6529 thru J6536	NOT USED.	
J6537	Same as J6501. Part of W6513.	
J6538	NOT USED.	
J6539	Same as J6501. Part of W6513.	
J6540	NOT USED.	
J6541	Same as J6501. Part of W6513.	
J6542	NOT USED.	
J6543	Same as J6501. Part of W6513.	
L6501	COIL, RADIO FREQUENCY: fixed; 56.0 uh, ±10%; 3.0 ohms max. DC resistance; powdered iron coil form; molded.	CL240-56
M6501	METER, AUDIO LEVEL: minus 20 to plus 3 db, 0-100% scale; ballistic movement; internal impedance 3,900 ohms; standard 2-3/16" rectangular case.	MR154
M6502 thru M6504	Same as M6501.	
P6501	CONNECTOR, PLUG, ELECTRICAL: RF; 1 round female coaxial contact; straight type; miniature bayonet lock series. Part of W6511.	PL204
P6502 thru P6508	Same as P6501. Part of W6511.	
P6509 thru P6536	NOT USED.	
P6537	Same as P6501.	
P6538	NOT USED.	
P6539	Same as P6501.	

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
P6540	NOT USED	
P6541	Same as P6501.	
P6542	NOT USED	
P6543	Same as P6501.	
R6501	RESISTOR, FIXED, COMPOSITION: 6,800 ohms, ±5%; 1/2 watt.	RC20GF682J
R6502	RESISTOR, FIXED, COMPOSITION: 100 ohms, ±5%; 1/2 watt.	RC20GF101J
R6503	RESISTOR, FIXED, COMPOSITION: 330 ohms, ±5%; 1/2 watt.	RC20GF331J
R6504	RESISTOR, FIXED, COMPOSITION: 4,700 ohms, ±5%; 1/2 watt.	RC20GF472J
R6505	RESISTOR, FIXED, COMPOSITION: 3,900 ohms, ±5%; 1/2 watt.	RC20GF392J
R6506	Same as R6502.	
R6507	RESISTOR, FIXED, COMPOSITION: 47 ohms, ±5%; 1/2 watt.	RC20GF470J
R6508	Same as R6501.	
R6509	RESISTOR, FIXED, COMPOSITION: 220,000 ohms, ±5%; 1/2 watt.	RC20GF224J
R6510	Same as R6509.	
R6511	RESISTOR, FIXED, COMPOSITION: 470 ohms, ±5%; 1/2 watt.	RC20GF471J
R6512	RESISTOR, FIXED, COMPOSITION: 22,000 ohms, ±5%; 1/2 watt.	RC20GF223J
R6513	Same as R6504.	
R6514	Same as R6509.	
R6515	Same as R6509.	
R6516	Same as R6512.	
R6517	Same as R6504.	
R6518	Same as R6511.	
R6519	Same as R6507.	
R6520	Same as R6507.	
R6521	Same as R6512.	
R6522	Same as R6504.	
R6523	Same as R6511.	
R6524	Same as R6507.	
R6525	Same as R6507.	
R6526	Same as R6512.	
R6527	Same as R6504.	

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R6528	Same as R6511.	
R6529	RESISTOR, VARIABLE, COMPOSITION: 5 megohms, ±10%; 2 watts; taper A.	RV4NAYSD505A
R6530	RESISTOR, FIXED, COMPOSITION: 390,000 ohms, ±5%; 1/2 watt.	RC20GF394J
R6531	RESISTOR, VARIABLE, COMPOSITION: 10,000 ohms, ±10%; 2 watts; linear taper.	RV4ATXA103A
R6532	RESISTOR, FIXED, COMPOSITION: 100,000 ohms, ±5%; 1/2 watt.	RC20GF104J
R6533	Same as R6531.	
R6534	Same as R6532.	
R6535	Same as R6529.	
R6536	Same as R6530.	
R6537	Same as R6529.	
R6538	Same as R6530.	
R6539	Same as R6531.	
R6540	Same as R6532.	
R6541	Same as R6531.	
R6542	Same as R6532.	
R6543	Same as R6529.	
R6544	Same as R6530.	
R6545	RESISTOR, FIXED, COMPOSITION: 1 megohm, ±5%; 1/2 watt.	RC20GF105J
R6546	RESISTOR, FIXED, COMPOSITION: 33,000 ohms, ±5%; 1/2 watt.	RC20GF333J
R6547	RESISTOR, FIXED, COMPOSITION: 1,200 ohms, ±5%; 1/2 watt.	RC20GF122J
R6548	Same as R6545.	
R6549	RESISTOR, FIXED, COMPOSITION: 68,000 ohms, ±5%; 1/2 watt.	RC20GF683J
R6550	RESISTOR, FIXED, COMPOSITION: 2,200 ohms, ±5%; 1/2 watt.	RC20GF222J
R6551	RESISTOR, VARIABLE, COMPOSITION: 100,000 ohms, ±10%; 2 watts; linear taper.	RV4ATRD104A
R6552 thru R6555	Same as R6545.	
R6556	RESISTOR, VARIABLE, COMPOSITION: 5 megohms, ±10%; 2 watts; taper A.	RV4NAYSD505A
R6557	RESISTOR, VARIABLE, COMPOSITION: 1 megohm, ±10%; 2 watts; taper C.	RV4NAYSD105C
R6558	Same as R6556.	

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R6559	Same as R6557.	
R6560	Same as R6556.	
R6561	Same as R6557.	
R6562	Same as R6556.	
R6563	Same as R6557.	
R6564	RESISTOR, FIXED, COMPOSITION: 1,200 ohms, ±5%; 2 watts.	RC42GF122J
R6565 thru R6567	Same as R6564.	
R6568	Same as R6545.	
R6569 thru R6572	Same as R6546.	
R6573 thru R6576	Same as R6507.	
R6577	RESISTOR, FIXED, WIREWOUND: 1,000 ohms, ±5%; current rating 140 ma; 20 watts.	RW110-20
S6501	SWITCH, ROTARY: 1 section, 2 position, contacts rated for 5 amps, 28 VDC and 0.5 amp, 110 VAC.	SW150
S6502	SWITCH, ROTARY: 2 pole, 1 section, 4 position; non-shorting type contacts rated for 5 amps, 28 VDC or 0.5 amp, 110 VAC.	SW120
T6501	TRANSFORMER, RADIO FREQUENCY: primary resistance 50 ohms; secondary resistance 5,000 ohms; frequency response 200 KC to 2 MC within 3 db; black case.	TZ107
T6502	TRANSFORMER, INTERMEDIATE FREQUENCY: tuned; 250 KC operating frequency; consists of two 1,000 uuf capacitors and one resistor, 15,000 ohms.	TT160
T6503	TRANSFORMER, INTERMEDIATE FREQUENCY: tuned; 250 KC operating frequency; consists of one, 600 uuf capacitor.	TT161
T6504 thru T6506	Same as T6503.	
TP6501	TERMINAL, FEED-THRU: teflon; press fit; 1.0 uuf capacitance, 2,000 volts.	TE169-1
V6501	TUBE, ELECTRON: dual triode; 9 pin miniature.	6CM7
V6502	TUBE, ELECTRON: remote cut-off RF pentode; 7 pin miniature	6BA6
V6503 thru V6505	Same as V6502.	
V6506	TUBE, ELECTRON: duo triode; 9 pin miniature.	12AT7

MAIN CHASSIS

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
V6507	Same as V6506.	
V6508	TUBE, ELECTRON: medium-mu twin triode; 9 pin miniature.	5814
W6501	CABLE ASSEMBLY: RF; consists of 6" length of RG174/U coaxial cable; one cable connector J6501.	CA480-114-6
W6502	Same as W6501. Consists of J6502.	
W6503	CABLE ASSEMBLY: RF; consists of 10" length of RG174/U coaxial cable; one cable connector J6503.	CA480-114-10
W6504	CABLE ASSEMBLY: RF, consists of 8" length of RG174/U coaxial cable; one cable connector J6504.	CA480-114-8
W6505	Same as W6503. Consists of J6505.	
W6506	Same as W6504. Consists of J6506.	
W6507	Same as W6503. Consists of J6507.	
W6508	Same as W6504. Consists of J6508.	
W6509	Same as W6503. Consists of J6509.	
W6510	Same as W6504. Consists of J6510.	
W6511	WIRING HARNESS, BRANCHED, ELECTRICAL: consists of 8 connectors, P6501 thru P6508.	CA863
W6512	WIRING HARNESS, BRANCHED, ELECTRICAL: consists of 8 connectors, J6518, J6519, J6521, J6522, J6524, J6525, J6527, J6528.	CA861
W6513	WIRING HARNESS, BRANCHED, ELECTRICAL: consists of 4 connectors, J6537, J6539, J6541, J6543.	CA862
XDS6501	LIGHT, INDICATOR: with green frosted lens; for miniature bayonet base T-3-1/4 bulb.	TS106-3
XDS6502 thru XDS6504	Same as XDS6501.	
XV6501	SOCKET, ELECTRON TUBE: 9 pin miniature.	TS103P01
XV6502	SOCKET, ELECTRON TUBE: 7 pin miniature.	TS102P01
XV6503 thru XV6505	Same as XV6502.	
XV6506	Same as XV6501.	
XV6507	Same as XV6501.	
XV6508	SOCKET, ELECTRON TUBE: noval (9 pin) stand-off socket with bayonet shield base, center shield and ground tab.	TS161-1

SECTION 7
SCHEMATIC DIAGRAMS

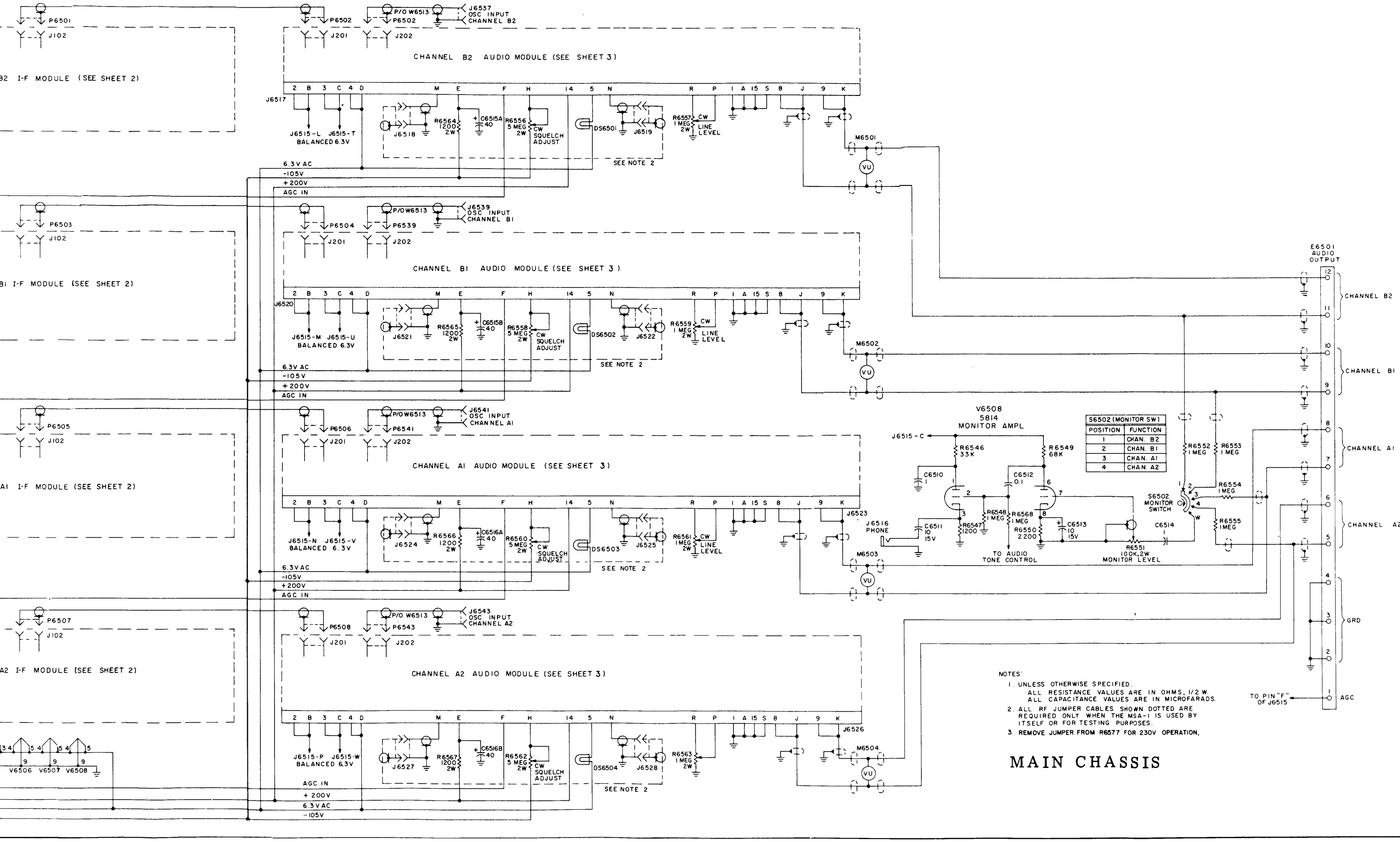
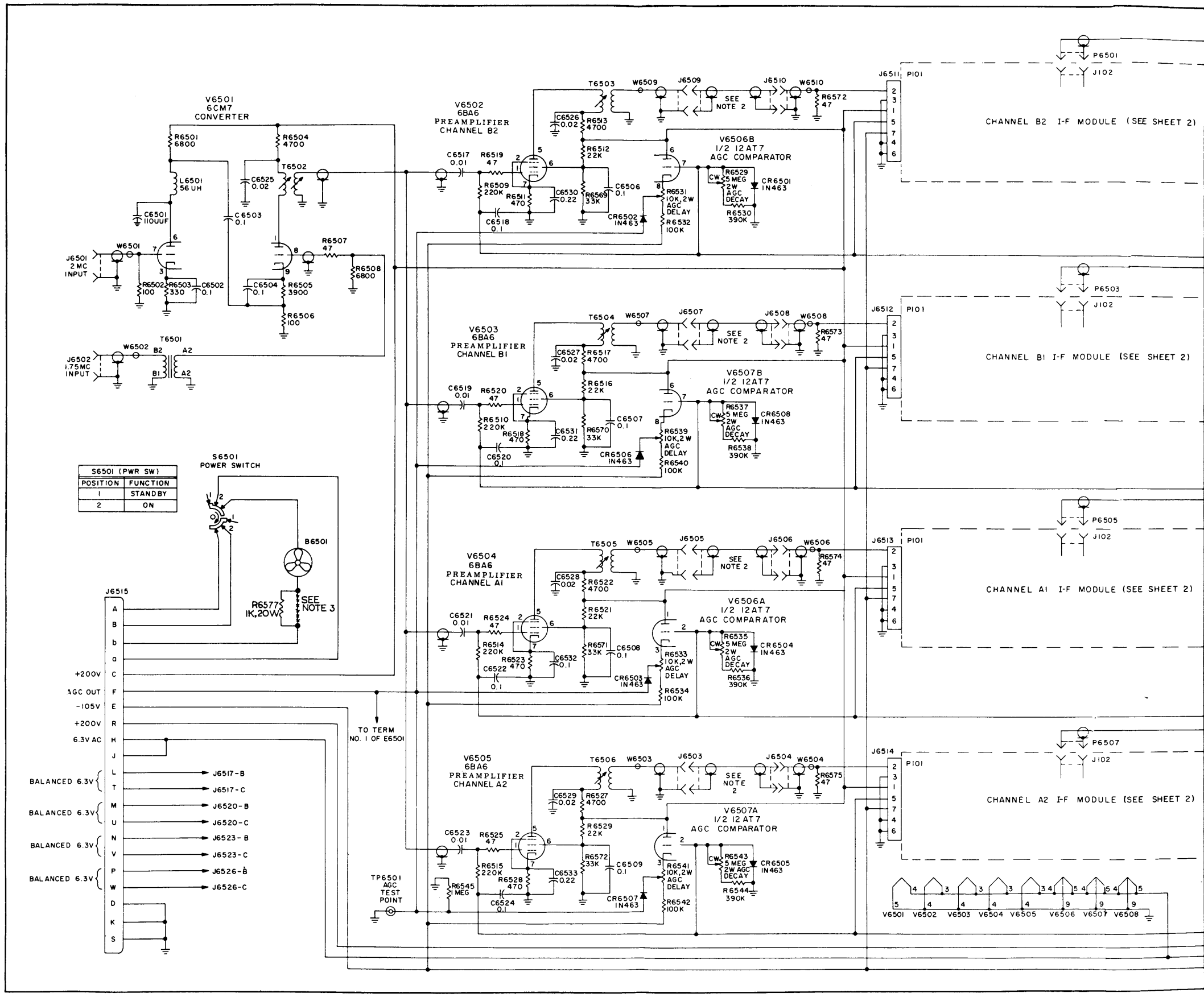


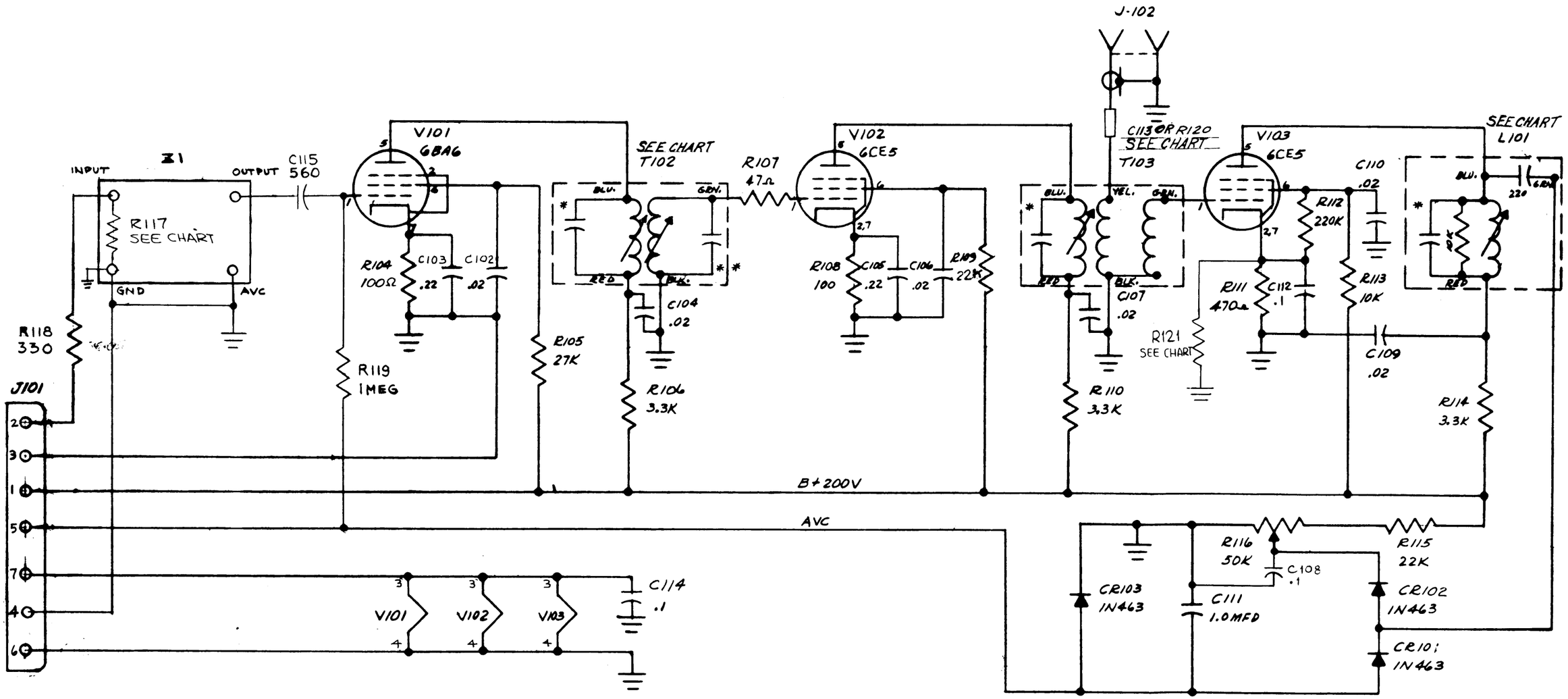
Figure 7-1. Schematic Diagram, MSA-1 (Sheet 1 of 3)



CK-708D

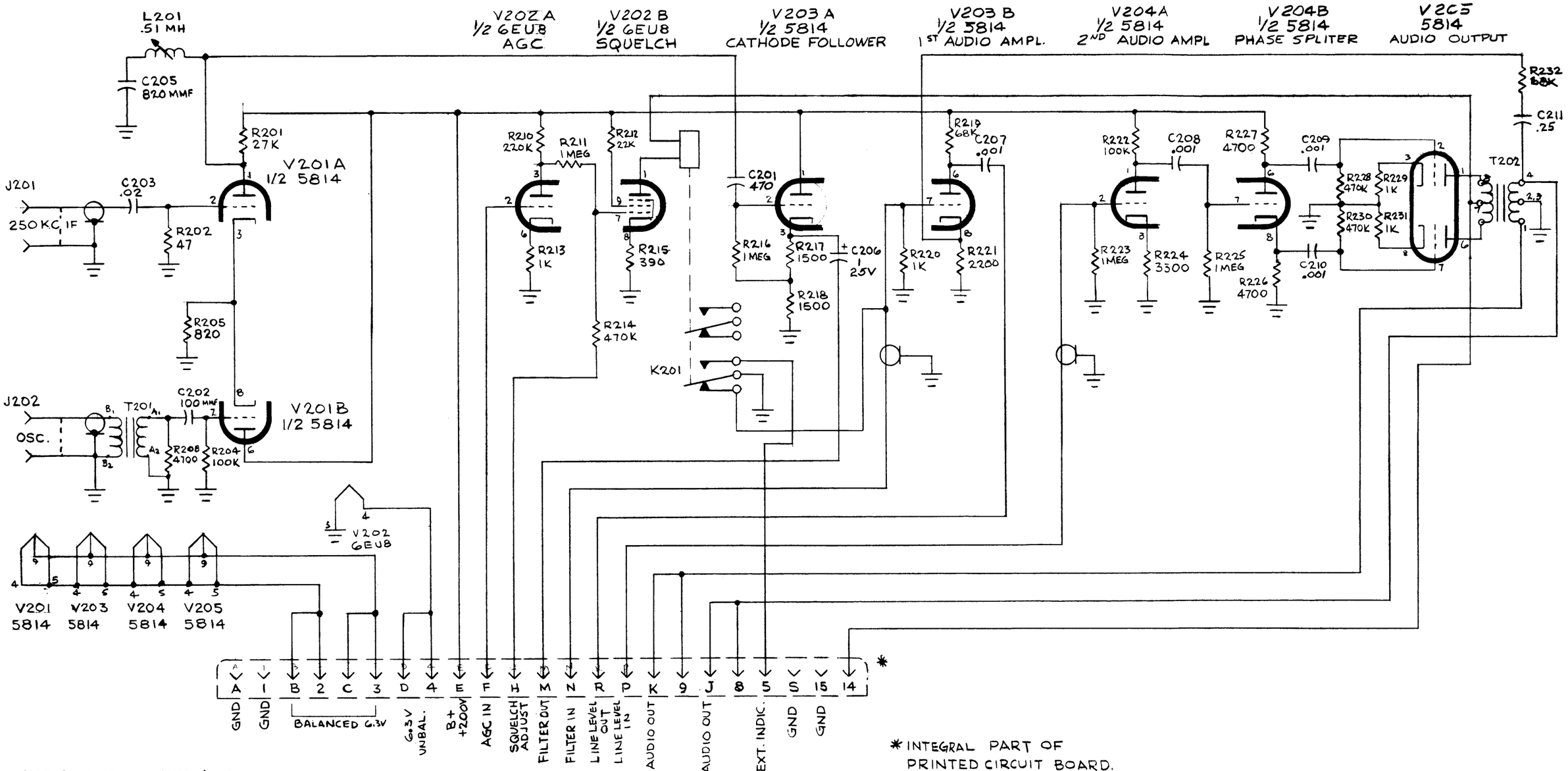
006654004A

VALUE CHART					
LOCATION	250KC (HFI-1, SBS-1)		205KC (SBS-7)		250KC (MSA-1, MSAA-1)
REF SYM	FOR AX303, 303-3, 304, 304-3		FOR AX303-2, 304-2		FOR AX468-1 THRU-8
	*	* *	*	* *	*	* *
T102	470	320	1000	470	470	320
T103	1000	NONE	2000	NONE	1000	NONE
L101	2000	NONE	3900	NONE	2000	NONE
C113	.22UF		.22UF		NONE	
R120	NONE		NONE		47 OHM.	
R117	560Ω		560Ω		NONE	
R121	NONE		NONE		100Ω	



CK519J

Figure 7-1. Schematic Diagram, MSA-1 (Sheet 2 of 3)



LAST SYMBOLS	MISSING SYMBOLS
R232	R203
C211	R206
T202	R207
V205	R209
L201	C204
K201	
J202	

NOTE:
UNLESS OTHERWISE SPECIFIED,
ALL RESISTANCE VALUES ARE IN OHMS, 1/2 WATT,
ALL CAPACITANCE VALUES ARE IN MICRO-FARADS.

AUDIO MODULE

CK709B

Figure 7-1. Schematic Diagram, MSA-1 (Sheet 3 of 3)