DEPARTMENT OF THE ARMY TECHNICAL MANUAL

DEPARTMENT OF THE AIR FORCE TECHNICAL ORDER

TM 11-377A
TO 16-35AM103-6

AMPLIFIER

AM-103B/U

DEPARTMENTS OF THE ARMY AND THE AIR FORCE

APRIL 1954

TECHNICAL MANUAL
No. 11-377A
TECHNICAL ORDER
No. 16-35AM103-6

DEPARTMENTS OF THE ARMY
AND THE AIR FORCE
WASHINGTON 25, D. C., *19 April 1954*

AMPLIFIER AM-103B/U

WARNING

HIGH VOLTAGE

is used in the operation
of this equipment.

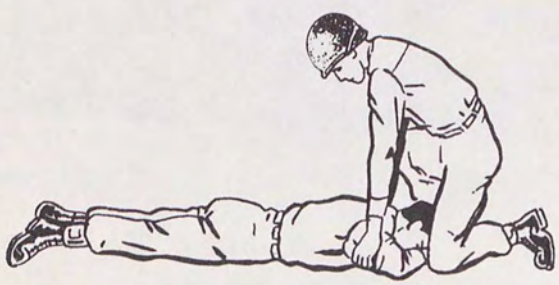
DEATH ON CONTACT

may result if personnel fail
to observe safety precautions.

Be careful not to contact high-voltage connections or 115-volt input connections when working on or near this equipment. When working inside the equipment, after the power has been turned off, always short-circuit the high-voltage capacitors.

A Position of operator and victim

B Compression phase



C Expansion phase (arm lift)

D Expansion phase (arm release)

TM AR-4

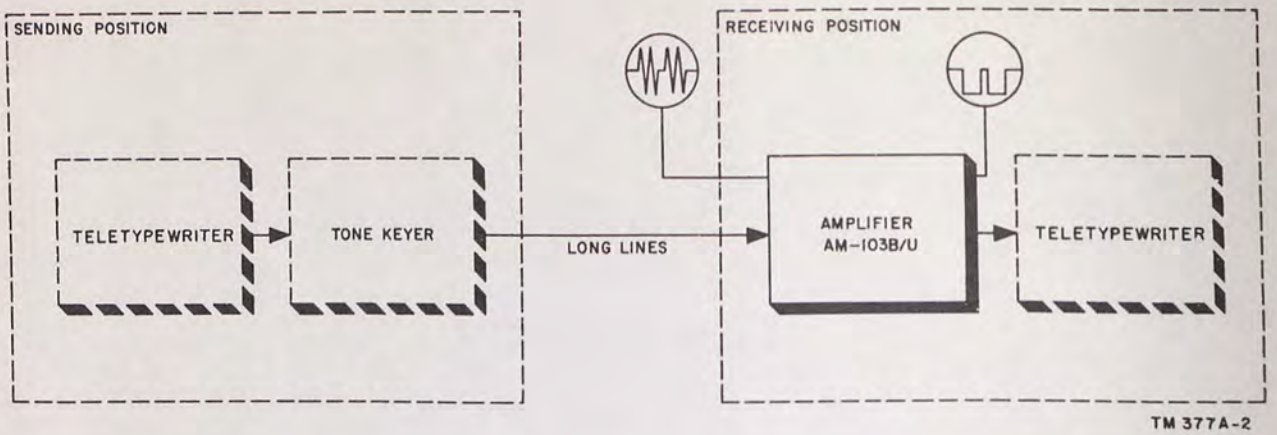


Figure 2, Amplifier AM-103B/U, typical system application.

keyer and applied to the long lines. At the receiving position, the amplifier changes the keyed-tone signals from the long lines back to the neutral signals that operate the receiving teletypewriter.

5. Technical Characteristics

Input signal:

Type	Keyed tone.
Frequency	500 to 5,000 cps.
Keying speed	1,000 wpm max.
Amplitude	−50 db to +20 db (6 mw reference).
Input impedance	500 ohms.

Output signal:

Type	Polar or neutral.
Amplitude	+20 db approx (6 mw reference).

Power:

Source requirements	88 to 132 v, 54 to 72 cps
Consumption	110 w.

Tubes:

Number	Type	Reference Symbol	Function
1	6SJ7	V1	Input amplifier
1	6H6	V2	Signal rectifier
2	6SN7GT	V3A	Limiter-amplifier
		V3B	Monitor amplifier
		V4A	D-c amplifier
		V4B	D-c phase inverter
2	6V6	V5	Output amplifier
		V6	Output amplifier
3	5Y3GT	V7	Rectifier
		V8	Rectifier
		V9	Rectifier

6. Packaging Data

a. Domestic. When packaged for domestic shipment, Amplifier AM-103B/U is placed in a corrugated carton containing corrugated bottom and side supports, and a corrugated panel protector. Running spares are packaged in a separate container with cellulose packing material. This container also is placed in the corrugated carton and the flaps of the carton are sealed down with tape. When packaged for domestic shipment, the desiccant is omitted.

b. Export. Packaging for export shipment is the same as described in subparagraph *a* above, except for the addition of the desiccant. The carton packaged for domestic shipment now is placed in a second corrugated carton containing a moistureproof and waterproof barrier, and the flaps are sealed with tape. This carton is placed in a wooden packing case containing a waterproof paper case liner, which is heat-sealed before the lid is nailed on the wooden packing case. The wooden packing case then is strapped with ⅝-inch steel straps. A typical illustration of packaging the amplifier is shown in figure 3. The size, weight, and volume of unpacked and both types of packaged equipment, are shown in the table below.

	Height (in.)	Width (in.)	Length (in.)	Volume (cu ft)	Weight (lb)
Unpacked	7	8¼	19	.64	40
Packed for domestic use	14¼	11¼	21½	1.99	50
Packed for export[a]	18½	15½	27	4.46	100

[a]Approximate

7. Description of Amplifier AM-103B/U

a. Amplifier AM-103B/U is a nine-tube rectifier, limiter, and amplifier unit that converts keyed a-f signals

into polar or neutral telegraph or teletypewriter signals. The frequency of the input tone signal must be between 500 and 5,000 cps.

b. Amplifier AM-103B/U consists of a single chassis designed for mounting on a standard 19-inch relay rack. A cover, which may be removed by a direct backward pull, protects the chassis from dust and dirt.

c. A removable section of the front panel (fig. 6) provides easy access to the tubes. To remove this section (fig. 6), turn the two Dzus fasteners on the front panel a quarter-turn counterclockwise and lift the section away from the front panel (fig. 26).

d. In addition to a POWER ON-OFF switch S1, the front panel contains OUTPUT REVERSE switch S5, OUTPUT LEVEL switch S3, OUTPUT SINGLE-DOUBLE switch S4, and LOW PASS FILTER switch S2. S1 and S5 are two-position toggle-type switches, S2 and S3 are four-position rotary-type switches, and S4 is a two-position rotary switch. The front panel also contains three controls for adjusting the amplitude of the input signal, the waveshape, and the magnitude of the output signal. These controls are in the form of rotary-type potentiometers and consist of INPUT ATTENUATOR R7, NOISE REJECTOR R30, and SIGNAL BALANCE R31. The function of these controls is described in paragraph 16.

e. The front panel also contains jack J1 for monitoring the input signal, and meter M1 for indicating the polarity and amplitude of the output current.

8. Running Spares

Note. If the 6SN7GT or 6V6 tubes of Amplifier AM-103B/U must be replaced, use the ruggedized types listed below.

Following is a list of running spares for Amplifier AM-103B/U.

2 tubes, type 5Y3GT.
1 tube, type 6H6.
1 tube, type 6SJ7.
1 tube, type 6SN7WGT.
1 tube, type 6V6Y.
6 fuses, cartridge, 3 amperes.

9. Additional Equipment Required

The following material is not supplied as a part of Amplifier AM-103B/U, but is required for its installation and operation:

1 two-conductor cable to connect the amplifier to the power source.
3 two-conductor shielded cables to connect the amplifier to the source of keyed-tone signals, monitor station, and terminating equipment.

The four cables do not require lugs or other devices at the amplifier end. Plugs, jacks, and such devices may be attached to the other ends of the cables when required by the associated equipment (fig. 5).

CHAPTER 2

OPERATING INSTRUCTIONS

Section I. SERVICE UPON RECEIPT OF EQUIPMENT

10. Siting

The selection of the best location for wire equipment depends on local conditions such as the following: the need to house the equipment where its shelter cannot be seen; the type of housing available; possible installation in vehicle; the terrain; and the need for easy access to messengers. The choice of location for Amplifier AM-103B/U is also dependent on the location of the equipment with which it is associated.

11. Uncrating, Unpacking, and Checking New Equipment

Note. For used or reconditioned equipment, refer to paragraph 14.

a. General. Equipment may be shipped in oversea packing cases or in domestic packing cases. When new equipment is received, select a location where the equipment may be unpacked without exposure to the elements and which is convenient to the permanent or semipermanent installation of the equipment. The instructions in subparagraph *b* below apply to equipment shipped in export packing cases, and the instructions in subparagraph *e* below, to equipment in domestic packing cases.

Caution: Be careful when uncrating, unpacking, and handling the equipment. If it becomes damaged or exposed, a complete overhaul may be required or the equipment might be rendered useless.

b. Step-by-step Instructions for Uncrating and Unpacking Export Shipments (fig. 3).

(1) Place the packing cases as near the operating position as convenient.

(2) Cut and fold back the steel straps.

(3) Remove the nails with a nail puller. Remove the top and one side of the packing case. Do not attempt to pry off the sides and top; the equipment may be damaged.

(4) Remove the waterproof paper case liner.

(5) Open the outer corrugated cardboard carton.

(6) Remove the moistureproof and vaporproof barrier covering the inner cardboard carton.

(7) Inspect the indicator card on top of the inner carton. The crystals of the card are normally blue. Pink crystals indicate that moisture has penetrated the barrier.

c. Opening Inner Corrugated Carton.

(1) Open the top of the inner cardboard carton.

(2) Remove the spare parts box and any tissue that has been used as packing material.

(3) Remove the two corrugated spacers and the corrugated panel protector.

(4) Remove Amplifier AM-103B/U from the inner carton, and place it on a workbench or near its final location.

d. Checking.

(1) Check the contents of the packing case against the master packing slip.

(2) Check the fuse at the rear of the amplifier chassis for rating, condition, and proper insertion.

(3) Check each tube against breakage and make certain that each is in its proper socket. Refer to figure 4 for Amplifier AM-103B/U tube locations.

e. Unpacking Domestic Packing Cases. Equipment may be received in domestic packing cases. The instructions given in subparagraphs *c* and *d* above apply also to unpacking domestic shipments. Open the carton that protects the equipment. Remove the spare parts box and

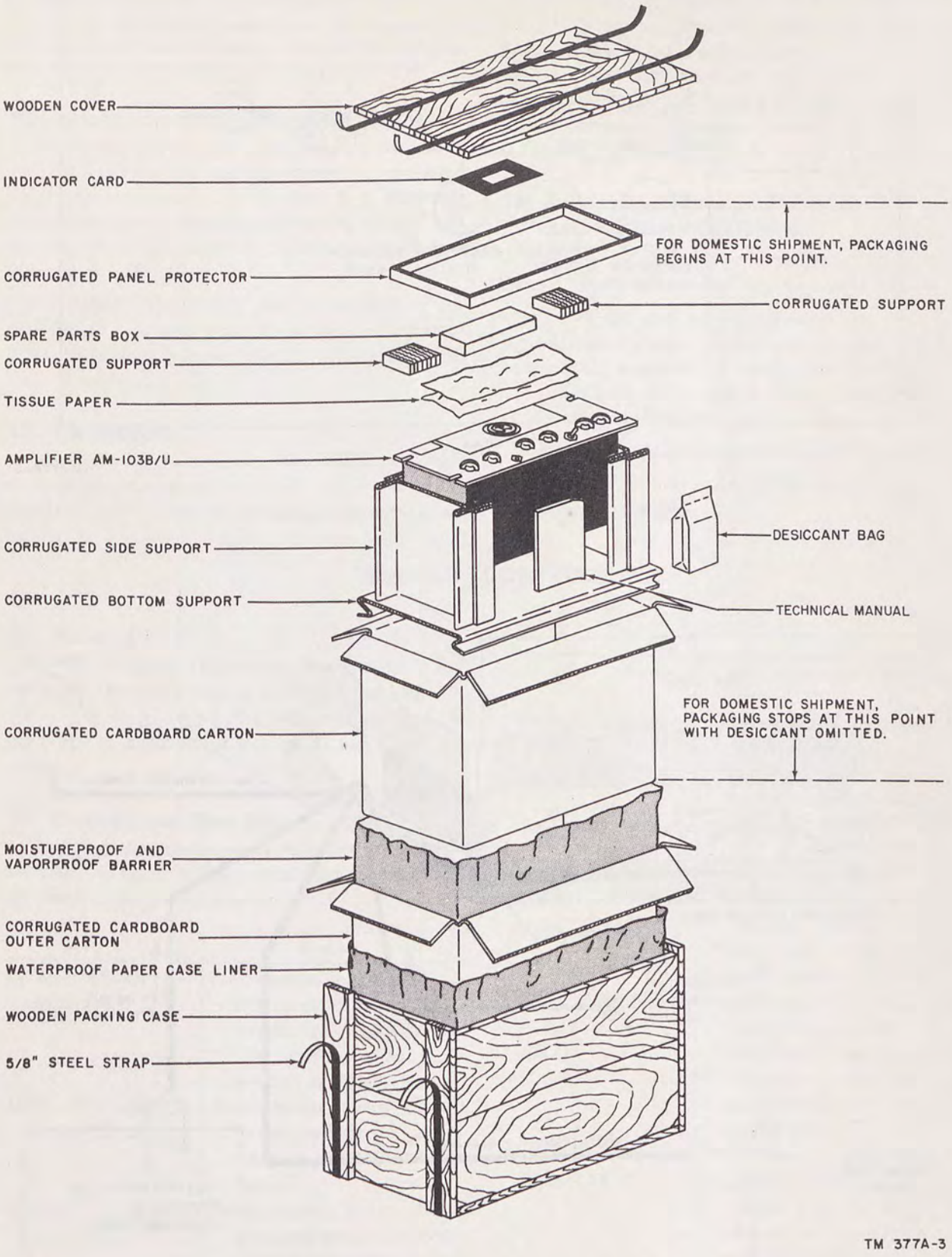


Figure 3. Amplifier AM103B/U, packing and packaging diagram.

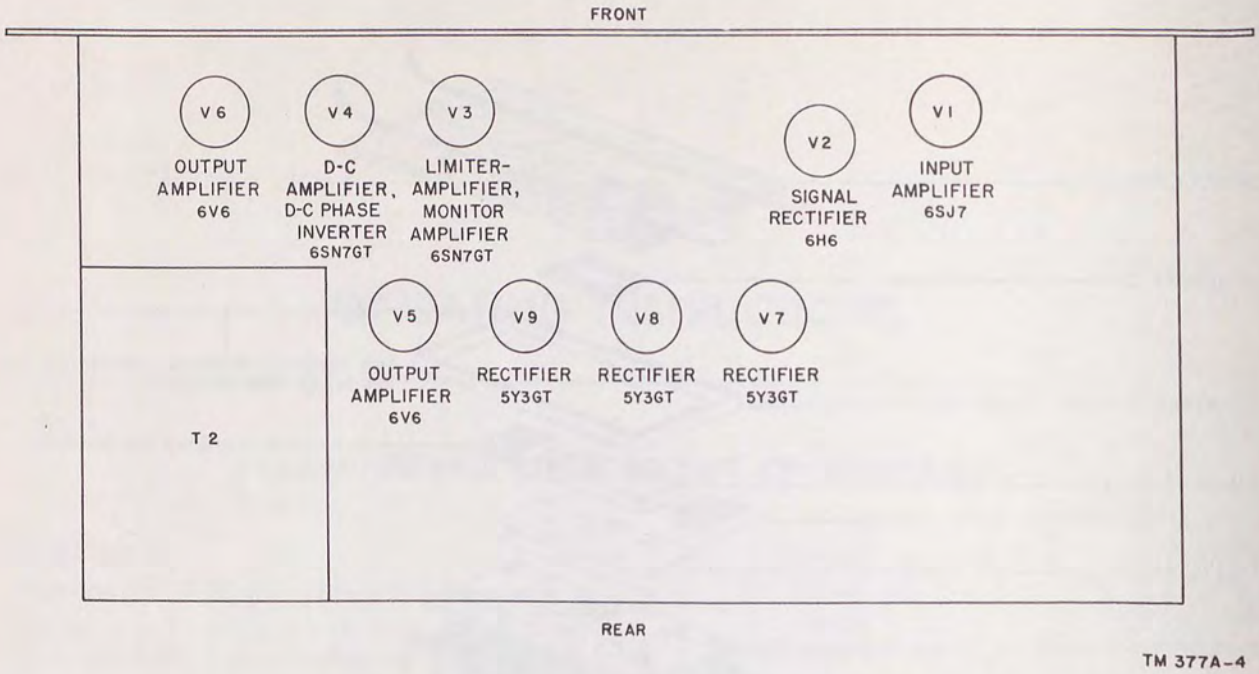


Figure 4. Amplifier AM-103B/U, tube location diagram.

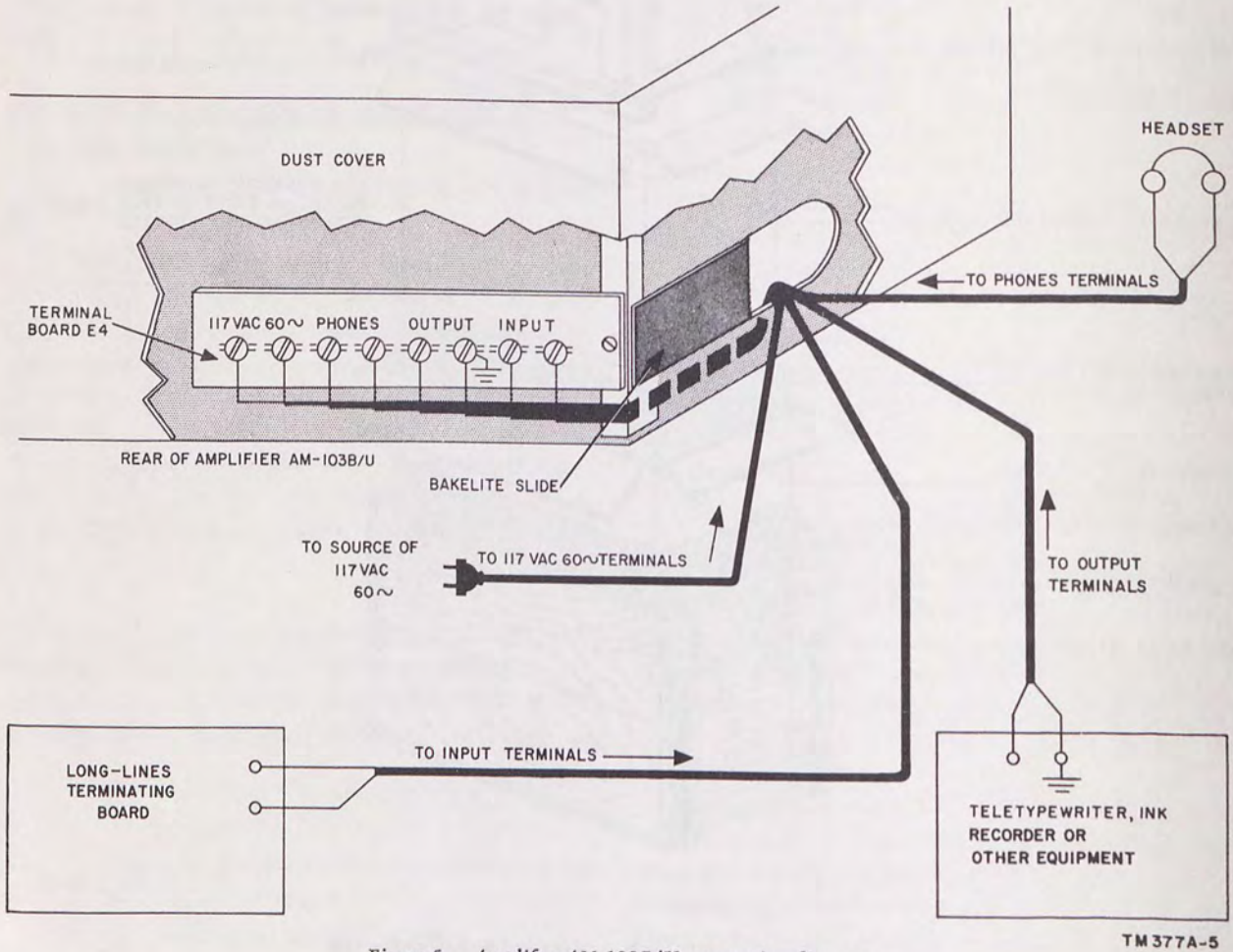


Figure 5. Amplifier AM-103B/U, connection diagram.

the amplifier unit from the carton. Check the contents of the packing case against the master packing slip.

Note. Save the original packing cases and containers for both export and domestic shipments. They can be used again when the equipment is repacked for storage or shipment.

12. Installation of Amplifier AM-103B/U

a. Amplifier AM-103B/U is shipped from the factory with the input leads to input transformer T3 connected for an input impedance of 500 ohms. If a 5,000-ohm input impedance is required, unsolder the shielded lead from terminal 2 of transformer T3 and resolder the lead to terminal 3 (fig. 10).

b. Amplifier AM-103B/U can be mounted in any standard 19-inch relay rack. Four slots in the front panel, one near each corner, permit the amplifier to be fastened to the rack (fig. 6).

13. Connections

All connections to Amplifier AM-103B/U are made to terminals on terminal board E4 at the rear of the chassis. Figure 5 shows the location of the terminals on the terminal board. To make connections to the terminals, remove the dust cover from the chassis with a direct backward pull. Slide the bakelite strip in the slot in the left side of the chassis toward the rear. Strip about ½ inch of insulation from the ends of suitable lengths of wire. Insert each wire in the slot in the left side of the chassis, dress the wire around the lower left corner of the chassis, and connect it to the proper terminal.

14. Service upon Receipt of Used or Reconditioned Equipment

a. Follow the instructions in paragraph 11 for uncrating, unpacking, and checking the equipment.

b. Check the used or reconditioned equipment for tags or other indications pertaining to changes in the wiring of the equipment. If any changes in wiring have been made, note the changes in this manual, preferably on the schematic diagram.

c. Check the operating controls for ease of operation.

d. Perform the installation and connection procedures given in paragraphs 12 and 13.

Section II. CONTROLS

15. General

Careless setting of controls can cause damage to this equipment. For this reason, it is important to know the function of every control. The actual operation of the equipment is discussed in sections III and IV of this chapter.

16. Controls and Their Uses

Controls on the front panel of Amplifier AM-103B/U are shown in figure 6. The controls and their functions are listed in the following table.

Control	Function
POWER ON-OFF switch (S1).	Two-position toggle switch. In OFF position, power is removed from amplifier. In ON position, power is applied to amplifier.
LOW PASS FILTER switch (S2).	Four-position rotary switch. Varies amount of capacitance in low-pass filter circuit.
OUTPUT LEVEL switch (S3).	Four-position rotary switch. Selects output current amplitude and waveshape by controlling amount of resistance and capacitance in output circuit.
OUTPUT SINGLE DOUBLE switch (S4).	Two-position rotary switch. In SINGLE position, output of Amplifier AM-103B/U is neutral (unidirectional). In DOUBLE position, output of Amplifier AM-103B/U is polar (bidirectional).
OUTPUT REVERSE switch (S5).	Two-position toggle switch. Reverses polarity of mark and space output signals with respect to each other.
INPUT ATTENUATOR control (R7).	Potentiometer. Controls amplitude of signal input to input amplifier. Turning control clockwise increases amplitude of signal on input amplifier grid.
NOISE REJECTOR control (R30).	Potentiometer. Enables signal rectifier V2A and V2B to be biased above noise level of input signal. Turning control clockwise increases bias on signal rectifier.

Control	Function
SIGNAL BALANCE control (R31).	Potentiometer. Determines time duration of mark signal with respect to duration of space signal by controlling bias on d-c amplifier V4A. Turning control clockwise decreases the bias on the d-c amplifier.
Meter (M1).	Milliammeter. Indicates both current amplitude and polarity of output signal.
MONITOR jack (J1).	Jack. Provides means for monitoring input signal from front panel of amplifier.

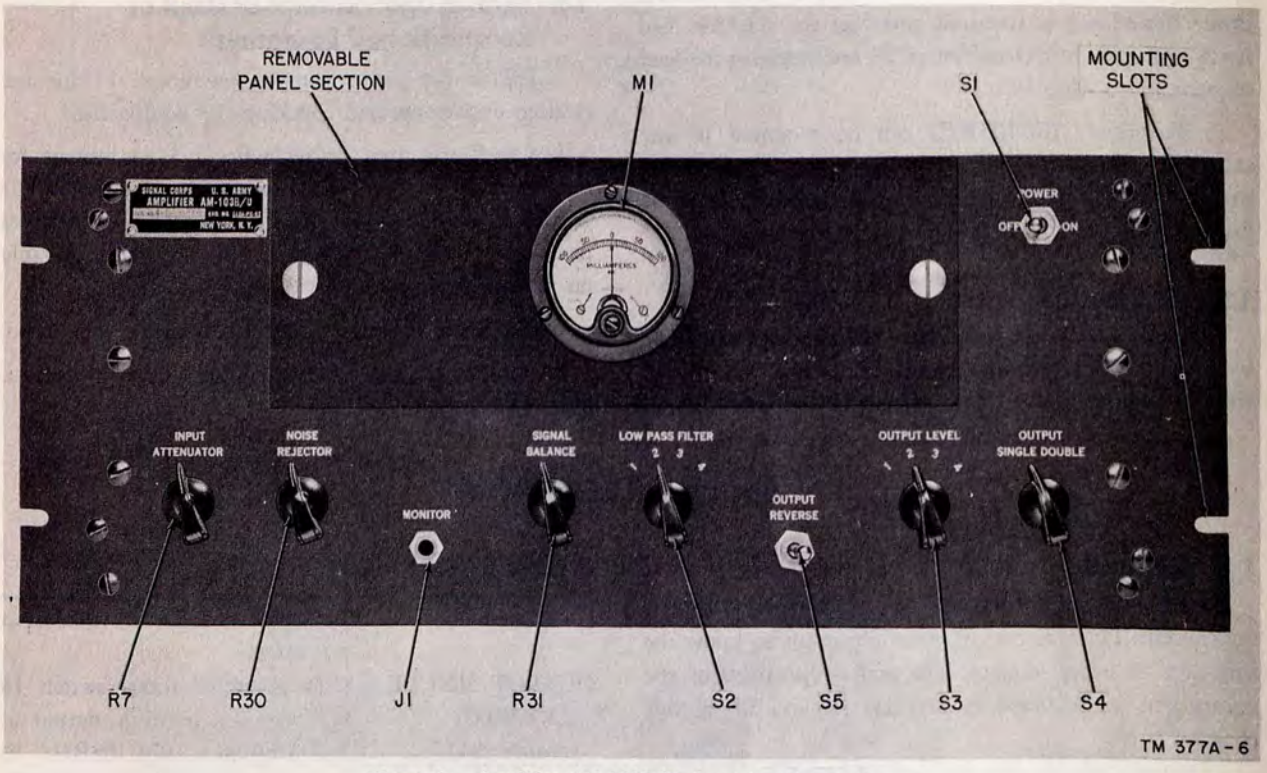


Figure 6. Amplifier AM-103B/U, front panel controls.

Section III. OPERATION UNDER USUAL CONDITIONS

17. Preliminary Starting Procedure

a. Check to see that input transformer T3 primary is connected for the required input impedance. For 500-ohm input impedance, the INPUT terminals on terminal board E4 connect to terminals 1 and 2 of transformer T3; for 5,000-ohm input impedance, the INPUT terminals connect to terminals 1 and 3.

b. Be sure that power and communication lines are connected properly to terminal board E4 (fig. 5) and that adjacent terminals are not short-circuited.

18. Starting Procedure

a. Set INPUT ATTENUATOR potentiometer R7, NOISE REJECTOR potentiometer R30, and SIGNAL BALANCE potentiometer R31 to the middle of their ranges. Place OUTPUT REVERSE switch S5 in the right-hand position.

b. The table which follows indicates the proper settings of LOW PASS FILTER switch S2 and OUTPUT LEVEL switch S3 for keying speeds from 5 to more then 220 wpm. Set these switches to the positions corresponding to the keying speed of the input signal.

Note. When the amplifier is driving an ink recorder, place OUTPUT LEVEL switch S3 in position 4 regardless of keying speed. When the amplifier is driving a tone keyer, place OUTPUT LEVEL switch S3 in position 3 for keying speeds up to 120 wpm, and in position 4 for keying speeds greater than 120 wpm.

Keying speed (wpm)	LOW PASS FILTER switch S2 position	OUTPUT LEVEL switch S3 position
5-25	1	1, 2, 3, or 4
25-60	2	2, 3, or 4
60-120	2 or 3	3 or 4
120-220	3 or 4	3 or 4
220 and above	4	4

c. Set OUTPUT switch S4 to SINGLE for neutral output or to DOUBLE for polar output. Set OUTPUT switch S4 in accordance with the requirements of the driven equipment. For actuating a polarized relay, such as in a high-speed ink recorder, DOUBLE output will give more positive operation. For actuating a nonpolarized relay, such as in a teletypewriter, SINGLE output is required.

d. Turn POWER switch S1 to the ON position. Allow 2 minutes for the unit to warm up. The amplifier is now in operation. When keying signals are applied to the INPUT terminals, the amplifier will drive the ink recorder, teletypewriter, or other associated equipment.

e. Abnormal line conditions may prevent the amplifier from keying the driven equipment properly. These abnormal conditions and the required corrective measures are discussed in paragraph 19.

19. Abnormal Operating Conditions

a. A weak input signal will cause erratic operation of the driven equipment. Turn INPUT ATTENUATOR potentiometer R7 clockwise to increase the amplitude of the input signal at the grid of input amplifier V1. To obtain an indication of the strength of the input signal, plug a headset into MONITOR jack J1 on the front panel.

b. If the noise level of the input signal is high, noise pulses may key the amplifier. To suppress line noise, turn NOISE REJECTOR potentiometer R30 in a clockwise direction. To obtain an indication of noise level in the input signal, plug a headset into MONITOR jack J1.

Note. If NOISE REJECTOR potentiometer R30 is turned too far in a clockwise direction, the signals also will be rejected. Adjust this control only to the point where the best performance of the receiving equipment is obtained.

c. Proper operation of teletypewriter equipment requires that the duration of the mark signal be approximately equal to that of the space signal. If the mark-to-space time relationship is unequal, the driven equipment may fail to operate. To increase the time duration of the mark signal in relation to the space signal, turn SIGNAL BALANCE potentiometer R31 in a clockwise direction. Figure 14 illustrates the results of correct and incorrect settings of SIGNAL BALANCE control.

d. In usual teletypewriter and telegraph practice, the mark signal is transmitted as a tone-on condition and the space signal as a tone-off condition. If, however, these conditions are reversed, Amplifier AM-103B/U will produce an inverted output. That is, the mark signal will be positive with respect to the space signal. To correct this inversion, throw OUTPUT REVERSE switch S5 to the left-hand position. The table below indicates the polarity of the mark signal output of Amplifier AM-103B/U under both conditions of line transmission and in both positions of OUTPUT REVERSE switch S5.

Input mark signal	Position of OUTPUT REVERSE Switch S5	Polarity of output mark signal[a]
Tone on.	Right-hand.	Negative.
Tone on.	Left-hand.	Positive.
Tone off.	Right-hand.	Positive.
Tone off.	Left-hand.	Negative.

[a] With respect to space signal.

20. Stopping Procedure

To de-energize the amplifier, throw POWER switch S1 to the OFF position. No additional procedure is necessary.

Section IV. OPERATION UNDER UNUSUAL CONDITIONS

21. General

The operation of Amplifier AM-103B/U may be difficult in regions where extreme cold, heat, humidity and moisture, sand conditions, etc., prevail. In the following paragraphs, instructions are given on procedures for minimizing the effect of these unusual operating conditions.

22. Operation in Arctic Climates

Subzero temperatures and climatic conditions associated with cold weather affect the efficient operation of the equipment. Instructions and precautions for operation under such adverse conditions follow:

a. Handle the equipment carefully.

b. Keep the equipment warm and dry.

c. Locate the equipment inside a heated inclosure whenever possible. Do not allow cold drafts to come in contact with the glass envelope of a heated tube because this will shatter the envelope.

d. When equipment that has been exposed to the cold is brought into a warm room, it will sweat until it reaches room temperature. When the equipment reaches

room temperature, dry it thoroughly. This condition also arises when the equipment warms up during the day after exposure during a cold night.

23. Operation in Tropical Climates

When operated in tropical climates, the amplifier may be installed in tents, huts, or, when necessary, in underground dugouts. When equipment is installed below ground and when it is set up in swampy areas, moisture conditions are more acute than normal. Ventilation is usually very poor, and the high relative humidity causes condensation of moisture on the equipment whenever the temperature of the equipment becomes lower than the surrounding air. To minimize this condition, place lighted electric bulbs so that the heat from the bulbs will minimize the condensation of moisture on the equipment.

24. Operation in Desert Climates

a. Conditions similar to those encountered in tropical climates often prevail in desert areas. Use the same measures described in paragraph 23 to insure proper operation of the equipment.

b. The main problem that arises with equipment operation in desert areas is the large amount of sand, dust, and dirt which enters the equipment. The ideal preventive measure is to house the equipment in a dustproof shelter. Since, however, such a building is seldom available and would require air conditioning, the next best precaution is to make the building in which the equipment is located as dustproof as possible with available materials. Hang wet sacking over the windows and doors; cover the inside walls with heavy paper. Use sand to secure the tent side walls to prevent their flapping in the wind.

c. Never tie power cords, signal cords, or other wiring connections to either the inside or the outside of tents. Desert areas are subject to sudden wind squalls which may jerk the connections loose or break the lines.

d. Keep the equipment as free from dust as possible. Make frequent preventive maintenance checks (ch. 3). This equipment does not need lubrication and it should be kept free from oil and grease. Excessive amounts of dust, sand, or dirt that come into contact with oil and grease result in grit, which will damage the equipment.

CHAPTER 3

ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

Section I. PREVENTIVE MAINTENANCE SERVICES

25. Tools and Equipment

No special tools or equipment are supplied or issued for Amplifier AM-103B/U. None is required for organizational preventive maintenance. Only the usual tools generally available to maintenance personnel such as screwdrivers and pliers are required. They are supplied in Tool Equipment TE-41.

26. Definition of Preventive Maintenance

Preventive maintenance is work performed on the equipment, when the equipment is not in use, to keep it in good working order so that breakdowns and needless interruptions in service will be kept to a minimum. Preventive maintenance differs from troubleshooting and repair. Its aim is to prevent certain troubles from occurring. See AR 750-5.

27. General Preventive Maintenance Techniques

a. Use #0000 sandpaper to remove corrosion.

b. Use a clean, dry, lint-free cloth or a dry brush for cleaning.

(1) If necessary, moisten the cloth or brush with Solvent, Dry Cleaning (SD); then wipe the parts dry with a cloth. Do not use cleaning solvent (SD) for electrical contacts.

(2) Clean electrical contacts with a cloth moistened with carbon tetrachloride; then wipe them with the dry cloth.

c. If available, use dry compressed air at a line pressure not exceeding 60 pounds per square inch to remove dust from inaccessible places; be careful, however, not to cause any mechanical damage to the equipment from the air blast.

d. For further information on preventive maintenance techniques, refer to TB SIG 123.

Caution: Repeated contact of carbon tetrachloride with the skin or prolonged breathing of the fumes is dangerous. Make sure adequate ventilation is provided.

28. Use of Preventive Maintenance Forms (figs. 7 and 8)

a. The information in paragraph 29 is presented as a guide to the individual making an inspection of the equipment in accordance with instructions on DA Forms 11-238 and 11-239. The decision as to which items on the forms are applicable to this equipment is a tactical decision to be made in the case of first echelon maintenance by the communication officer/chief or his designated representative, and, in the case of second and third echelon maintenance, by the individual making the inspection. Instructions for the use of each form appear on the reverse side of the form.

b. Specific preventive maintenance procedures applicable to Amplifier AM-103B/U are outlined in paragraph 30 and should be referred to before completing forms DA 11-238 and 11-239.

29. Performing Preventive Maintenance

The electrical components of Amplifier AM-103B/U require routine preventive maintenance to keep the instrument operating at peak efficiency. Hit-and-miss methods are not satisfactory. For this reason, only authorized preventive maintenance should be practiced, and the instructions given here must be used by personnel assigned to such duties.

Caution: Do not tighten screws, nuts, and bolts beyond the pressure for which they were designed. Overtightening will result in bent, broken, and damaged parts and stripped threads.

a. Perform all work when the instrument is discon-

OPERATOR FIRST ECHELON MAINTENANCE CHECK LIST FOR SIGNAL CORPS EQUIPMENT

RADIO COMMUNICATION, DIRECTION FINDING, CARRIER, RADAR

INSTRUCTIONS: See other side

EQUIPMENT NOMENCLATURE: AMPLIFIER AM-103B/U | EQUIPMENT SERIAL NO.

LEGEND FOR MARKING CONDITIONS: ✓ Satisfactory; X Adjustment, repair or replacement required; (X) Defect corrected.
NOTE: Strike out items not applicable.

DAILY

NO.	ITEM	CONDITION S	M	T	W	T	F	S
(1)	COMPLETENESS AND GENERAL CONDITION OF EQUIPMENT *(receiver, transmitter, carrying cases, wire and cable, microphones, tubes, spare parts, technical manuals and accessories).* Par. 30a(1)							
(2)	LOCATION AND INSTALLATION SUITABLE FOR NORMAL OPERATION. Par. 30a(2)							
(3)	CLEAN DIRT AND MOISTURE FROM ANTENNA, MICROPHONE, HEADSETS, CHESTSETS, KEYS, JACKS, PLUGS, TELEPHONES, CARRYING BAGS, COMPONENT PANELS. Par. 30a(3)							
(4)	INSPECT SEATING OF READILY ACCESSIBLE "PLUCK-OUT" ITEMS: TUBES, LAMPS, CRYSTALS, FUSES, CONNECTORS, VIBRATORS, PLUG-IN COILS AND RESISTORS. Par. 30a(4)							
(5)	INSPECT CONTROLS FOR BINDING, SCRAPING, EXCESSIVE LOOSENESS, WORN OR CHIPPED GEARS, MISALIGNMENT, POSITIVE ACTION. Par. 30a(5)							
(6)	CHECK FOR NORMAL OPERATION. Par. 30a(6)							

WEEKLY

NO.	ITEM	CONDITION	NO.	ITEM	CONDITION
(7)	CLEAN AND TIGHTEN EXTERIOR OF COMPONENTS AND CASES, RACK MOUNTS, SHOCK MOUNTS, ANTENNA MOUNTS, COAXIAL TRANSMISSION LINES, WAVE GUIDES, AND CABLE CONNECTIONS. Par. 30b(1)		13	INSPECT STORAGE BATTERIES FOR DIRT, LOOSE TERMINALS, ELECTROLYTE LEVEL AND SPECIFIC GRAVITY, AND DAMAGED CASES.	
(8)	INSPECT CASES, MOUNTINGS, ANTENNAS, TOWERS, AND EXPOSED METAL SURFACES, FOR RUST, CORROSION, AND MOISTURE. Par. 30b(2)		(14)	CLEAN AIR FILTERS, BRASS NAME PLATES, DIAL AND METER WINDOWS, JEWEL ASSEMBLIES. Par. 30b(5)	
(9)	INSPECT CORD, CABLE, WIRE, AND SHOCK MOUNTS FOR CUTS, BREAKS, FRAYING, DETERIORATION, KINKS, AND STRAIN. Par. 30b(3)		(15)	INSPECT METERS FOR DAMAGED GLASS AND CASES. Par. 30b(6)	
10	INSPECT ANTENNA FOR ECCENTRICITIES, CORROSION, LOOSE FIT, DAMAGED INSULATORS AND REFLECTORS.		(16)	INSPECT SHELTERS AND COVERS FOR ADEQUACY OF WEATHERPROOFING. Par. 30b(7)	
11	INSPECT CANVAS ITEMS, LEATHER, AND CABLING FOR MILDEW, TEARS, AND FRAYING.		17	CHECK ANTENNA GUY WIRES FOR LOOSENESS AND PROPER TENSION.	
(12)	INSPECT FOR LOOSENESS OF ACCESSIBLE ITEMS: SWITCHES, KNOBS, JACKS, CONNECTORS, ELECTRICAL TRANSFORMERS, POWERSTATS, RELAYS, SELSYNS, MOTORS, BLOWERS, CAPACITORS, GENERATORS, AND PILOT LIGHT ASSEMBLIES. Par. 30b(4)		18	CHECK TERMINAL BOX COVERS FOR CRACKS, LEAKS, DAMAGED GASKETS, DIRT AND GREASE.	

(19) IF DEFICIENCIES NOTED ARE NOT CORRECTED DURING INSPECTION, INDICATE ACTION TAKEN FOR CORRECTION. Par. 30b(8)

DA FORM 1 MAY 51 11-238 REPLACES DA AGO FORM 419, 1 DEC 50, WHICH IS OBSOLETE.

TM 377A-26

Figure 7. DA Form 11-238.

SECOND AND THIRD ECHELON MAINTENANCE CHECK LIST FOR SIGNAL CORPS EQUIPMENT

RADIO COMMUNICATION, DIRECTION FINDING, CARRIER, RADAR

INSTRUCTIONS: See other side

EQUIPMENT NOMENCLATURE: AMPLIFIER AM-103B/U — EQUIPMENT SERIAL NO.

LEGEND FOR MARKING CONDITIONS: ✓ Satisfactory; X Adjustment, repair or replacement required; (X) Defect corrected.
NOTE: Strike out items not applicable.

NO.	ITEM	CONDITION	NO.	ITEM	CONDITION
(1)	COMPLETENESS AND GENERAL CONDITION OF EQUIPMENT *(receiver, transmitter, carrying cases, wire and cable, microphones, tubes, spare parts, technical manuals and accessories).* Par. 30c(1)		(19)	ELECTRON TUBES - INSPECT FOR LOOSE ENVELOPES, CAP CONNECTORS, CRACKED SOCKETS: INSUFFICIENT SOCKET SPRING TENSION; CLEAN DUST AND DIRT CAREFULLY; CHECK EMISSION OF RECEIVER TYPE TUBES. Par. 30c(14)	
(2)	LOCATION AND INSTALLATION SUITABLE FOR NORMAL OPERATION. Par. 30c(2)		20	INSPECT FILM CUT-OUTS FOR LOOSE PARTS, DIRT, MISALIGNMENT AND CORROSION.	
(3)	CLEAN DIRT AND MOISTURE FROM ANTENNA, MICROPHONE, HEADSETS, CHESTSETS, KEYS, JACKS, PLUGS, TELEPHONES, CARRYING BAGS, COMPONENT PANELS. Par. 30c(3)		(21)	INSPECT FIXED CAPACITORS FOR LEAKS, BULGES, AND DISCOLORATION. Par. 30c(15)	
(4)	INSPECT SEATING OF READILY ACCESSIBLE "PLUCK-OUT" ITEMS: TUBES, LAMPS, CRYSTALS, FUSES, CONNECTORS, VIBRATORS, PLUG-IN COILS AND RESISTORS. Par. 30c(4)		22	INSPECT RELAY AND CIRCUIT BREAKER ASSEMBLIES FOR LOOSE MOUNTINGS; BURNED, PITTED, CORRODED CONTACTS; MISALIGNMENT OF CONTACTS AND SPRINGS; INSUFFICIENT SPRING TENSION; BINDING OF PLUNGERS AND HINGE PARTS.	
(5)	INSPECT CONTROLS FOR BINDING, SCRAPING, EXCESSIVE LOOSENESS, WORN OR CHIPPED GEARS, MISALIGNMENT, POSITIVE ACTION. Par. 30c(5)		23	INSPECT VARIABLE CAPACITORS FOR DIRT, MOISTURE, MISALIGNMENT OF PLATES, AND LOOSE MOUNTINGS.	
(6)	CHECK FOR NORMAL OPERATION. Par. 30c(6)		(24)	INSPECT RESISTORS, BUSHINGS, AND INSULATORS, FOR CRACKS, CHIPPING, BLISTERING, DISCOLORATION AND MOISTURE. Par. 30c(16)	
(7)	CLEAN AND TIGHTEN EXTERIOR OF COMPONENTS AND CASES, RACK MOUNTS, SHOCK MOUNTS, ANTENNA MOUNTS, COAXIAL TRANSMISSION LINES, WAVE GUIDES, AND CABLE CONNECTIONS. Par. 30c(7)		(25)	INSPECT TERMINALS OF LARGE FIXED CAPACITORS AND RESISTORS FOR CORROSION, DIRT AND LOOSE CONTACTS. Par. 30c(17)	
(8)	INSPECT CASES, MOUNTINGS, ANTENNAS, TOWERS, AND EXPOSED METAL SURFACES, FOR RUST, CORROSION, AND MOISTURE. Par. 30c(8)		(26)	CLEAN AND TIGHTEN SWITCHES, TERMINAL BLOCKS, BLOWERS, RELAY CASES, AND INTERIORS OF CHASSIS AND CABINETS NOT READILY ACCESSIBLE. Par. 30c(18)	
(9)	INSPECT CORD, CABLE, WIRE, AND SHOCK MOUNTS FOR CUTS, BREAKS, FRAYING, DETERIORATION, KINKS, AND STRAIN. Par. 30c(9)		(27)	INSPECT TERMINAL BLOCKS FOR LOOSE CONNECTIONS, CRACKS AND BREAKS. Par. 30c(19)	
10	INSPECT ANTENNA FOR ECCENTRICITIES, CORROSION, LOOSE FIT, DAMAGED INSULATORS AND REFLECTORS.		28	CHECK SETTINGS OF ADJUSTABLE RELAYS.	
11	INSPECT CANVAS ITEMS, LEATHER, AND CABLING FOR MILDEW, TEARS, AND FRAYING.		29	LUBRICATE EQUIPMENT IN ACCORDANCE WITH APPLICABLE DEPARTMENT OF THE ARMY LUBRICATION ORDER.	
12	INSPECT FOR LOOSENESS OF ACCESSIBLE ITEMS: SWITCHES, KNOBS, JACKS, CONNECTORS, ELECTRICAL TRANSFORMERS, POWERSTATS, RELAYS, SELSYNS, MOTORS, BLOWERS, CAPACITORS, GENERATORS, AND PILOT LIGHT ASSEMBLIES. Par. 30c(10)		30	INSPECT GENERATORS, AMPLIDYNES, DYNAMOTORS, FOR BRUSH WEAR, SPRING TENSION, ARCING, AND FITTING OF COMMUTATOR.	
13	INSPECT STORAGE BATTERIES FOR DIRT, LOOSE TERMINALS, ELECTROLYTE LEVEL AND SPECIFIC GRAVITY, AND DAMAGED CASES.		(31)	CLEAN AND TIGHTEN CONNECTIONS AND MOUNTINGS FOR TRANSFORMERS, CHOKES, POTENTIOMETERS, AND RHEOSTATS. Par. 30c(20)	
(14)	CLEAN AIR FILTERS, BRASS NAME PLATES, DIAL AND METER WINDOWS, JEWEL ASSEMBLIES. Par. 30c(11)		(32)	INSPECT TRANSFORMERS, CHOKES, POTENTIOMETERS, AND RHEOSTATS FOR OVERHEATING AND OIL-LEAKAGE. Par. 30c(21)	
(15)	INSPECT METERS FOR DAMAGED GLASS AND CASES. Par. 30c(12)		33	BEFORE SHIPPING OR STORING - REMOVE BATTERIES.	
(16)	INSPECT SHELTERS AND COVERS FOR ADEQUACY OF WEATHERPROOFING. Par. 30c(13)		34	INSPECT CATHODE RAY TUBES FOR BURNT SCREEN SPOTS.	
17	CHECK ANTENNA GUY WIRES FOR LOOSENESS AND PROPER TENSION.		35	INSPECT BATTERIES FOR SHORTS AND DEAD CELLS.	
18	CHECK TERMINAL BOX COVERS FOR CRACKS, LEAKS, DAMAGED GASKETS, DIRT AND GREASE.		36	INSPECT FOR LEAKING WATERPROOF GASKETS, WORN OR LOOSE PARTS.	
			(37)	MOISTURE AND FUNGIPROOF. Par. 30c(22)	
(38)	IF DEFICIENCIES NOTED ARE NOT CORRECTED DURING INSPECTION, INDICATE ACTION TAKEN FOR CORRECTION. Par. 30c(23)				

DA FORM 11-239, MAY 51 — REPLACES DA AGO FORM 419, 1 DEC 50, WHICH IS OBSOLETE. 16—64382-1

TM 377A-27

Figure 8. DA Form 11-239.

nected from the power line. Remove the dust cover with a direct backward pull. Disconnect the power and communication lines from terminal board E4 located at the rear of the chassis. Remove Amplifier AM-103B/U from the relay rack by taking out the two screws at each side of the front panel and sliding the unit from the rack.

b. Check to see if any component is overheating. If a component, other than a tube, becomes so hot that it cannot be touched, its temperature is too high and the cause must be established.

c. Visual inspection is the most important operation in preventive maintenance because it gives the first indication that repairs or adjustments are required. A careful observer will not overlook minor signs of trouble since valuable time and effort can be saved if such trouble is corrected before a major breakdown occurs. A maintenance man must be thoroughly familiar with the normal operation of Amplifier AM-103B/U. It will enable him to recognize signs of defective equipment.

(1) Carefully examine all parts of the equipment. Note the state of cleanliness and the placement of wires. Signs of overheating are indicated by discoloration of the affected parts. Note the general condition of resistors, capacitors, switches, and wiring.

(2) Look for loose or broken connections, loose mountings, or broken parts, and cut, frayed, or peeling insulation of wires.

(3) Examine all recesses for accumulation of dust or dirt, especially between connecting terminals. Keep parts, connections, and terminals free of dirt and corrosion. In tropical and high-humidity locations, look for fungi growth and mildew.

(4) See that all tubes are seated properly in their sockets and check the tightness of all the mounting screws and nuts. After a loose connection is tightened, apply varnish with a small brush to moistureproof and fungiproof it.

30. Preventive Maintenance Techniques

The following preventive maintenance operations are performed by organizational personnel at the intervals indicated unless these intervals are reduced by the local commander. The checklist is a summary of the preventive maintenance operations to be performed on Amplifier AM-103B/U. For best performance of the Amplifier AM-103B/U, follow the procedure outlined in the checklist as frequently as it is required. Preventive maintenance is applied as explained in paragraph 29. Do not use gasoline as a cleaning fluid; do not smoke near inflammable liquids.

a. Daily.

(1) Be sure that the equipment is complete. Check to see that tubes, fuse, connecting cables, and technical manual are included.

(2) Inspect the mounting of Amplifier AM-103B/U. Make certain that it is firmly attached to the relay rack with all connecting cables properly connected.

(3) Clean the external surface of the dust cover and the front panel.

(4) Take off the removable section of the front panel by turning the two Dzus fasteners a quarter-turn counterclockwise Check to see that the tubes are firmly seated in their sockets.

(5) Turn all rotary controls and switches to ascertain that they do not bind.

(6) Check to see that operation of Amplifier AM-103B/U is normal.

b. Weekly.

(1) Inspect and, if necessary, tighten power and communication line connections to terminal board E4 on the rear of the chassis.

(2) Inspect the case and chassis for evidence of corrosion. Remove any corrosion with sandpaper #0000.

(3) Inspect power and communication line cables for evidence of fraying and broken insulation.

(4) Check to see that front-panel knobs are tight.

(5) Clean the nameplate and output current meter window.

(6) Inspect the output current meter for damaged glass and case.

(7) Inspect the dust cover for evidence of binding and for dents or scratches.

(8) Correct any deficiencies found during inspection. If corrective action is not possible immediately, note the condition and indicate the remedy on DA Form 11-238.

c. Monthly.

Caution: Disconnect the equipment from the power source before performing the following operations. When the operations are completed, reconnect the power and check to see that operation is satisfactory.

(1) Check to see that spare parts are available and complete.

(2) Check to see that the location and installation of Amplifier AM-103B/U is suitable for normal operation.

(3) Remove the dust cover from the equipment and clean the interior of the dust cover and the chassis.

(4) Make certain that the tubes are seated properly in their sockets and that the fuseholder cap makes good contact with the fuse.

(5) Turn all controls and rotary switches. Be sure that the potentiometers do not bind and that switches operate with positive action.

(6) If repairs are made, check to see that the amplifier operates normally at the conclusion of the inspection.

(7) Clean the rack mounting with solvent (SD). Inspect terminal board E4 at the rear of the chassis for broken or bent lugs and for stripped threads on screws.

(8) Inspect the exterior of the chassis and the dust cover for foreign matter. Remove any corrosion with sandpaper #0000.

(9) Inspect the power and communication line cables for breaks and for frayed or stripped insulation.

(10) Check to see that the locking nuts of the front panel controls are secure. Make certain that the case of the output current meter is mounted firmly on the panel.

(11) Clean the nameplate and the window of the output current meter.

(12) Inspect the glass and case of the output current meter for cracks or breakage.

(13) Amplifier AM-103B/U is not waterproof. Use a dry cloth to wipe off any moisture that may be on the unit. Take steps to correct the cause of the moisture.

(14) Inspect tubes for cracked or loose envelopes. Inspect socket connections for loose wires or for bad contact between socket and tube base.

(15) Inspect capacitors C9, C10, and C11 for evidence of leakage.

(16) Inspect resistors for signs of overheating as evidenced by discoloration or flaking.

(17) Check to see that all solder connections are clean and tight.

(18) Check to see that connections to the switches and to the meter on the front panel are secure. Special care must be taken with the meter connections since they may easily be loosened or broken when the removable section of the front panel is removed.

(19) Inspect the resistor and capacitor boards for cracks and for loose or broken solder lugs.

(20) Amplifier AM-103B/U contains many heavy components. Make certain that the mechanical mountings of chokes L1 and L2 and transformers T1, T2, and T3 are secure.

(21) Inspect chokes L1 and L2 and transformers T1, T2, and T3 for evidence of overheating and for oil leakage.

(22) Apply varnish with a small brush to any new solder connections to protect them against moisture and fungi.

(23) On the bottom of DA Form 11-239, note action to be taken for correction of deficiencies not remedied at the time of inspection.

Section II. WEATHERPROOFING AND PAINTING

31. Weatherproofing

a. General. Signal Corps equipment, when operated under severe climatic conditions such as prevail in tropical, arctic, and desert regions, requires special treatment and maintenance. Fungus growth, insects, dust, corrosion, salt spray, excessive moisture, and extreme temperatures are harmful to most materials.

b. Tropical Maintenance. A special moistureproofing and fungiproofing treatment has been devised which, if properly applied, provides a reasonable degree of protection. This treatment is explained in TB SIG 13 and TB SIG 72.

c. Winter Maintenance. Special precautions necessary to prevent poor performance or total operational failure of equipment in extremely low temperatures are explained in TB SIG 66 and TB SIG 219.

d. Desert Maintenance. Special precautions necessary to prevent failure in areas subject to extremely high temperatures, low humidity, and excessive sand or dust are explained in TB SIG 75.

e. Protection Against Moisture. If the surrounding temperature is higher than the temperature in the vicinity of Amplifier AM-103B/U, moisture may condense on the unit. To offset this difficulty, place lighted electric bulbs where the heat will warm the components of Amplifier AM-103B/U.

32. Rustproofing and Painting

a. When the finish on the front panel or the dust cover has been scarred or damaged badly, touch up the

bared surface to prevent rust and corrosion. Clean the scarred surface down to the bare metal. Use #000 sandpaper to obtain a bright smooth finish. For severe rust, use solvent (SD) to soften the rust and then use sandpaper to remove the rust.

Caution: Do not use steel wool or emery cloth instead of sandpaper. Minute particles of conducting material may enter the equipment and cause a short circuit or ground the circuits.

b. When a touch up job is necessary, apply paint with a small brush. Remove dirt and corrosion from the case by cleaning corroded metal with solvent (SD). In severe cases, it may be necessary to use solvent (SD) to soften the corrosion and then use sandpaper to complete the preparation for painting. Paint used will be authorized and consistent with existing regulations.

Section III. TROUBLESHOOTING AT ORGANIZATIONAL MAINTENANCE LEVEL

33. General

The trouble shooting and the repair work that can be performed at the organizational maintenance level (repairmen) is limited necessarily in scope by the tools, test equipment, and replaceable parts available, and by the existing tactical situation. Accordingly, trouble shooting is based on the performance of the equipment, the use of the senses, continuity checks and voltage measurements in determining such troubles as burned-out tubes and defective switches.

a. The following tools and test equipments are required for organizational trouble shooting:

Equipment	Technical manual	Sig C stock No.
Multimeter TS-297/U.	TM-11-5500.	3F4325-297.
Tool Equipment TE-41.		6R38041.

b. The paragraphs which follow in this section help to determine which circuits are at fault, and to localize the fault to an item such as a tube or fuse.

34. Visual Inspection

a. Failure of Amplifier AM-103B/U may be caused by one or more of the following faults:

(1) Worn, broken, or disconnected power or communication lines.
(2) Burned-out fuse.
(3) Broken wires.
(4) Defective tubes.

b. When the cause of the failure is not immediately apparent, inspect as many of the above items as is practicable before starting a detailed examination of the component parts of the equipment. Obtain detailed information from the operator regarding the performance of the equipment at the time trouble occurred.

c. Visually inspect the equipment for mechanical damage which might have caused failure. Remember that the trouble may not be in the equipment itself but in the installation, or the trouble may be due to external conditions. In this event, test the installation if possible.

35. Trouble Shooting by Using Equipment Performance Checklist

a. General. The equipment performance checklist (par. 36) will help to locate trouble in the equipment. The list contains the item to be checked, the normal indications of correct operation, and the corrective measures that can be taken to the operator. *To use this list, follow the items in numerical sequence.*

b. Action or Condition. For some items, the information given in the *Action or condition* column consists of various switch and control settings under which the item is to be checked. For other items, it represents an action that must be taken to check the normal indication given in the *Normal indications* column.

c. Normal Indications. The normal indications listed include the visible and audible signs that the operator should perceive when he checks the items. If the indications are not normal, the operator should apply the recommended corrective measures.

d. Corrective Measures. The corrective measures listed are those which the operator can make without turning in the equipment for repairs. A reference to chapter 5 in the table indicates that trouble shooting at the field maintenance level is necessary. If the set is completely inoperative or if the recommended corrective measures do not yield results, trouble shooting is necessary. However, if the tactical situation requires that communicatiion be maintained, and if the set is not completely inoperative, the operator must keep the set in operation as long as it is possible to do so.

36. Equipment Performance Checklist

	Item No.	Item	Action or condition	Normal indications	Corrective measures
PREPARATORY	1	Terminal board connections.	Connect power and communication lines to terminals on terminal board E4 as shown in figure 5. Make sure POWER switch is in the OFF position.		
	2	Controls.	Set front panel controls as follows: INPUT ATTENUATOR R7 to middle of its range, NOISE REJECTOR R30 to middle of its range, SIGNAL BALANCE R31 to middle of its range, OUTPUT REVERSE S5 to left-hand position, LOW PASS FILTER S2 to position 2, OUTPUT S4 toSINGLE OUTPUT LEVEL S3 to position 4.		
START	3	Filament circuit.	Throw POWER ON-OFF switch S1 to the ON position.	Tubes light.	Inspect fuse if none of the tubes light. Examine any tube that does not light and refer to chapter 5.
EQUIPMENT	4	Neutral output.	Apply steady mark signal to INPUT terminals.	Meter needle remains at zero.	
	5	Output reverse.	Throw OUTPUT REVERSE switch S5 to right-hand position.	Meter needle deflects to right.	Inspect connections to OUTPUT terminals.
	6	Polar output.	*a.* Place OUTPUT switch S4 in	*a.* Meter deflects to right.	*a.* Examine connections to OUTPUT ter-

Equipment Performance Checklist—Cont.

	Item No.	Item	Action or condition	Normal indications	Corrective measures
PERFORMANCE			DOUBLE position and OUTPUT REVERSE switch S5 in left-hand position. Disconnect cable from INPUT terminals.		minal. If connections are satisfactory but meter does not deflect refer to paragraph 37.
			b. Throw OUTPUT REVERSE switch S5 to right-hand position.	*b.* Meter needle deflects to left.	*b.* Refer to paragraph 37.
	7	Keying.	Apply slow speed (5-15 wpm) keying signals to INPUT terminals. Set OUTPUT switch S4 in SINGLE position and OUTPUT REVERSE switch S5 in left-hand position.	Meter needle deflects to the right in step with input keying signals.	Turn INPUT ATTENUATOR control R7 clockwise and NOISE REJECTOR R30 control counterclockwise until meter indicates output is keyed.
STOP	8	POWER switch.	Throw POWER switch S1 to the OFF position.	Tube lights go out.	Refer to paragraph 37.

37. Trouble-shooting Chart for Organizational Maintenance Repairman

a. General. The trouble-shooting chart in subparagraph *b* lists symptoms of trouble in Amplifier AM-103B/U together with the corrective measures that may be taken at the organizational maintenance level. Continuity inspections, where indicated, must be made with the power cable disconnected from the unit.

Notes.

1. Terminate the OUTPUT terminals of the proper associated equipment, and be sure that the associated equipment is functioning properly.

2. The type 6SN7GT and 6V6 tubes in Amplifier AM-103B/U are interchangeable with tube types 6SN7WGT and 6V6Y.

3. If the suggested corrective measures are not effective, trouble shooting at field maintenance level is indicated.

b. Organizational Trouble-shooting Chart.

Symptom	Corrective measures
1. Tubes do not light when POWER switch S1 is placed in the ON position.	1. *a.* Inspect fuse F1 for continuity. *b.* Inspect POWER switch S1 for continuity. *c.* Inspect primary winding (gray leads) of filament transformer T1 for continuity.
2. Tubes light when POWER switch S1 is placed in the ON position, but amplifier is totally inoperative.	2. *a.* Inspect primary winding (gray leads) of power transformer T2 for continuity.

Symptom	Corrective measures
	b. Check to see that supply voltage is 117 VAC, 60 cycle.
3. With no signal applied to INPUT terminals, OUTPUT switch S4 in DOUBLE position, and OUTPUT REVERSE switch S5 in left-hand position, meter needle does not deflect to left.	3. *a.* Replace tube V8 (type 5Y3GT). *b.* Replace to V5 (type 6V6Y). *c.* Inspect meter M1 for continuity.
4. With no signal applied to INPUT terminals, OUTPUT switch S4 in DOUBLE position, and OUTPUT REVERSE switch S5 in right-hand position, meter needle does not deflect to right.	4. *a.* Replace tube V7 (type 5Y3GT). *b.* Replace tube V6 (type 6V6Y).
5. With steady mark signal applied to INPUT terminals and OUTPUT REVERSE switch S5 in right-hand position, meter needle does not deflect to left.	5. *a.* Replace tube V9 (type 5Y3GT). *b.* Replace tube V1 (type 6SJ7). *c.* Replace tube V2 (type 6H6). *d.* Replace tube V3 (type 6SN7WGT). *e.* Replace tube V4 (type 6SN7WGT). *f.* Inspect OUTPUT REVERSE switch S5 for continuity.

CHAPTER 4

THEORY

38. General

a. Teletypewriter signaling currents are square-wave pulses of direct current. Unless repeaters or line relays are used, these signals cannot be transmitted over land lines more than approximately 20 miles. Beyond this distance, the signals become distorted and error is introduced into the information received at the other end of the line. For this reason, when teletypewriter signals are to be sent over long lines, they are converted into keyed a-f sine-wave signals at the sending position. A band-pass filter then may be placed in the line to remove noise and allow only the wanted signals to operate the receiving equipment. In normal practice, the *mark* signal is sent as a tone-on condition and the *space* signal as a tone-off condition. At the receiving position, the keyed a-f signals must be changed back to square-wave d-c signals before they can operate the receiving teletypewriter. Radioteletypewriter and carrier telegraph systems also use keyed-tone signals to send information. As in long-lines transmission, these keyed-tone signals also must be changed to d-c signals in order to operate the receiving equipment.

b. Amplifier AM-103B/U converts the keyed-tone signals from long lines or from a radio receiver into square-wave d-c signals. The amplifier rectifies the a-f signals and filters, shapes, and amplifies the resultant d-c pulses. The output circuit of the amplifier may be arranged to provide either unidirectional (neutral) or bidirectional (polar) output signals.

c. For operation under normal conditions, the mark (tone-on) signal appears at the output of Amplifier AM-103B/U as a d-c pulse, negative with respect to the space (tone-off) signal. If the mark signal from long lines or the radio receiver is a tone-off condition, the output of the amplifier will be inverted. The mark signal will be positive with respect to the space signal and the receiving equipment will fail to operate. To correct this signal inversion, Amplifier AM-103B/U provides means to restore the output signals to their correct polarity.

d. The waveshape of the output signals of Amplifier AM-103B/U can be altered by means of a switching arrangement to suit the input requirements of several types of recording devices. A square-wave output can be obtained to operate teletypewriters. A sharply peaked output waveshape can be obtained to operate high-speed ink recorders.

39. Block Diagram (fig. 9)

The basic circuits and stages of Amplifier AM-103B/U consist of an input amplifier V1 (par. 40), a signal rectifier V2A and V2B (par. 41), a limiter-amplifier V3A and low-pass filter (par. 42), a signal balance control R31, a d-c amplifier V4A and a d-c phase inverter V4B (par. 43), two output amplifiers V5 and V6 (par. 44), an output level circuit (par. 45), a monitor amplifier V3B (par. 46), and three power supplies V7, V8, and V9 (par. 47, 48 and 49).

a. Input amplifier V1 amplifies the keyed a-f input signals. These signals then are applied to signal rectifier V2A and V2B.

b. Signal rectifier V2A and V2B is a full-wave rectifier that converts the keyed a-f signals into rectified d-c pulses. These signals contain a ripple frequency twice that of the tone-signal frequency of the input signals. Low-level noise pulses are removed from the input by the operation of NOISE REJECTOR potentiometer R30.

c. Limiter amplifier V3A amplifies the d-c pulses and limits the peaks of the signal ripple voltage. The low-pass filter attenuates the ripple present in the output of tube V3A and also removes any high-level, short-duration noise pulses that may be present in the input signals.

d. D-c amplifier V4A amplifies and limits the d-c signals. SIGNAL BALANCE control R31 determines the duration of the mark signal with respect to the space signal. D-c phase inverter V4B operates in conjunction with d-c amplifier V4A and produces an output 180 degrees out of phase with that of d-c amplifier V4A,

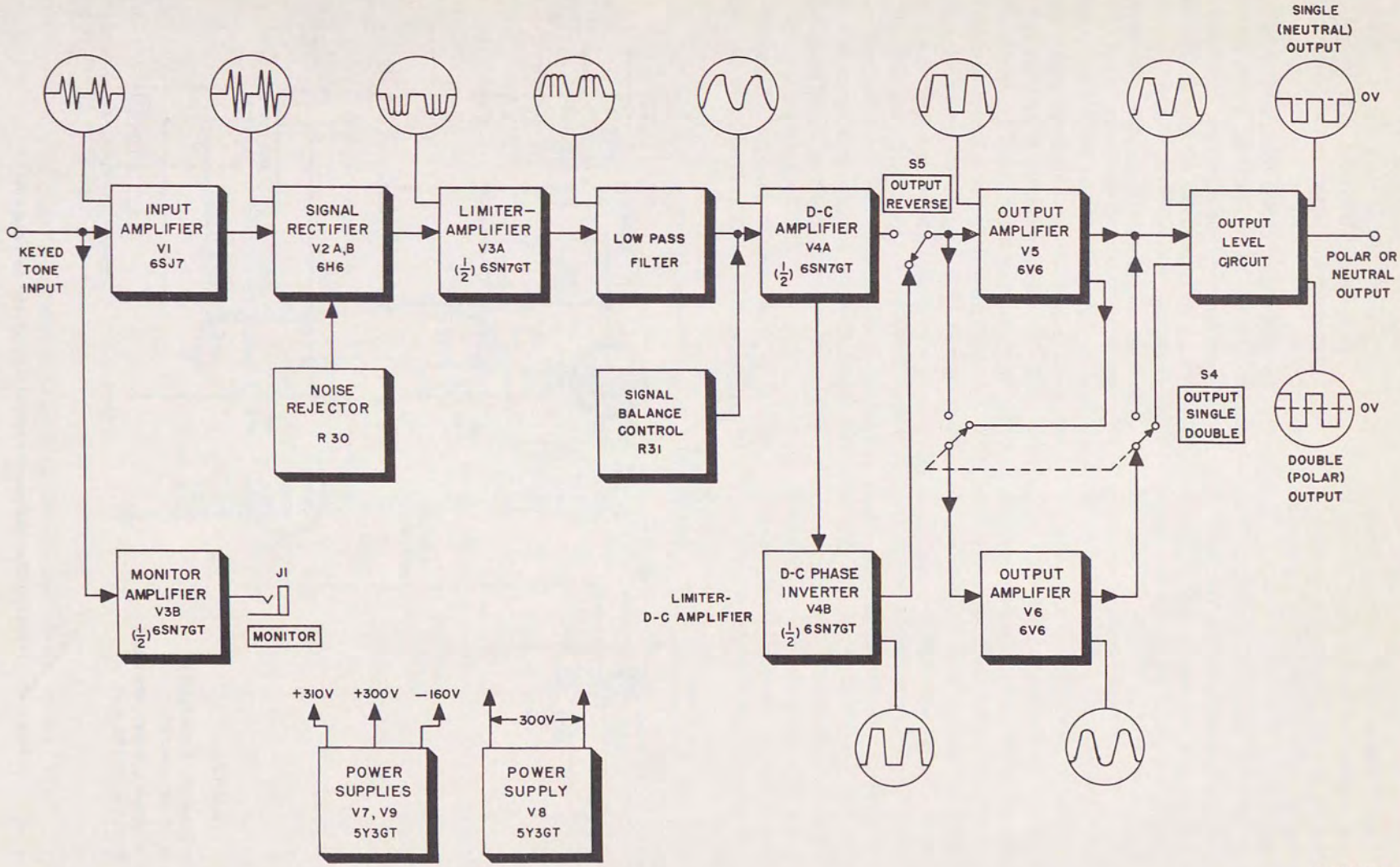


Figure 9. Amplifier AM-103B/U, block diagram.

depending on the position of OUTPUT REVERSE switch S5.

e. OUTPUT REVERSE switch S5 applies the output of either the d-c amplifier or the d-c phase inverter to output amplifiers V5 and V6. The type of operation of output amplifiers V5 and V6 depends on the position of OUTPUT switch S4.

(1) With OUTPUT switch S4 in SINGLE position, output amplifiers V5 and V6 operate in parallel, amplify the signals, and apply unidirectional (neutral) signals to the output circuit.

(2) With OUTPUT switch S4 in DOUBLE position, output amplifiers V5 and V6 operate alternately, one on mark signals, the other on space signals. The tubes then apply bidirectional (polar) signals to the output level circuit.

f. The output level circuit consists of resistors and capacitors that can be switched into the output circuit, and provides for modifying the output impedance of the output circuit to conform to the requirements of the driven equipment.

g. Monitor amplifier V3B amplifies the keyed a-f

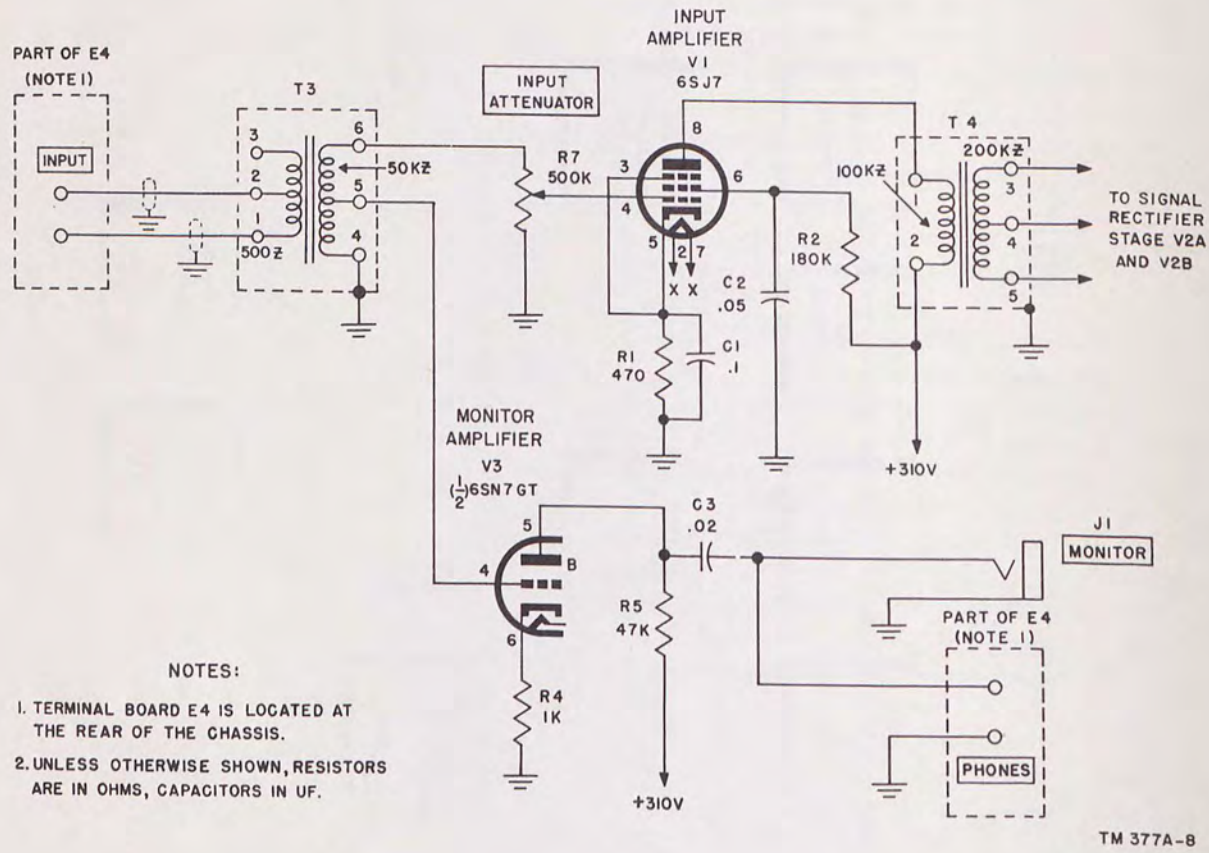


Figure 10. Input amplifier. and monitor amplifier stages schematic diagram.

input signals and provides means of monitoring the incoming signals with MONITOR jack J1.

b. The power supplies furnish the a-c and d-c voltages required to energize and to operate the tubes of Amplifier AM-103B/U.

40. Input Amplifier Stage (fig. 10)

Input amplifier V1 is a high-gain pentode operated as a class A amplifier. The function of this stage is to amplify the keyed a-f input signals to a level high enough to insure consistent positive operation of the signal rectifier.

a. The keyed a-f signals from the control source are applied to the INPUT terminals of terminal board E4 and are coupled through input transformer T3 to INPUT ATTENUATOR potentiometer R7. The slider arm of potentiometer R7 transfers a portion of the input signal voltage to the grid of input amplifier V1. V1 amplifies the signals and couples them through transformer T4 to the signal rectifier circuit.

b. For 500-ohm input impedance, the INPUT terminals on terminal board E4 are connected to terminals 1 and 2 of transformer T3. For 5,000-ohm input impedance, the INPUT terminals are connected to terminals 1 and 3 of transformer T3.

c. Resistor R1, bypassed by capacitor C1, provides cathode bias for tube V1. Resistor R2, bypassed by capacitor C2, is the screen voltage dropping resistor. The plate of tube V1 is connected to the +310-volt supply through the primary winding (terminals 1 and 2) of transformer T4.

41. Signal Rectifier Stage (fig. 11)

Tube V2 is a duo-diode connected in a full-wave rectifier circuit. The function of this stage is to convert the keyed a-f input signals into d-c pulses and to reject low-level noise.

a. The keyed a-f signals are applied from the secondary winding (terminals 3 and 5) of transformer T4 to the plates of signal rectifier V2A and V2B. The cathodes of the signal rectifier are connected to the slider arm of NOISE REJECTOR potentiometer R30, which is part of the bleeder resistance of the +310-volt power supply. Potentiometer R30 biases the cathodes at some positive voltage which can be varied between 0 and 70 volts. Before the signal rectifier can conduct, the signal on the plates must exceed the positive bias voltage on the cathodes. Since low-level noise impulses in the input signal do not drive the plates positive with respect to the cathodes, the signal rectifier does not conduct and low-level noise is suppressed. The relatively high-level keying signals cause the plates to become positive with respect to the cathodes and the signal rectifier conducts.

b. The d-c output signals of signal rectifier V2A and

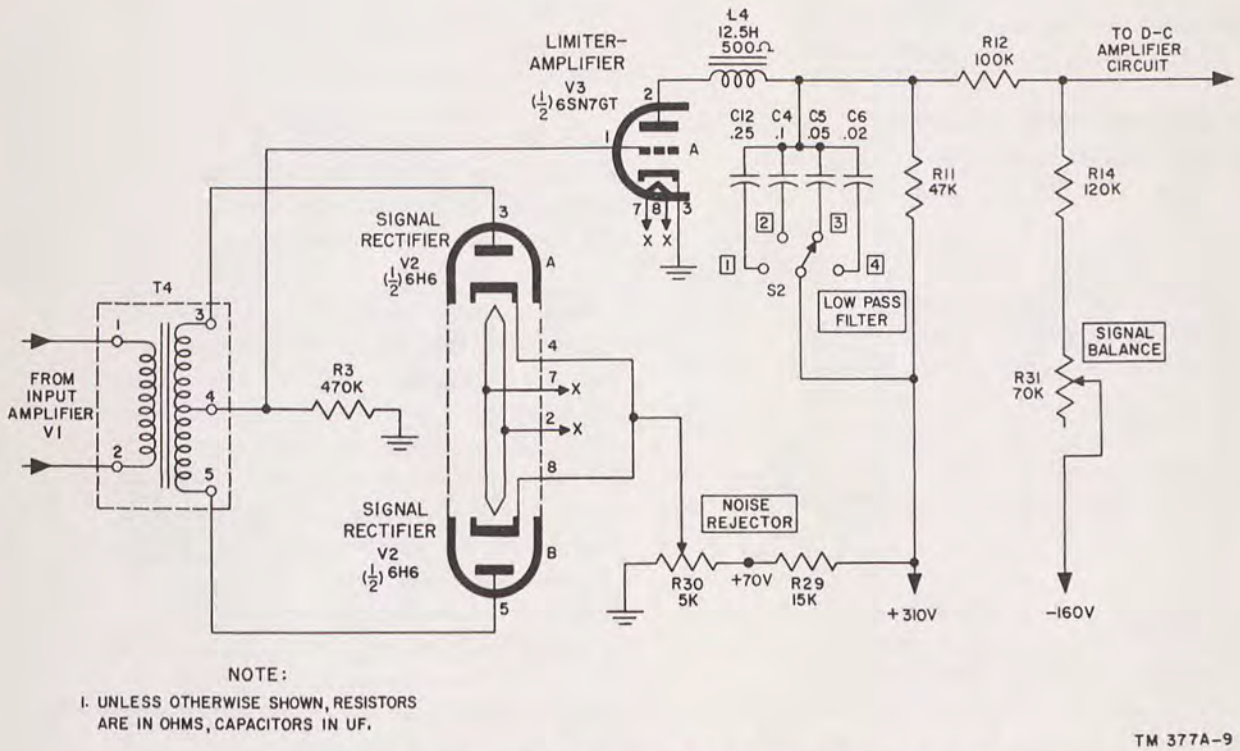


Figure 11. Signal rectifier and limiter-amplifier stages schematic diagram.

V2B appear across resistor R3, which is connected to the center tap (terminal 4) of transformer T4. These rectified signals are negative with respect to ground and contain a ripple voltage, the frequency of which is twice the input tone frequency.

42. Limiter-Amplifier Stage and Low-pass Filter (fig. 11)

Limiter-amplifier V3A consists of one section of a twin triode with a low-pass filter in the plate circuit. The function of this stage is to limit the peaks of and to remove the ripple from the rectified output pulses of signal rectifier V2A and V2B. The stage also suppresses short-duration high-level noise pulses and converts the rectified d-c pulses into trapezoidal-wave signals.

a. Resistor R11 is part of a bleeder network composed of resistors R12, R14, and variable resistor R31. This network is connected across the +310-volt power supply and returns to ground through resistor R25 (fig. 12). The grid of d-c amplifier V4A (fig. 13) is connected to the junction of resistors R12 and R14. The sliding arm of potentiometer R31 is connected to a source that is −160 volts with respect to ground. The voltage division across the bleeder network is such that the bias voltage applied to the grid is always negative with respect to ground or its cathode. The magnitude of this negative potential depends on the setting of SIGNAL BALANCE control R31, and may be varied from approximately −17 to −37 volts. A, figure 12 illustrates the voltage distribution in the bleeder network during a space signal.

b. The mark signal developed across resistor R3 as a result of full-wave rectification is applied to the grid of limiter-amplifier V3A (fig. 11). Since the input audio tone is keyed or interrupted periodically, the mark signal consists of a rectified d-c pulse containing a ripple frequency twice the frequency of the input tone signal. If the peak amplitude of the ripple reaches a sufficiently high potential, it will drive limiter-amplifier V3A to cutoff. When V3A is driven to cutoff, the plate current falls to zero and the plate potential rises to full plate supply voltage. As the trailing edge of the tone envelope rises, plate current begins to flow and plate potential decreases. This limiting action of tube V3A clips part of the ripple voltage from the mark signal. The remaining ripple is removed by the low-pass filter as described in subparagraph *c* below. When V3A is cutoff, the only current flowing through resistor R11 is bleeder current.

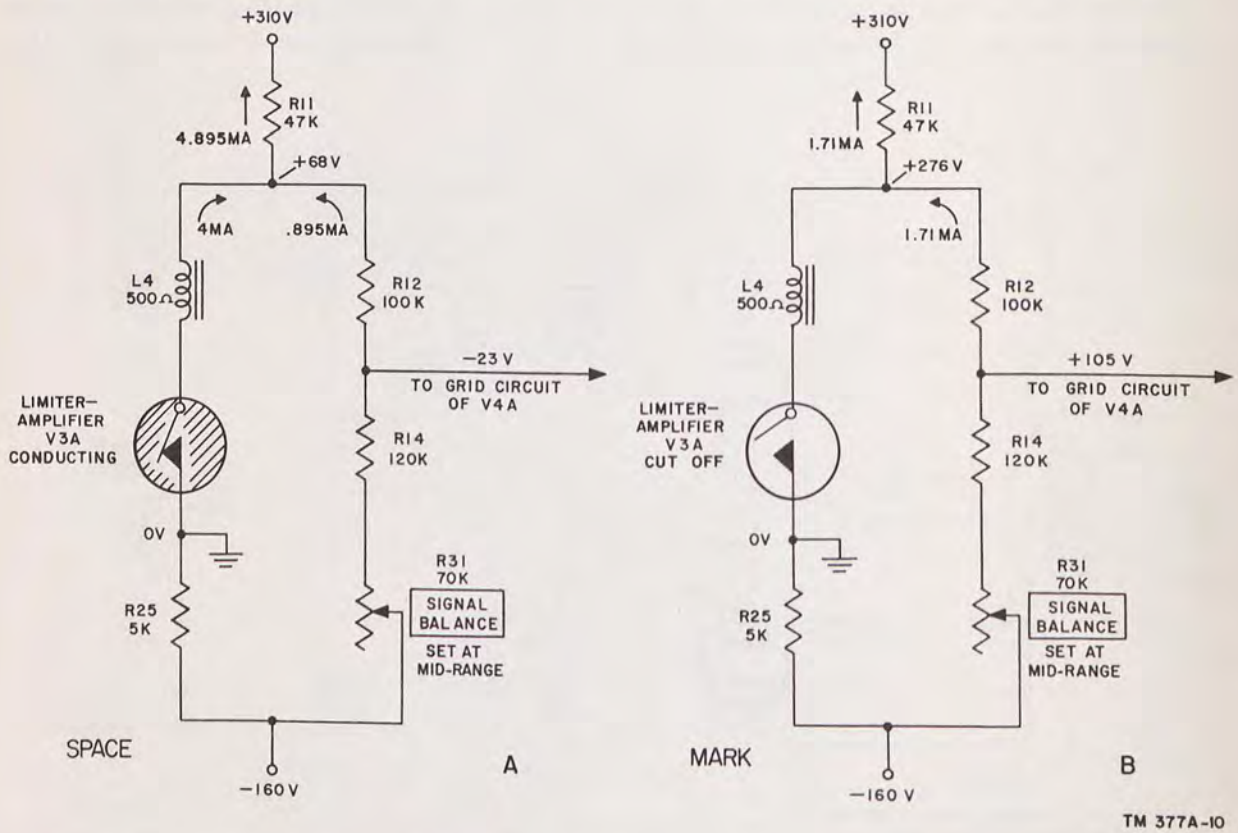


Figure 12. A. Space condition. B. Mark condition. Resistance bridge network in plate circuit of limiter-amplifier V3A, simplified schematic diagram.

Under these conditions, the voltage at the junction of resistors R12 and R14, which is applied to the grid of d-c amplifier V4A, rises to +105 volts. Figure 12B illustrates the voltage distribution in the bleeder network during a mark signal.

c. The low-pass filter in the plate circuit of limiter-amplifier V3A consists of inductance L4 and one of the capacitors (C12, C4, C5, or C6) as determined by the position of LOW PASS FILTER switch S2. The filter removes the ripple from the output of limiter-amplifier tube V3A (subpar. (1) below), blocks short-duration high-level noise pulses (subpar. (2) below), and changes the waveshape of the square-wave mark signals (subpar. (3) below).

(1) Inductance L4 presents a high impedance at the ripple frequency and the associated capacitor has a relatively low impedance at the ripple frequency. Therefore the greater part of the ripple voltage appears across inductance L4 and relatively small ripple voltage appears across the associated capacitor. In actual operation, limiter-amplifier V3A is driven with a relatively high-amplitude signal, which causes low-level, clipping of the ripple frequency at the output of V3A (subpar. *a*(2) above). Only high-frequency components of the ripple frequency appear across the filter network, thereby permitting still better ripple attenuation, since the impedance of the filter increases with increasing frequency. The desired signal, which at this point is a low-frequency keyed d-c voltage, is attenuated relatively little by the filter. This signal appears across resistor R11, the load resistor of the filter section. The signal is applied to the grid of d-c amplifier V4A through series resistors R12 and R13 (figs. 11 and 13).

(2) Noise pulses in the input signal that are of the same or greater amplitude than the mark signals will not be suppressed in the noise rejector circuit (par. 41*a*) and will cause false mark signals from the signal rectifier. High-amplitude, short-duration noise pulses will drive the grid of limiter-amplifier V3A to cutoff for an instant, which ordinarily would cause a positive voltage to appear on the grid of d-c amplifier V4A. However, inductance L4 opposes the decrease of plate current in limiter-amplifier V3A and the capacitor discharges through resistor R11. If limiter-amplifier V3A is cutoff only for an instant, the current through resistor R11 is maintained almost constant. In this way, short-duration noise pulses do not affect the operation of the succeeding stages.

(3) The low-pass filter will completely block frequencies above a certain critical cutoff frequency, which is inversely proportional to the amount of capacitance in the circuit. Frequencies below cutoff frequency will be passed. However, the filter offers some opposition to these frequencies also and tends to remove them. Therefore, the square-wave keying signals, whose frequency must be below cutoff frequency, also are affected by the filter. The inductance L4 opposes the sharp decrease in plate current caused by the sharp cutoff of limiter-amplifier V3A at the beginning of a mark signal and also opposes the sharp increase in plate current at the end of the mark signal. While the leading edge of the mark signal is rising, the capacitor selected by LOW PASS FILTER switch S2 charges exponentially to a higher positive potential through resistor R11. As the trailing edge of the mark signal decreases to a lower positive potential, the capacitor discharges through resistor R11. The decay time of the capacitor is prolonged by inductance L4. Thus both the leading and the trailing edge of the mark signal waveform are sloped. Optimum settings of LOW PASS FILTER switch S2 for various keying speeds are shown in the table in paragraph 18.

43. D-c Amplifier Stage, SIGNAL BALANCE Control R31, and D-c Phase Inverter Stage (fig. 13)

D-c amplifier V4A consists of one section of a twin triode. D-c phase inverter V4B is the other section of the triode. The function of the d-c amplifier is to amplify the keyed signals from limiter-amplifier V3A. SIGNAL BALANCE control R31 establishes the correct mark-to-space time ratio. D-c phase inverter V4B inverts the output of d-c amplifier V4A and provides keyed signals of the correct polarity to output amplifiers V5 and V6 depending on the position of OUTPUT REVERSE switch S5.

a. D-c Amplifier V4A.

(1) *Space signal.* The grid of d-c amplifier V4A is connected to the resistance-bridge network in the plate circuit of limiter-amplifier V3A (A, fig. 12). During the space signal interval, the bias on the grid of V4A is determined by the setting of SIGNAL BALANCE control

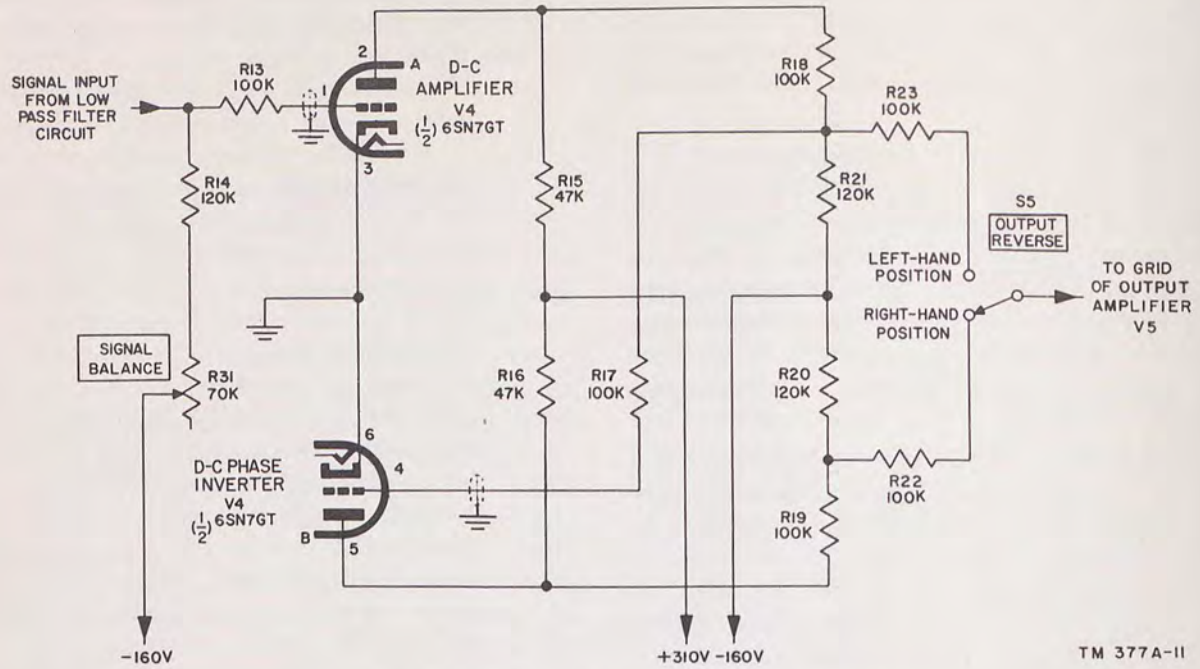


Figure 13. D-c amplifier, and d-c phase inverter stages schematic diagram.

R31. However, regardless of the control setting, the potential is sufficiently negative to cut off the tube. Since no plate current flows, the plate potential rises to +218 volts. Under this condition, the voltage at the junction of resistors R21 and R18 is +25 volts. With OUTPUT REVERSE switch S5 in the left-hand position, this voltage is applied through resistor R23 to the grid of output amplifier V5 (A, fig. 15).

(2) *Mark signal.* The mark signal from the limiter-amplifier has a trapezoidal waveshape (par. 42*b*(3)). Consequently, on a mark signal, the grid of d-c amplifier V4A does not go positive

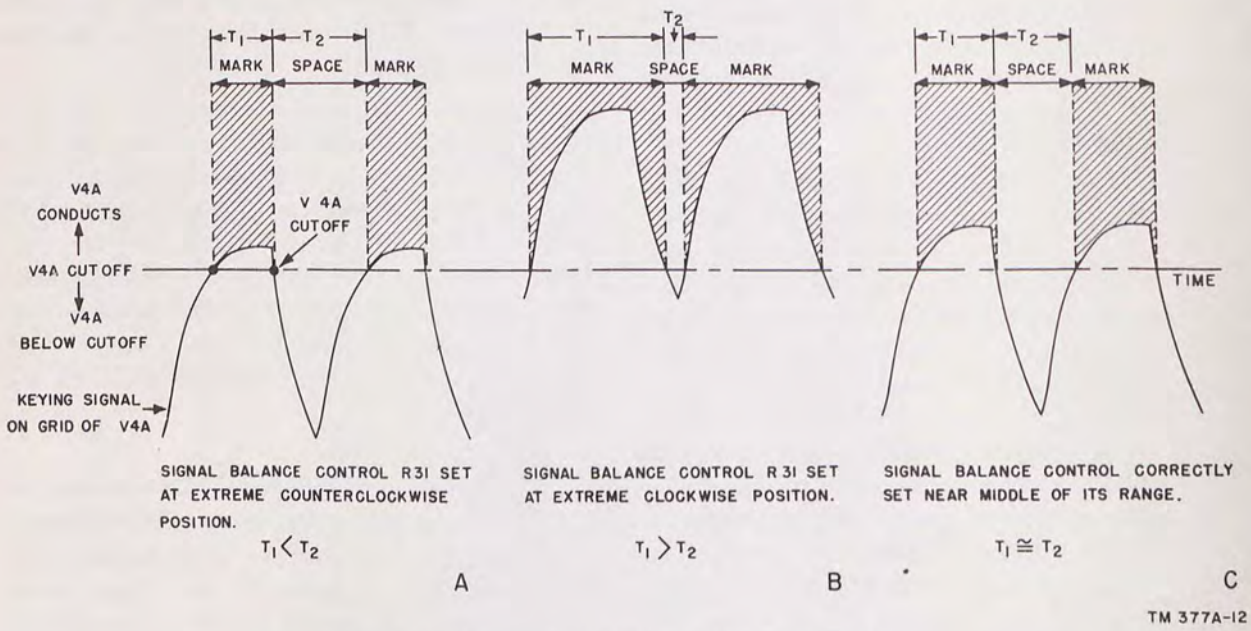


Figure 14. Function of SIGNAL BALANCE control R31.

instantaneously, but instead goes positive gradually. Depending on the setting of SIGNAL BALANCE control R31 (subpar. *b* below), cutoff voltage will be exceeded toward the beginning or toward the end of the leading edge of the mark signal waveshape, and the d-c amplifier will conduct. Under this condition, plate current in addition to bleeder current flows through resistor R15 (fig. 15). The voltage at the junction of resistors R21 and R18 decreases to −54 volts. With OUTPUT REVERSE switch S5 in left-hand position, this voltage is applied through resistor R23 to the grid of output amplifier V5.

b. SIGNAL BALANCE Control R31. The purpose of SIGNAL BALANCE control R31 is to adjust the mark-to-space time ratio of the keyed signal. Depending on the setting of the potentiometer, the static bias on the grid of d-c amplifier V4A is between −15 and −40 volts (fig. 13). The positive mark signal from limiter-amplifier V3A first must overcome this bias before d-c amplifier V4A can conduct. If the control is set at or near its maximum counterclockwise position, the bias on the grid is relatively small and d-c amplifier V4A will conduct toward the beginning of the leading edge of the mark signal waveshape (fig. 14). If the control is set at or near its maximum clockwise position, the bias is far below cutoff potential and the mark signal is not positive enough to overcome the bias until near the end of its leading edge. The same action occurs at the end of the mark signal. If the bias on the grid is small, the tube does not return to cutoff condition until near the end of the trailing edge of the mark signal waveshape. If the bias is great, cutoff occurs near the beginning of the trailing edge. D-c amplifier V4A therefore conducts for a greater or lesser portion of the mark signal from limiter-amplifier V3A, depending on the setting of SIGNAL BALANCE control R31. Hence the width of the mark signal is directly proportional to the time interval between plate current *on* and plate current *off* of d-c amplifier V4A and also is inversely proportional to the width of the space signal.

c. D-c Phase Inverter V4B.

(1) *Space signal.* The grid of d-c phase inverter V4B is connected through series resistor R17 to the junction of resistors R18, R21, and R23. During a space signal, the voltage at the junction of these resistors is +25 volts (A, fig. 15). With a positive voltage applied to its grid, the d-c phase inverter conducts. Plate current flows through resistor R16, which is part of a bleeder network in the power supply. This bleeder network consists of resistors R20, R19, and R16. When the d-c phase inverter conducts, both plate and bleeder current flow through resistor R16. Under this condition, the voltage at the junction of resistors R20 and R19 is −46 volts. With OUTPUT REVERSE switch S5 in the right-hand position, this voltage is applied through resistor R22 to the grid of output amplifier V5.

(2) *Mark signal.* During a mark signal, the voltage at the junction of resistors R18, R21, and R23, which is the voltage applied through series resistor R17 to the grid of the d-c phase inverter, is −54 volts (B, fig. 15). This voltage is sufficient to cut off the phase inverter, and plate current ceases to flow. The only current that flows through resistor R16 is bleeder current. The voltage at the junction of resistors R19 and R20 rises to +44 volts. With OUTPUT REVERSE switch in the right-hand position, this voltage is applied through resistor R22 to the grid of output amplifier V5.

44. Output Amplifiers (fig. 16)

Output amplifiers V5 and V6 are beam power pentodes. The function of this stage is to amplify the signals either from d-c amplifier V4A or from d-c phase inverter V4B, depending on the position of OUTPUT REVERSE switch S5. In the following discussion, switch S5 is assumed to be in its normal operating (right-hand) position and the signals from d-c phase inverter V4B are applied to the output amplifiers.

a. OUTPUT Switch S4 in SINGLE Position. With OUTPUT switch S4 in SINGLE position, output amplifiers V5 and V6 operate in parallel (fig. 17). One section of switch S4 connects the control grid of output amplifier V6 to the control grid of V5. The second section of switch S4 grounds the cathode of V6. The cathode of V5 is grounded permanently. The third section of switch S4 connects the plate of V6 and the screen grid of V5 to B+ of power supply V8. The plate of V5 is connected permanently to power supply V8 through resistor R9. The fourth section of switch S4 short-circuits resistors R6 and R26 and applies B− of power supply V8 to the output level circuit.

(1) *Space signal.* During a space signal, the voltage at the junction of resistors R19, R20, and R22 is −46 volts (A, fig. 15). This voltage is applied through series resistor R22 and OUTPUT REVERSE switch S5 to the control grids of output amplifiers V5 and V6, and the tubes are cut off. With the tubes cut off, no current

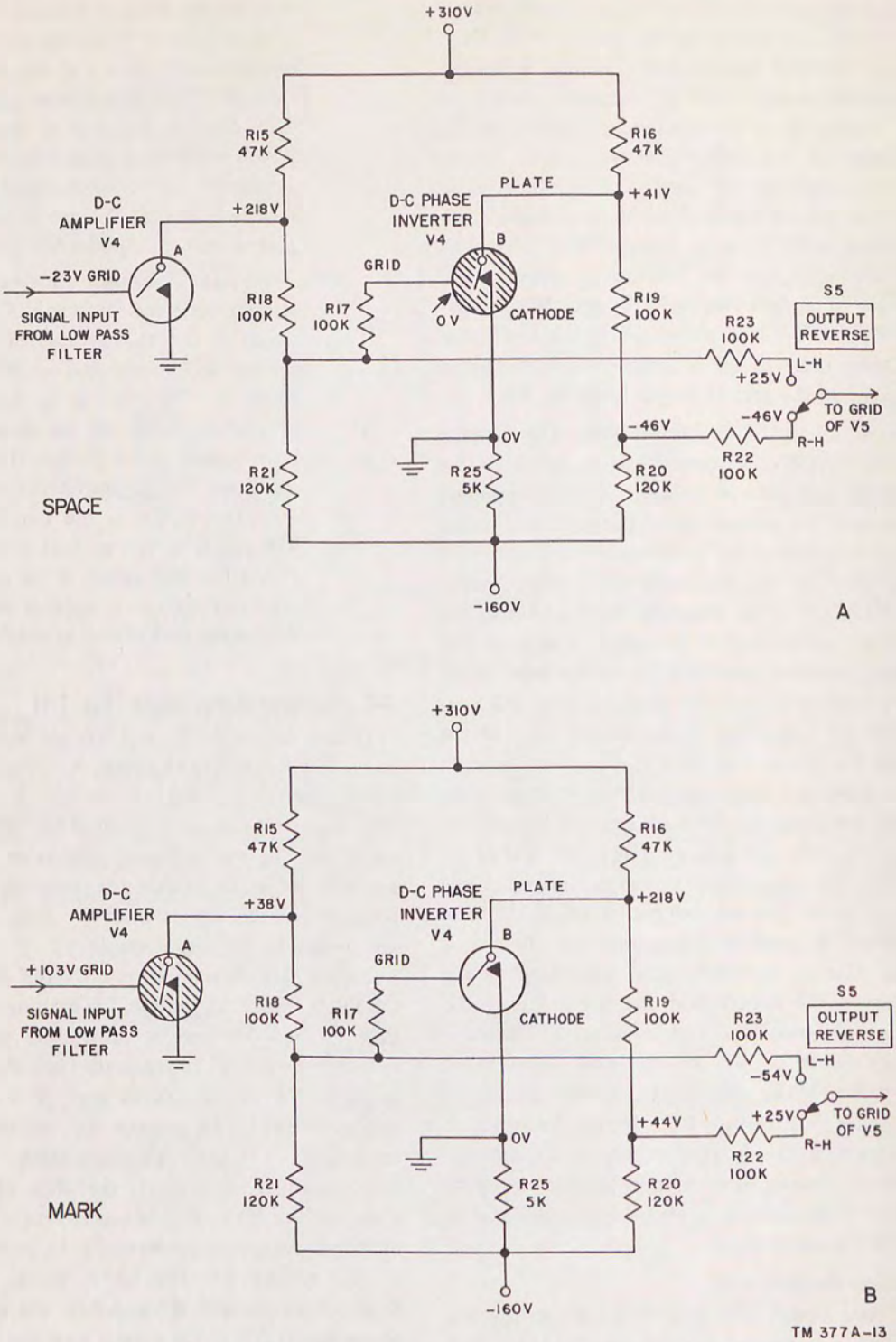


Figure 15. A. Space signal. B. Mark signal. Resistance bridge network in plate circuits of d-c amplifier V4A and d-c phase inverter V4B, simplified schematic diagram.

flows through resistor R8 and no output signal is applied to the output level circuit. A space (zero-voltage) signal appears at the OUTPUT terminals of the amplifier.

(2) *Mark signal.* During a mark signal, the voltage at the junction of resistors R19, R20, and R22 is +44 volts (B, fig. 15). This voltage is applied through series resistor R22 and OUT-

PUT REVERSE switch S5 to the control grids of the output amplifiers, and the tubes conduct. When the tubes conduct, current flows from B— of power supply V8 through resistors R6 and R8 to ground and then to the cathodes of the output amplifiers. The negative voltage, with respect to ground, that is developed across resistor R8 is applied to the output level circuit, and a negative mark signal appears at the OUTPUT terminals of the amplifier.

b. OUTPUT Switch S4 in DOUBLE Position. With OUTPUT switch S4 in DOUBLE position (fig. 18), tubes V5 and V6 operate alternately. V5 generates the mark signal and V6 generates the space signal. The first and third sections of OUTPUT switch S4 connect the grid and cathode of output amplifier V6 across resistor R6. The second section of switch S4 connects the plate of V6 to B+ of power supply V7. The fourth section of switch S4 opens the jumper that short-circuits resistors R6 and R26 in SINGLE position.

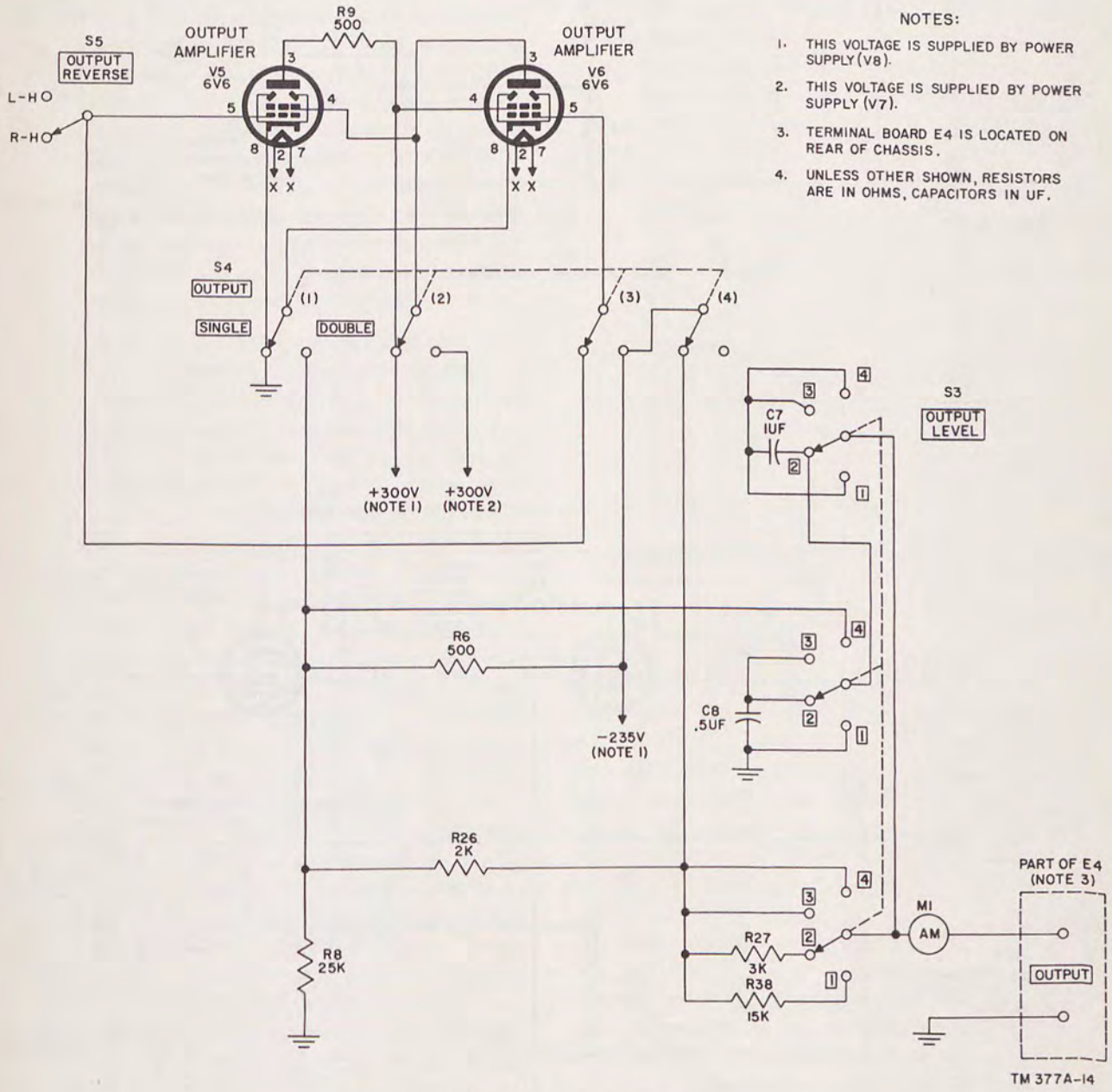


Figure 16. Output circuit, schematic diagram.

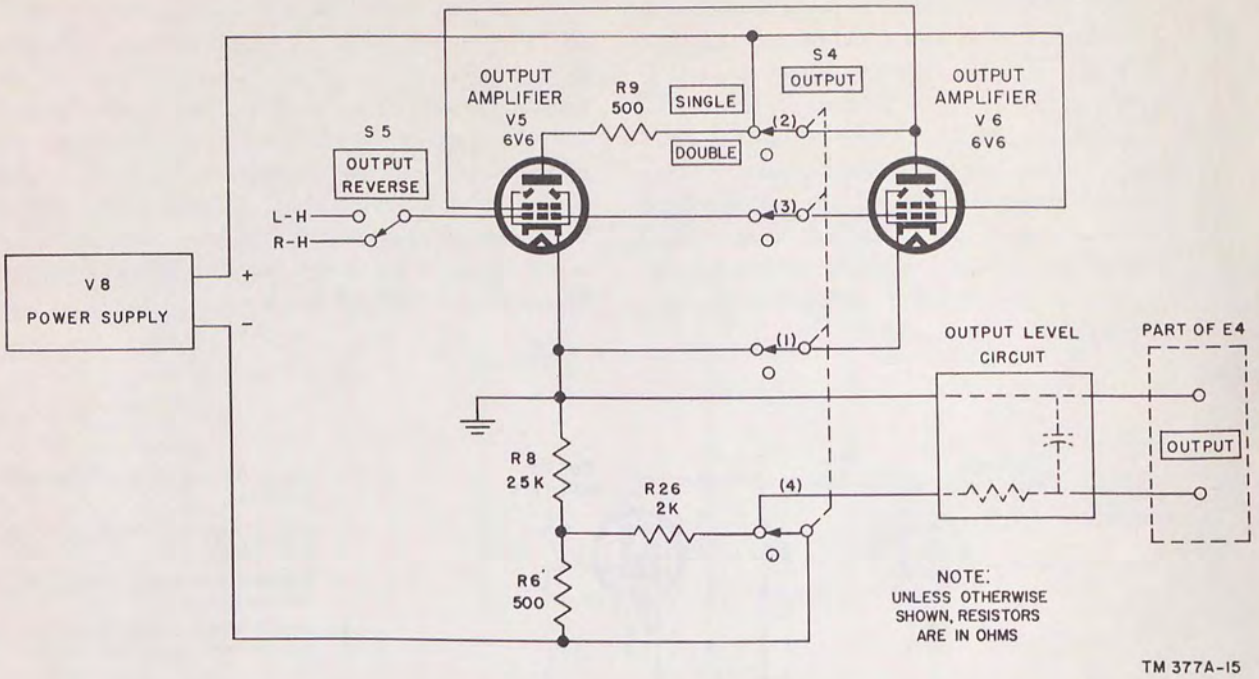


Figure 17. SINGLE output, simplified schematic diagram.

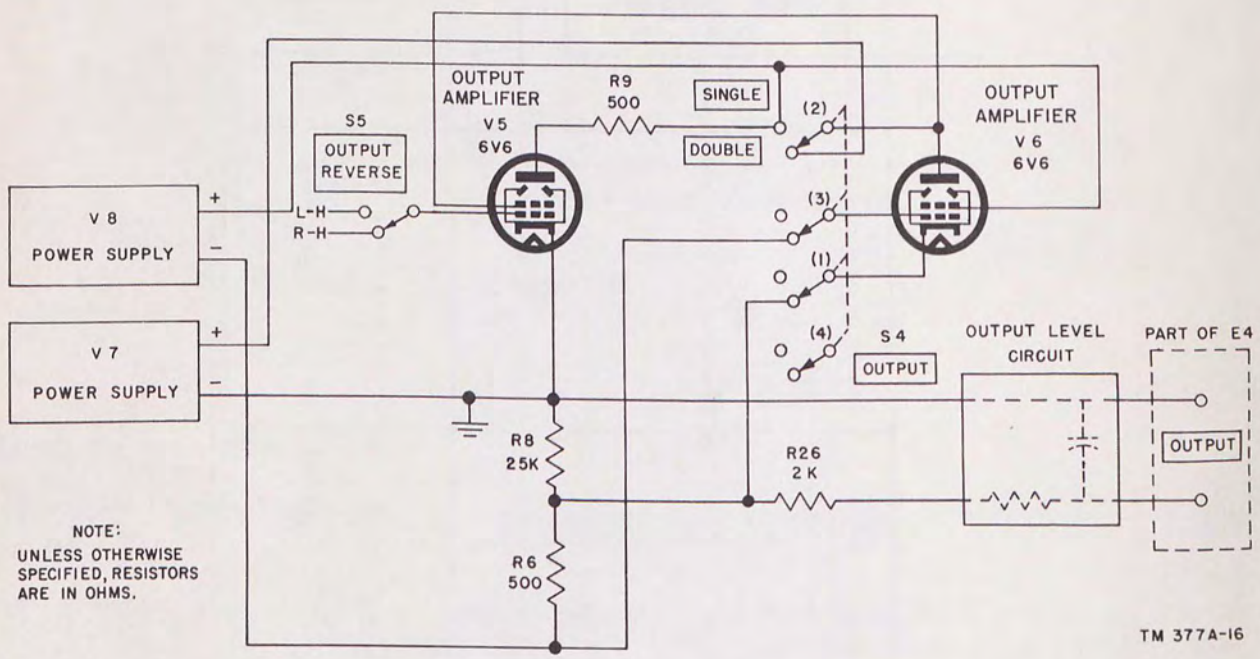


Figure 18. DOUBLE output, simplified schematic diagram.

(1) *Space signal.* During a space signal, the −46-volt potential which exists at the junction of resistors R19, R20, and R22 (A, fig. 15) is applied through series resistor R22 and OUTPUT REVERSE switch S5 to the control grid of output amplifier V5. This negative potential is sufficient to cut off the tube. Since this cutoff voltage is not applied to the control grid of output amplifier V6, V6 conducts. Plate current flows from B− of power supply V7 to ground and from ground through resistor R8 to the cathode of V6. The screen grid of V6 is connected to B+ of power supply V8. Screen current therefore flows from B− of power supply V8, through resistor R6, to the cathode of V6. The positive voltage developed across resistor R8 by the flow of plate current is applied to the output level circuit and a positive space signal appears at the OUTPUT terminals of the amplifier. The negative voltage developed across resistor R6 by the flow of screen current is applied to the grid of V6 and holds the grid approximately 10 volts negative with respect to the cathode.

(2) *Mark signal.* During a mark signal, the +44-volt potential that exists at the junction of resistors R19, R20, and R22 (B, fig. 15) is applied through series resistor R22 and OUTPUT REVERSE switch S5 to the grid of output amplifier V5. Tube V5 draws grid current, and the resulting voltage drop across resistor R22 causes the tube to operate under effectively zero bias condition. Plate current flows from B− of power supply V8 through resistors R6 and R8 to ground and from ground to the cathode of V5. Since the screen grid of output amplifier V6 also is connected to B+ of power supply V8, V6 draws screen current from B− of power supply V8, through resistor R6 to the cathode of V6. The voltage drop across resistor R6, resulting from the flow of V5 plate current and V6 screen current, places a potential on the control grid of V6 of approximately −235 volts with respect to ground and on the cathode of approximately −220 volts with respect to ground. Consequently the current drawn by output amplifier V6 is relatively small compared with the current drawn by output amplifier V5. The negative voltage developed across resistor R8 by the flow of V5 plate current is applied to the output level circuit, and a negative mark signal appears at the OUTPUT terminals of the amplifier.

c. OUTPUT REVERSE switch S5 in left-hand position. With OUTPUT REVERSE switch S5 in the left-hand position, the polarity of the output signals of output amplifiers V5 and V6 is reversed.

(1) *Space signal.* During a space signal interval, a potential of +25 volts is applied to the control grid of tube V5 through series grid resistor R23 (A, fig. 15). The voltage drop developed across this resistor will maintain a zero bias operating condition. Plate current path is from the plate voltage supply source, utilizing rectifier tube V8, through resistors R6 and R8 to ground, then through tube V5 back to the positive side of the plate voltage source. The portion of the current that flows through resistor R8 develops a negative space signal that is applied to the output load.

(2) *Mark signal.* During a mark signal interval a potential of −54 volts is applied to the control grid output amplifier tube V5 through OUTPUT REVERSE switch S5 (B, fig. 15), driving the tube to cutoff. With OUTPUT switch S4 in SINGLE position, there is no current flow through resistor R8, hence there is no mark signal output appearing at the output load. With OUTPUT switch S4 in DOUBLE position, tube V6 conducts. The plate current path is through cathode bias resistor R8, through the tube, to the plate voltage supply source. The voltage drop developed across resistor R8 raises the cathode potential to approximately +270 volts above ground; hence the mark signal across the output load is of positive polarity.

45. Output Level Circuit (fig. 19)

The output level circuit is a series network comprising resistors R26, R27, and R28, zero-centered d-c milliammeter M1, and external load, and shunt capacitors C7 and C8. This network is always across the meter and the external load, either individually or in series with one another, except when OUTPUT LEVEL switch S3 is in position 4. This series-parallel network is connected in parallel with cathode bias resistor R8. The magnitude and polarity of the output current indication through meter M1 is a function of the magnitude and polarity of the voltage developed across resistor R8 and the value of the current-limiting resistance inserted in series with the meter. The value of series resistance and shunt capacitance is determined by the setting of OUTPUT LEVEL switch S3.

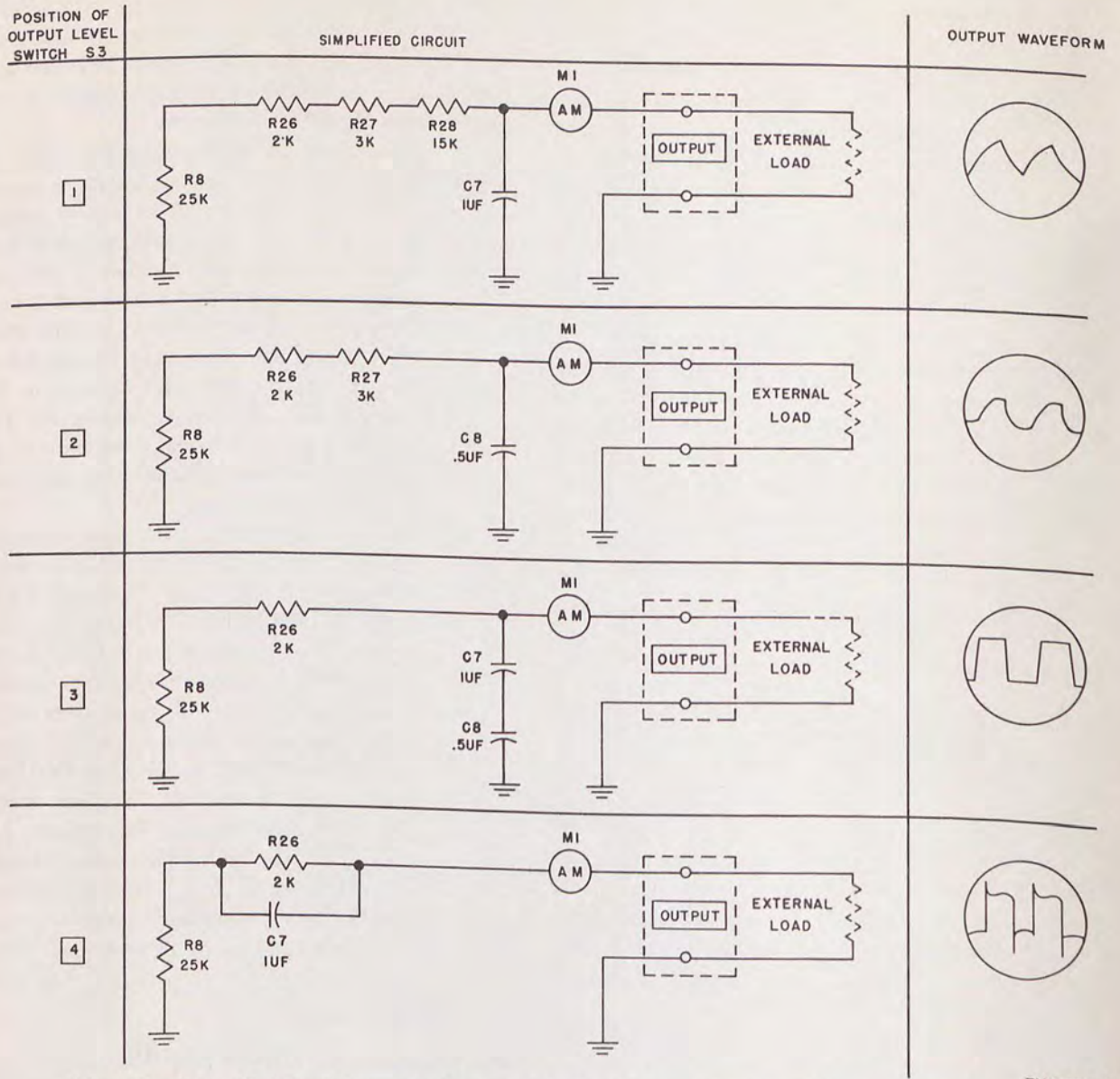


Figure 19. Output level circuit in positions 1 to 4 of OUTPUT LEVEL switch S3, simplified schematic diagram.

a. OUTPUT LEVEL Switch S3 in Position 1. The output level circuit with switch S3 in position 1 consists of resistors R26, R27, and R28 in series with meter M1 and the external load (fig. 19). Capacitor C7 is across meter M1 and the external load. The mark-space keying signals appear across resistor R8 (par. 44) and are applied to the load through the resistors and the meter. On a mark signal, the capacitor charges through the resistors. Maximum current does not flow through the load until the capacitor is charged. On a space signal, the capacitor discharges through the resistors and through the load. The discharge of the capacitor keeps the current through the load from sharply decreasing.

b. OUTPUT LEVEL Switch S3 in Position 2. The output level circuit with switch S3 in position 2 consists of resistors R26 and R27 in series with meter M1 and the external load (fig. 19). Capacitor C8 is across the meter and the external load. Since the capacitance and the resistance in the circuit are smaller than when switch S3 is in position 1, the capacitor charges faster on a mark signal and discharges faster on a space signal. Consequently, current through the external load reaches a maximum more quickly on a mark signal and decreases more quickly on a space signal. The resultant output waveshape is trapezoidal in form.

c. OUTPUT LEVEL Switch S3 in Position 3. The

output level circuit with switch S3 in position 3 consists of resistor R26 in series with meter M1 and the external load (fig. 19). Capacitors C7 and C8 in series are connected across the meter and the external load. Since the capacitance in the circuit is small, current through the load reaches a maximum almost instantly on a mark signal and falls off rapidly on a space signal. Resultant output waveshape is effectively a square wave.

d. OUTPUT LEVEL Switch S3 in Position 4. The output level circuit with switch S3 in position 4 consists

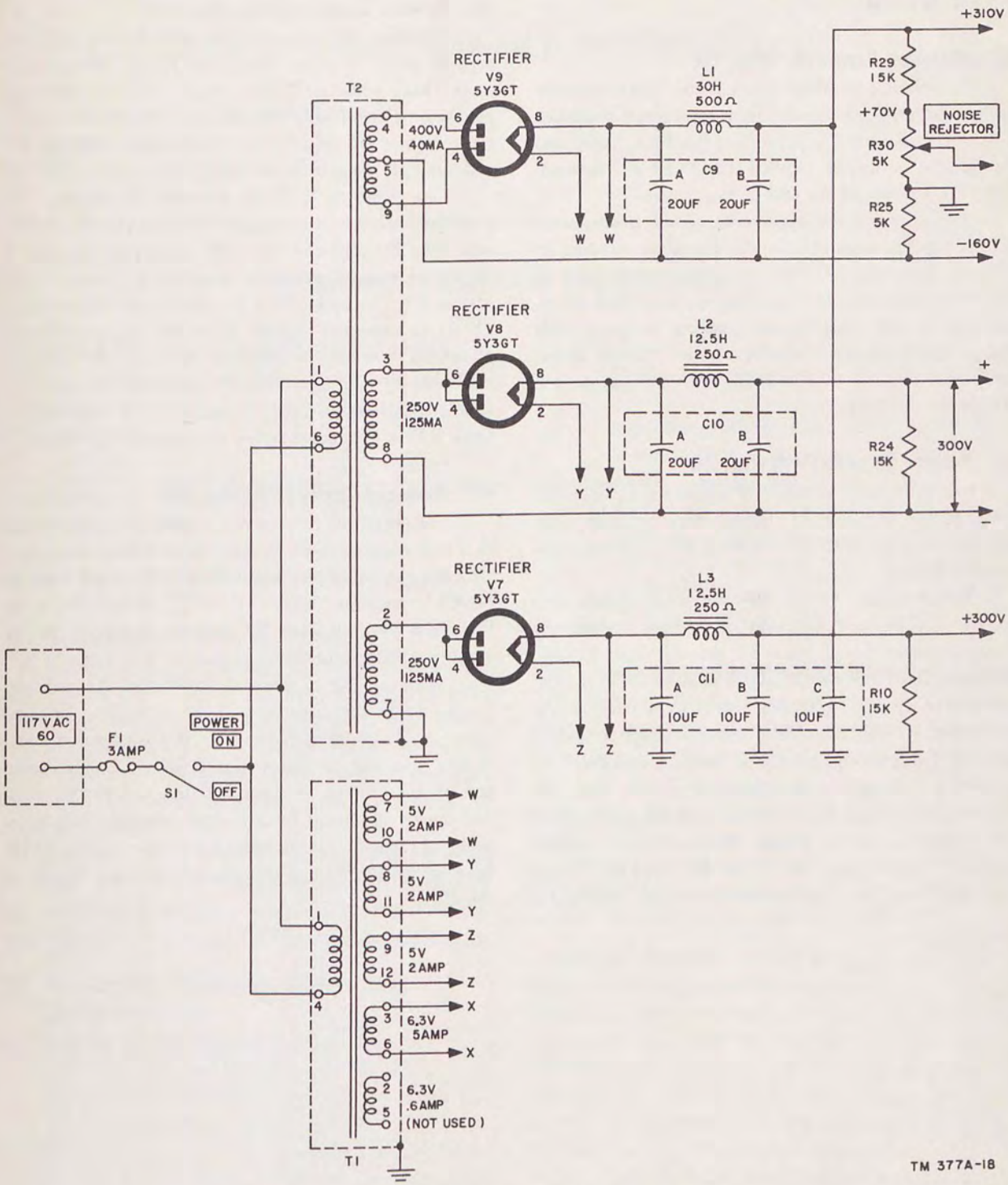


Figure 20. Power supplies (V7, V8, and V9,), schematic diagram.

of resistor R26 in series with the meter and the external load (fig. 19). Capacitor C7 is in shunt with resistor R26. The capacitor applies a large initial surge of current to the load at the beginning of a mark signal, after which the current falls to a lower value and stabilizes at this value. At the end of the mark signal, the trailing edge of the waveshape also is peaked sharply in the opposite direction.

46. Monitor Amplifier (fig. 10)

a. The monitor amplifier utilizes tube V3B to amplify the keyed-tone input signal. The output signal is applied to MONITOR jack J1, located on the front panel, and also to the terminals marked PHONES on terminal board E4, located on the rear of the chassis.

b. A portion of the keyed-tone signal is abstracted from a tap (terminal 5) on the secondary winding of input transformers T3, and it is applied to the grid of tube V3B. The amplifier uses degenerative feedback by omission of the usual bypass capacitor across cathode resistor R4. The output signal is applied through blocking capacitor C3 to MONITOR jack J1 and to the PHONES terminals.

47. Power Supply (V9) (fig. 20)

a. Full-wave rectifier tube V9 supplies d-c plate voltage to input amplifier V1, limiter-amplifier tube V3A, monitor amplifier V3B, d-c amplifier V4A, and d-c phase inverter V4B.

b. The external 115-volt 60-cycle power source connects to the primary windings of filament transformer T1 and power transformer T2 through fuse F1 and POWER ON-OFF switch S1. Winding W-W of filament transformer T1 provides 5 volts a-c to energize the filament of rectifier tube V9. The high-voltage secondary winding (terminal 4 and 9), of power transformer T2 supplies a-c voltage to the plates of rectifier tube V9. The center tap (terminal 5) of the high-voltage winding (B—) connects to the bleeder networks in the limiter-amplifier circuit (par. 42), the d-c amplifier circuit (par. 43*a*), and the d-c phase inverter circuit (par. 43*c*). A fourth bleeder network, consisting of resistor R25, NOISE REJECTOR potentiometer R30, and resistor R29, supplies cathode bias voltage to signal-rectifier V2A and V2B. The rectified +310-volt output of the rectifier is filtered by a pi-type network composed of capacitor C9A, inductance L1, and capacitors C9B and C11C.

48. Power Supply (V8) (fig. 20)

a. Rectifier V8, connected as a half-wave rectifier, supplies power to output amplifiers V5 and V6 and also to the load, when OUTPUT switch S4 is in SINGLE position. When OUTPUT switch S4 is in DOUBLE position, tube V8 supplies power to output amplifier V5 and, on mark signals, to the load.

b. One winding Y-Y of filament transformer T1 provides 5 volts a-c to energize the filament of rectifier tube V8. The plates of tube V8 connect to terminal 3 of a high-voltage secondary winding of power transformer T2. The other end (terminal 8) of the winding (B—) is connected through R6 to the ungrounded end of resistor R8. The +300-volt output of the rectifier is filtered by a pi-type network composed of capacitor C10A, inductance L2, and capacitor C10B. Bleeder resistor R24 is connected across the output of the filter.

49. Power Supply (V7) (fig. 20)

a. The output of rectifier V7, connected in the circuit as a half-wave rectifier, is disconnected from the other circuits of the amplifier when OUTPUT switch S4 is in SINGLE position. When OUTPUT switch S4 is in DOUBLE position, tube V7 supplies power to output amplifier V6 and, on space signals, to the load.

b. Winding Z-Z of filament transformer T1 provides 5 volts a-c to energize the filament of rectifier V7. The plates of V7 connect to one end of a high-voltage secondary winding of power transformer T2. The other end of the winding is grounded. The +300-volt rectified output is filtered by a pi-type network filter composed of capacitor C11A, inductance L3, capacitor C11B. Bleeder resistor R10 is connected across the output of the filter.

CHAPTER 5

FIELD MAINTENANCE INSTRUCTIONS

Note. This chapter contains information for field maintenance. The amount of repair that can be performed by units having field maintenance responsibility is limited only by the tools and test equipment available and by the skill of the repairman.

Section I. PREREPAIR PROCEDURES

50. Tools, Materials, and Test Equipment

Tools, materials, and test equipment needed for performing the prerepair procedures in this section are listed below.

Item	Sig C stock No.
Tool Equipment TE-113	6R38113
Solvent, Dry Cleaning (SD)	6G1914
Carbon tetrachloride	6G184
Electron Tube Test Set TV-2/U	3F3952-2

51. Removal of Pluck-out Parts

a. Removing Tubes. When the tubes (fig. 4) are cool, remove each tube by grasping the base and using a direct upward pull. Move the tube gently from side to side if it does not pull out easily. Never attempt to remove or jiggle the tube while holding the glass envelope. Label each tube so that it will be replaced in its proper socket.

b. Removing Fuses. Fuse F1 is located on terminal board E4 at the rear of the chassis. Turn the fuseholder cap counterclockwise and remove the fuseholder cap from its socket. Extract the fuse from the fuseholder cap.

52. Inspecting, Cleaning, and Testing Removed Parts

a. Inspecting, Cleaning, and Testing Tubes.

(1) *Inspecting.* Inspect each tube for cracks in the envelope, looseness between envelope and base, and bent or broken prongs.

(2) *Cleaning* Clean the tubes with a cloth moistened with solvent (SD). If necessary, clean the prongs with crocus cloth.

(3) *Testing.* Test the tubes for proper emission, leakage, and short circuits. Use Electron Tube Test TV-2/U or place doubtful tubes in an Amplifier AM-103B/U known to be operating properly.

b. Inspecting, Cleaning, and Testing Fuse.

(1) *Inspecting.* Inspect the fuse for evidences of burning, corrosion, and looseness.

(2) *Cleaning.* If necessary, clean the fuse ends with crocus cloth.

(3) *Testing.* Check the fuse for continuity.

53. Cleaning and Inspecting Chassis

a. Cleaning. Thorough cleaning of the amplifier chassis is necessary to insure optimum performance. Corrosion, dust, or rust can damage parts and cause arcing or low-resistance leakage between high-voltage points and ground. Remove loose dust with a brush. Remove dirt and grease on the chassis and parts with a brush or cloth moistened with solvent (SD). Clean the terminals on terminal board E4 with a small brush or cloth moistened with carbon tetrachloride.

Caution: Repeated contact of carbon tetrachloride with the skin or prolonged breathing of the fumes is dangerous. Make sure adequate ventilation is provided.

b. Inspecting. After the amplifier has been cleaned thoroughly and carefully, make a visual inspection of the parts for rust, corrosion, loose connections, frayed or burned insulation, loose screws, burned or charred resistors, and leaking electrolytic capacitors. Inspect tube sockets, potentiometers and switches for broken, loose or bent contacts and lugs. Inspect terminal board E4 for

loose or stripped screws, bent or broken lugs, and evidence of arcing or burning.

54. Reassembling the Equipment

a. Replace the tubes and fuses in their respective sockets.

b. Remount the amplifier on the relay rack.

c. Connect the power and communication lines to the terminal board E4 at the rear of the chassis (par. 13).

d. Replace the dust cover.

e. Begin with item 2, and perform the equipment performance test as described in paragraph 36.

Section II. TROUBLE-SHOOTING AT FIELD MAINTENANCE LEVEL

Warning: When servicing the amplifier, be extremely careful because of the high voltages exposed. Keep one hand in the pocket when measuring socket voltages with the probe. Before touching any part after the power is shut off, short-circuit the part to ground.

55. Trouble-shooting Procedures

The first step in servicing a defective equipment is to sectionalize the fault to the *component* responsible for the abnormal operation of the system. The second step is to localize the fault. Localization means tracing the fault to the defective *part* responsible for the abnormal condition. Some faults such as burned-out resistors, arcing, and short-circuited transformers often can be located by sight, smell, and hearing. The majority of faults, however, must be localized by checking voltages and resistances.

a. System Sectionalization. Amplifier AM-103B/U can be used in many system applications. For this reason, system sectionalization is beyond the scope of this manual.

b. Component Sectionalization and Localization. The tests listed below aid in isolating the source of trouble. To be effective, the procedure should be followed in the order given. Remember that servicing procedure should cause no further damage to the equipment. First, trouble should be localized to a single stage or circuit. Then the trouble may be isolated within that stage or circuit by appropriate voltage, resistance, and continuity measurements. The service procedure is summarized as follows:

(1) *Visual inspection.* The purpose of visual inspection (par. 34) is to locate any visible trouble. Through this inspection alone, the repairman frequently may discover the trouble, or determine the stage in which the trouble exists. This inspection is valuable in avoiding additional damage to the equipment which might occur through improper servicing methods and in forestalling future failures.

(2) *Checking key circuits for short circuits.* These measurements (par. 59) prevent further damage to the equipment from possible short circuits. Since this test gives an indication of the condition of the filter circuits, its function is more than preventive.

(3) *Operational test.* The operational test (par. 60) is important because it frequently indicates the general location of trouble. In many instances, the information gained will determine the exact nature of the fault. To utilize this information fully, all symptoms must be interpreted in relation to one another.

(4) *Trouble-shooting chart.* The trouble symptoms listed in this chart (par. 61) will aid greatly in localizing trouble.

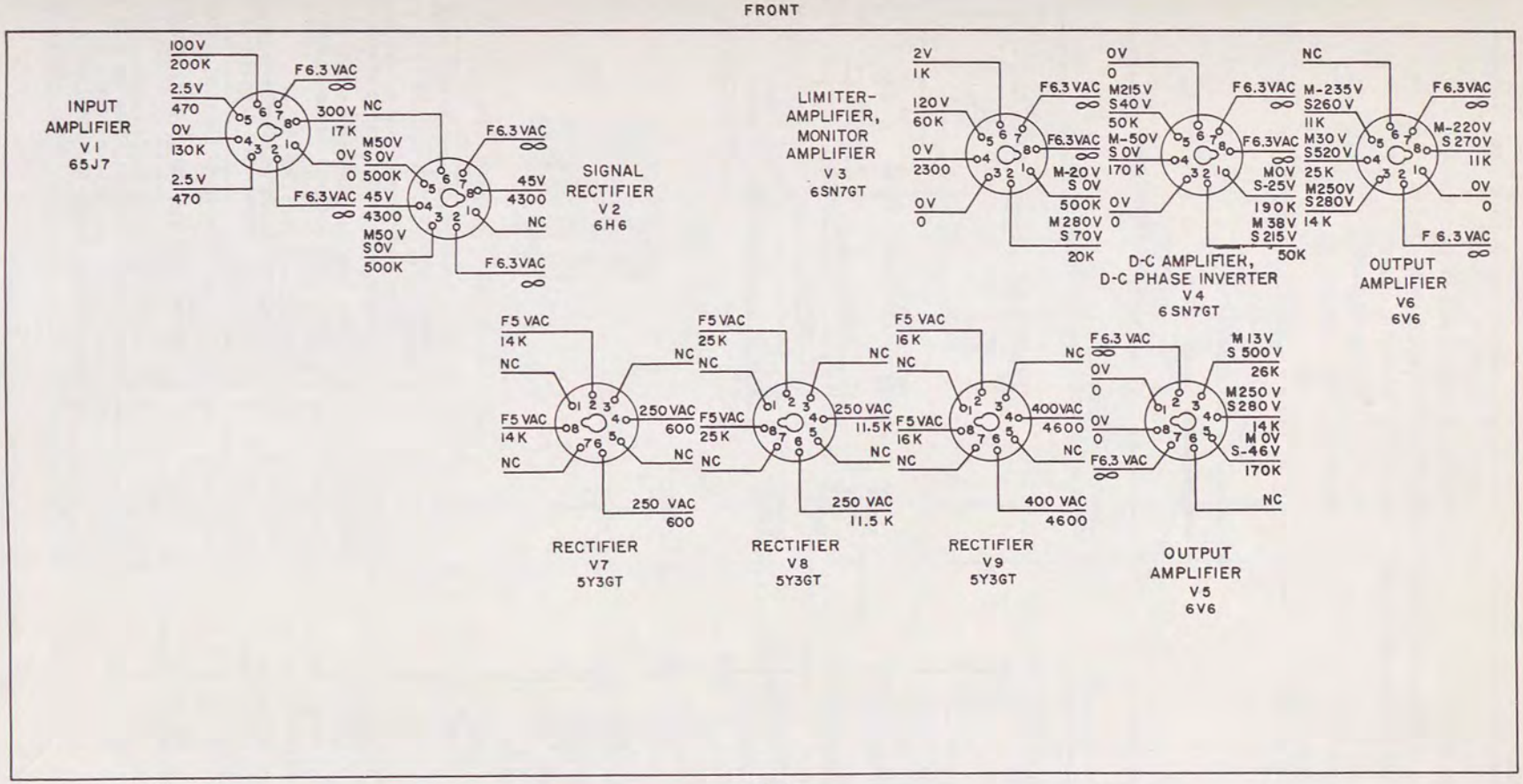
(5) *Intermittent faults.* In all these tests, the possibility of intermittent faults should not be overlooked. If present, this type of trouble often may be made to appear by tapping or jarring the suspected component.

56. Trouble-shooting Data

Caution:

Take advantage of the material supplied in this manual. It will help in the rapid location of faults. Consult the following trouble-shooting data:

Fig. or par. No.	Title
Fig. 4	Amplifier AM-103B/U, tube location diagram.
Par. 15	Location and function of controls.
Par. 36	Equipment performance checklist.
Fig. 9	Amplifier AM-103B/U, block diagram showing basic circuit and stages.
Par. 50	Tools and materials required for field maintenance.
Pars. 57 & 67	Test equipment required for trouble shooting and final testing, field maintenance level.

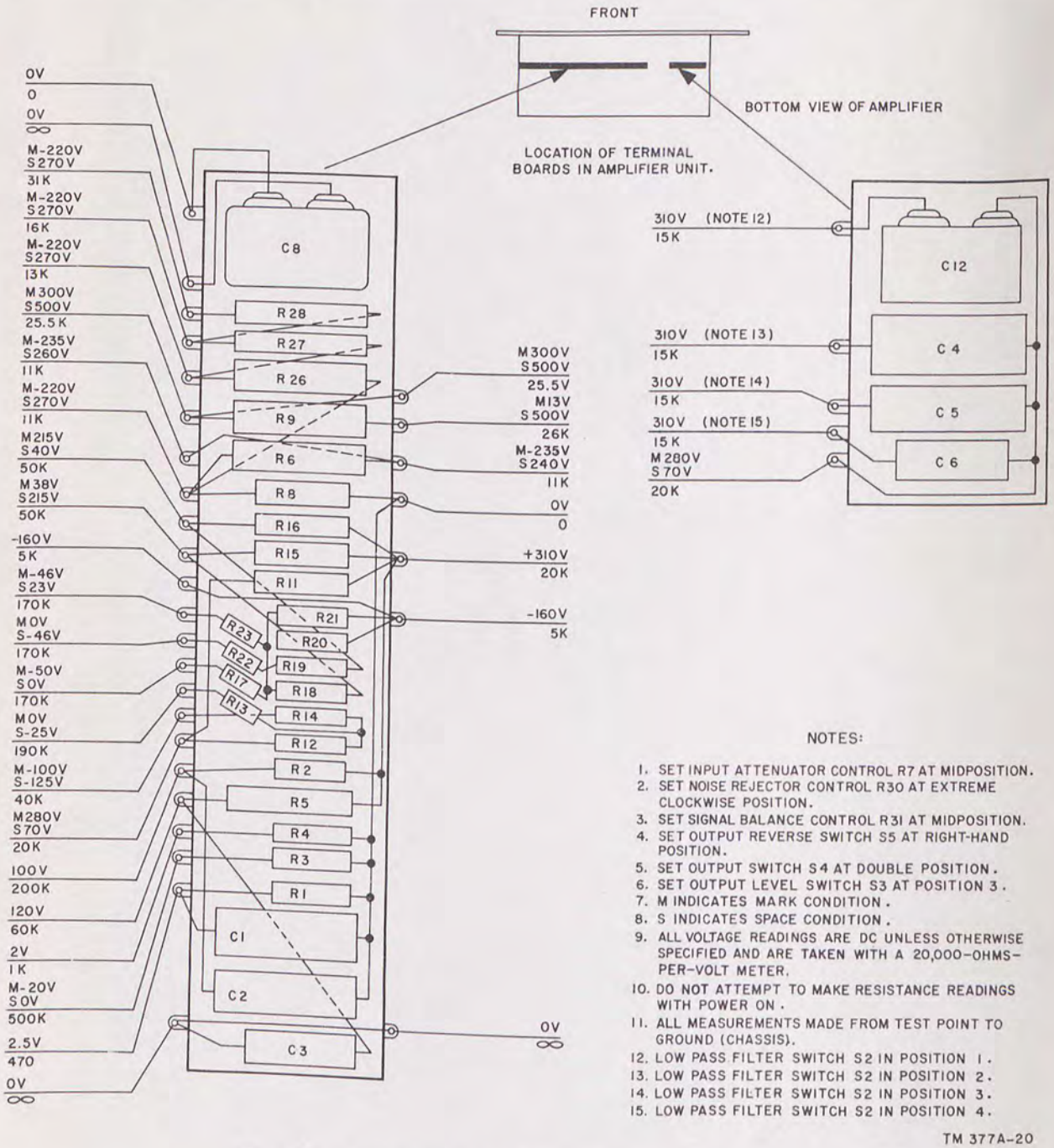


NOTES:

1. SET INPUT ATTENUATOR CONTROL R7 AT MIDPOSITION.
2. SET NOISE REJECTOR CONTROL R30 AT EXTREME CLOCKWISE POSITION.
3. SET SIGNAL BALANCE CONTROL R31 AT MIDPOSITION.
4. SET OUTPUT REVERSE SWITCH S5 AT RIGHT-HAND POSITION.
5. SET OUTPUT SWITCH S4 AT DOUBLE POSITION.
6. F INDICATES VOLTAGE MEASURED ACROSS FILAMENT PINS.
7. NC INDICATES NO CONNECTION.
8. M INDICATES MARK CONDITION.
9. S INDICATES SPACE CONDITION.
10. ALL VOLTAGE READINGS ARE DC UNLESS OTHERWISE SPECIFIED AND ARE TAKEN WITH A 20,000-OHMS-PER-VOLT METER.
11. DO NOT ATTEMPT TO MAKE RESISTANCE MEASUREMENTS WITH POWER ON.
12. ALL MEASUREMENTS MADE FROM TEST POINT TO GROUND (CHASSIS).

TM 377A-19

Figure 21. Tube socket voltage and resistance diagram.



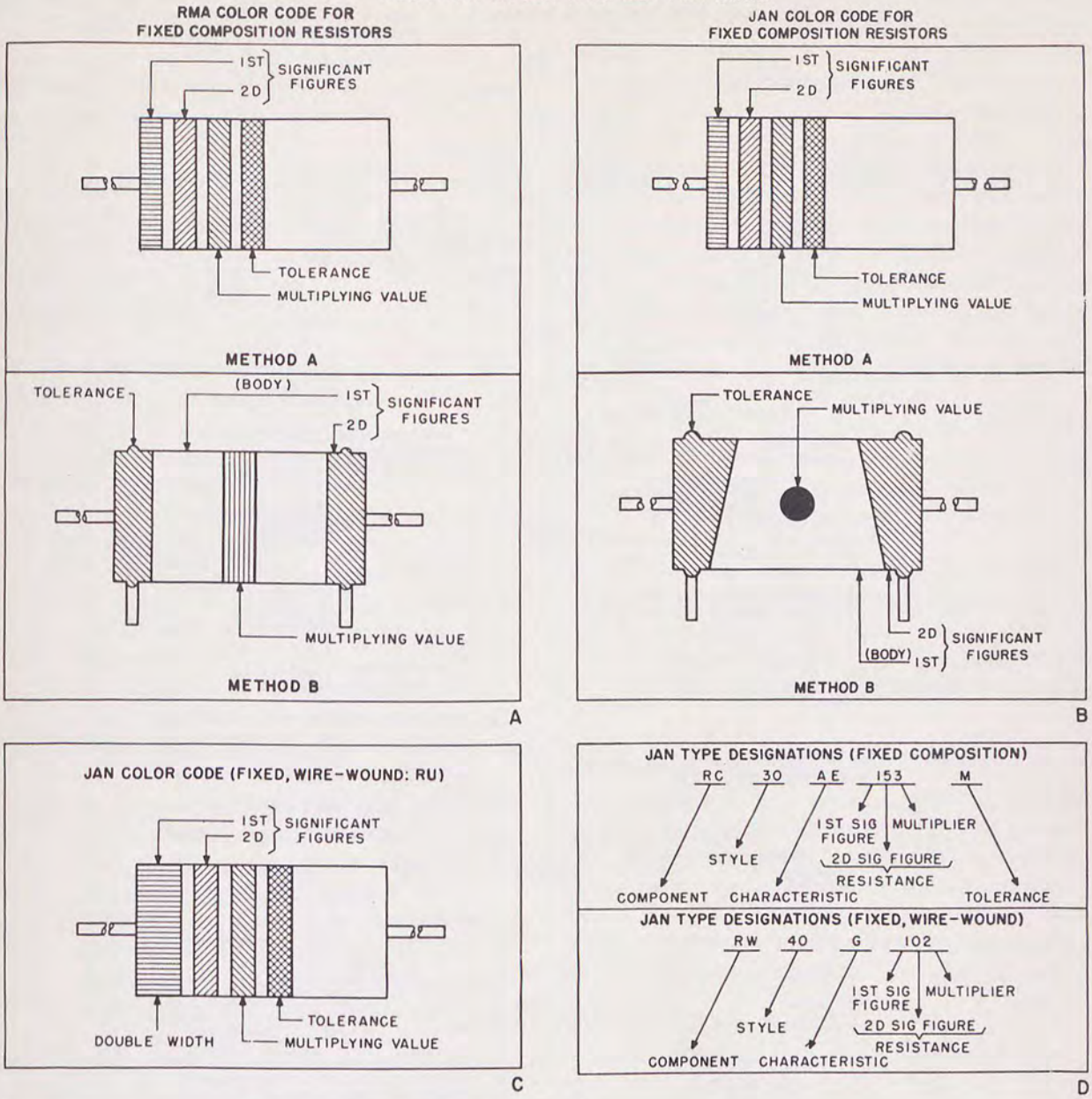
NOTES:

1. SET INPUT ATTENUATOR CONTROL R7 AT MIDPOSITION.
2. SET NOISE REJECTOR CONTROL R30 AT EXTREME CLOCKWISE POSITION.
3. SET SIGNAL BALANCE CONTROL R31 AT MIDPOSITION.
4. SET OUTPUT REVERSE SWITCH S5 AT RIGHT-HAND POSITION.
5. SET OUTPUT SWITCH S4 AT DOUBLE POSITION.
6. SET OUTPUT LEVEL SWITCH S3 AT POSITION 3.
7. M INDICATES MARK CONDITION.
8. S INDICATES SPACE CONDITION.
9. ALL VOLTAGE READINGS ARE DC UNLESS OTHERWISE SPECIFIED AND ARE TAKEN WITH A 20,000-OHMS-PER-VOLT METER.
10. DO NOT ATTEMPT TO MAKE RESISTANCE READINGS WITH POWER ON.
11. ALL MEASUREMENTS MADE FROM TEST POINT TO GROUND (CHASSIS).
12. LOW PASS FILTER SWITCH S2 IN POSITION 1.
13. LOW PASS FILTER SWITCH S2 IN POSITION 2.
14. LOW PASS FILTER SWITCH S2 IN POSITION 3.
15. LOW PASS FILTER SWITCH S2 IN POSITION 4.

TM 377A-20

Figure 22. Resistor-capacitor board voltage and resistance diagram.

RESISTOR COLOR AND LETTER CODE



STANDARDS				
COLOR	SIGNIFICANT FIGURE	MULTIPLYING VALUE	TOLERANCE (%)	JAN LETTER TOLERANCE
BLACK	0	1	–	–
BROWN	1	10	± 1	F
RED	2	100	± 2	G
ORANGE	3	1,000	± 3	–
YELLOW	4	10,000	± 4	–
GREEN	5	100,000	± 5	–
BLUE	6	1,000,000	± 6	–
VIOLET	7	10,000,000	± 7	–
GRAY	8	100,000,000	± 8	–
WHITE	9	1,000,000,000	± 9	–
GOLD	–	0.1	± 5	J
SILVER	–	0.01	±10	K
NO COLOR	–	–	±20	M

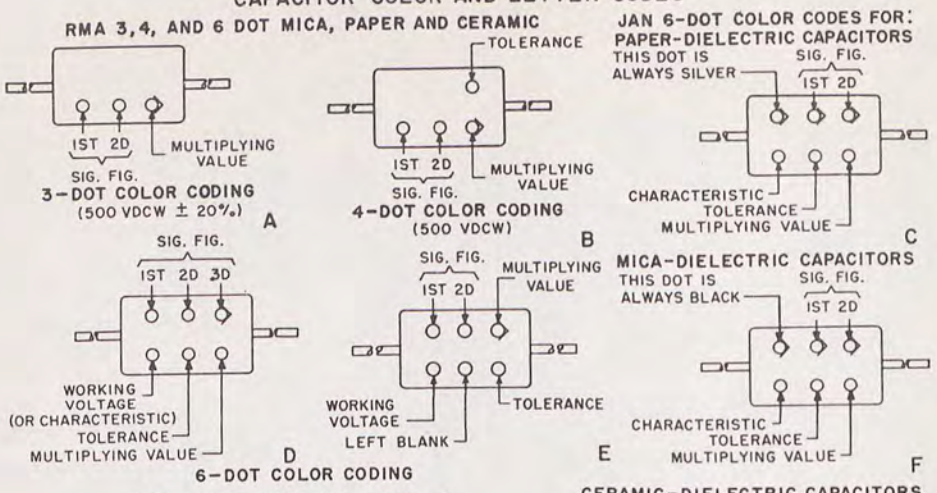
NOTES:

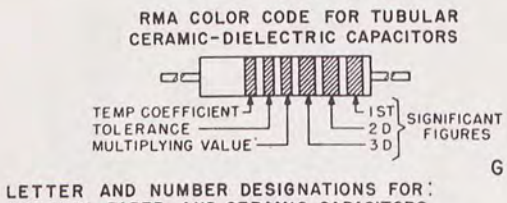
1. RESISTORS WITH AXIAL LEADS ARE INSULATED. RESISTORS WITH RADIAL LEADS ARE NON-INSULATED.
2. RMA: RADIO MANUFACTURERS ASSOCIATION.
3. JAN: JOINT ARMY - NAVY.
4. THESE COLOR AND NUMBER CODES GIVE ALL RESISTANCE VALUES IN OHMS.
5. RESISTIVE COMPONENTS USED FOR LETTER TOLERANCES ARE: RC, RN, AND RU.
6. WATTAGE FOR RW TYPES IS FOUND IN THE JAN SPECIFICATIONS UNDER CHARACTERISTICS.

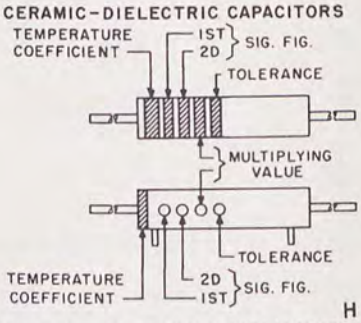
TM RC

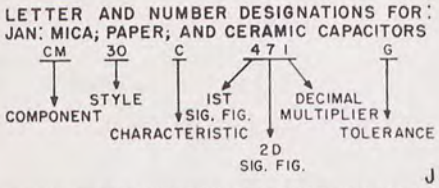
Figure 23. Resistor color and letter code.

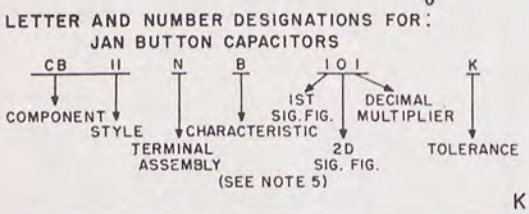
CAPACITOR COLOR AND LETTER CODES

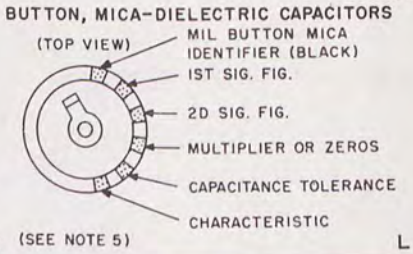












- STANDARDS -					JAN MICA-CM		JAN PAPER-CN		JAN CERAMIC-CC					
										CAP. TOL. FOR MORE THAN 10 UUF		CAP. TOL. FOR 10 UUF OR LESS		
COLOR	SIG. FIG.	DECIMAL MULTIPLIER	% TOL.	VDCW	LETTER TOL.	CHARAC-TERISTIC	LETTER TOL.	CHARAC-TERISTIC	DEC. MULT.	%	LETTER DESIG-NATION	UUF	LETTER DESIG-NATION	CHARAC-TERISTIC
BLACK	0	1	±20	500	M	A	M	.A	1	±20	M	±2.0	G	C
BROWN	1	10	± 1	100	-	B	-	E	10	± 1	F	-	-	H
RED	2	100	± 2	200	G	C	-	H	100	± 2	G	-	-	L
ORANGE	3	1,000	± 3	300	-	D	N*	J	1,000	-	-	-	-	P
YELLOW	4	10,000	± 4	400	-	E	-	P	-	-	-	-	-	R
GREEN	5	100,000	± 5	500	-	F	-	R	-	± 5	J	±0.5	D	S
BLUE	6	1,000,000	± 6	600	-	G	-	S	-	-	-	-	-	T
VIOLET	7	10,000,000	± 7	700	-	-	-	T	-	-	-	-	-	U
GRAY	8	100,000,000	± 8	800	-	-	-	-	0.01	-	-	±0.25	C	B
WHITE	9	1,000,000,000	± 9	900	-	-	-	-	0.1	± 10	K	±1.0	F	SL
GOLD	-	0.1	± 5	1,000	J	-	-	-	-	-	-	-	-	A
SILVER	-	0.01	±10	2,000	K	-	K	-	-	-	-	-	-	-
NO COLOR	-		±20	500	-	-	-	-	-	-	-	-	-	-

* THE TOLERANCE OF THIS CAPACITOR IS ±30%, NOT ±3%

NOTES

JAN: JOINT ARMY-NAVY
RMA: RADIO MANUFACTURERS ASSOCIATION

1. THESE COLOR AND LETTER CODES GIVE CAPACITANCES IN MICROMICROFARADS
2. THIS TABLE IS ADAPTED FOR JAN AND RMA COLOR AND JAN LETTER TYPE DESIGNATIONS
3. CERAMIC AND MICA CAPACITORS, BOTH JAN AND RMA, ARE GENERALLY 500 VDCW
4. BUTTON CAPACITORS ARE GENERALLY 300 VDCW
5. READ BUTTON CAPACITOR TOLERANCE UNDER CERAMICS OF MORE THAN 10 UUF
6. CHARACTERISTICS ARE AVAILABLE IN JAN CAPACITOR SPECIFICATION MANUALS
7. THE COMPONENTS USED ABOVE FOR JAN LETTER TYPE DESIGNATIONS ARE:
   CB MICA BUTTON: *CC* CERAMIC; *CM* MICA MOULDED: *CN* PAPER MOULDED

TM CC

Figure 24. Capacitor color and letter codes.

57. Test Equipment Required for Trouble Shooting

The test equipment required for trouble shooting is listed below. The technical manuals associated with the test equipment also are indicated.

Test equipment	Stock No. or technical manual
Electron Tube Test Set TV-2/U	3F3952-2
Multimeter TS-352/U	TM 11-5527
Signal Generator SG-15/PCM	TM 11-2096
Headset HS-20	4A920

58. General Precautions

Whenever the amplifier is serviced, observe the following precautions very carefully:

a. Be careful when making voltage measurements. Voltages up to 500 volts exist in the unit.

b. Careless replacement of parts often makes new faults inevitable. Note the following points:

(1) Before a part is unsoldered, note the position of the leads. If the part, such as a transformer, has a number of connections, tag each of the leads to it.

(2) Be careful not to damage other leads by pulling or pushing them out of the way.

(3) Do not allow drops of solder to fall into the set because they may cause short circuits.

(4) A carelessly soldered connection may create a new fault. It is important to make well-soldered joints, since a poorly soldered joint is one of the most difficult faults to find.

(5) When the power and communication lines are connected to the terminal board at the rear of the chassis, make sure that the leads do not short-circuit the adjacent terminals.

59. Checking Key Circuits for Short Circuits

a. Filament Circuits. The filaments of the tubes operate from power supplied by the secondary windings of filament transformer T1. The resistance of each secondary winding is less than 1 ohm; hence, the windings cannot be checked satisfactorily for short circuits with an ohmmeter. Visual inspection of the filament pins at the tube sockets and voltage measurements at the transformer taps will reveal the presence of short circuits in the filament circuits. The complete schematic diagram (fig. 28) indicates the voltages that should be obtained at the taps of transformer T1. The table in paragraph 62 contains complete resistance and voltage information for all coils and transformers.

b. High-voltage Circuits. Trouble within the amplifier often may be detected by checking the resistance of the high-voltage circuits to ground. Make the following tests at the tube sockets (fig. 21) before applying power to a unit that is known to be defective. Disconnect the power and communication lines from terminal board E4 before making these tests. If the resistance is zero or unusually low in any of the following measurements, remove the tube in the affected circuit and retest the circuit. If the short circuit is cleared, a breakdown has occurred within the tube. If the short circuit is not cleared, test each section of the associated filter capacitor.

(1) *V7 power supply.* The resistance between pin 8 of rectifier V7 and ground should be approximately 15,000 ohms. The resistance between pin 4 and ground should be 600 ohms.

(2) *V8 power supply.* The resistance between pin 8 of rectifier V8 and ground should be about 25,000 ohms. The resistance between pin 6 and ground should be about 11,500 ohms.

(3) *V9 power supply.* The resistance between pin 8 of rectifier V9 and ground should be approximately 16,000 ohms. The resistance between pin 4 and ground and also between pin 6 and ground should be about 4,600 ohms.

60. Operational Test

To determine if the amplifier is operating normally, follow the procedures listed in the equipment performance checklist (par. 36). This checklist is important because it frequently indicates the general location of trouble. Listen for crackling or buzzing noises, which indicate high-voltage arcing. Inspect the amplifier for smoke or the odor of burned or overheated parts.

61. Trouble-shooting Chart

The following chart is supplied as an aid in locating trouble in Amplifier AM-103B/U. This chart lists the symptoms that the repairman observes, either visually or audibly, while making a few simple tests. The chart also indicates how to localize trouble quickly to a particular circuit or stage. Once the trouble has been localized to a stage or circuit, inspection of tubes and voltage and resistance measurements of this stage or circuit ordinarily should be sufficient to isolate the defective part. Normal voltage and resistance measurements are given in figures 21 and 22. Refer to figures 25 and 27 for identification of components as seen from the top and bottom of the chassis respectively. Figures 23 and 24 show the resistor and capacitor color codes and should be used as an additional check in identifying the parts of Amplifier AM-103B/U. Figure 28 is a complete

schematic diagram of the equipment. Figure 29 is a wiring diagram that is useful when locating, testing, and replacing parts.

Notes.

1. Set INPUT ATTENUATOR, NOISE REJECTOR, and SIGNAL BALANCE controls to the middle of their ranges.

2. When performing the following tests, refer to notes in paragraph 37.

3. Unless otherwise specified, a 500-cycle tone signal from Signal Generator SG-15/PCM is to be applied to the INPUT terminals of terminal board E4 during the following tests. The input level should be between −20 and +20 dbm. The output level of Amplifier AM-103B/U is independent of the input level between these ranges.

Symptom	Probable trouble	Correction
1. Amplifier fails to operate and tubes do not light when POWER switch S1 is turned to the ON position.	*a.* Primary voltage supply is inoperative.	*a.* Check to see that supply voltage is 117 VAC, 60 cycles.
	b. Fuse F1 is open.	*b.* Replace fuse.
	c. Open primary winding of filament transformer T1.	*c.* With power removed, check resistance of primary (par. 62).
	d. Switch S1 is defective.	*d.* With power removed, check continuity of switch S1 in the ON position. Replace if necessary.
2. Tubes light, but high-voltage readings are low or zero.	Faulty power supplies or high-voltage secondaries of power transformer T2.	Test tubes V7, V8, and V9 and replace if necessary. Remove tubes V7, V8, and V9, and check high-voltage AC across secondaries of T2. Secondary winding connected to XV9 should measure 400 volts. Secondaries connected to XV7 and XV8 should read 250 volts. Replace tubes, turn power off, and proceed with continuity measurements until faulty part is detected.
3. High-voltage readings are normal. No signal is heard when headset is plugged into MONITOR jack J1.	*a.* No signal input.	*a.* Check Signal Generator SG-15/PCM (refer to TM 11-2096 for information on Signal Generator SG-15/PCM and Test Set TS-140/PCM).
	b. Transformer T3 is defective.	*b.* Take resistance measurements of windings of transformer T3 (par. 62). Replace if necessary.
	c. Faulty monitor amplifier V3.	*c.* Examine tube V3 and replace if defective.
	d. Headset is defective.	*d.* Check signal at MONITOR jack using another headset.
	e. Capacitor C3 or resistor R4 or R5 is defective.	*e.* Inspect capacitor C3 and resistors R4 and R5. If necessary, replace.
	f. Jack J1 is defective.	*f.* Check contact between jack J1 and plug of headset.
4. Signal heard at MONITOR jack J1, but voltage at pin 1 of tube V3A is zero.	*a.* Faulty input amplifier VI.	*a.* Examine tube VI and replace if defective.
	b. Faulty signal rectifier V2.	*b.* Examine tube V2 and replace if defective.
	c. Transformer T4 is defective.	*c.* Measure resistance of windings of transformer T4 (par. 62).
	d. Resistor R3 or potentiometer R30 is defective.	*d.* Inspect resistor R3 and potentiometer R30 and replace if necessary.

Symptom	Probable trouble	Correction
5. *a.* With tone signal applied to INPUT terminals, voltage is normal at pin 1 of tube V3 (greater than −25 volts), but voltage on grid of V4A is below cutoff.	*a.* Choke L4 is open; lowpass filter capacitor is short circuited; R11 is open; no plate supply voltage; R12 is open; V3A is defective.	*a.* Inspect L4, R11, R12, and R13, C4, C5, C6, C12, and V3. Replace defective parts.
b. With no input tone signal, voltage at pin 1 of V3 is zero (normal), but voltage at pin 1 of V4 is above cutoff.	*b.* Negative bias supply is defective; R13, R14, R25, or R31 is open or short circuited.	*b.* Inspect resistors R13, R14, R25, and R31. Replace defective parts.
6. *a.* With tone signal input applied to INPUT terminals, voltage on pin 1 of V4 is above cutoff, but voltage on pin 4 of V4 is also above cutoff.	*a.* Amplitude of input signal is insufficient; V4A is defective; R21 is open; R17 is open; pin 4 of V4B is short circuited to ground; negative bias supply is defective; R25 is open or short circuited.	*a.* Inspect resistors R17, R21, and R25, and tube V4. Replace defective parts.
b. With no input signal, voltage at pin 1 of V4 is above cutoff, and voltage at pin 1 is also above cutoff.	*b.* No plate supply voltage for V4B. Resistor R15, R16, or R18 is open or short circuited.	*b.* Inspect resistors R15, R16, and R18 and replace if necessary.
7. *a.* With tone signal applied to INPUT terminals and OUTPUT REVERSE switch S5 in left-hand position, voltage at pin 5 of V5 is above cutoff.	*a.* Input signal level is too low; resistor R23 is open; switch S5 is defective.	*a.* Measure level of input signal; inspect resistor R23 and switch S5 and replace if necessary.
b. With tone signal applied to INPUT terminals and OUTPUT REVERSE switch S5 in right-hand position, voltage at pin 5 of V5 is below cutoff.	*b.* Resistors R21, R19, and R16 are open. Tube V4 is defective. Switch S5 is defective.	*b.* Inspect resistors R21, R19, R16, tube V4, and switch S5. Replace defective parts.
8. *a.* Disconnect Signal Generator SG-15/PCM from INPUT terminals. Place S5 in left-hand position, S4 in the DOUBLE position, and S3 in position 4. Meter does not deflect toward the right.	*a.* Half-wave rectifier V8 is defective; R9 is open; V5 is defective; R6 or R8 is open or short circuited; switch S5 is defective. V5 screen supply (tube V7) is defective; external load is open; R26 is open; meter M1 is defective; switch S4 is defective.	*a.* Check tubes V5, V7, V8, resistors R6, R8, R9, R26, switches S4 and S5, meter M1, and external load. Replace defective parts.

Symptom	Probable trouble	Correction
b. With other controls set as in *a* above, throw OUTPUT REVERSE switch S5 to right-hand position. Meter does not deflect toward the left.	*b.* Output amplifier V6 is defective; rectifiers V7 and V8 are defective; R6 or R8 is open or short circuited; R26 is open; meter M1 is defective; switches S4 and S5 are defective; external load is open.	*b.* Check tubes V6, V7, V8, resistors R6, R8, R26, meter M1, switches S4 and S5, and external load. Replace defective parts.

62. Additional Trouble-shooting Information

The d-c resistance of coil windings, the a-c and d-c resistance of transformer windings, the measurements of mark and space signals are listed in the table that follows.

a. Read all notes given in the table before starting measurements.

b. Before taking measurements, disconnect all power and communication lines from terminal board E4 in the rear of the amplifier.

c. Use Signal Generator SG-15/PCM as a source for the 500-cycle tone as indicated in note 2 following the table.

d. Make all measurements with Multimeter TS-352/U.

Part	Voltage				Resistance	
	Measured between terminals	AC/DC	Measurement Mark	Measurement Space	Terminals	Ohms
L1	1 and ground	DC	320	310	1-2	500
	2 and ground	DC	300	295	—	—
L2	1 and ground	DC	41	520	1-2	250
	2 and ground	DC	29	520	—	—
L3	1 and ground	DC	250	280	1-2	250
	2 and ground	DC	240	270	—	—
T1	1-4	AC	117	117	1-4	4
	7-10	AC	5	5	7-10	Less than 1
	8-11	AC	5	5	8-11	Less than 1
	9-12	AC	5	5	9-12	Less than 1
	3-6	AC	6.3	6.3	3-6	Less than 1
	2-5 (not used)					
T2	4-5	AC	400	400	4-6	490
	5-6	AC	400	400	—	—
	3-8	AC	250	250	3-8	70
	2-7	AC	250	250	2-7	70
	1-9	AC	117	117	1-9	2.7
T3	1-2	AC	NM	NM	1-2	11
	4-5	AC	NM	NM	2-3	102
	5-6	AC	NM	NM	4-6	2100
T4	1 and ground	DC	300	300	1-2	1000
	2 and ground	DC	300	300	3-4	2000
	3 and ground	DC	−85	−85	4-5	2000
	4 and ground	DC	−85	−85	—	—
	5 and ground	DC	−85	−85	—	—

Notes.

1. All readings are taken with a 20,000-ohms-per-volt meter set at the range that gives a reading nearest mid-scale.

2. Measurements under mark conditions are made with a 500-cycle tone applied to the INPUT terminals at an input level of −20 db.

3. Terminal numbers for transformers are as indicated on the schematic diagram (fig. 28).

4. Set controls as follows:

Control	*Position*
INPUT ATTENUATOR	Midrange
NOISE REJECTOR	Midrange
SIGNAL BALANCE	Midrange
LOW PASS FILTER	1
OUTPUT REVERSE	Right-hand
OUTPUT LEVEL	1
OUTPUT	DOUBLE

Section III. REPAIR

63. Replacement of Parts

To replace the tubes of Amplifier AM-103B/U, turn the two Dzus fasteners on the front panel a quarter-turn counterclockwise and take off the removable section. To replace other parts of the amplifier, take off the dust cover with a direct backward pull and remove the unit from its mounting rack. If the replacement of a part requires the disconnection of numerous wires, carefully mark the wires connected to the part with tags or other devices to avoid misconnection when the new part is installed. The wiring diagram (fig. 29) shows the color coding of the wires.

64. Refinishing

Instructions for refinishing badly marred panels are given in TM 9-2851. Rustproofing instructions for metal parts are given in TB SIG 23.

65. Alinement

The circuits of Amplifier AM-103B/U do not require special alinement procedures. Procedure for final testing and equipment required is described in section 4.

Section IV. FINAL TESTING

66. General

This section is intended as a guide to be used in determining the quality of a repaired Amplifier AM-103B/U. The minimum test requirements outlined in paragraph 68 below shall be met by maintenance personnel with adequate test equipment and the necessary skills. Repaired equipment meeting these requirements will furnish uniformly satisfactory operation.

67. Test Equipment Required for Final Testing

The equipment required for the final testing of Amplifier AM-103B/U is listed below.

Oscilloscope OS-8A/U.
Signal Generator SG-15/PCM (TM 11-2096).
Telegraph key or pushbutton SPST switch.
Resistors, 1-watt or larger, one each of the following values:
  1,000 ohms
  25,000 ohms
Capacitor, paper, 600 WVDC, .1 UF.
Reactor, 10-30 henries inductance.

68. Tests

a. Output Current. The purpose of the following test is to insure that the output current of a repaired Amplifier AM-103B/U is of sufficient amplitude under various load conditions to prevent erratic operation of the driven equipment.

(1) Connect Signal Generator SG-15/PCM to the INPUT terminals on terminal board E4 at the rear of the chassis. Set the signal generator for 500 cps; set the input level at approximately −20 db.

(2) Set the INPUT ATTENUATOR R7, the NOISE REJECTOR R30, and the SIGNAL BALANCE control R31 of the amplifier to the middle of their ranges. Set LOW PASS FILTER switch S2 to position 1. Set OUTPUT REVERSE switch S5 to the left-hand position.

(3) Connect the 100-ohm resistor across the OUTPUT terminals of terminal board E4. Set OUTPUT switch S4 to the SINGLE position. Turn POWER switch S1 to the ON

position and allow the equipment to reach operating temperature. Observe the meter reading in each position of OUTPUT LEVEL switch S3 and compare it with the corresponding reading in the table below. Place OUTPUT switch S4 in the DOUBLE position and repeat the procedure. After performing this procedure with the 1K resistor connected across the OUTPUT terminals, connect the 25K resistor and compare the meter readings obtained with those shown in the table.

Resistance across OUTPUT terminals (ohms)	Meter M1 readings (ma)							
	Position of OUTPUT switch							
	SINGLE				DOUBLE			
	Position of OUTPUT LEVEL switch				Position of OUTPUT LEVEL switch			
	1	2	3	4	1	2	3	4
1K	10	35	70	70	8	28	45	75
25K	4	8	9	9	4	6	7	8

(4) If the readings obtained are less than 80 percent of those given in the table, test output amplifier tubes V5 and V6 for low emission. If low readings are obtained in only one position of OUTPUT LEVEL switch S3, check the components associated with that position of the OUTPUT LEVEL switch (fig. 19).

b. Waveshape Test. The purpose of the following test is to insure that the output waveshapes of the amplifier conform to the requirements of the equipment that it is driving.

(1) Connect one lead of Signal Generator SG-15/PCM to one INPUT terminal on terminal board E4 and the other lead to one terminal of the telegraph key or pushbutton switch. Connect the other terminal of the key or switch to the second INPUT terminal. Set Signal Generator SG-15/PCM for 1-kc output at a level between −20 and +20 dbm.

(2) Set the INPUT ATTENUATOR, NOISE REJECTOR, and SIGNAL BALANCE controls of the amplifier to the middle of their ranges. Set the LOW PASS FILTER switch to position 1, the OUTPUT REVERSE switch to the left-hand position, and the OUTPUT switch to the DOUBLE position.

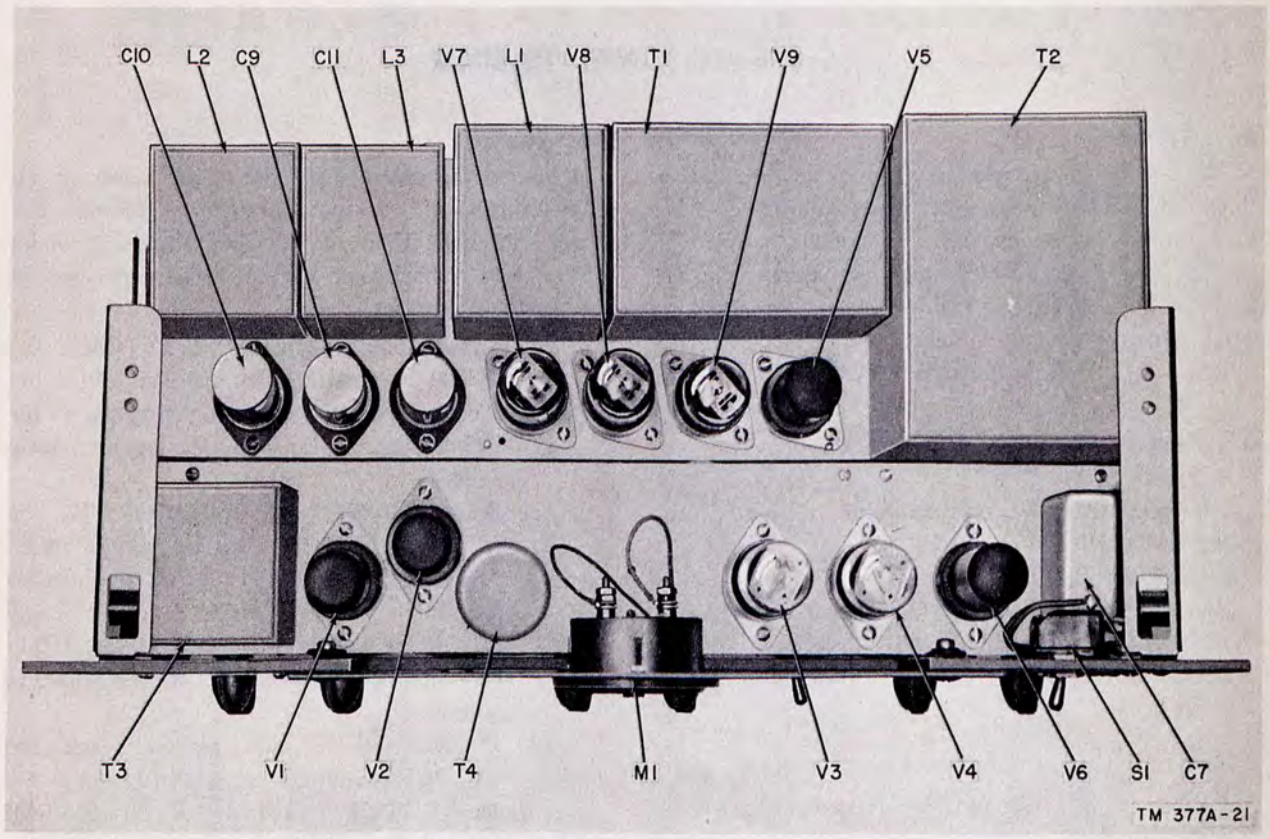


Figure 25. Amplifier AM-103B/U, top view.

(3) Connect the reactor to the OUTPUT terminals on terminal board E4.

(4) Connect the vertical binding posts of Oscilloscope OS-8A/U to the OUTPUT terminals of the amplifier. Place the .1-uf capacitor in series with the ungrounded lead. Set the sweep

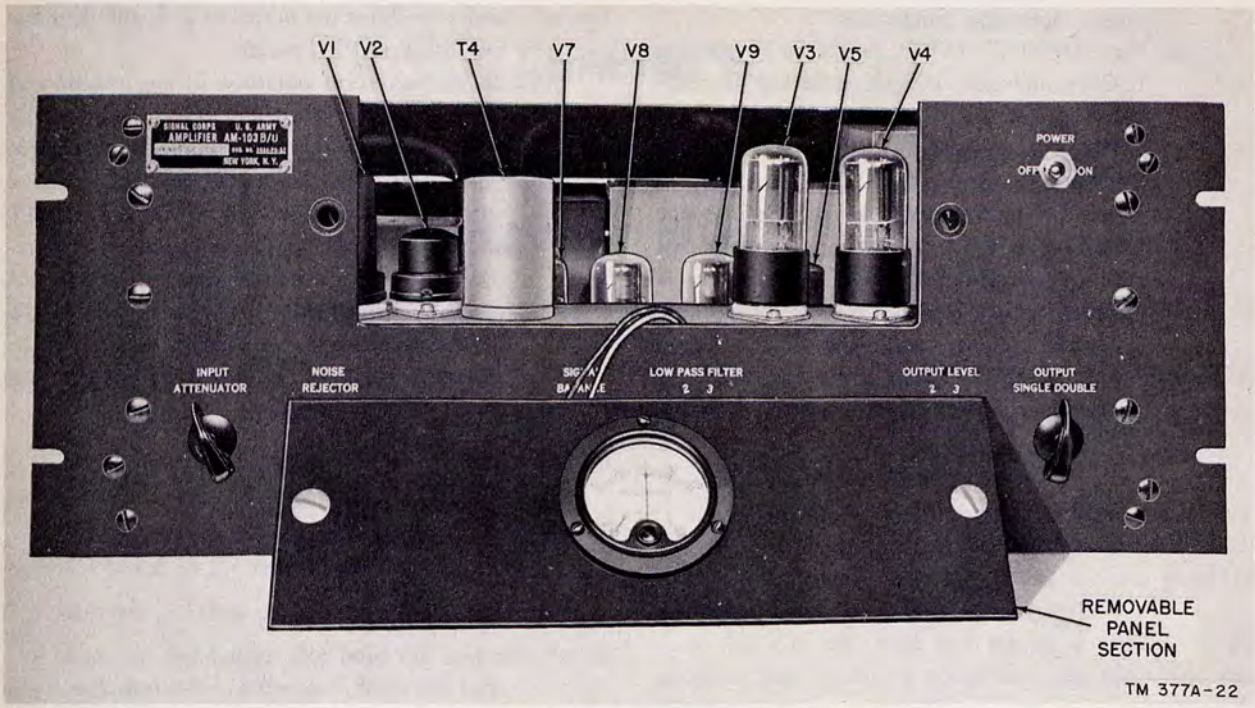


Figure 26. Amplifier AM-103B/U, front panel section removed.

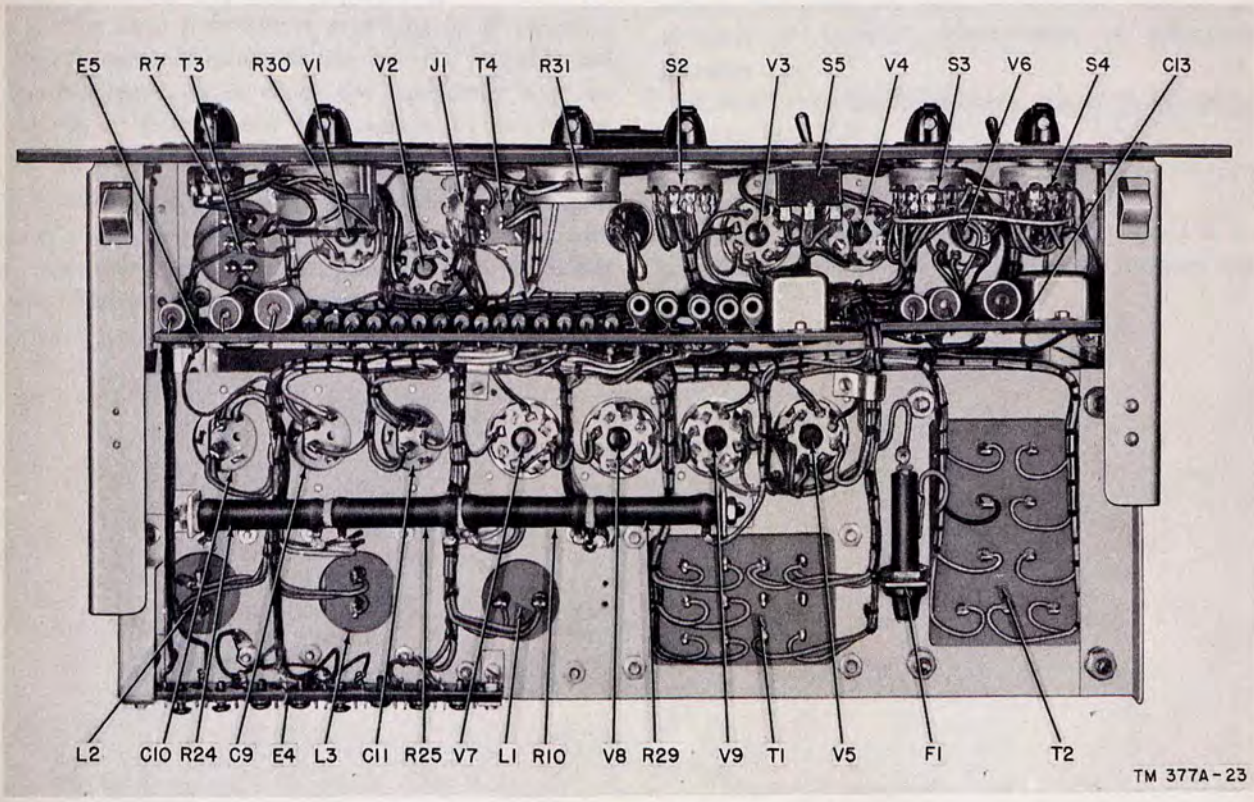


Figure 27. Amplifier AM-103B/U, bottom view.

frequency of Oscilloscope OS-8A/U between 16 and 20 cps.

(5) Turn POWER switch S1 of the amplifier to the ON position and allow it to reach the proper operating temperature.

(6) Place OUTPUT LEVEL switch S3 in position 1. Open and close the telegraph key or push-button switch three or four times a second and observe the waveform that appears on the oscilloscope.

Note. The waveform on the Oscilloscope OS-8A/U will be imperfectly synchronized with the horizontal sweep, because it is manually keyed. However, it will be possible to obtain a clear indication of the keyed waveform if the manual keying speed is varied slightly.

(7) Compare the waveshape obtained with that shown in fig. 19 for position 1 of OUTPUT LEVEL switch S3.

(8) Repeat the procedure in subparagraphs (6) and (7) above for positions 2, 3, and 4 of the OUTPUT LEVEL switch.

(9) If the waveform obtained in any position of OUTPUT LEVEL switch S3 is substantially different from the corresponding waveform in fig. 19, check the components associated with that position of the OUTPUT LEVEL switch. For high-speed operation of ink recorders, it is important that the waveform obtained in position 4 of the OUTPUT LEVEL switch S3 be sharply peaked at its leading edge.

CHAPTER 6

SHIPMENT, LIMITED STORAGE, AND DEMOLITION TO PREVENT ENEMY USE

69. Removing From Service

a. Remove the dust cover from the rear of the unit.

b. Disconnect the power line from the terminal board in the rear of the unit.

c. Disconnect all the communication lines from the terminal board in the rear of the unit.

d. Replace the dust cover on the unit.

e. Remove the screws that hold the amplifier to the relay rack and remove the unit from the rack.

70. Disassembly and Repacking

a. The exact procedure in repacking for shipment or limited storage depends on the material available and the conditions under which the equipment is to be shipped or stored. Refer to paragraph 11 and reverse the instructions given in that paragraph.

b. Whenever practicable, place a dehydrating agent such as silica gel inside the crate. Protect the crate with a waterproof barrier. Seal the seams of the paper barrier with waterproof sealing compound or tape. Pack the protected crate in a padded wooden case, providing at least three inches of excelsior padding or some similar material between the paper barrier and the packing case.

71. Methods of Destruction

a. Smash. Smash the controls, tubes, switches, capacitors, and transformers, and all other equipment associated with the amplifiers; use sledges, axes, pickaxes, hammers, crowbars, or other heavy tools.

b. Cut. Cut all cords and wiring connected to the amplifier and associated equipment; use axes, handaxes, or machetes.

c. Burn. Burn the wooden packing case, corrugated cartons, and protective material, technical manual; use gasoline, oil, kerosene, flamethrowers, or incendiary grenades.

d. Bend. Bend panels, switches, chassis, power plugs, and tube terminals.

e. Explosives. If explosives are necessary, use firearms, grenades, or TNT.

f. Disposal. Bury or scatter the destroyed parts in slit trenches, foxholes or other holes, or throw the parts into streams.

g. Destroy. Destroy everything.

APPENDIX

REFERENCES

1. Army Regulations

AR 380–5	Military Security (Safeguarding Security Information).
AR 750–5	Maintenance of Supplies and Equipment (Maintenance Responsibilities and Shop Operation).

2. Supply Bulletins

SR 725–405–5	Preparation and Submission of Requisitions for Signal Corps Supplies.

3. Test Equipment

TM 11–2096	Signal Generator SG-15/PCM.
TM 11–4700	Electrical Indicating and Measuring Instruments. Repair Instructions.
TM 11–5500	Multimeter TS-297/U.
TM 11–5527	Multimeter TS-352/U.

4. Painting, Preserving, and Lubrication

TB SIG 13	Moistureproofing and Fungiproofing Signal Corps Equipment.
TM 9–2851	Painting Instructions for Field Use.

5. Camouflage, Decontamination, and Demolition

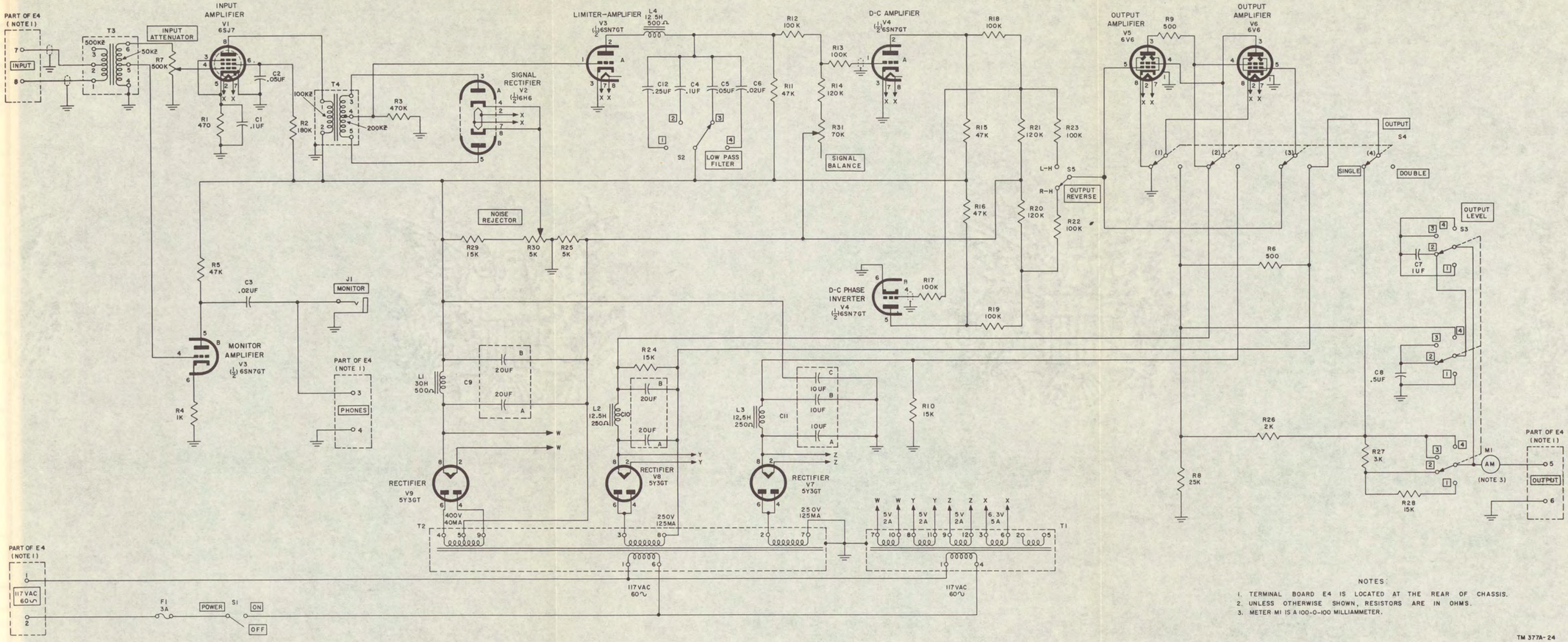
FM 5–20	Camouflage, Basic Principles.
FM 5–25	Explosives and Demolitions.
TM 3–220	Decontamination.

6. Other Publications

FM 72–20	Jungle Warfare.
SR 310–20–4	Index of Training Publications.
SR 310–20–4	Index of Technical Manuals, Technical Regulations, Technical Bulletins, Supply Bulletins, Lubrication Orders, and Modification Work Orders.
SR 310–20–5	Index of Administrative Publications.
SR 700–45–5 AFR 65–26	Unsatisfactory Equipment Report (Reports Control Symbol CSGLD-247).
SR 745–45–5 Navy Shipping Guide Article 1850–4 AFR 71–4	Report of Damaged or Improper Shipment (Reports Control Symbols CSGLD-66 (Army), SandA 70-6 (Navy), and AF-MC-U2 (Air Force)).
TB SIG 4	Methods for Improving the Effectiveness of Jungle Radio Communication.
TB SIG 25	Preventive Maintenance of Power Cords.
TB SIG 66	Winter Maintenance of Signal Equipment.
TB SIG 72	Tropical Maintenance of Ground Signal Equipment.
TB SIG 75	Desert Maintenance of Ground Signal Equipment.
TB SIG 123	Preventive Maintenance Practices for Ground Signal Equipment.

TB SIG 219	Operation of Signal Equipment at Low Temperatures.
TB SIG 223	Field Expedients for Wire and Radio.
TM 11–483	Suppression of Radio Noises.
TM 11–486	Electrical Communication Systems Engineering.
TM 11–661	Electrical Fundamentals (Direct Current).
TM 11-664	Theory and use of Electronic Test Equipment.
TM 11–681	Electrical Fundamentals (Alternating Current).

INDEX



NOTES:

1. TERMINAL BOARD E4 IS LOCATED AT THE REAR OF CHASSIS.
2. UNLESS OTHERWISE SHOWN, RESISTORS ARE IN OHMS.
3. METER M1 IS A 100-0-100 MILLIAMMETER.

TM 377A-24

Figure 28. Amplifier AM-103B/U, schematic diagram.

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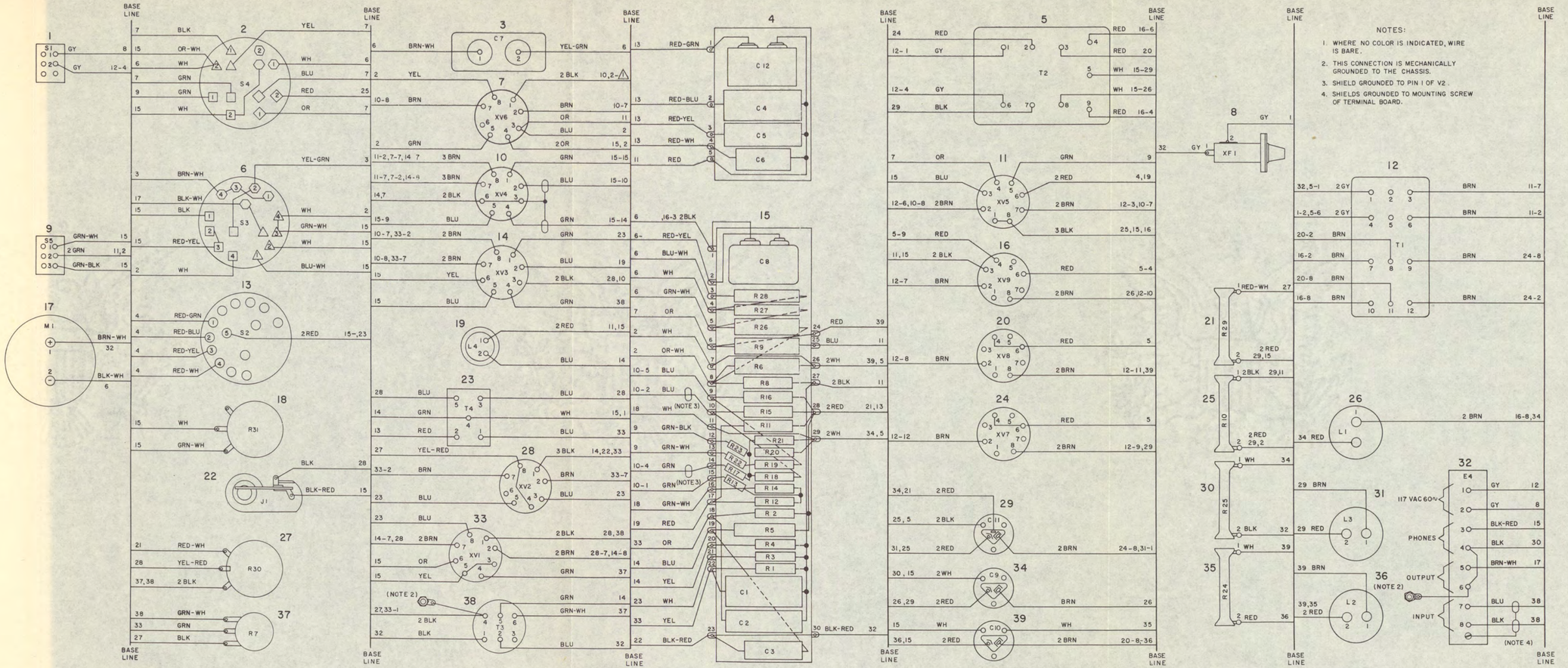

Figure 29. Amplifier AM-103B/U, wiring diagram.

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[AG 413.47 (26 Mar 54)]

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