RESTRICTED

SERIAL NO. 2851

INSTRUCTION BOOK

FOR

NAVY MODEL RAL-8

RADIO RECEIVING EQUIPMENT

ADDENDA SHEET
RAL-8 INSTRUCTION BOOK

CHANGE A

Pages 48 and 53

Symbol R-203. Change description to read: 6200 ohms ±5%, 3 watt, composition, pigtail. Delete Navy Type Number. Change Magnavox Drawing Number to B230077G178.

Symbol R-204. Delete Navy Type Number

Page 51

Symbol R-203, R-204. Delete Navy Type Number.

(Change A is incorporated in CMX-20131-A power units, serials 810 to 3000 inclusive).

FORM EL-546
MARCH, 1944

Manufactured For

U. S. NAVY DEPARTMENT BUREAU OF SHIPS

By

The Magnavox Company
FORT WAYNE, INDIANA

CONTRACT: NXss-21827

DATE OF CONTRACT: 14 JANUARY, 1943

FORM EL 531 — LITHO IN U.S.A.

WARNING

OPERATION OF THIS EQUIPMENT INVOLVES THE USE OF HIGH VOLTAGES WHICH ARE DANGEROUS TO LIFE. OPERATING PERSONNEL MUST AT ALL TIMES OBSERVE ALL SAFETY REGULATIONS. DO NOT CHANGE TUBES OR MAKE ADJUSTMENTS INSIDE EQUIPMENT WITH HIGH VOLTAGE SUPPLY ON. DO NOT DEPEND UPON DOOR SWITCHES OR INTERLOCKS FOR PROTECTION BUT ALWAYS SHUT DOWN MOTOR GENERATORS OR OTHER POWER EQUIPMENT. UNDER CERTAIN CONDITIONS DANGEROUS POTENTIALS MAY EXIST IN CIRCUITS WITH POWER CONTROLS IN THE OFF POSITION DUE TO CHARGES RETAINED BY CAPACITORS, ETC. TO AVOID CASUALTIES ALWAYS REMOVE POWER, DISCHARGE AND GROUND CIRCUITS PRIOR TO TOUCHING THEM.
THE ATTENTION OF OFFICERS AND OPERATING PERSONNEL IS DIRECTED TO BUREAU OF SHIPS MANUAL OF ENGINEERING INSTRUCTIONS, CHAPTER 31 (MIMEOGRAPHED FORM) OR SUBSEQUENT REVISIONS THEREOF ON THE SUBJECT OF "RADIO — SAFETY PRECAUTIONS TO BE OBSERVED."

CONTRACTURAL GUARANTEE

The equipment including all parts and spare parts, except vacuum tubes, shall be guaranteed for a service period of one year with the understanding that, as a condition of this contract, all items found to be defective as to design, material, workmanship or manufacture shall be replaced without delay and at no expense to the Government, provided that such guarantee and agreement shall not obligate the contractor to make replacement of defective material unless the failure, exclusive of normal shelf life deterioration, occurs within a period of two years from the date of delivery of the equipment to and acceptance by the Government, and provided further, that if any part or parts (except vacuum tubes) fail in service or are found defective in ten per cent (10 per cent) or more, but not less than two, of the total number of equipments furnished under the contract, such part or parts, whether supplied in the equipment or as spares, shall be conclusively presumed to be of defective design, and as a condition of contract subject to one hundred per cent (100%) replacement of all similar units supplied on subject contract by suitable redesigned replacements. Failure due to poor workmanship while not necessarily indicating poor design, will be considered in the same category as failure due to poor design. Redesigned replacements which will assure proper operation of the equipment shall be supplied promptly, transportation paid, to the Naval activities using such equipment, upon receipt of proper notice and without cost to the Government. All defective parts originally furnished under contract shall be held subject to rejection and return to the contractor.

THIS PERIOD OF TWO YEARS AND THE SERVICE PERIOD OF ONE YEAR SHALL NOT INCLUDE ANY PORTION OF THE TIME THAT THE EQUIPMENT FAILS TO GIVE SATISFACTORY PERFORMANCE DUE TO DEFECTIVE ITEMS AND THE NECESSITY FOR REPLACEMENT THEREOF, AND PROVIDED FURTHER, THAT ANY REPLACEMENT PART SHALL BE GUARANTEED TO GIVE ONE YEAR OF SATISFACTORY SERVICE.

INDEX

INDEX—(Continued)

ILLUSTRATIONS

Figure

DRAWINGS

REPORT OF FAILURE

Report of failure of any part of this equipment, during its service life, shall be made to the Bureau of Ships in accordance with current instructions. The report shall cover all details of the failure and give the date of installation of the equipment. For procedure in reporting failures see Chapter 31 (mimeographed form) of the Manual of Engineering Instructions, or Bureau of Ships Radio and Sound Bulletin Number 7, dated July 1, 1942, or superseding instructions.

Contract: NXss-21827 Date of Contract: 14 January, 1943

Serial Number of Equipment _____

Date of Acceptance by the Navy _____

Date of Delivery to Contract Destination _____

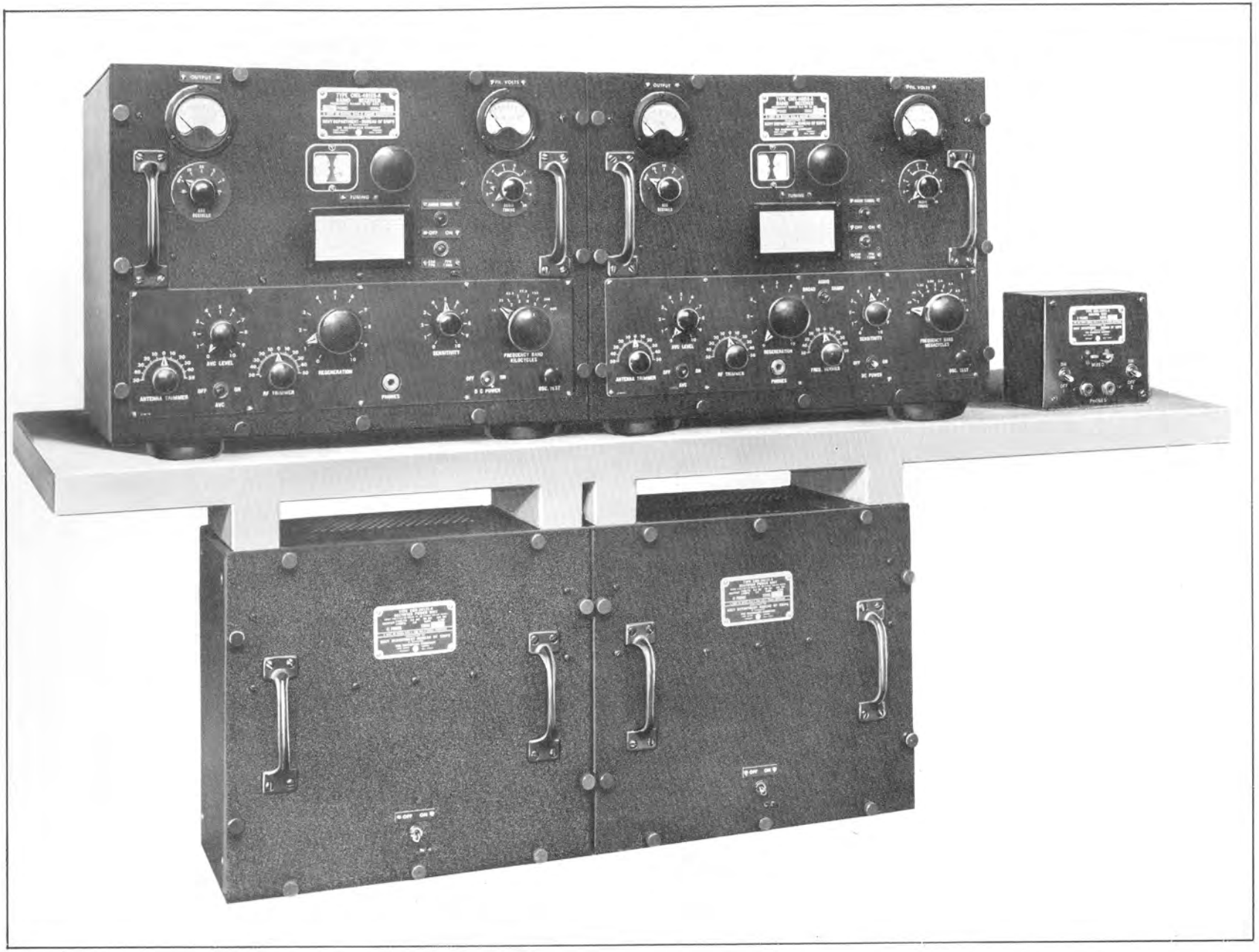
Date of Completion of Installation _____

Date Placed in Service _____

Blank spaces in this book shall be filled in at time of installation. Operating personnel shall also mark the "date placed in service" on the date plate located below the model nameplate on the equipment, using suitable methods and care to avoid damaging the equipment.

All requests or requisitions for replacement material should include complete descriptive data covering the part desired, in the following form:

1. Name of part desired.
2. Navy Type number (if assigned) including prefix and suffix as applicable.
3. Model designation (including suffix) of equipment in which used.
4. Navy Type designation (including prefix and suffix where applicable) of major unit in which part is used.
5. Symbol designation of part.
6. (a) Navy Drawing Number.
   (b) Manufacturer's Drawing Number.
7. Rating or other descriptive data.
8. Commercial designation.



Frontispiece—Model RAL Equipment mounted with a Model RAK Equipment

RESTRICTED

This instruction book is furnished for the information of commissioned, warranted, enlisted and civilian personnel of the Navy whose duties involve design, instruction, operation and installation of radio and sound equipment. The word "RESTRICTED" as applied to this instruction book, signifies that this instruction book is to be read only by the above personnel, and that the contents of it should not be made known to persons not connected with the Navy.

I
INTRODUCTION

1.1 THESE INSTRUCTIONS SHOULD BE READ AND STUDIED WITH GREAT CARE BEFORE THE INSTALLATION OR OPERATION OF THIS EQUIPMENT IS ATTEMPTED IN ORDER THAT OPTIMUM PERFORMANCE MAY BE OBTAINED.

1.2 These instructions cover the installation, operation, and servicing of the Model RAL-8 Radio Receiving Equipment. This receiving equipment is designed for a-c operation, being equipped with a power unit for supplying all operating voltages required from an a-c source of 110, 115, or 120 volts, 60 cycles, 1 phase.

1.3 This equipment covers the frequency range of 0.3-23.0 megacycles and is designed for optimum performance for the reception of pure, modulated or interrupted CW, damped radio telegraph signals, or voice-modulated CW. The output circuit is designed for use with one pair of 600-ohm phones.

1.4 The RAL Series equipment is designed for independent operation but is so designed with respect to size, shape and mechanical arrangement as to permit installation adjacent to an RAK Series equipment forming a complete two-channel equipment suitable for guarding two frequencies simultaneously by one operator. A separate control unit, Type CMX-23073-A, may be used for this installation to provide greatest flexibility of operation. This unit is described in a subsequent section of this instruction book.

II
EQUIPMENT

2.1 Each equipment consists of the following major component units:
(a) Receiver Unit, Type CMX-46156-A.
(b) Power Unit, Type CMX-20131-A.
(c) Control Unit, Type CMX-23073-A. (Not furnished with Model RAK Series Equipment.)

2.2 In addition to the major units, each complete equipment includes the following items:
(a) Spare parts box, containing spares for major units.
(b) Cables, as follows:

Item	*Quan.*	*Description*	*Dwg. No.*
W-101	1	Cable, output, 2-conductor, shielded	B460246
W-102	1	Cable, output of filter to receiver	B460247
W-201	1	Cable, power, 4-conductor, shielded	C460245
W-301	2	Cable, A-C supply, 2-conductor	B460248

(c) Shock absorbers, as follows:

Item	*Quan.*	*Description*	*Dwg. No.*
SA-101 A	4	Shock absorber, upper portion, 1⅛" thick	A102064G1
SA-101 B	4	Shock absorber, lower portion, ½" thick	A102064G2

(d) Miscellaneous mounting hardware, as follows:

Item	*Quan.*	*Description*	*Dwg. No.*
H-101	4	Bolt, ½"-13, 3½" long, hex. head	A102067
H-102	4	Washer, flat, 2" O.D., 9/16" I.D., 0.1285" thick	A101831G39
H-103	8	Nut, ½"-13, hexagonal	A105141G5

Note: All necessary hardware for interlocking the receiver and power units of the Models RAK and RAL Equipments are furnished only with the Model RAK.

III
TUBE COMPLEMENT

3.1 The following Navy standard vacuum tubes are required for each equipment:

4—Type -6D6 R-F Amplifiers, Detector and Audio.
2—Type -41 Output and AVC.
1—Type -5Z3 Rectifier.
1—Type -874 Voltage Regulator.
1—Type -876 Current Regulator.

IV
POWER REQUIREMENTS

4.1 Normal Operation.

4.1–1 The receiver is designed to operate from a 110-, 115-, or 120-volt, 60-cycle, single-phase, a-c supply with a fast and slow voltage variation not exceeding ±10%.

4.1–2 The total power consumption of the RAL Series equipment is approximately 200 watts.

NOTE: THE RAL EQUIPMENT SHOULD *NOT* BE OPERATED UNDER ANY CONDITION WITHOUT THE CURRENT-REGULATOR TUBE IN THE POWER UNIT BEING USED.

4.2 Emergency Battery Operation.

4.2–1 The filament supply may be obtained from a 6-volt storage battery. The current drain is approximately 2 amperes.

4.2–2 A single "B" potential of 180 volts is required. This supply may be either a storage battery or a suitable combination of dry cell batteries. The current drain is approximately 45 milliamperes. No "C" batteries are required.

V
ANTENNA REQUIREMENTS

5.1 This equipment is primarily designed for operation with a separate antenna not used for other equipment. However, the Model RAL Equipment may be operated on an antenna common with the Model RAK Equipment as an emergency measure. The antennas should be spaced at least 6 feet from any parallel stay, mast or stack, must be well insulated and erected as high as possible. The length of the antenna should be approximately 50 feet in the clear. A ½-megohm static-drain resistor should be permanently installed between each antenna and ground. The antenna lead connecting to each receiver should be flexible insulated cable and terminate in a Navy Type -49121 concentric plug. This plug connects to the Navy Type -49120 concentric jack, located on the rear of the receiver.

If a particularly long antenna installation is desirable or if the lead-in arrangement obtains particularly high capacity to ground, the shorting link located on a terminal board adjacent to the antenna concentric jack J-102 must be opened. This link is accessible only after the receiver chassis has been removed from its cabinet. To remove the receiver chassis, loosen the thumb screws holding the front panel to the cabinet; withdraw the chassis by pulling on the two panel handles. After the link has been opened, be sure to tighten the terminal screw after placing the link against the insulation board so that the link will not short due to vibration.

It is preferable to use the receiver with the link shorted; necessity for opening the link will be evidenced by inability to obtain resonance with the antenna trimmer, particularly on Bands "1" and "2".

NOTE: NO OTHER RECEIVER SHOULD BE USED ON THE SAME ANTENNA WITH THIS EQUIPMENT EXCEPT AS AN EMERGENCY MEASURE.

5.2 When it is necessary to operate this equipment from an antenna common to a RAK Equipment as an emergency measure, the shorting link on the terminal board adjacent the antenna concentric jack, must be OPEN.

5.3 The ground connection should be made to some grounded metal portion of the ship, as specified under "Wiring" (paragraph 6.4–2) and should be soldered, if practicable, to prevent variable, or high-resistance contact due to corrosion.

5.4 The use of bonded stays is equally as desirable with this equipment as with other Navy receivers to eliminate noises arising from variable contacts or grounds on such stays.

VI
INSTALLATION

6.1 Receiver Unit Mounting.

6.1–1 It is essential that the receiver unit be secured to its table by means of the rubber shock absorber mounting provided. Figure 15 illustrates in detail the manner in which these receivers are to be installed, including dimensions for drilling the operating table or desk. In planning this installation, care should be exercised to provide for a clearance of at least three inches or more from the back of the receivers to the bulkhead or nearest obstruction in order to permit movement of cables when withdrawing the chassis from the cabinets for servicing. Should these receivers be operated in pairs, the cabinets must be bolted together and in place after the chassis have been removed. To remove the receiver chassis, it is necessary to loosen the thumb screws holding the front panel to the cabinet. These thumb screws do not come clear of the panel. If the equipment has been previously set up, it will be necessary to disconnect the cables to the auxiliary equipment. Using the handles provided on the front panel, remove the chassis completely from the cabinet. CARE SHOULD BE TAKEN TO SET THE CHASSIS ON A FLAT SURFACE FREE FROM ANY OBJECTS WHICH MIGHT DAMAGE THE SHIELDING.

6.1–2 The several cables of this equipment should be fed through the holes in the rear of the cabinet and connected as shown in Figure 16. The large shielded cable (W-201) connects the receiver unit to the power unit. A smaller shielded cable (W-101) connects the control unit (its use being optional) to the receiver unit while another cable (W-301) connects the power unit to the control unit. Should only one receiver unit and no control unit be used, refer to Figure 16 for the power cord connections.

6.1–3 Using a one-inch drill, pierce the top of the desk in accordance with the dimensions given in Figure 15. Place one rubber shock absorber (SA-101A) in each of these holes. Locate the cabinets in their proper positions on the desk top so that their mounting holes coincide with the holes in the shock absorbers and insert the mounting bolts. Next, place the bottom shock absorber (SA-101B), a metal washer, nut and lock nut on each bolt as shown in Figure 15, but do not tighten the nuts. In case two receivers are used together, bolt the adjacent sides by means of the short bolts provided. Place these bolts in the holes inside the cabinets. Place washers under the heads and washers, lockwashers and nuts on the opposite end of the bolt. Before tightening these nuts, carefully align the cabinets both horizontally and vertically. When the cabinets have been secured to each other, tighten the mounting bolts just sufficiently to slightly compress the rubber shock absorbers.

6.2 Power Unit Mounting.

6.2–1 The power unit cabinet should be mounted beneath the operating table by means of four bolts, washers and lockwashers (not supplied). It should be spaced a minimum of 1½ inches from the bottom of the table by cleats or other means so as to allow ample ventilation. The details of the installation and the drilling plan for these mounting bolts are also shown in Figure 15. Remove the power unit from the cabinet by first loosening the panel thumb screws and then withdraw by means of the two handles provided on the panel. If the equipment has been previously set up, it will be necessary to remove the cable connections from the terminal board at the right-hand side of the power unit, just in back of the panel. For further details, see Figure 16.

6.3 Control Unit Mounting.

6.3–1 The control unit cabinet should be mounted at any convenient place on the operating table by means of two bolts through two holes provided in the bottom of the cabinet and fastened securely with lockwashers and nuts. To remove the chassis, unloosen the four screws in the panel. Use of the control unit is optional with this equipment, its operation being described in paragraph 9.6.

6.4 Wiring.

6.4–1 The wiring between units is shown in Figure 16. At installation, the supply voltage should be measured or otherwise ascertained and the primary taps of the power transformer (T-201) shifted if necessary to comply with the nominal line rating. These taps are connected at the factory for 115 volts as indicated by the marking "115" adjacent to the terminals to which the *red* wires from toggle switch S-202 is connected (see Figures 1, 4 and 21). If the supply voltage is nearer 110 or 120 volts than 115 volts, shift these *red* wires to one of the two other pairs of terminals (marked "110" and "120," respectively) as required. To eliminate as much a-c hum and other electrical interference as possible, the 110-, 115-, or 120-volt, a-c supply should be connected to the power unit by a shielded twisted pair of wires (No. 14 or larger), or run in grounded conduit as far as the bulkhead adjacent to the power unit and terminated in a junction box. In no case should transformers or other a-c equipment be located in close proximity to the receiver.

6.4–2 Grounds should be made to some grounded metal portion of the ship. Contact surfaces must be scraped free from paint. Pipes should be avoided since they are a questionable ground aboard ship.

NOTE: THE IMPORTANCE OF SECURING A GOOD GROUND WITH A SHORT, DIRECT, LOW RESISTANCE GROUND LEAD CANNOT BE OVER-EMPHASIZED. THIS IS OF PARTICULAR IMPORTANCE IN MINIMIZING PICKUP AND INTERFERENCE FROM NEARBY TRANSMITTERS.

6.4–3 Sufficient slack should be left in sections of cables external to cabinets to permit withdrawal of chassis from cabinets for service checking with voltages applied.

6.4–4 Emergency Battery Operation.

Referring to Figure 16, Cable W-101 is used to connect the receiver output to the output line or to the control unit if used. In an emergency, should it be desired to operate the receiver on batteries, Cable W-201 connects the receiver unit to a battery terminal block (not supplied). The battery terminal block must be arranged to supply screw terminals for connection to the spade terminals of Cable W-201. Wiring from the batteries to the terminal block should be run in grounded conduit and the filament wiring should be of sufficient size to offer negligible voltage drop (each receiver draws approximately 2 amperes filament current).

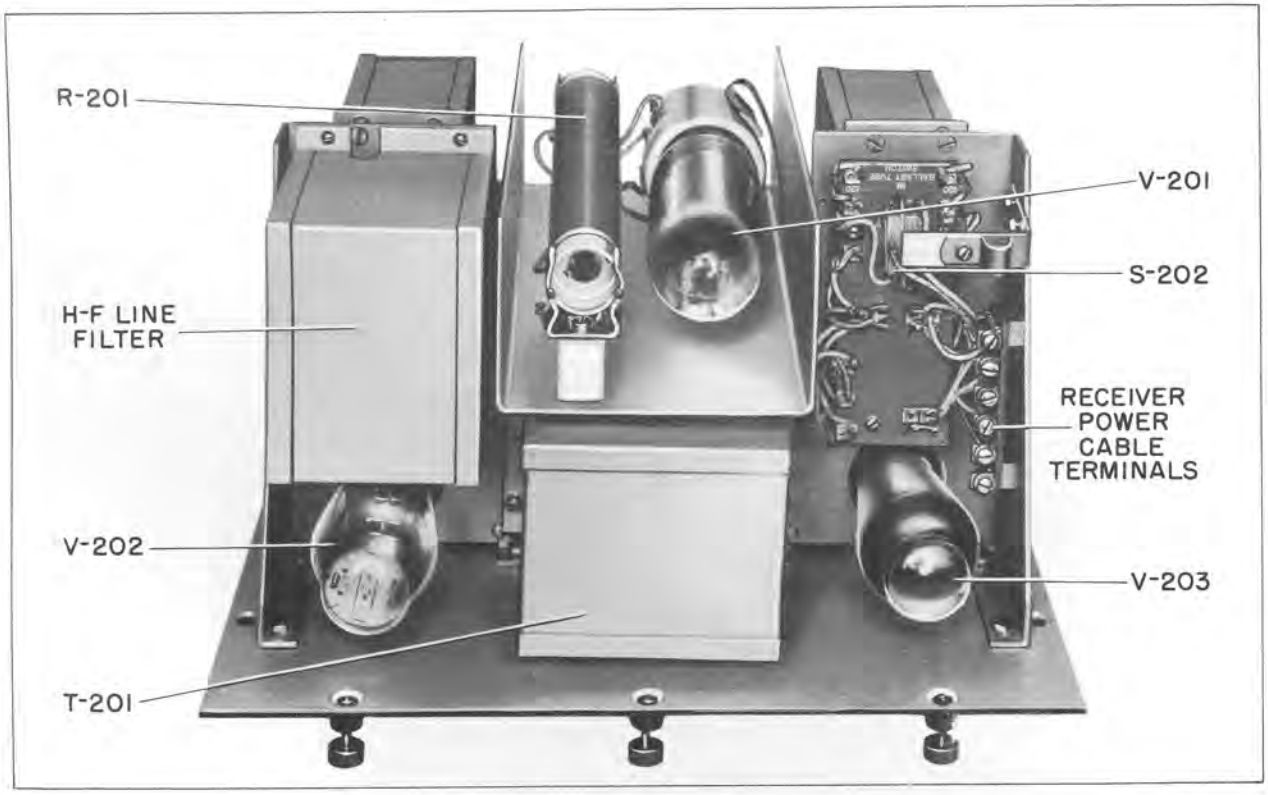


Figure 1—Power Unit CMX-20131-A (Top View of Chassis)

VII
TUBE LOCATIONS

7.1 Power Unit CMX-20131-A.

7.1–1 The tube locations are shown in Figures 1 and 16.

(a) Type -5Z3 rectifier, left front of chassis.
(b) Type -874 voltage regulator, right front of chassis.
(c) Type -876 current regulator, center rear.

7.2 Receiver Unit CMX-46156-A.

7.2–1 The tube locations are shown in Figures 2 and 16.

(a) Type -6D6 first r-f, rear left of chassis.
(b) Type -6D6 2nd r-f, rear center of chassis.
(c) Type -6D6 detector, rear right of chassis.
(d) Type -41 output limiter (AVC) left front of chassis.
(e) Type -41 audio output, center front of chassis.
(f) Type -6D6 first audio, right front of chassis.

VIII
CONSTRUCTION

8.1 Dimensions and Weights.

8.1–1 Figure 15 illustrates the overall dimensions of the RAL and RAK equipments as arranged for installation. The weights of the units are as follows:

(a) Type CMX-46156-A Receiver Unit ..... 69 lbs.
(b) Type CMX-20131-A Power Unit ..... 41 lbs.
(c) Type CMX-23073-A Control Unit ..... 2 lbs.

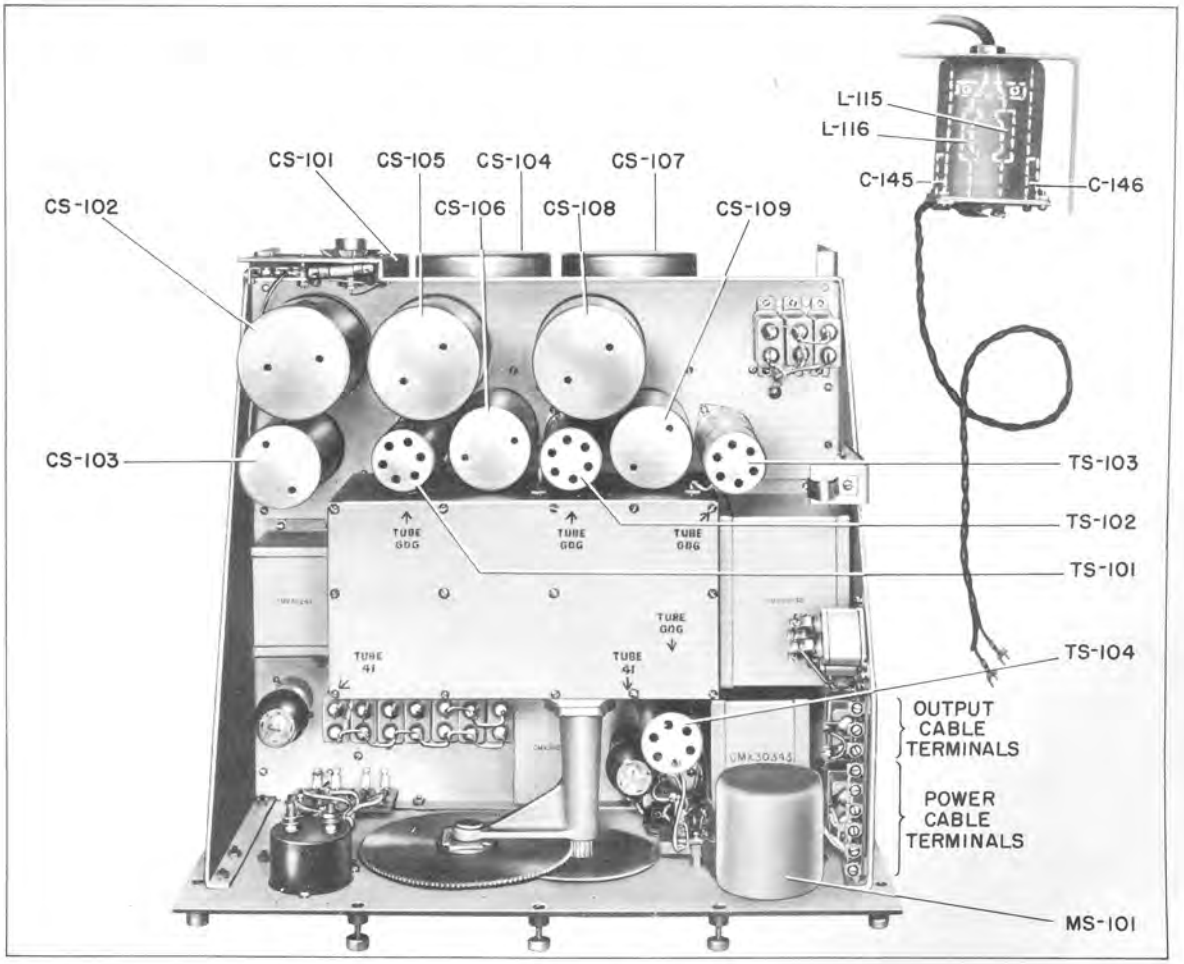


Figure 2—Receiver Unit CMX-46156-A (Top View of Chassis)

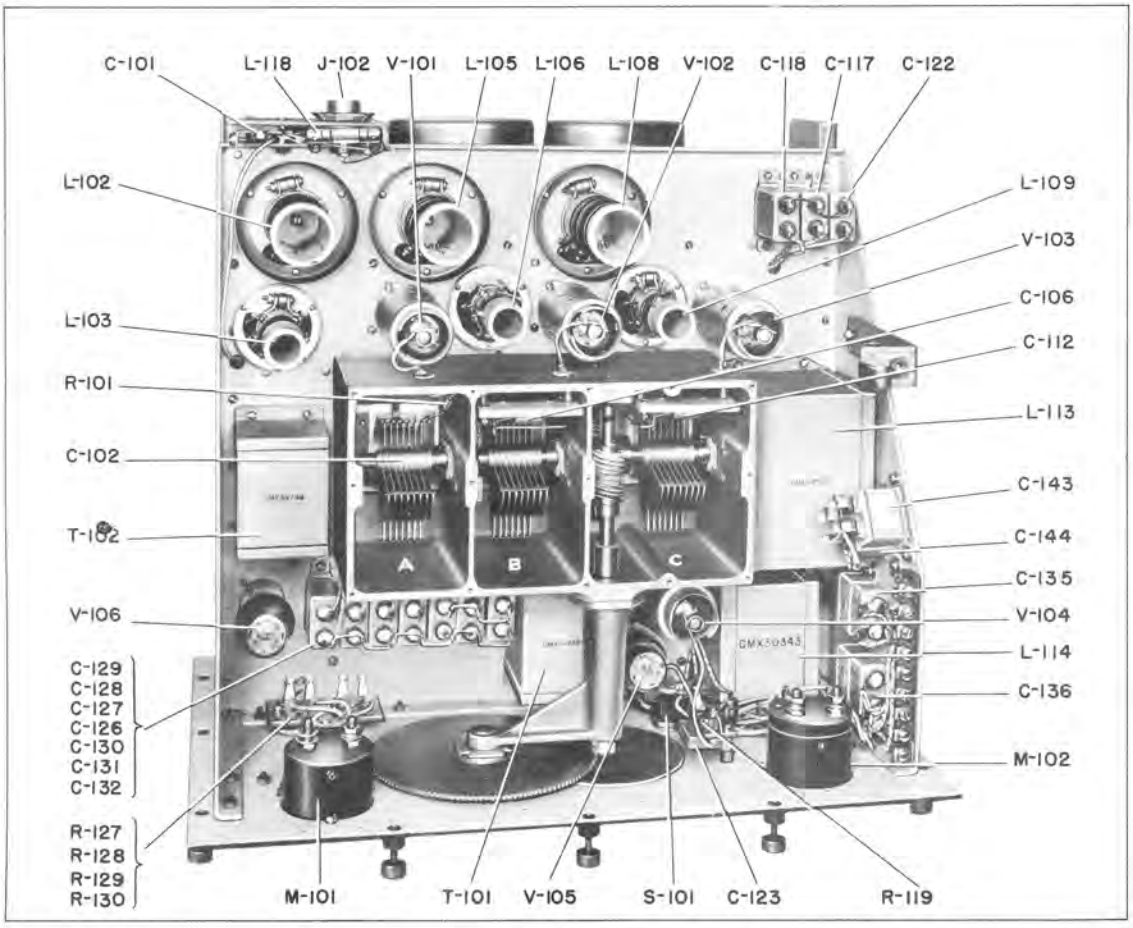


Figure 3—Receiver Unit CMX-46156-A (Top View of Chassis—Covers Removed)

8.2 Receiver Unit CMX-46156-A.

8.2–1 As indicated in Figure 15, the receiver unit is designed for table mounting. The cabinet may be permanently fastened to the table and the chassis is removable for access to tubes, for servicing, and for cable connections. All components are mounted on the chassis or panel forming a single assembly (see Figures 2, 3, and 6). Audio and AVC components are mounted directly behind the panel with filter and audio tuning units at the right, the first audio and output tubes in the center, and the AVC circuit at the left. Audio wiring, resistors, etc., are located beneath the chassis. The tuning condenser assembly is located just back of the audio components. The top plate on the condenser assembly is removable for inspection. At the rear of the chassis are located the r-f and detector tubes and the r-f coils, which are protected and shielded by screw cans. The power terminals are located at the right of the chassis and the antenna and ground terminals at the left. The band switch, r-f components and wiring are located beneath the chassis in a fabricated shield box. The large cover plate on the bottom of the receiver is removable for inspection and access to these parts.

8.3 Power Unit CMX-20131-A.

8.3–1 The power unit is designed for mounting underneath a table (see Figure 15). The cabinet may be permanently mounted, the chassis being removable for access to tubes, for servicing, and for cable connections. All components are mounted on the chassis or panel forming a single assembly (see Figures 1, 4, and 7). On the top of the chassis from left to right are located the rectifier tube, h-f line filter shield, power transformer, voltage regulator tube, resistor board and power terminals. The line filter shield at the left rear is removable for access to the line input terminals and fuses. In the center at the rear is located the current-regulator tube. Beneath the chassis from left to right are located the l-f line filter, ripple filter reactors, and ripple filter capacitor pack.

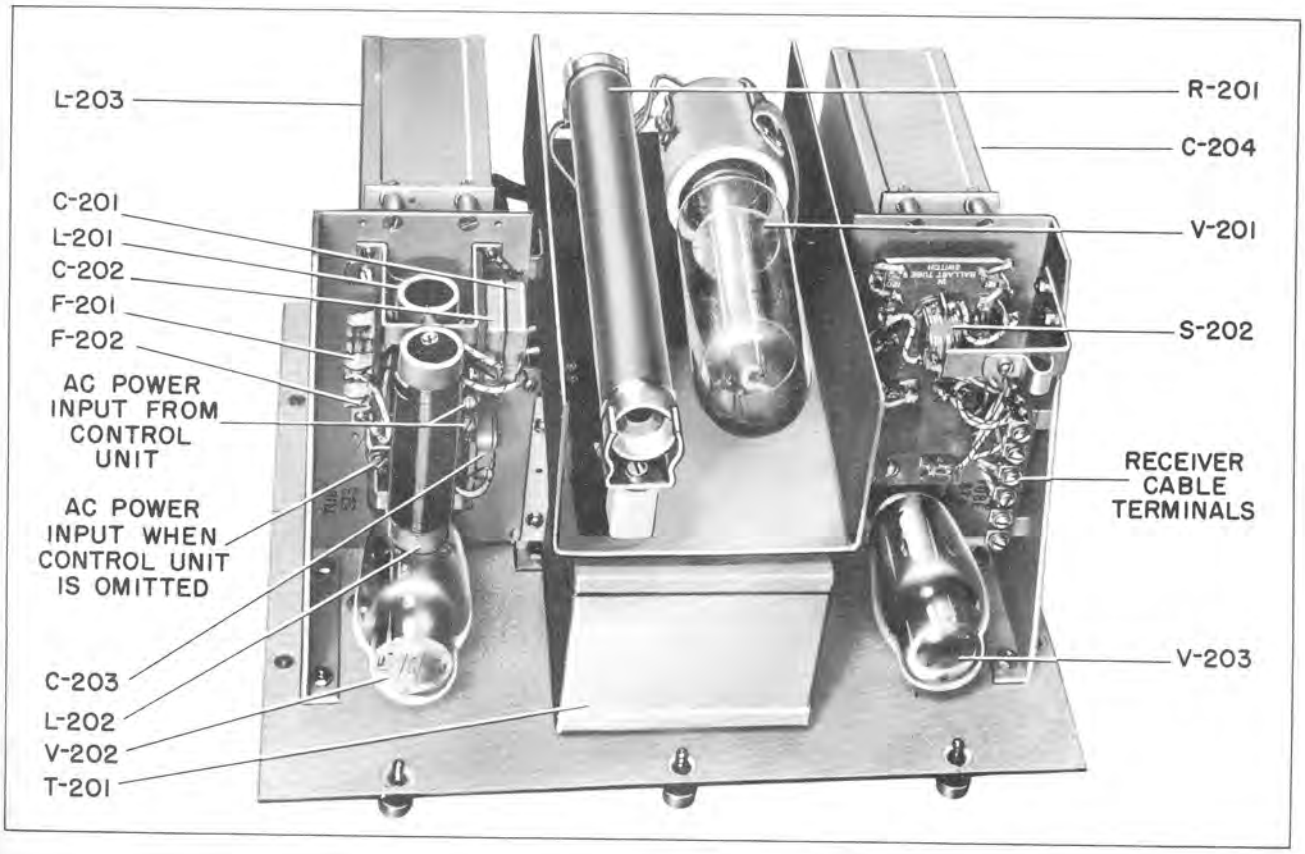


Figure 4—Power Unit CMX-20131-A (Top View of Chassis—Covers Removed)

8.4 Control Unit CMX-23073-A.

8.4–1 The control unit contains output jacks, mixer switch and power switches mounted on the panel. (See Figure 5.) Fuses and terminal boards are mounted on a bracket secured to the panel. The case may be permanently mounted to any flat surface (see Figure 15).

IX

CIRCUIT DESCRIPTION

9.1 The schematic diagram of the receiver unit (Figure 17) shows the arrangement of the radio- and audio-frequency circuits.

9.2 The antenna is capacitively coupled to the first tuned circuit, the coupling being designed to give optimum energy transfer in order to secure the best possible signal-to-noise ratio. When a particularly long or high-capacity antenna is used or when it is necessary to operate this receiver on the same antenna with an RAK equipment, looser coupling is desirable. The antenna input circuit, therefore, has been so arranged that an additional capacitor is placed in series with the usual antenna coupling capacitor when the link across capacitor C-101 is "opened." See "Antenna Requirements," Section V.

9.3 The requisite sensitivity and selectivity at the signal frequency is obtained by the use of two r-f stages and a regenerative detector stage. Uni-control is accomplished by means of a 3-gang variable capacitor, tuning the two r-f stages and the detector.

9.3–1 The frequency range of 0.3 to 23 megacycles is covered in nine bands by means of coil switching as shown on the schematic diagram. The necessary inductances are wound

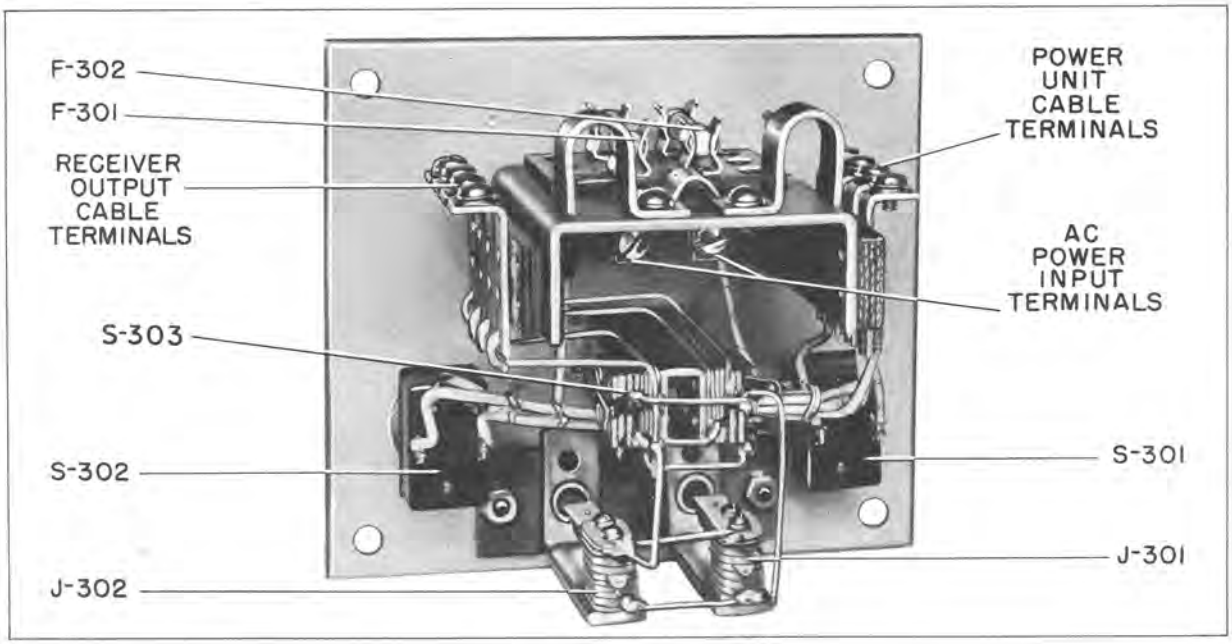


Figure 5—Control Unit CMX-23073-A (Rear View of Panel)

on three sets of coil bodies. Unused portions of the coils are grounded or short circuited where they would otherwise cause undesirable losses in the tuned circuit.

9.3–2 Two Type -6D6 tubes are used as r-f amplifiers and a third Type -6D6 is used as a regenerative detector.

9.3–3 In order to hold the sensitivity of the receiver essentially constant over the wide frequency range employed and to improve selectivity, the plate circuit of the first r-f amplifier stage is tapped down on its tuning impedance for bands 4 to 9 and transformer coupling is used for bands 1 to 3. Transformer coupling also is employed between the plate of the second r-f stage and the grid of the detector.

9.3–4 CW reception and improved sensitivity and selectivity is accomplished by the use of a specially designed autodyne detector circuit. This detector employs the familiar electron coupling with the resultant minimizing of reaction in all circuit switching in the audio system. A very high degree of frequency stability is inherent in this type of circuit. The particular design obviates the necessity for frequent adjustment of the "Regeneration" control and renders it possible to obtain the desired performance characteristics of this detector without critical adjustments of the control.

9.3–5 Sensitivity is controlled by varying the cathode potential of the two r-f stages with respect to the grid potential of those stages.

9.3–6 In order to obtain optimum performance of the equipment under all service conditions, small trimmer capacitors, adjustable from the front panel, are provided in the first and second r-f tuned circuits.

9.3–7 To permit greater ease in searching and following drifting signals, a very small trimmer capacitor (frequency vernier), controllable from the front panel, has been provided. This adjustment makes possible the variation of the autodyne oscillator frequency by an amount between .35% and .05% of its frequency. The greater range of adjustment is obtained at the high-frequency ends of the various bands.

9.3–8 The unit is completely shielded both internally and externally to minimize cross talk between receivers. All power leads are filtered with resistance-capacity filters. Interstage shielding is provided to increase selectivity and stability, and to minimize reaction.

9.4 The audio system includes two stages of amplification and an output limiter. Filters are provided which increase the effective CW selectivity and improve the signal-to-noise ratio.

9.4–1 A low-pass filter immediately follows the detector circuit and may be disconnected from the circuit by means of a switch on the front panel. This filter provides attenuation of less than 6 db. at 1200 cycles and more than 40 db. at frequencies above 1600 cycles.

9.4–2 A variable audio-frequency attenuator which may be switched in or out of the circuit by means of a panel control follows the low-pass filter. This attenuator operates over the range of 450-1300 cycles (this indicates "acceptance" of the frequency to which the attenuator is adjusted and "attenuation" of other frequencies). A choice of resonant frequency is afforded by means of a 10-position switch and a 2-position range switch. Schematically, this attenuator is a tuned circuit inserted in parallel with the grid of the first audio stage.

9.4–3 A Type -6D6 tube is used in the first audio-frequency amplifier stage.

9.4–4 The first audio stage is resistance coupled to a Type -41 output stage which, in turn, is transformer coupled for use with an output impedance of approximately 600 ohms. The output transformer employs an electrostatic shield and a center-tapped output winding to obtain a balanced output circuit.

9.4–5 A switch operated from the front panel permits an audio limiter tube (Type -41) to operate on the plate circuit of the output stage. The switch connects the output limiter transformer in parallel with the primary of the output transformer. The output limiter transformer has a high voltage step-up ratio and feeds the Type -41 tube which is connected as a biased rectifier. When the receiver output reaches a certain level (determined by an adjustable bias on the rectifier), the rectifier starts drawing grid current and the rectifier grid resistance decreases. This resistance reflected through the high-ratio transformer results in a low effective impedance load in the receiver output stage plate circuit, and thus limits the output voltage to a certain value. Since the AVC is operated by audio output only, it is not affected by strong CW signals which do not produce an audio beat note. The output level to which the signal is limited may be varied by adjustment of the rectifier bias from the control on the front panel.

NOTE: THIS CONTROL IS NOT INTENDED FOR USE ON VOICE-MODULATED SIGNALS SINCE IT INTRODUCES HARMONICS OF THE AUDIBLE NOTE AND PRODUCES PROHIBITIVE DISTORTION.

9.4–6 A rectifier type DB output meter and range switch are provided on the front panel. This meter indicates the audio level delivered to the headphones.

9.4–7 A voltmeter which indicates filament voltage is provided on the front panel.

9.4–8 Normally, the a-c power is controlled either from the control unit or the power unit. In addition, a d-c power "On-Off" switch is provided on the receiver panel for use only in the event the receiver in an emergency is operated on batteries. *If this switch is opened when the receiver is normally operated on a.c., the load is removed from the power unit and overloading and damage of certain of its parts may result.* For this reason, shorting links are provided behind the panel (see Figure 6) which permanently close this switch circuit. If it is desired in an emergency to operate the receiver on batteries, these links should be opened.

9.5 Power Unit CMX-20131-A, shown schematically in Figure 18, has been very carefully designed in order to maintain an accurate calibration of the receiver and a high degree of frequency stability. Several special features are embodied in the design in order to afford very constant voltage on all of the tubes used in the receiver unit and particularly on the screen grid of the autodyne detector which is the element principally affected by power supply voltage variation. The power supply circuit consists essentially of r-f filters on the a-c supply line, a Type -876 current regulator, an electrostatically shielded power transformer, a Type -5Z3 rectifier tube, a specially developed two-stage filter, a Type -874 voltage regulator and a protective bleeder.

9.5–1 The r-f filter unit has been very carefully designed to substantially eliminate cross talk between several equipments operating from one power supply system and to reduce interference which may be present on the a-c line.

9.5–2 The power transformer has been designed for operation from a 110-, 115-, or 120-volt, 60-cycle supply, and taps are provided on the primary to accommodate any of these nominal voltages. The total power consumption of this transformer under normal operation (with the current regulator tube in use) is approximately 200 watts. Filament supply is obtained from a center-tapped winding on this transformer and is, therefore, regulated by the current-regulator tube.

9.5–3 The Type -5Z3 rectifier tube and bleeder provide a plate source of good regulation.

9.5–4 The screen voltage of the autodyne detector is stabilized by means of a Type -874 regulator tube.

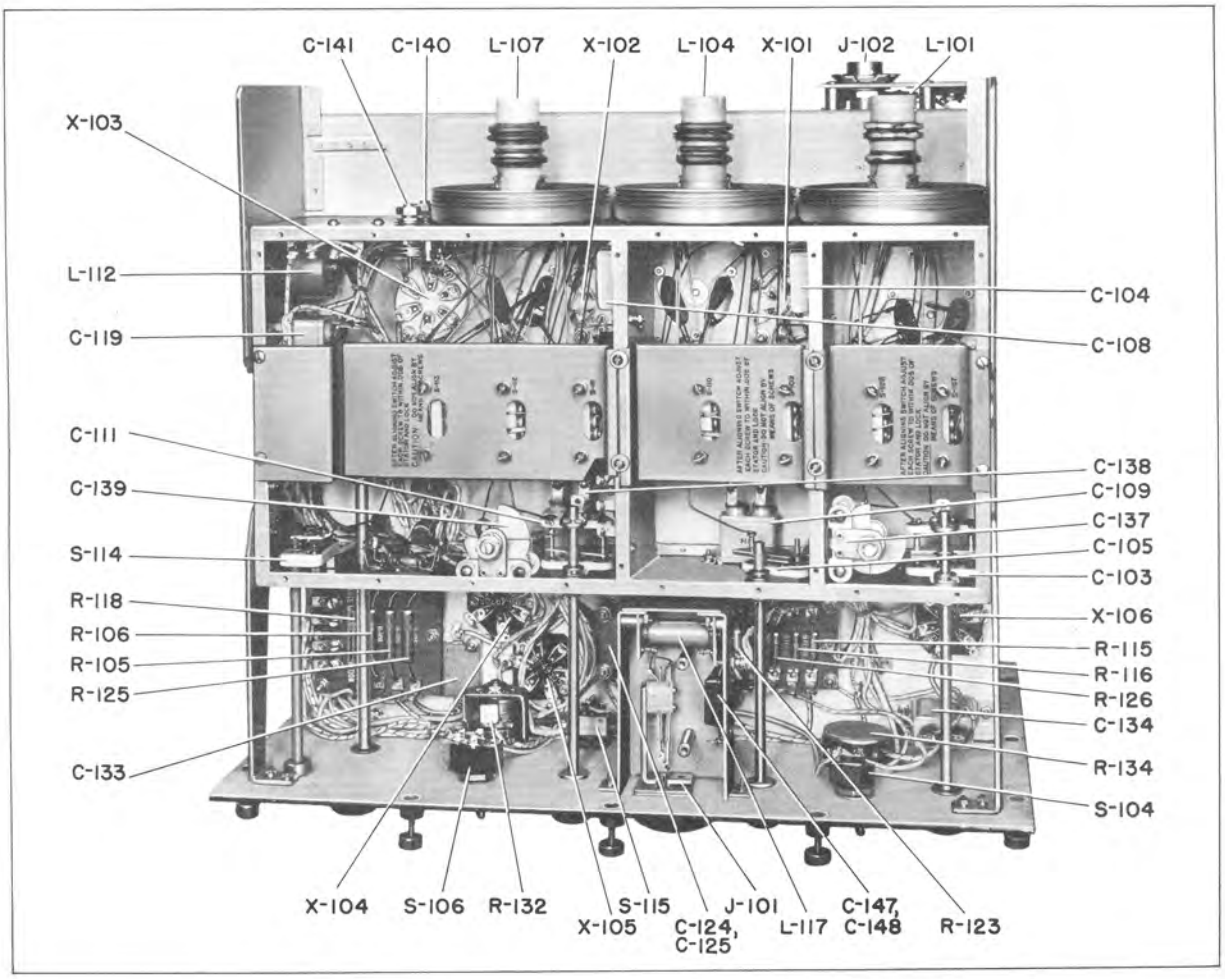


Figure 6—Receiver Unit CMX-46156-A (Bottom View of Chassis—Covers Removed)

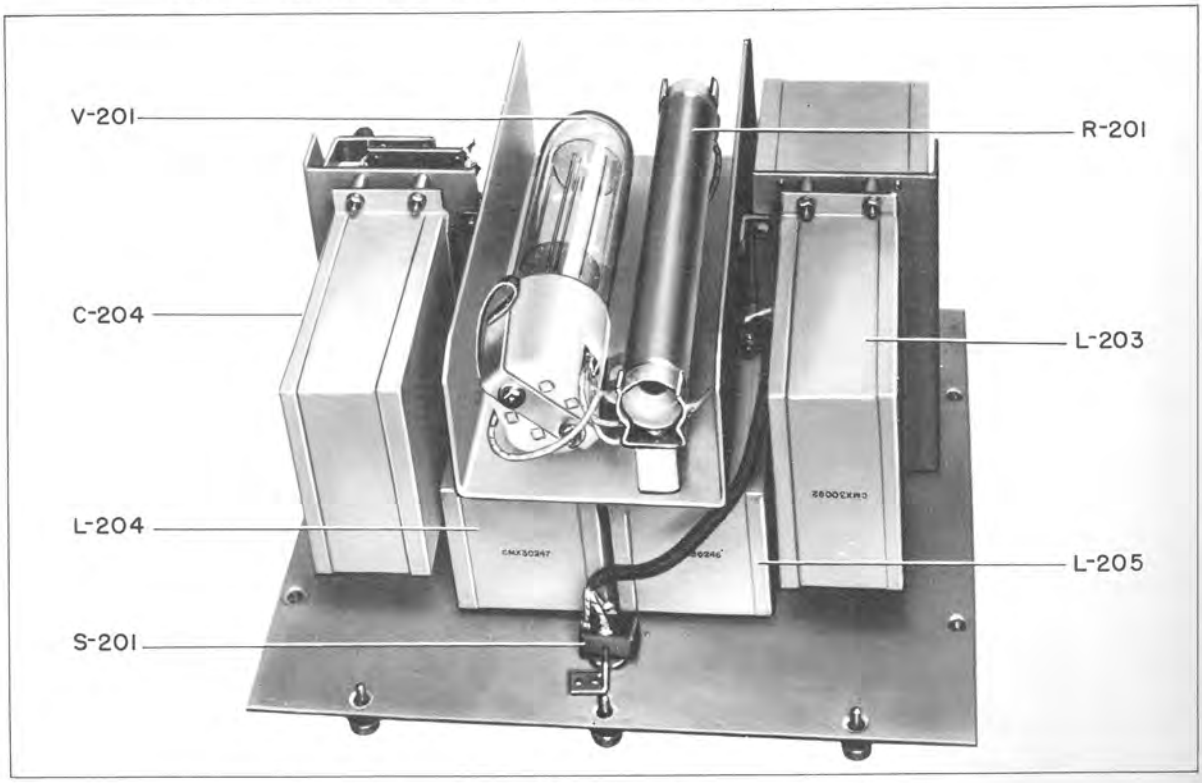


Figure 7—Power Unit CMX-20131-A (Bottom View of Chassis)

9.5–5 A power switch is provided on the front panel of this unit for turning the equipment on and off when no control unit is employed.

9.5–6 In order to make this power unit interchangeable with the one used in the RAK Series equipment, provision is made for the elimination of the current-regulator tube (Type -876) from the circuit when the power unit is used with the RAK equipment. Since the latter receiver operates at relatively low frequencies, the additional freedom from effect of line voltage variation obtained from the current-regulator tube is not needed if the line regulation is within ±10 per cent. In the interest of conserving primary supply current, its use with the RAK Series equipment is not recommended under normal circumstances and the tube should be removed from its socket. It must, however, be used with the RAL Series equipment. A switch, therefore, is provided inside the unit to permit operation with or without this tube. (See Figures 1 and 4.) This switch connects the current-regulator tube and switches the power transformer primary for operation in series with the current-regulator tube or directly connected to the line filter. (See paragraph 10.2-3.)

9.5–7 Referring to Figure 16, it will be observed that four terminals are provided for connecting the 110-, 115-, or 120-volt, 60-cycle supply to the power unit. When this equipment is used with the control unit, the power connection from the control unit to the power unit is made to the two right-hand terminals. When no control unit is employed, the connection is made to the left-hand terminals. Connecting to the two right-hand terminals removes the power switch on the panel from the circuit. (See Figure 4.)

9.6 Control Unit CMX-23073-A (see Figure 5) is shown schematically in Figure 19. The use of this control unit makes possible the guarding of two channels simultaneously. The output of each receiver feeds into the control unit where a 3-position switch is provided which makes available, in the two headphone jacks, signals from either or both of the receivers. Two power switches also are provided on the control unit panel for controlling the power to each receiver independently. The a-c power supply feeds into the control unit and each side of the line is fused. The two supply cables connect to suitable terminals on the power units, which terminals are arranged to omit from the circuit the switch and the fuses in the power unit.

9.7 In order to reduce interference from neighboring transmitters several filter circuits have been introduced as follows:

9.7–1 For reduction of U.H.F. interference, a choke coil (L118) is connected between the antenna terminal and a terminating ceramic spacer. Normally, this choke coil is shunted by a bus; this bus should be cut if interference is reduced by temporarily disconnecting the antenna.

9.7–2 A filter assembly connected to the output jack J101 and consisting of coils L117A and L117B and by-pass capacitors C147 and C148 eliminates signal pick-up on the phone leads. The shield around the phone jack prevents direct radiation from the jack itself. See Figure 6.

9.7–3 An output cable filter assembly consisting of series coils L115 and L116 and by-pass capacitors C145 and C146 prevents signal pick-up on the phone leads and output cable connecting the control box to the receiver. It is mounted in a shielding can which prevents any direct radiation when assembled inside the receiver cabinet. This filter unit is mounted in the cabinet and is illustrated in Figure 2.

9.7–4 A grounding wiper is provided for the main tuning shaft to reduce radiation inside of the receiver.

9.7–5 Grounding clamps are provided on the receiver and power supply cases for grounding the braided shielding of the output and power supply cables. (W101 and W201.)

X
OPERATION

10.1 Controls of Receiver Unit CMX-46156-A.

10.1–1 The antenna should be connected to the concentric jack marked "Antenna," located at the rear of the cabinet. See "Antenna Requirements," Section V.

10.1–2 "FREQUENCY BAND" Selector Control: This control serves as a means for changing the required inductance for the various radio-frequency bands. The switch pointer should be set on the band number falling between the frequencies which establish the desired frequency range. Frequencies are marked in megacycles.

10.1–3 "TUNING" Control: The tuning control varies the setting of the three-gang variable tuning condenser. The scale increases with frequency.

10.1–4 "ANTENNA TRIMMER" Control: This controls a variable trimmer capacitor for antenna tuning stage (1st r-f grid circuit). In general, it is adjusted once for each band, preferably at the high-frequency end.

10.1–5 "RF TRIMMER" Control: This controls a variable trimmer capacitor for the second r-f tuned grid circuit. In general, it is adjusted once for each band, preferably at the high-frequency end.

10.1–6 "FREQ. VERNIER" Control: This control is a very small trimmer capacitor connected in the autodyne detector tuned circuit to obtain small variations in audio beat-note. The panel scale is zero at the center. Calibration and tuning are normally accomplished with the "Freq. Vernier" set at zero.

10.1–7 "FIL. VOLTS" Meter: The filament voltmeter indicates when the power is turned "On" and should read approximately 6 volts when the equipment is operating properly.

10.1–8 "AVC OFF-ON" Switch: This switch when in the "On" position, places the automatic volume control in operation; when in the "Off" position, it disconnects the automatic volume control. The automatic volume control is *not* intended for use on voice modulated signals.

10.1–9 "AVC LEVEL" Control: This control varies the bias on the AVC tube and thereby sets the volume level when the "AVC Off-On" switch is in the "On" position.

10.1–10 "REGENERATION" Control: This control varies the screen-grid potential of the autodyne detector, thus regulating the degree of feedback required for oscillation.

10.1–11 "SENSITIVITY" Control: This control varies the cathode potential of the two r-f tubes with respect to their grid potentials.

10.1–12 "AUDIO TUNING" Control: This 10-position switch selects the proper inductance in the audio-frequency variable attenuator circuit to permit this circuit to pass frequencies in the range of 450 to 770 or 770 to 1300 cycles depending upon the position of the audio tuning range switch (see 10.1–14). The switch positions are numbered to increase with respect to frequency.

10.1–13 Audio Tuning "OFF-ON" Switch: This switch places the audio-frequency variable attenuator in or out of the circuit.

10.1–14 Audio Tuning "450-770" or "770-1300" Switch: This switch selects the range of frequency in cycles in which the 10-position "Audio Tuning" control is operable.

10.1–15 "AUDIO BROAD-SHARP" Switch: This control places a low-pass filter in the audio circuit directly following the detector when the switch is placed in the "Sharp" position and removes the filter from the circuit when the switch is placed in the "Broad" position.

10.1–16 "OUTPUT" Meter: This rectifier type a-c meter indicates the audio-frequency output level delivered to the headphones. It is calibrated in decibels above and below zero level, which is 6 milliwatts of audio output.

10.1–17 "ADD DECIBELS" Switch: This range switch is used to read "Add Decibels" (algebraically) in connection with the "Output" meter. Five positions are provided: "Off," "15," "10," "5," and "0" in a clockwise direction.

10.1–18 "OSC. TEST" Button: This push button is connected from the detector cathode to ground. When it is depressed, it stops the detector from oscillating and produces a definite double click in the headphones. In many cases, the detector enters and leaves oscillation so gradually that it is necessary to use this button in order to determine whether or not the detector is oscillating.

10.1–19 "DC POWER OFF-ON" Switch: This switch is not used in the normal operation of this equipment and is accordingly wired out of the circuit by short-circuiting links located under the chassis (see Figure 6).

NOTE: HOWEVER, SHOULD OCCASION ARISE, THIS EQUIPMENT MAY BE OPERATED FROM A BATTERY SUPPLY CONSISTING OF SUITABLE FILAMENT AND PLATE BATTERIES. THIS METHOD OF OPERATION WILL REQUIRE OPENING OF THE SHORT CIRCUITING LINKS (SEE FIGURES 6 AND 20), AND CONNECTION OF CABLE W-201 AS INDICATED BY THE DOTTED LINES IN FIGURE 16. OPERATION OF THE RECEIVER WILL THEN BE CONTROLLED BY THE "DC POWER" SWITCH ON THE FRONT PANEL.

10.1–20 "PHONES" Jack: This jack provides termination for a pair of low-impedance (600-ohm) headphones.

10.2 Controls of Power Unit CMX-20131-A.

10.2–1 "OFF-ON" Switch: This switch located on the front panel controls all power to the power unit when not used in conjunction with a control unit.

10.2–2 Reference to Figure 16 shows that when the power unit is used in conjunction with the control unit, connection is made to the right-hand input terminals of the power unit. With this connection, the panel switch and the power unit fuses are disconnected from the circuit.

10.2–3 Current Regulator Switch: This switch is located under a terminal board at the right rear top of the chassis (see Figures 1 and 4) and should be thrown to the "In" position for this equipment. In this position, the proper primary connections to the transformer are made for operation with current regulation.

10.3 Controls of Control Unit CMX-23073-A.

10.3–1 For operation of Receiver No. 1, place the switch "On-Off 1" in the "On" position, the "1"-"mixed"-"2" switch in the "1" position and the "On-Off 2" switch in the "Off" position. The headphones should be plugged into one of the phone jacks on the control unit.

10.3–2 For operation of Receiver No. 2, proceed as in 10.3–1 above except that all switches should be thrown to the "2" position.

10.3–3 For simultaneous monitoring of the output from two receivers, both No. 1 and No. 2 "On-Off" switches should be placed in the "On" position and the "1"-"mixed"-"2" switch should be placed in the "mixed" position. The headphones should be plugged into one of the jacks on the control unit. The phone jacks on the receiver units are not controlled by the "1"-"mixed"-"2" switch. Two phone jacks are provided to permit simultaneous monitoring or operation by two operators.

10.4 CW Reception.

10.4–1 To apply power to the equipment, the proper "Off-On" switch should be thrown to the "On" position. The filament voltmeter should indicate approximately 6 volts. Allow sufficient time for the tube heaters to reach their operating temperature. This time will probably be not less than 30 seconds.

(a) When using a single RAL Series equipment, the "Off-On" switch on the power unit controls the power to the receiver.

(b) When using this equipment in combination with an RAK Series equipment, the proper "On-Off" switch on the control unit controls the power to the desired receiver.

10.4–2 To receive a signal whose frequency is known, throw the Audio Tuning and AVC "Off-On" switches to the "Off" position and the "Audio Broad-Sharp" switch to the "Broad" position and set the "Freq. Vernier" on zero.

10.4–3 Set the "Frequency Band" switch to the band number corresponding to the frequency range which includes the frequency of the station desired.

10.4–4 The "Tuning" control should be set to the desired frequency by reference to the calibration chart and the "Sensitivity" control should be advanced until a perceptible noise level is obtained. The "Antenna Trimmer" and the "R-F Trimmer" should be adjusted for *maximum* noise output.

CAUTION: KEEP "SENSITIVITY" CONTROL RETARDED. Due to the high degree of sensitivity incorporated in the equipment, the "Sensitivity" control can only be used near maximum under ideal conditions of low external noise level. For ordinary operating conditions, it is necessary to retard the "Sensitivity" control in order to avoid OVERLOADING THE RECEIVER WITH NOISE and masking the desired signal.

10.4–5 The "Regeneration" control should be set so that the detector is oscillating as evidenced by a double click heard in the headphones when the "Osc. Test" button is pressed and released.

10.4–6 The "Tuning" control should now be adjusted until the desired signal is heard and finally set to produce as near a 1000-cycle beat note as possible. Finally, adjust the "Antenna Trimmer" and "R-F Trimmer" for maximum signal.

10.4–7 Fine adjustment of beat note may now be obtained by the use of the "Freq. Vernier" control and this control may be used to follow transmitter or receiver drift.

10.4–8 In cases where the frequency of the signal is not known (such as when searching), excellent advantage may be taken of the uni-control feature, exercising care to keep the "Sensitivity" control at such a point as not to overload the receiver with noise.

10.4–9 The "AVC Level" control will maintain a substantially constant output signal level for wide fluctuation in the field intensity of the received signal. It materially assists in copying signals through heavy static because the static peaks are held to such a low value that the operator's attention is not distracted from copying the signals. To utilize this control, advance the "Sensitivity" control until the noise level is perceptible (not in excess of –10 db), then throw the "AVC-Off-On" switch to the "On" position and adjust the "AVC Level" control until a copyable signal is obtained.

NOTE: TO USE THE "AVC LEVEL" CONTROL TO BEST ADVANTAGE, THE SIGNAL SHOULD BE HELD TO AS LOW A VALUE AS WILL PERMIT GOOD COPY.

10.4–10 Throwing the Audio Tuning "Off-On" switch to the "On" position will result in increased selectivity and reduced noise level permitting of improved reception. The desired signal may be tuned to produce any beat note within the range of 450 to 1300 cycles and audio tuning adjusted to produce a maximum response at this beat frequency. It will often be found easier to set the Audio Tuning to a desired frequency such as 1000 cycles, and to adjust the CW beat note to this frequency by the Frequency Vernier, rather than to adjust the Audio Tuning to the beat frequency. The following table shows an approximate calibration of the audio tuning:

TABLE No. 1 AUDIO TUNING

Audio Tuning Switch 450-770	*Audio Tuning Switch 770-1300*
Tap 1—450 cycles	Tap 1— 800 cycles
" 2—475 "	" 2— 845 "
" 3—500 "	" 3— 890 "
" 4—530 "	" 4— 940 "
" 5—565 "	" 5— 990 "
" 6—600 "	" 6—1040 "
" 7—640 "	" 7—1100 "
" 8—680 "	" 8—1160 "
" 9—725 "	" 9—1225 "
" 10—770 "	" 10—1300 "

10.4–11 Throwing the "Audio Broad-Sharp" switch to the "Sharp" position will result in increased selectivity and an improved signal-to-noise ratio. This filter accepts signals up to 1200 cycles and rejects signals above 1600 cycles.

10.5 ICW or Modulated Signal Reception.

10.5–1 The procedure is the same as outlined above with the exception that the "Regeneration" control should be maintained slightly below the setting which produces oscillation. There should not be a pronounced double click as the "Osc. Test" button is pressed.

10.5–2 Particularly on the higher frequencies, a considerable improvement in both sensitivity and selectivity results when the "Regeneration" control is set reasonably near but below the condition of oscillation.

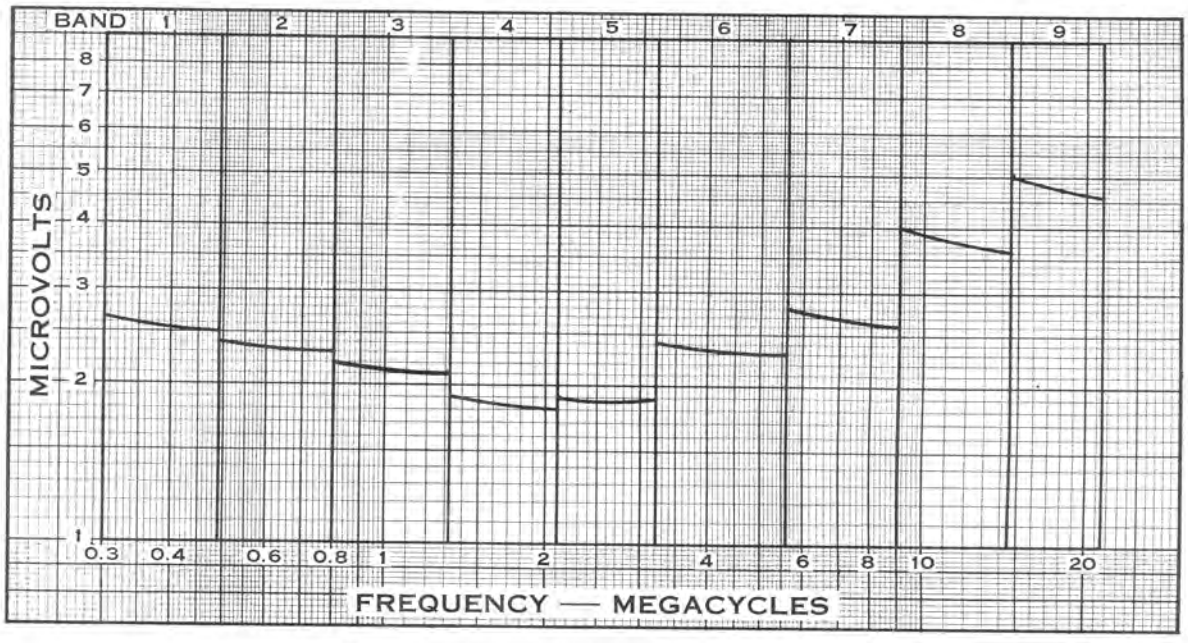


Figure 8—Sensitivity (microvolts for 6/.05 M.W. Signal/Noise Ratio)

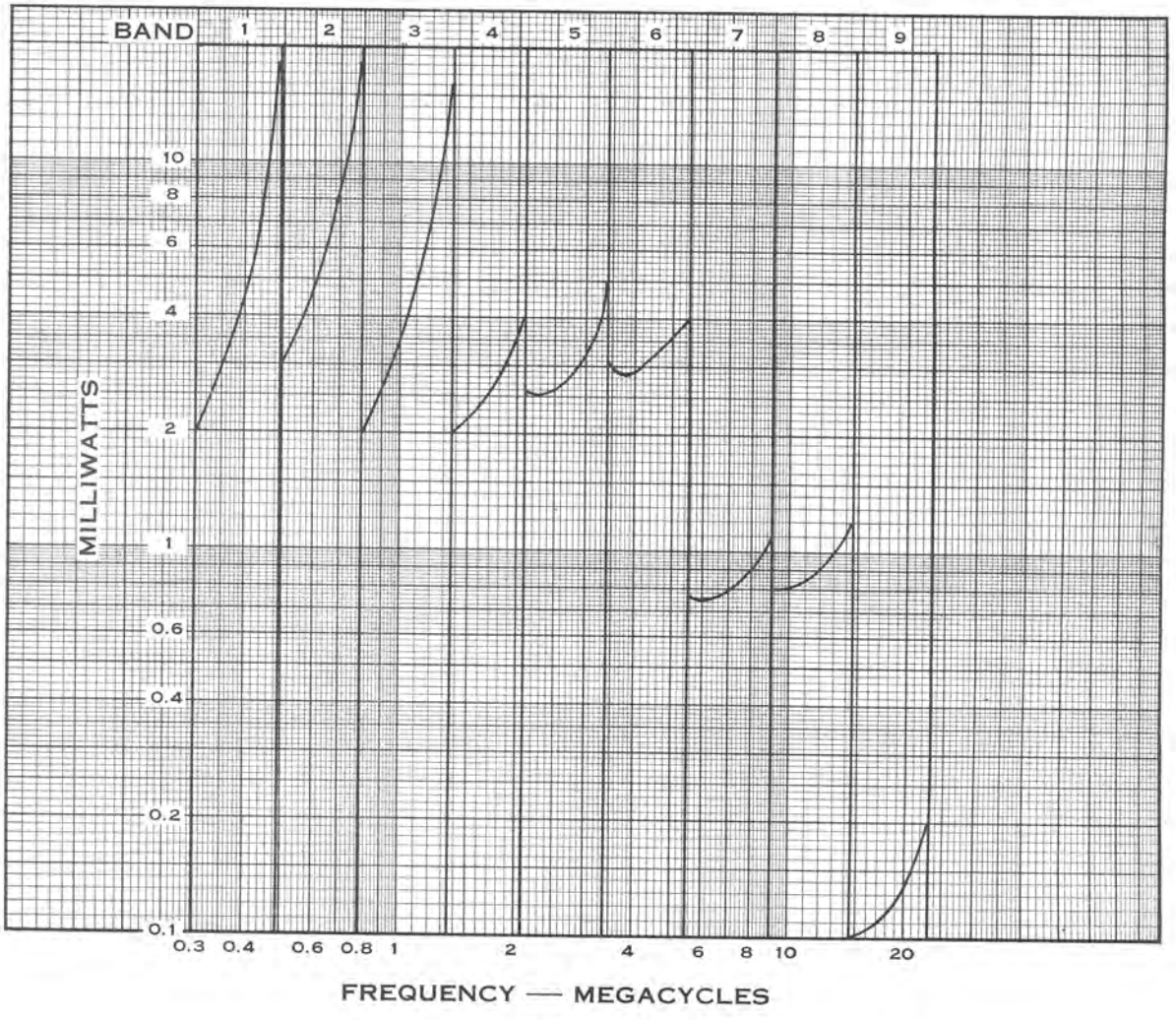


Figure 9—Maximum Noise

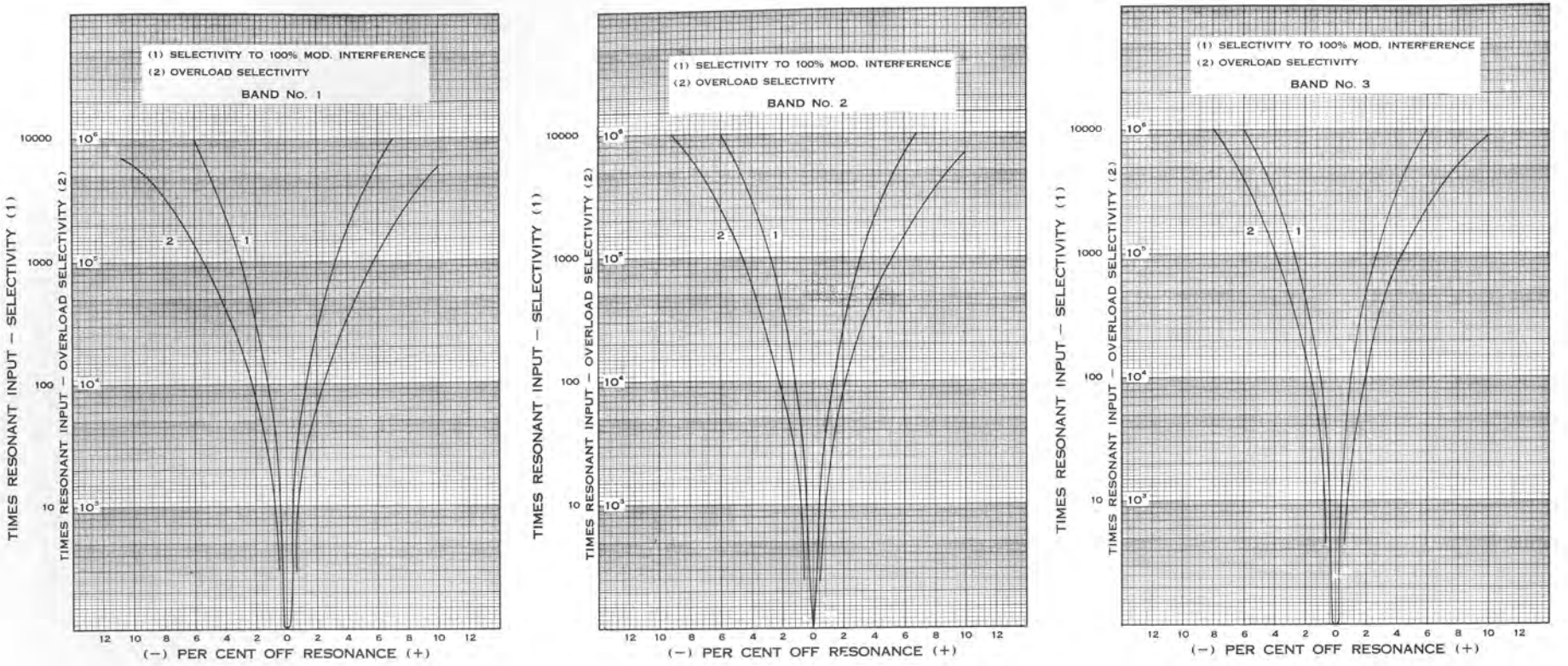


Figure 10—Average Selectivity and Overload Selectivity—Bands 1, 2 and 3
(1) Selectivity to 100% Mod. Interference; (2) Overload Selectivity

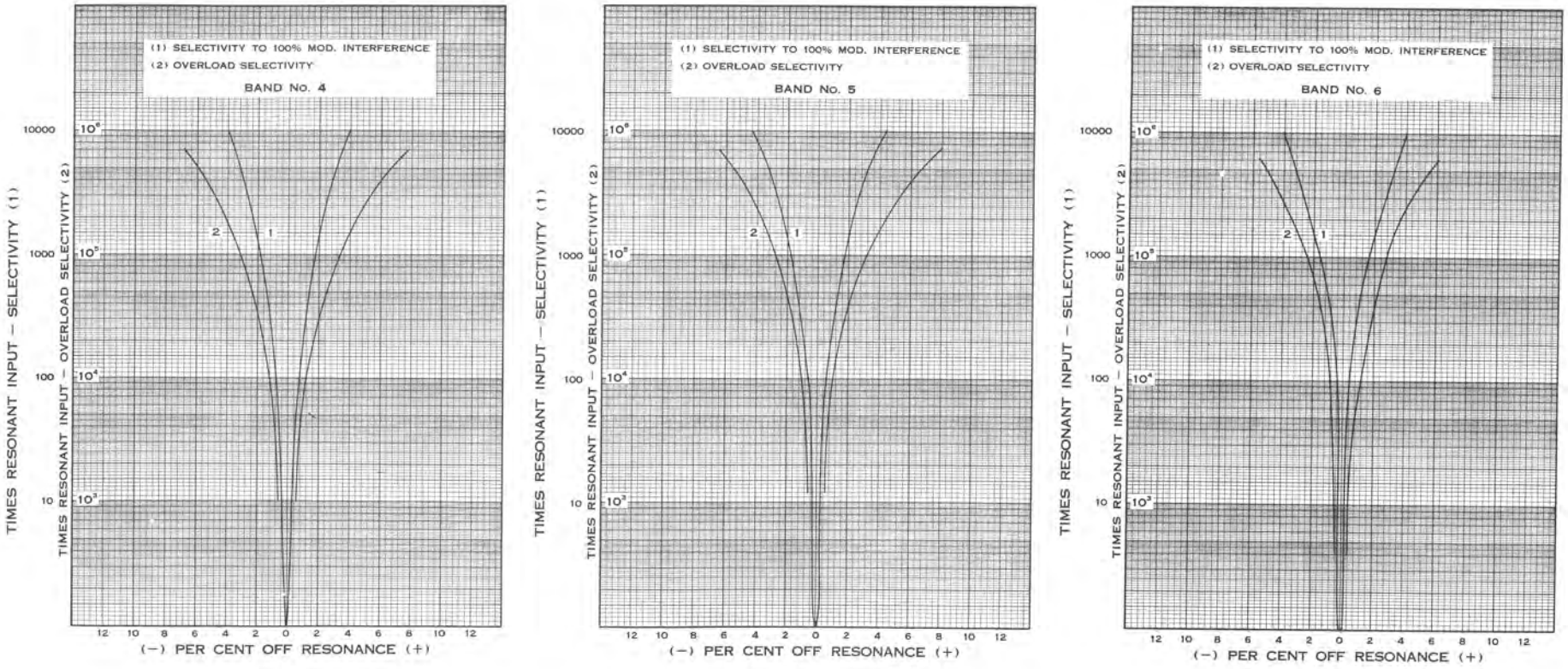


Figure 11—Average Selectivity and Overload Selectivity—Bands 4, 5 and 6
(1) Selectivity to 100% Mod. Interference; (2) Overload Selectivity

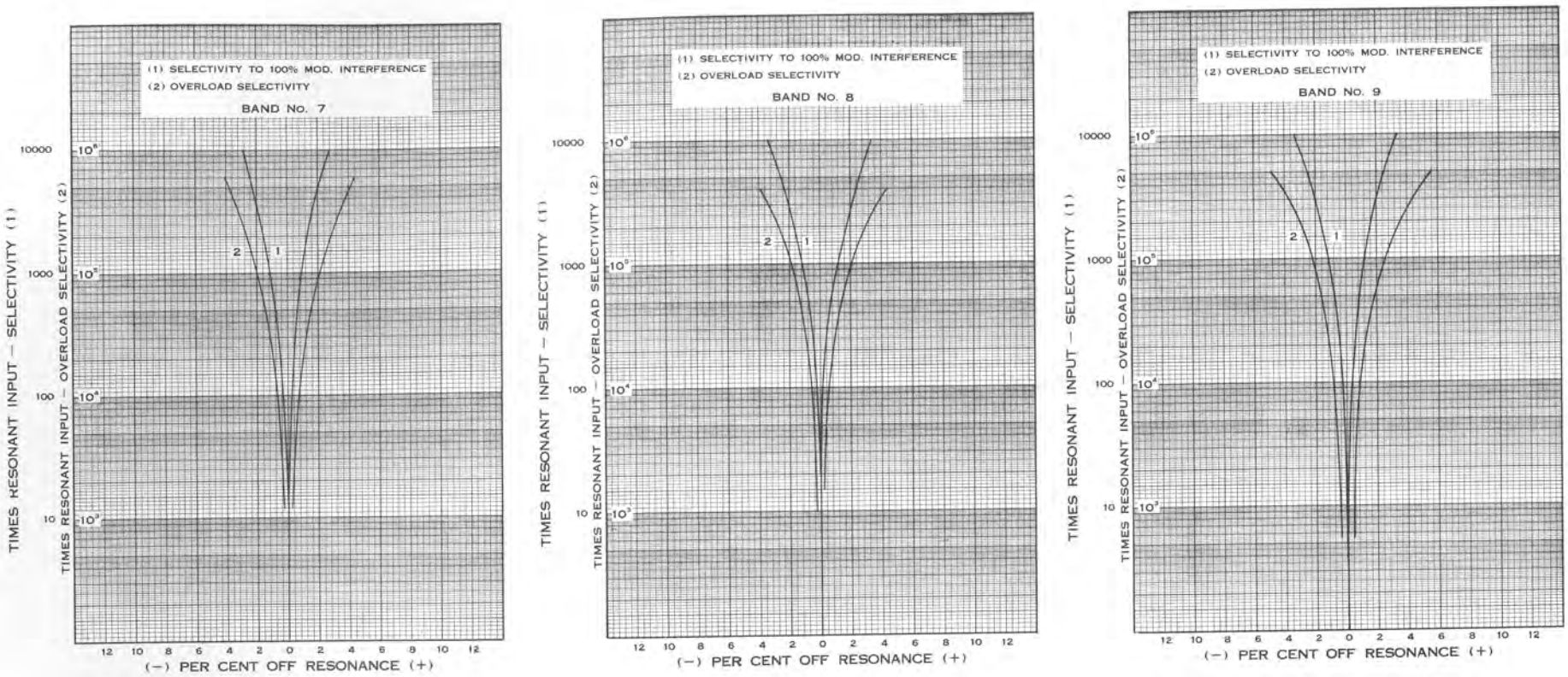


Figure 12—Average Selectivity and Overload Selectivity—Bands 7, 8 and 9
(1) Selectivity to 100% Mod. Interference; (2) Overload Selectivity

10.5–3 The low-pass filter does not respond to frequencies appreciably higher than 1200 cycles which is inadequate for the proper reproduction of speech. The frequency characteristic of the "Audio Tuning" circuits is such as to be inadequate for the proper reception of speech.

10.5–4 When receiving CW or ICW, the Audio Tuning "Off-On" switch should be thrown to the "ON" position. For reception of MCW signals, set the switch to the "OFF" position.

10.5–5 When receiving ICW, the "Audio-Sharp" condition may be used provided the frequency of modulation lies in the range of 250 to 1200 cycles.

XI
PERFORMANCE

11.1 Sensitivity.

11.1–1 Figure 8 gives approximate normal sensitivities for the various bands. The procedure and conditions of measurement are as follows: With "AVC-Off," "Audio-Broad," "Audio Tuning-Off," and with a 600-ohm non-inductive resistance at receiver output terminals, pure CW is applied from a signal generator to the receiver input through a 300-ohm non-inductive dummy antenna resistance. The output beat note is held at 1000 cycles (receiver tuned 1 kilocycle higher than signal). The regeneration control is set at standard oscillation (increased beyond critical oscillation to the point where the output drops 3 db or from 2.68 V. in 600 ohms at critical oscillation to 1.9 V. at standard oscillation). The "Sensitivity" control is set for 50 microwatts (0.173 V. in 600 ohms) noise output with no signal input. The microvolts input then required to produce 6 mw output (1.9 V. in 600 ohms) is measured.

NOTE: THE CRITICAL OSCILLATION POINT IS THAT ADJUSTMENT OF THE "REGENERATION" CONTROL PRODUCING THE MOST FEEBLE OSCILLATIONS, RESULTING IN MAXIMUM OUTPUT. THIS CONDITION IS USUALLY TOO CRITICAL TO EMPLOY AS AN OPERATING ADJUSTMENT BUT IS A REFERENCE SETTING FOR STANDARD AND MEASUREMENT COMPARISON.

11.1–2 It is to be expected that the sensitivity will vary from time to time due to atmospheric conditions, tube characteristics, external noise conditions, etc., so that unless the sensitivity is definitely low (as indicated by high input microvolts) no attempt should be made to improve performance.

11.2 Maximum Noise.

11.2–1 Figure 9 shows approximate values of maximum receiver noise level for the various bands. This data will be found useful for a rough check on sensitivity. The method of measurement is to adjust the receiver as for sensitivity (see 11.1), switch off the signal generator, increase the "Sensitivity" control to maximum and measure output noise voltage. The measured values of noise may be expected to vary considerably due to atmospheric conditions, tube characteristics, external noise conditions, etc., so that unless the noise output is definitely low, no attempt should be be made to improve performance and, in any case, the sensitivity should first be accurately checked as explained in Section 11.1.

11.2–2 If measuring equipment is not available, an approximate measurement may be made by adjusting the "Regeneration" control to critical oscillation and all other controls for maximum noise output. The antenna terminal should be connected to ground through a 300-ohm resistor preferably inside the receiver cabinet (to eliminate external noise pickup). In this case, the noise output should be approximately 3 db higher than the values shown in Figure 9. (This is twice the value of milliwatts shown therein.)

11.3 Selectivity and Overload Selectivity.

11.3–1 Figures 10, 11 and 12 show Selectivity and Overload ratios for each band. Curves (1) show the selectivity to 100% modulated interference when the receiver is operated for CW reception. They correspond closely with actual conditions at the middle of the band and represent an average for the band. This data is taken by first adjusting the receiver as for sensitivity measurement (par. 11.1) with 6 mw output at resonance. The signal is then modulated 30% and the frequency varied. The ratios of inputs off resonance (required to produce 6 mw output) to the normal (resonant) input are noted and the data corrected by multiplying by 3.33 to simulate 100% modulated interference.

11.3–2 Curves (2) of Figures 10, 11, and 12 show the overload selectivity characteristics for each band. These curves correspond closely with actual conditions at the middle of the band and represent an average for the band. This data is taken by first adjusting the receiver as for sensitivity measurement (par. 11.1). With the resonant signal being received, a CW interfering signal is applied at various frequencies off resonance and the ratios of inputs off resonance (required to reduce the resonant signal output by 3 db) to the normal (resonant) input are noted.

11.4 Calibration.

11.4–1 Figure 13 shows average frequency calibration curves and band coverage of this equipment. Table No. 2 gives the nominal frequency range of each band.

TABLE No. 2

Band	*Frequency Range (Megacycles)*	*Band*	*Frequency Range (Megacycles)*
1	0.3 — 0.49	6	3.4 — 5.5
2	0.49 — 0.8	7	5.5 — 8.8
3	0.8 — 1.33	8	8.8 — 14.3
4	1.33 — 2.08	9	14.3 — 23.0
5	2.08 — 3.4		

XII

MAINTENANCE—TROUBLE LOCATION AND REMEDY

12.1 General.

12.1–1 This equipment has been carefully adjusted at the factory for optimum performance and is designed to maintain this adjustment for long periods of time. If any major adjustments or repairs become necessary, it is recommended that such adjustments and repairs be made in a well equipped laboratory where the proper tools and measuring equipment are available. Before making any changes in receiver adjustment, it should be definitely ascertained that the difficulty being experienced is not the result of external or normal deteriorating influences such as worn out vacuum tubes, improper operating voltages, blown fuses, external noises, etc.

IN TESTING OR INSPECTING CIRCUITS IN THIS EQUIPMENT, CARE MUST BE EXERCISED NOT TO DISARRANGE R-F WIRING.

12.2 Equipment.

12.2–1 Where standard laboratory equipment is not available, the following equipment is recommended for use in locating troubles.

12.2–2 Radio Receiver Analyzing Equipment, Model OE (or equivalent), consisting of one Type 22193 DC Voltmeter/Milliammeter/Ohmmeter; one Type 22194 AC Voltmeter Capacity Meter; one Type 60001 Vacuum Tube Circuit Selector Unit.

12.2–3 Calibrated Test Oscillator, Model LN (or equivalent) — frequency range 0.3 to 23 megacycles.

12.3 Dead Receiver.

12.3–1 With "AVC-Off," "Audio Tuning-Off," "Audio-Broad" and "Sensitivity" control at maximum, increase the "Regeneration" control setting from minimum to maximum, depressing the "Osc. Test" button at intervals. If no clicks or noise outputs are heard in the phones on any band, the following procedure may be followed for location of trouble.

12.3–2 Check the vacuum tubes, particularly the detector tube.

12.3–3 Check the power supply (see 12.10).

12.3–4 Test the head phones and the output circuit wiring for short- or open-circuits.

12.3–5 Test the audio amplifier (see 12.11).

12.4 Weak Signals With Receiver Noise Level Normal.

12.4–1 If the receiver operates in a normal manner as indicated by the characteristic noise output (see 11.2) and no signals are in evidence, inspect the external antenna circuit.

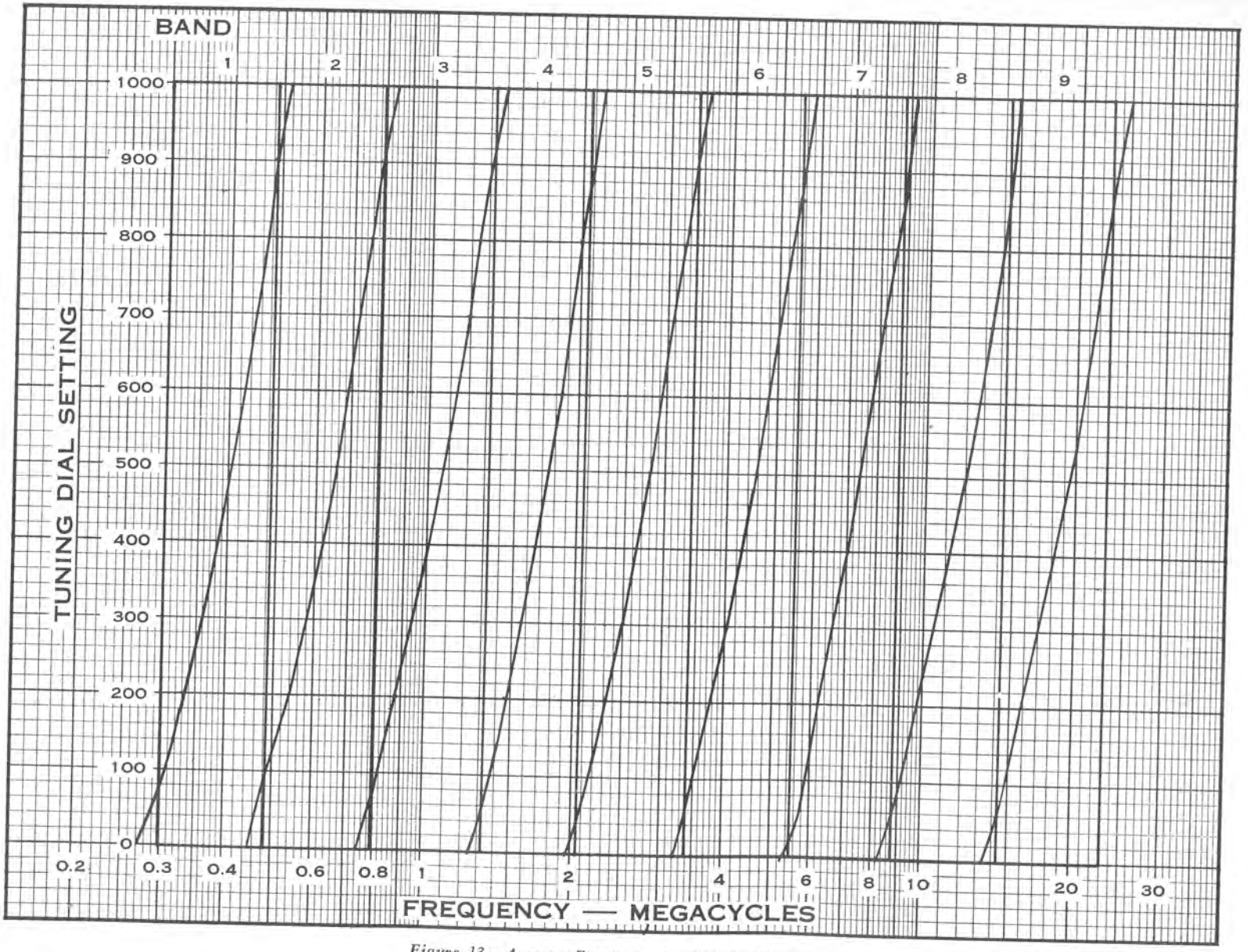


Figure 13—Average Frequency Calibration Curves

12.4–2 Withdraw the receiver partially from the cabinet and inspect the antenna connections.

12.5 Weak Signals With Detector Failing to Oscillate on All Bands.

12.5–1 With "AVC-Off," "Audio Tuning-Off" and "Audio-Broad," set the "Sensitivity" control at maximum, advance the "Regeneration" control and depress the "Osc. Test" button, noting whether the detector oscillates. If the detector fails to oscillate or oscillates with the "Regeneration" control near maximum on all bands, the following procedure should be followed:

12.5–2 Check the power supply (see 12.10).

12.5–3 Test the detector tube (see 12.13).

12.5–4 Test the detector tube socket voltages (see 12.14).

12.5–5 Test the detector circuit wiring (see 12.15).

12.5–6 Test the switch contacts (see 12.16).

12.6 Weak Signals with Detector Oscillating Normally.

12.6–1 Test the power supply (see 12.10).

12.6–2 Test the tubes (see 12.13).

12.6–3 If the power supply and the tubes are satisfactory and the receiver noise level is definitely low (see 11.2), the trouble may be located in the output circuit, audio amplifier or r-f amplifier.

12.6–4 Test the output circuit and the headphones for short- and open-circuits. If one side of the output circuit is grounded, the output will be reduced.

12.6–5 Test the audio amplifier (see 12.11).

12.6–6 Test the r-f amplifier (see 12.12).

12.7 Failure of Detector to Oscillate on Some Bands; Other Bands Normal.

12.7–1 If the detector oscillates normally on some of the bands, it may be assumed that the power supply and the tubes are satisfactory and that the trouble is due to faulty band switch contacts or failure in the wiring between the band switch and portion of circuits used in the inoperative bands.

12.7–2 Test the r-f (plate) and detector tube socket voltages, switching the "Frequency Band" switch on and off of the inoperative bands (see 12.14).

12.7–3 Test the detector circuit wiring on inoperative bands (see 12.15).

12.8 Weak Signals on Some Bands; Other Bands Normal—Detector Oscillating Normally on All Bands.

12.8–1 If normal operation is obtained on part of the bands as indicated by normal receiver noise level (see 11.2) and if the detector oscillates normally on all bands, the trouble is localized in the portion of the r-f circuits connecting to the band switch in the weak signal bands.

12.8–2 Test the r-f tube socket voltages, switching the "Frequency Band" switch on and off of the weak signal bands (see 12.14).

12.8–3 Test the r-f circuit wiring on the weak signal bands (see 12.15).

12.9 Panel Trimmer Controls.

12.9–1 Operation of these controls may be used as an indication of proper functioning of the associated tuned circuits.

12.9–2 In general, the setting for maximum response will vary for different bands and, in the case of the "Antenna Trimmer," for different antenna constants. These controls are designed to take care of normal minor variations in receiver alignment which occur over a period of time. A few divisions variation will normally occur over a given band due to slight mismatch of the inductances.

12.9–3 Failure of these controls to resonate the circuits, as indicated by maximum response on a signal or maximum noise output on all bands, indicates a defect in the respective circuits. Test the associated tube (see 12.13), tube socket voltages (see 12.14), and circuit continuity (see 12.15).

12.9–4 Failure of these controls to resonate the circuits on a particular band (other bands operating normally) indicates defects in the portion of the respective circuits connecting to the band switch on the particular band. Test tube socket voltages (see 12.14), switching the "Frequency Band" switch on and off of the inoperative band. If the voltages and circuit continuity are correct, the receiver alignment should be investigated (see 12.17).

12.9–5 An abnormally large change in either trimmer setting over a given band or failure to resonate at only one end of a band indicates that the tuning condenser section or the inductance used in the particular circuit and band has been damaged. If both trimmer settings change in the same direction over a band, this may indicate that the detector tuning condenser or inductance is at fault. (Refer to paragraph 12.17.)

12.10 Power Supply.

12.10–1 If trouble is traced to the power supply, the following procedure may be followed:

12.10–2 Note the receiver panel voltmeter reading. This meter should read approximately 6 V. for normal operation and indicates the filament voltage which is obtained from a winding on the power transformer in the power unit. This also indicates that power is being supplied to the power unit and thus serves as a "power on" indicator.

12.10–3 If no voltage is indicated (assuming that the meter is not defective), test the a-c line voltage and fuses in the a-c line, control unit and power unit. Refer to Figure 16.

12.10–4 Partially remove the receiver from the cabinet and check the voltage at the power terminal board. Refer to Figure 16. The terminals are numbered from 1 to 9, No. 1 being nearest the panel. These voltages should measure approximately as follows:

TABLE No. 3—RECEIVER TERMINAL VOLTAGES

Terminal	*Voltage*
1 or 9 to 6	180 V. D.C.
1 or 9 to 5	90 V. D.C.
2 to 3	5.9 V. A.C.

12.10–5 If the above voltages fail to check, test the a-c power supply voltage. Partially remove the power unit from its case and measure the power unit terminal voltages. Refer to Figure 16. The power unit terminals are numbered from 1 to 6, No. 1 being nearest the panel. These voltages should measure approximately as follows:

TABLE No. 4

POWER UNIT TERMINAL VOLTAGES

Terminal	*Voltage*
1 to 5	180 V. D.C.
1 to 4	90 V. D.C.
2 to 3	5.9 V. A.C.

12.10–6 If the above voltages fail to check and the line input voltage and fuses are operative, test the power unit tubes (see 12.13).

12.10–7 Test the power unit circuits for continuity (see 12.15).

12.11 Audio Amplifier.

12.11–1 To determine if the audio amplifier is operating, partially withdraw the receiver from the cabinet and touch the grids of the detector and first a-f tubes. Pronounced clicks should be heard in the phones.

12.11–2 If the above test indicates a defect in the amplifier circuit with satisfactory power supply (see 12.10) and output circuit connections (see 12.3–3), the audio tubes should be checked (see 12.13) and the audio circuits tested (see 12.15).

12.11–3 If in the test of 12.11–1, a pronounced click is obtained when the first audio grid is touched, but touching the detector grid gives no indication, the trouble is located in the portion of the circuit between these two points.

12.11–4 If measuring equipment is available, the audio gain may be checked by application of 1000-cycle input to the first audio grid. The input required for zero level (6 milliwatts) output should be approximately 0.015 volt.

12.12 R-F Amplifier.

12.12–1 A defective r-f amplifier may be detected by abnormal operation of the trimmer controls (see 12.9), "Sensitivity" control, or by first ascertaining that the remainder of the circuit is operative.

12.12–2 With the "Sensitivity" control at minimum, a barely audible hum should be noted and it should be possible to hear the detector go into oscillation if the "Regeneration" control is advanced rapidly. With the detector oscillating, the characteristic double click should be heard when the "Osc. Test" button is depressed. Further tests indicating normal operation of detector output and audio amplifier circuits are noted under 12.11.

12.12–3 If a fault is located in the r-f amplifier by the above methods with normal power supply (see 12.10) and antenna connections (see 12.4–2), it should be determined whether the trouble exists on all bands or on only one or more particular bands.

12.12–4 If the trimmer operation is not normal, refer to paragraph 12.9.

12.12–5 If the trimmer operation is normal and low sensitivity as indicated by the tests outlined in paragraph 11.1 is obtained on all bands, test the r-f amplifier tubes (see 12.13), socket voltages (see 12.14) and circuit continuity (see 12.15).

12.12–6 If trouble is located on a particular band or bands with other bands operating normally, check the socket voltages (see 12.14) and circuit continuity (see 12.15), switching the "Frequency Band" switch on and off of the inoperative band. Check the "Frequency Band" switch (see 12.16).

12.12–7 Before making extensive circuit tests, an attempt should be made to localize the trouble in the first or second amplifier stage. This may be done by applying input from a test oscillator to the respective grids.

12.13 Tube Characteristics.

12.13–1 If trouble is traced to tubes in a portion of the circuit, the trouble may be quickly checked by replacing the doubtful tube with a tube of known characteristics and rechecking the performance of the equipment.

12.13–2 Tubes may be tested for open heaters or shorts between elements by use of a continuity meter or click test with the precaution that the rated voltage of the filament is not exceeded.

12.13–3 Tubes will be found to deteriorate gradually with use, resulting in a gradual reduction in performance of the equipment. It is therefore advisable to replace tubes after 1000 hours of service or to measure them at regular intervals to determine if the limit of serviceability has been reached. Table No. 5 gives standard characteristics for the tubes used in this equipment and low limits of "emission" and "transconductance." Test of "emission" is usually sufficient to indicate the condition of a tube, but a better correlation between test results and actual conditions is obtained by measurement of "transconductance." Actual operating voltages on the tubes as used in this equipment are appreciably lower than the ratings shown in the table so that extended tube life is assured.

TABLE No. 5—TUBE CHARACTERISTICS

Tube Type	Fil. Volts	Fil. Current (Amps.)	Plate Volts	Screen Volts	Grid Bias Volts	Plate Current (MA.)	*Emission Current (MA.)	Screen Current (MA.)	AC Plate Resistance (Ohms)	Ampl. Factor	Average Transcond. (Micromhos)
-6D6	6.3	0.3	250	100	– 3	8.2	100	2.0	800,000	1280	1600
-41	6.3	0.4	250	250	–18	32	200	5.5	68,000	150	2200
-874	..	..	90	..	..	30	..	(striking voltage 125 V.)			
-876	50	1.7	..	..	..	..	..	..	.....	....	....
-5Z3	5.	3.0	..	..	..	..	240	..	.....	....	....
-5Z3	(AC voltage per plate 500 RMS—Max. DC Output Current 250 M.A.)										

Tube Type	Low Limits *Emission (MA.)	Low Limits Transconductance (Micromhos)
-6D6	50	1200
-41	70	1300
-874	..	....
-5Z3	..	....
-5Z3	190	....

* For "emission" tests, all grids are connected to the plate and are 50 volts positive with respect to the cathode or filament, except the Type -5Z3 tube on which a potential of 40 volts is used with both plates connected together.

12.13–4 Measurement of "emission" and "transconductance" is not always an absolute indication of the condition of tubes for their various applications, particularly in the case of detector tubes and AVC tubes. An unsatisfactory detector tube is best indicated by its oscillating properties. A tube which does not function properly in the detector stage may often be used in an amplifier stage without loss in performance. A low output tube may often be utilized in the AVC position.

12.14 Tube Socket Voltages.

12.14–1 Measurement of socket voltages may be used as a check on power supply and receiver circuit connections.

12.14–2 The following table gives average tube socket voltages for this equipment. These voltages are not operating voltages and will vary considerably with different types of volt-meters. The values stated below apply for the Model OE Radio Receiver Analyzing Equipment.

TABLE No. 6—TUBE SOCKET VOLTAGES

Due to the change in load when one tube is removed, the voltages measured at the tube sockets are somewhat higher than the corresponding voltages of Tables 3 and 4.

Tube Type	*Function*	*Plate*	*Screen*	*Supp.*	*Cath.*	*Grid*	*Heater*
-6D6	1st RF	190	90	0	0	0	6
-6D6	2nd RF	175	90	0	0	0	6
-6D6	Detector	150	45	0	0	0	6
-6D6	Audio	185	170	0	0	0	6
-41	Output	200	200	. .	0	0	6
-41	AVC	0	0	. .	185	0	6

In making the above measurements, the receiver should be operated at normal supply voltage and allowed to warm up for approximately 10 minutes before taking readings. Readings are taken by removing one tube at a time and measuring voltages between the socket terminals and ground. Set "AVC Level-10," "AVC-Off," "Regeneration-10," "Sensitivity-10," "Audio Tuning-Off," "Audio-Broad." Figure 14 shows socket terminal arrangements.

TABLE No. 6a—TUBE OPERATING VOLTAGES AND CURRENTS

Tube	*Function*	*Plate* E	*Plate* MA.	*Screen* E	*Screen* MA.	*Cathode* E	*Supp.* E	*Heater* E	*Note*
-6D6	1st RF	140	4.5	72	1.2	3–40	3–40	5.8 (AC)	1
-6D6	2nd RF	80	4.5	72	1.1	3–40	3–40	5.8 (AC)	1
-6D6	Detector	50–140	0.0–2.5	17–30	0.0–0.4	0	17–30	5.8 (AC)	2
-6D6	Audio	24	1.2	27	0.3	1.5	1.5	5.8 (AC)	
-41	Output	115	11.0	120	1.75	7.5	——	5.8 (AC)	
-41	AVC	0	0	0	0	180	——	5.8 (AC)	3
-5Z3	Rectifier	230 AC — from each plate to ground.						4.9 (AC)	

The above are average operating voltage and current values as obtained by measurement with a Model OE Radio Receiver Analyzing Equipment. Readings were taken under the following test conditions: Receiving Equipment in normal operative condition, antenna disconnected, line voltage 115, current-regulator tube IN, "AVC-Off," "Sensitivity" control on 10 (see Note 1), "Regeneration" control on 5 (see Note 2), "Frequency Band" switch on "1," and "Tuning" control on 0–0. DC voltages measured to heater (ground).

Note 1. Cathode to heater voltage varies with position of "Sensitivity" control. Average limits are shown.

Note 2. Detector voltages and currents vary with position of "Regeneration" control. Average limits are shown.

Note 3. Cathode to heater voltage measured with "AVC Level" control at maximum.

For the above measurements with Model OE Radio Receiver Analyzing Equipment, the lowest possible voltmeter scale should be used, as follows:

Voltages	*Meter*	*Resistance*	*Voltages*	*Meter*	*Resistance*
0/1	0/1	20,000	10/25	0/25	500,000
1/2.5	0/2.5	50,000	25/50	0/50	1,000,000
2.5/5	0/5	100,000	50/100	0/100	2,000,000
5/10	0/10	200,000	100/250	0/250	5,000,000

The color code used for bus wiring between the "Frequency Band" switch and coils is shown in the following table:

TABLE No. 7
BUS WIRING COLOR CODE

Ant. and plate leads	Red
Tuned circuit "high"	White
Tuned circuit "low" (taps)	Green
Det. cathode circuit	Blue
Bands 1 4 7	1 dot
2 5 8	2 dots
3 6 9	3 dots

In cases where a single lead is used for more than one band, the number of dots correspond with the lowest frequency band for which the lead is used.

12.14–3 If trouble exists on a particular band, the tube socket voltages should be measured on both the inoperative band and on an operative band to indicate which portion of the circuit is at fault.

12.14–4 If a source of trouble is localized in a particular portion of the circuit by the above analysis, this portion of the circuit should be tested for continuity and inspected (see 12.15).

12.15 Circuit Continuity.

12.15–1 After tracing a fault to a particular portion of the circuit by the foregoing tests, the circuit should be systematically inspected, tested for continuity, short circuits, ground or failure of component parts, with power off. Refer to following drawings:

Diagram	*Figure*
Receiver Unit Schematic	17
Receiver Unit Connection	20
Power Unit Schematic	18
Power Unit Connection	21

12.15–2 If an ohmmeter is available, point-to-point resistance measurements will be useful in locating faults. The following tables indicate the approximate resistances in this equipment.

TABLE No. 8—RECEIVER UNIT POINT-TO-POINT RESISTANCES

Points		*Resistance*		*Condition*
Terminal No. 6 to	1st RF plate	10,000	ohms	
" "	2nd RF plate	20,000	ohms	
" "	Detector plate	30,000	ohms	
" "	Audio plate	120,000	ohms	
" "	Output plate	5,125	ohms	"AVC-Off"
" "	Output plate	4,800	ohms	"AVC-On"
" "	AVC cathode	0		"AVC Level — 10"
" "	AVC cathode	9,740		"AVC Level — 0"
" "	1st RF screen	18,000	ohms	
" "	2nd RF screen	18,000	ohms	
" "	1st AF screen	500,000	ohms	
" "	Ground	9,740	ohms	
Terminal No. 5 to	Detector screen	28,800	ohms	"Regeneration — 10"
Ground to	Detector screen	10,000	ohms	"Regeneration — 0"
" "	1st RF grid	110.5		"Frequency Band — 1"
" "	2nd RF grid	1.0	megohms	
" "	Detector grid	2.2	megohms	
" "	Audio grid	100,000	ohms	
" "	Output grid	1.0	megohms	
" "	AVC-screen grid plate	3,500	ohms	
Terminal No. 7 to No. 8		40	ohms	"Add Decibels Off"
Ground to No. 7		20	ohms	"Add Decibels Off"
" " " 8		20	ohms	"Add Decibels Off"

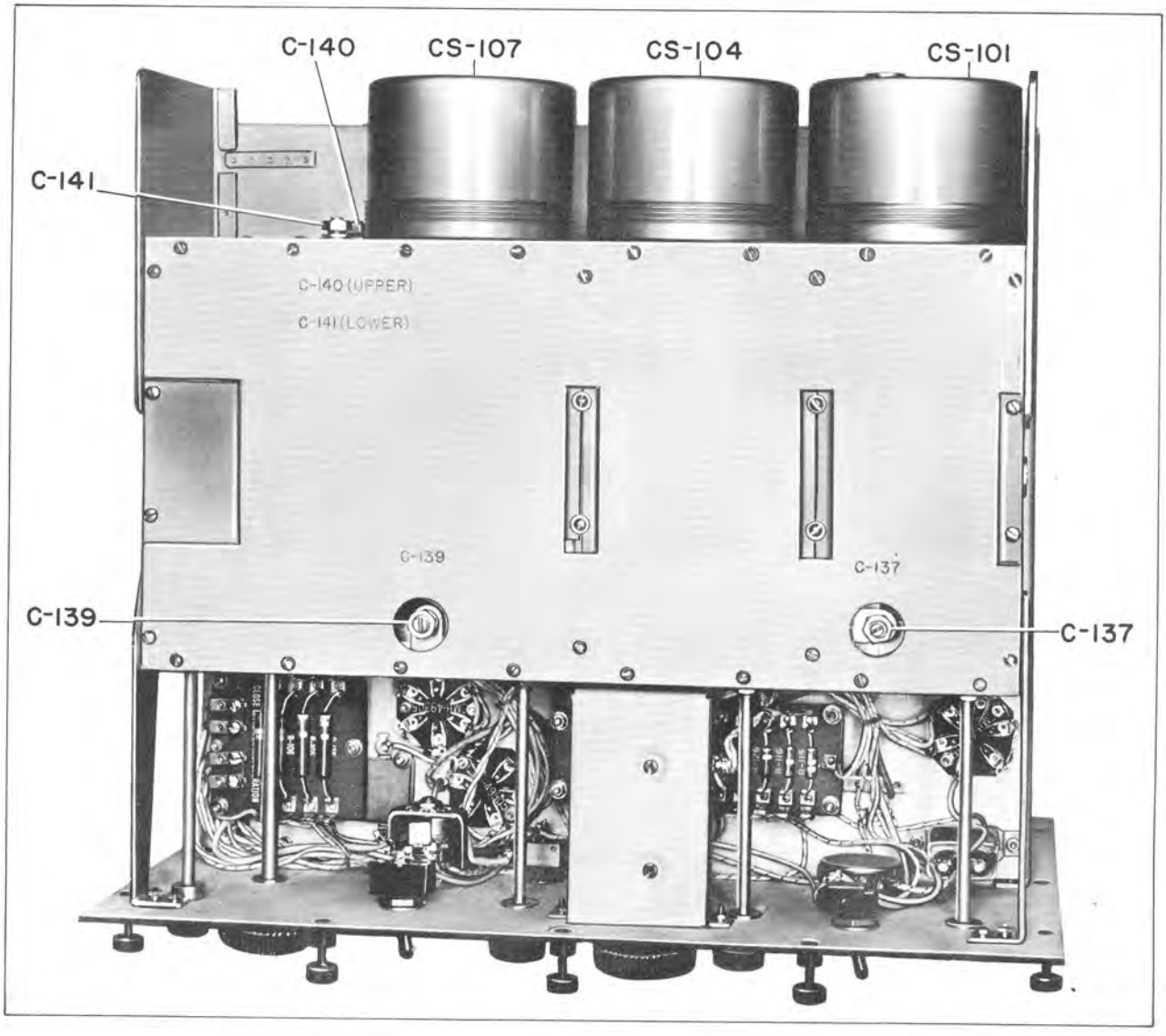


Figure 14—Receiver Unit CMX-46156-A (Bottom View of Chassis)

The above values apply for the receiver unit alone — external cables disconnected, all tubes out of sockets, and receiver set on "Frequency Band—1," and "Tuning—0."

12.15–3 Power unit point-to-point resistances are approximately as noted in the following table:

TABLE No. 9

POWER UNIT POINT-TO-POINT RESISTANCES

Points	*Resistance*	*Condition*
Terminal No. 2 to No. 3	1.0 ohms	
Terminal No. 1 to No. 5	20,000 ohms	
Terminal No. 1 to No. 4	23,000 ohms	
-5Z3 socket (fil. to fil.)	0.15 ohms	
-5Z3 socket (plate to plate)	250 ohms	
R-H power line terminals	Infinite	"On-Off Switch—"Off"
R-H power line terminals	7.0 ohms	"On-Off Switch—"On"
Power terminals to ground.....	Infinite	

Above values apply for the power unit alone (external cables and wiring disconnected) with all tubes in sockets and with current-regulator tube "In" (the condition of operation of the power unit with this equipment).

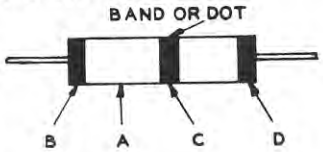
12.15–4 Component parts may be identified by cross reference from the item numbers in Figures 17 and 18.

12.15–5 Carbon resistors may be identified by color code as follows:

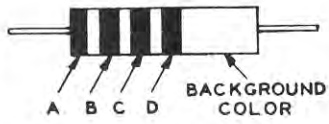
TABLE No. 10—RMA COLOR CODE FOR RESISTORS

Color	*A 1st Digit*	*B 2nd Digit*	*C Ciphers*
Black	. .	0	.0
Brown	1	1	0
Red	2	2	00
Orange	3	3	000
Yellow	4	4	0000
Green	5	5	00000
Blue	6	6	000000
Purple	7	7	0000000
Grey	8	8	00000000
White	9	9	. . . . .

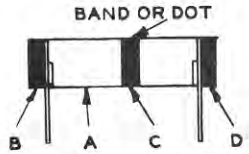
D—Tolerance Code
Gold: 5%
Silver: 10%
Omit: 20%



Original Color Arrangement for Axial Leads



New Color Arrangement for Axial Leads



Standard Color Arrangement for Radial Leads

12.16 "Frequency Band" Switch.

12.16–1 To inspect the "Frequency Band" switch and circuit connections, the large plate on the bottom of the chassis may be removed. This switch has been carefully aligned at the factory, the four contacts on each section being accurately adjusted for equalized pressure and maximum contact area. Readjustment of the switch should rarely be found necessary.

IF ANY MAJOR REPAIRS ON THE SWITCH ASSEMBLY BE FOUND NECESSARY, SUCH REPAIRS SHOULD BE MADE IN A WELL EQUIPPED LABORATORY SINCE SERIOUS MECHANICAL MISALIGNMENT OF THE CONTACTS OR MISALIGNMENT OF HIGH-FREQUENCY INDUCTANCES DUE TO DERANGEMENT OF R-F WIRING MAY RESULT.

In order to readjust or replace switch parts and for access to switch wiring, it will be necessary to remove the switch retaining brackets mounted inside the switch compartments at the bottom of the chassis. After removal of the large plate on the bottom of the chassis, the switch retaining bracket for a particular compartment may be removed without removing the brackets for other compartments. The brackets are mounted by means of screws at the partition shields.

When the switch retaining bracket is replaced, the switch stator sections must be first accurately positioned so that the movable contacts exactly center on the fixed contacts when the switch is set to positions determined by the detent. The retaining bracket is then mounted in position with the adjusting screws backed off. Finally, the adjusting screws must be screwed in to just touch the stators, then backed off to leave a very slight clearance (approximately .005 in.), then locked by means of the lock nuts. UNDER NO CONDITION SHOULD SCREWS EXERT FORCE AGAINST THE STATORS AS THIS WILL CAUSE BENDING, WITH CONSEQUENT BINDING OF THE SWITCH SHAFT.

CAUTION: DO NOT ALIGN BY MEANS OF SCREWS.

12.16–2 Switch contacts may be tested by pressing the movable contact down on its fixed contact with a tool of insulating material. Associated circuits should be checked for loose contacts before disturbing the switch assembly.

12.16–3 The switch is self-cleaning and should wipe itself clean if rotated back and forth over the questionable contact several times. Should further cleaning become necessary, the rotating member may be pressed down against the fixed member far enough to permit disengaging the "C" washer from its slot in the rotating hub at the back of the fixed member. If the "C" washer is removed, the rotating member may be slid along the shaft away from the fixed member permitting access to the contacts. Care must be taken not to compress the springs farther than necessary or they will require readjustment.

12.16–4 Should necessity of replacing a switch section arise, the switch shaft must be removed, the switch section connections unsoldered at the switch plate, the new section inserted, connections soldered, and switch shaft replaced. Receiver alignment should then be checked (see 12.17). To remove switch shaft, remove taper pin

fastening the bevel gear to the switch shaft. Remove the bearing bushing at the end of the shaft opposite the drive and slide the shaft out, taking care that none of the switch sections are binding on the shaft. When replacing the shaft, see that the bevel gears are properly meshed to provide alignment between switch position and position indicated by the panel control before pinning.

12.17 Receiver Alignment.

12.17–1 Receiver alignment may be readily checked by observing operation of the panel trimmers (see paragraph 12.9 and Figure 6). These trimmers should resonate the respective tuned circuits at any point in their range. A rough indication may be obtained by noting the increase in receiver noise level as the trimmers are tuned through resonance. For accurate alignment check, the receiver must be adjusted as for sensitivity measurements (see 11.1). This adjustment may be approximated with sufficient accuracy for most purposes by setting the "Sensitivity" control at "9" and the "Regeneration" control at approximately ½ division above critical oscillation.

12.17–2 Bands 1-2-3. Adjust trimmer C-141 to bring the panel "RF Trimmer" settings for the high-frequency ends of bands 1, 2 and 3 as near zero as possible.

12.17–3 Bands 4-5-6. Adjust trimmer C-140 to bring the panel "RF Trimmer" settings for the high-frequency ends of bands 4, 5 and 6 as near zero as possible.

12.17–4 Bands 7-8-9. Adjust trimmer C-139 to bring the panel "RF Trimmer" settings for the high-frequency ends of bands 7, 8 and 9 as near zero as possible. Set trimmer C-137 to bring panel "Antenna Trimmer" settings for the high-frequency ends of bands 7, 8 and 9 as near zero as possible.

12.17–5 The following table gives nominal frequencies and approximate dial settings which should be used in aligning the receiver.

TABLE No. 11
ALIGNING FREQUENCIES

Band	*Nominal Frequency (KC)*	*Dial Setting (Approx.)*
1	300- 490	78-892
2	490- 800	89-896
3	800- 1,330	85-898
4	1,330- 2,080	64-847
5	2,080- 3,400	57-885
6	3,400- 5,500	69-880
7	5,500- 8,800	58-910
8	8,800-14,300	73-912
9	14,300-23,000	83-858

12.17–6 As noted in paragraph 12.9–5, an abnormal change in either trimmer setting over a given band, or failure to resonate at only one end of a band indicates that the tuning condenser section or the inductance used in the particular circuit and band has been damaged. If both trimmer settings change in the same direction over a band, this may indicate that the detector tuning condenser or inductance is at fault. Such conditions on the higher frequency bands may result if the wiring between the band switch and tuned circuit inductances is disarranged.

UNLESS THESE CONDITIONS SERIOUSLY IMPAIR OPERATION, NO ATTEMPT SHOULD BE MADE TO REPAIR INDUCTANCE OR TUNING CAPACITOR ALIGNMENT OR REPLACE COILS. THESE OPERATIONS SHOULD VERY RARELY BECOME NECESSARY AND SHOULD BE DONE ONLY IN A WELL EQUIPPED LABORATORY.

12.18 Lubrication.

12.18–1 Mechanical moving parts such as the tuning condenser drive mechanism, band switch drive mechanism, and bearings should be periodically inspected and, if necessary, lightly greased with a non-fluid mineral oil or light grease such as grade A of Navy Department specification 14G 1. Lubrication of electrical contacting surfaces is not advisable unless tendency for cutting appears; when required, a light grease such as vaseline should be used very sparingly, all surplus grease being removed.

12.19 Cleaning.

12.19–1 ABRASIVE SUBSTANCES SUCH AS EMERY CLOTH, STEEL WOOL, ETC., SHOULD NEVER BE USED FOR CLEANING IN OR ABOUT ANY PART OF THIS EQUIPMENT.

NAVY TYPE NUMBER	NAME OF MAJOR UNIT	PART DESIGNATION GROUP
CMX-46156-A	Receiver Unit for Model RAL-8 Equipment	101–199
CMX-20131-A	Power Unit for Model RAL-8 Equipment	201–299
CMX-23073-A	Control Unit for optional use with Models RAK-8 and RAL-8	301–399

13.1 TABLE No. 12
PARTS LIST BY SYMBOL DESIGNATIONS
Receiver Unit CMX-46156-A

Symbol Desig.	Sub	Function	Description	Navy Type No.	Navy Spec. or Dwg.	Manufacturer	Mfg. No.	Magnavox Drawing No.
			CAPACITORS					
*C-101		Antenna series capacitor used with COMMON antenna connection	Molded mica, 400 mmf. ±10%, 500 V. D.C. (working)			Sangamo		B250073G145
C-102	A	Main tuning on 1st R.F. stage	3-gang variable 25.3 ± 1 to 207 ± 5 mmfd. per section			Hammarlund Mfg. Co.		XD260037G2
	B	Main tuning on 2nd R.F. stage						
	C	Main tuning on detector stage						
*C-103		ANTENNA TRIMMER on 1st R.F. stage	Variable air trimmer, 5.3 to 27 mmf. ±5%, 4 plates	§-48575		Hammarlund or Bud Radio		B260036G1
*C-104	A	Cathode R.F. filter by-pass on 1st R.F. tube	Paper, oil-filled, 2-section 0.125—0.125 mfd. ±15%, 500 V. D.C. (working)	CBV-48555-15	RE-13A-488	John E. Fast Co.		B250102G1
	B	Screen R.F. filter by-pass on 1st R.F. tube						
*C-105		R.F. TRIMMER on 2nd R.F. stage	Variable air trimmer, 3.4 mmfd. (approx.) to 17.5 mmfd. ±5%, 3 plates	§-48573		Hammarlund or Bud Radio		B260037
*C-106		Grid coupling between 1st and 2nd R.F. stages	Molded mica, 510 mmf. ±5%, 500 V. D.C. (working)			Micamold, Sangamo or Solar		C250107G1064
*C-107		Plate supply by-pass on 1st R.F. tube	Molded mica, .01 mfd. ±10%, 600 V. D.C. (working)			Micamold and Sangamo		C250106G1148
*C-108	A	Cathode R.F. filter by-pass on 2nd R.F. tube	Same as C-104	CBV-48555-15				
	B	Screen R.F. filter by-pass on 2nd R.F. tube						C250111G1046
*C-109		Filter by-pass on screen of 2nd R.F. tube	Molded mica, .01 mfd. ±10%, 300 V. D.C. (working)					
*C-110		Plate supply by-pass on 2nd R.F. tube	Paper, oil-filled, 0.1 mfd. ±10%, 500 V. D.C. (working)	CBV-48552-10	RE-13A-488	John E. Fast Co.		B250101G5
*C-111		FREQUENCY VERNIER on detector circuit	Variable air trimmer, 2 plates	§48574				B260038

* Spare parts furnished for all items preceded by an asterisk.
§ CHC or CDB.

Symbol Desig.	Sub	Function	Description	Navy Type No.	Navy Spec. or Dwg.	Manufacturer	Mfg. No.	Magnavox Drawing No.
*C-112		Grid coupling between 2nd R.F. and det. stages	Same as C-106					
*C-113		Heater R.F. filter by-pass on detector tube	Same as C-109					
*C-114		Heater R.F. filter by-pass on detector tube	Same as C-109					
*C-115		Heater R.F. filter by-pass on detector tube	Same as C-109					
*C-116		Heater R.F. filter by-pass on detector tube	Same as C-109					
*C-117		Filter by-pass on screen and suppressor of detector tube	Paper, oil-filled, 1.0 mfd. ±10%, 250 V. D.C. (working)	CBV-48553-10	RE-13A-488	John E. Fast Co.		B250101G3
*C-118		Filter by-pass on screen and suppressor of detector tube	Same as C-117	CBV-48553-10				
*C-119		Used in parallel with C-117 as a screen-suppressor or filter by-pass on detector tube	Same as C-110	CBV-48552-10				
*C-120		Detector plate circuit R.F. filter by-pass	Molded mica, 51 mmf. ±5%, 500 V. D.C. (working)					C250107G2040
*C-121		Detector plate circuit R.F. filter by-pass	Same as C-120					
*C-122		Detector plate filter by-pass	Same as C-117	CBV-48553-10				
*C-123		Coupling capacitor between detector plate circuit and 1st audio grid	Same as C-107					
*C-124		Plate by-pass on 1st audio tube	Molded mica, .001 mfd. ±10%, 2500 V. D.C. (working)					C250106G1136
*C-125		Coupling capacitor between 1st audio and output tubes	Same as C-124					
*C-126		Cathode by-pass on 1st audio tube	Same as C-117					B250101G3
*C-127		Screen by-pass on 1st audio tube	Same as C-117	CBV-48553-10				
*C-128		Screen and plate by-pass on output tube	Same as C-117	CBV-48553-10				
*C-129		Plate filter by-pass on 1st audio tube	Same as C-117	CBV-48553-10				
*C-130		Cathode by-pass on output tube	Same as C-117	CBV-48553-10				
*C-131		Cathode by-pass on output tube	Same as C-117	CBV-48553-10				
*C-132		Cathode by-pass on output tube	Same as C-117	CBV-48553-10				
*C-133		Plate by-pass on output tube	Same as C-107					
*C-134		Cathode by-pass on AVC tube	Same as C-117	CBV-48553-10	RE-13A-488	John E. Fast Co.		B250101G3

* Spare parts furnished for all items preceded by an asterisk.

13.1 TABLE No. 12 (Continued)
PARTS LIST BY SYMBOL DESIGNATIONS
Receiver Unit CMX-46156-A

Symbol Desig.	Sub	Function	Description	Navy Type No.	Navy Spec. or Dwg.	Manufacturer	Mfg. No.	Magnavox Drawing No.
*C-135	A	Input filter by-pass on 90-volt "B" supply	Same as C-104	CBV-48555-15				
	B	Input filter by-pass on 180-volt "B" supply						
*C-136	A	Input filter by-pass on 6-volt positive supply	Same as C-104	CBV-48555-15				
	B	Input filter by-pass on 6-volt negative supply						
*C-137		H.F. alignment on bands 7, 8 and 9 of antenna 1st R.F. stage	Variable air trimmer, 5.5 to 35 mmf. ±10%, 5 plates	§48576		Hammarlund or Bud Radio		B260036G2
*C-138		Aux. plate filter by-pass in parallel with C-107 on 1st R.F. tube on L.F. bands 1, 2 and 3 only	Same as C-110	CBV-48552-10				
*C-139		Detector coil alignment capacitor on bands 7, 8 and 9	Same as C-137	§48576				
*C-140		Detector coil alignment capacitor on bands 4, 5 and 6	Variable air trimmer, 3.5 +0% −20% to 13.7 +20% −0%, 4 plates	□-48582				B260035G3
*C-141		Detector coil alignment capacitor on bands 1, 2 and 3		□-48582				
*C-142		Detuning cap. on pri. winding of L.F. detector coil when band 7 is used	Same as C-106					
*C-143		Series tuning capacitor used with variable attenuator L-114	Paper, oil-filled, .025 mfd. ±10%, 600 V. D.C. (working)	CBV-48806-10				B250101G1
*C-144		Series tuning capacitor used with variable attenuator L-114	Paper, oil-filled, .075 mfd. ±10%, 600 V. D.C. (working)	CBV-48807-10				B250101G2
*C-145		Output cable filter by-pass	Same as C-109					
*C-146		Output cable filter by-pass	Same as C-109					
*C-147		Output jack filter by-pass	Same as C-109					
*C-148		Output jack filter by-pass	Same as C-109					
			COIL SHIELDS					
CS-101		Shield for L-101	Coil shield, copper, threaded, 4″ dia., 3″ long			Aluminum Goods Co.		B631270G2
CS-102		Shield for L-102	Coil shield, copper, threaded, 3″ dia., 4½″ long			Aluminum Goods Co.		B631270G1

* Spare parts furnished for all items preceded by an asterisk.
§ CHC or CDB.
□ COC or CBK.

Symbol Desig.	Sub	Function	Description	Navy Type No.	Navy Spec. or Dwg.	Manufacturer	Mfg. No.	Magnavox Drawing No.
CS-103		Shield for L-103	Coil shield, aluminum, threaded, 2¼" dia., 4⅛" long			Aluminum Goods Co.		631268
CS-104		Shield for L-104	Same as CS-101					
CS-105		Shield for L-105	Same as CS-102					
CS-106		Shield for L-106	Same as CS-103					
CS-107		Shield for L-107	Same as CS-101					
CS-108		Shield for L-108	Same as CS-102					
CS-109		Shield for L-109	Same as CS-103					
			JACKS					
J-101		Headphone connection	Telephone jack, 4-spring, 2-circuit	CTC-49021	RE-13A-481D	Chicago Tel. Supply		A180278
J-102		Antenna jack	Concentric jack, accommodates concentric plug Navy Type 49121	CN-49120		National Electric Machine Shops		XB180315G2
			INDUCTANCES					
L-101		Ant. coupling coil and 1st RF tuned circuit inductance for L.F. bands 1, 2 and 3	Coil, r-f, comprising 4 windings on steatite ceramic tube 1" dia. x 2⅝" long with 5 terminals. 1st, 3rd and 4th sections universal wound with litz (10/A.W.G. No. 41 E.) D.S.C. wire using 4 crosses per turn and ⅛" wire traverse; 2nd section single-layer close wound with A.W.G. No. 30 E.S.S.C. wire. Spacing 1 3/16" from terminal end of tube to 1st section, 1/32" between 1st and 2nd sections, ⅜" between 1st and 3rd sections, and 1/16" between 3rd and 4th sections. 1st Section: 70 turns; 2nd Section: 5 turns; 3rd and 4th Sections: 90 turns each			Meissner or Sickles		C360146G1
L-102		Ant. coupling coil and 1st RF tuned circuit inductance for bands 4, 5 and 6	Coil, r-f, comprising 4 single-layer windings on steatite ceramic threaded (32/inch) tube 1½" dia. x 4" long with 5 terminals. 1st, 2nd and 3rd sections wound in thread with A.W.G. No. 26 E. wire; 4th section wound in groove with A.W.G. No. 30 E. wire. 1st Section: 15 turns, started 1 5/32" from terminal end and wound toward opposite end skipping 4 threads upon completing 4¾ turns; 2nd Section: 16 turns, started 1 27/32" from terminal end and wound toward opposite end skipping 4 threads upon completing 11¾ turns; 3rd Section:			Meissner or Sickles		C360143

13.1 TABLE No. 12 (Continued)
PARTS LIST BY SYMBOL DESIGNATIONS
Receiver Unit CMX-46156-A

Symbol Desig.	Sub	Function	Description	Navy Type No.	Navy Spec. or Dwg.	Manufacturer	Mfg. No.	Magnavox Drawing No.
			31 turns, started 2 9/16" from terminal end and wound toward opposite end skipping 4 threads upon completing 28 turns; 4th Section: 5 turns in groove 0.063" deep and located approx. 1 25/32" from terminal end					
L-103		Ant. coupling coil and 1st RF tuned circuit inductance for H.F. bands 7, 8 and 9	Coil, r-f, comprising 2 single-layer windings on steatite ceramic threaded (16/inch) tube 1" dia. x 3 1/4" long with 6 terminals. 1st section wound in thread with A.W.G. No. 17 E. wire; 2nd section wound in groove with A.W.G. No. 30 E.S.S.C. wire. 1st Section: 15 turns, started 1 3/8" from terminal end and wound toward opposite end with taps at 8th and 12th turns; 2nd Section; 2-6/7 turns in groove 0.060" deep and located 1 9/16" from terminal end			Meissner or Sickles		XC360140
L-104		Pri. and 2nd RF tuned circuit inductance for L.F. bands 1, 2 and 3	Coil, r-f, same as L-101 except 2nd section universal wound and spaced 1/8" from 1st section. 2nd section consists of 20 turns A.W.G. No. 30 E.S.S.C. wire with 4 crosses per turn and 1/16" wire traverse			Meissner or Sickles		C360146G2
L-105		2nd RF tuned circuit inductance for bands 4, 5 and 6	Coil, r-f, comprising 3 single-layer windings on steatite ceramic threaded (32/inch) tube 1 1/2" dia. x 4" long with 5 terminals. Sections same as in L-102 except as noted below. 1st Section: Same as 1st section of L-102 except with 4-thread skip in winding at 3 3/4 turns and tap brought out at end of next 9 turns; 2nd Section: Same as 2nd section of L-102 except with 4-thread skip in winding at 12 1/4 turns; 3rd Section: Same as 3rd section of L-102 except 32 turns and 3-thread skip in winding upon completing 27 1/4 turns			Meissner or Sickles		C360144
L-106		2nd RF tuned circuit inductance for H.F. bands 7, 8 and 9	Coil, r-f, single-layer winding on steatite ceramic threaded (16/inch) tube 1" dia. x 3 1/4" long with 4 terminals. Winding same as 1st section of L-103			Meissner or Sickles		XB360141

Symbol Desig.	Sub	Function	Description	Navy Type No.	Navy Spec. or Dwg.	Manufacturer	Mfg. No.	Magnavox Drawing No.
L-107		Pri. detector tuned circuit inductance and "regeneration" windings for L.F. bands 1, 2 and 3	Coil, r-f, comprising 7 windings on steatite ceramic tube 1" dia. x 2 5/8" long with 8 terminals. 1st, 4th and 7th sections single-layer close wound with A.W.G. No. 30 E.S.S.C. wire; 2nd, 3rd, 5th and 6th sections same as L-104 except as noted below. Spacing 1/32" between 1st and 2nd, 4th and 5th, and 6th and 7th sections respectively. 1st Section: 4 1/4 turns; 2nd Section: Same as 1st section of L-104; 3rd Section: Same as 2nd section of L-104 except 28 turns; 4th Section: 3 turns; 5th and 6th Sections: Same as 3rd and 4th sections of L-104 respectively; 7th Section: 3 turns			Meissner or Sickles		C360146G3
L-108		Pri. detector tuned circuit inductance and "regeneration" windings for L.F. bands 4, 5 and 6	Coil, r-f, comprising 5 single-layer windings on steatite ceramic threaded (32/inch) tube 1 1/2" dia. x 4" long with 7 terminals. 1st, 2nd, 3rd and 4th sections same as L-102 except as noted below: 5th section wound in thread with A.W.G. No. 30 E. wire. 1st Section: Same as 1st section of L-102 except with 4-thread skip in winding at 11 turns; 2nd Section: Same as 2nd section of L-102 except with 4-thread skip in winding at 4 turns; 3rd Section: Same as 3rd section of L-102; 4th Section: Same as 4th section of L-102 except groove located approx. 1 1/8" from terminal end; 5th Section: 2 turns, started 2 15/32" from terminal end and wound toward opposite end 2/3 turn, then returned to a point 1 1/16" from terminal end and wound toward opposite end 1 1/3 turns			Meissner or Sickles		C360145
L-109		Detector tuned circuit inductance for H.F. bands 7, 8 and 9	Coil, r-f, comprising 3 single-layer windings on steatite ceramic threaded (16/inch) tube 1" dia. x 3 1/4" long with 9 terminals. 1st and 2nd sections wound in thread and 3rd section in groove. 1st and 3rd sections same as L-103 except as noted below. 2nd section wound with A.W.G. No. 30 E.S.S.C. wire. 1st Section: Same as 1st section of L-103 except tapped at 3, 7 and 14 turns; 2nd Section: 2-1/7 turns, started 1 5/16" from terminal end and wound toward opposite end; 3rd Section: Same as 2nd section of L-103 except 1-1/7 turns and groove 0.045" deep			Meissner or Sickles		XC360142

13.1 TABLE No. 12 (Continued)
PARTS LIST BY SYMBOL DESIGNATIONS
Receiver Unit CMX-46156-A

Symbol Desig.	Sub	Function	Description	Navy Type No.	Navy Spec. or Dwg.	Manufacturer	Mfg. No.	Magnavox Drawing No.
L-110		RF choke used as filter in heater lead of detector tube	Coil, r-f, 30 turns A.W.G. No. 20 E. wire, single-layer close wound on fibre tube ½" dia. x 1¾" long			The Magnavox Co.		A360150
L-111		RF choke used as filter in heater lead of detector tube	Same as L-110					
L-112		RF choke used as part of plate filter on detector	Coil, r-f choke, 475 turns A.W.G. No. 36 E.S.S.C. wire, universal wound with 4 crosses per turn and ⅛" wire traverse on wood bobbin ½" dia. x ⅝" long, entirely enclosed and sealed in phenolic shell. Inductance 0.005 h ±10% at 175 kc. DC resistance 44 ohms	CML-47094		Meissner Elec. Mfg. Co.		A360149
L-113		Low-pass filter between detector plate and 1st audio grid to attenuate audio - frequency response above 1200 cycles	Filter, impregnated and sealed in can with six leads. Consists of two parts: (1) A single reactor of 40 henries, and (2) a network of three reactors in series and six capacitors, four of which form the legs. From input to output side, the reactors are 22.8 h, 13.2 h, and 13.2 h respectively. The four capacitors forming the legs are, from input to output side, 2000 mmfd, 1800 mmfd, 1300 mmfd, and 1500 mmfd. One 650-mmfd capacitor is connected across each of the 13.2-h reactors. Voltage rating of each capacitor is 500 volts DC (working)	CMX-53032		The Magnavox Co.		XC350014G2
*L-114		Var. attenuator used optionally across grid circuit of 1st audio stage for audio tuning	Reactor, impregnated and sealed in can. Consists of 2500 turns A.W.G. No. 29 E. wire with taps located as follows from input to output side: 1360, 1460, 1560, 1670, 1780, 1910, 2040, 2180, and 2340 turns. Coil traverse 1¼", DC resistance, 86 ohms	CMX-30343		The Magnavox Co.		XC350012
*L-115		Output cable filter	RF choke, single layer wound on steatite core, 1000 MA rating. Inductance 5.5 microhenries, 0.85 ohms DC resistance					A360138
*L-116		Output cable filter	Same as L-115					

* Spare parts furnished for all items preceded by an asterisk.

Symbol Desig.	Sub	Function	Description	Navy Type No.	Navy Spec. or Dwg.	Manufacturer	Mfg. No.	Magnavox Drawing No.
L-117	A	Output jack filter	Dual RF choke, comprising 2 single layer, right-hand, close wound windings of 30 turns each. Wound together in bifilar on laminated phenolic form, 1/2" dia. x 5/8" long. Coil mounted between 2 1/16" thick laminated phenolic terminal boards 1" wide x 1 1/4" long each having 2 brass, open terminals			The Magnavox Co.		XB360139
	B	Output jack filter						
*L-118		Antenna series choke for u-h-f signal pick-up suppression	Same as L-115					
			METERS					
M-101		Connected across output	Output meter, zero center, −10 to +5 db ±5%, 5000 ohms ±5% DC resistance, 2 1/2" dia. flush type. Reference output impedance 600 ohms; zero power level 6 milliwatts	△-22152	17-I-12a	Westinghouse and General Electric		C550007G1
M-102		Connected across heater leads	Voltmeter, AC-DC, 0 to 10 V. ±2% (15-100 cycles and 5 to 7 V. DC) 2 1/2" dia. flush type	△-22246	17-I-12a	Westinghouse and General Electric		C550007G2
			METER SHIELDS					
MS-101		Shield for M-102	Meter shield, cast iron, fine grain; overall dimensions: 2 19/32" diameter, 2 3/4" long; three tapped mounting holes, 4-40 thread.			The Magnavox Co.		B660054
			RESISTORS					
*R-101		Parasitic suppressor in grid circuit of 1st R.F. tube	100 ohms ±10%, 1/2 watt, wire-wound, pigtail					B230066G50
*R-102		Cathode bias and filter resistor on 1st R.F. tube	510 ohms ±5%, 1/2 watt, carbon, pigtail	†63355	RE-13A-372G			B230063G152
*R-103		Screen filter on 1st R.F. tube	10,000 ohms ±10%, 1/2 watt, carbon, pigtail	†63360	RE-13A-372G			B230063G74
*R-104		Plate filter on 1st R.F. tube	Same as R-103	†63360				
*R-105		Part of R.F. screen voltage divider	7500 ohms ±5%, 1 watt, carbon, pigtail	†63291	RE-13A-372G			B230062G180
*R-106		Part of R.F. screen voltage divider	11,000 ohms ±5%, 1 watt, carbon, pigtail	†63291	RE-13A-372G			B230062G184
*R-107		Grid resistor on 2nd R.F. tube	1 megohm, ±10%, 1/2 watt, carbon, pigtail	†63360	RE-13A-372G			B230063G98

* Spare parts furnished for all items preceded by an asterisk.
† CCC or CIR.
△ CAY or CG.

13.1 TABLE No. 12 (Continued)
PARTS LIST BY SYMBOL DESIGNATIONS
Receiver Unit CMX-46156-A

Symbol Desig.	Sub	Function	Description	Navy Type No.	Navy Spec. or Dwg.	Manufacturer	Mfg. No.	Magnavox Drawing No.
*R-108		Cathode bias resistor on 2nd R.F. tube	Same as R-102	†63355				
*R-109		Screen filter on 2nd R.F. tube	Same as R-103	†63360				
*R-110		Plate filter on 2nd R.F. tube	Same as R-103	†63360				
*R-111		Grid leak on detector tube	2.2 megohms ±10%, ½ watt, carbon, pigtail	†63360	RE-13A-372G			B230063G102
*R-112		Screen suppressor filter on detector tube	Same as R-103	†63360				
*R-113		Used as part of R.F. filter in plate circuit of detector tube	Same as R-103	†63360				
*R-114		Plate load on detector tube	100,000 ohms ±10%, ½ watt, carbon, pigtail	†63360	RE-13A-372G			B230063G86
*R-115		Part of detector screen voltage divider	24,000 ohms ±5%, ½ watt, carbon, pigtail	†63355	RE-13A-372G			B230063G192
*R-116		Part of detector screen voltage divider	51,000 ohms ±5%, ½ watt, carbon, pigtail	†63355	RE-13A-372G			B230063G200
*R-117		Plate filter on detector tube	Same as R-103	†63360				
*R-118		Plate filter on 2nd R.F. and detector tubes	10,000 ohms ±10%, 1 watt, carbon, pigtail	†63288	RE-13A-372G			B230062G74
*R-119		Grid resistor on 1st audio tube	Same as R-114	†63360				
*R-120		Plate load on 1st audio tube	Same as R-114	†63360				
*R-121		Grid resistor on output tube	Same as R-107	†63360				
*R-122		Cathode bias resistor on 1st audio tube	1000 ohms ±10%, ½ watt, carbon, pigtail	†63360	RE-13A-372G			B230063G62
*R-123		Screen filter on 1st audio tube	390,000 ohms ±5%, ½ watt, carbon, pigtail	†63355				
*R-124		Plate filter on 1st audio tube	20,000 ohms ±5%, ½ watt, carbon, pigtail	†63355	RE-13A-372G			B230063G190
*R-125		Screen and plate filter on output tube	4700 ohms ±10%, 1 watt, carbon, pigtail	63288	RE-13A-372G			B230062G70
*R-126		Cathode bias resistor on output tube	620 ohms ±5%, ½ watt, carbon, pigtail	†63355	RE-13A-372G			B230063G154
*R-127		Part of output meter multiplier	12,000 ohms ±5%, ½ watt, carbon, pigtail	†63355	RE-13A-372G			B230063G185
*R-128		Part of output meter multiplier	11,000 ohms ±5%, ½ watt, carbon, pigtail	†63355	RE-13A-372G			B230063G184

* Spare parts furnished for all items preceded by an asterisk.
† CCC or CIR.

Symbol Desig.	Sub	Function	Description	Navy Type No.	Navy Spec. or Dwg.	Manufacturer	Mfg. No.	Magnavox Drawing No.
*R-129		Part of output meter multiplier	Same as R-128	†63355	RE-13A-372G			
*R-130		Part of output meter multiplier	3900 ohms ±5%, ½ watt, carbon, pigtail	†63355	RE-13A-372G			B230063G173
*R-131		Impedance limiting resistor across L.F. detector sec. winding on bands 1, 2 and 3	Same as R-114	†63360				
*R-132	A	Grid bias control on 2nd R.F. tube, SENSITIVITY	Potentiometer (dual-unit) — each section 10,000 ohms ±5%, 4 watts, wire wound	CTC-63428	RE-13A-492B	Chicago Tel. Supply Co.	583	B220049G1
	B	Grid bias control on 1st R.F. tube						
*R-133		Screen voltage control on detector tube, regeneration	Potentiometer, 25,000 ohms ±15%, 2 watt, wire wound, linear	‡63247	RE-13A-492B	Wirt or Clarostat		B220050G1
*R-134		Grid bias control on AVC tube, AVC level	Potentiometer, 20,000 ohms ±10%, 2 watts, wire wound with first quarter turn clockwise, 1000 ohms	‡63429	RE-13A-492B			B220050G2
			SWITCHES					
*S-101		Connects "AUDIO TUNING" var. attenuator (L-114) across grid circuit of 1st audio tube	Toggle switch, SPST, 3 amp. 250 V	CAE-24000	RE-24AA-118A	Cutler-Hammer Co.	8280	C160080G1
*S-102		Connects either high or low freq. "AUDIO TUNING" var. attenuator across grid-circuit of 1st audio tube	Toggle switch, DPDT, 1 amp. 250 V, 3 amp. 125 V	CHH-24003	RE-24AA-118A	Arrow-Hart & Hegeman Elec. Co.	20905-EP	C160037G11
S-103		Used to change taps on var. attenuator	Rotary switch, single deck, ten-position			Chicago Tel. Supply	W-228-110	B160088G2
*S-104		Connects AVC trans. (T-102) across plate circuit of output tube	Same as S-101	CAE-24000				
S-105		Used to change resistance in series with output "db" meter	Rotary switch, single deck, five-position					
*S-106		Breaks +A and +B supply on battery-operated equipment	Toggle switch, DPST, 3 amp. 250 V	CAE-24001	RE-24AA-118A	Cutler-Hammer Co.	8360	C160080G3
S-107		1st RF circuit band sw. section	Switch section, 18 silver contacts on Steatite plate			The Magnavox Co.		XC160087G1
S-108		1st RF circuit band sw. section	Same as S-107 except for contact wiring			The Magnavox Co.		XC160087G2
S-109		2nd RF circuit band sw. section	Same as S-107 except for contact wiring			The Magnavox Co.		XC160087G3
S-110		2nd RF circuit band sw. section	Same as S-107 except for contact wiring			The Magnavox Co.		XC160087G4
S-111		Detector circuit band sw. section	Same as S-107 except for contact wiring			The Magnavox Co.		XC160087G5
S-112		Detector circuit band sw. section	Same as S-107 except for contact wiring			The Magnavox Co.		XC160087G6
S-113		Detector circuit band sw. section	Same as S-107 except for contact wiring			The Magnavox Co.		XC160087G7
S-114		Connects detector cathode to ground to stop oscillation, OSC. TEST	Push-button, 3 spring contact, steatite base			The Magnavox Co.		XA160085
*S-115		Connects low-pass audio filter (L-113) in series with detector output circuit	Same as S-102	CHH-24003				

* Spare parts furnished for all items preceded by an asterisk.
† CCC or CIR.
‡ CWC or CMC.

13.1 TABLE No. 12 (Continued)
PARTS LIST BY SYMBOL DESIGNATIONS
Receiver Unit CMX-46156-A

Symbol Desig.	Sub	Function	Description	Navy Type No.	Navy Spec. or Dwg.	Manufacturer	Mfg. No.	Magnavox Drawing No.
			TRANSFORMERS					
*T-101		Couples plate circuit of output tube to telephone jack; secondary mid-tapped to ground; 600 ohms output impedance	Output transformer; Ratio 3.94 to 1. 427 ohms Pri., 41.7 ohms Sec. DC resistance. Impregnated and sealed in a can	CMX-30242A		The Magnavox Co.		XB330015
*T-102		Used optionally across plate circuit of output tube to feed grid of AVC tube	AVC transformer: Ratio 1 to 12.5. 57 ohms Pri., 3540 ohms Sec. DC resistance. Impregnated and sealed in a can	CMX-30244		The Magnavox Co.		XB320012
			TUBE SHIELDS					
TS-101	A	Shield for V-101	Tube shield body, aluminum, chimney type, $1\frac{37}{64}$" dia., $3\frac{27}{32}$" long			Aluminum Goods Mfg. Co.	Special	A631527
	B		Tube shield cap, aluminum, $1\frac{5}{8}$" dia., $2\frac{1}{16}$" long			Aluminum Goods Mfg. Co.	S-618	A631528
TS-102		Shield for V-102	Same as TS-101					
TS-103		Shield for V-103	Same as TS-101					
TS-104		Shield for V-104	Same as TS-101					
			VACUUM TUBES					
*V-101		1st RF ampl.	Triple-grid, supercontrol amplifier tube	-6D6	RE-13A-600A	RCA (Radiotron)	6D6	
*V-102		2nd RF ampl.	Same as V-101	-6D6				
*V-103		Detector	Same as V-101	-6D6				
*V-104		1st audio ampl.	Same as V-101	-6D6				
*V-105		2nd audio ampl.	P. A. pentode tube	-41	RE-13A-600A	RCA (Radiotron)	41	
*V-106		AVC	Same as V-105	-41				
			SOCKETS					
*X-101		Receptacle for 1st RF tube	Six-prong, wafer-type, ceramic base, $1\frac{27}{32}$" hole centers	CEJ-49364	RE-38AA-136A	E. F. Johnson Co.		A180274
*X-102		Receptacle for 2nd RF tube	Same as X-101	CEJ-49364				
*X-103		Receptacle for detector tube	Same as X-101	CEJ-49364				
*X-104		Receptacle for 1st audio tube	Six-prong, wafer-type, phenolic base	▲-49308	RE-38AA-140A	Ucinite or American Radio Hardware		A180275
*X-105		Receptacle for 2nd audio tube	Same as X-104	▲-49308				
*X-106		Receptacle for AVC tube	Same as X-104	▲-49308				

* Spare parts furnished for all items preceded by an asterisk.
▲ CUF or CMH.

Symbol Desig.	Sub	Function	Description	Navy Type No.	Navy Spec. or Dwg.	Manufacturer	Mfg. No.	Magnavox Drawing No.
Power Unit CMX-20131-A								
			CAPACITORS					
*C-201		RF by-pass on AC input power leads	Same as C-107					
*C-202		RF by-pass on A Cinput power leads	Same as C-107					
*C-203		RF by-pass on AC input power leads	Same as C-107					
*C-204		Main voltage filter	Capacitor pack paper containing 3/3/3 mfd. ±10%, oil filled, 400 V. max. DC, 200 V. peak AC, 400 V. DC (working)	CBV-48540A	RE-48AA-13/A	John E. Fast Co.		B250100
			FUSES					
*F-201		Used in AC input line	Fuse, glass cartridge type, 3 amp., 250 volts		17-F-2f	Littelfuse, Inc.	1043	A180157G7
*F-202		Used in AC input line	Same as F-201					
			INDUCTANCES					
L-201		Used in series with AC input	RF choke, 69 turns A.W.G. No. 18 enameled copper wire wound on 1" dia. phenolic tube			The Magnavox Co.		XB360147G1
L-202		Used in series with AC input	Same as L-201					
L-203		Line filter on AC input	RF filter, 2 iron core reactors and 2 paper capacitors, impregnated and sealed in a can. Reactors .073 and .084 ohms resistance, approx., 2 to 12 mill-henries inductance. Capacitors 1.0 mfd. ±10%, 300 V. DC (working) each	CMX-30248		The Magnavox Co.		XC360154
L-204		Used as 1st section of main filter on DC output; end section in series with middle filter capacitor acts as a tuned low impedance to ripple frequency	Filter reactor, tapped, iron-core, impregnated and sealed, 210 ohms ±7.5% DC resistance, 5200 ohms at 3 V. 60 cycles, .08 amp. DC, 3 leads	CMX-30247		The Magnavox Co.		XB350016G2
L-205		Used as 2nd section of main filter on DC output	Same as L-204 except 2 leads	CMX-30246		The Magnavox Co.		XB350016G1
			RESISTORS					
*R-201		Drop resistor in series with current regulator lamp across AC input	80 ohms ±10%, 200 watts, vitreous enamel, ferrule type, 9⅝" long	△-63184	RE-13A-372G	Ohmite or Ward-Leonard		B240022G1
*R-202		Bleeder across HV output	20,000 ohms ±5%, 3 watts, composition, pigtail		RE-13A-372G	Continental Carbon Co.		B230077G190

* Spare parts furnished for all items preceded by an asterisk.
△ COA or COM.

13.1 TABLE No. 12 (Continued)
PARTS LIST BY SYMBOL DESIGNATIONS
Power Unit CMX-20131-A

Symbol Desig.	Sub	Function	Description	Navy Type No.	Navy Spec. or Dwg.	Manufacturer	Mfg. No.	Magnavox Drawing No.
*R-202		Voltage divider in series with voltage regulator tube across HV output to supply 90 volts DC	6200 ohms ±5%, 2 watts, composition, pigtail	CCC-63426				B230061G178
*R-204		Used in parallel with R-203	Same as R-203	CCC-63426				
			SWITCHES					
*S-201		Used to break both sides of AC input	Same as S-106	CAE-24001				
*S-202		Used to disconnect current regulated AC supply from power transformer Pri. tap and to connect AC supply directly across full Pri. windings. This switch to be thrown only with current-regulator tube (V-201) removed	Same as S-102	CHH-24003				
			TRANSFORMERS					
T-201		Main high and low voltage AC supply	Power transformer — impregnated and sealed in can—15 leads. Pri. No. 1—62, 65, 68 V; DC res. 2 ohms. Pri. No. 1 and No. 2—110, 115, 120 V; DC res. 5.03 ohms. Plate winding—500 V (mid-tapped); DC res. 250 ohms. Rect. fil. 5.57 V. Ampl. fil. 7.16 V (mid-tapped). All voltages no load at 60 cycles. Pri. No. 1 for use with current regulator tube only	CMX-30444		The Magnavox Co.		B300016
			VACUUM TUBES					
*V-201		Current regulator	Current-regulator tube	CRC-876	RE-13A-600A	RCA (Radiotron)	876	
*V-202		Rectifier	Full-wave rectifier tube	CRC-5Z3	RE-13A-600A	RCA (Radiotron)	5Z3	
*V-203		Voltage regulator	Voltage-regulator tube	CRC-874	RE-13A-600A	RCA (Radiotron)	874	
			SOCKETS					
X-201		Receptacle for current-regulator tube	Mogul size, encased in porcelain			Bryant Elec. Co.	4062	A180250
*X-202		Receptacle for rectifier tube	Four-prong, wafer-type, phenolic base with shock mounting end supports	‡-49311A		Ucinite and American Radio Hardware		XA180284
*X-203		Receptacle for voltage-regulator tube	Same as X-202	‡-49311A				

* Spare parts furnished for all items preceded by an asterisk.
‡ CUF or CMH.

Control Unit CMX-23073-A

Symbol Desig.	Sub	Function	Description	Navy Type No.	Navy Spec. or Dwg.	Manufacturer	Mfg. No.	Magnavox Drawing No.
			FUSES					
*F-301		Used in input line.	Fuse, glass cartridge type, 5 amp., 250 volts		17-F-2f	Littelfuse, Inc.	1358	A180157G9
*F-302		Used in input line	Same as F-301					
			JACKS					
J-301		Output jack	Same as J-101	CTC-49021				
J-302		Output Jack	Same as J-101	CTC-49021				
			SWITCHES					
*S-301		Power switch	Same as S-106	CAE-24001				
*S-302		Power switch	Same as S-106	CAE-24001				
S-303		Used to connect output of either receiver unit or of both to telephone jacks	Mixer switch, low capacity, 4-pole, 3-position			Stromberg-Carlson Telephone Mfg. Co.	172A (modified)	A160084

* Spare parts furnished for all items preceded by an asterisk.

13.2 TABLE No. 13
PARTS LIST BY NAVY TYPE NUMBERS
(The quantities listed do not include the spare parts)
CMX-46156-A Receiver Unit for Model RAL-8
CMX-20131-A Power Unit for Model RAL-8
CMX-23073-A Control Unit for Optional Use with Models RAL-8 and RAK-8

Quantity	Navy Type No.	Symbol Designations	Description
		MISCELLANEOUS (CLASS 10)	
3		CS-101, CS-106, CS-109	Coil shield, copper, 2¼" dia., 4⅛" long
3		CS-102, CS-105, CS-108	Coil shield, copper, 3" dia., 4½" long
3		CS-103, CS-104, CS-107	Coil shield, copper, 4" dia., 3" long
5		TS-101, TS-102, TS-103, TS-104, TS-105	Tube shield and cap, aluminum
		INDICATING INSTRUMENTS (CLASS 22)	
1	– 22152	M-101	
1	– 22246	M-102	
		SWITCHES (CLASS 24)	
2	– 24000	S-101, S-104	
4	– 24001	S-106, S-201, S-301, S-302	
3	– 24003	S-102, S-115, S-202	
2		S-103, S-105	
1		S-107	Switch segment, 18 contacts
1		S-108	Switch segment, 18 contacts
1		S-109	Switch segment, 18 contacts
1		S-110	Switch segment, 18 contacts
1		S-111	Switch segment, 18 contacts
1		S-112	Switch segment, 18 contacts
1		S-113	Switch segment, 18 contacts
1		S-114	Push-button, 3 contacts
1		S-303	Low-capacity, 4-pole, 3-pos. switch
		FUSES, PROTECTIVE DEVICES, ETC. (CLASS 28)	
2		F-201, F-202	Fuse, 3 amps., 250 volts
2		F-301, F-302	Fuse, 5 amps., 250 volts
		A-F TRANSFORMERS AND REACTORS (CLASS 30)	
1	– 30242A	T-101	
1	– 30244	T-102	
1	– 30246	L-205	
1	– 30247	L-204	
1	– 30248	L-203	
1	– 30343	L-114	
1	– 30444	T-201	
		VACUUM TUBES AND V. T. SOCKETS (CLASS 38)	
2	– 41	V-105, V-106	
1	– 874	V-203	
1	– 876	V-201	
3	– 49308	X-104, X-105, X-106	
2	– 49311A	X-202, X-203	
3	– 49318	X-101, X-102, X-103	
1	– 523	V-202	
4	– 6D6	V-101, V-102, V-103, V-104	
1		X-201	Mogul size ceramic socket
		R-F INDUCTANCES (CLASS 47)	
1		L-101	Antenna coil
1		L-102	Antenna coil
1		L-103	Antenna coil
1		L-104	RF coil
1		L-105	RF coil
1		L-106	RF coil
1		L-107	Detector coil
1		L-108	Detector coil
1		L-109	Detector coil
1		L-110	RF choke
1		L-111	RF choke
1	– 47094	L-112	RF choke
3		L-115, 116, 118	RF choke
1		L-117A & B	RF choke
2		L-201, L-202	RF choke
		CAPACITORS (CLASS 48)	
9		C-109, C-113, C-114, C-115, C-116, C-145, C-146, C-147, C-148	Mica, .01 mfd., 300 V. D.C.
6		C-107, C-123, C-133, C-201, C-202, C-203	Mica, .01 mfd., 600 V. D.C.
1	– 48540A	C-204	Paper, 3/3/3 mfd., 400 V. D.C.

13.2 TABLE No. 13 (Continued)
PARTS LIST BY NAVY TYPE NUMBERS

Quantity	Navy Type No.	Symbol Designations	Description
		CAPACITORS (CLASS 48)—Continued	
2		C-120, C-121	Mica, 51 mmf., 500 V. D.C.
3	–48552-10	C-110, C-119, C-138	Paper, .1 mfd., 250 V. D.C.
11	–48553-10	C-117, C-118, C-122, C-126, C-127, C-128, C-129, C-130, C-131, C-132, C-134	Paper, 1.0 mfd., 250 V. D.C.
4	–48555-15	C-104, C-108, C-135, C-136	Paper, .125—.125 mfd., 500 V. D.C.
2		C-124, C-125	Mica, .001 mfd., 2500 V. D.C.
1		C-101	Mica, 400 mmf., 500 V. D.C.
3	–48561	C-106, C-112, C-142	Mica, 510 mmf. 2500 V. D.C.
1	–48573	C-105	Variable, 3.4 to 17.5 mmf.
1	–48574	C-111	Variable, 2 plate
1	–48575	C-103	Variable, 5.3 to 27 mmf.
2	–48576	C-137, C-139	Variable, 5.5 to 35 mmf.
2	–48582	C-140, C-141	Variable, 3.5 to 13.7 mmf.
1	–48806-10	C-143	Paper, .025 mfd., 600 V.
1	–48807-10	C-144	Paper, .075 mfd., 600 V.
1		C-102	Variable air capacitor, 3-gang, 25.3 ±1 to 207 mmf. ±5%
		JACKS, PLUGS, PHONES, ETC. (CLASS 49)	
3	–49021	J-101, J-301, J-302	
		FILTERS (CLASS 53)	
1	–53032	L-113	
		RESISTORS, POTENTIOMETERS, ETC. (CLASS 63)	
1	–63184	R-201	
1	–63247	R-133	
1	–63288	R-125	4700 ohms
1	–63288	R-118	10,000 ohms
1	–63291	R-105	7500 ohms
1	–63291	R-106	11,000 ohms
2	–63355	R-102, R-108	510 ohms
1	–63355	R-126	620 ohms
1	–63355	R-130	3900 ohms
2	–63355	R-128, R-129	11,000 ohms
1	–63355	R-127	12,000 ohms
1	–63355	R-124	20,000 ohms
1	–63355	R-115	24,000 ohms
1	–63355	R-116	51,000 ohms
1	–63355	R-123	510,000 ohms
1	–63360	R-122	1000 ohms
7	–63360	R-103, R-104, R-109, R-110, R-112, R-113, R-117	10,000 ohms
4	–63360	R-114, R-119, R-120, R-131	100,000 ohms
2	–63360	R-107, R-121	1 megohm
1	–63360	R-111	2.2 megohms
2	–63426	R-203, R-204	6200 ohms
1	–63426	R-202	20,000 ohms
1	–63428	R-132	
1	–63429	R-134	
1		R-101	100 ohms

13.3 TABLE No. 14

SPARE PARTS LIST BY NAVY TYPE DESIGNATIONS

CMX-46156-A Receiver Unit for Model RAL-8
CMX-20131-A Power Unit for Model RAL-8
CMX-23073-A Control Unit for Optional Use with Models RAK-8 and RAL-8
Contract NXss-21827—Dated: 14 January 1943

Quan.	Navy Type No.	Symbol Designations	Description	Magnavox Drawing No.
			CMX-46156-A RADIO RECEIVER	
1			Spare Parts Box	D990132
4	6D6	V-101, V-102, V-103, V-104	Vacuum Tube, Type 6D6	
2	41	V-105, V-106	Vacuum Tube, Type 41	
1	CMX-10012		Spanner Wrench	XA631655
1	CAE-24000	S-101, S-104	Toggle Switch, S.P.S.T., 3 amp., 250 V.	C160080G1
1	CAE-24001	S-106, S-201, S-301, S-302	Toggle Switch, D.P.S.T., 3 amp., 250 V.	C160080G3
1	CHH-24003	S-102, S-115, S-202	Toggle Switch, D.P.D.T., 3 amp., 250 V.	C-160037G11
1	CMX-30242A	T-101	Output Transformer, D.C. resistance: primary, 427 ohms, secondary 41.7 ohms	XB330015
1	CMX-30244	T-102	A.V.C. Transformer, D.C. resistance: primary 57 ohms, secondary 3540 ohms	B320012
1	CMX-30343	L-114	Reactor, audio attenuator, D.C. resistance: 86 ohms.	C350012
2	CBV-48552-10	C-110, C-119, C-138	Capacitor, paper, oil-filled, 0.1 mfd. ±10%, 500 V. D.C. (working)	B250101G5
6	CBV-48553-10	C-117, C-118, C-122, C-126, C-127, C-128, C-129, C-130, C-131, C-132, C-134	Capacitor, paper, oil-filled, 1.0 mfd. ±10%, 250 V. D.C. (working)	B250101G3
2	CBV-48555-15	C-104, C-108, C-135, C-136	Capacitor, paper, oil-filled, 0.125—0.125 mfd. ±15%, 500 V. D.C. (working)	B250102G1
1	§ -48573	C-105	Capacitor, variable, 3.4 to 17.5 mmf., 3 plate	B260037
1	§ -48574	C-111	Capacitor, variable, 2 plate	B260038
1	§ -48575	C-103	Capacitor, variable, 5.3 to 27 mmf., 4 plate	B260036G1
1	§ -48576	C-137, C-139	Capacitor, variable, 5.5 to 35 mmf., 5 plate	B260036G2
1	□ -48582	C-140, C-141	Capacitor, variable, 3.5 to 13.7 mmf., 4 plate	B260035G3
1	CBV-48806-10	C-143	Capacitor, paper, oil-filled, .025 mfd. ±10%, 600 V. D.C. (working)	B250101G1
1	CBV-48807-10	C-144	Capacitor, paper, oil-filled, .075 mfd. ±10%, 600 V. D.C. (working)	B250101G2
2	CUF-49308	X-104, X-105, X-106	Tube Socket, 6-prong, wafer type, phenolic base	A180275
2		L-115, L-116, L-118	R. F. Choke, inductance: 5.5 microhenries, 0.85 ohms. D.C. resistance, 1000 ma.	A360138
2	CEJ-49364	X-101, X-102, X-103	Tube Socket, 6-prong, wafer type, ceramic base	A180274
1	‡ -63247	R-133	Potentiometer, 25,000 ohms ±10%, 2 watt, wire wound, linear	B220050G1
1	† -63288	R-125	Resistor, 4700 ohms ±10%, 1 watt, carbon, pigtail	B230062G70
1	† -63288	R-118	Resistor, 10,000 ohms ±10%, 1 watt, carbon, pigtail	B230062G74
1	† -63291	R-105	Resistor, 7500 ohms ±5%, 1 watt, carbon, pigtail	B230062G180
1	† -63291	R-106	Resistor, 11,000 ohms ±5%, 1 watt, carbon, pigtail	B230062G184
1	† -63355	R-102, R-108	Resistor, 510 ohms, ±5%, ½ watt, carbon, pigtail	B230063G152
1	† -63355	R-123	Resistor, 390,000 ohms ±5%, ½ watt, carbon, pigtail	B230063G221
1	† -63355	R-126	Resistor, 620 ohms ±5%, ½ watt, carbon, pigtail	B230063G154
1	† -63355	R-130	Resistor, 3900 ohms ±5%, ½ watt, carbon, pigtail	B230063G173
1	† -63355	R-128, R-129	Resistor, 11,000 ohms ±5%, ½ watt, carbon, pigtail	B230063G184
1	† -63355	R-127	Resistor, 12,000 ohms ±5%, ½ watt, carbon, pigtail	B230063G185
1	† -63355	R-124	Resistor, 20,000 ohms ±5%, ½ watt, carbon, pigtail	B230063G190
1	† -63355	R-115	Resistor, 24,000 ohms ±5%, ½ watt, carbon, pigtail	B230063G192
1	† -63355	R-116	Resistor, 51,000 ohms ±5%, ½ watt, carbon, pigtail	B230063G200
1	† -63360	R-122	Resistor, 1000 ohms ±10%, ½ watt, carbon, pigtail	B230063G62
4	† -63360	R-103, R-104, R-109, R-110, R-112, R-113, R-117	Resistor, 10,000 ohms ±10%, ½ watt, carbon, pigtail	B230063G74
2	† -63360	R-114, R-119, R-120, R-131	Resistor, 100,000 ohms ±10%, ½ watt, carbon, pigtail	B230063G86
1	† -63360	R-107, R-121	Resistor, 1 megohm ±10%, ½ watt, carbon, pigtail	B230063G98
1	† -63360	R-111	Resistor, 2.2 megohm ±10%, ½ watt, carbon, pigtail	B230063G102
1		R-101	Resistor, 100 ohms ±10%, ½ watt, wire wound, pigtail	B230066G50
1	CTC-63428	R-132	Potentiometer, dual-unit, each section 10,000 ohms ±5%, 4 watt	B220049G1
1	‡ -63429	R-134	Potentiometer, 20,000 ohms ±10%, 2 watt, wire wound, first quarter turn clockwise, 1000 ohms	B220050G2
2		C-106, C-112, C-142	Capacitor, molded mica, 510 mmf. ±5%, 500 V. D.C. (working)	C250107G1064
5		C-109, C-113, C-114, C-115, C-116, C-145, C-146, C-147, C-148	Capacitor, molded mica, .01 mfd. ±10%, 300 V. D.C. (working)	C250111G1046
1		C-120, C-121	Capacitor, molded mica, 51 mmf. ±5%, 500 V. D.C. (working)	C250107G2040
2		C-107, C-123, C-133, C-201, C-202, C-203	Capacitor, molded mica, .01 mfd. ±10%, 600 V. D.C. (working)	C250106G1148
1		C-124, C-125	Capacitor, molded mica, .001 mfd. ±10%, 2500 V. D.C. (working)	C250106G1136
1		C-101	Capacitor, molded mica, 400 mmf. ±10%, 500 V. D.C. (working)	B250073G145

‡ CWC, CMC. † CIR, CCC. § CHC, CDB. □ COC, CBK.

13.3 TABLE No. 14 (Continued)

SPARE PARTS LIST BY NAVY TYPE DESIGNATIONS (Continued)

CMX-46156-A Receiver Unit for Model RAL-8
CMX-20131-A Power Unit for Model RAL-8
CMX-23073-A Control Unit for Optional Use with Models RAK-8 and RAL-8
Contract NXss-21827—Dated: 14 January 1943

Quan.	Navy Type No.	Symbol Designations	Description	Magnavox Drawing No.
			CMX-20131-A POWER UNIT	
1	CAE-24001	S-106, S-201, S-301, S-302	Toggle Switch, D.P.S.T., 3 amp., 250 V.	C160080G3
1	CHH-24003	S-102, S-115, S-202	Toggle Switch, D.P.D.T., 3 amp., 250 V.	C160037G11
1		F-201, F-202	Fuse, 3 amp., 250 V., cartridge type	A180157G7
1		F-301, F-302	Fuse, 5 amp., 250 V., cartridge type	A180157G9
1	CUF-49311A	X-202, X-203	Tube Socket, 4-prong, wafer type, phenolic base, in shock mounting	XA180284
2		C-107, C-123, C-133	Capacitor, molded mica, .01 mfd. ±10%, 600 V. D.C. (working)	C250106G1148
		C-201, C-202, C-203		
1	CBV-48540A	C-204	Capacitor, paper, oil-filled, 3-3-3 mfd. ±20%, 400 V. D.C. (working)	B250100
1	▲ -63184	R-201	Resistor, 80 ohms ±10%, 200 watt, vitreous enamel	B240022G1
1	CCC-63426	R-203, R-204	Resistor, 6200 ohms ±5%, 2 watt, carbon, pigtail	B230061G178
1		R-202	Resistor, 20,000 ohms ±5%, 3 watt, carbon, pigtail	B230077G190
1	876	V-201	Vacuum Tube, Type 876, current regulator	
1	5Z3	V-202	Vacuum Tube, Type 5Z3, full wave rectifier	
1	874	V-203	Vacuum Tube, Type 874, voltage regulator	

▲ CAO, COM.

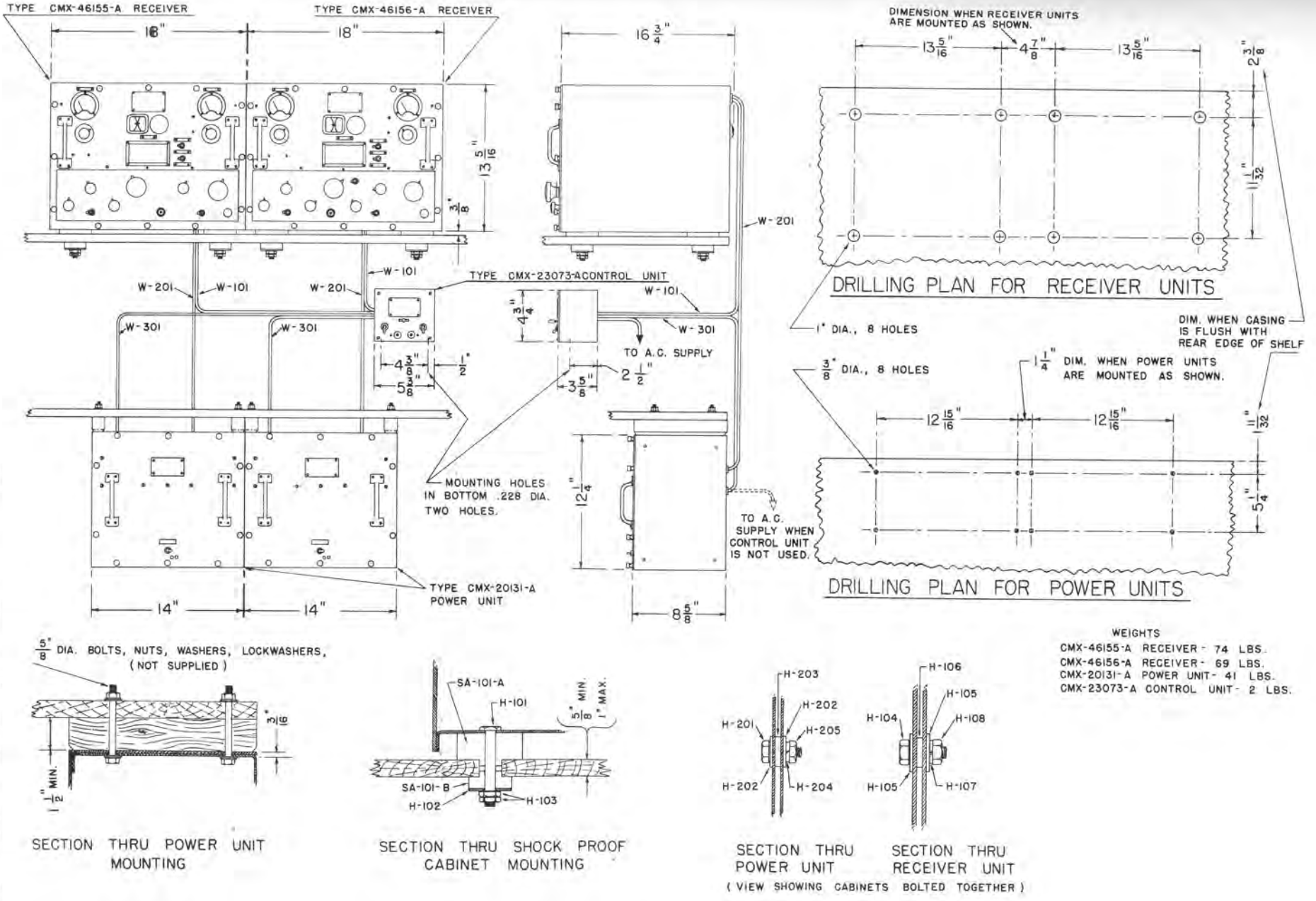


Figure 15—Outline and Installation

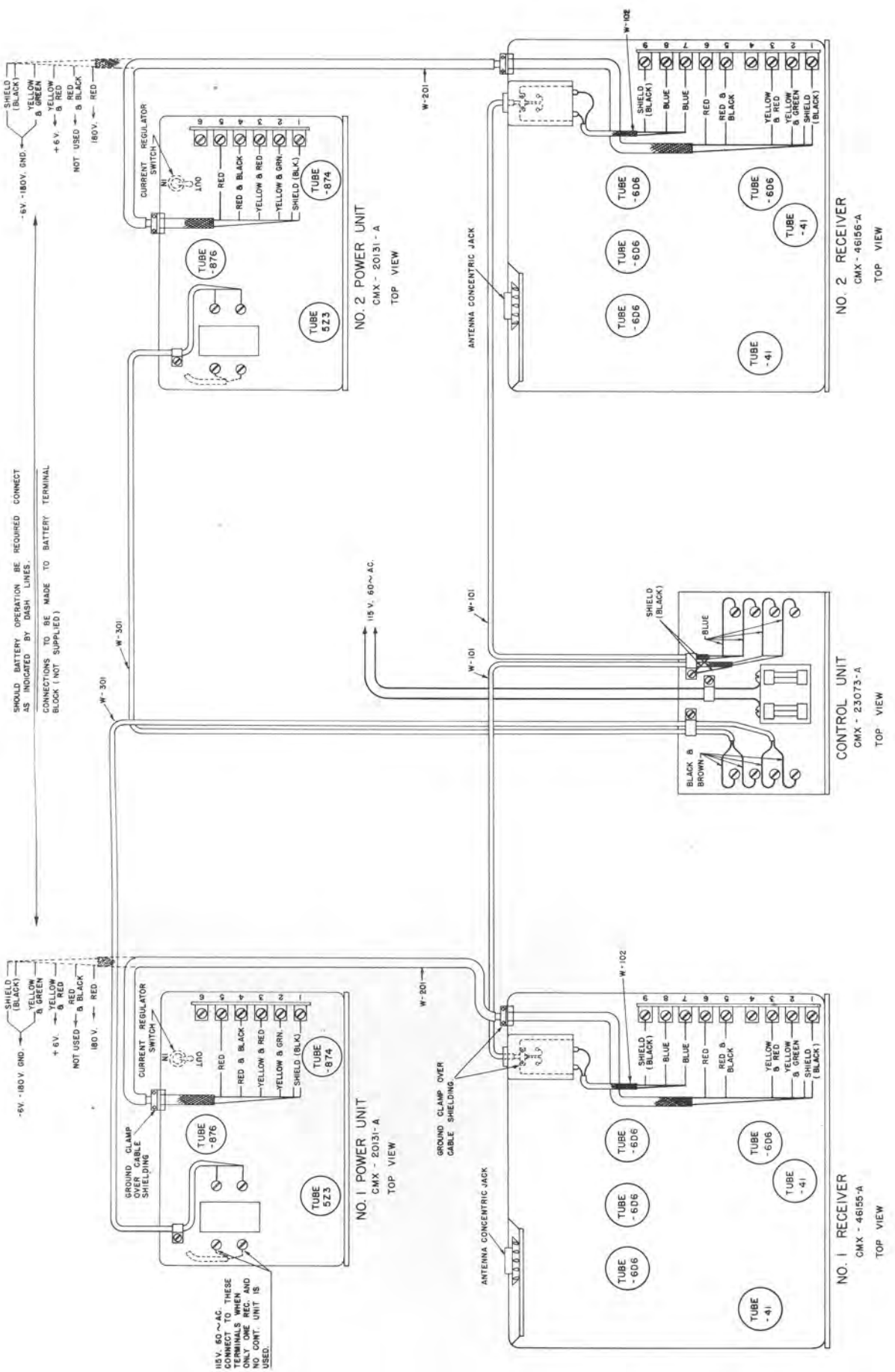


Figure 16—External Cable Connection Diagram

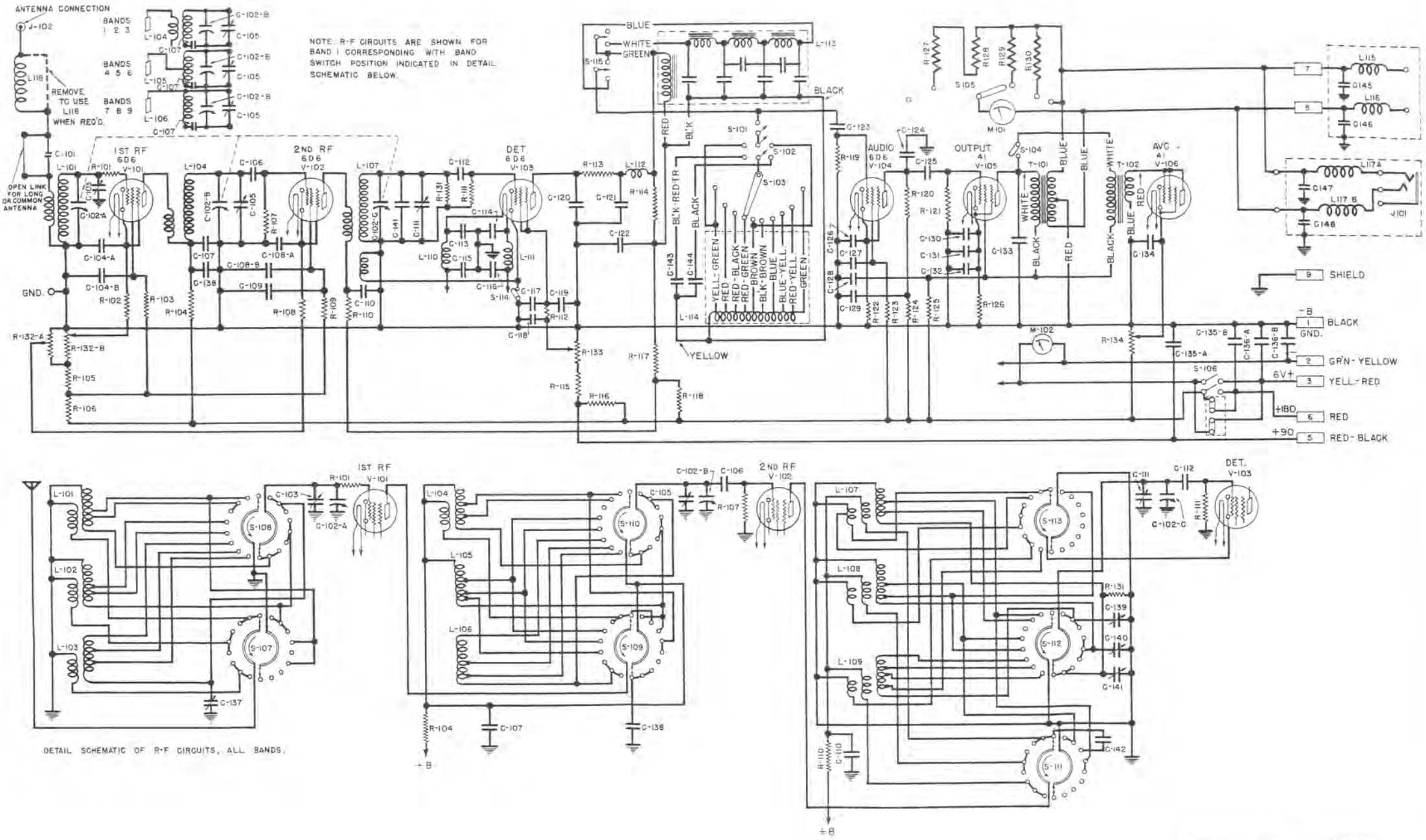
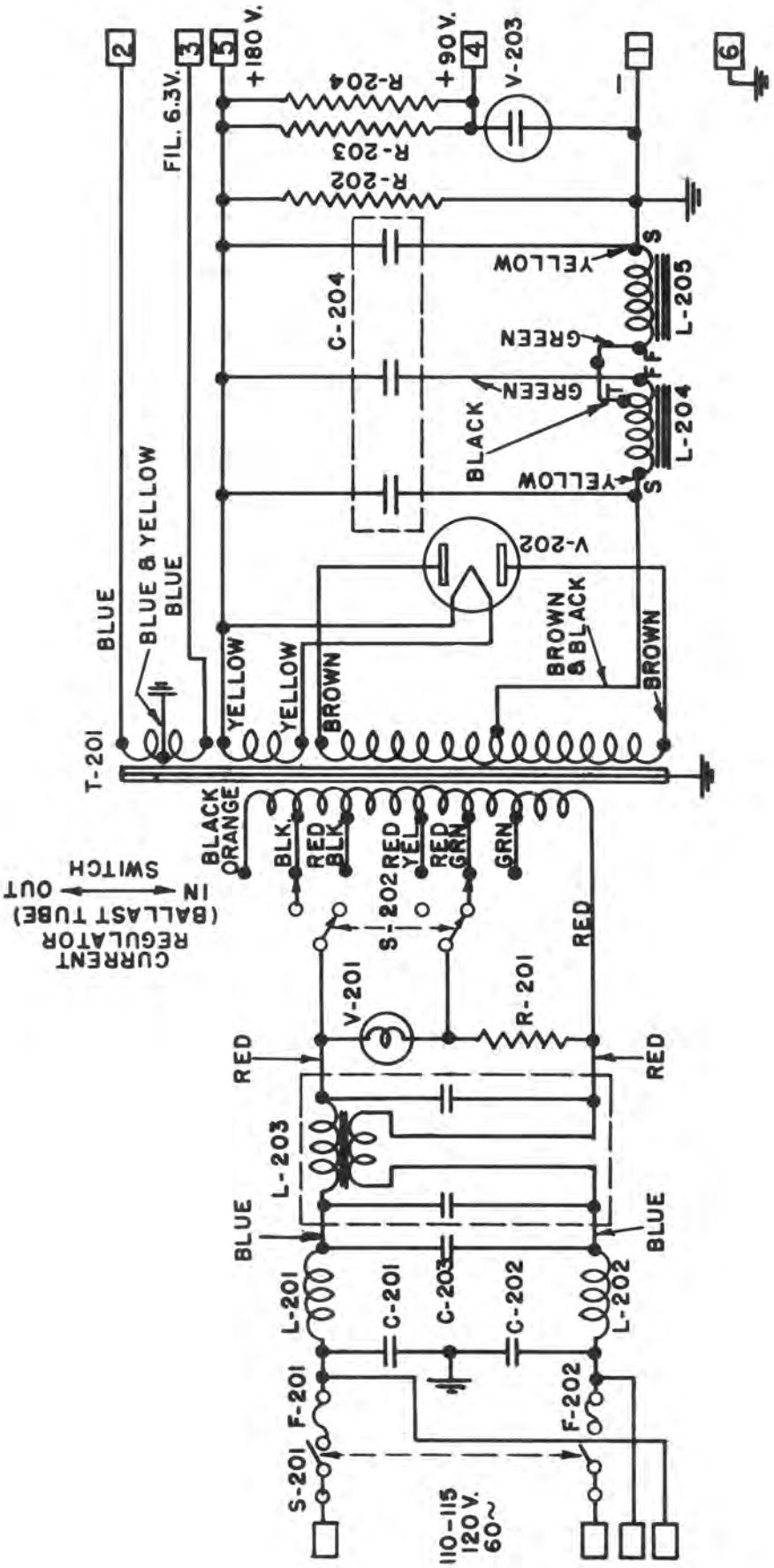


Figure 17—Schematic Diagram, Receiver Unit CMX-46156-A



WIRE COLORS INDICATED ARE TRACER COLORS. SOLID COLOR IS WHITE.

Figure 18—Schematic Diagram, Power Unit CMX-20131-A

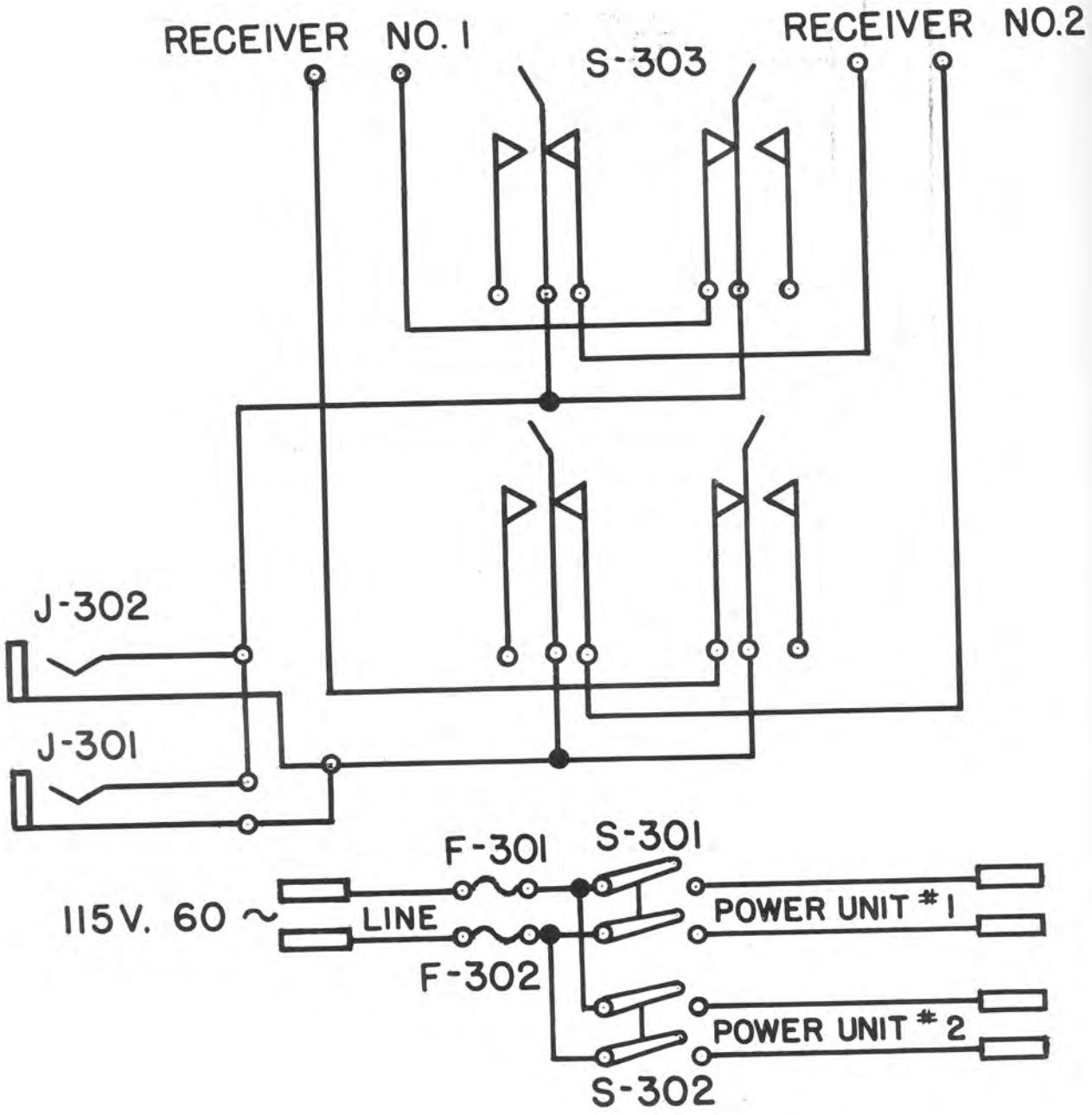


Figure 19—Schematic Diagram, Control Unit CMX-23073-A

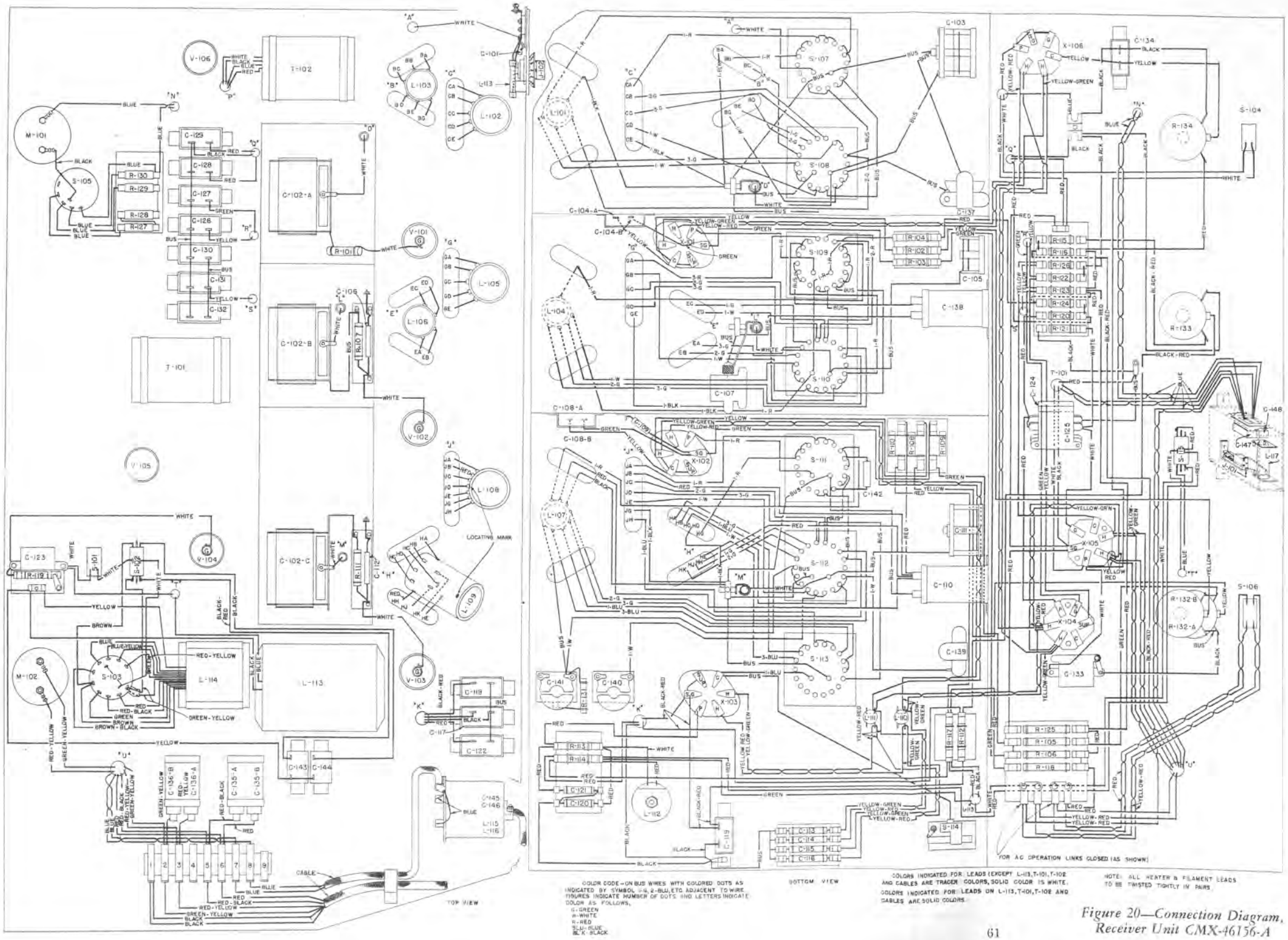
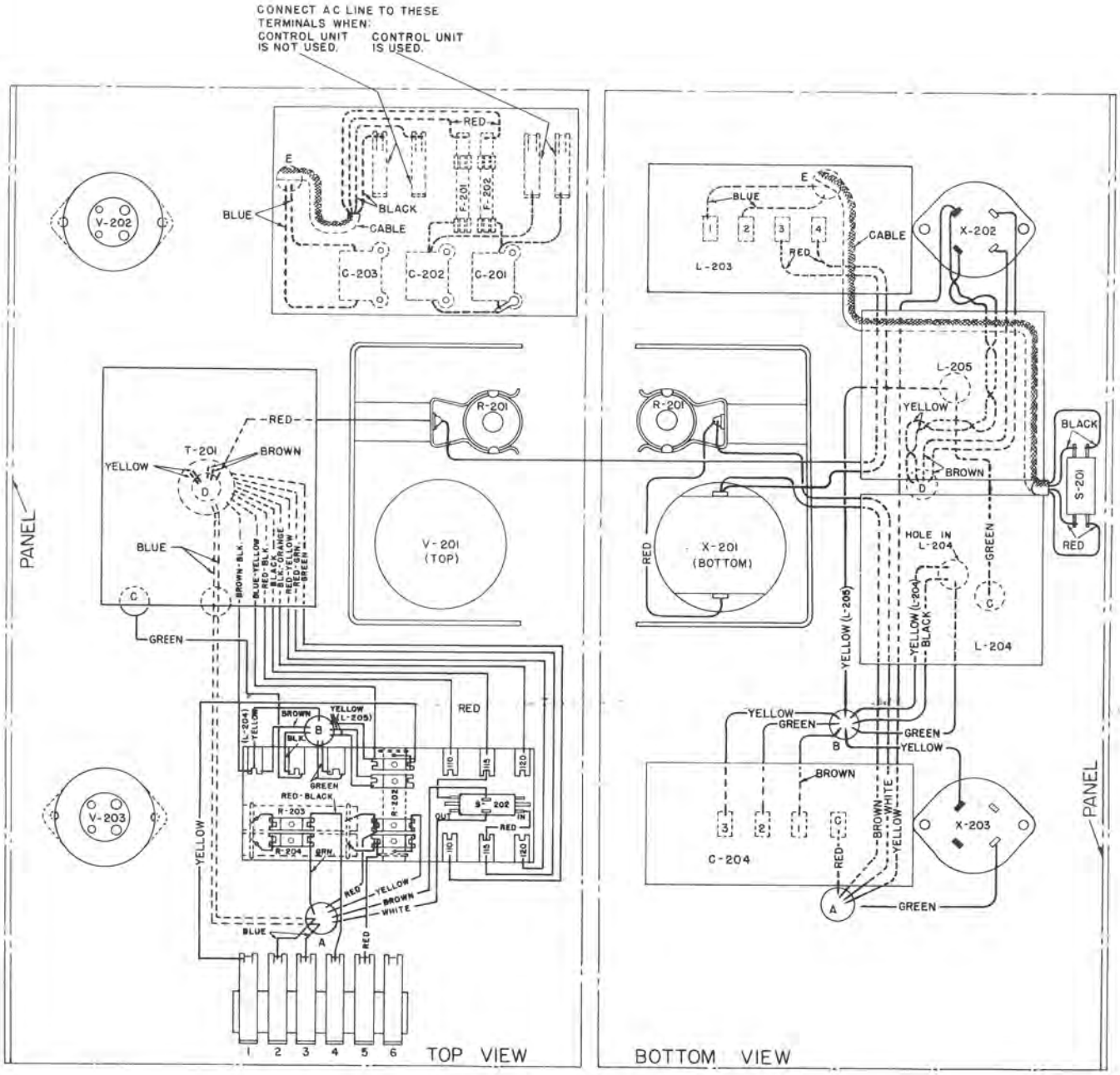
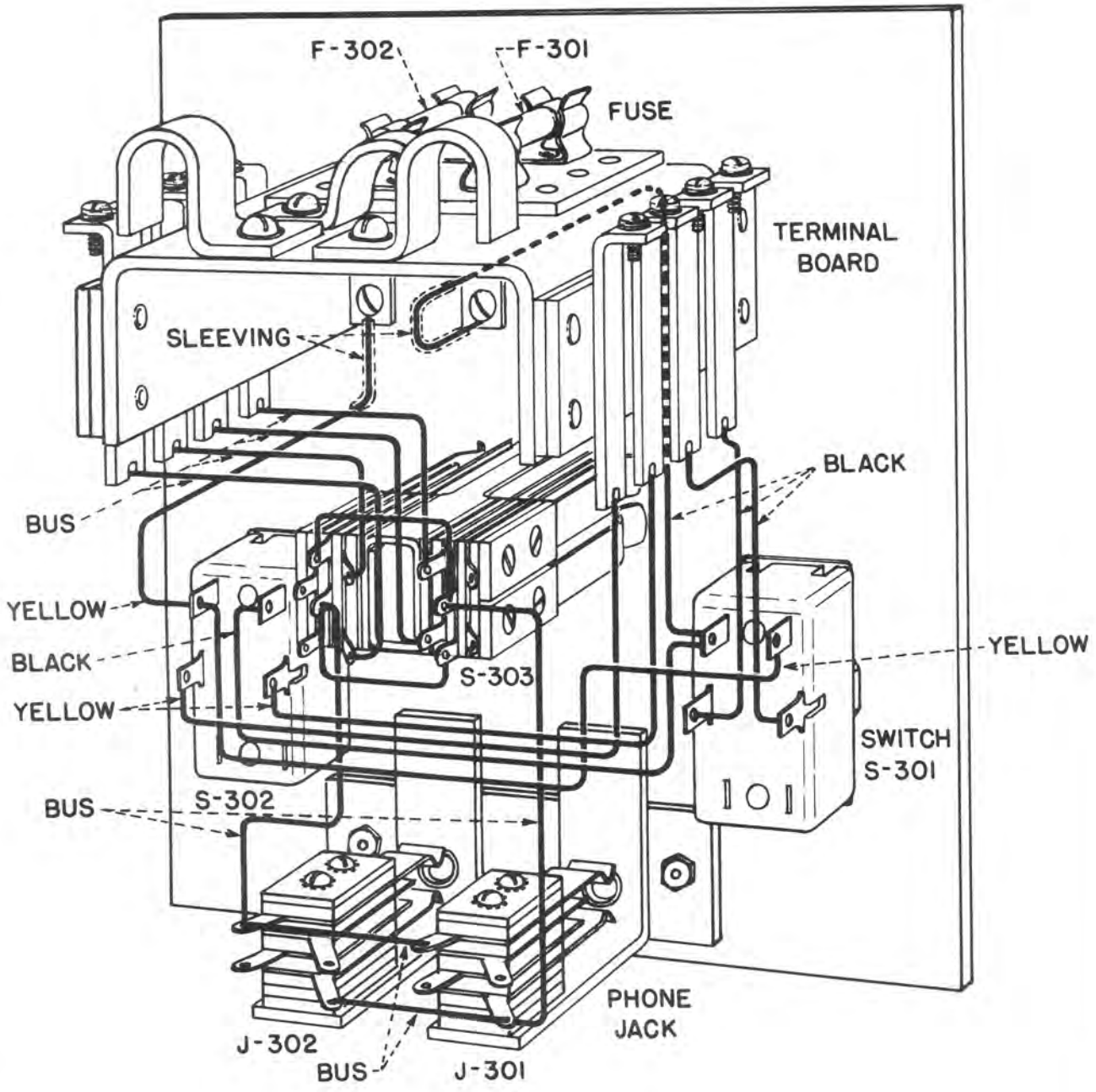


Figure 20—Connection Diagram, Receiver Unit CMX-46156-A



WIRE COLORS INDICATED ARE TRACER COLORS. SOLID COLOR IS WHITE.

Figure 21—Connection Diagram, Power Unit CMX-20131-A



WIRE COLORS INDICATED ARE TRACER COLORS. SOLID COLOR IS WHITE.

Figure 22—Connection Diagram, Control Unit CMX-23073-A

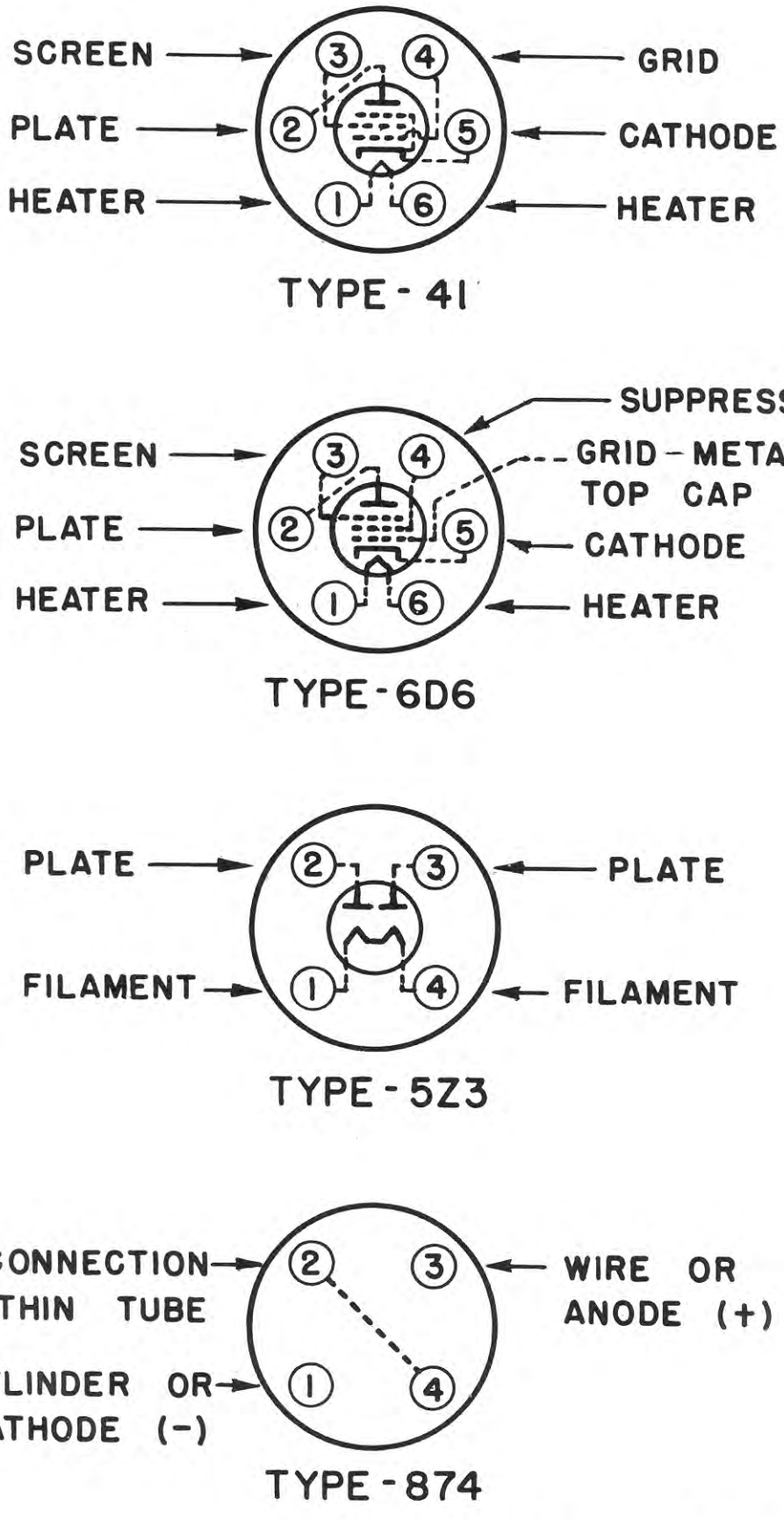


Figure 23—Tube Socket Connections (bottom view)

K4XL's  BAMA

This manual is provided FREE OF CHARGE from the "BoatAnchor Manual Archive" as a service to the Boatanchor community.

It was uploaded by someone who wanted to help you repair and maintain your equipment.

If you paid anyone other than BAMA for this manual, you paid someone who is making a profit from the free labor of others without asking their permission.

You may pass on copies of this manual to anyone who needs it. But do it without charge.

Thousands of files are available without charge from BAMA. Visit us at http://bama.sbc.edu